NHS Education for Scotland

Scottish Dental Clinical Effectiveness Programme

Prevention and Treatment of Periodontal Diseases in Primary Care

Guidance Development Methodology

April 2024

Scottish Dental Clinical Effectiveness Programme
Dundee Dental Education Centre, Frankland Building,
Small's Wynd, Dundee DD1 4HN
Email scottishdental.cep@nes.scot.nhs.uk
Website www.sdcep.org.uk

NICE accredited
www.nice.org.uk/accreditation

NICE has accredited the process used by the **Scottish Dental Clinical Effectiveness Programme** to produce the second edition of its *Prevention and Treatment of Periodontal Diseases in Primary Care* guidance. Accreditation is valid for 5 years from 15 March 2021. More information on accreditation can be viewed at www.nice.org.uk/accreditation.

For further information about SDCEP's accreditation, visit www.sdcep.org.uk/how-we-work/nice-accreditation.

Contents

1 Overview of the SDCEP guidance development process

SDCEP first published *Prevention and Treatment of Periodontal Diseases in Primary Care* in 2014. Since then, there have been various developments that have merited an update to this guidance, including the publication of relevant guidelines from the European Federation of Periodontology, the British Society of Periodontology and Public Health England. Accordingly, SDCEP convened a Guidance Development Group (GDG) to review and update the guidance (see Section 2).

The first edition of the guidance was developed following SDCEP's standard guidance development process (www.sdcep.org.uk/how-we-work/guidance-development-process), which is accredited by the National Institute for Health and Care Excellence (NICE; www.nice.org.uk/about/what-we-do/accreditation).

A scheduled review of the guidance topic commenced in 2019 in line with SDCEP's five-year guidance review period. This process was paused in 2020 while SDCEP responded to the unique challenges posed by the COVID-19 pandemic, and restarted in 2021. The updating followed the relevant steps of the process described in the SDCEP *Guidance Development Process Manual* (Version 2.0, February 2019), with modifications appropriate for an update, as outlined below:

- Convening a new Guidance Development Group (GDG);
- Scoping including horizon scanning literature review and research on stakeholder attitudes to the topic and existing guidance;
- Agreement on scope and key clinical questions;
- Preparation of draft updated guidance including:
    - Systematic literature review,
    - Evidence appraisal, synthesis and summary,
    - Considered judgements,
    - Review and revision of existing recommendations, formulation of new recommendations and grading.
- Open consultation and peer review;
- Review of consultation and peer review feedback;
- Revision of the guidance and other related products;
- Final draft sign off;
- Design for publication;
- Dissemination and implementation.

Specific details of the methodology used for the development of the second edition of the *Prevention and Treatment of Periodontal Diseases in Primary Care* guidance are presented either in the updated guidance (www.periodontalcare.sdcep.org.uk) or in the following sections of this methodology document.

For further details, queries or requests for unpublished information, please contact SDCEP using the details provided on the front page of this document.

2 The Guidance Development Group

A Guidance Development Group (GDG) comprising individuals from a range of relevant branches of the dental profession was convened to update this guidance. One patient representative participated in the guidance update. A second patient representative was recruited but did not participate.

Madeleine Murray (Chair)	Specialist in Restorative Dentistry, Edinburgh. Honorary Senior Clinical Lecturer, University of Glasgow
Sabina Camber	Dental Hygienist, Devon; Representative of the British Society of Dental Hygiene and Therapy
Susan Carson	Consultant in Public Health/Dental Public Health, NHS Forth Valley/ Southeast and Tayside Dental Public Health Network
Grant Creaney	Clinical Lecturer and Honorary Specialist Registrar in Dental Public Health, University of Glasgow
Shauna Culshaw	Professor of Periodontology & Immunology, University of Glasgow; Honorary Consultant in Periodontics, NHS Greater Glasgow and Clyde; Honorary Researcher, Public Health Scotland
Ian Dunn	Specialist Periodontist, Liverpool; Representative of the British Society of Periodontology and Implant Dentistry
Julian Ekiert	Patient Representative
Paul Friel	General Dental Practitioner, Paisley
Rose Marie Goutcher	General Dental Practitioner, Glasgow; Specialty Dentist in Restorative Dentistry, Glasgow Dental Hospital, NHS Greater Glasgow and Clyde
Maxine Lee	BSc Oral Health Sciences Programme Lead and Honorary Clinical Teacher, Dundee Dental Hospital and School, University of Dundee
Michael Paterson	Consultant and Specialist in Restorative Dentistry, James Cook University Hospital, Middlesborough; Specialist Periodontist, Leeds
Philip Preshaw	Dean of Dentistry and Professor of Periodontology, Dundee Dental Hospital and School, University of Dundee; Representative of the British Society of Periodontology and Implant Dentistry
Amir Savage	Specialist Periodontist and Implant Dentist, Winchester
Shazad Saleem	General Dental Practitioner, Oldham; Representative of the British Society of Periodontology and Implant Dentistry
Brian Stevenson	Consultant in Restorative Dentistry, Dundee Dental Hospital and School

Online and face-to-face meetings of the GDG took place as part of the guidance development process.

3 Scoping research

SDCEP's research collaborators TRiaDS (Translation Research in a Dental Setting; www.triads.org.uk) carried out research during the development of the first edition of the *Prevention and Treatment of Periodontal Diseases in Primary care* guidance and after its publication.[1] Following the TRiaDS framework for translating guidance recommendations into practice,[2] this focused on evaluating whether users of the guidance had changed their practice since its publication and investigated factors that influence practitioner behaviour with respect to recommendations within the guidance. This work was presented to the guidance development group (GDG) convened to update the guidance.

TRiaDS carried out additional research to inform the scope and content of the guidance update. Two questionnaires were developed, to investigate current practice and beliefs related to the management of patients with periodontal diseases. Invitations to participate were sent to dentists, dental hygienists and dental therapists. The first questionnaire was disseminated to practitioners in July 2020. This asked practitioners about their current practice and beliefs regarding their use of the 2017 Classification of Periodontal Diseases and Conditions.[3] The second questionnaire was disseminated to practitioners in May 2021, and asked about current practice and beliefs related to scale and polish, root surface debridement, and remuneration. Results from both questionnaires were presented to the GDG during the development of the guidance update.

The scope for the guidance update agreed by the GDG is included in Appendix 1. The aims and target patient groups are essentially the same as for the first edition of the guidance.

4 Key clinical questions

The second edition of the guidance considered the same twenty clinical questions from the first edition of the guidance, with some edits to wording made for clarity. Eight new clinical questions related to risk assessment and treatment planning, periodontitis and systemic conditions, management of furcations, periodontal maintenance, and management of patients with dental implants were added.

The clinical questions covered by the guidance update are listed below:

Risk assessment
1. In patients accessing dental services, does conducting/recording a structured periodontal risk assessment, compared to no structured periodontal risk assessment, aid in the prediction of long-term outcomes of periodontal disease status such as attachment level, bone loss and tooth loss? 2. Does conducting/recording a structured periodontal risk assessment, compared to no structured periodontal risk assessment, influence the treatment (e.g. targeted risk factor control, oral hygiene instruction, individual recall intervals) provided by the dental team? 3. In patients who are at increased risk of periodontitis, does receiving information about their periodontal risk result in behaviour changes to reduce this risk, such as smoking cessation or improved oral hygiene?

Prevention and management of gingival inflammation
4. In the general population, what are the self-care oral hygiene practices that constitute an effective regime to prevent plaque-induced gingivitis and periodontitis? 5. In patients accessing dental services, does the provision of oral hygiene instruction, compared to no instruction, result in improved clinical outcomes, such as plaque levels and gingival health? 6. In the general population, are rechargeable powered toothbrushes, compared to manual toothbrushes, more effective at reducing levels of plaque and gingivitis? 7. In the general population, is interdental cleaning in addition to toothbrushing, compared to toothbrushing alone, more effective at reducing plaque levels and gingivitis? 8. In the general population, are toothpastes that contain fluoride and another active ingredient, compared to toothpastes which only contain fluoride, more effective at reducing plaque levels and gingivitis? 9. In patients with a diagnosis of periodontal health, is supra-gingival professional mechanical plaque removal (PMPR) alone, compared to no supra-gingival PMPR, effective in preventing periodontal diseases (gingivitis/periodontitis)? 10. In patients with a diagnosis of gingivitis, is supra-gingival professional mechanical plaque removal (PMPR) and oral hygiene instruction (OHI) compared to no supra-gingival PMPR and OHI, effective in improving gingival health?
Periodontitis and systemic conditions
11. In patients with a diagnosis of periodontitis who also have a specific medical condition, does control of their periodontitis improve the control of their medical condition? 12. In patients with a diagnosis of periodontitis who are pregnant, does control of their periodontitis improve their pregnancy outcomes?
Treatment of periodontitis - instrumentation
13. In patients with a diagnosis of periodontitis, is sub-gingival professional mechanical plaque removal (PMPR), compared to supra-gingival PMPR alone or no treatment, effective in stabilizing their disease? 14. In patients with a diagnosis of periodontitis, is power driven professional mechanical plaque removal (PMPR), compared to hand PMPR, more effective in stabilizing their disease? 15. In patients with a diagnosis of periodontitis, is full mouth professional mechanical plaque removal (PMPR) more effective than quadrant PMPR in stabilizing their disease? 16. In patients with a diagnosis of periodontitis who have furcation involvement of multi-rooted teeth, is nonsurgical periodontal treatment, compared to surgical periodontal treatment, effective in promoting long-term tooth retention?

Treatment of periodontitis – adjunctive medication
17. In patients with a diagnosis of periodontitis, does the use of local antimicrobial therapy (antiseptics or antibiotics), as an adjunct to professional mechanical plaque removal (PMPR), compared to PMPR alone, result in improvements in clinical parameters such as probing depth and clinical attachment level? 18. In patients with a diagnosis of periodontitis, does the use of systemic antibiotic therapy as an adjunct to professional mechanical plaque removal (PMPR), compared to PMPR alone, result in improvements in clinical outcomes such as probing depth and clinical attachment level? 19. In patients with a diagnosis of periodontitis, does the use of adjunctive host modulation therapy in conjunction with professional mechanical plaque removal (PMPR), compared to PMPR alone, result in improvements in clinical outcomes such as probing depth and clinical attachment level? 20. In patients with a diagnosis of periodontitis, what treatments are effective in reducing dentine sensitivity following professional mechanical plaque removal (PMPR)?
Maintenance
21. In a patient with a diagnosis of periodontitis, does supportive periodontal therapy, compared to no supportive periodontal therapy, maintain stability of the patient's disease status? 22. In a patient with a diagnosis of periodontitis who is undergoing supportive periodontal therapy (SPT), is there evidence to inform which SPT care regime is most effective at maintaining the stabilization of the patient's disease status?
Dental implants
23. Is the risk of peri-implant disease higher in patients with a diagnosis of periodontitis before implant placement compared to patients with no previous periodontal disease? 24. In patients with a diagnosis of periodontitis who are considering dental implant(s), what interventions carried out before implant placement, compared to no interventions, reduce the risk of peri-implant disease? 25. In patients with dental implants, does implant-specific supportive therapy, compared to no therapy, reduce the risk of peri-implant disease? 26. In patients with peri-implant mucositis, is there evidence to support a specific intervention to recover peri-implant tissue health? 27. In patients with peri-implantitis, is there evidence to support a specific intervention to recover peri-implant tissue health? 28. In patients with peri-implant mucositis or peri-implantitis, does the use of antibiotic therapy as an adjunct to peri-implant therapy, compared to peri-implant therapy alone, result in improved peri-implant tissue health?

As for the first edition of the guidance, these clinical questions informed the evidence search strategy and formed the basis for the evidence summaries and considered judgements made by the GDG.

5 Literature search

The guiding principle for developing guidance within SDCEP is to first source existing guidelines, policy documents, legislation or other recommendations. Similarly, relevant systematic reviews are also identified. These documents are appraised for their quality of development, evidence base and applicability to the remit of the guidance under development. In the absence of these documents or when supplementary information is required, other published literature and unpublished work may be sought.

During scoping for this guidance update, the *BSP implementation of European S3 – level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3)[4] and Public Health England's *Delivering Better Oral Health* toolkit (DBOH)[5] were identified as high-quality guidelines relevant to the majority of the clinical questions. A third relevant guideline, the European Federation of Periodontology (EFP*) Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline,*[6] was identified at a later stage in the updating of the guidance. Evidence to inform recommendations for seventeen of the twenty-eight clinical questions (i.e. questions 4-15, 17-19, 21, 22) was largely derived from these core guidelines.

For clinical questions not covered by the BSP-S3, DBOH or EFP guidelines (i.e. questions 1-3, 16, 20, 23-28), comprehensive literature searches of online databases, including MEDLINE, EMBASE, the Cochrane Database of Systematic Reviews, Epistemonikos, Trip, Google Scholar and the Centre for Reviews and Dissemination, were performed. Details of the searches, including the dates these were performed and the number of records retrieved, can be found in Appendix 2.

In accordance with SDCEP's standard process, the evidence searches and screening focussed on systematic reviews and guidelines, before considering primary studies.

Potentially eligible articles were identified independently by two reviewers from the list of titles and abstracts retrieved. An article was considered potentially eligible if it met both of the following criteria:

1. The article was a systematic review or a guideline. An article would be included as a systematic review, if it included a methods section, a search of one or more electronic databases and details of included studies. An article was included as a guideline if it made recommendations for clinical practice.
2. The article was relevant to the clinical question(s).

Copies of potentially eligible articles were retrieved and further checked against the criteria above. Additional manual searching of guideline repositories and other resources, and follow up of citations from relevant articles found through the systematic searching, was carried out. Other sources of evidence identified by GDG members were considered, taking relevance and methodological quality into account.

6 Evidence appraisal and synthesis

The AGREE II instrument was used to assess the methodological quality of the three core guidelines (i.e. BSP-S3, DBOH, EFP). The AGREE II instrument is a simple and validated assessment tool that provides an overall quality score for each guideline and an indication of how reliable the guideline might be (www.agreetrust.org). The assessments produced using the AGREE II tool used for assessing guidelines are available on request.

For the clinical questions not covered by the core guidelines, eligible articles that were potentially relevant for each question were identified from the search results and appraised for their methodological quality, evidence base and applicability, with precedence given to the most recent articles.

For the updating of this guidance, systematic reviews were assessed for methodological quality using criteria informed by AMSTAR.[7] The GRADE (Grading of Recommendations, Assessment, Development and Evaluation) approach was used to assess and rate the certainty of the reported evidence (www.gradeworkinggroup.org). Following this approach, evidence from randomised controlled trials (RCTs) starts at high certainty then is downrated for concerns relating to risk of bias, inconsistency, indirectness, imprecision and publication bias. Observational studies start at low certainty, and can be upgraded for large effect size, dose response and opposing effect of confounding, or downgraded as for RCTs. Accordingly, the evidence certainty was rated as high, moderate, low or very low. The GRADE framework is a widely accepted system for grading both the evidence and the recommendations and is used internationally by other guideline producers.

The individual data extraction and evidence appraisal forms for each of the relevant articles are available on request. Details of the evidence reported in the reviews and used to inform this guidance are included in the Considered Judgement Forms in Appendix 3.

7 Considered judgements and development of recommendations

For clinical questions covered by the core guidelines, a summary of the evidence cited in the guidelines, including an assessment of the evidence certainty, was presented to the GDG to inform and facilitate the review and updating and/or development of the recommendations in the guidance. This was supplemented by other relevant evidence identified. Any significant changes to the evidence base since the development of the recommendations in the first edition of the guidance were noted. For clinical questions not covered by the core guidelines, the synthesised evidence retrieved from the literature search for each of these clinical questions was summarised and distributed to the GDG to inform and facilitate the development of the recommendations in the guidance as described previously. The process for the review/development of the recommendations followed the GRADE approach, with considered judgements based on the certainty of evidence, balance of risks, values and preferences, and the acceptability and feasibility of the treatment options. The impact of potential barriers to implementation of the recommendations, identified during development of the first edition and after publication through stakeholder involvement and external consultation, was also considered. The relative importance of each of the criteria for a given recommendation was decided by the GDG. Decisions on the wording of the recommendations and their strength were reached by group consensus.

According to GRADE the strength of a recommendation may be defined as:

Strength	**Details**
Strong recommendation	The guideline panel is confident that the desirable effects of an intervention outweigh its undesirable effects (strong recommendation for an intervention) or that the undesirable effects of an intervention outweigh its desirable effects (strong recommendation against an intervention). A strong recommendation implies that most or all individuals will be best served by the recommended course of action.
Weak (or **conditional**) recommendation	A weak recommendation is one for which the desirable effects probably outweigh the undesirable effects (weak recommendation for an intervention) or undesirable effects probably outweigh the desirable effects (weak recommendation against an intervention) but appreciable uncertainty exists. A weak recommendation implies that not all individuals will be best served by the recommended course of action.

The evidence summaries, GDG consideration of the criteria and the resulting outcomes for each key recommendation are recorded in the Considered Judgement Forms (one for each key clinical question) which can be found in Appendix 3. The recommendation strength (strong or conditional) and the certainty of evidence rating (high, moderate, low or very low) are stated in the guidance along with each recommendation, for clarity. Brief explanations of the basis for each recommendation are also included in the guidance text.

This considered judgement process was followed both for reviewing the key recommendations developed for the first edition of the guidance, and for developing new recommendations.

8 Consultation and external peer review

The six-week open consultation period was initiated in early July 2023 and notification of this was sent to a wide range of individuals and bodies with specific interest in the management of patients with periodontal diseases, and to those involved in the organisation of dental services and education in the UK. End-users of the guidance, dentists, dental therapists and dental hygienists in Scotland, were notified of the consultation via the NES Portal. During this period, the consultation draft was made available on the SDCEP website for comment, with a consultation feedback form provided to facilitate the process. Implementation interviews with potential end-users of the guidance also took place at this time and a patient focus group considered the content and presentation of the patient information leaflets. Reports detailing the findings of these activities can be found at https://www.triads.org.uk/projects/periodontal-care/.

Targeted external peer review is a process that occurs in parallel with open consultation and is primarily a means of additional quality assurance. Peer reviewers, representing a range of expertise and

experience in relevant dental fields and individuals with knowledge of guidance methodology, were invited to comment on the applicability and suitability of the guidance to the intended audience (predominantly primary dental care in Scotland) and to indicate whether they agreed that the process used to update the guidance was satisfactory. They were also asked to provide any other relevant feedback.

The seven peer reviewers who provided feedback represented a range of dental expertise and experience, and some also had knowledge of guidance development methodology.

The peer reviewers were asked to declare any interests.

Name	Role
Iain Chapple	Professor of Periodontology and Consultant in Restorative Dentistry, University of Birmingham
Anne-Marie Glenny	Professor of Health Sciences, University of Manchester; Joint Coordinating Editor, Cochrane Oral Health
Mark Ide	Professor in Periodontology / Associate Dean for Taught Postgraduate Education, King's College, London
Roshni Karia	General Dental Practitioner; Council Member, College of General Dentistry; Clinical Tutor (Periodontology)
Ian Needleman	Professor of Periodontology and Evidence-informed Healthcare, UCL Eastman Dental Institute, London
Philipp Sahrmann	Head of Section Periodontology and Senior Researcher, University of Basel
Jeanie Suvan	Associate Professor and Programme Director MSc in Dental Hygiene, UCL Eastman Dental Institute

All comments received through the consultation and peer review process were reviewed, the feedback was considered by the GDG, and the guidance was amended accordingly prior to publication.

9 Updating the guidance

A review of the context of this guidance (e.g. regulations, legislation, trends in working practices, evidence) will take place five years after publication and, if this has changed significantly, the guidance will be updated accordingly.

10 Conflicts of interest

All contributors to SDCEP, including members of the GDG and external expert peer reviewers, are required to complete an SDCEP Declaration of Interests form to disclose relevant interests including financial conflicts of interest, such as receipt of fees for consulting with industry, and intellectual conflicts of interest, such as publication of original data bearing directly on a recommendation. These

forms are held by SDCEP, updated yearly and details of interests are available on request. At the beginning of each group meeting during guidance development, participants are asked to confirm whether there are any changes to their Declaration of Interests.

Declared interests which could have potentially constituted a conflict of interest were considered by the SDCEP Programme Development Team (PDT) and the GDG chair to decide whether and how the extent of the individual's participation in the guidance development should be limited (e.g. exclusion from certain decisions or stages, or complete withdrawal).

Further information on SDCEP's approach to conflicts of interest is available in the SDCEP *Guidance Development Process Manual* (Version 2.0, February 2019).

Details of the Declarations of Interest for all individuals involved in the *Prevention and Treatment of Periodontal Diseases in Primary Care* guidance update project are available on request. A summary of the disclosures, the consideration of potential conflicts of interest, and management decisions are provided in the following table.

Summary of Disclosures
All of the GDG members, peer reviewers and members of the SDCEP PDT completed and returned the Declaration of Interests form. Paid and unpaid professional roles involving the provision of dental care or education were not considered to be a conflict of interests. Several group members declared membership of committees or societies related to their healthcare roles, but this was also considered unlikely to lead to a conflict of interest. The Clinical Chair of the group had no conflicts of interests. Five of the fifteen external GDG members declared direct financial interests relevant to the guidance topic which could potentially cause, or be perceived to cause, conflicts of interest. One member of the SDCEP PDT has interests relevant to the guidance. In addition, six of the seven external peer reviewers declared interests relevant to the guidance topic.
Details of Interest(s)
1. Two GDG members and two peer reviewers declared receiving occasional teaching, training, lecture and speaker remuneration from dental healthcare companies.
2. One GDG member and two peer reviewers declared receiving consultancy and/or advisor fees from dental healthcare or biotech companies.
3. One GDG member and three peer reviewers declared receiving grants from funding bodies to support research related to periodontal diseases.
4. Three GDG members and two peer reviewers declared receiving funding from pharmaceutical or dental healthcare companies related to periodontal research.
5. One GDG member declared ownership of a company providing Continuing Professional Development in Periodontology.

6. One GDG member declared being a director of a company providing apps for periodontal charting (no longer available).
7. One member of SDCEP's PDT was a Principal Investigator (PI) on two clinical trials relevant to periodontal care.
8. One peer reviewer declared ownership of shares in a biotech company.
9. Five peer reviewers declared that they had participated in the development of guidelines related to the guidance topic (i.e. EFP/BSP and DBOH guidelines).
Consideration of potential to cause conflict(s) of interest *Are these interests likely in any way to affect the impartiality of the group member in his/her role in the guidance development e.g. in making recommendations?*
1. These activities were considered to be part of the individuals' professional roles in dental education and unlikely to cause any bias. It was agreed that no specific action was required.
2. It was considered unlikely that the guidance would specifically recommend any particular dental healthcare product and therefore unlikely that the declared interests would cause a conflict of interest.
3. These activities were considered to be part of the individuals' professional roles and unlikely to cause any bias. It was agreed that no specific action was required.
4. It was considered unlikely that the guidance would specifically recommend any particular dental healthcare product and therefore unlikely that the declared interests would cause a conflict of interest.
5. It was considered unlikely that the guidance would specifically recommend any provider of dental CPD and therefore unlikely that the declared interest would cause a conflict of interest.
6. It was considered unlikely that the guidance would specifically recommend any particular software for periodontal charting and therefore unlikely that the declared interest would cause a conflict of interest.
7. While being able to contribute to discussion and debate, PDT members do not vote on recommendations. Therefore, it was considered unlikely that the declared interests would cause a conflict.
8. It was considered unlikely that the guidance would specifically recommend any particular product from a biotech company and therefore unlikely that the declared interest would cause a conflict of interest.
9. Peer reviewers are selected on the basis of their expertise and experience in the relevant field and it is therefore not unexpected that they may have participated in the development of other relevant guidelines. While it could be perceived that this could lead to bias, it was considered important that these individuals be included in the peer review process, given that the other guidelines, and the evidence on which they were based, were used as a basis for the majority of the recommendations in the SDCEP guidance.

Decision on the management of the conflict(s) of interest *Should the group member be excluded from any stages of guidance development or decisions, or be asked to withdraw from the process?*
As the declared interests 1-9 were not considered to cause conflicts of interests, it was agreed that no specific action was required. All GDG members were notified that if at any point during the guidance update process they felt that their impartiality could be affected, then they should raise this within a meeting and/or contact SDCEP or the group chair to advise of this.

11 Equality impact assessment for this guidance

The possibility of inequalities associated with the guidance was considered at various stages during the development of the first edition of the guidance and during the updating for the second edition. Potential issues were identified through discussions with guidance development group members, from interviews with practitioners, the responses to the patient questionnaire and feedback from external consultation and peer review. Issues identified and actions taken were recorded in an Equality Impact Assessment (EQIA) checklist which is available on request.

12 Environmental considerations for this guidance

While the potential environmental impact of the recommendations and clinical advice was noted during the updating of the guidance, this did not directly inform the considered judgement process. The GDG is conscious that prevention of periodontal diseases is one of the most powerful means of reducing the environmental impact of oral healthcare. A section communicating this and other environmental messages is included within the guidance introduction.

References

1. Forbes G, Rutherford S, Stirling D, Young L, Clarkson J. Current practice and factors influencing the provision of periodontal healthcare in primary dental care in Scotland: an explorative study. *Br Dent J.* 2015;218(7):387-391; discussion 391.
2. Clarkson JE, Ramsay CR, Eccles MP, et al. The translation research in a dental setting (TRiaDS) programme protocol. *Implement Sci.* 2010;5:57.
3. Caton JG, Armitage G, Berglundh T, et al. A new classification scheme for periodontal and peri-implant diseases and conditions - Introduction and key changes from the 1999 classification. *J Clin Periodontol.* 2018;45 Suppl 20:S1-S8.
4. West N, Chapple I, Claydon N, et al. BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice. *J Dent.* 2021;106:103562.
5. Delivering Better Oral Health: an evidence-based toolkit for prevention. Public Health England; 2021: https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention.
6. Herrera D, Sanz M, Kebschull M, et al. Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline. *J Clin Periodontol.* 2022;49 Suppl 24:4-71.
7. Shea BJ, Reeves BC, Wells G, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ.* 2017;358:j4008.

Appendix 1 Scope

Background

The first edition of the Scottish Dental Clinical Effectiveness Programme (SDCEP) *Prevention and Treatment of Periodontal Diseases in Primary Care* guidance provided recommendations and practical advice to assist and support primary care dental teams in providing appropriate care for patients both at risk of and with periodontal diseases. The guidance was developed by individuals from a range of branches of the dental profession with an interest in the management of periodontal diseases and a patient representative, using SDCEP's NICE Accredited standard guidance development process.

The first edition was published in 2014 and a scheduled review of the guidance topic commenced in 2019 in line with SDCEP's five-year guidance review period. This process was paused in 2020 while SDCEP responded to the unique challenges posed by the COVID-19 pandemic, and restarted in 2021.

Guidance aim

The second edition of the *Prevention and Treatment of Periodontal Diseases in Primary Care* guidance will aim to support the dental team to identify and manage patients at risk of and with periodontal diseases in primary care, improve the quality of decision making for referral to secondary care and improve the overall oral health of the population. The guidance will focus on the screening, assessment and management of risk factors for periodontal diseases and on the prevention and non-surgical management of periodontal diseases in primary care. Information on diagnosis will be updated to reflect the 2017 Classification and Case Presentation framework. There will also be advice on the management of dental implants, including advice on periodontal aspects of pre-implant placement assessment and the prevention and treatment of peri-implant diseases. Advice on record keeping will be included. The guidance will be presented in a manner that aims to facilitate implementation of the recommendations.

Target patient groups

The guidance will be applicable to patients of all ages in all population groups accessing dental services.

Target end-users

The guidance is primarily directed at all clinicians who are involved in the detection, prevention and management of periodontal diseases in primary care. These include dentists, dental therapists, dental hygienists and oral health educators in general dental practice, and the public dental service. The guidance is also of relevance to the hospital dental service, those involved in dental education and undergraduate trainees. General medical practitioners and medical specialists will also find parts of the guidance relevant. Patients and carers may also refer to the guidance and use the accompanying patient information.

Clinical questions

The Guidance Development Group (GDG) will decide if the second edition of the guidance will address the same clinical questions as the first edition of the guidance and will consider whether questions should be added/removed. The group will also consider whether the recommendations for each question

from the first edition of the guidance should remain extant or be amended in the light of new information.

Process for guidance review and update

The guiding principle for developing SDCEP guidance is to first source existing guidelines and systematic reviews and, as appropriate to the topic, policy documents, legislation or other recommendations. In accordance with this, the scheduled review will focus on relevant systematic reviews and guidelines, before considering primary studies. The articles will be appraised using GRADE or AGREE II.

Preliminary scoping work has identified two relevant, high-quality guidelines which were published in 2021: the *BSP implementation of European S3-level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) and Public Health England's *Delivering Better Oral Health* toolkit (DBOH). In the interests of efficiency and to reduce duplication of effort, these guidelines will be the basis for the update of the SDCEP guidance. However, it was recognised that these two guidelines may not address all the clinical questions agreed by the GDG. Therefore, if additional evidence is required, comprehensive searches of electronic databases will be conducted as described in the SDCEP Guidance Development Manual.* The evidence searches and screening will focus on systematic reviews and guidelines, before considering primary studies, and the articles will be appraised using GRADE or AGREE II.

As part of the preliminary work for this update, information on the views of practitioners relating to the previous guidance and to the management of periodontal diseases in general was sought and this will also be considered by the GDG when updating the guidance.

For clinical questions covered by the BSP-3 and DBOH guidelines, the GDG will review the guideline recommendations and the evidence that underpins them, and where significant new information that could affect the recommendations in the SDCEP guidance is identified, the GDG will follow a considered judgement process to review and amend them accordingly. For all other clinical questions, the standard SDCEP evidence appraisal and considered judgement process will be followed to review, and where necessary update, current recommendations or to formulate new recommendations.

The clinical advice points and other guidance content will be reviewed and updated in light of any new information identified. This will include amendments to align with the new classification system for periodontal and peri-implant diseases and the updated criteria for diagnosis along with examples of demonstrated or agreed good practice such as the *Healthy Gums Do Matter* toolkit.

The GDG will review the supporting tools accompanying the guidance, including the Guidance in Brief, tools for Risk Assessment, Smoking Cessation information, and Patient Information Leaflets. Additional patient feedback on the patient information will be sought.

If significantly changed from the first edition, a draft of the updated guidance will be subject to external peer review. A short open consultation may also be carried out if required.

* https://www.sdcep.org.uk/wp-content/uploads/2019/03/SDCEP-GuidanceDevelopmentProcessManual_Feb-2019.pdf

The updated guidance will be published online via the SDCEP website and SDCEP *Dental Companion* app. Notification of online publication will be widely disseminated to the dental profession in Scotland and to UK dental organisations and bodies. Patient information will also be shared with relevant organisations. Specific information may be targeted to the medical profession including general medical practice and those involved in diabetes care.

Appendix 2 Evidence searches

Questions 1-3: Risk assessment

Database	Version/issue	Date of search	Records retrieved
Cochrane Database of Systematic Reviews	Issue 6, 2022	7 June 2022	123
MEDLINE Ovid	1946 to 7 June 2022	7 June 2022	248 (with filter)
EMBASE Ovid	1980 to 7 June 2022	7 June 2022	375 (with filter)
Epistemonikos	Whole database to 7 June 2022	7 June 2022	297
Centre for Reviews and Dissemination database	1994 to March 2015 (discontinued)	7 June 2022	87
		Total retrieved	1140
		After de-duplication	**781**

COCHRANE DATABASE OF SYSTEMATIC REVIEWS (CDSR) Search Strategy

#1 MeSH descriptor: [Periodontal Diseases] explode all trees
#2 MeSH descriptor: [Periodontics] this term only
#3 MeSH descriptor: [Periodontal Index] this term only
#4 periodont*
#5 ((probing near/3 bleed*) or (probe near/3 bleed*) or (probing near/3 pocket*) or (probe near/3 pocket*) or (probing near/3 depth) or (probe near/3 depth))
#6 ((gingiv* near/3 pocket*) or (gingiv* near/3 hemorr*) or (gingiv* near/3 haemorr*) or (gingiv* near/3 bleed*) or (gingiv* near/3 blood*))
#7 #1 or #2 or #3 or #4 or #5 or #6
#8 MeSH descriptor: [Risk Assessment] explode all trees
#9 MeSH descriptor: [Decision Support Techniques] explode all trees
#10 ((risk* near/3 indicat*) or (risk* near/1 assess*) or (risk* near/3 predict*) or (risk* near/3 analys*) or (risk* near/3 scor*) or (risk* near/3 calculat*))
#11 ("health correlates" or "population at risk")
#12 ((decision near/3 aid*) or (decision near/3 analys*) or (decision near/3 model*) or (decision near/3 support*))
#13 ("DenPlan Excel" or DEP-PA or DEPPA or HIDEP or "health improvement in dental practice" or "risk assessment-based individualized treatment" or RABIT or "dentition risk system" or PRA)
#14 #8 or #9 or #10 or #11 or #12 or #13
#15 #7 and #14

MEDLINE Ovid Search Strategy

1. exp periodontal diseases/
2. periodontics/
3. periodontal index/
4. periodont$.ti,ab.
5. ((probing adj3 bleed$) or (probe adj3 bleed) or (probing adj3 pocket$) or (probe adj3 pocket$) or (probing adj3 depth) or (probe adj3 depth)).ti,ab.
6. ((gingiv$ adj3 pocket$) or (gingiv$ adj3 hemorr$) or (gingiv$ adj3 haemorr$) or (gingiv$ adj3 bleed$) or (gingiv$ adj3 blood$)).ti,ab.
7. 1 or 2 or 3 or 4 or 5 or 6
8. exp risk assessment/
9. exp decision support techniques/
10. ((risk$ adj3 indicat$) or (risk$ adj1 assess$) or (risk$ adj3 predict$) or (risk$ adj3 analys$) or (risk$ adj3 score$) or (risk$ adj3 calculat$)).ti,ab.
11. (health correlates or "population at risk").ti,ab.
12. ((decision adj3 aid$) or (decision adj3 analys$) or (decision adj3 model$) or (decision adj3 support$)).ti,ab.
13. ("DenPlan Excel" or DEP-PA or HIDEP or "health improvement in dental practice" or "risk assessment-based individualized treatment" or rabit or "dentition risk system" or PRA).ti,ab.
14. 8 or 9 or 10 or 11 or 12 or 13
15. 7 and 14

This subject search was linked to the systematic review filter from the Scottish Intercollegiate Guidelines Network (SIGN) to limit a search to systematic reviews in MEDLINE (from SIGN, *Search filters*, online at https://www.sign.ac.uk/what-we-do/methodology/search-filters/, accessed 7 June 2022):

1. Meta-Analysis as Topic/
2. meta analy$.tw.
3. metaanaly$.tw.
4. Meta-Analysis/
5. (systematic adj (review$1 or overview$1)).tw.
6. exp Review Literature as Topic/
7. systematic review.pt.
8. or/1-7
9. cochrane.ab.
10. embase.ab.
11. (psychlit or psyclit).ab.
12. (psychinfo or psycinfo).ab.
13. (cinahl or cinhal).ab.
14. science citation index.ab.
15. bids.ab.
16. cancerlit.ab.
17. or/9-16
18. reference list$.ab.
19. bibliograph$.ab.
20. hand-search$.ab.

21. relevant journals.ab.
22. manual search$.ab.
23. or/18-22
24. selection criteria.ab.
25. data extraction.ab.
26. 24 or 25
27. Review/
28. 26 and 27
29. Comment/
30. Letter/
31. Editorial/
32. animal/
33. human/
34. 32 not (32 and 33)
35. or/29-31,34
36. 8 or 17 or 23 or 28
37. 36 not 35

EMBASE Ovid Search Strategy

1. exp periodontitis/
2. periodontics/
3. periodontal index/
4. periodont$.ti,ab.
5. ((probing adj3 bleed$) or (probe adj3 bleed) or (probing adj3 pocket$) or (probe adj3 pocket$) or (probing adj3 depth) or (probe adj3 depth)).ti,ab.
6. ((gingiv$ adj3 pocket$) or (gingiv$ adj3 hemorr$) or (gingiv$ adj3 haemorr$) or (gingiv$ adj3 bleed$) or (gingiv$ adj3 blood$)).ti,ab.
7. 1 or 2 or 3 or 4 or 5 or 6
8. exp risk assessment/
9. exp decision making task/
10. exp decision support system/
11. ((risk$ adj3 indicat$) or (risk$ adj1 assess$) or (risk$ adj3 predict$) or (risk$ adj3 analys$) or (risk$ adj3 score$) or (risk$ adj3 calculat$)).ti,ab.
12. (health correlates or "population at risk").ti,ab.
13. ((decision adj3 aid$) or (decision adj3 analys$) or (decision adj3 model$) or (decision adj3 support$)).ti,ab.
14. ("DenPlan Excel" or DEP-PA or HIDEP or "health improvement in dental practice" or "risk assessment-based individualized treatment" or rabit or "dentition risk system" or PRA).ti,ab.
15. 8 or 9 or 10 or 11 or 12 or 13 or 14
16. 7 and 15

This subject search was linked to the SIGN search filter to limit a search to systematic reviews in Embase (from SIGN, *Search filters*, online at https://www.sign.ac.uk/what-we-do/methodology/search-filters/, accessed 7 June 2022):

1. exp Meta Analysis/
2. ((meta adj analy$) or metaanalys$).tw.
3. (systematic adj (review$1 or overview$1)).tw.
4. or/1-3
5. cancerlit.ab.
6. cochrane.ab.
7. embase.ab.
8. (psychlit or psyclit).ab.
9. (psychinfo or psycinfo).ab.
10. (cinahl or cinhal).ab.
11. science citation index.ab.
12. bids.ab.
13. or/5-12
14. reference lists.ab.
15. bibliograph$.ab.
16. hand-search$.ab.
17. manual search$.ab.
18. relevant journals.ab.
19. or/14-18
20. data extraction.ab.
21. selection criteria.ab.
22. 20 or 21
23. review.pt.
24. 22 and 23
25. letter.pt.
26. editorial.pt.
27. animal/
28. human/
29. not (27 and 28)
30. or/25-26,29
31. 4 or 13 or 19 or 24
32. 31 not 30

Epistemonikos Search Strategy

Search limited to systematic reviews

(periodont* AND (("risk assess*") or ("decision support") or ("risk indicat*") or (risk AND predict*) or (risk AND scor*) or (risk AND calculat*) or ("decision aid*") or ("risk analys*") or (decision AND model*) or ("decision analys*") or ("DenPlan Excel") or (DEP-PA) or (HIDEP) or ("health improvement in dental practice") or ("risk assessment based individualized treatment") or (RABIT) or ("dentition risk system") or (PRA)))

Centre for Reviews and Dissemination search strategy

1	MeSH DESCRIPTOR Periodontitis EXPLODE ALL TREES
2	(periodont*)
3	MeSH DESCRIPTOR Risk Assessment EXPLODE ALL TREES
4	MeSH DESCRIPTOR Decision Support Techniques EXPLODE ALL TREES
5	(risk*)
6	("decision support")
7	("decision aid*")
8	#1 OR #2
9	#3 OR #4 OR #5 OR #6 OR #7
10	#8 AND #9

Question 16: Management of furcation involvement

Database	Version/issue	Date of search	Records retrieved
Cochrane Database of Systematic Reviews	Issue 6, 2022	8 June 2022	10
MEDLINE Ovid	1946 to 8 June 2022	8 June 2022	77 (with filter)
EMBASE Ovid	1980 to 8 June 2022	8 June 2022	82 (with filter)
Epistemonikos	Whole database to 8 June 2022	8 June 2022	24
Centre for Reviews and Dissemination database	1994 to March 2015 (discontinued)	8 June 2022	15
		Total retrieved	207
		After de-duplication	**113**

COCHRANE DATABASE OF SYSTEMATIC REVIEWS (CDSR) Search Strategy

#1 MeSH descriptor: [Furcation Defects] this term only
#2 ((tooth and furcation) or (tooth and trifurcation) or (tooth and bifurcation) or (tooth and tri-furcation) or (tooth and bi-furcation))
#3 ((teeth and furcation) or (teeth and trifurcation) or (teeth and bifurcation) or (teeth and tri-furcation) or (teeth and bi-furcation))
#4 ((root* and furcation) or (root* and trifurcation) or (root* and bifurcation) or (root* and tri-furcation) or (root* and bi-furcation))
#5 ((defect* and furcation) or (defect* and trifurcation) or (defect* and bifurcation) or (defect* and tri-furcation) or (defect* and bi-furcation))
#6 ((periodont* and furcation) or (periodont* and trifurcation) or (periodont* and bifurcation) or (periodont* and tri-furcation) or (periodont* and bi-furcation)
#7 ((lesion* and intraradicular) or (lesion and intra-radicular) or (lesion* and "intra radicular"))
#8 ((lesion* and intra-furcal) or (lesion* and intrafurcal) or (lesion* and "intra furcal"))
#9 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8

MEDLINE Ovid Search Strategy

1. Furcation defects/
2. (tooth and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
3. (teeth and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
4. (root$ and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
5. (defect$ and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
6. (periodont$ and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
7. (lesion$ and (intra-radicular or intraradicular or "intra radicular")).mp.
8. (lesion$ and (intra-furcal or intrafurcal or "intra furcal")).mp.
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8

This subject search was linked to the systematic review filter from the Scottish Intercollegiate Guidelines Network (SIGN) to limit a search to systematic reviews in MEDLINE (from SIGN, *Search filters*, online at https://www.sign.ac.uk/what-we-do/methodology/search-filters/, accessed 7 June 2022):

1. Meta-Analysis as Topic/
2. meta analy$.tw.
3. metaanaly$.tw.
4. Meta-Analysis/
5. (systematic adj (review$1 or overview$1)).tw.
6. exp Review Literature as Topic/
7. systematic review.pt.
8. or/1-7
9. cochrane.ab.
10. embase.ab.
11. (psychlit or psyclit).ab.
12. (psychinfo or psycinfo).ab.
13. (cinahl or cinhal).ab.
14. science citation index.ab.
15. bids.ab.
16. cancerlit.ab.
17. or/9-16
18. reference list$.ab.
19. bibliograph$.ab.
20. hand-search$.ab.
21. relevant journals.ab.
22. manual search$.ab.
23. or/18-22
24. selection criteria.ab.
25. data extraction.ab.
26. 24 or 25
27. Review/
28. 26 and 27
29. Comment/
30. Letter/
31. Editorial/
32. animal/
33. human/
34. 32 not (32 and 33)
35. or/29-31,34
36. 8 or 17 or 23 or 28
37. 36 not 35

EMBASE Ovid Search Strategy

1 (tooth and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
2 (teeth and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
3 (root$ and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.

4 (defect$ and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
5 (periodont$ and (furcation or trifurcation or bifurcation or tri-furcation or bi-furcation)).mp.
6 (lesion$ and (intra-radicular or intraradicular or "intra radicular")).mp.
7 (lesion$ and (intra-furcal or intrafurcal or "intra furcal")).mp.
8 1 or 2 or 3 or 4 or 5 or 6 or 7

This subject search was linked to the SIGN search filter to limit a search to systematic reviews in Embase (from SIGN, *Search filters*, online at https://www.sign.ac.uk/what-we-do/methodology/search-filters/, accessed 7 June 2022):

1. exp Meta Analysis/
2. ((meta adj analy$) or metaanalys$).tw.
3. (systematic adj (review$1 or overview$1)).tw.
4. or/1-3
5. cancerlit.ab.
6. cochrane.ab.
7. embase.ab.
8. (psychlit or psyclit).ab.
9. (psychinfo or psycinfo).ab.
10. (cinahl or cinhal).ab.
11. science citation index.ab.
12. bids.ab.
13. or/5-12
14. reference lists.ab.
15. bibliograph$.ab.
16. hand-search$.ab.
17. manual search$.ab.
18. relevant journals.ab.
19. or/14-18
20. data extraction.ab.
21. selection criteria.ab.
22. 20 or 21
23. review.pt.
24. 22 and 23
25. letter.pt.
26. editorial.pt.
27. animal/
28. human/
29. not (27 and 28)
30. or/25-26,29
31. 4 or 13 or 19 or 24
32. 31 not 30

Epistemonikos Search Strategy

Search limited to systematic reviews

(title:(((tooth AND furcation) OR (tooth AND trifurcation) OR (tooth AND bifurcation) OR (tooth AND tri-furcation) OR (tooth AND bi-furcation) OR (teeth AND furcation) OR (teeth AND trifurcation) OR (teeth AND bifurcation) OR (teeth AND tri-furcation) OR (teeth AND bi-furcation) OR (root* AND furcation) OR (root* AND trifurcation) OR (root* AND bifurcation) OR (root* AND tri-furcation) OR (root* AND bi-furcation) OR (defect* AND furcation) OR (defect* AND trifurcation) OR (defect* AND bifurcation) OR (defect* AND tri-furcation) OR (defect* AND bi-furcation) OR (periodont* AND furcation) OR (periodont* AND trifurcation) OR (periodont* AND bifurcation) OR (periodont* AND tri-furcation) OR (periodont* AND bi-furcation) OR (lesion* AND intra-radicular) OR (lesion* AND intraradicular) OR (lesion* AND "intra radicular) OR (lesion* AND intrafurcal) OR (lesion* AND intra-furcal) OR (lesion* AND "intra furcal"))) OR abstract:(((tooth AND furcation) OR (tooth AND trifurcation) OR (tooth AND bifurcation) OR (tooth AND tri-furcation) OR (tooth AND bi-furcation) OR (teeth AND furcation) OR (teeth AND trifurcation) OR (teeth AND bifurcation) OR (teeth AND tri-furcation) OR (teeth AND bi-furcation) OR (root* AND furcation) OR (root* AND trifurcation) OR (root* AND bifurcation) OR (root* AND tri-furcation) OR (root* AND bi-furcation) OR (defect* AND furcation) OR (defect* AND trifurcation) OR (defect* AND bifurcation) OR (defect* AND tri-furcation) OR (defect* AND bi-furcation) OR (periodont* AND furcation) OR (periodont* AND trifurcation) OR (periodont* AND bifurcation) OR (periodont* AND tri-furcation) OR (periodont* AND bi-furcation) OR (lesion* AND intra-radicular) OR (lesion* AND intraradicular) OR (lesion* AND "intra radicular) OR (lesion* AND intrafurcal) OR (lesion* AND intra-furcal) OR (lesion* AND "intra furcal"))))

Centre for Reviews and Dissemination search strategy

1	MeSH DESCRIPTOR Furcation Defects EXPLODE ALL TREES
2	(((tooth and furcation) or (tooth and trifurcation) or (tooth and bifurcation) or (tooth and tri-furcation) or (tooth and bi-furcation)))
3	(((teeth and furcation) or (teeth and trifurcation) or (teeth and bifurcation) or (teeth and tri-furcation) or (teeth and bi-furcation)))
4	(((root* and furcation) or (root* and trifurcation) or (root* and bifurcation) or (root* and tri-furcation) or (root* and bi-furcation)))
5	(((defect* and furcation) or (defect* and trifurcation) or (defect* and bifurcation) or (defect* and tri-furcation) or (defect* and bi-furcation)))
6	(((periodont* and furcation) or (periodont* and trifurcation) or (periodont* and bifurcation) or (periodont* and tri-furcation) or (periodont* and bi-furcation)))
7	(((lesion* and intraradicular) or (lesion and intra-radicular) or (lesion* and "intra radicular")))
8	(((lesion* and intra-furcal) or (lesion* and intrafurcal) or (lesion* and "intra furcal")))
9	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8

Question 20: Management of dentine sensitivity

Database	Version/issue	Date of search	Records retrieved
Cochrane Database of Systematic Reviews	Issue 7, 2022	11 July 2022	30
MEDLINE Ovid	1946 to 11 July 2022	11 July 2022	27 (with filter)
EMBASE Ovid	1980 to 11 July 2022	11 July 2022	17 (with filter)
Epistemonikos	Whole database to 11 July 2022	11 July 2022	36
Centre for Reviews and Dissemination database	1994 to March 2015 (discontinued)	11 July 2022	23
		Total retrieved	133
		After de-duplication	**106**

COCHRANE DATABASE OF SYSTEMATIC REVIEWS (CDSR) Search Strategy

#1 MeSH descriptor: [Periodontal Diseases] explode all trees
#2 MeSH descriptor: [Periodontics] this term only
#3 MeSH descriptor: [Periodontal Index] this term only
#4 periodont*
#5 ((probing near/3 bleed*) or (probe near/3 bleed*) or (probing near/3 pocket*) or (probe near/3 pocket*) or (probing near/3 depth) or (probe near/3 depth))
#6 ((gingiv* near/3 pocket*) or (gingiv* near/3 hemorr*) or (gingiv* near/3 haemorr*) or (gingiv* near/3 bleed*) or (gingiv* near/3 blood*))
#7 MeSH descriptor: [Dental Prophylaxis] explode all trees
#8 (root* near/3 planing)
#9 ((dental near/3 scal*) or (subgingival near/3 scal*) or (sub-gingival near/3 scal*) or (root* near/3 scal*) or (supragingival near/3 scal*) or (supra-gingival near/3 scal$))
#10 ((subgingival near/5 curettage) or (sub-gingival near/5 currettage) or (subgingival near/5 debrid*) or (sub-gingival near/5 debrid*))
#11 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10
#12 MeSH descriptor: [Dentin Sensitivity] this term only
#13 ((dentin* near/5 sensitiv*) or (dentin* near/5 hypersensitiv*) or (dentin* near/5 hyper-sensitiv*) or (dentin* near/5 oversensitiv*) or (dentin* near/5 over-sensitiv*))
#14 ((tooth near/5 sensitiv*) or (tooth near/5 hypersensitiv*) or (tooth near/5 hyper-sensitiv*) or (tooth near/5 oversensitiv*) or (tooth near/5 over-sensitiv*))
#15 ((teeth near/5 sensitiv*) or (teeth near/5 hypersensitiv*) or (teeth near/5 hyper-sensitiv*) or (teeth near/5 oversensitiv*) or (teeth near/5 over-sensitiv*))
#16 #12 or #13 or #14 or #15
#17 #11 and #16

MEDLINE Ovid Search Strategy

1. exp periodontal diseases/
2. periodontics/
3. periodontal index/
4. periodont$.ti,ab.
5. ((probing adj3 bleed$) or (probe adj3 bleed) or (probing adj3 pocket$) or (probe adj3 pocket$) or (probing adj3 depth) or (probe adj3 depth)).ti,ab.
6. ((gingiv$ adj3 pocket$) or (gingiv$ adj3 hemorr$) or (gingiv$ adj3 haemorr$) or (gingiv$ adj3 bleed$) or (gingiv$ adj3 blood$)).ti,ab.
7. exp dental prophylaxis/
8. ((dental or subgingival or sub-gingival or root$ or supragingival or supra-gingival) and scal$).ti,ab.
9. (root$ adj3 planing).ti,ab.
10. ((subgingival or sub-gingival) adj5 (curettage or debrid$)).ti,ab.
11. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12. dentin sensitivity/
13. (dentin$ adj5 (sensitiv$ or hypersensitiv$ or hyper-sensitiv$ or oversensitiv$ or over-sensitiv$)).ti,ab.
14. (tooth adj5 (sensitiv$ or hypersensitiv$ or hyper-sensitiv$ or oversensitiv$ or over-sensitiv$)).ti,ab.
15. (teeth adj5 (sensitiv$ or hypersensitiv$ or hyper-sensitiv$ or oversensitiv$ or over-sensitiv$)).ti,ab.
16. 12 or 13 or 14 or 15
17. 11 and 16

This subject search was linked to the systematic review filter from the Scottish Intercollegiate Guidelines Network (SIGN) to limit a search to systematic reviews in MEDLINE (from SIGN, *Search filters*, online at https://www.sign.ac.uk/what-we-do/methodology/search-filters/, accessed 7 June 2022):

1. Meta-Analysis as Topic/
2. meta analy$.tw.
3. metaanaly$.tw.
4. Meta-Analysis/
5. (systematic adj (review$1 or overview$1)).tw.
6. exp Review Literature as Topic/
7. systematic review.pt.
8. or/1-7
9. cochrane.ab.
10. embase.ab.
11. (psychlit or psyclit).ab.
12. (psychinfo or psycinfo).ab.
13. (cinahl or cinhal).ab.
14. science citation index.ab.
15. bids.ab.
16. cancerlit.ab.
17. or/9-16

18. reference list$.ab.
19. bibliograph$.ab.
20. hand-search$.ab.
21. relevant journals.ab.
22. manual search$.ab.
23. or/18-22
24. selection criteria.ab.
25. data extraction.ab.
26. 24 or 25
27. Review/
28. 26 and 27
29. Comment/
30. Letter/
31. Editorial/
32. animal/
33. human/
34. 32 not (32 and 33)
35. or/29-31,34
36. 8 or 17 or 23 or 28
37. 36 not 35

EMBASE Ovid Search Strategy

1. exp periodontitis/
2. periodontics/
3. periodontal index/
4. periodont$.ti,ab.
5. ((probing adj3 bleed$) or (probe adj3 bleed) or (probing adj3 pocket$) or (probe adj3 pocket$) or (probing adj3 depth) or (probe adj3 depth)).ti,ab.
6. ((gingiv$ adj3 pocket$) or (gingiv$ adj3 hemorr$) or (gingiv$ adj3 haemorr$) or (gingiv$ adj3 bleed$) or (gingiv$ adj3 blood$)).ti,ab.
7. exp dental prophylaxis/
8. ((dental or subgingival or sub-gingival or root$ or supragingival or supragingival) adj3 scal$).ti,ab.
9. (root$ adj3 planing).ti,ab.
10. ((subgingival or sub-gingival) adj5 (curettage or debrid$)).ti,ab.
11. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12. dentin sensitivity/
13. (dentin$ adj5 (sensitiv$ or hypersensitiv$ or hyper-sensitiv$ or oversensitiv$ or over-sensitiv$)).ti,ab.
14. (tooth adj5 (sensitiv$ or hypersensitiv$ or hyper-sensitiv$ or oversensitiv$ or over-sensitiv$)).ti,ab.
15. (teeth adj5 (sensitiv$ or hypersensitiv$ or hyper-sensitiv$ or oversensitiv$ or over-sensitiv$)).ti,ab.
16. 12 or 13 or 14 or 15
17. 11 and 16

This subject search was linked to the SIGN search filter to limit a search to systematic reviews in Embase (from SIGN, *Search filters*, online at https://www.sign.ac.uk/what-we-do/methodology/search-filters/, accessed 7 June 2022):

1. exp Meta Analysis/
2. ((meta adj analy$) or metaanalys$).tw.
3. (systematic adj (review$1 or overview$1)).tw.
4. or/1-3
5. cancerlit.ab.
6. cochrane.ab.
7. embase.ab.
8. (psychlit or psyclit).ab.
9. (psychinfo or psycinfo).ab.
10. (cinahl or cinhal).ab.
11. science citation index.ab.
12. bids.ab.
13. or/5-12
14. reference lists.ab.
15. bibliograph$.ab.
16. hand-search$.ab.
17. manual search$.ab.
18. relevant journals.ab.
19. or/14-18
20. data extraction.ab.
21. selection criteria.ab.
22. 20 or 21
23. review.pt.
24. 22 and 23
25. letter.pt.
26. editorial.pt.
27. animal/
28. human/
29. not (27 and 28)
30. or/25-26,29
31. 4 or 13 or 19 or 24
32. 31 not 30

Epistemonikos Search Strategy

Search limited to systematic reviews

(title:((periodont* AND (tooth or teeth or dentin*) AND (sensitiv* OR hypersensitiv* OR oversensitiv*))) OR abstract:((periodont* AND (tooth or teeth or dentin*) AND (sensitiv* OR hypersensitiv* OR oversensitiv*))))

Centre for Reviews and Dissemination search strategy

1	MeSH DESCRIPTOR periodontitis EXPLODE ALL TREES IN DARE
2	MeSH DESCRIPTOR periodontics EXPLODE ALL TREES IN DARE
3	(periodont*) IN DARE
4	(((probing and bleed*) or (probe and bleed) or (probing and pocket*) or (probe and pocket*) or (probing and depth) or (probe and depth))) IN DARE
5	(((gingiv* and pocket*) or (gingiv* and hemorr*) or (gingiv* and haemorr*) or (gingiv* and bleed*) or (gingiv* and blood*))) IN DARE
6	((root* and planing)) IN DARE
7	(((dental and scal*) or (subgingival and scal*) or (sub-gingival and scal*) or (root* and scal*) or (supragingival and scal*) or (supra-gingival and scal$))) IN DARE
8	(((subgingival and curettage) or (sub-gingival and currettage) or (subgingival and debrid*) or (sub-gingival and debrid*))) IN DARE
9	MeSH DESCRIPTOR periodontal index EXPLODE ALL TREES IN DARE
10	MeSH DESCRIPTOR dental prophylaxis EXPLODE ALL TREES IN DARE
11	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10
12	MeSH DESCRIPTOR dentin sensitivity IN DARE
13	(((dentin* and sensitiv*) or (dentin* and hypersensitiv*) or (dentin* and hyper-sensitiv*) or (dentin* and oversensitiv*) or (dentin* and over-sensitiv*))) IN DARE
14	(((tooth and sensitiv*) or (tooth and hypersensitiv*) or (tooth and hyper-sensitiv*) or (tooth and oversensitiv*) or (tooth and over-sensitiv*))) IN DARE
15	(((teeth and sensitiv*) or (teeth and hypersensitiv*) or (teeth and hyper-sensitiv*) or (teeth and oversensitiv*) or (teeth and over-sensitiv*))) IN DARE
16	#12 OR #13 OR #14 OR #15
17	#11 AND #16

Question 24: Pre-implant protocols

Database	Version/issue	Date of search	Records retrieved
Cochrane Database of Systematic Reviews	Limit 2019-2022	18 Nov 2022	0
MEDLINE Ovid	1946 to 17 Nov 2022	18 Nov 2022	11
EMBASE Ovid	1974 to 17 Nov 2022	18 Nov 2022	12
Epistemonikos	Whole database to 17 Nov 2023	18 Nov 2022	1
TRIP	Limit 2019-2022	18 Nov 2022	0
Google Scholar		18 Nov 2022	1
Centre for Reviews and Dissemination database	Whole database	18 Nov 2022	3
		Total retrieved	28
		After de-duplication	**18**

COCHRANE DATABASE OF SYSTEMATIC REVIEWS (CDSR) Search Strategy

((dental OR oral) AND implant* AND (periodontitis OR "perio dontitis") AND (((periimplant* OR "peri implant*") AND (disease OR mucositis OR complication*)) OR periimplantitis OR "peri implantitis")) AND (("pre implant*" OR "prior to implant*" OR preimplant*) OR Title:(pre OR prior OR before))

MEDLINE Ovid Search Strategy

1. Dental Implants/
2. exp Dental Implantation/
3. Dental Prosthesis, Implant-Supported/
4. (implant* adj5 dent*).mp.
5. (((overdenture* or crown* or bridge* or prosthesis or restoration*) adj5 (Dental or oral)) and implant*).mp.
6. (blade implant* and (dental or oral)).mp.
7. ((endosseous adj5 implant*) and (dental or oral)).mp.
8. (oral adj5 implant*).mp.
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. exp Periodontitis/
11. (pericementitides or pericementitis or periodontitides or periodontitis).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
12. 10 or 11
13. Peri-Implantitis/

14. peri-implantitis.mp.
15. peri-implant mucositis.mp.
16. peri-implant disease*.mp.
17. periimplantitis.mp.
18. periimplant mucositis.mp.
19. periimplant disease*.mp.
20. (peri-implant* adj3 complication*).mp.
21. (periimplant* adj3 complication*).mp.
22. 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21
23. 9 and 12 and 22
24. ((pre or before or prior to) adj3 (implant* or placement* or procedure*)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
25. Preoperative Care/
26. (preimplant* or preplacement).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
27. (preoperat* or pre operat*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
28. (presurg* or pre surg*).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
29. (preparat* adj2 (implant* or placement* or procedure*)).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
30. 24 or 25 or 26 or 27 or 28 or 29
31. 23 and 30
32. limit 31 to "reviews (best balance of sensitivity and specificity)"
33. limit 31 to (consensus development conference or consensus development conference, nih or guideline or meta analysis or practice guideline or "systematic review")
34. 31 and guid*.ti.
35. 32 or 33 or 34

EMBASE Ovid Search Strategy

1. exp tooth implant/
2. tooth implantation/
3. Dental Prosthesis, Implant-Supported/
4. (implant* adj5 dent*).mp.

5. (((overdenture* or crown* or bridge* or prosthesis or restoration*) adj5 (Dental or oral)) and implant*).mp.
6. (blade implant* and (dental or oral)).mp.
7. ((endosseous adj5 implant*) and (dental or oral)).mp.
8. (oral adj5 implant*).mp.
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. exp Periodontitis/
11. (pericementitides or pericementitis or periodontitides or periodontitis).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
12. 10 or 11
13. exp periimplantitis/
14. peri-implantitis.mp.
15. peri-implant mucositis.mp.
16. peri-implant disease*.mp.
17. periimplantitis.mp.
18. periimplant mucositis.mp.
19. periimplant disease*.mp.
20. (peri-implant* adj3 complication*).mp.
21. (periimplant* adj3 complication*).mp.
22. 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21
23. 9 and 12 and 22
24. ((pre or before or prior to) adj3 (implant* or placement* or procedure*)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
25. preoperative period/ or preoperative care/ or preoperative education/ or preoperative evaluation/ or preoperative treatment/
26. (preimplant* or preplacement).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
27. (preoperat* or pre operat*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
28. (presurg* or pre surg*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
29. (preparat* adj2 (implant* or placement* or procedure*)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
30. 24 or 25 or 26 or 27 or 28 or 29
31. 23 and 30
32. limit 31 to "reviews (best balance of sensitivity and specificity)"
33. limit 31 to (consensus development or meta analysis or "systematic review")
34. 31 and guid*.ti.
35. 31 and ((systematic adj3 review).ti. or prisma.ab.)
36. 32 or 33 or 34 or 35

Epistemonikos Search Strategy

((dental OR oral) AND implant* AND (((periimplant* OR "peri implant*") AND (disease OR mucositis OR complication*)) OR periimplantitis OR "peri implantitis")) AND (periodontitis OR "perio dontitis") AND ("pre implant*" OR "prior to implant*" OR preimplant*)

Centre for Reviews and Dissemination search strategy

(dental OR oral) AND implant* AND (((periimplant* OR "peri implant*") AND (disease OR mucositis OR complication*)) OR periimplantitis OR "peri implantitis") AND (periodontitis OR "perio dontitis") AND (pre OR prior OR before OR preparat* OR preimplant*)

TRIP database search strategy

((dental OR oral) AND implant* AND (((periimplant* OR "peri implant*") AND (disease OR mucositis OR complication*)) OR periimplantitis OR "peri implantitis")) AND (periodontitis OR "perio dontitis") AND ("pre implant*" OR "prior to implant*" OR preimplant*)

Google Scholar search strategy

(dental OR oral) implants (((periimplant OR "peri implant") AND (disease OR mucositis OR complications)) OR periimplantitis OR "peri implantitis")) (periodontitis OR "perio dontitis") ("pre implant" OR "prior to implant" OR "pre implantation") [titles of first 50 results checked for relevance]

Question 25: Maintenance of dental implants

Database	Version/issue	Date of search	Records retrieved
Cochrane Database of Systematic Reviews	Limit 2019-2022	18 Nov 2022	0
MEDLINE Ovid	1946 to 15 Nov 2022	18 Nov 2022	21
EMBASE Ovid	1974 to 15 Nov 2022	18 Nov 2022	19
Epistemonikos	Whole database to 17 Nov 2022	18 Nov 2022	0
TRIP	Limit 2019-2022	18 Nov 2022	3
Google Scholar		18 Nov 2022	3
		Total retrieved	46
		After de-duplication	**29**

COCHRANE DATABASE OF SYSTEMATIC REVIEWS (CDSR) Search Strategy

(dental or oral) and implant* and (((periimplant* or "peri implant*") and (disease or mucositis or complication*)) or periimplantitis or "peri implantitis") and supportive and therapy in Title Abstract Keyword

MEDLINE Ovid Search Strategy

1. Dental Implants/
2. exp Dental Implantation/
3. Dental Prosthesis, Implant-Supported/
4. (implant* adj5 dent*).mp.
5. (((overdenture* or crown* or bridge* or prosthesis or restoration*) adj5 (Dental or oral)) and implant*).mp.
6. (blade implant* and (dental or oral)).mp.
7. ((endosseous adj5 implant*) and (dental or oral)).mp.
8. (oral adj5 implant*).mp.
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. Peri-Implantitis/
11. peri-implantitis.mp.
12. peri-implant mucositis.mp.
13. peri-implant disease*.mp.
14. periimplantitis.mp.
15. periimplant mucositis.mp.
16. periimplant disease*.mp.
17. (peri-implant* adj3 complication*).mp.
18. (periimplant* adj3 complication*).mp.
19. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20. (support* adj5 therap*).mp.
21. ((implant or implants) adj5 (aftercare or after care)).mp.

22. (periodontal therap* and implant*).mp.
23. (supportive adj3 (care or maintenance)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
24. 20 or 21 or 22 or 23
25. (supportive and implant* and therap*).ti.
26. supportive therap*.ti.
27. 25 or 26
28. 27 and (9 or 19)
29. 9 and 19 and 24
30. 28 or 29
31. limit 30 to yr="2019 -Current"
32. limit 31 to "reviews (best balance of sensitivity and specificity)"
33. limit 31 to (consensus development conference or consensus development conference, nih or guideline or meta analysis or practice guideline or "systematic review")
34. 30 and guid*.ti. 2
35. 32 or 33 or 34

EMBASE Ovid Search Strategy

1. exp tooth implant/
2. tooth implantation/
3. Dental Prosthesis, Implant-Supported/
4. (implant* adj5 dent*).mp.
5. (((overdenture* or crown* or bridge* or prosthesis or restoration*) adj5 (Dental or oral)) and implant*).mp.
6. (blade implant* and (dental or oral)).mp.
7. ((endosseous adj5 implant*) and (dental or oral)).mp.
8. (oral adj5 implant*).mp.
9. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10. exp periimplantitis/
11. peri-implantitis.mp.
12. peri-implant mucositis.mp.
13. peri-implant disease*.mp.
14. periimplantitis.mp.
15. periimplant mucositis.mp.
16. periimplant disease*.mp.
17. (peri-implant* adj3 complication*).mp.
18. (periimplant* adj3 complication*).mp.
19. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20. (support* adj5 therap*).mp.
21. ((implant or implants) adj5 (aftercare or after care)).mp.
22. (periodontal therap* and implant*).mp.
23. (supportive adj3 (care or maintenance)).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
24. 20 or 21 or 22 or 23

25. (supportive and implant* and therap*).ti.
26. supportive therap*.ti.
27. 25 or 26
28. 27 and (9 or 19)
29. 9 and 19 and 24
30. 28 or 29
31. limit 30 to yr="2019 -Current"
32. limit 31 to "reviews (best balance of sensitivity and specificity)"
33. limit 31 to (consensus development or meta analysis or "systematic review")
34. 31 and guid*.ti.
35. 32 or 33 or 34

Epistemonikos Search Strategy

((dental OR oral) AND implant* AND (((periimplant* OR "peri implant*") AND (disease OR mucositis OR complication*)) OR periimplantitis OR "peri implantitis")) OR abstract:((dental OR oral) AND implant* AND (((periimplant* OR "peri implant*")

TRIP database search strategy

(dental or oral) and implant* and (((periimplant* or "peri implant*") and (disease or mucositis or complication*)) or periimplantitis or "peri implantitis") AND ("supportive therapy" OR "supportive periodontal therapy")

Google Scholar search strategy

("systematic review" OR guideline) AND (dental OR oral) AND (implant OR implants) AND (((periimplant OR "peri implant") AND (disease OR mucositis OR complications)) OR "peri implantitis") AND ("supportive therapy" OR "supportive periodontal therapy")

Questions 26-28: Treatment of peri-implant disease

Database	Version/issue	Date of search	Records retrieved
Cochrane Database of Systematic Reviews	Limit 2013-2023	6 Jan 2023	0
MEDLINE Ovid	1946 to 5 Jan 2023	6 Jan 2023	332
EMBASE Ovid	1974 to 5 Jan 2023	6 Jan 2023	312
Epistemonikos	Limit 2013-2023	6 Jan 2023	7
TRIP	Limit 2013-2023	6 Jan 2023	3
Google Scholar	Limit 2013-2023	6 Jan 2023	13
Centre for Reviews and Dissemination database	Limit 2013-2023	6 Jan 2023	2
		Total retrieved	46
		After de-duplication	**29**

COCHRANE DATABASE OF SYSTEMATIC REVIEWS (CDSR) Search Strategy

((periimplantitis OR "peri implantitis" OR "peri implant mucositis" OR "periimplant mucositis") AND (tissue OR antibiotic* OR "anti biotic*" OR antibiotic*))

MEDLINE Ovid Search Strategy

1. Peri-Implantitis/
2. peri-implantitis.mp.
3. peri-implant mucositis.mp.
4. peri-implant disease*.mp.
5. periimplantitis.mp.
6. periimplant mucositis.mp.
7. periimplant disease*.mp.
8. (peri-implant* adj3 complication*).mp.
9. (periimplant* adj3 complication*).mp.
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11. limit 10 to (english language and yr="2013 -Current")
12. limit 11 to "reviews (best balance of sensitivity and specificity)"
13. limit 11 to (consensus development conference or consensus development conference, nih or guideline or meta analysis or practice guideline or "systematic review")
14. 11 and (guid* or systematic review or meta analy*).ti.
15. 12 or 13 or 14
16. tissue*.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
17. peri implant therap*.mp.

18. periimplant therap*.mp.
19. exp Anti-Bacterial Agents/
20. antibiotic*.mp.
21. anti biotic*.mp.
22. 16 or 17 or 18 or 19 or 20 or 21
23. 15 and 22

EMBASE Ovid Search Strategy

1. periimplantitis/
2. peri-implantitis.mp.
3. peri-implant mucositis.mp.
4. peri-implant disease*.mp.
5. periimplantitis.mp.
6. periimplant mucositis.mp.
7. periimplant disease*.mp.
8. (peri-implant* adj3 complication*).mp.
9. (periimplant* adj3 complication*).mp.
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11. limit 10 to (english language and yr="2013 -Current")
12. limit 11 to "reviews (best balance of sensitivity and specificity)"
13. limit 11 to (consensus development or meta analysis or "systematic review")
14. 11 and (guid* or systematic review or meta analy*).ti.
15. 12 or 13 or 14
16. tissue*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]
17. peri implant therap*.mp.
18. periimplant therap*.mp.
19. exp antibiotic agent/
20. antibiotic*.mp.
21. anti biotic*.mp.
22. 16 or 17 or 18 or 19 or 20 or 21
23. 15 and 22
24. limit 23 to (books or chapter or conference abstract or conference paper or "conference review" or editorial or erratum or letter or note or "preprint (unpublished, non-peer reviewed)")
25. 23 not 24

Epistemonikos Search Strategy

(title:(((periimplantitis OR "peri implantitis" OR "peri implant mucositis" OR "periimplant mucositis") AND (tissue OR antibiotic* OR "anti biotic*" OR antibiotic*))) OR abstract:(((periimplantitis OR "peri implantitis" OR "peri implant mucositis" OR "periimplant mucositis") AND (tissue OR antibiotic* OR "anti biotic*" OR antibiotic*))))

TRIP database search strategy

((periimplantitis OR "peri implantitis" OR "peri implant mucositis" OR "periimplant mucositis") AND (tissue OR antibiotic* OR "anti biotic*" OR antibiotic*))

Google Scholar search strategy

("systematic review" OR guideline) AND ((periimplantitis OR "peri implantitis" OR "peri implant mucositis" OR "periimplant mucositis") AND (tissue OR antibiotic* OR "anti biotic*" OR antibiotic*))

Centre for Reviews and Dissemination database search strategy

((periimplantitis OR "peri implantitis" OR "peri implant mucositis" OR "periimplant mucositis") AND (tissue OR antibiotic* OR "anti biotic*" OR antibiotic*))

Appendix 3 Considered judgement forms

The following forms document the considered judgement for each key clinical question. Each form includes a list of references relevant to the question.

Risk assessment (questions 1-3)

Key Question 1

In patients accessing dental services, does conducting/recording a structured periodontal risk assessment, compared to no structured periodontal risk assessment, aid in the prediction of long-term outcomes of periodontal disease status such as attachment level, bone loss and tooth loss?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Risk assessment

A structured approach to the assessment of risk using a validated risk assessment (RA) tool incorporates a series of questions or examinations which are known to be associated with the onset or progression of periodontal disease to allow a more objective judgement of risk. This contrasts with an unstructured risk assessment, where factors associated with periodontal disease are identified and used by the clinician to make a subjective judgement as to the extent to which these factors may contribute to disease progression (Heitz-Mayfield 2005).

A comprehensive, systematic search of the literature found no evidence directly comparing the performance of a structured periodontal RA with an unstructured periodontal RA in relation to the ability to predict long-term outcomes of periodontal disease such as attachment level, bone loss and tooth loss.

Risk Assessment Tools

The 2015 European Federation of Periodontology (EFP) Consensus report on *Principles in Prevention of Periodontal Diseases* (Tonetti 2015) included information and recommendations related to risk assessment tools for the prevention of periodontitis. This was based on a systematic review (Lang 2015) which identified and evaluated the effectiveness of tools used to assess levels of risk for periodontitis progression. Five different risk assessment tools were identified. Three of the tools (the Periodontal Risk Assessment [PRA], the Periodontal Risk Calculator [PRC; subsequently incorporated into Previser] and the Dentition Risk System [DRS]) were investigated in 10 cohort studies and longitudinal data was assessed by the review authors. Studies investigating the remaining two tools had a cross-sectional design and the effectiveness of these was not evaluated due to a lack of a validated tool to assess the risk of bias in this type of study.

The 10 cohort studies included 2,130 patients, with observation periods ranging from 3 to 12 years. Six studies were assessed as being at low risk of bias and four assessed as being at moderate risk of bias, based on the Newcastle-Ottawa quality assessment scale. The results were not combined due to heterogeneity so the findings of each study were reported in a narrative format. One small study (n=20) found that the PRA tool did not significantly predict outcomes in terms of tooth loss. However, results for the remaining 9 studies suggest that the tools were able to predict periodontitis progression and/or tooth loss:

- In 2 studies, the PRA assessed risk significantly predicted outcomes in terms of tooth loss.
- In 4 studies, the PRA assessed risk significantly predicted outcomes in terms of periodontitis progression and tooth loss.

- In 1 study, the PRC assessed risk significantly predicted outcomes in terms of tooth loss.
- In 1 study, the PRC assessed risk significantly predicted outcomes in terms of periodontitis progression and tooth loss.
- In 1 study, the DRS assessed risk significantly predicted outcomes in terms of tooth loss.

The review authors concluded that, in general, these studies suggest that RA tools can effectively identify subjects with different probabilities of disease progression and tooth loss. There is no evidence concerning the impact of risk assessment on clinical management, but the review authors note that even in the absence of this, clinicians may consider application of these principles to clinical practice.

Accordingly, the EFP consensus report noted that validated risk assessment tools may be useful to facilitate patient communication in terms of goal setting, planning, and self-assessment (Good practice point) and recommended that patients should be stratified in terms of risk of disease progression and tooth loss (strong recommendation; level of evidence: 2), with the risk assessment used to facilitate clinical decision making (weak recommendation; level of evidence: 5 [expert opinion]). There was also a statement noting that *'these tools may be useful to communicate risk to the patient and any potential preventative targets'*.

Predictors of periodontitis progression

Lang (2015) noted that the predictors that inform the various risk assessment tools are broadly the same, although tools differ in how they assess these. The authors also noted that most of the tools reviewed are variations of a few basic approaches that are particularly based on the PRC and PRA. Common predictors across all three tools are age, age relative to degree of bone loss, smoking status, systemic disease status (most notably diabetes), and pocket depth. Predictors that occur in two out of three tools include bleeding on probing, furcation involvement, bone loss/lesions and presence of marginal restorations.

Risk factors

Public Health England's *Delivering Better Oral Health* (DBOH) guideline notes that the primary prevention of periodontitis and gingivitis involves control of modifiable risk factors which include tobacco, alcohol and diabetes. Tobacco use (Aminoshariae 2020, Leite 2018) and uncontrolled diabetes (Nascimento 2018) are both well-established risk factors for periodontal disease. There is emerging low-certainty evidence that alcohol consumption is associated with periodontitis (Pulikkotil 2020, Amaral 2009). DBOH also notes that there are marked inequalities by socio-economic status in terms of disease burden and Public Health England's *Inequalities in oral health in England* (2021) report states that there is '*clear and consistent evidence for social gradients in the prevalence of dental decay, tooth loss, oral cancer, self-rated oral health, oral health-related quality of life, oral hygiene, and service use'*.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) notes that following an initial diagnosis of periodontitis and prior to potential therapy, initial discussions with patients should include causes of the condition and risk factors for disease progression. It is recognised that risk factor control may include employing behavioural change interventions aimed at eliminating/mitigating recognised risk factors for periodontitis onset and progression. Moderate certainty evidence supports interventions for smoking cessation (Ramseier 2020) and diabetes control (Nascimento 2018, Ramseier 2020). Evidence supporting other lifestyle modifications, such as physical exercise, dietary counselling and weight loss is inconsistent and low certainty at best and the BSP-S3 guideline notes that further research is needed.

The evaluation of risk factors as predictors of periodontal disease progression have been the subject of several reviews). Helal (2019) undertook a systematic review and meta-analysis to assess the consistency and magnitude of any association between a total of 12 predictors and tooth loss. The review included 20 studies (15,422 patients, mean follow-up: 12 years) which were quality assessed and subjected to a random effects meta-analysis. The authors concluded that those who were older, non-compliant, smoking or patients with diabetes, and teeth with bone loss, high probing pocket depth, mobility, or molars, especially with furcation involvement, showed higher risks for tooth loss. The certainty of the evidence is considered low due to substantial heterogeneity and indirectness with regard to the populations studied, treatment provided and definitions and reporting of predictors.

Carvalho (2021) updated a previous systematic review (Chambrone 2010) evaluating risk factors/predictors of tooth loss in patients with periodontitis who underwent periodontal therapy and long-term periodontal maintenance (PM). The review included 36 papers reporting on 33 studies (30 retrospective, 3 prospective). Overall, individual studies' outcomes demonstrated that patient-related factors (age, gender, active smoking and compliance regarding PM) and tooth-related factors (tooth type, tooth location, baseline PPD, presence of furcation involvement and baseline mobility) are relevant risk factors predicting tooth loss during PM. Meta-regressions revealed no significance in both retrospective and prospective trials in terms of tooth loss, with an average of 0.1 tooth loss per year per patient (P<0.001). However, baseline characteristics (smoking, diabetes mellitus, cardiovascular disease, being male and teeth with furcation lesions) showed no significance as predictor of tooth loss when the results of studies were combined. The certainty of the evidence is considered low due to the retrospective nature of most of the included studies and substantial heterogeneity.

It should be noted that the use of tooth loss as an outcome measure has strengths and limitations. Although tooth loss is a relatively hard end point, and not easy to bias, in the reviews by Helal (2019) and Carvalho (2021) most tooth loss was reported as due to reasons other than periodontal disease and in the latter review the percentage of tooth loss due to periodontal reasons ranged from 0.45% to 14.4%.

In a narrative review, Heitz-Mayfield (2005) examined the evidence for individual predictive factors associated with a patient's susceptibility to progression of periodontitis. This included medical and dental risk factors and was widened to consider a range of social factors. However, evidence for the role of these in the progression of periodontitis was limited, with inconclusive evidence found for the impact of alcohol consumption and psychological factors such as stress and depression. Age has been indicated as risk factor for alveolar bone loss (Papapanou 1989) or clinical attachment loss (Ismail 1990) and individuals with a family history of aggressive disease are considered to be at high risk (Kinane 2003).

A number of studies have reported that the prevalence and severity of periodontitis are higher in certain ethnic/racial groups (Brown 1994, Oliver 1998, Borrell 2002). However, confounding factors associated with ethnicity and race such as occupational status, socio-economic status, income, education, access to health services, cultural and environmental factors are likely to have a significant role in this observed disparity.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance.

While no direct evidence comparing a structured risk assessment to an unstructured risk assessment was identified, there is evidence that risk assessment performed using a validated tool can reliably predict a patient's risk of disease progression and tooth loss. The evidence is considered low certainty due to the observational nature of the data and substantial heterogeneity that precluded meta-analysis. Social, medical and dental predictors that are commonly included in such a risk assessment are age, smoking status, systemic disease status (e.g. diabetes), pocket depth, bleeding on probing, furcation involvement and bone loss.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- Adverse events were not reported in the reviews cited above.
- It is unlikely that serious adverse effects would occur as the result of a structured risk assessment.
- Conducting a structured RA could help identify not only risk factors for oral diseases but also those affecting a patient's overall health.
- The ability of RA tools to stratify patients by risk level may help to identify individuals at risk and with disease and allow for more effective targeting of treatment
- RA tools may be useful in facilitating patient communication in terms of goal setting, planning, and self-assessment.
- RA tools may help clinicians to communicate with patients about the patient's periodontal disease and patient's individual risk profile, thereby avoiding possible miscommunication regarding the presence and management of disease.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- RA tools can effectively identify subjects with different probabilities of disease progression and tooth loss, enabling clinicians to target treatments for patients in relation to their respective risk level.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- Values and preferences were generally not addressed by the reviews cited
- Clinicians may value having a clear and objective assessment of disease and risk profile to present to their patients to aid communication and avoid misunderstandings
- Patients are likely to value objective assessment and communication of their disease status
- Patients may value risk-based information which enables them to improve their oral health and prevent future problems.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Some dentists may prefer to continue their current practice rather than undertake structured risk assessments.
- Patients with a high score on a risk assessment may require particular care in counselling and discussion to help them understand that they can impact the progression of disease with home care measures and support from the dental team, to avoid them becoming discouraged and demotivated to improve their oral health.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- A structured RA will require clinical and administrative time.
- Using validated RA tools may incur additional costs e.g. purchasing licensed software.
- A recent systematic review of economic evaluations of prognostic methods and models for the prediction of risk for caries (n=4) or periodontitis (n=2) found no evidence that it was cost-effective to use them (Fransson 2021).

7. Other factors

Indicate any other factors taken into account.

- While tools based on risk factors permit the grouping of patients according to different levels of average risk, they do not allow the accurate prediction of individual patient outcomes.
- It is not yet clear how clinicians alter individual patient management based on a structured risk assessment. However, the risk assessment can highlight to clinicians those at risk and those who should be treated/managed differently.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group noted the lack of evidence comparing the performance of a structured periodontal RA with an unstructured periodontal RA. The Group endorsed the use of a structured approach in using a range of medical,

dental and social factors to assign a periodontal risk level. The certainty of evidence presented was considered low as it is based on retrospective and prospective observational trials with a high level of heterogeneity.

The Group discussed the emerging risk of vaping (e-cigarettes) in terms of its relation to smoking. There is a lack of evidence in this area, as summarised by DBOH which noted findings about the impact of vaping on periodontal health were inconsistent but suggested that people who vaped are at greater risk for periodontal diseases compared to non-smokers. The Group agreed there is at present a lack of evidence in relation to the impact of vaping on periodontal health, but its effect is unlikely to be harmless. The discussion included anecdotal evidence from Group members of the relatively high prevalence of vaping among young adults and that this is a group who are likely to have taken up vaping without previously having been smokers. The Group also noted that smoking cessation services favour vaping over smoking and caution against dissuading individuals from vaping due to the potential risk of them returning to smoking. It was agreed that further investigation was needed on the impact of vaping and this would include contacting subject experts in this area to see if more up-to-date evidence was available. The Group agreed that notwithstanding the level of evidence available, the potential risk of vaping should be included in the narrative section which will be updated from the previous version of the guidance.

The Group agreed the importance of ensuring that the educational message is emphasised that RA tools are not viewed as prognosis tools. Risk assessment tools may indicate a higher level of risk but that should not be equated to a poor prognosis as risk factors are treatable and can be improved.

Recommendation in updated guidance:

- When carrying out a risk assessment, use a structured approach to assess the patient's medical, dental and social history, any relevant risk factors and the outcome of the clinical examination, to inform future treatment and recall.

Relevant text from main narrative:

While the importance of risk assessment to inform a patient's care is accepted, it is acknowledged that risk assessment itself is an imperfect science. Approaches to risk assessment may be structured (i.e. using a validated risk assessment tool) or unstructured (i.e. making a subjective judgement based on known risk factors). A structured approach to risk assessment, which incorporates a series of questions or examinations to assess a range of factors associated with periodontal disease, may allow for a more objective judgement of risk.

Various tools that enable a formal structured approach to risk assessment are available and evidence suggests that they can be effective at predicting periodontitis progression and/or tooth loss. The evidence is considered low certainty due to the observational nature of the data and substantial heterogeneity. Predictors common to these tools include age, smoking status, systemic disease status (most notably diabetes), pocket depth, furcation involvement and bone loss in relation to age.

- Assign a risk level, based on the patient's medical history, an assessment of risk factors and the outcome of the clinical examination, to inform future treatment and recall interval.
    - A structured approach to risk assessment that documents age, smoking status (including whether the patient uses e-cigarettes), oral hygiene status, systemic disease status (e.g. diabetes) and pocket depth may be helpful when assigning a risk level.
    - Relevant social factors include a family history of early tooth loss or periodontitis, non-attendance and socio-economic status.
    - Other clinical factors that may be considered are bleeding on probing, furcation involvement, bone loss in relation to age, bone lesions and presence of marginal restorations.

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Amaral Cda S, Vettore MV, Leão A. The relationship of alcohol dependence and alcohol consumption with periodontitis: a systematic review. Journal of Dentistry. 2009;37(9):643-51

Aminoshariae A, Kulild J, Gutmann J. The association between smoking and periapical periodontitis: a systematic review. Clinical Oral Investigations. 2020;24(2):533-45.

Borrell LN, Burt BA, Gillespie BW, Lynch J, Neighbors H. Periodontitis in the United States: beyond black and white. Journal of Public Health Dentistry (2002) 2, 92–101.

Brown LF, Beck JD, Rozier RG. Incidence of attachment loss in community dwelling older adults. Journal of Periodontology (1994) 4, 316–323.

Carvalho R, Botelho J, Machado V, Mascarenhas P, Alcoforado G, Mendes JJ, Chambrone L. Predictors of tooth loss during long-term periodontal maintenance: An updated systematic review. J Clin Periodontol. 2021 Aug;48(8):1019-1036.

Chambrone L, Chambrone D, Lima LA, Chambrone LA. Predictors of tooth loss during long-term periodontal maintenance: a systematic review of observational studies. J Clin Periodontol. 2010 Jul;37(7):675-84.

Fransson, H, Davidson, T, Rohlin, M, Christell, H. There is a paucity of economic evaluations of prediction methods of caries and periodontitis — A systematic review. Clin Exp Dent Res. 2021; 7: 385– 398

Helal O, Göstemeyer G, Krois J, Fawzy El Sayed K, Graetz C, Schwendicke F. Predictors for tooth loss in periodontitis patients: Systematic review and meta-analysis. J Clin Periodontol. 2019 Jul;46(7):699-712.

Heitz-Mayfield LJ. Disease progression: identification of high-risk groups and individuals for periodontitis. J Clin Periodontol. 2005;32 Suppl 6:196-209.

Ismail AI, Morrison EC, Burt BA, Caffesse RG, Kavanagh MT. Natural history of disease in adults: findings from the Tecumseh Periodontal Disease Study, 1959–87. Journal of Dental Research 1990; 2, 430–435.

Kinane DF, Hart TC. Genes and gene polymorphisms associated with periodontal disease. Critical Reviews in Oral Biology and Medicine (2003) 6, 430–449.

Lang NP, Suvan JE, Tonetti MS. Risk factor assessment tools for the prevention of periodontitis progression a systematic review. J Clin Periodontol. 2015 Apr;42 Suppl 16:S59-70.

Leite FRM, Nascimento GG, Scheutz F, López R. Effect of Smoking on Periodontitis: A Systematic Review and Meta-regression. American Journal of Preventive Medicine. 2018;54(6):831-41.

Nascimento GG, Leite FRM, Vestergaard P, Scheutz F, López R. Does diabetes increase the risk of periodontitis? A systematic review and meta-regression analysis of longitudinal prospective studies. Acta Diabetologica. 2018;55(7):653-67.

Oliver RC, Brown LJ, Löe H. Periodontal diseases in the United States population. Journal of Periodontology (1998) 2, 269–278.

Papapanou PN, Wennstrom JL & Grondahl K. A 10-year retrospective study of periodontal disease progression. Journal of Clinical Periodontology (1989) 7, 403–11.

Pulikkotil SJ, Nath S, Muthukumaraswamy, Dharamarajan L, Jing KT, Vaithilingam RD. Alcohol consumption is associated with periodontitis. A systematic review and meta-analysis of observational studies. Community dental health. 2020;37(1):12-21

Public Health England. Inequalities in oral health in England. London: PHE; 2021

Ramseier CA, Woelber JP, Kitzmann J, Detzen L, Carra MC, Bouchard P. Impact of risk factor control interventions for smoking cessation and promotion of healthy lifestyles in patients with periodontitis: A systematic review. Journal of Clinical Periodontology 2020, January 7;47(Suppl 22):90-106.

Simpson TC, Clarkson JE, Worthington HV, MacDonald L, Weldon JC, Needleman I, Iheozor-Ejiofor Z, Wild SH, Qureshi A, Walker A, Patel VA, Boyers D, Twigg J. Treatment of periodontitis for glycaemic control in people with diabetes mellitus. Cochrane Database of Systematic Reviews, 2022 Issue 4. Art. No.: CD004714

Tonetti MS, Eickholz P, Loos BG, Papapanou P, van der Velden U, Armitage G, Bouchard P, Deinzer R, Dietrich T, Hughes F, Kocher T, Lang NP, Lopez R, Needleman I, Newton T, Nibali L, Pretzl B, Ramseier C, Sanz-Sanchez I, Schlagenhauf U, Suvan JE. Principles in prevention of periodontal diseases: Consensus report of group 1 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases. J Clin Periodontol. 2015 Apr;42 Suppl 16:S5-11.

Key Question 2

Does conducting/recording a structured periodontal risk assessment, compared to no structured periodontal risk assessment, influence the treatment (e.g. targeted risk factor control, oral hygiene instruction, individual recall intervals) provided by the dental team?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

A comprehensive, systematic search of the literature found no systematic reviews of studies directly comparing the performance of a structured periodontal RA with an unstructured periodontal RA in relation to influencing the treatment (e.g. targeted risk factor control, oral hygiene instruction, individual recall intervals) provided by the dental team. This reflects the findings of the systematic review conducted by Lang (2015) which was unable to identify any studies which evaluated in a comparative way the effect of knowledge of the risk assessment profile on the management of the patient.

The systematic review by Lang (2015) informed the 2015 European Federation of Periodontology (EFP) Consensus report on *Principles in Prevention of Periodontal Diseases* (Tonetti 2015). The consensus report noted that the implications of patient stratification using RA tools in terms of clinical decision-making were unclear, and that the tools' efficacy/effectiveness in terms of improvement of periodontal care and clinical outcomes had not been evaluated. Despite this, the consensus report considered RA tools valuable for capturing the complexity of the patient profile, which could be used to inform clinical decision making. It also noted that the tools may be useful in communicating risk to the patient and potential preventative targets.

A relevant, comparative study of four RA tools (PerioRisk, Periodontal Risk Assessment (PRA), Periodontal Risk Calculator (PRC), staging and grading systems) noted that, ideally, tools should provide customised recommendations for individuals, such as extra periodontal maintenance therapy (PMT) visits or antimicrobial therapy (Saleh 2022). Of the tools reviewed, only the PRA, provided a customised recommendation for individuals based on their risk level (regarding the number of PMT sessions to be provided in a year) and the accuracy of such recommendations had yet to be evaluated.

A relevant study (Thyvalikakath 2018) which cited the Lang (2015) review conducted focus groups with dentists and hygienists to explore their attitudes toward performing risk assessment for periodontal disease. A key barrier to employing RA tools was a perception that they lacked scientific validation. Participants felt that the development of such tools had focussed on translating research findings into the RA tool and not on evaluating if and how it can reduce a patient's risk. This prompted the authors to call for more research to validate RA results in real world clinical settings to determine how risk scores are determined, how they are used to make treatment decisions, how they are used in patient education and shared decision making and whether RA tools improve treatment processes and patient outcomes.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

As per clinical question 1:

- Adverse events were not reported in the reviews cited above.
- It is unlikely that serious adverse effects would occur as the result of a structured risk assessment.

- Conducting a structured RA could help identify not only risk factors for oral diseases but also those affecting a patient's overall health.
- The ability of RA tools to stratify patients by risk level may help to identify individuals at risk and with disease and allow for more effective targeting of treatment.
- RA tools may be useful in facilitating patient communication in terms of goal setting, planning, and self-assessment.
- RA tools may help clinicians to communicate with patients about the patient's periodontal disease and patient's individual risk profile thereby avoiding possible miscommunication regarding the presence and management of disease.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

As per clinical question 1:

- RA tools can effectively identify subjects with different probabilities of disease progression and tooth loss, enabling clinicians to target treatments for patients in relation to their respective risk level.

4. Values and preferences

Summarise any evidence or information on values and preferences.

As per question 1:

- Values and preferences were generally not addressed by the reviews cited.
- Clinicians may value having a clear and objective assessment of disease and risk profile to present to their patients to aid communication and avoid misunderstandings
- Patients are likely to value objective assessment and communication of their disease status
- Patients may value risk-based information which enables them to improve their oral health and prevent future problems.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

As per clinical question 1:

- Some dentists may prefer to continue their current practice rather than undertake structured risk assessments.
- Patients with a high score on a risk assessment may require particular care in counselling and discussion to help them understand that they can impact the progression of disease with home care measures and support from the dental team, to avoid them becoming discouraged and demotivated to improve their oral health.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

As per clinical question 1:

- A structured RA may be time consuming will require clinical and administrative time.
- Using validated RA tools may incur additional costs e.g. purchasing licensed software.
- A recent systematic review of economic evaluations of prognostic methods and models for the prediction of risk for caries (n=4) or periodontitis (n=2) found no evidence that it was cost-effective to use them (Fransson 2021).

7. Other factors

Indicate any other factors taken into account.

As per clinical question 1:

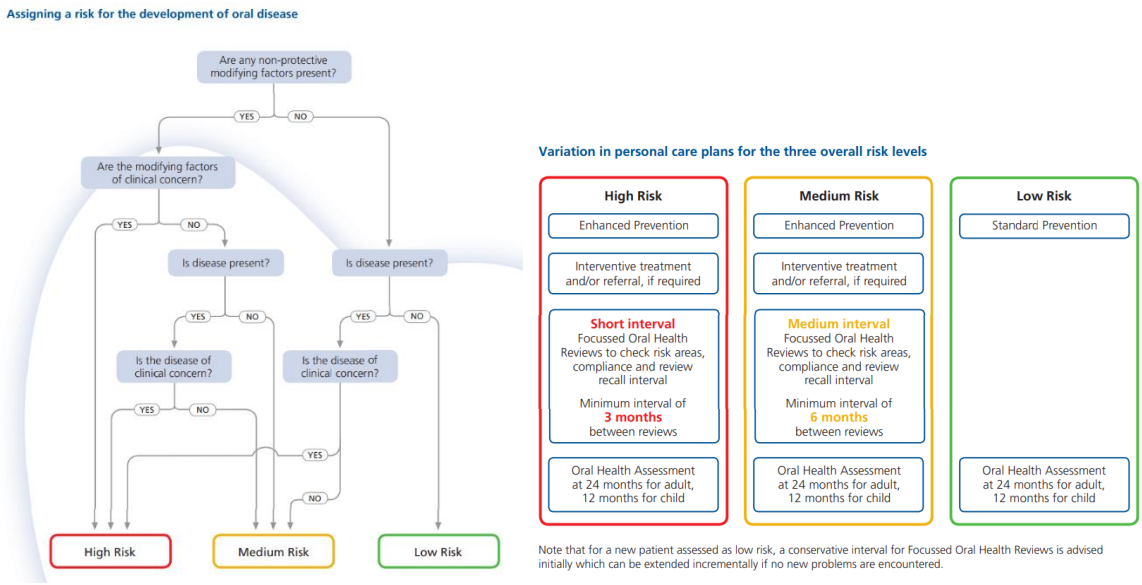
- The 2021 Economist Intelligence Unit (EIU) study noted that if gingivitis is not managed at a population level, this may significantly increase overall healthcare costs and reduce quality of life.

- While tools based on risk factors permit the grouping of patients according to different levels of average risk, they do not allow the accurate prediction of individual patient outcomes.
- It is not yet clear how clinicians alter individual patient management based on a structured risk assessment. However, the risk assessment can highlight to clinicians those at risk and those who should be treated/managed differently.

8. Additional information

Include any further information that is relevant to the considered judgement.

The SDCEP *Oral Health Assessment and Review* guidance includes a simplified illustration of the risk assessment process. The flowchart is used to assess the overall risk level for a particular patient, taking account of any relevant modifying factors and the results of the clinical examination. The overall risk level can then inform the personal care plan and recall interval. These could be adapted to be specific for periodontal risk and periodontal treatment planning.



9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group noted that evidence in this area was lacking, with that presented being indirect to the question. It was agreed that it was feasible to carry out a simple risk assessment, as some of the information has already been collected (e.g. medical history, smoking status), and that this assessment is useful for helping to stratify and streamline patients. The reliance solely on the use of computer-based risk assessments was questioned as it was noted that the clinician should be well placed to assess risk using their clinical judgement. It is important to understand how an assessment of clinical risk has been arrived at. It was thought that the use of clinical judgement will facilitate this, while the process might not be entirely clear when using a computer-based tool.

The Group endorsed the development of the proposed flowchart tool as a means of assessing risk. The example presented is a generic version for oral health assessment and this will need to be adapted for assessing periodontal health. The adaptation will need to take into account a number of issues which were discussed. These include ensuring the flowchart can be used for all patients and in so doing making it clear what type of risk is being assessed e.g. those for a new patient or a patient with existing disease. If the flowchart proposes recommended personal care plans, these will need to include treatment and recall considerations.

The Group discussed the issue of a risk assessment tool determining recall visits. A Group member identified research by Ramseier (2019) which examined the relationship between the time of recall visits and periodontal probing depths for patients enrolled in supportive periodontal therapy. Patients returning for SPT up to five times consecutively earlier than computed intervals suggested they should, presented statistically significantly lower mean PPDs compared with patients returning later. A discussion in the following GDG meeting (15/12/22) noted the findings of this evidence but agreed that it was not directly relevant to the application of tools to assess an individual's risk of periodontitis.

Recommendation in updated guidance:

- There is insufficient evidence to inform a recommendation. Further research is required. (100% agreement with this following discussion of additional evidence at following GDG meeting)

Strength of recommendation (strong or conditional):

- Not applicable

References

Fransson, H, Davidson, T, Rohlin, M, Christell, H. There is a paucity of economic evaluations of prediction methods of caries and periodontitis — A systematic review. Clin Exp Dent Res. 2021; 7: 385– 398

Lang NP, Suvan JE, Tonetti MS. Risk factor assessment tools for the prevention of periodontitis progression a systematic review. J Clin Periodontol. 2015 Apr;42 Suppl 16:S59-70.

Ramseier CA, Nydegger M, Walter C, Fischer G, Sculean A, Lang NP, Salvi GE. Time between recall visits and residual probing depths predict long-term stability in patients enrolled in supportive periodontal therapy. J Clin Periodontol. 2019 Feb;46(2):218-230.

Saleh MHA, Dukka H, Troiano G, Ravidà A, Qazi M, Wang HL, Greenwell H. Long term comparison of the prognostic performance of PerioRisk, periodontal risk assessment, periodontal risk calculator, and staging and grading systems. J Periodontol. 2022 Jan;93(1):57-68.

Thyvalikakath T, Song M, Schleyer T. Perceptions and attitudes toward performing risk assessment for periodontal disease: a focus group exploration BMC Oral Health. 2018, 18:90

Tonetti MS, Eickholz P, Loos BG, Papapanou P, van der Velden U, Armitage G, Bouchard P, Deinzer R, Dietrich T, Hughes F, Kocher T, Lang NP, Lopez R, Needleman I, Newton T, Nibali L, Pretzl B, Ramseier C, Sanz-Sanchez I, Schlagenhauf U, Suvan JE. Principles in prevention of periodontal diseases: Consensus report of group 1 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases. J Clin Periodontol. 2015 Apr;42 Suppl 16:S5-11.

Key Question 3

In patients who are at increased risk of periodontitis, does receiving information about their periodontal risk result in behaviour changes to reduce this risk, such as smoking cessation or improved oral hygiene?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The potential need for behavioural change in those at risk from periodontitis is recognised in guidance issued by Public Health England's *Delivering Better Oral Health* (DBOH) and the *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3).

DBOH notes that helping patients to improve their oral health involves providing tailored advice, teaching new skills, answering questions and regularly reinforcing key messages, whilst understanding that the ability to change is influenced by a range of individual, environmental and socioeconomic factors. BSP-S3 states that following an initial diagnosis of periodontitis and prior to potential therapy, initial discussions with patients should include causes of the condition, risk factors, treatment alternatives and expected risks and benefits including the option of no treatment. It is recognised that risk factor control may include employing behavioural change interventions aimed at eliminating/mitigating recognised risk factors for the onset and progression of periodontitis.

A comprehensive, systematic search of the literature identified additional systematic reviews evaluating behavioural interventions for specific periodontal risk factors, notably smoking, diabetes and oral hygiene (OH). It should be noted that although the studies included in the reviews examined the use of behavioural change interventions to improve periodontal outcomes, it is difficult to ascertain whether this approach included the specific discussion of risk factors. The search located no published reviews focussing on risk communication in a dental setting. A review that investigated how patients value and respond to different forms of information on health risks (Harris 2020) found no studies relating to oral health messages but is helpful in placing risk communication in a clinical setting in context.

Risk Communication

A systematic review that aimed to identify and evaluate the format of risk information given to patients in a clinical setting (Harris 2020) found 9 RCTs and 3 non-RCTs that provided information about cardiovascular risk, asthma risk, type 2 diabetes mellitus information and healthy 'life-check' information. Although the authors note that some studies were rated as having a low risk of bias in many domains, most were judged to have a high or unclear risk of bias in at least one domain, with performance and detection bias a particular weakness in all studies.

The most common format identified was computerised information. Although this format makes tailoring of risk information possible and enables simple and visual representation of complex risk information, the review found that further face-to-face or personal reinforcement to interpret and discuss the information may be required to achieve a beneficial effect. Other studies presented risk information by way of population diagrams, coloured charts or photographs. Limited evidence was found for the effectiveness of visual aids in prompting patients to adopt healthier lifestyles, or even to enhance clinical communication. The review concluded that risk information itself may have a limited impact on health behaviour and the way in which clinical information is communicated during the appointment is still critical as to whether or not there is to be any change in behaviour.

Oral hygiene

The 2015 European Federation of Periodontology (EFP) *Consensus report on Principles in Prevention of Periodontal Diseases* (Tonetti 2015) included information and recommendations on behavioural change based

on a systematic review evaluating psychological approaches to behavioural change for improved plaque control in periodontitis patients (Newton 2015). The review identified 14 studies (10 RCTs, 4 cohort/observational studies) across seven theoretical models of health-related behaviour. A broad range of periodontal measures were included in the studies and measures of adherence were largely self-reported or measures of disease status. The review authors concluded that change in oral hygiene behaviour is related to patient-perceptions of harmful consequences, their own susceptibility to periodontitis and their benefits from change. The consensus report stated that behavioural change can be facilitated by goal setting (i.e., identifying with the patient the change to be made), planning (i.e., working with the patient to decide when, where and how they will undertake the behaviour change) and self-monitoring (i.e., encouraging the patient to assess their own behaviour in relation to the goals).

Two more recent systematic reviews examined the use of behavioural interventions to improve oral hygiene (Carra 2020) and self-care (Jarvinen 2018) for periodontal patients.

Carra (2020) looked at the efficacy of behavioural interventions, including motivational interviewing, psychological interventions and cognitive behavioural therapy delivered by oral health professionals and/or psychologist/counsellor compared to standard oral health information. The pooled data analysis showed no significant clinical benefits (in terms of improved plaque and bleeding scores) for patients receiving the psychological interventions compared to the control group, at short term (3 months) and overall (any follow-up duration) and evidence on the effectiveness of other communication methods, such as self-inspection and use of videotapes, to improve OH was inconclusive. The overall quality of evidence was low with a high risk of bias and the interpretation of the results is limited by the high level of heterogeneity observed.

Jarvinen (2018) evaluated behavioural and educational interventions used to improve self-care (brushing and interdental cleaning) in adult periodontitis patients compared with conventional instruction or education. The review identified 6 RCTs (n=284 patients) but due to the high degree of heterogeneity across the studies, a meta-analysis was not conducted and results were described individually. Four studies compared behavioural approaches to traditional patient instruction: cognitive behavioural therapy (n=2), motivational interviewing (n=2), self-regulation theory (n=1) and the client self-care commitment model (n=1). The remaining two studies employed traditional instruction without the use of any specific behavioural methods to look at the impact of patient self-inspection and audiovisual instruction on OH. Behavioural intervention groups seemed to perform slightly better than control based on clinical outcome measures such as the presence of plaque or number of periodontal pockets and also in terms of increased patient-reported compliance (e.g. effectiveness of self-care and frequency of interdental cleaning). While all behavioural interventions appear more effective than conventional instruction, no one behaviour change method could be identified as superior. The review concludes that while there is some low certainty evidence supporting the use of behavioural interventions, the size/level of benefits remains unclear.

Smoking cessation

DBOH recommends that, at every opportunity, dental professionals should adopt the ASK, ADVISE, ACT approach to delivering smoking cessation i.e. ask patients if they smoke and record smoking status, advise on the most effective way of quitting and act on patient response, such as refer to local stop smoking support. This strong recommendation is based on moderate certainty evidence that interventions for smoking cessation improve periodontal health (Ramseier 2020). It should be noted that the approach to smoking cessation in NHSScotland may differ slightly.

The BSP-S3 guideline recommendation that tobacco smoking cessation interventions be implemented in patients undergoing periodontitis therapy (recommendation grade: A [strong]) is based on 6 prospective studies with at least six month's follow-up that assessed different interventions, some of which were delivered in parallel with periodontal treatment (Ramseier 2020). The success of these interventions on smoking cessation was considered moderate (quit rates of 4-30% after 1-2 years) except in one study, where no difference was observed. Two studies also demonstrated benefits in periodontal outcomes (PD, CAL), when comparing former smokers to smokers and oscillators.

A recent Cochrane review (Holliday 2021) assessed the effectiveness of tobacco cessation interventions offered by dental professionals. A total of 20 studies (10 RCTs, 10 cluster-RCTs) involving 14,897 participants compared four types of interventions by dental professionals with usual care, brief advice, very brief advice, or less active treatment. The outcome of interest was abstinence from tobacco use at least six months from baseline. The review found very low-certainty evidence of benefit from behavioural support provided by dental professionals, comprising either one session, or more than one session. There was moderate-certainty evidence of benefit from behavioural interventions provided by dental professionals combined with the provision of Nicotine Replacement Therapy (NRT) or e-cigarettes, compared with control. The review did not detect a benefit from multiple-session behavioural support provided by dental professionals delivered in a high school or college, instead of a dental setting. Adverse effects were only reported in one study and mostly appeared to be related to periodontitis or periodontal therapy. It should be noted that although the review itself is well done, a number of limitations are identified, such as self-assessment of smoking cessation in some studies rather than assessed by tests (saliva, breath) and incomplete reporting and drop-outs of more than 50% of participants in some studies.

Diabetes control

DBOH recommends that patients with diabetes should try to maintain good diabetes control as they are at greater risk of developing serious periodontitis and less likely to benefit from periodontal treatment if the diabetes is not well controlled (recommendation grade: conditional). This is based on low certainty evidence that poorly controlled diabetes substantially increases the risk or progression of periodontitis (Nascimento 2018). Moderate certainty evidence found that interventions to improve diabetic control led to improved periodontal health (Ramseier 2020) and that periodontal treatment improved diabetic control (Baeza 2020). DBOH also recommends that for patients with diabetes, dental professionals should explain risk related to diabetic control; ask about HbA1c (glycated haemoglobin) levels and assess and discuss clinical management (Good Practice Point). It notes that a study found that almost three-quarters of diabetic patients were unaware of the link between diabetes and periodontal health (Siddiqi 2019).

BSP-S3 recommends diabetes control interventions in patients undergoing periodontitis therapy (recommendation grade: A [strong]). This is based on two, small, 6-month RCTs performed at university settings that found that provision of interventions to address oral hygiene and to highlight the link between diabetes and periodontitis resulted in significantly improved HbA1c levels, oral hygiene measures and periodontal outcomes (Ramseier 2020).

Other relevant conditions/lifestyle factors

The BSP-S3 guideline notes that other relevant factors associated with healthy lifestyles (stress reduction, dietary counselling, weight loss or increased physical activities) may also be part of the overall strategy for reducing patients' risk factors. It includes questions related to the effect of interventions related to physical exercise, dietary counselling and weight loss on the outcomes of periodontitis therapy. While some studies suggest that these interventions may be beneficial, the evidence is inconsistent and low certainty at best (Ramseier 2020). Therefore, rather than making a recommendation, the BSP-S3 guideline states that it is unclear if these interventions may have a positive impact in periodontitis therapy and that additional research is needed.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance.

There is no direct evidence that informing patients about their periodontal risk results in behaviour changes to reduce their risk but there is some low to moderate certainty evidence that interventions to promote improved oral hygiene, smoking cessation and diabetes control have some success in changing patient behaviour. Both DBOH and the BSP-S3 guideline recommend that behaviour change interventions to address modifiable risk factors such as smoking, diabetes control and inadequate oral hygiene be employed as a first step of therapy and throughout treatment including step four, supportive periodontal care.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- The review of tobacco cessation delivered by dental professionals noted one study which reported adverse events (Holliday 2021). Most of these appeared to be related to periodontitis or periodontal therapy, although some, such as mouth ulceration or soreness, could have been related to the nicotine in the intervention or as a common side-effect of tobacco-use cessation.
- There is no evidence to support one type of behavioural intervention as being more effective than any other (Carra 2020, Jarvinen 2018).
- Interventions aimed at reducing risks associated with smoking and diabetes may have a beneficial effect on general health.
- The dental team often has more contact with the public than other medical professionals and therefore may have more opportunity to discuss risk modifications that may be of benefit to general health than other health care professionals

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- A review investigating whether patients with diabetes are aware of the bidirectional relationship between diabetes and periodontal disease found that less than half have knowledge about their increased risk for periodontal disease, and often the dentist is not the main source of information to motivate them (Maia 2022).
- Behavioural interventions should be tailored to particular risk factor groups, for example patients who smoke/use tobacco, patients with diabetes.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- Specific interventions should be provided to address the patient's knowledge, attitude, motivation, and behaviours rather than providing unspecific information or unstructured education (Carra 2020).
- Patients' skills, knowledge, level of motivation and values should be taken into account in educational interventions for periodontitis patients (Jarvinen 2018).

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Dental staff and patients may experience a degree of discomfort when risk-related discussions take place during clinical practice (Harris 2020).
- Both the dental team and patients may find conducting potentially sensitive conversations about lifestyle and behaviour challenging.
- The dental team already discuss behaviour change with patients but it is accepted that some current payment models do not explicitly support these additional interventions which take clinical time to deliver
- Changing patient health behaviours can be difficult and challenging. Patients may be resistant to change and can be more intent on visiting a dentist to fix existing problems than preventing future disease (Thyvalikakath 2018).

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Behavioural interventions will require clinical time and may incur additional costs.
- There may also be time and costs related to potential reinforcement activity.
- Reducing modifiable risk is likely to reduce disease progression and thereby avoid some of the costs associated with management of more advanced diseases. This is in line with the 2021 Economist Intelligence Unit (EIU) study which noted that if gingivitis is not managed at a population level, this may significantly increase overall healthcare costs and reduce quality of life.

- Training in behaviour change techniques may be required.

7. Other factors

Indicate any other factors taken into account.

- There is little evidence to inform which particular behavioural intervention (type, duration, frequency) is effective and in which situation but change in oral hygiene behaviour is related to patient-perceptions of harmful consequences, their own susceptibility to periodontitis and their benefits from change (Newton 2015).
- Behaviour change interventions can be delivered by any suitably-trained dental team member and individual practices should identify who in the dental team is best placed to deliver these interventions and signpost to other services as indicated e.g. smoking cessation, diabetic care team
- There is a medico-legal obligation to inform patients of their risk.
- Risk reduction may involve using a variety of strategies including oral hygiene education and behavioural change interventions e.g. smoking cessation,

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group noted that there is insufficient evidence to determine whether informing patients about their periodontal risk results in behaviour changes to reduce their risk, but did recognise the value of the behavioural change interventions recommended by DBOH and BSP-S3 to address modifiable risk factors such as smoking, diabetes control and inadequate oral hygiene. It was emphasised that informing patients of all risks, not just periodontal risks, is a medico-legal obligation. Adopting a risk assessment approach is to the benefit of all patients and contributes to the delivery of integrated healthcare. The Group agreed that it may be better to signpost patients to services outside the practice (e.g. smoking cessation) to ensure access and optimise outcomes from behavioural change interventions.

Recommendation in updated guidance:

- For patients who are at increased risk of periodontitis, provide information about their periodontal risk, how it affects them and the ways that they can reduce this risk (e.g. provide oral hygiene instruction or advice on smoking cessation) as part of a strategy to encourage behaviour change.

Relevant text from main narrative:

Once a risk level has been assigned to a patient, it is important that the patient is aware of that risk. The BSP-S3 guideline notes that following a diagnosis of periodontitis and prior to potential therapy, initial discussions with patients should include information on the causes of the condition and risk factors for disease progression.

While there is no direct evidence that informing patients about their periodontal risk results in behaviour changes to reduce their risk, there is some evidence that interventions to promote improved oral hygiene, smoking cessation and diabetes control have some success in changing patient behaviour.

The certainty of the evidence is considered to be low due to risk of bias, heterogeneity and indirectness. However, ensuring patients' understanding of their risk is considered part of ongoing informed consent.

- Explain to patients who smoke the effect smoking can have on their oral health and general health. Direct patients who express a desire to stop smoking to smoking cessation services.
- Explain to patients who have diabetes that sub-optimally controlled blood sugar levels increase the risk of developing periodontitis or worsening existing periodontitis. Consider communicating with their GMP if necessary.
- Explain to patients with diabetes and periodontitis that periodontal inflammation can interfere with their glycaemic control.
- Explain to all patients the benefits of a healthy, balanced diet to their overall health and oral health in particular.
- Ensure that patients who are pregnant are aware of their increased risk of developing pregnancy gingivitis or, if they have a diagnosis of periodontitis, worsening existing disease. Highlight the possible need for more frequent visits for professional mechanical plaque removal (PMPR) or, if required, periodontal maintenance care during pregnancy.

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Baeza M, Morales A, Cisterna C, Cavalla F, Jara G, Isamitt Y and others. Effect of periodontal treatment in patients with periodontitis and diabetes: systematic review and meta-analysis. Journal of Applied Oral Sciences. 2020;28:e20190248-e

Carra MC, Detzen L, Kitzmann J, Woelber JP, Ramseier CA, Bouchard P. Promoting behavioural changes to improve oral hygiene in patients with periodontal diseases: A systematic review. J Clin Periodontol. 2020 Jul;47 Suppl 22:72-89.

Harris R, Vernezza C, Laverty L, Lowers V, Burnside G, Brown S, et al. Presenting patients with information on their oral health risk: the PREFER three-arm RCT and ethnography. Health Serv Deliv Res 2020;8(3)

Holliday R, Hong B, McColl E, Livingstone-Banks J, Preshaw PM. Interventions for tobacco cessation delivered by dental professionals. Cochrane Database Syst Rev. 2021 Feb 19;2(2):CD005084.

Järvinen M, Stolt M, Honkala E, Leino-Kilpi H, Pöllänen M. Behavioural interventions that have the potential to improve self-care in adults with periodontitis: a systematic review. Acta Odontol Scand. 2018 Nov;76(8):612-620.

Maia MB, Souza JGS, Bertolini M, Costa RC, Costa GS, Torres SAS, Ferreira EF, Martins AMEBL. Knowledge of bidirectional relationship between diabetes and periodontal disease among diabetes patients: A systematic review. Int J Dent Hygiene. 2022;00:1–13.

Nascimento GG, Leite FRM, Vestergaard P, Scheutz F, López R. Does diabetes increase the risk of periodontitis? A systematic review and meta-regression analysis of longitudinal prospective studies. Acta Diabetologica. 2018;55(7):653-67.

Newton JT, Asimakopoulou K. Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behaviour change for improved plaque control in periodontal management. J Clin Periodontol. 2015 Apr;42 Suppl 16:S36-46.

Ramseier CA, Woelber JP, Kitzmann J, Detzen L, Carra MC, Bouchard P. Impact of risk factor control interventions for smoking cessation and promotion of healthy lifestyles in patients with periodontitis: A systematic review. J Clin Periodontol. 2020 Jul;47 Suppl 22:90-106.

Siddiqi A, Zafar S, Sharma A, Quaranta A. Diabetic patients' knowledge of the bidirectional link: are dental health care professionals effectively conveying the message? Australian Dental Journal. 2019;64(4);312-326.

Thyvalikakath T, Song M, Schleyer T. Perceptions and attitudes toward performing risk assessment for periodontal disease: a focus group exploration BMC Oral Health (2018) 18:90

Tonetti MS, Eickholz P, Loos BG, Papapanou P, van der Velden U, Armitage G, Bouchard P, Deinzer R, Dietrich T, Hughes F, Kocher T, Lang NP, Lopez R, Needleman I, Newton T, Nibali L, Pretzl B, Ramseier C, Sanz-Sanchez I, Schlagenhauf U, Suvan JE. Principles in prevention of periodontal diseases: Consensus report of group 1 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases. J Clin Periodontol. 2015 Apr;42 Suppl 16:S5-11.

Prevention and management of gingival inflammation (questions 4-10)

Key Question 4

In the general population, what are the self-care oral hygiene practices that constitute an effective regime to prevent plaque-induced gingivitis and periodontitis?

Recommendation in 2014 edition of guidance:

- No specific recommendation, although OH TIPPS is recommended and includes OHI and toothbrushing

Basis for recommendation:

N/A

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline includes a conditional recommendation on self-care plaque removal based on indirect evidence from two systematic reviews (Needleman 2015, Lamont 2018). The certainty of the evidence is considered low due to indirectness. The guideline states that professional intervention alone is insufficient to prevent periodontal disease starting or deteriorating and recommends that patients be advised of the best methods of plaque removal to prevent gingivitis, achieve lowest risk of periodontitis and tooth loss. A further good practice point suggests that those with extensive inflammation should initially receive toothbrushing advice followed by advice on interdental plaque control.

The recent *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline relies on the recommendations from the 2015 European Federation of Periodontology (EFP) Consensus report on *Principles in Prevention of Periodontal Diseases* (Tonetti 2015). The BSP-S3 guideline recommends the provision of oral hygiene instruction throughout all the steps of periodontal therapy to reduce plaque and gingivitis, primarily by toothbrushing with interdental brushing recommended for those with gingival inflammation. This is based on evidence from a meta review of systematic reviews (Van der Weijden 2015) which found that brushing with a manual or powered toothbrush resulted in a weighted mean 42-46% reduction in plaque score. Plaque levels and bleeding tendency were also slightly reduced at six months after a single baseline session of OHI and dental prophylaxis.

Does the evidence differ from previously?

N/A

What is the certainty of the evidence?

The certainty of the evidence is considered moderate due to methodological issues with the systematic reviews included in the meta review.

While the relationship of biofilm to gingivitis has been well-established in clinical studies, the certainty of the evidence supporting plaque removal by toothbrushing in the longer term control of gingivitis is not considered strong. However, this is mostly due to the lack of studies which directly compare plaque removal with no plaque removal. Ethical considerations would make this study design unfeasible.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

Desirable effects of recommending plaque removal include improved oral hygiene and a reduced risk of periodontal disease and dental caries. There are unlikely to be any undesirable effects of recommending plaque removal and providing oral hygiene instruction on the correct way to use toothbrushes and interdental cleaning aids.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

The review which underpins the BSP-S3 recommendation focussed on the efficacy of homecare regimens for mechanical plaque removal in managing gingivitis. The BSP-S3 guideline group considered this evidence to be applicable to periodontitis patients throughout all steps of periodontal therapy, including those enrolled in supportive periodontal care.

DBOH includes advice relating to vulnerable children and adults, particularly those lacking manual dexterity and mental capacity. These patients may require additional assistance and support with toothbrushing, and carers as well as patients may require training in the use of oral hygiene aids.

4. Values and preferences

Summarise any evidence or information on values and preferences.

Through the GUIDE project, a citizen science platform inviting members of the public (citizens) to share their experiences of dental care and suggest ideas to improve them, stakeholders have indicated that evidence-based information related to oral health self care and how to maintain good oral health is of great importance to them.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

The intervention is likely to be acceptable to all stakeholders. There are financial implications for patients in trying to follow good oral hygiene practices.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

The intervention is likely to feasible as it is considered to be current good practice. The financial costs to patients may be a barrier in some situations.

7. Other factors

Indicate any other factors taken into account.

The evidence presented here should be considered along with the evidence presented in the Oral Hygiene Instruction, Toothbrushes, Toothpaste and Interdental Cleaning Considered Judgement tables.

The social determinants of health at an individual basis should be considered to ensure that the guidance recommendations do not exclude patients who are not able to adhere to due to their individual circumstances.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- There was no formal question or recommendation in the first edition of the guidance.

Considered judgement:

The Group agree that regular removal of plaque is vital in the prevention of periodontal diseases and during the treatment and maintenance phase in those individuals with a diagnosis of periodontitis. Both the DBOH and BSP-S3 guidelines recommend that patients be advised of the best methods of plaque removal, primarily by toothbrushing with supplemental interdental cleaning advised to control gingival inflammation. This is informed by the well-established relationship between plaque biofilm and gingivitis and supported by moderate certainty evidence that toothbrushing is effective at removing plaque. The Group agree that establishing an effective home-care regime is important both in terms of an individual's oral health and the overall benefits to sustainability and planetary health. It was noted that patients are keen to access evidence-based information on

how to maintain good oral health and that patient information should employ holistic approach to prevention of oral diseases. Some patients, such as those with additional care needs, may need assistance and support in the use of oral hygiene aids. The Group also note that the cost of oral hygiene aids can be a barrier in some situations.

Recommendation in updated guidance:

- Advise patients (and their carers, where appropriate) to regularly remove plaque biofilm using a toothbrush, and interdental aids where required, as an effective regime to prevent and facilitate management of plaque-induced gingivitis and periodontitis.

Relevant text from main narrative:

Plaque biofilm is the principal local modifiable risk factor for development of gingival inflammation and periodontitis. Plaque biofilm retentive factors (e.g. calculus, local dental crowding, dentures etc.) are also considered risk factors for disease initiation and progression as they increase the likelihood that oral hygiene will be compromised, and that plaque will accumulate. Consequently, regular removal of plaque biofilm and plaque retentive factors is essential in the prevention of periodontal diseases, and during treatment and maintenance care in those individuals with a diagnosis of periodontitis.

Both the DBOH and BSP-S3 guidelines recommend that patients be advised of the best methods of plaque biofilm removal, primarily by toothbrushing with supplemental interdental cleaning advised to control gingival inflammation. This is informed by the well-established relationship between plaque biofilm and gingivitis and supported by evidence from a meta review of systematic reviews which found that toothbrushing is effective at removing plaque biofilm. The evidence is considered to be of moderate certainty due to methodological issues with the systematic reviews included in the meta review. DBOH notes that professional intervention alone, in the form of dental professional delivered, in-surgery removal of plaque biofilm and calculus, is insufficient to prevent periodontal disease starting or deteriorating and recommends that patients be advised of the best methods of personal plaque biofilm removal to prevent gingivitis, and to achieve lowest risk of periodontitis and tooth loss.

- Advise patients to regularly remove plaque using a toothbrush, and interdental aids where required.

Strength of recommendation (strong or conditional):

- Strong (100% agreement).

References

Lamont T, Worthington HV, Clarkson JE, Beirne PV. Routine scale and polish for periodontal health in adults. Cochrane Database of Systematic Reviews 2018, Issue 12. Art. No.: CD004625.

Needleman I, Nibali L, Di Iorio A. Professional mechanical plaque removal for prevention of periodontal diseases in adults – systematic review update. Journal of Clinical Periodontology 2015; 42 (Suppl. 16): S12–S35.

Newton T, Asimakopoulou K. Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behaviour change for improved plaque control in periodontal management. J Clin Periodontol 2015; 42 (Suppl. 16): S36–S46

Tonetti MS, Eickholz P, Loos BG, Papapanou P, van der Velden U, Armitage G, Bouchard P, Deinzer R, Dietrich T, Hughes F, Kocher T, Lang NP, Lopez R, Needleman I, Newton T, Nibali L, Pretzl B, Ramseier C, Sanz-Sanchez I, Schlagenhauf U, Suvan JE, Fabrikant E, Fundak A. Principles in prevention of periodontal diseases–Consensus report of group 1 of the 11th European workshop on periodontology on effective prevention of periodontal and peri-implant diseases. J Clin Periodontol 2015; 42 (Suppl. 16): S5–S11.

Van der Weijden FA, Slot DE. Efficacy of homecare regimens for mechanical plaque removal in managing gingivitis: a metareview, J. Clin. Periodontol. 42 (Suppl. 16) (2015) S77–S91.

Key Question 5

In patients accessing dental services, does the provision of oral hygiene instruction, compared to no instruction, result in improved clinical outcomes, such as plaque levels and gingival health?

Recommendation in 2014 edition of guidance:

- The guidance development group recommend that clinicians use the Oral Hygiene TIPPS behaviour change strategy for patients who have inadequate oral hygiene.

Basis for recommendation:

Six systematic reviews (Gray 2008, Hujoel 2005, Kay 1998, Kay 1996, Renz 2007, Watt 2005) indicated that one-to-one chair-side oral hygiene instruction (OHI) can result in improved oral hygiene, although the results may be short term. The evidence was considered low quality due to methodological deficiencies in the primary studies. The risk of bias in some studies was high, some studies included inappropriate populations and in some instances the follow-up periods were insufficient. The systematic reviews themselves did not always adhere to accepted reporting guidelines. The Group noted that a one-to-one chair-side discussion about the causes of gum disease, the importance of good oral hygiene and a demonstration of effective oral hygiene techniques is acknowledged best practice in preventing periodontal diseases and maintaining periodontal health following treatment. The evidence available at the time, although low quality, supported this, particularly when the evidence supporting the provision of oral hygiene instruction in conjunction with supra-gingival debridement was considered. Therefore, the guidance development group recommended that clinicians use the Oral Hygiene TIPPS behaviour change strategy for patients who have inadequate oral hygiene.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Both Public Health England's *Delivering Better Oral Health* (DBOH) guideline and the recent *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline advise that oral hygiene advice delivered by the dental team is an integral part of the prevention and management of periodontal diseases. However, both guidelines acknowledge that no specific method of delivering advice has proven to be superior.

DBOH found low to moderate certainty evidence that motivational methods reduce plaque (Huang, 2018) but very low to low certainty evidence with regards to a reduction in gingivitis. It also notes that amongst teenagers receiving orthodontic care, there is moderate certainty evidence that reminders reduce plaque and gingivitis in the short term, and very low certainty evidence that they do so over a 3-month period (Mohammed 2018, Lima 2018). There is currently insufficient evidence to support the use of m-Health (mobile phone messages) to improve oral hygiene in mothers, children and orthodontic patients.

The BSP-S3 guideline found insufficient evidence to support the use of psychological interventions, such as motivational interviewing or cognitive behavioural therapy, to influence patients' compliance with oral hygiene practices (Carra 2020).

Both guidelines note that behaviour change approaches are viewed as being important in improving patients' plaque control and recommend emphasizing the importance and benefits of effective oral hygiene to patients when discussing their oral health. DBOH specifically highlights the SDCEP Oral Hygiene TIPPS behaviour change strategy as a useful resource for addressing inadequate oral hygiene.

Does the evidence differ from previously?

There is an increase in the body of evidence since the first edition of the SDCEP guidance was published. However, there is still no high certainty evidence to support a specific method of behaviour change to influence oral hygiene behaviours.

What is the certainty of the evidence?

Overall, the certainty of the evidence to support any particular type of intervention to improve oral hygiene is low. There is some low to moderate certainty evidence in terms of plaque reduction but the evidence regarding gingivitis reduction is low to very low certainty.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

The evidence is unclear about the magnitude of the desirable effects of the intervention (i.e. how much improvement in oral hygiene can be achieved). However, there are unlikely to be many undesirable effects resulting from the intervention.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

DBOH notes that vulnerable children and adults, including those with physical or learning disabilities, may require assistance and support with toothbrushing and that oral hygiene care and advice for those with learning disabilities should be based on professional expertise and the needs and preferences of the individual and their carer(s).

The BSP-S3 guideline recommendations are applicable to patients in supportive periodontal care but are also relevant to the general dental population.

One of the advantages of the SDCEP Oral Hygiene TIPPS behaviour change intervention is that it can be individually tailored to suit each patient e.g. to help them understand how oral hygiene might benefit them, to teach them the most effective oral hygiene skills, to develop confidence in their oral hygiene abilities, to set targets for change that they feel able to achieve and to challenge perceived barriers to performance. This can also be adapted to help train and support carers. However, there is no evidence that this intervention is more effective and other behaviour change methods are available.

4. Values and preferences

Summarise any evidence or information on values and preferences.

Not specifically addressed by either guideline.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

The intervention is likely to be acceptable to those of the dental team who feel confident in discussing these issues with their patients. Those who feel less confident, for example oral health educators, may require training and the Oral Hygiene TIPPS video was created as a resource to support the implementation of the intervention. Patients are likely to find the intervention acceptable if it is delivered in a way that highlights the advantages to them and helps them develop the skills to clean effectively.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Dental teams are already able to deliver and claim for oral hygiene instruction as part of their role. Delivery of specific oral hygiene and risk factor control advice does take significant time in the dental setting and it is recognised that this can be challenging. Additional training may be required on the implementation of Oral Hygiene TIPPS or other behaviour change interventions.

7. Other factors

Indicate any other factors taken into account.

Other tools to support dental teams, such as an adapted Oral Hygiene TIPPS video aimed at patients, may be helpful.

In 2021, the Economist Intelligence Unit (EIU) developed a model to assess periodontitis costs and health outcomes in six European countries (France, Germany, Italy, the Netherlands, Spain and the UK), with the aim of

determining the return on investment of periodontitis treatment and the management of gingivitis over a ten-year period (EIU 2021). This economic analysis suggested that in scenarios where gingivitis is eliminated or where the rate of diagnosis of periodontitis is increased to 90%, with all those cases being appropriately managed, a positive return on investment in all six countries is highly likely, with elimination of gingivitis using home care prevention techniques (such as tooth brushing and interdental brushing) being the most cost effective scenario. The EIU study also noted that if gingivitis is not managed at a population level, this may significantly increase overall healthcare costs and reduce quality of life.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of the guidance:

- The guidance development group recommend that clinicians use the Oral Hygiene TIPPS behaviour change strategy for patients who have inadequate oral hygiene.

Considered judgement:

The Group agree that instruction on the best methods of plaque control is important in the prevention and management of periodontal diseases. While there is insufficient evidence to support one method of oral hygiene instruction over another, both the DBOH and BSP-S3 guidelines view behaviour change approaches as being important in improving patients' plaque control. The Group agree that oral hygiene instruction is important in improving plaque control in patients who have sub-optimal oral hygiene. It is important that this is individually tailored to suit each patient and should assist and encourage them to improve their oral hygiene skills as well as their understanding of the value of good self-care routines. Patients with periodontitis may require more frequent reinforcement of oral hygiene instruction, including advice on the importance of cleaning inerdentally.

The Group note that while the Oral Hygiene TIPPS behaviour change strategy is a useful tool, other methods of behaviour change are available. The Group agree that there is a role for virtual oral hygiene instruction consultations, both in terms of access to care and reducing patient travel, but these should not be viewed as a replacement for in-practice consultations.

Recommendation in updated guidance:

- Use behaviour change methods when providing oral hygiene instruction for patients who have sub-optimal oral hygiene.

Relevant text from main narrative:

It is usual practice to discuss oral hygiene routines, the effect of inadequate plaque control and to provide oral hygiene instruction as part of periodontal management. While there has been much research into methods to support patient behaviour change with regard to oral hygiene, there is to date no robust evidence to support any particular type of behaviour change intervention. There is low to moderate certainty evidence that motivational methods result in a reduction in plaque levels but very low to low certainty evidence with regard to a subsequent reduction in gingivitis. Factors affecting the certainty of the evidence include risk of bias, heterogeneity and limited study sizes. There is insufficient evidence to support the use of specific psychological interventions, such as motivational interviewing or cognitive behavioural therapy, to influence patients' compliance with oral hygiene practices. However, building motivation and confidence are likely to be important components of successful behaviour change.

Accordingly, both the DBOH and BSP-S3 guidelines state there is insufficient evidence to support the use of any *specific* oral hygiene behaviour change intervention. However, both guidelines note that behaviour change

approaches are viewed as being important in improving patients' plaque control and recommend emphasizing the importance and benefits of effective oral hygiene to patients when discussing their oral health.

- Provide oral hygiene instruction (coaching) to ensure patients can effectively remove plaque biofilm.
    - Assist and encourage the patient to improve their oral hygiene skills as well as their understanding of the value of good self-care routines.
    - Oral Hygiene TIPPS is an example of a behaviour change strategy that can be used to highlight the importance of effective plaque biofilm removal and to show the patient how they can achieve this.
    - For patients with extensive inflammation, begin with advice on toothbrushing then move on to advice on interdental cleaning.
    - Some patients, such as those with additional care needs, may need assistance and support in the use of oral hygiene aids.
    - Where patients have crowded teeth or dental appliances, specific help with cleaning of those areas and use of appropriate plaque biofilm removal devices will be necessary.

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Carra MC, Detzen L, Kitzmann Woelber JP, Ramseier CA, Bouchard P, Promoting behavioural changes to improve oral hygiene in patients with periodontal diseases: A systematic review. Journal of Clinical Periodontology 2020;47:72–89.

Economist Intelligence Unit Limited. Time to take gum disease seriously. The societal and economic impact of periodontitis. (2021) https://impact.economist.com/perspectives/sites/default/files/eiu-efp-oralb-gum-disease.pdf

Gray D, McIntyre G. Does oral health promotion influence the oral hygiene and gingival health of patients undergoing fixed appliance orthodontic treatment? A systematic literature review. Journal of Orthodontics. 2008;35(4):262-269.

Huang J, Yao Y, Jiang J, Li C. Effects of motivational methods on oral hygiene of orthodontic patients: A systematic review and meta-analysis. Medicine (Baltimore). 2018;97(47):e13182.

Hujoel PP, Cunha-Cruz J, Loesche WJ, Robertson PB. Personal oral hygiene and chronic periodontitis: a systematic review. Periodontology 2000. 2005;37:29-34.

Järvinen M, Stolt M, Honkala E, Leino-Kilpi H, Pöllänen M. Behavioural interventions that have the potential to improve self-care in adults with periodontitis: a systematic review. Acta Odontol Scand. 2018;76(8):612-20.

Kay E, Locker D. A systematic review of the effectiveness of health promotion aimed at improving oral health. Community Dental Health. 1998;15(3):132-144.

Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. Community Dentistry and Oral Epidemiology. 1996;24(4):231-235.

Lima IFP, de Andrade Vieira W, de Macedo Bernardino Í, Costa PA, Lima APB, Pithon MM, et al. Influence of reminder therapy for controlling bacterial plaque in patients undergoing orthodontic treatment: A systematic review and meta-analysis. Angle Orthod. 2018;88(4):483-93.

Mohammed H, Rizk MZ, Wafaie K, Ulhaq A, Almuzian M. Reminders improve oral hygiene and adherence to appointments in orthodontic patients: a systematic review and meta-analysis. European Journal of Orthodontics. 2018;41(2):204-13.

Newton TJ, Asimakopoulou K. Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behaviour change for improved plaque control in periodontal management. Journal of Clinical Periodontology 2015; 42 (Suppl. 16): S36–S46.

Renz A, Ide M, Newton T, Robinson PG, Smith D. Psychological interventions to improve adherence to oral hygiene instructions in adults with periodontal diseases. Cochrane Database of Systematic Reviews. 2007;Issue 2: Art. No.: CD005097. DOI: 10.1002/14651858.CD005097.pub2.

Watt RG, Marinho VC. Does oral health promotion improve oral hygiene and gingival health? Periodontology 2000. 2005;37:35-47.

Key Question 6

In the general population, are rechargeable powered toothbrushes, compared to manual toothbrushes, more effective at reducing levels of plaque and gingivitis?

Recommendation in 2014 edition of guidance:

- The group recommend that patients should be advised to regularly clean their teeth, using either a manual or rechargeable powered toothbrush, and that an effective technique should be employed

Basis for recommendation:

There was a lack of high quality evidence to support a recommendation for any type of toothbrush. One systematic review (Robinson et al. 2005) suggested that powered rotation oscillation toothbrushes are more effective at reducing plaque and gingivitis indices than manual toothbrushes. However, the evidence was considered low quality due to the majority of studies judged to be at unclear or high risk of bias and weaknesses in other methodological areas. The clinical significance of the reductions in plaque and gingival indices observed was unclear. Another systematic review which compared different types of powered toothbrushes (Deacon et al. 2010) could not recommend any particular type of powered brush due to a lack of relevant studies. It was agreed by the group that effective plaque removal can also be achieved using a manual toothbrush.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline recommends that patients should use a manual or powered toothbrush (recommendation grade: strong). This is based on moderate-certainty evidence suggesting that powered toothbrushes reduce plaque and gingivitis more than manual toothbrushing in the short- and long-term. These findings are consistent across several reviews but the clinical importance of the results are unclear (Grender, 2020, Clark-Perry 2020, Wang 2020, Elkerbout 2020). Powered toothbrushes do not appear to cause more soft tissue trauma than manual toothbrushes (Yaacob, 2014). The guideline notes that many people will not be able to afford a powered toothbrush and stresses that teeth can be cleaned effectively with either type of toothbrush. Additionally, it concludes that the evidence is insufficient to determine whether any particular powered brush mode of action is superior (Deacon 2010).

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline states that the use of a powered toothbrush may be considered as an alternative to manual tooth brushing for patients in supportive periodontal care (recommendation grade: 0 [open/conditional]). This is based on the evidence from one systematic review (Slot, 2020) which included 5 RCTs at high risk of bias. The review found that there was no difference between powered and manual toothbrushes with respect to any clinical parameters, with the exception of one comparison where a positive significant effect for bleeding on probing was demonstrated in favour of the powered toothbrush. A second review was also cited (Van der Weijden & Slot 2015) which found that tooth brushing is effective in reducing levels of dental plaque and furthermore that some powered toothbrushes have a benefit over manual toothbrushes in reducing levels of plaque and gingivitis.

Does the evidence differ from previously?

There is an increase in the body of evidence since the first edition of the SDCEP guidance was published. However, there is still uncertainty about whether the improvements to outcomes such as plaque levels and bleeding observed with powered toothbrushes are clinically important.

What is the certainty of the evidence?

Some studies were considered to have a significant risk of bias due to methodological and reporting issues. However, the overall certainty of the evidence is considered moderate due to the consistency of findings across studies.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

The BSP-S3 guideline notes that adverse events were not evaluated in the review cited.

DBOH states that there is moderate-certainty evidence supporting the safety of powered toothbrushes (Yaacob 2014).

The evidence does not currently suggest a difference in clinical outcomes when using either type of toothbrush. Therefore, the balance of effects does not favour one type of toothbrush over the other and both are likely to be effective if used correctly.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

The review which underpins the BSP-S3 recommendation focussed on periodontitis patients enrolled in periodontal maintenance care. However, the recommendation also relied on evidence from the 2015 European Federation of Periodontology (EFP) workshop on *Prevention and Control of Gingivitis* (Van der Weijden & Slot 2015) which examined the effectiveness of toothbrushing in control of plaque and gingivitis.

DBOH addresses oral hygiene issues for specific groups:

- Vulnerable children and adults may benefit from using a powered brush. However, there is some evidence of participant difficulties with, or fears of, using the powered toothbrushes.
- Patients with physical disabilities may benefit from adaptations such as grip handles to help with control of oral hygiene aids.
- Patients with orthodontic appliances should undertake plaque control using aids suggested by the orthodontic team
- Patients with bridges and dental implants should undertake plaque control using the aids suggested by the dental team

Patients with dentures should be advised on aspects of oral hygiene affecting both their teeth and their denture.

Pressure sensitive powered toothbrushes may be useful for patients who have gingival recession and exposed root surfaces, which are more sensitive to abrasion during toothbrushing.

The BSP-S3 guideline notes that the choice of an appropriate toothbrush should take the individual patient's abilities, needs, preferences, and manual dexterity into account when selecting a toothbrush.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline notes that no data on patient preference was available from the review cited. However, it does note that patient preferences should be taken into account when deciding on a choice of toothbrush.

DBOH does not address this in the narrative.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

Using either a powered or manual toothbrush is likely to be acceptable. However, DBOH notes that in some vulnerable children and adults there is some evidence of difficulties with, or fears of, using powered toothbrushes.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

The BSP-S3 guideline notes that a manual toothbrush is less expensive than a power toothbrush.

DBOH notes that many people will not be able to afford a powered toothbrush.

7. Other factors

Indicate any other factors taken into account.

DBOH recommends the use of a small toothbrush head with medium texture. This conditional recommendation is based on low certainty evidence of gingival lesions when hard bristle brushes were used (Ranzan 2019). If a patient wishes to use a powered toothbrush, a discussion on the different types of toothbrush and brush heads available, and the benefits of each, is important.

The message to 'spit, don't rinse' should also be delivered to patients during oral hygiene instruction.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The group recommend that patients should be advised to regularly clean their teeth, using either a manual or rechargeable powered toothbrush, and that an effective technique should be employed.

Considered judgement:

The Group agree that regular removal of plaque is vital in the prevention of periodontal diseases and during the treatment and maintenance phase in those individuals with a diagnosis of periodontitis. Both the DBOH and BSP-S3 guidelines recommend the use of either a manual or powered toothbrush. Although moderate certainty evidence (Van der Weijden & Slot 2015, Grender, 2020, Clark-Perry 2020, Wang 2020, Elkerbout 2020) suggests that powered toothbrushes are more effective at removing plaque than manual brushes, the clinical importance of this difference is unclear. There are also some instances where a powered toothbrush may not be the best choice; for example, some patients, such as those with additional care needs, do not like using or are afraid of powered toothbrushes. There are also additional financial costs associated with powered toothbrushes and they have a higher environmental impact than manual toothbrushes.

The Group agree that the choice of toothbrush should be made on an individual patient basis, taking into account the patient's abilities, needs, preferences, and manual dexterity. The Group note that, irrespective of brush type chosen, an effective toothbrushing technique is required and this should be taught as part of oral hygiene instruction where required. In addition, in situations where a patient is struggling to clean effectively with a manual toothbrush, suggesting the use of a powered toothbrush might be of benefit.

Recommendation in updated guidance:

- Advise patients to regularly clean their teeth and gums, using either a manual or rechargeable powered toothbrush, and that an effective technique should be employed.

Relevant text from main narrative:

The DBOH and BSP-S3 guidelines recommend the use of either a manual or powered toothbrush, with both considered to be effective provided that the correct technique is employed.

Research suggests that, for the general population, powered toothbrushes are more effective at removing plaque than manual toothbrushes but the size of difference is small and its clinical benefit unclear. The evidence is considered to be of moderate certainty; despite the significant risk of bias in some studies due to methodological and reporting issues, there was consistency of findings for improved plaque removal in favour of powered toothbrushes. However, manual toothbrushes can remove plaque effectively and it is likely that the skill and technique used during tooth cleaning is more important that any particular difference between manual and powered brushes.

Both guidelines note that the choice of toothbrush should be made on an individual patient basis, taking into account the patient's abilities, needs, preferences, and manual dexterity.

Factors to consider when discussing toothbrushes include toothbrush head size, mode of operation, general design, cost, environmental impact and patient preference. DBOH recommends a small toothbrush head with medium texture, as there is low certainty evidence that hard textured brushes can result in gingival lesions.

Irrespective of brush type chosen, an effective toothbrushing technique is required and this should be taught as part of oral hygiene instruction. In situations where a patient is struggling to clean effectively with a manual toothbrush, suggesting the use of a powered toothbrush might be of benefit.

- Advise patients that to prevent or control gingival inflammation (bleeding gums) they need to remove plaque with a toothbrush.
    - Highlight that to control inflammation, plaque should be removed from their teeth and from the margin where the gum and tooth meet.
- Advise patients to regularly clean their gums and teeth, using either a manual or rechargeable powered toothbrush, using an effective technique.
    - Discuss with the patient the most appropriate type of toothbrush to use, taking account of their abilities, needs, preferences and manual dexterity.
    - Manual and rechargeable powered toothbrush heads for daily use should be small, medium textured and of a simple design and should be changed when obvious signs of wear appear.
- Advise patients to brush all tooth surfaces and where the tooth and the gum meet twice a day for at least 2 minutes.
    - Adopting a methodical approach, cleaning the outside, inside and biting surfaces of the teeth, will ensure all surfaces are cleaned.
    - Spitting toothpaste out and not rinsing after brushing is beneficial for caries prevention.
    - Leaving an interval of at least 30 minutes between consuming acidic or erosive foods and/or drinks and toothbrushing will reduce the risk of enamel loss.
- Advise patients with gingival inflammation, periodontitis, orthodontic appliances and/or complex restorations, that effective toothbrushing is likely to take longer than two minutes.
- Advise patients that bleeding on brushing is a sign of gingival and periodontal inflammation and that they should not stop brushing if their gums bleed.
    - If bleeding on brushing has been present, resolution of this signifies a reduction in inflammation.

Strength of recommendation (strong or conditional):

- Strong (100% agreement).

References

Clark-Perry D, Levin L. Systematic review and meta-analysis of randomized controlled studies comparing oscillating-rotating and other powered toothbrushes. J Am Dent Assoc. 2020;151(4):265-75.e6.

Deacon SA, Glenny AM, Deery C, Robinson PG, Heanue M, Walmsley AD, and others. Different powered toothbrushes for plaque control and gingival health. Cochrane Database of Systematic Reviews. 2010(12).

Elkerbout TA, Slot DE, Rosema NAM, Van der Weijden GA. How effective is a powered toothbrush as compared to a manual toothbrush? A systematic review and meta-analysis of single brushing exercises. International Journal of Dental Hygiene. 2020;18(1):17-26.

Grender J, Adam R, Zou Y. The effects of oscillating-rotating electric toothbrushes on plaque and gingival health: A meta-analysis. Am J Dent. 2020;33(1):3-11.

Lyne A, Ashley P, Saget S, Porto Costa M, Underwood B, Duane B. Combining evidence-based healthcare with environmental sustainability: using the toothbrush as a model. British Dental Journal. 2020;229(5):303-9.

Ranzan N, Muniz F, Rosing CK. Are bristle stiffness and bristle end-shape related to adverse effects on soft tissues during toothbrushing? A systematic review. International Dental Journal. 2019;69(3):171-82.

Robinson P, Deacon SA, Deery C, Heanue M, Walmsley, AD, Worthington HV, Glenny AM, Shaw, BC. Manual versus powered toothbrushing for oral health. Cochrane Database of Systematic Reviews. 2005(2)

Slot DE, Valkenburg C, Van der Weijden GA. Mechanical plaque removal of periodontal maintenance patients: A systematic review and network meta-analysis. J Clin Periodontol. 2020;47:107–124.

Van der Weijden FA, Slot DE. Efficacy of homecare regimens for mechanical plaque removal in managing gingivitis -a meta review- J Clin Periodontol 2015; 42 (Suppl. 16): S77–S91.

Wang P, Xu Y, Zhang J, Chen X, Liang W, Liu X, and others. Comparison of the effectiveness between power toothbrushes and manual toothbrushes for oral health: a systematic review and meta-analysis. Acta Odontologica Scandinavica. 2020;78(4):265-74.

Yaacob M, Worthington HV, Deacon SA, Deery C, Walmsley AD, Robinson PG, et al. Powered versus manual toothbrushing for oral health. Cochrane Database of Systematic Reviews. 2014(6).

Key Question 7

In the general population, is interdental cleaning in addition to toothbrushing, compared to toothbrushing alone, more effective at reducing plaque levels and gingivitis?

Recommendation in 2014 edition of guidance:

- Due to the importance of effective plaque removal in the prevention of periodontal diseases, especially for susceptible individuals, and because toothbrushing does not adequately clean the approximal tooth surfaces, the group recommend that patients be advised to clean interdentally once a day.

Basis for recommendation:

One systematic review (Sambunjak 2011) suggested that the use of floss in addition to toothbrushing reduces gingivitis at one, three and six months compared to toothbrushing alone. However, there was insufficient evidence to determine the efficacy of floss to reduce plaque levels. The evidence was considered to be low quality due to poor reporting in the primary studies, with all studies judged to be at high or unclear risk of bias. Three systematic reviews (Slot 2008, Imai 2012, Poklepovic 2013) indicated that using interdental brushes in addition to toothbrushing is more effective at reducing plaque and gingivitis than flossing plus toothbrushing, at those sites which can accommodate an interdental brush. The evidence was considered low quality due to inconsistencies in findings across reviews, the limited number of primary studies and a high or unclear risk of bias. The review by Poklepovic also found some very low quality evidence, based on one primary study judged to be at high risk of bias, that using interdental brushes in addition to toothbrushing is more effective at reducing plaque and gingivitis than toothbrushing alone.

The group agreed that the quality of evidence supporting interdental cleaning was low, and also noted that the clinical significance of the reductions in plaque and gingival indices was unknown. However, due to the importance of effective plaque removal in the prevention of periodontal diseases, especially for susceptible individuals, and because toothbrushing does not adequately clean the approximal tooth surfaces, the group recommended that patients be advised to clean interdentally once a day.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline recommends that patients clean interdentally daily, using an interdental brush where space allows, with dental floss/tape recommended for smaller spaces. This conditional recommendation is based on low to very-low certainty evidence that adjunctive interdental cleaning reduces gingivitis and plaque in patients without severe periodontal disease, although the clinical significance of this is unclear (Worthington 2019). DBOH suggests that interdental cleaning takes place before toothbrushing, as there is some evidence that doing so can help patients form a lasting habit (Mazhari 2018).

The proceedings of the 2015 European Federation of Periodontology (EFP) *Prevention and Control of Gingivitis* workshop (Chapple 2015) strongly recommends daily interdental cleaning to reduce plaque and gingival inflammation. When gingival inflammation is present, inter-dental cleaning, preferably with interdental brushes, should be professionally taught to patients, with other inter-dental cleaning devices/methods suggested when the use of IDB's is not appropriate.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline recommends that tooth brushing should be supplemented by the use of interdental brushes (where anatomically possible) for patients in supportive periodontal care (recommendation grade: A [strong]). The systematic review which underpins this recommendation (Slot 2020) found moderate certainty evidence that using interdental brushes in addition to manual toothbrushing was significantly more effective at plaque removal than manual toothbrushing alone. There is moderate certainty evidence that in larger interdental spaces, using floss in addition to manual toothbrushing is not as effective at plaque removal as the interdental brushes. Accordingly, the BSP-S3 guideline does not recommend floss as the first-choice method of interdental cleaning for patients in supportive periodontal care (recommendation grade: B).

Does the evidence differ from previously?

There is an increase in the body of evidence since the first edition of the SDCEP guidance was published. The review by Sälzer (2015) which underpins the 2015 workshop on *Prevention and Control of Gingivitis* states there is moderate certainty evidence to support the efficacy of inter-dental brushes on plaque removal and reduction of gingivitis. Worthington (2019) concluded that interdental cleaning using floss or interdental brushes may be more effective than toothbrushing alone to reduce gingivitis or plaque in patients without severe periodontal disease. Interdental brushes may be more effective than floss, but the review noted that the overall effect sizes observed may not be clinically relevant. The review by Slot (2020) concludes that the use of interdental brushes in addition to toothbrushing results in a clinically relevant effect on plaque levels for patients enrolled in a periodontal maintenance programme.

What is the certainty of the evidence?

The certainty of the evidence was judged in these guidelines to be very low to moderate for the different comparisons described above and some conclusions are drawn from indirect comparisons via network meta analysis.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

As noted above, the potential benefits of using interdental brushes are a reduction of plaque and bleeding (gingivitis) and this is of greater significance in patients with a diagnosis of periodontitis. The proceedings of the 2015 EFP workshop on *Prevention and Control of Gingivitis* (Chapple 2015) notes that caution should be exercised in recommending IDBs at healthy sites where attachment loss is not evident as use in these areas may result in trauma. It suggests that floss may have a role to play in this situation and that professional instruction is vital for achieving optimal effectiveness and to avoid trauma. The BSP-S3 guideline notes that there is a moderate risk of trauma if interdental brushes are not used correctly but concludes that the benefits of their use far outweigh the risks. It also notes that it is crucial for dental professionals to provide individual instruction in the correct use of interdental brushes.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

While cleaning interdentally may be beneficial for all patients, it is more important for those at risk of, or with a diagnosis of, gingivitis or periodontitis. In these patients, the presence of even small amounts of plaque can promote inflammation and disease progression and removal of plaque from interdental spaces is likely to be extremely important in controlling their disease. Therefore, the balance of effects is likely to be more in favour of interdental cleaning due to the increased potential harms in this patient group if biofilm is not removed at these interdental sites.

DBOH includes advice for those with evidence of periodontitis/higher risk. It notes that cleaning at the gum level is particularly important for people with experience of periodontitis and that these patients are likely to have larger interdental spaces more suited to being cleaned with interdental brushes.

The BSP-S3 guideline recommendations are applicable to patients in supportive periodontal care (Stage 4) but are also likely to be relevant to patients receiving active periodontal treatment (Stages 1-3) and in prevention of disease (Chapple 2015).

Each guideline recommends that clinicians assess the patient's manual dexterity and ability to use interdental aids and provide appropriate instruction.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline notes that there is clinical evidence that patients with open interdental spaces prefer the use of interdental brushes to the use of dental floss. It states that patient preferences need to be taken into

consideration when discussing the best ways to clean interdentally. The practitioner should give advice on removing plaque and biofilm while avoiding tooth and tissue trauma.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

The intervention is likely to be acceptable to most patients. Some may not like the sensation of using interdental brushes, or the additional cost associated with their use. However, interdental brushes are less likely to cause gingival trauma than dental floss and there is evidence that patients find interdental brushes easier to use than dental floss (Christou 1998). The additional time and skill required to clean interdentally may be a barrier to compliance.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

The BSP-S3 guideline notes that patients may require instruction on how to use interdental cleaning aids effectively.

There is an additional cost associated with the addition of interdental cleaning aids to the oral hygiene routine. DBOH notes that many people with periodontitis will require different size interdental brushes for smaller and larger spaces. This will also impact on the cost of the intervention.

7. Other factors

Indicate any other factors taken into account.

DBOH notes that the interdental brush should fit snugly in the interdental space.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

Due to the importance of effective plaque removal in the prevention of periodontal diseases, especially for susceptible individuals, and because toothbrushing does not adequately clean the approximal tooth surfaces, the Group recommend that patients be advised to clean interdentally once a day.

Considered judgement:

The Group agree that regular removal of plaque is vital in the prevention of periodontal diseases and during the treatment and maintenance phase in those individuals with a diagnosis of periodontitis. The DBOH guideline recommends daily interdental cleaning to reduce plaque and gingival inflammation, with interdental brushes considered more effective than floss in spaces big enough to accommodate them. This conditional recommendation is based on low to very-low certainty evidence that interdental cleaning reduces gingivitis and plaque in patients without severe periodontal disease, although the clinical significance of this is unclear (Worthington 2019). The BSP-S3 guideline recommends the use of interdental brushes for periodontitis patients in supportive periodontal care. This strong recommendation is supported by moderate certainty evidence that using interdental brushes in addition to manual toothbrushing is significantly more effective at plaque removal than manual toothbrushing alone (Slot 2020).

The Group agree that recommendations on interdental cleaning should be tailored to the individual patient. The evidence suggests that interdental cleaning has more benefit in patients with a diagnosis of periodontitis, and that interdental brushes are the method of first choice in these patients. The Group agree that interdental cleaning is particularly important in these susceptible individuals and that this should be performed on a daily basis with appropriately sized interdental brushes. Floss is appropriate in spaces that cannot accommodate interdental brushes. The evidence supporting interdental cleaning in patients without severe periodontitis is less

clear. Consequently, daily interdental cleaning is considered less important in patients without a diagnosis of periodontitis, although these patients should still be advised to clean interdentally when required to prevent and/or resolve gingival inflammation. The Group agree that the advice on interdental cleaning method and frequency should be tailored to each patient's particular situation. Given the contrast in both the effectiveness of the intervention and the certainty of evidence in each patient sub-group, the Group agree that separate recommendations for each sub-group are appropriate.

Recommendations in updated guidance:

- Advise patients with a diagnosis of periodontitis to clean interdentally every day, using appropriately sized interdental brushes where the interdental space allows, and floss in interdental spaces too small to allow interdental brush use.
- Advise patients without a diagnosis of periodontitis but who have gingival inflammation to clean interdentally as required to control their inflammation. The method and frequency of cleaning should be tailored to individual patients.

Relevant text from main narrative:

As toothbrushing does not adequately clean the approximal tooth surfaces, cleaning interdentally is important to ensure effective plaque removal. A systematic review found that interdental cleaning using floss or interdental brushes may be more effective than toothbrushing alone to reduce gingivitis or plaque but noted that the overall effect sizes observed may not be clinically relevant. The authors observed that interdental brushes may be more effective than floss. The evidence is considered to be of low to very-low certainty due to risk of bias, substantial unexplained heterogeneity, and lack of precision in the effect estimates. Accordingly, DBOH recommends that patients clean interdentally daily, using an interdental brush where space allows, with dental floss/tape recommended for smaller spaces. DBOH also suggests that interdental cleaning takes place before toothbrushing, as there is some evidence that doing so can help patients form a lasting habit.

In patients with a diagnosis of periodontitis, there is evidence from a systematic review that using interdental brushes in addition to manual toothbrushing is more effective at plaque removal than manual toothbrushing alone and that using interdental brushes in larger spaces where they fit is more effective than using dental floss. The evidence is considered to be of moderate certainty; the review employed a network meta-analysis so some of the comparisons were indirect, most studies included in the review were at high risk of bias but there was consistency of results across studies. Accordingly, the BSP-S3 guideline recommends that tooth brushing should be supplemented by the use of interdental brushes (where there is space for them) for patients in supportive periodontal care. It does not recommend floss as the first-choice method of interdental cleaning for these patients.

- Advise patients with a diagnosis of periodontitis to clean interdentally every day.
    - Appropriately sized interdental brushes should be used where the interdental space allows, with floss used in interdental spaces too small to allow interdental brush use.
    - To be effective, the interdental brush should fit snugly into the interdental space without the wire rubbing against the tooth. More than one size of interdental brush may be required depending on the sizes of the interdental spaces present.
    - Patients with negative architecture of the papillae should be advised to press gently into the shallow craters. A larger interdental brush may be required to clean effectively.
- Advise patients with gingival inflammation but who do not have a diagnosis of periodontitis to clean interdentally as required to control their inflammation.
- Instruct patients in the use of interdental aids appropriate to their particular situation, including their level of manual dexterity and ability to use each type of aid.

Strength of recommendation (strong or conditional):

- Strong recommendation for patients with a diagnosis of periodontitis (100% agreement)

- Conditional recommendation for patients without a diagnosis of periodontitis but with gingival inflammation (100% agreement).

References

Chapple ILC, Van der Weijden F, Doerfer C, Herrera D, Shapira L, Polak D, Madianos P, Louropoulou A, Machtei E, Donos N, Greenwell H, Van Winkelhoff AJ, Eren Kuru B, Arweiler N, Teughels W, Aimetti M, Molina A, Montero E, Graziani F. Primary prevention of periodontitis: managing gingivitis. J Clin Periodontol. 2015; 42 (Suppl. 16): S71–S76.

Christou V, Timmerman MF, Van der Velden U, & Van der Weijden FA (1998). Comparison of different approaches of interdental oral hygiene: Interdental brushes versus dental floss. Journal of Periodontology, 69(7), 759–764.

Imai PY, X.; MacDonald, D. Comparison of interdental brush to dental floss for reduction of clinical parameters of periodontal disease: A systematic review. Canadian Journal of Dental Hygiene. 2012;46(1):63-78.

Mazhari F, Boskabady M, Moeintaghavi A, Habibi A. The effect of toothbrushing and flossing sequence on interdental plaque reduction and fluoride retention: A randomized controlled clinical trial. J Periodontol. 2018;89(7):824-32

Poklepovic T, Worthington HV, Johnson TM, et al. Interdental brushing for the prevention and control of periodontal diseases and dental caries in adults. Cochrane Database of Systematic Reviews 2013; Issue 12; Art. No.: CD009857. DOI: 10.1002/14651858.CD009857.pub2.

Sälzer S, Slot DE, Van der Weijden FA, Dörfer CE. Efficacy of inter-dental mechanical plaque control in managing gingivitis–a meta-review. J Clin Periodontol 2015; 42 (Suppl. 16): S92–S105.

Sambunjak D, Nickerson JW, Poklepovic T, et al. Flossing for the management of periodontal diseases and dental caries in adults. Cochrane Database of Systematic Reviews 2011; Issue 12: Art. No.: CD008829. DOI: 10.1002/14651858.CD008829.pub2

Slot DE, Dörfer CE, Van der Weijden GA. The efficacy of interdental brushes on plaque and parameters of periodontal inflammation: a systematic review. International Journal of Dental Hygiene. 2008;6(4):253-264.

Slot DE, Valkenburg C, van der Weijden CF. Mechanical plaque removal of periodontal maintenance patients – a systematic review and network meta-analysis, J. Clin. Periodontol. 47 (Suppl. 22) (2020) 107–124.

Worthington HV, MacDonald L, Poklepovic Pericic T, Sambunjak D, Johnson TM, Imai P, et al. Home use of interdental cleaning devices, in addition to toothbrushing, for preventing and controlling periodontal diseases and dental caries. Cochrane Database Syst Rev. 2019;4(4):Cd012018.

Key Question 8

In the general population, are toothpastes that contain fluoride and another active ingredient, compared to toothpastes which only contain fluoride, more effective at reducing plaque levels and gingivitis?

N.B. This question about toothpastes is not the same as the question posed in the first edition of the guidance, which concerned triclosan/copolymer-containing toothpastes. Triclosan-containing products have been withdrawn in the UK due to concern over effects on hormone levels and the potential long-term public health risks. However, the previous recommendation and the basis for making it are included below for reference.

Recommendation in 2014 edition of guidance:

- The group are unable to make a specific recommendation on the use of triclosan/copolymer-containing toothpastes.

Basis for recommendation:

The evidence from one systematic review (Riley 2013) suggested that fluoride toothpastes which also contain triclosan/copolymer are more effective at reducing plaque indices (plaque levels, plaque severity) and gingivitis indices (inflammation, bleeding) than fluoride toothpastes which do not contain triclosan/ copolymer. These reductions were evident regardless of initial plaque and gingivitis levels. However, the clinical relevance of these was unclear. The evidence was considered to be moderate quality due to the consistency in results observed both across studies and in a sensitivity analysis of high quality studies. No publication bias was detected but the group noted that the majority of studies in the review were funded by industry and were concerned that this could be a major source of bias. As a consequence, the group felt unable to make a specific recommendation on the use of triclosan/copolymer-containing toothpastes.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline recommends that patients brush twice a day with a toothpaste containing 1350 to 1500 ppm fluoride. This is based on moderate certainty evidence for the value of toothbrushing with fluoride toothpaste for prevention of dental caries (Walsh 2019). There is no further information on additional toothpaste active ingredients.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) states that adjunctive antiseptics, delivered either by toothpaste or mouthrises, may be considered in specific cases to help control gingival inflammation for patients in supportive periodontal care (SPT) (recommendation grade: 0 [open/conditional]). This is based on a systematic review of 73 RCTs (Figuero 2020) that found a statistically significant improvement in gingival indices when adjunctive antiseptics were used. However, there was significant heterogeneity and a high risk of bias both within and across studies.

The BSP-S3 guideline group were unable to make a specific recommendation on the most effective antiseptic toothpaste and suggest that further research is appropriate. This in contrast to the *European Federation for Periodontology (EFP) S3-Level Clinical Practice Guideline* (Sanz 2020), on which the BSP-S3 guideline is based, which makes a conditional recommendation to consider products containing chlorhexidine, triclosan co-polymer (T+C) and stannous fluoride-sodium hexametaphosphate (SF+SM). However, there were a very limited number of studies included in the analyses for SF+SM and chlorhexidine; there were considerably more studies included in the analyses of T+C dentifrice, but this is no longer available in the UK due to health concerns.

Does the evidence differ from previously?

The systematic review which underpins the BSP-S3 guideline includes toothpastes with active ingredients other than triclosan and copolymer, but the evidence to support the use of these alternative products is minimal.

What is the certainty of the evidence?

The certainty of the evidence for triclosan and copolymer toothpastes is considered moderate due to the consistency of findings across a large number of studies. The certainty of the evidence for both stannous fluoride

with sodium hexametaphosphate and chlorhexidine is very low due to the very small number of studies included in the analysis.

However, the risk of bias is high for all studies in the review due to the number of industry sponsored studies and the possibility of publication bias.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

There is moderate certainty evidence that triclosan and copolymer toothpaste is effective at reducing plaque levels and bleeding, with very low certainty evidence in favour of stannous fluoride with sodium hexametaphosphate toothpaste and chlorhexidine toothpaste. However, triclosan and copolymer toothpaste is not available in the UK.

The BSP-S3 guideline notes that where adverse events were reported, these mainly concerned tooth staining, although soft tissue irritation and taste alteration were also reported.

DBOH does not include any information on toothpastes containing additional active ingredients.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

The BSP-S3 guideline notes that there is no supporting evidence to recommend adjunctive antiseptics in a specific patient group. However, in patients unable to effectively control supragingival biofilm using their usual OH products, the decision to recommend a toothpaste and/or mouthrinse that contains an active agent in addition to fluoride, should be made on an individual patient basis, taking into account both local factors (levels of gingival inflammation related to plaque level, accessibility for cleaning, anatomical factors, etc.) and more general factors (systemic factors, general health status, frailty, limited dexterity, some of which may be more relevant in elderly patients). Additional aspects to consider include patient preferences (cost, taste etc.), unwanted effects (staining, burning sensation during use) and possible impact on the oral microbiome.

DBOH does not include any information on toothpastes containing additional active ingredients.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline notes that toothpastes are widely accepted by the population. However, this does not necessarily mean that toothpastes with additional additives would be acceptable.

DBOH does not address this in the narrative.

Through the GUIDE project, a citizen science platform inviting members of the public (citizens) to share their experiences of dental care and suggest ideas to improve them, stakeholders have indicated that evidence-based information related to oral health self care and how to maintain good oral health is of great importance to them. Therefore, evidence-based information on the most effective toothpaste options is likely to be valuable to patients.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

Patients are already advised to use toothpaste so the intervention is likely to be acceptable.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

The BSP-S3 guideline notes that patients will already be using a toothpaste. Toothpastes with additional or novel ingredients are generally more expensive than regular fluoride-containing toothpaste. Some antiseptic toothpaste formulations are not available in the UK.

DBOH does not address this in the narrative.

7. Other factors

Indicate any other factors taken into account.

Other toothpastes with alternative additives (e.g. Gengigel, Vitis, Tooth Mousse, those containing aloe-vera) are often sold within dental practices. However, there is no evidence to support their use in preventing and managing periodontal diseases.

Fluoride-containing toothpastes are important in caries prevention; this includes the prevention of root caries which can occur in patients with gingival recession.

Scotland has very low levels of fluoride in drinking water therefore fluoride-containing toothpastes are an important fluoride delivery method.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The clinical question relating to toothpaste in the first edition of the guidance was different and the Group chose not to make a recommendation.

Considered judgement:

The Group agree that fluoride-containing toothpastes are important for caries prevention. DBOH recommends that patients brush twice a day with a toothpaste containing 1350 to 1500 ppm fluoride. This strong recommendation is supported by moderate certainty evidence for the value of toothbrushing with fluoride toothpaste for prevention of dental caries (Walsh 2019). The BSP-S3 guideline incudes a conditional recommendation that adjunctive antiseptics, delivered either by toothpaste or mouthrises, may be considered in specific cases to help control gingival inflammation for patients in supportive periodontal care (SPT). However, no specific recommendation was made on the most effective toothpaste due to a lack of evidence.

The Group agree that while fluoride-containing toothpastes are primarily recommended in terms of caries prevention, they have a role to play in managing aspects of periodontal disease such as root caries. It was also noted that information on the most effective toothpastes would be welcomed by patients. The Group agree that there is insufficient evidence to recommend any particular adjunctive antiseptic toothpaste ingredient for regular use. However, in specific circumstances, it may be useful to recommend antiseptic-containing toothpastes for short-term control of acute and/or painful inflammation where mechanical debridement is not possible. The Group agree that there is a lack of evidence to support the use of other toothpaste products which claim to have a role in gingival and periodontal health.

Recommendation in updated guidance:

- Advise all patients to use a toothpaste containing 1350-1500 ppm fluoride to prevent dental caries.
- There is insufficient evidence to support the use of toothpastes with additional additives to control gingivitis and periodontitis on a routine basis.

Relevant text from main narrative:

While there is moderate certainty evidence (as assessed within DBOH) supporting the value of toothbrushing with a fluoride-containing toothpaste for the prevention of dental caries, the evidence to support the use of specific toothpastes with additional additives to control gingivitis and periodontitis is less certain.

The BSP-S3 guideline includes a conditional recommendation that adjunctive antiseptics, delivered either by toothpaste or mouthrinses, may be considered in specific cases to help control gingival inflammation for

patients in maintenance care. However, no specific recommendation was made on the most effective toothpaste due to a lack of evidence.

- Advise the patient that mechanical removal of plaque is of primary importance in the control of plaque biofilm and gingivitis. Toothpastes are considered an adjunct to this process and deliver fluoride, which is important in caries prevention.
    - Advise the patient to use a toothpaste containing 1350-1500 ppm fluoride and to 'spit, don't rinse' during tooth cleaning.
- Advise the patient that there is no evidence to support the adjunctive use of antiseptics in toothpastes to control gingival inflammation and periodontitis on a routine basis.

Strength of recommendation (strong or conditional):

- Strong (100% agreement).

References

Figuero E, Roldan S, Serrano J, Escribano M, Martin C, Preshaw PM. Efficacy of adjunctive therapies in patients with gingival inflammation. A systematic review and meta-analysis, J. Clin. Periodontol. 47 (Suppl. 22) (2020) 125–143.

Riley P, Lamont T. Triclosan/copolymer containing toothpastes for oral health. Cochrane Database of Systematic Reviews 2013, Issue 12. Art. No.: CD010514. DOI: 10.1002/14651858.CD010514.pub2.

Sanz M, Herrera D, Kebschull M, Chapple I, Jepsen S, Beglundh T, Sculean A, Tonetti MS. Treatment of stage I-III periodontitis-The EFP S3 level clinical practice guideline, J. Clin. Periodontol. 47 (Suppl. 22) (2020) 4–60.

Walsh T, Worthington HV, Glenny AM, Marinho VC, Jeroncic A. Fluoride toothpastes of different concentrations for preventing dental caries. Cochrane Database of Systematic Reviews 2019; (3).

Key Questions 9 & 10

In patients with **a diagnosis of periodontal health**, is professional mechanical plaque removal (PMPR) alone, compared to no PMPR, effective in preventing periodontal diseases (gingivitis/periodontitis)?

In patients with **a diagnosis of gingivitis**, is professional mechanical plaque removal (PMPR) and oral hygiene instruction (OHI) compared to no PMPR and OHI, effective in improving gingival health.

Professional mechanical plaque removal (PMPR) is defined as supragingival and/or subgingival removal of plaque, calculus and debris from a tooth or root surface performed with manual and/or powered instruments; it encompasses the terms scale and polish; supra- and sub-gingival scaling; supra-gingival mechanical biofilm control; root surface debridement; root surface instrumentation; periodontal instrumentation.

Recommendation in 2014 edition of guidance:

- The guidance development group recommends that supra-gingival debridement is carried out where required and that clinicians also use the Oral Hygiene TIPPS behaviour change strategy for patients who have inadequate oral hygiene.

Basis for recommendation:

Two systematic reviews (Needleman 2005, Beirne 2013) suggested that provision of supra-gingival debridement may result in a reduction in plaque levels and gingival bleeding. The evidence to support this was considered low quality due to risk of bias, risk of confounding, inconsistent results and a lack of well-conducted/well-reported RCTs. The evidence also suggested that provision of supra-gingival debridement in combination with oral hygiene instruction may result in improved clinical outcomes such as plaque and gingival bleeding. The evidence for this was considered to be of moderate quality due to a consistency of findings both within and between studies. More frequent treatment was considered to be more effective in terms of improved clinical outcomes, including plaque levels and gingival bleeding, although it was not possible to specify an optimal frequency for treatment.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline found high certainty evidence that a regular 6 or 12 monthly dental visit to remove plaque, calculus, debris and staining and provide OHI, was of no significant benefit in regularly attending patients at low risk of disease progression presenting with gingival health, gingivitis or mild (not classified) periodontal disease in a general dental practice setting over a 3- or 4-year period (Lamont 2018). The review found no significant differences in outcomes such as gingivitis or probing depth when compared with no scheduled scale and polish treatments. It should be noted that significant changes in probing depth would not necessarily be expected over the stated timescale in this patient population. Levels of calculus were reduced in the scale and polish groups, but the clinical relevance of the small reductions observed is unclear. The certainty of the evidence for the gingivitis, probing depth and calculus outcomes is considered high due to a low risk of bias and the consistent findings of the two studies included in the review. Accordingly, while DBOH includes a Good Practice Point recommending that factors that impede effective plaque control are corrected, it also notes that '*no benefits of 'routine scale and polish' have been demonstrated for adults with good periodontal health'*. The guideline states that *'daily, effective plaque removal is critical to periodontal health'*, with professional interventions such as 'routine scale and polish' considered less important.

The recent *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline did not specifically review the evidence for removal of supragingival dental biofilm and calculus. This guideline focuses on the treatment of patients with Stage I-III periodontitis rather than those with a diagnosis of periodontal health or gingivitis. However, the guideline does cite the previous European Workshop *Principles in Prevention of Periodontal Diseases* (Tonetti 2015), which recommended repeated and individually tailored OHI to treat gingival conditions (*'moderate strength'* recommendation), with the addition of professional mechanical plaque removal (PMPR) both supra-gingivally and sub-marginally, where required, to allow good self-performed oral hygiene. This latter point was included as a Good Practice Point rather than a graded recommendation but the rationale for this is not explicit. The

systematic review which supports these recommendations (Needleman 2015) included studies with patients who did not have periodontitis and found *'moderate strength'* evidence that PMPR provides no additional benefit to plaque and gingival bleeding outcomes over that achieved by repeated thorough oral hygiene instructions. It noted that '*there is little value in providing PMPR without OHI. In fact, repeated, thorough OHI can achieve a similar benefit* [in terms of plaque and bleeding levels] *to repeated PMPR.*'

Does the evidence differ from previously?

Previously, there was low certainty evidence that supragingival debridement was beneficial for preventing periodontal diseases. In the time since the first edition of the guidance was published, a large multi-centre trial into the effectiveness of 'routine scale and polish', combined with OHI, at different intervals, in patients with gingival health, gingivitis or mild (unclassified disease) with low risk of disease progression, over a 3–4-year period in a general dental practice setting, was performed and several systematic reviews have been published. There is now more certainty that in-surgery professional mechanical plaque removal, while considered helpful in allowing good self-performed oral hygiene and motivating patients, is less important for gingival health than effective self-performed oral hygiene in this low-risk group in the short term.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

The review (Lamont 2018) which underpins the DBOH recommendation notes that adverse effects were not measured in either of the two included studies. The BSP-S3 guideline and the 2015 *Principles on Prevention of Periodontal Diseases* (Tonetti 2015) do not address this issue.

While the evidence suggests that a 6-12 monthly dental visit (to remove plaque, calculus, debris and staining and provide OHI) in regularly attending individuals with gingival health, gingivitis or mild (unclassified) periodontitis at low risk of disease progression in a general practice setting over 3-4 years, did not result in significant differences in periodontal outcomes such as gingivitis or probing depth compared to no scheduled dental visit, the intervention may have other benefits. A 6-12 monthly dental visit will provide an opportunity for ongoing risk assessment, re-evaluation of the patient's disease status, revision of oral hygiene skills and targeted PMPR as indicated.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

Patients with particular risk factors, for example those who smoke, those with a history of diabetes, a family history of periodontitis or early tooth loss, those who are pregnant, or those who attend for care irregularly, will require separate consideration.

DBOH states '*in sites where calculus and restorations with ledges prevent plaque removal, the retentive factor can be removed. This may not be necessary where there are no signs of gingivitis but may be required if there is evidence of disease*.'

In patients with a diagnosis of gingival/periodontal health, provision of targeted OHI will be required if there is evidence of ineffective self-care, for example, plaque or calculus retention suggesting the patient is not completely removing plaque in those areas; plaque retentive factors should be removed to allow effective self-care.

In patients with a diagnosis of gingivitis, removal of calculus and plaque retentive factors may be required to allow effective self-care and resolution of inflammation. However, the evidence does not support the provision of this treatment at any particular frequency and suggests that concurrent OHI is required to achieve the best outcomes. This targeted approach would rely on accurate risk assessment, disease detection, diagnosis and disease status classification.

PMPR recommendations for patients with a diagnosis of periodontitis (active or historic) will be considered separately.

4. Values and preferences

Summarise any evidence or information on values and preferences.

There is some low to very low certainty evidence that patients who received routine scale and polish treatments felt that their teeth were cleaner than those who were scheduled to receive no treatment (Lamont 2018). However, there is high certainty evidence that there is little or no difference between groups in terms of oral health-related quality of life.* However, the Group raised concerns that the OHIP-14 tool, which was used to gauge quality of life, does not have the sensitivity required to assess differences between groups for these type of interventions.

One of the two studies included in the Lamont 2018 review found that participants valued, and were willing to pay for, oral hygiene advice (OHA) and periodontal instrumentation (PI; considered equivalent to PMPR), with greater financial value placed on PI than on OHA (Ramsay 2018).

*Measured using the OHIP-14, a 14-item self-reported oral health-specific questionnaire referring to symptoms in the past 12 months. Each item is scored from 0 to 4 (very often) and the scores added to produce a summary score ranging from 0 to 56, with 56 being the worst outcome.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

The removal of calculus and staining from teeth, a component of PMPR, is currently often provided as part of standard oral health care, the 'routine scale and polish', and as such is likely to be acceptable to both patients and the dental team. However, learning that the evidence suggests that, in regularly attending, low risk patients with gingivitis, mild periodontitis or who are periodontally healthy, routine provision of this intervention has no significant benefit may reduce acceptability of current practice.

A management regime focussed on patient risk assessment, accurate detection and diagnosis of disease, individualised support for effective oral hygiene and PMPR targeted at patients with disease, may require a change in focus for both dental practices and individual clinicians and patients. For example, the aim of management of low-risk patients with healthy periodontal tissues who have purely aesthetic concerns due to the presence of staining and calculus may be different from management aimed at control of disease.

To support acceptability of the structured and targeted provision of treatment, clinicians may need to be reassured that extensive and high certainty evidence underpins this strategy.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Clinical time is already dedicated to appointments for calculus removal and oral hygiene instruction for patients attending dental appointments. A change in focus to support risk assessment of patients is feasible as clinicians already have the knowledge and skill to do this. However, support will be required to manage a transition to a more targeted approach in some environments. It is likely to be feasible to provide targeted PMPR as an adjunct to individualised oral hygiene instruction for patients without a diagnosis of periodontitis where this is indicated. The impact on costs associated with this are unknown. Clinicians may require training on strategies for risk assessment and effective ways of providing OHI.

PMPR provided purely as a cosmetic intervention to remove stain and visible calculus could be provided to patients privately, but this will disadvantage those who are not able to pay for this service.

With regards to the costs associated with this intervention, there are concerns that current funding models in the UK do not enable clinicians to provide the most appropriate care for some patients, with this being a particular issue for those patients with a diagnosis of periodontitis. This limits the capacity to adopt a more targeted, evidence-based approach to care. It was agreed by the Group that changes to funding models will be required to support evidence-based practice.

7. Other factors

Indicate any other factors taken into account.

In 2021, the Economist Intelligence Unit (EIU) developed a model to assess periodontitis costs and health outcomes in six European countries (France, Germany, Italy, the Netherlands, Spain and the UK), with the aim of

determining the return on investment of periodontitis treatment and the management of gingivitis over a ten-year period (EIU 2021). This economic analysis suggested that in scenarios where gingivitis is eliminated or where the rate of diagnosis of periodontitis is increased to 90%, with all those cases being appropriately managed, a positive return on investment in all six countries is highly likely, with elimination of gingivitis using home care prevention techniques (such as tooth brushing and interdental brushing) being the most cost-effective scenario. The EIU study also noted that if gingivitis is not managed at a population level, this may significantly increase overall healthcare costs and reduce quality of life.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group recommends that supra-gingival debridement is carried out where required and that clinicians also use the Oral Hygiene TIPPS behaviour change strategy for patients who have inadequate oral hygiene.

Considered judgement:

The Group agree that effective oral-hygiene self-care is critical to periodontal health and that interventions provided by dental professionals should facilitate this. Provision of oral hygiene instruction, where required, is essential to enable patients to improve their oral hygiene skills. Removal of plaque retentive factors, such as calculus, is helpful in allowing good self-performed oral hygiene and motivating patients, although evidence suggests that this alone is not sufficient to lead to improvements in periodontal health.

Recommendations in updated guidance:

These recommendations should be considered along with other relevant recommendations, for example those on risk assessment and oral hygiene instruction.

- For patients with a diagnosis of periodontal health, prioritise individualised oral hygiene instruction over professional mechanical plaque removal (PMPR) to encourage effective oral self-care.
- For patients with a diagnosis of gingivitis, provide individualised oral hygiene instruction. In addition, assess levels of plaque and calculus and deliver professional mechanical plaque removal (PMPR) at required sites, especially where inflammation is present, to enable and encourage oral hygiene self-care.

Relevant text from main narrative:

For patients with a diagnosis of periodontal health:

In patients with a diagnosis of periodontal health, the priority is to support the patient to maintain their healthy status.

The *Delivering Better Oral Health* toolkit (DBOH) notes the importance of daily, effective plaque removal and the 11th European Workshop in Periodontology consensus report *Principles in prevention of periodontal diseases* recommends repeated and individually tailored oral hygiene instruction (OHI), with the addition of professional mechanical plaque removal (PMPR) both supragingivally and submarginally, where required, to allow good self-performed oral hygiene.

A systematic review assessed studies investigating the provision of periodontal "standard care" (i.e. 6-monthly review appointments, where the focus was on calculus removal) conducted in general dental practice in regularly attending adults without severe periodontitis compared to less frequent care. The review found that providing calculus removal on a less frequent basis was as effective as "standard care" when assessing plaque biofilm (low certainty evidence due to risk of bias and indirectness) and gingival bleeding (high certainty evidence) levels over two to three years follow-up.

Periodontal health is dependent on the patient controlling, and eliminating where possible, risk factors for disease and consistently performing adequate home care. Support from the dental team, such as providing information about risk factors, support for skills development in oral hygiene and removal of plaque retentive factors will help the patient achieve this. For some patients, calculus removal will be required as part of the process of supporting periodontal health to enable adequate home care.

For patients with a diagnosis of periodontal health:

- Explain that healthy periodontal tissues are important to retain teeth, that disease may develop in the presence of risk factors and that the dental team will regularly check the status of the patient's periodontal health.
- Provide personalised oral hygiene advice and instruction, where required, to assist and encourage the patient to improve their oral hygiene skills as well as their knowledge base on the value of good self-care routines.
- Where applicable, give information regarding personal risk factors and modifying them, for example, smoking cessation advice and diabetes control.
- Assess whether professional mechanical plaque removal (PMPR) is required, for example at sites where calculus or other plaque retentive factors are present, and provide as necessary.
- Continue to check the patient's risk profile and their periodontal health status regularly.

For patients with a diagnosis of gingivitis:

In patients with a diagnosis of gingivitis, the priority is to support the patient to resolve the inflammation and avoid progression to more serious disease.

The 2015 *European Workshop Principles in Prevention of Periodontal Diseases* recommends repeated and individually tailored oral hygiene instruction (OHI) to treat gingival conditions, with the addition of professional mechanical plaque removal (PMPR) both supra- and subgingivally, where required, to allow good self-performed oral hygiene. DBOH states that 'daily, effective plaque removal is critical to periodontal health', with professional interventions such as 'routine scale and polish' considered less important.

A systematic review assessed studies investigating the provision of periodontal "standard care" (i.e. 6-monthly review appointments, where the focus was on calculus removal) conducted in general dental practice in regularly attending adults without severe periodontitis compared to less frequent care. The review found that providing calculus removal on a less frequent basis was as effective as "standard care" when assessing plaque biofilm (low certainty evidence due to risk of bias and indirectness) and gingival bleeding (high certainty evidence) levels over two to three years follow-up.

Resolving inflammation and avoiding progression to more serious disease is dependent on the patient controlling, and eliminating where possible, risk factors for disease and improving and consistently performing adequate home care. In combination with this, patients are supported by the dental team who can provide information about risk factors, support for skills development in oral hygiene and removal of plaque retentive factors. Calculus removal is likely to be required to enable adequate home care.

For patients with a diagnosis of gingivitis:

- Explain to the patient that gingivitis is a risk factor for periodontitis, which can lead to tooth loss.
- Provide personalised oral hygiene advice and instruction to assist and encourage the patient to improve their oral hygiene skills, with the aim of reducing and controlling their inflammation as well as improving their understanding of the value of good self-care routines.
- Where applicable, give information regarding personal risk factors and modifying them, for example, advice on smoking cessation and diabetes control.

- Perform professional mechanical plaque removal (PMPR) at sites where inflammation is present.
    - Remove both supra and subgingival plaque and calculus using an appropriate method.
- Ensure that local plaque retentive factors are corrected - for example, remove overhanging restorations or alter denture design.
- Re-assess at future visits to determine whether the gingivitis has resolved.

Strength of recommendation (strong or conditional):

- Recommendation 1 (periodontal health): Strong (87% agreement)
- Recommendation 2 (gingivitis): Strong (100% agreement)

References

Beirne P, Worthington HV, Clarkson JE. Routine scale and polish for periodontal health in adults. Cochrane Database of Systematic Reviews. 2013;Issue 11:Art. No.: CD004625. DOI:.1002/14651858.CD004625.pub4.

Economist Intelligence Unit Limited. Time to take gum disease seriously. The societal and economic impact of periodontitis. (2021) https://impact.economist.com/perspectives/sites/default/files/eiu-efp-oralb-gum-disease.pdf

Gomes SC, Romagna R, Rossi V, Corvello PC, Angst PD, Supragingival treatment as an aid to reduce subgingival needs: a 450-day investigation, Braz. Oral Res. 28 (2) (2014).

Lamont T, Worthington HV, Clarkson JE, Beirne PV. Routine scale and polish for periodontal health in adults. Cochrane Database of Systematic Reviews. 2018(12).

Needleman I, Suvan J, Moles DR, Pimlott J. A systematic review of professional mechanical plaque removal for prevention of periodontal diseases. Journal of Clinical Periodontology. 2005;32 (Suppl 6):229-282.

Needleman I, Nibali L, Di Iorio A. Professional mechanical plaque removal for prevention of periodontal diseases in adults – systematic review update. J Clin Periodontol 2015; 42 (Suppl. 16): S12–S35.

Ramsay CR, Clarkson JE, Duncan A, Lamont TJ, Heasman PA, Boyers D, et al. Improving the Quality of Dentistry (IQuaD): a cluster factorial randomised controlled trial comparing the effectiveness and cost–benefit of oral hygiene advice and/or periodontal instrumentation with routine care for the prevention and management of periodontal disease in dentate adults attending dental primary care. Health Technol Assess 2018;22(38).

Tonetti MS, Eickholz P, Loos BG, Papapanou P, van der Velden U, Armitage G, Bouchard P, Deinzer R, Dietrich T, Hughes F, Kocher T, Lang NP, Lopez R, Needleman I, Newton T, Nibali L, Pretzl B, Ramseier C, Sanz-Sanchez I, Schlagenhauf U, Suvan JE, Fabrikant E, Fundak A. Principles in prevention of periodontal diseases–Consensus report of group 1 of the 11th European workshop on periodontology on effective prevention of periodontal and peri-implant diseases. J Clin Periodontol 2015; 42 (Suppl. 16): S5–S11.

Periodontitis and systemic conditions (questions 11-12)

Key Question 11

In patients with a diagnosis of periodontitis who also have a specific medical condition, does control of their periodontitis improve the control of their medical condition?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline states that there are risks to general health resulting from having active periodontal diseases. It highlights that some systemic diseases, such as diabetes or cardiovascular disease share similar genetic and/or environmental influences with periodontal diseases.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline notes that periodontal infections are associated with a range of systemic diseases, including diabetes (Sanz 2018) and cardiovascular diseases (Sanz 2020).

The European Federation of Periodontology (EFP) *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) includes two statements and a recommendation related to the impact of periodontal treatment on systemic health in patients with stage III or IV periodontitis. These are based on a systematic review (Orlandi 2022) which found that:

- in people with no reported systemic co-morbidity and who are considered systemically healthy, periodontal treatment had no statistically significant effects on systemic biomarkers of inflammation and metabolic control at six months follow-up (low certainty evidence; three RCTs at low risk of bias);
- in one study investigating people with a cardiac co-morbidity, periodontal treatment had no statistically significant overall effect on cardiovascular events (very low certainty evidence; one RCT at high risk of bias);
- periodontal treatment reduced serum high sensitivity C-reactive protein (15 RCTs, high heterogeneity), fasting plasma glucose (6 RCTs, high heterogeneity) and increased flow-mediated dilation (2 RCTs, low heterogeneity); no statistically significant reductions were observed for other biomarkers; the certainty of the evidence was considered moderate.

Accordingly, the EFP guideline makes the following statements/recommendations:

- *Treatment of periodontitis **may** improve levels of biomarkers of systemic inflammation and cardio-metabolic risk in people with no reported systemic co-morbidity.* (Statement)
- *It is currently unclear if the treatment of periodontitis improves "hard" outcomes or complications of systemic non-communicable diseases (NCDs) in patients with periodontitis with a co-morbid NCD.* (Statement)
- *We **suggest** that treatment of periodontitis is **performed** to reduce systemic inflammation, to reduce cardiovascular risk profile and to improve metabolic control in patients with co-morbid NCD; however, treatment protocols should include careful consideration of the general health status of the patient (e.g., quadrant vs. full-mouth approach).* (Recommendation – Grade B)

Diabetes

DBOH recommends that patients with diabetes should try to maintain good diabetes control as they are at greater risk of developing serious periodontitis and less likely to benefit from periodontal treatment if the

diabetes is not well controlled (recommendation grade: conditional). This is based on low certainty evidence that poorly controlled diabetes substantially increases the risk or progression of periodontitis (Nascimento 2018). Moderate certainty evidence found that diabetic control improved periodontal health (Ramseier 2020) and that periodontal treatment improved diabetic control (Baeza 2020). DBOH also recommends that for patients with diabetes, dental professionals should explain risk related to diabetic control; ask about HbA1c (glycated haemoglobin) levels and assess and discuss clinical management (Good Practice Point). It notes that a study found that almost three-quarters of diabetic patients were unaware of the link between diabetes and periodontal health (Siddiqi 2019).

BSP-S3 recommends diabetes control interventions in patients undergoing periodontitis therapy (recommendation grade: A [strong]). This is based on two, 6-month RCTs performed at university settings that found that provision of interventions to address oral hygiene and to highlight the link between diabetes and periodontitis resulted in significantly improved HbA1c levels, oral hygiene measures and periodontal outcomes (Ramseier 2020).

A Cochrane review (Simpson 2022) investigated the effects of periodontal treatment on glycaemic control in people with diabetes mellitus (type I or II) and periodontitis. The review included 35 studies which randomised 3249 participants to periodontal treatment or control; almost all patients had type II diabetes with various levels of metabolic control. Two studies were assessed as being at low risk of bias, 14 studies at high risk of bias, and the risk of bias in 19 studies was unclear. An absolute reduction in HbA1c of 0.43% (4.7 mmol/mol) was observed 3 to 4 months after treatment of periodontitis (95% CI -0.59% to -0.28%; -6.4 mmol/mol to -3.0 mmol/mol). Similarly, after 6 months an absolute reduction in HbA1c of 0.30% (3.3 mmol/mol) (95% CI -0.52% to -0.08%; -5.7 mmol/mol to -0.9 mmol/mol), and after 12 months, an absolute reduction of 0.50% (5.4 mmol/mol) (95% CI -0.55% to -0.45%; -6.0 mmol/mol to -4.9 mmol/mol) was observed. The authors conclude that there is moderate-certainty evidence that periodontal treatment using subgingival instrumentation improves glycaemic control in people with both periodontitis and diabetes by a clinically significant amount when compared to no treatment or usual care. They note that further trials evaluating periodontal treatment versus no treatment/usual care are unlikely to change the overall conclusion reached in the review.

The NICE guidelines on management of type 1 diabetes (NG17) and type 2 diabetes (NG28) in adults were amended in 2022 to include updated recommendations on periodontitis based on the Cochrane review above (Simpson 2022). These recommendations address concerns that people with diabetes are often unaware of their risk of periodontal disease and may not be having regular oral health reviews. The guidelines recommend that adults with diabetes are informed that they are at higher risk of periodontitis and advised that if they do develop periodontitis, managing it can improve their blood glucose control and can reduce their risk of hyperglycaemia. The guidelines also recommend that adults with diabetes have regular oral health reviews and that those who have been diagnosed with periodontitis are offered dental appointments to manage and treat their periodontal disease.

Cardiovascular Disease

DBOH notes that while there is ongoing debate about the role of periodontitis in cardiovascular diseases (Sanz 2020, Lavigne 2020), at present no firm conclusions can be drawn. A Cochrane review (Liu 2019) investigated the effects of periodontal therapy for primary or secondary prevention of cardiovascular disease (CVD) in people with chronic periodontitis. The review included two RCTs, both evaluated as being at high risk of bias. The authors concluded that there was very low certainty, inconclusive evidence about the effects of scaling and root planing compared to supragingival scaling for primary prevention of CVD in people diagnosed with periodontitis and metabolic syndrome. They also conclude that there is no reliable evidence available regarding secondary prevention of CVD in people diagnosed with chronic periodontitis and CVD.

Hypertension

A Cochrane review (Luo 2021) assessed the effect and safety of different periodontal treatment modalities on blood pressure (BP) in people with chronic periodontitis. The review included 8 RCTs; five had low risk of bias, one had unclear risk of bias, and two had high risk of bias. It found no evidence of a difference in changes in systolic and diastolic BP when periodontal treatment was compared to no treatment in people diagnosed with

periodontitis and other cardiovascular diseases except hypertension in both the short (3 months; very low certainty evidence) and long (6 months; low certainty evidence) term. No changes in systolic or diastolic BP were observed in people diagnosed with periodontitis in the short and long term (low certainty evidence). There was also no difference when intensive periodontal treatment was compared to supra-gingival scaling (very low certainty evidence). One study suggested that periodontal treatment may reduce SBP and DBP in the short term in people with hypertension and chronic periodontitis (moderate certainty evidence), but the authors could draw no conclusions on this intervention.

Rheumatoid Arthritis

DBOH states that there is currently insufficient information to determine the true relationship between rheumatoid arthritis and periodontal disease. It cites a systematic review that found low certainty evidence of a reduction in rheumatoid arthritis disease activity (as measured by Disease Activity Score [DAS 28]) following non-surgical treatment of periodontitis (Calderaro et al, 2017). However, the clinical importance of this reduction is unclear. There is no evidence of a difference in other biomarkers of disease activity or patient-related outcomes between those receiving periodontal therapy and those who did not. The review authors note that further research is required to confirm these findings. A previous review (Kaur 2014) also found reductions in some biomarkers of disease activity, but not others, following periodontal therapy. The authors of this earlier review also recommend further research to fully determine whether periodontal treatment influences rheumatoid arthritis disease activity.

Alzheimer's Disease

Associations between periodontal disease and Alzheimer's disease have been proposed (Hu 2021, Kaliamoorthy 2022) but further research is required to determine the significance of this and to determine if periodontal treatment has any beneficial effects.

Other conditions

Associations between periodontal disease and other inflammatory conditions, such as psoriasis, have been proposed due to similarities in the dysregulation of the host inflammatory response (Zhang 2022). Additionally, chronic kidney disease has been linked to periodontal disease, based on a hypothesis that chronic, systemic inflammation can lead to kidney damage (Chambrone 2013). However, in all cases, there is insufficient evidence to infer a causal relationship or to determine whether periodontal treatment has an impact on the status of the medical condition.

Other relevant evidence

A review assessing the methodological quality of systematic reviews investigating the effect of nonsurgical periodontal treatment on systemic disease outcomes (Taylor 2021), found that most had 'low' or 'critically low' AMSTAR 2 confidence ratings. The AMSTAR 2 tool lists 7 domains that can "critically affect the validity of a review and its conclusions" (Shea 2017) and most of the reviews identified were lacking in one or more AMSTAR 2 critical domains. This suggests that the findings of these reviews may not accurately represent the effect of nonsurgical periodontal treatment on systemic disease outcomes. The authors conclude that future reviews should be conducted and reported according to agreed methodological standards and that additional, high quality studies on the impact of periodontal treatment on systemic health are required.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance, but information on proposed links with systemic diseases was included. There is now higher certainty evidence supporting both the link between diabetes and periodontal disease and the positive impact of periodontal treatment on diabetes control. There is also a larger body of evidence linking periodontal disease with other systemic diseases. However, this is still not sufficient to prove a causal association or to determine if periodontal treatment has a beneficial effect on the control of these diseases. Further high quality research is required to answer the clinical question related to diseases other than diabetes.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- There are likely to be few undesirable effects of recommending periodontal treatment for those patients who need it, whether or not they have another systemic condition. However the EFP guideline notes that *potential adverse systemic effects of full mouth treatment protocols in certain risk patients should be considered*. Accordingly, treatment approaches which may limit levels of post-treatment inflammation (e.g. quadrant rather than full mouth PMPR) could be considered for patients with a systemic co-morbidity.
- For patients with diabetes, there is moderate certainty evidence that periodontal treatment is beneficial in terms of the positive impact on glycaemic control.
- The authors of the Cochrane review investigating the effect of periodontal treatment on diabetic control (Simpson 2022) noted that adverse effects were rarely evaluated and therefore they could not draw any reliable conclusions about any possible harms caused by the intervention.
- Where evidence is insufficient to make a specific recommendation, highlighting the possible links between periodontitis and systemic disease and the importance of good periodontal health to overall health may be helpful.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- There is moderate-certainty evidence that periodontal treatment using subgingival instrumentation improves glycaemic control in people with both periodontitis and diabetes by a clinically significant amount when compared to no treatment or usual care.
- While there is some evidence of a link between periodontal disease and other systemic conditions such as cardiovascular disease or rheumatoid arthritis, there is insufficient evidence to determine whether periodontal treatment influences the clinical and longer term outcomes of these diseases.
- A specific recommendation on the management of patients with both periodontitis and diabetes based on moderate certainty evidence is possible.
- It may not be possible to make a recommendation for patients with other systemic conditions due to the lack of evidence, but advice could be given to discuss with patients the possible links and the importance of good oral health, including control of oral inflammation, to their overall health.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- Patients may value oral health interventions that help them manage their systemic disease.
- Patients may value information about the impact of oral health on general health and advice on how they can optimise this.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Oral health interventions that help them manage their systemic disease are likely to be acceptable to patients.
- Information about the impact of oral health, in terms of levels of inflammation, on general health and advice on how they can optimise this is likely to be acceptable to patients.
- Providing advice on the importance of good oral health to overall health, and providing treatment where required, is likely to be acceptable to the dental team.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Providing advice on the importance of good oral health to overall health, and providing treatment where required, is likely to be feasible.

- Delivery of specific risk factor control advice takes significant time in the dental setting and current funding models do not include a specific fee to cover this.

7. Other factors

Indicate any other factors taken into account.

- It will be important to promote dissemination of information about impact of dental health on general health to GMPs and medical teams.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group agree that there is low to moderate certainty evidence of the link between periodontal disease and diabetes. Consequently the Group agreed that patients with diabetes should be informed of the potential impact of their condition on their periodontal health. The Group also noted the growing body of evidence emerging on the link between other systemic diseases and periodontal disease but that a positive association has yet to be established. However they felt it was important to recommend that periodontal treatment is provided to this group of patients with the aim of reducing inflammation.

The Group discussed the guidance on quadrant versus full mouth approach for treating patients with periodontitis and systemic conditions notably cardiovascular disease. The Group noted the EFP S3 recommendation that both approaches can be used but that clinicians should be aware that there is evidence of systemic implications (e.g. acute systemic inflammatory response) with full-mouth protocols. The EFP guidelines note that such an approach should always include careful consideration of the general health status of the patient and the Group agreed to incorporate and reference this guidance into the current recommendation.

The Group discussed dissemination of information in relation to patients with diabetes. It was noted that the previous version of the guidance did include information for medical staff who deal with individuals with diabetes highlighting the link between periodontitis and diabetes and asking them to raise it with them. A Group member highlighted the lack of knowledge of patients on the implications of diabetes for their oral health and how little information there is available on this subject. It was noted that there are a number of resources available including those from the EFP for healthcare professionals and the general public and that it might be useful to signpost these in the guidelines and in so doing avoid potential duplication. It would be important to consider the inclusion of resources such as these in developing a dissemination strategy.

Recommendations in updated guidance:

- For patients with diabetes and periodontitis, provide periodontal treatment, including oral hygiene instruction and supra- and sub-gingival professional mechanical plaque removal (PMPR) with the aim of reducing oral inflammation and improving diabetes control.
- For patients with periodontitis and with systemic conditions that may be related to periodontitis, provide periodontal treatment, including oral hygiene instruction and supra- and sub-gingival professional mechanical plaque removal (PMPR) with the aim of reducing oral inflammation.

Relevant text from main narrative:

Periodontitis is an inflammatory disease of the soft tissues and bone supporting the teeth in susceptible individuals that is associated with dental plaque biofilm. This has been linked with an increase in systemic

inflammation, which may impact on other body tissues and increase risks associated with other inflammation-mediated conditions (e.g. diabetes or cardiovascular disease).

Patients with diabetes have an increased risk of developing periodontal diseases. Sub-optimally controlled diabetes enhances the signs and symptoms of gingivitis and periodontitis and has an adverse effect on wound healing, making treatment of these patients more difficult. There is moderate certainty evidence that non-surgical periodontal treatment improves glycaemic control in patients with a diagnosis of periodontitis who also have diabetes. The improvements observed are clinically significant and sustained over at least a 12-month period. The certainty of the evidence is considered moderate due to risk of bias, largely due to lack of blinding in the primary studies. The NICE guidelines on management of diabetes recommend that adults with diabetes have regular oral health reviews and that those who have been diagnosed with periodontitis are offered dental appointments to manage and treat their periodontal disease.

There is a body of evidence indicating an association between periodontitis and cardiovascular disease. This may be due to shared risk factors and/or the impact of chronic inflammatory diseases (such as periodontitis) on the cardiovascular system. However, there is currently no reliable evidence that treatment of periodontal disease can improve cardiovascular outcomes. Two Cochrane reviews did not find any conclusive evidence regarding the effect of periodontal treatment on cardiovascular disease or hypertension.

Associations between periodontitis and other chronic inflammatory conditions, such as rheumatoid arthritis, chronic kidney disease and psoriasis, have been proposed but there is insufficient evidence to determine if periodontal treatment influences the activity of these diseases. In addition, Alzheimer's disease has been linked with periodontitis but further research is required to determine the significance of this and to determine if periodontal treatment has an impact on clinical outcomes.

- Explain to all patients who have diabetes that sub-optimally controlled diabetes increases the risk of developing periodontitis or worsening existing periodontitis. Give personalised advice on oral hygiene and carry out periodontal treatment where required.
- For patients who have both a diagnosis of periodontitis and diabetes, explain that treatment of their periodontal disease is likely to improve control of their diabetes. Consider communicating with their general medical practitioner or diabetic care team if necessary.
- For patients who have both a diagnosis of periodontitis and diabetes, carry out non-surgical periodontal treatment, including subgingival PMPR where required.
- For patients with other health conditions that may be linked to periodontitis (e.g. cardio-vascular disease, rheumatoid arthritis), emphasise the importance of good oral health and control of oral inflammation to general health. Carry out periodontal treatment where required.
    - For patients with unstable cardiovascular disease, consider the health status of the patient and the potential risks of a full mouth delivery approach before periodontal instrumentation is carried out.

Strength of recommendation (strong or conditional):

- Diabetes: Strong (100% agreement)
- Systemic diseases (not diabetes): Conditional (100% agreement)

References

Akram Z, Shafqat SS, Aati S, Kujan O, Fawzy A. Clinical efficacy of probiotics in the treatment of gingivitis: A systematic review and meta-analysis. Australian Dental Journal. 2020;65(1):12-20

Baeza M, Morales A, Cisterna C, Cavalla F, Gisela Jara G, Isamitt Y and others. Effect of periodontal treatment in patients with periodontitis and diabetes: systematic review and meta-analysis. Journal of Applied Oral Sciences 2020 January 10;28:e20190248. doi: 10.1590/1678-7757-2019-0248.

Calderaro DC, Corrêa JD, Ferreira GA, Barbosa IG, Martins CC, Silva TA and others. Influence of periodontal treatment on rheumatoid arthritis: a systematic review and meta-analysis. Revista Brasileira de Reumatologia (English Edition). 2017;57(3):238-44

Chambrone L, Foz AM, Guglielmetti MR, Pannuti CM, Artese HPC, Feres M, Romito GA. Periodontitis and chronic kidney disease: a systematic review of the association of diseases and the effect of periodontal treatment on estimated glomerular filtration rate. J Clin Periodontol 2013; 40: 443–456.

Hu X, Zhang J, Qui Y, Lui Z. Periodontal disease and the risk of Alzheimer's disease and mild cognitive impairment: a systematic review and meta-analysis. Psychogeriatrics. 2021 Jun. doi: 10.1111/psyg.12743.

Kaliamoorthy S, Nagarajan M, Sethuraman V, Jayavel K, Lakshmanan V, Palla S. Association of Alzheimer's disease and periodontitis - a systematic review and meta-analysis of evidence from observational studies. Med Pharm Rep. 2022 Apr;95(2):144-151.

Kaur S, Bright R, Proudman SM, Bartold PM. Does periodontal treatment influence clinical and biochemical measures for rheumatoid arthritis? A systematic review and meta-analysis. Semin Arthritis Rheum. 2014; 44(2):113-122.

Lavigne SE, Forrest JL. An umbrella review of systematic reviews of the evidence of a causal relationship between periodontal disease and cardiovascular diseases: position paper from the Canadian Dental Hygienists Association. Canadian journal of dental hygiene 54(1): 32-41. 2020;54:32-41

Liu W, Cao Y, Dong L, Zhu Y, Wu Y, Lv Z, Iheozor-Ejiofor Z, Li C. Periodontal therapy for primary or secondary prevention of cardiovascular disease in people with periodontitis. Cochrane Database of Systematic Reviews 2019, Issue 12. Art. No.: CD009197.

Luo Y, Ye H, Liu W, Lv Z, Jia Y, Li C, Zhang Y. Effect of periodontal treatments on blood pressure. Cochrane Database of Systematic Reviews 2021, Issue 12. Art. No.: CD009409.

Nascimento GG, Leite FRM, Vestergaard P, Scheutz F, López R. Does diabetes increase the risk of periodontitis? A systematic review and meta-regression analysis of longitudinal prospective studies. Acta Diabetologica. 2018;55(7):653-67.

Orlandi M, Aguilera EM, Marletta D, Petriev A, Suvan J, D'Aiuto F. Impact of the treatment of periodontitis on systemic health and quality of life: A systematic review. J Clin Periodontol. 2022; 49 (Suppl. 24): 314–327.

Ramseier CA, Woelber JP, Kitzmann J, Detzen L, Carra MC, Bouchard P. Impact of risk factor control interventions for smoking cessation and promotion of healthy lifestyles in patients with periodontitis: A systematic review. Journal of Clinical Periodontology 2020, January 7;47(Suppl 22):90-106.

Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F and others. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International Diabetes Federation and the European Federation of Periodontology. Journal of Clinical Periodontology. 2018;45(2):138-49.

Sanz M, Marco Del Castillo A, Jepsen S, Gonzalez-Juanatey JR, D'Aiuto F, Bouchard P and others. Periodontitis and cardiovascular diseases: Consensus report. Journal of Clinical Periodontology. 2020;47(3):268-88.

Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, Moher D, Tugwell P, Welch V, Kristjansson E, et al. 2017. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. BMJ. 358:j4008

Siddiqi A, Zafar S, Sharma A, Quaranta A. Diabetic patients' knowledge of the bidirectional link: are dental health care professionals effectively conveying the message? Australian Dental Journal. 2019;64(4);312-326. doi.org/10.1111/adj.12721

Simpson TC, Clarkson JE, Worthington HV, MacDonald L, Weldon JC, Needleman I, Iheozor-Ejiofor Z, Wild SH, Qureshi A, Walker A, Patel VA, Boyers D, Twigg J. Treatment of periodontitis for glycaemic control in people with diabetes mellitus. Cochrane Database of Systematic Reviews, 2022 Issue 4. Art. No.: CD004714

Taylor HL, Rahurkar S, Treat TJ, Thyvalikakath TP, Schleyer TK. Does Nonsurgical Periodontal Treatment Improve Systemic Health? Journal of Dental Research 2021, Vol. 100(3) 253–260

Zhang X, Hongqiu G, Xie S, Su Y. Periodontitis in patients with psoriasis: A systematic review and meta-analysis. Oral Diseases. 2022;28:33–43.

Key Question 12

In patients with a diagnosis of periodontitis who are pregnant, does control of their periodontitis improve their pregnancy outcomes?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline notes that periodontal infections are associated with adverse pregnancy outcomes. It refers to the EFP/AAP consensus report (Sanz 2013) which outlines the epidemiology and possible biological mechanisms that support a potential link between periodontitis and adverse pregnancy outcomes and also provides recommendations on the management of patients with periodontitis during pregnancy. While the impact of periodontal treatment on adverse pregnancy outcomes was unclear, the report advised that periodontal care should be provided as required.

The more recent European Federation of Periodontology (EFP) *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) states that it is unclear whether treatment of periodontitis during pregnancy reduces pre-term births (<37 weeks) or reduces other adverse pregnancy outcomes. This statement is based on a systematic review (Orlandi 2022) of 16 RCTs which found evidence that treatment of periodontitis resulted in a statistically significant reduction in pre-term births (37 weeks). However, concerns about heterogeneity (linked to differences in study populations, settings and care providers), inconsistency and risk of bias impact the certainty of this evidence. No statistically significant impact was observed for other pregnancy outcomes. More information on the findings of this review is provided later in this section.

Prevalence

A recent systematic review (Chen 2022) investigating the prevalence of periodontitis in pregnancy reported a prevalence of 40% (95% CI: 10 to 100%; 3 studies). This figure is based on data from a limited number of studies, due to inconsistent definitions of periodontal diseases across studies included in the review. Figures estimating the prevalence of periodontal indicators were based on a greater number of studies and suggest that in patients who are pregnant, bleeding on probing has a prevalence of 67% (95% CI: 56 to 80%; 15 studies), clinical attachment loss ≥4 mm has a prevalence of 42% (95% CI: 27 to 57%; 15 studies) and probing depth ≥4 mm has a prevalence of 24% (95% CI: 12 to 37%; 11 studies). Risk of bias and heterogeneity was high and the authors note that the results should be viewed with caution.

Epidemiology

A systematic review of observational studies identified modest but significant associations between periodontal disease and preterm birth, low birth weight and pre-eclampsia (Ide 2013). The authors note that this finding appears to be influenced by study design and methodology, with associations being less clear in prospective studies, compared to retrospective studies, and in studies where periodontitis was assessed as a continuous variable (e.g. probing depth or attachment level scores) rather than as a categorical assessment (presence or absence of periodontitis). This finding is supported by other reviews which also identify associations between periodontal disease and adverse pregnancy outcomes (Zhang 2022, Manrique-Corredor 2019, Daalderop 2018, Corbella 2016), while acknowledging association does not confer causality.

Impact of Periodontal Treatment

A Cochrane review which investigated whether treating periodontal disease in pregnant women prevents or reduces perinatal and maternal morbidity and mortality (Iheozor-Ejiofor 2017) found that periodontal treatment may reduce low birth weight compared to no treatment (risk ratio 0.67, 95% CI 0.48 to 0.95; participants = 3470;

studies = 7; I^2 = 59%). The certainty of the evidence is low due to high risk of bias and serious inconsistency in the data. The impact of periodontal treatment on preterm birth was unclear (risk ratio 0.87, 95% CI 0.70 to 1.10; participants = 5671; studies = 11; I^2 = 66%), with evidence assessed as low certainty due to high risk of bias and inconsistency. The effect of periodontal treatment on other outcomes, such as perinatal mortality and preeclampsia in pregnant women with periodontal disease, is unclear (very low certainty evidence). It is also unclear what type of periodontal treatment during pregnancy is better in preventing adverse birth outcomes.

There are several more recent publications that consider the impact of periodontal treatment on pregnancy outcomes. Bi et al. (2021) suggest that periodontal treatment leads to significant differences between intervention and control groups for four outcomes: risk of perinatal mortality (RR=0.53, 95% CI=0.30–0.93; p=0.03; 8 RCTs, n=5942), preterm birth (RR=0.78; 95% CI=0.62–0.98; p=0.03; 18 RCTs, n=7335), birth weight (MD=200.79g; 95% CI=63.34–337.24; p=0.004; 11 RCTs, n=4708) and gestational age at birth (MD=0.94, 95% CI=0.25–1.63; p=0.007; 9 RCTs, n=2162). Some of these findings are inconsistent with the findings of the Cochrane review (Iheozor-Ejiofor 2017) described above. The certainty of the evidence supporting these results is low to very low, mainly due to high risk of bias (mainly lack of blinding of participants), imprecision, and significant heterogeneity.

Another review that attempts to determine the impact of periodontal treatment on outcomes related to pregnancy (Orlandi 2022), and which informs the 2022 EFP *Treatment of stage IV periodontitis* guideline, found that periodontal treatment is associated with a reduction in preterm birth <37 weeks (RR 0.77 95%CI 0.60, 0.98; p=0.036; I^2=67.1%; 14 studies). This is based on 14 RCTs, most of which were at moderate (8/14) or high (3/14) risk of bias. Heterogeneity was substantial, possibly due to differences in settings, variation in periodontitis diagnosis and pregnancy outcomes definitions, gestational age at the time of treatment provided, and different operators and modalities of treatment, and sensitivity analysis resulted in the observed effect becoming non-significant. The results for all other pregnancy-related outcomes were non-significant. The certainty of the evidence is likely to be low due to risk of bias, inconsistency and possible risk of publication bias.

A review that compared the effect of scaling and root planing alone and with the adjunctive use of mouthwash (MW) to prevent adverse pregnancy outcomes (Le 2022) found SRP alone was only associated with increased birthweight (MD = 93.85; 95%CI = 3.27-184.42; P = 0.042; I^2 = 84%; 9 studies) while addition of MW to the treatment regime led to improvements in risk of preterm birth (RR = 0.37, 95%CI = 0.16-0.84; P = 0.017; I^2 = 93%; 7 studies), risk of low birth weight (RR = 0.54, 95%CI = 0.40-0.74; P <0.0001; I^2 = 0%; 4 studies), gestational age (MD = 0.78; 95%CI = 0.19-1.37; P = 0.009; I^2 = 87%; 6 studies) and birth weight (MD = 121.77; 95%CI = 3.19-240.34; P = 0.044; I^2 = 81%; 6 studies). However, the certainty of the evidence is judged to be low to very low, due to risk of bias (lack of blinding, especially in the studies related to MW), inconsistency (considerable heterogeneity observed for some outcomes), imprecision (wide confidence intervals for some comparisons) and risk of publication bias.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance, but information on the link between pregnancy and gingivitis, and advice on the management of pregnancy-associated gingivitis, was included.

There is now more evidence supporting an association between periodontal disease and adverse pregnancy outcomes, although it should be noted that association does not confer causality. Reviews of studies that investigate the impact of periodontal treatment on adverse pregnancy outcomes are inconsistent, with some reviews reporting that periodontal treatment can benefit several pregnancy-related outcomes (Bi 2021, Le 2022), while others have found benefits for only one outcome (Iheozor-Ejiofor 2017, Orlandi 2022). In all cases, the evidence supporting the intervention is considered to be, at best, low certainty, mainly due to risk of bias and inconsistency (high heterogeneity). Further, high quality research is required to determine if periodontal treatment leads to improved pregnancy outcomes.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- There is a lack of evidence supporting the use of periodontal treatment to improve pregnancy outcomes but there is robust evidence supporting this intervention to improve the periodontal health of these patients.
- The evidence suggests that interventions to control oral inflammation are safe during pregnancy.
- General obstetric guidelines suggest that elective procedures should be avoided in the first trimester due to the possible stress to the foetus and preferably rendered during the second trimester (Sanz 2013).

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

Sanz 2013 provides separate recommendations for the oral health management of healthy, gingivitis and periodontitis patients during pregnancy, summarised below:

- Pregnant patients who have a healthy periodontium should be given advice on prevention, including oral hygiene instruction where necessary. Information about the impact pregnancy can have on oral health (higher incidence of bleeding, possible gingival enlargement) should also be provided.
- Pregnant patients with a diagnosis of gingivitis should be given advice on prevention and the impact of pregnancy on oral health as above. Oral hygiene instruction, and non-surgical periodontal treatment where required, should be provided with the aim of resolving the inflammation. Frequent monitoring of the periodontal status should be maintained throughout pregnancy.
- Pregnant patients with a diagnosis of periodontitis should be given advice on prevention and the impact of pregnancy on oral health as above. Oral hygiene instruction and non-surgical periodontal treatment should be provided with the aim of reducing inflammation. Extensive traumatic interventions should be avoided. Localised gingival enlargement should be managed with non-surgical treatment in the first instance, and surgical excision should be delayed until the inflammation has been controlled.

The Group discussed this point and noted that in some situations delaying surgical excision is not practical as there is no response to non-surgical treatment of inflammation or it is a risk and so immediate referral or direct excision of the gingival enlargement are the best options. It was noted that the evidence for these courses of action has not been reviewed and the Group agreed that an advice point should be added to the guidance to cover this situation. The Group agreed the wording for the advice point as follows: patients with large gingival overgrowths, not responding to non-surgical treatment, can be promptly referred for excision or can be excised by the general dental practitioner. This should take place up until six weeks before the birthdate.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- DBOH notes that readiness to change behaviour may be more likely at certain key points in a person's life course, such as pregnancy or new parenthood. This may increase the effectiveness of interventions to improve oral hygiene or address tobacco/alcohol use in this patient group.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Pregnant patients tend to be more receptive to oral health care messages.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Pregnant patients are entitled to free dental care during their pregnancy and for 12 months after the baby is born.

7. Other factors

Indicate any other factors taken into account.

- Periodontal treatment should be avoided during the third trimester, if possible, as long periods in the prone position are not advised during pregnancy.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group agreed that there was insufficient evidence that treatment of periodontal disease improves pregnancy outcomes. However they noted that periodontal treatment is considered safe in pregnancy and should be provided when required. The Group also noted that there is now more evidence to support an association between periodontal disease and adverse pregnancy outcomes. However this does not confer causality. The evidence reviewed is inconsistent and considered low certainty at best due to risk of bias and high heterogeneity.

The Group discussed the statement in the subgroup considerations section regarding the treatment for gingival enlargement and the timing of it. It was agreed that an advice point about the management of gingival enlargement would be included along with an advice point that periodontal treatment should be avoided during the third trimester, if possible, as long periods in the prone position are not advised during pregnancy.

Recommendation in updated guidance:

- No recommendation made as there is insufficient evidence to determine if treatment of periodontitis in patients who are pregnant improves pregnancy outcomes.

Relevant text from main narrative:

Periodontal treatment during pregnancy is considered safe and should be provided when required.

While periodontitis has been linked with adverse pregnancy outcomes, such as pre-term birth and low birth weight, the exact nature of the relationship remains unclear. Studies to determine if periodontal treatment leads to improved pregnancy outcomes have been performed but several systematic reviews have found a lack of evidence that treatment to control periodontal disease is of benefit. The recent European Federation of Periodontology (EFP) *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* states that it is unclear whether treatment of periodontitis during pregnancy reduces pre-term births (<37 weeks) or reduces other adverse pregnancy outcomes. Overall, there is insufficient evidence to determine if treatment of periodontitis in patients who are pregnant improves pregnancy outcomes.

Note that long periods in the prone position are not advised during pregnancy. Therefore, long periods lying flat in a dental chair should be avoided in the third trimester, where possible.

- For patients with a diagnosis of periodontitis who are planning to become pregnant, discuss with them the association between pregnancy and periodontitis.
  - Encourage these patients to have periodontal treatment and to aim for periodontal stability before becoming pregnant.
  - Strongly encourage and support smoking cessation if the patient smokes.

- Provide support before and during pregnancy to help the patient maintain good oral hygiene and to control oral inflammation.
- Provide non-surgical periodontal care where required, ideally during the second trimester.
    - Periodontal treatment is considered safe in pregnancy and should be provided when required.
    - Reassure the patient that periodontal treatment is safe for both mother and baby during pregnancy.
- Once the baby is born, continue to provide periodontal care, where required.

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Bi WG, Emami E, Luo ZC, Santamaria C and Wei SQ. Effect of periodontal treatment in pregnancy on perinatal outcomes: a systematic review and meta-analysis. Journal of Maternal-fetal & Neonatal Medicine 2021, Vol. 34, No. 19, 3259–3268.

Chen P, Hong F, Yu X. Prevalence of periodontal disease in pregnancy: A systematic review and meta-analysis. J Dent. 2022 Aug 20;125:104253.

Corbella S, Taschieri S, Del Fabbro M, Francetti L, Weinstein R, Ferrazzi E. Adverse pregnancy outcomes and periodontitis: A systematic review and meta-analysis exploring potential association. Quintessence Int. 2016 Mar;47(3):193-204.

Daalderop LA, Wieland BV, Tomsin K, Reyes L, Kramer BW, Vanterpool SF, Been JV. Periodontal Disease and Pregnancy Outcomes: Overview of Systematic Reviews. JDR Clinical & Translational Research Volume 3, Issue 1, January 2018, Pages 10-27.

Ide M, Papapanou PN. Epidemiology of association between maternal periodontal disease and adverse pregnancy outcomes – systematic review. J Clin Periodontol 2013; 40 (Suppl. 14): S181–S194.

Iheozor-Ejiofor Z, Middleton P, Esposito M, Glenny AM. Treating periodontal disease for preventing adverse birth outcomes in pregnant women. Cochrane Database of Systematic Reviews 2017, Issue 6. Art. No.: CD005297.

Le QA, Eslick GD, Coulton KM, Akhter R, Lain S, Nassar N, Yaacoub A, Condous G, Leonardi M, Eberhard J, Nanan R. Differential Impact of Periodontal Treatment Strategies During Pregnancy on Perinatal Outcomes: A Systematic Review and Meta-analysis. J Evid Base Dent Pract 2022: [101666]

Manrique-Corredor J, Orozco-Beltran D, Lopez-Pineda A, Quesada JA, Gil-Guillen VF, Carratala-Munuera C. Maternal periodontitis and preterm birth: Systematic review and meta- analysis. Community Dent Oral Epidemiol. 2019;47:243–251.

Orlandi M, Aguilera EM, Marletta D, Petriev A, Suvan J, D'Aiuto F. Impact of the treatment of periodontitis on systemic health and quality of life: A systematic review. J Clin Periodontol. 2022; 49 (Suppl. 24): 314–327.

Sanz M, Kornman K, and on behalf of working group 3 of the joint EFP/AAP workshop. Periodontitis and adverse pregnancy outcomes: consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. J Clin Periodontol 2013; 40 (Suppl. 14): S164–S169.

Zhang Y, Feng W, Li J, Cui L, Chen ZJ. Periodontal Disease and Adverse Neonatal Outcomes: A Systematic Review and Meta-Analysis. Front Pediatr. 2022 May 4;10:799740.

Treatment of periodontitis – instrumentation (questions 13-16)

Key Question 13

In patients with a diagnosis of periodontitis, is subgingival professional mechanical plaque removal (PMPR), compared to supragingival PMPR alone or no treatment, effective in stabilizing their disease?

Recommendation in 2014 edition of guidance:

- Carry out root surface instrumentation at sites of ≥4 mm probing depth where subgingival deposits are present or which bleed on probing. Local anaesthesia may be required for this.

Basis for recommendation:

Four systematic reviews (Elley 2000, Hung 2002, Suvan 2005, Van der Weijden 2002) indicated that the provision of subgingival instrumentation may result in better clinical outcomes (both in terms of statistical significance and clinical significance) than either supragingival debridement or no treatment, particularly for areas where probing depths are greater than 3 mm in depth. The evidence is considered to be of moderate quality due to the volume of mostly low-quality studies which show consistent findings. Areas with shallow probing depths (less than 3 mm in depth) may have worse clinical outcomes, particularly where subgingival instrumentation is rigorous, and these may be more effectively treated by supragingival debridement.

The evidence also suggests that effective oral hygiene instruction given concurrently is required for optimal results. The evidence for this is considered low quality due to poor study designs, poor reporting and the possibility of bias.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline recommends that subgingival periodontal instrumentation (PMPR) is employed to treat periodontitis in order to reduce gingival inflammation, the number of diseased sites and probing pocket depths (recommendation grade: A [strong]). The systematic review which underpins this recommendation (Suvan 2020) analysed data from 11 prospective studies (assessing longitudinal changes reported in RCTs investigating other PICO questions related to subgingival instrumentation (PMPR)) and found that provision of subgingival instrumentation (PMPR) results in improvements to post-treatment clinical parameters, compared to baseline measurements. A mean pocket probing depth (PPD) reduction of 1.7 mm, a mean proportion of closed pockets of 74% and a mean reduction of bleeding on probing of 63% at 6/8 months was observed. Deeper sites (>6 mm) demonstrated a greater mean PPD reduction of 2.6 mm. The findings of this review are consistent with previously published reviews on the same topic. As noted in the BSP-S3 guideline, the lack of high certainty data from RCTs is likely due to the ethical difficulties of including a control group receiving no treatment in such a trial. One relevant RCT was included in the review and indicated a significant benefit of sub-gingival instrumentation (PMPR) in terms of pocket closure, defined as probing pocket depth (PPD) ≤4 mm and absence of bleeding on probing (BOP), at three months post treatment. However, the consistency of the evidence across the 11 prospective studies, most of which were at low risk of bias, supported by the findings of the single RCT, led the BSP-S3 guideline group to rate the evidence as strong (high certainty).

Does the evidence differ from previously?

Previously, there was moderate certainty evidence to support provision of subgingival instrumentation (PMPR) to improve periodontal health in patients with periodontitis. This was due the consistency of findings across a substantial volume of low certainty studies. The certainty of evidence of subsequent individual studies is still considered low, due to their prospective nature, but the findings add weight to the existing evidence and the group developing the BSP-S3 guideline rated the evidence as strong (high certainty). However, it should be noted that while the BSP-S3 guideline reports that there was no evidence of publication bias in the systematic review, heterogeneity was high, mostly likely due to the nature of the data and its interpretation.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

The BSP-S3 guideline states:

'Patient reported outcomes were inconsistently reported and adverse events, when reported, were rare…. An overall consideration of the benefit versus harm of sub-gingival instrumentation supports the strength of the recommendation.'

The review which underpins the BSP-S3 recommendation (Suvan 2020) noted that discomfort following instrumentation (sub-gingival PMPR) was reported in 5 studies assessing quadrant-wise versus full mouth approaches for subgingival instrumentation (PMPR).

Evidence from prospective and retrospective studies suggest that withholding the intervention will lead to worse clinical outcomes, particularly for those at high risk of disease and who present with severe bone loss. Therefore, it is likely that the desirable effects of the intervention will outweigh any undesirable effects. Designing a controlled trial to provide higher certainty evidence of this would be ethically challenging as the intervention is currently provided as standard care with no other single treatment options supported.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

PMPR recommendations for patients with a diagnosis of periodontitis who smoke or who have systemic risk factors will be considered separately.

The BSP-S3 guideline states:

The majority of studies were conducted in well controlled research environments and included specifically selected populations, i.e. those with no systemic disease. Whilst results from studies involving populations with systemic diseases were not included in the systematic review, and being mindful of a lack of evidence that outcomes achieved by this therapy are different in patients with existing systemic co-morbidities, there is a consensus, by expert opinion, that sub-gingival instrumentation is efficacious in these groups, with the magnitude of the effect requiring further study.

There is moderate certainty evidence that periodontal treatment using subgingival instrumentation (PMPR) improves glycaemic control in people with both periodontitis and diabetes by a clinically significant amount when compared to no treatment or usual care (Simpson 2022).

Specific advice on treating particular sub-groups, for example those with additional care needs, may facilitate provision of the intervention in these patient groups. Advice for those who care for these patients may also be helpful.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline does not address this criterion. However, provision of subgingival instrumentation (PMPR) is currently standard practice in the treatment of periodontitis. The mode of treatment (full mouth or quadrant) and delivery (instrument type) is covered by other clinical questions but decisions around both are likely to include consideration of both patient and clinician preferences.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

As provision of subgingival instrumentation (PMPR) is currently standard practice in the treatment of periodontitis, the intervention is likely to be acceptable to all stakeholders.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

As provision of subgingival instrumentation (PMPR) is currently standard practice in the treatment of periodontitis, the intervention is likely to be feasible. There may be additional training needs.

With regards to the costs associated with this intervention, there are concerns that funding models in the UK do not enable clinicians to provide the most appropriate care for some patients, with this being a particular issue for those patients with a diagnosis of periodontitis. This limits the capacity to adopt a more targeted, evidence-based approach to care. It was agreed by the Group that changes to funding models will be required to support evidence-based practice.

7. Other factors

Indicate any other factors taken into account.

The previous SDCEP guidance noted that the evidence suggested that oral hygiene instruction should be provided concurrently to achieve optimal results. More recently, the BSP-S3 guideline recommends that oral hygiene be optimised (first step of treatment) as part of non-surgical management, before subgingival instrumentation (PMPR) is initiated. BSP-S3 also recommends that *'the same oral hygiene guidance to control gingival inflammation'* is provided throughout all steps of periodontal therapy. Consequently, oral hygiene instruction and support should be an ongoing part of treatment as effective self-care by the patient is key to stabilising the disease.

It was noted that patient engagement with the first step of therapy is essential to the success of periodontal treatment and that non- engagement may result in progression to the second step of therapy (e.g. subgingival instrumentation (PMPR)) being delayed or considered inappropriate for that patient.

In addition to oral hygiene instruction, the BSP-S3 guideline advises that review and discussion of patient risk factors and advice and support in their control, e.g. for smoking cessation, is important at all stages of therapy.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group recommends supra-gingival debridement and root surface instrumentation (PMPR) for probing depths of ≥4 mm where sub-gingival deposits are present or which bleed on probing. Where probing depths are less than 4 mm, the guidance development group agrees that sub-gingival instrumentation (PMPR) is only appropriate where sub-gingival deposits are present

Considered judgement:

The Group noted that although the evidence reviewed here could be considered as moderate certainty due to the observational nature of the included studies, they also agreed with the BSP interpretation of the evidence. The BSP guideline group noted the volume and consistency of the evidence was sufficient to make a strong recommendation in favour of sub-gingival instrumentation. The Group agreed a recommendation in line with BSP wording which is not prescriptive in terms of probing depths.

The Group discussed the ethical need to provide treatment but this must be balanced in the situation where patients do not engage, potentially compromising the value of that treatment. In recognising this type of situation the narrative should include a reference to behaviour change and its role in effecting change. The Group also acknowledged that the clinician, as well as the patient, has an important role to play in the process of delivering behavioural change.

Recommendation in updated guidance:

- For patients with a diagnosis of periodontitis, carry out subgingival professional mechanical plaque removal (PMPR) in order to reduce probing pocket depth, gingival inflammation, bleeding on probing (from the base of the pocket) and the number of diseased sites.

Relevant text from main narrative:

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline advocates a stepwise approach to periodontal therapy. It recommends supragingival professional mechanical plaque removal (PMPR) and control of retentive factors, as part of the first step of therapy for patients with a diagnosis of periodontitis. Interventions to address inadequate oral hygiene and other modifiable risk factors, such as smoking and diabetes, are also recommended.

The second step of therapy aims to address subgingival plaque biofilm, endotoxin and calculus. A recent review of the evidence confirmed the efficacy of subgingival instrumentation (subgingival PMPR) in the non-surgical treatment of periodontitis. The evidence is considered to be high certainty due to consistency of the findings across a substantial number of prospective studies. Accordingly, the BSP-S3 guideline recommends that subgingival periodontal instrumentation (subgingival PMPR) be employed to treat periodontitis to reduce gingival inflammation, the number of diseased sites and probing pocket depths.

Step 2 of therapy

- Continue to encourage and support effective self-performed oral hygiene during this step of therapy.
- Where applicable, reinforce the importance of modifying personal risk factors such as smoking and diabetes.
- Assess the level of deposits, extent of disease along with patient preference and operator preference and skill to determine the number and length of appointments required for thorough subgingival PMPR.
- Carry out subgingival PMPR at sites of ≥4 mm probing depth where subgingival deposits are present or which bleed on probing. Local anaesthesia may be required for this.
    - Site specific instruments may be required to adequately instrument difficult to reach sites (e.g. furcations).
    - Advise the patient that they may experience some discomfort and sensitivity immediately following treatment.
    - Advise the patient that as periodontal pocketing and gingival swelling reduce when the disease stabilises, they may notice a degree of interdental (black triangles) or smooth surface recession.
- Assess the response to Step 2 of therapy to decide whether further periodontal treatment is indicated.
- Where residual disease is present after Steps 1 and 2 of therapy, discuss with the patient options for further treatment.
    - Step 3 of therapy could involve further non-surgical or surgical treatment or onward referral for specialist care.
- Once the active phase of treatment is complete, arrange and encourage regular maintenance care (Step 4 of therapy) to prevent and detect any areas of recurrent disease and to maintain stability.

Strength of recommendation (strong or conditional):

- Strong (100% agreement)

References

Elley K, Gold L, Burls A, Gray M. Scale and polish for chronic periodontal disease. A West Midlands Development and Evaluation Service Report; 2000. 074421739.

Hung HC, Douglass CW. Meta-analysis of the effect of scaling and root planing, surgical treatment and antibiotic therapies on periodontal probing depth and attachment loss. Journal of Clinical Periodontology. 2002;29(11):975-986.

Simpson TC, Clarkson JE, Worthington HV, MacDonald L, Weldon JC, Needleman I, Iheozor-Ejiofor Z, Wild SH, Qureshi A, Walker A, Patel VA, Boyers D, Twigg J Treatment of periodontitis for glycaemic control in people with diabetes mellitus. Cochrane Database of Systematic Reviews 2022, Issue 4. Art. No.: CD004714.

Suvan JE. Effectiveness of mechanical nonsurgical pocket therapy. Periodontology 2000. 2005;37:48-71.

Van der Weijden GA, Timmerman MF. A systematic review on the clinical efficacy of subgingival debridement in the treatment of chronic periodontitis. Journal of Clinical Periodontology. 2002;29 (Suppl 3):55-71.

Key Question 14

In patients with a diagnosis of periodontitis, is power driven professional mechanical plaque removal (PMPR), compared to hand PMPR, more effective in stabilizing their disease?

Recommendation in 2014 edition of guidance:

- Ensure that all instruments are used appropriately and that site-specific instruments are used where required.

Basis for recommendation:

Three systematic reviews (Slot 2008, Tunkel 2002, Hallmon 2003) suggested that power driven root surface instrumentation (RSI) and hand RSI are equally effective in terms of improved clinical outcomes. One review (Tunkel 2002) suggested that root damage and root roughness were more likely with machine driven sub-gingival debridement than with manual debridement, but soft tissue laceration was more likely using manual methods. There was also evidence that power driven RSI is more efficient, taking 37% less time than hand RSI. The evidence was considered low quality due to concerns about the design of the primary studies, inadequate reporting of data and the possible risk of bias.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline suggests that sub-gingival periodontal instrumentation can be performed either using hand or powered (sonic/ultrasonic) instruments, either alone or in combination (recommendation grade: A [strong]). The systematic review which underpins this recommendation, which included six RCTs, (Suvan 2020) found that subgingival instrumentation performed with power driven instruments and subgingival instrumentation using hand instruments are equally effective in terms of clinical outcomes (probing depth reduction, clinical attachment level gain) at 6/8 months follow-up. No significant differences were observed between treatment groups at any time point or for different categories of initial pocket depth in any of the included studies. The certainty of the evidence is considered high due to consistency of the findings across the four included studies, all of which were judged to be at low risk of bias. Some heterogeneity was observed but the review authors suggest that this is due to variety of different instruments used in the different studies. The findings are consistent with previously published reviews on the same topic. The guideline notes that patient-reported outcomes and adverse events were inconsistently reported by the included studies but no obvious differences between hand and powered instruments in terms of post-operative sensitivity were noted.

Does the evidence differ from previously?

Previously, there was low certainty evidence that both treatment modalities provide similar outcomes. There is now a more substantial body of research which provides high certainty evidence that subgingival instrumentation using either power driven or hand instruments are equally effective in improving periodontal health.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

As stated above, the systematic review which underpins the BSP-S3 recommendation (Suvan 2020) noted that patient-reported outcomes and adverse events were inconsistently reported. Previous reviews have suggested that both types of instrument can cause adverse effects, such as root or soft tissue damage, if used incorrectly. The BSP-S3 guideline notes that the use of all types of instruments is technique-sensitive and that specific training is required. Ensuring adequate skill levels will reduce the likelihood of such adverse events, as will using the appropriate instrument for each clinical site.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

Some patients may not be able to tolerate the noise and vibrations which accompany power-driven instruments. Additionally, the use of water coolant for powered instruments can be an issue in patients with swallowing difficulties. Sensitivity during treatment can also influence patient tolerance. Local anaesthesia may be required. The BSP-S3 guideline notes that patient preferences with respect to instrument choice should be respected.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline notes that patient preference may conflict with the clinician's recommendation in terms of type of instrument. The guideline recommends that the patient's views should be respected, while incorporating the operator's ability to provide good quality, effective treatment outcomes based on their experience and skill.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

Stakeholders are likely to find a recommendation to use either type of instrument, as appropriate, acceptable.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

The BSP-S3 guideline states that cost-effectiveness was not evaluated by the studies included in the review which underpins the recommendation. It also notes that there is no evidence that the use of one type of instrument is superior in terms of requisite treatment time. However, previous evidence suggested that power driven subgingival instrumentation is more efficient, taking 37% less time than subgingival instrumentation using hand instruments (Tunkel 2002). Additionally, a recent study which investigated the use of ultrasonic versus hand instruments for full mouth debridement (Johnston 2020) found that ultrasonic instrumentation resulted in shorter treatment time, with full mouth treatment completed in an average of 75.39 (SD 17.83) minutes using ultrasonic instruments compared with 96.90 (SD 23.54) minutes using hand instruments.

Regular upkeep is required to maintain the effectiveness of hand instruments. A considerable level of skill, time and care is needed to avoid damage to the instrument, ensure effective sharpening and avoidance of sharps injuries for the operator. Ultrasonic instruments also require regular monitoring to ensure that they remain appropriate for use, according to manufacturers' instructions.

7. Other factors

Indicate any other factors taken into account.

The BSP-S3 guideline notes that the choice of instrument should be based upon the experience/skills and preference of the operator together with patient preference. The guideline also states that clinicians should ensure that they have the appropriate training and skill to use each type of instrument.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group recommends that instrumentation should always be performed to a high standard and that a combination of methods can be used; the choice of method should be based on clinician/patient preferences and access to the site/s to be treated.

Considered judgement:

The group agree that, based on the evidence, the outcomes of treatment are not dependent on the type of instrument used. Therefore, hand or powered (sonic/ultrasonic) instruments, either alone or in combination may be used. The group note that sub-gingival instrumentation should be carried out to a high standard and that the choice of instrument should be based on patient and clinician preferences, the clinical situation and the goal of treatment.

Recommendation from updated guidance:

- For patients with a diagnosis of periodontitis, use either powered instruments, manual instruments, or a combination of both, to carry out sub-gingival professional mechanical plaque removal (PMPR) to a high standard; base the choice of instrument on clinician and patient preferences, the clinical situation and the goal of treatment.

Relevant text from main narrative:

Instrument choice

A review of current evidence confirmed that there is no difference in the quality of subgingival debridement achieved by using hand instruments or powered scalers if both methods are performed effectively. The evidence is considered to be high certainty due to the due to consistency of findings across four RCTs, all of which were judged to be at low risk of bias. Accordingly, the BSP-S3 guideline recommends that sub-gingival periodontal instrumentation is performed with hand or powered (sonic/ultrasonic) instruments, either alone or in combination. Successful utilisation of these instruments requires a thorough understanding of tooth and root anatomy, knowledge of how each particular instrument works and an awareness of which instrument works best in a particular area.

Air polishing devices can be used during periodontal instrumentation. There is some evidence that these devices are as effective at removing soft plaque biofilm deposits as hand or powered (sonic/ultrasonic) instruments. Studies investigating the effectiveness of air polishing devices have largely focussed on the use of these instruments in supportive care rather than during active therapy. In most situations, they have been shown to be effective at removing biofilm, particularly supragingivally, and are acceptable to patients. However, as these devices do not remove calculus, hand or powered instruments are also required for thorough debridement if calculus is present. Therefore, the use of air polishers is more applicable during Step 4 of therapy (Maintenance) and where calculus removal is not required. Use of air polishers around implant-supported restorations in healthy patients has been shown to be safe but care should be taken if inflammation is present.

Irrespective of the method(s) of instrumentation employed, thorough mechanical removal of plaque biofilm and calculus from crown and root surfaces is key to effective treatment and resolution of inflammation.

The actual time required to adequately instrument each tooth will depend on the level of deposits, the tooth type, the depth of the pocket, whether there is furcation involvement, the presence of challenging anatomy and the location in the mouth. It takes several minutes of instrumentation to effectively debride the root surface. Although effective instrumentation by either method takes time, powered PMPR can be more efficient, taking 37% less time than debridement using hand instruments.

- Remove supra- and subgingival plaque, endotoxin, calculus and debris using hand or powered (sonic/ultrasonic) instruments, either alone or in combination.
    - The choice of instrument(s) should take account of patient preferences and operator ability and experience.
- Ensure that all instruments are used appropriately and that site-specific instruments are used where required.
    - Allow sufficient time to adequately instrument the root surface. For example, furcations around deep defects will require more time than a single rooted tooth.
    - Do not apply the pointed end of sonic and ultrasonic tips to the root surface; use only the sides of the working tip for debridement.

- Use overlapping strokes to instrument all of the affected root surface.

Strength of recommendation (strong or conditional):

- Strong (100% agreement)

References

Hallmon WW, Rees TD. Local anti-infective therapy: mechanical and physical approaches. A systematic review. Annals of Periodontology. 2003;8(1):99-114.

Johnston W, Paterson M, Piela K, Davison E, Simpson A, Goulding M, Ramage G, Sherriff A, Culshaw S. The systemic inflammatory response following hand instrumentation versus ultrasonic instrumentation – A randomized controlled trial. Journal of Clinical Periodontology, 2020;47:1087–1097.

Suvan J, Leira Y, Moreno Sancho FM, Graziani F, Derks J, Tomasi C. Subgingival instrumentation for treatment of periodontitis. A systematic review. J Clin Periodontol. 2020 Jul;47 Suppl 22:155-175.

Slot et al The effect of the Vector scaler system on human teeth: a systematic review. International Journal of Dental Hygiene 2008; 6: 154-165.

Tunkel J, Heinecke A, Flemmig TF. A systematic review of efficacy of machine-driven and manual subgingival debridement in the treatment of chronic periodontitis. Journal of Clinical Periodontology. 2002;29(s3):72-81.

Key Question 15

In patients with a diagnosis of periodontitis, is full mouth professional mechanical plaque removal (PMPR) more effective than quadrant PMPR in stabilising their disease?

Recommendation in 2014 edition of guidance:

- Assess the level of deposits, extent of disease and patient preference to determine the number and length of appointments required for thorough debridement.

Basis for recommendation:

Three systematic reviews (Eberhard 2008, Farman 2008, Lang 2008) indicated that both full mouth and quadrant debridement are effective in the treatment of periodontitis, providing that the debridement is thorough. There was no evidence of a difference between the two treatment modalities in terms of clinical outcomes. However, in some studies, more adverse effects (pain, fever) were observed where full mouth debridement was conducted. The evidence was considered low quality due to the diversity of the primary study designs, which made comparison of data across studies difficult, the variability of the findings and the possibility of bias.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline suggests that sub-gingival periodontal instrumentation can be performed either using a traditional quadrant-wise approach or a full mouth delivery approach using a 1 or 2 stage technique within a 24-hour period (recommendation grade: B). The systematic review of 13 RCTs which underpins this recommendation (Suvan 2020) found that both full mouth and quadrant debridement are effective in the treatment of periodontitis, provided that the debridement is thorough. No significant differences were observed between treatment groups for the outcomes of probing depth reduction, clinical attachment level gain or pocket closure at any time point or for different categories of initial pocket depth. The findings are in agreement with those of a 2015 Cochrane Review (Eberhard 2015). The certainty of the evidence is considered moderate due to the consistency of the findings across the eight included studies, all of which were judged to be at low or unclear risk of bias. The review found no evidence of a difference between the two treatment modalities in terms of clinical outcomes. It noted that full mouth approaches have been linked with increases in post-treatment acute systemic inflammatory markers (Graziani 2015). Additionally, some clinicians have reported that they find the full mouth approach is more physically demanding to deliver (Loggner Graff 2009). Therefore, the BSP-S3 guideline states that decisions on the mode of treatment delivery should be based on an assessment of the patient's general health, patient's individual preferences and the preferences, skills and experience of the clinician.

Does the evidence differ from previously?

Previously, there was low certainty evidence that both treatment modalities provide similar outcomes. There is now a more substantial body of research which provides moderate certainty evidence that full mouth or quadrant RSI are equally effective in improving periodontal health. This is supported by the findings of two systematic reviews (Eberhard 2015, Suvan 2020).

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

The review which underpins the BSP-S3 recommendation (Suvan 2020) notes that full mouth delivery has been implicated in the increases in levels of inflammatory biomarkers observed shortly after treatment. The review cites a study by Graziani (2015) which found a 3-fold increase in levels of C-reactive protein (CRP) at 24 hours following full mouth delivery compared to baseline. No significant differences in CRP levels were observed 24 hours after quadrant delivery and no differences between groups were observed at later follow-up periods. However, a more recent study (Johnston 2020) found that although levels of CRP do increase in the 24 hour period after full mouth treatment, the average magnitude of the increase from baseline was 1.67-fold, with no

difference from baseline observed at later follow-up periods. The authors speculate that the more limited increase in CRP levels observed in their study may be due to differences in the pre-treatment protocols of the two studies. Participants in the Johnson (2020) study received supra-gingival instrumentation at a prior appointment, which is consistent with current practice, whereas participants in the Graziani (2015) study appear to have received both supra- and sub-gingival treatment at the same appointment. The removal of supragingival plaque deposits prior to sub-gingival instrumentation is likely to have resulted in reduced levels of inflammation and reduced bacterial load at the initiation of full mouth treatment in the Johnston (2020) study. It should be noted that the clinical significance of the observed transient increases in inflammatory biomarkers is unclear.

The difference in study protocols also impacted on the time taken to provide treatment; the average length of time spent delivering the full mouth treatment in the Graziani (2015) study was significantly longer (123±18 minutes) than in the Johnston study (86.8±23.5 minutes).

In line with the findings of the Suvan (2020) systematic review, the Graziani (2015) study found that both full mouth and quadrant treatment modalities resulted in significant clinical benefits in terms of all standard periodontal parameters. The Johnston (2020) study, which focussed on the use of ultrasonic versus hand instruments for full mouth debridement, also noted that all patients' clinical parameters showed marked improvement following therapy. Additionally, this study found that ultrasonic instrumentation resulted in shorter treatment time, with full mouth treatment completed in an average of 75.39 (SD 17.83) minutes using ultrasonic instruments compared with 96.90 (SD 23.54) minutes using hand instruments.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

The BSP-S3 guideline notes that clinicians should consider the general health status of the patient when planning treatment delivery. The full mouth treatment approach can be physically demanding for both the clinician delivering the treatment and the patient receiving it. For patients who may be less able to tolerate lengthy treatment, such as those with additional support needs, it may be prudent to provide treatment over several appointments. However, some patients may prefer to have the treatment completed within a 24-hour period. The BSP-S3 guideline notes that patient preference may conflict with the clinician's recommendation in terms of mode of treatment delivery and recommends that patient autonomy should be respected.

4. Values and preferences

Summarise any evidence or information on values and preferences.

Some patients may wish to have their treatment provided at two appointments in 24 hours (full mouth) as this will reduce the number of visits to the practice. Other patients may find it more convenient to be treated at multiple appointments over several weeks.

Some clinicians may find providing full mouth PMPR more physically and psychologically demanding (Loggner Graff 2009) and may wish to provide quadrant treatment as an alternative.

Good communication between clinician and patient is recommended to ensure that both are content with the mode of treatment selected.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

Stakeholders are likely to find a recommendation to jointly decide on treatment modality acceptable.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Either mode of PMPR delivery is likely to feasible if the individual circumstances of clinicians and patients are considered when deciding on a treatment modality. The BSP-S3 guideline notes that there is limited evidence on the cost-effectiveness of different modes of delivery.

Full mouth treatment may be more efficient overall when associated activities such as recording/checking medical history, surgery cleaning etc. are taken into account, as these activities will need to be repeated during quadrant delivery.

7. Other factors

Indicate any other factors taken into account.

In addition to patient preference, the level of calculus deposits, as well as the skill and experience of the operator, should also be taken into account when considering a treatment modality. It may be prudent to treat patients with substantial calculus deposits over more than one appointment.

While the full mouth treatment modality reduces the number of visits to the practice, it may also result in reduced opportunities to reinforce preventive messages and oral health instruction.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group recommends that the choice of treatment modality should be made on an individual basis, taking into account patient and clinician preferences

Considered judgement:

The Group agrees that, based on evidence which suggests that clinical outcomes from full mouth or quadrant treatment are similar, both treatment strategies are suitable for the management of patients with a diagnosis of periodontitis. The Group notes that it is important for a balance to be struck between the advantages and disadvantages of each strategy and the choice of treatment modality should be made based on consideration of patient factors, patient preferences and the expertise and preferences of the clinician.

Recommendation in updated guidance:

- For patients with a diagnosis of periodontitis, perform professional mechanical plaque removal (PMPR) using either a full mouth or quadrant approach, taking into account patient factors and preferences and clinician skills, experience and preferences.

Relevant text from main narrative:

A review of current evidence confirms that, in terms of clinical outcomes, there is no difference between providing PMPR over one or two long appointments within a 24 hour period (full mouth approach) or, alternatively, spreading PMPR over several shorter appointments (quadrant approach). The evidence is considered to be of moderate certainty due to the consistency of findings across the included studies, which were judged to be at low or unclear risk of bias. Some clinicians have reported that providing treatment at fewer, longer appointments is more physically demanding. Operator and patient fatigue, as well as the patient's preferences, need to be considered when planning appointments.

Accordingly, the BSP-S3 guideline suggests that sub-gingival periodontal instrumentation can be performed either using a traditional quadrant approach or a full mouth approach using a 1 or 2 stage technique within a 24-hour period.

- Assess the level of deposits, extent of disease along with patient preference and operator preference and skill to determine the number and length of appointments required for thorough subgingival PMPR.

Strength of recommendation (strong or conditional):

- Strong (100% agreement)

References

Eberhard J, Jervoe-Storm PM, Needleman I, Worthington H, Jepsen S. Full-mouth treatment concepts for chronic periodontitis: a systematic review. Journal of Clinical Periodontology. 2008;35(7):591-604.

Eberhard J, Jepsen S, Jervøe-Storm PM, Needleman I, Worthington HV. Full-mouth treatment modalities (within 24 hours) for chronic periodontitis in adults. Cochrane Database of Systematic Reviews 2015, Issue 4.

Farman M, Joshi RI. Full-mouth treatment versus quadrant root surface debridement in the treatment of chronic periodontitis: a systematic review. British Dental Journal. 2008;205(9):E18.

Graziani F, Cei S, Orlandi M, Gennai S, Gabriele M, Filice, N, Nisi M, D'Aiuto, F. (2015). Acute phase response following full mouth versus quadrant non-surgical periodontal treatment. A randomized clinical trial. Journal of Clinical Periodontology, 42(9), 843–852.

Johnston W, Paterson M, Piela K, Davison E, Simpson A, Goulding M, Ramage G, Sherriff A, Culshaw S. The systemic inflammatory response following hand instrumentation versus ultrasonic instrumentation – A randomized controlled trial. Journal of Clinical Periodontology, 2020;47:1087–1097.

Lang NP, Tan WC, Krahenmann MA, Zwahlen M. A systematic review of the effects of full-mouth debridement with and without antiseptics in patients with chronic periodontitis. Journal of Clinical Periodontology. 2008;35(8 Suppl):8-21.

Loggner Graff I, Asklöw B, Thorstensson H. (2009). Full-mouth versus quadrant-wise scaling–clinical outcome, efficiency and treatment discomfort. Swedish Dental Journal, 33(3), 105–113.

Suvan J, Leira Y, Moreno Sancho FM, Graziani F, Derks J, Tomasi C. Subgingival instrumentation for treatment of periodontitis. A systematic review. J Clin Periodontol. 2020 Jul;47 Suppl 22:155-175.

Key Question 16

In patients with a diagnosis of periodontitis who have furcation involvement of multi-rooted teeth, is nonsurgical periodontal treatment, compared to surgical periodontal treatment, effective in promoting long-term tooth retention?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

N.B. Randomised controlled trials relating to the management of furcation involved teeth in primary care are lacking. Generally, studies involve interventions delivered in secondary care, usually involving surgical treatment or are observational and retrospective describing long term management outcomes.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) recommends that molars with residual pockets and associated class II and III furcation involvement receive periodontal therapy (recommendation grade: A [strong]). It also includes a statement that furcation involvement is not an indication for extraction. It should be noted that 'periodontal therapy' encompasses surgical, non-surgical and regenerative treatment strategies.

Tooth retention and survival rates

Reviews by Huynh-Ba (2009) and Nibali (2016) are cited as supporting evidence by the BSP-S3 guideline with regard to tooth retention and survival. Both of these reviews rely on mostly retrospective data and therefore their findings should be interpreted cautiously.

Huynh-Ba (2009) investigated the prognosis of teeth with furcation involvement managed with different treatment strategies. Only two small scale studies report on teeth treated with non-surgical therapy (scaling and root planing). One found that 100% of Degree I furcation-involved (FI) molars survived at 5 years (n=32 teeth). The other reported a survival rate of 90.7% over a 5-12 year period (n=54 teeth); for teeth with Degree I, Degree II and Degree III furcation involvement at baseline, the survival rates were 97% (31/32 teeth), 94% (17/18 teeth) and 25% (1/4 teeth) respectively. The authors state that non-surgical conservative furcation therapy is effective in preventing Degree I furcation involved teeth from further interradicular disease progression. However, they note that this treatment regime is not suitable for more advanced furcation lesions (Degree II and III) as these cannot be adequately maintained by the patient's home care and are likely to progress without more advanced treatment.

Nibali (2016) investigated tooth loss in molars without and with furcation involvement and found that, over 10-15 years of supportive periodontal therapy, the average tooth loss/year was 0.01 and 0.02, respectively. This suggests that, while the incidence of tooth loss is low in both groups, furcation involvement approximately doubles the risk of tooth loss for molars in supportive periodontal therapy. There is also some evidence that this additional risk increases further with longer follow up periods. Additionally, the degree of furcation involvement is significantly associated with risk of tooth loss, increasing from furcation degree I to II to III. However, the authors note that most molars affected by FI respond well to periodontal treatment and even in the presence of degree III furcations, only 30% of molars were lost in a follow-up period of 5–15 years.

Treatment options

The two reviews which underpin the BSP-S3 guideline recommendation investigated non-surgical and surgical management options for Class I, II and III defects. One considered non-surgical management and resective surgery (Dommisch 2020; 7 observational studies, 665 patients) and the other focussed on the regenerative surgical treatment (Jepsen 2020; 20 RCTs, 575 patients) of furcation defects.

The review by Dommisch (2020) is most relevant to the key question above as the control group included patients managed with non-surgical treatment. It found that rates of survival between teeth with class II or III furcation involvement treated surgically and those treated non-surgically do not differ substantially. Over follow up periods which ranged from 4 to 30.8 years, survival ranged from 38-94.4% (root amputation or resection, root separation), 62-67% (tunnel preparation), 63-85% (open flap debridement) and 68-80% (non-surgical treatment). In the case of class II furcations, non-surgical treatment seems to be as effective as resective surgical treatment. Teeth with the most advanced level of disease (Class III) have the worst outcomes and surgical treatment does appear to be slightly better in these cases. Confounders such as smoking status and frequency of supportive periodontal therapy are not addressed by the studies, but the review authors state that regular supportive periodontal therapy is the key factor for long-term tooth retention. They conclude that the evidence does not currently suggest that resective treatment has an additional benefit over that achieved with non-surgical treatment or open flap debridement. They also note that molars with class I furcation involvement show a similar prognosis as molars without furcation involvement.

The review by Jepsen (2020) found that regenerative treatment is more effective in Class II furcation lesions than resective techniques. The review did not include non-surgical treatment as a control. However, the authors do note that several studies have shown there is no significant difference in the long-term prognosis (risk for tooth loss) of molars with class I furcation involvement and molars without furcation involvement in supportive periodontal therapy.

The BSP-S3 guideline then makes further recommendations on the management of specific types of furcation involvement, some of which involve surgical treatment which is unlikely to be relevant to primary care dentistry. Periodontal regenerative surgery is recommended for management of residual deep pockets associated with mandibular class II furcation involvement (Grade A[strong]; high quality evidence) and suggested for maxillary molars with residual pockets and associated buccal class II furcation involvement (Grade B; moderate quality evidence), based on the systematic review by Jepsen (2020). Advice on regenerative biomaterials is also provided. These recommendations are most likely to be relevant to specialists. However, for maxillary interdental class II furcation involvement, and both maxillary and mandibular class III furcation involvement, open recommendations based on low quality evidence from the Dommisch (2020) review advise that non-surgical instrumentation, open flap debridement (OFD), periodontal regeneration, root separation or root resection may be used to treat these teeth, with the choice of treatment based on criteria such as the degree of bone loss, surgical accessibility and ensuring that the patient will be able to perform good oral hygiene.

There is a general consensus that retention of teeth with furcation lesions should be considered, even where the degree of furcation involvement is severe, as there is some evidence that a proportion of these teeth can be retained and successfully managed by non-surgical treatment in the long term.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance.

What is the certainty of the evidence?

The certainty of the evidence supporting regenerative treatment is considered high (20 RCTs; 575 patients). The certainty of the evidence supporting resective and non-surgical treatment is considered low (mostly based on observational studies).

It should be noted that most of the data considered in the systematic reviews cited above is from clinical trials, dental hospitals and private practice, with a lack of evidence from primary care. Accordingly, the data on longevity and survival rates may not be directly applicable to a primary care setting.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

The BSP-S3 guideline notes that in the case of surgical and non-surgical therapies '*We did not identify data about harm directly related to the procedures*'.

In the case of regenerative therapies, which are unlikely to be relevant to primary care dental services, the BSP-S3 guideline notes that '*The benefit of regenerative therapies to promote tooth retention outweighs the adverse events which consist mainly of local wound failure*.'

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

Should patients with different degrees of furcation involvement be considered separately?

Tooth retention and survival rates

- Teeth with more advanced furcation involvement have a higher risk is being lost, with 8%, 18% and 30% of teeth with furcation degree I, II and III respectively, lost in follow-up periods of up to 18 years, equating to 0.01, 0.02 and 0.03 teeth/patient/year (Nibali 2016).
- Dommisch (2020) found low certainty evidence on the outcomes of non-surgical treatment of molars with Class II and III furcation involvement:
  Treatment with SRP (based on data from 3 studies, at 9-30 years follow-up)
  - FI Class II: 72-82% survival rate
  - FI Class III: 56-73% survival rate

  Treatment with repeated SRP (based on data from 1 study, 10-27 years follow-up)
  - FI Class II: 85% survival rate
  - FI Class III: 45% survival rate

Treatment options

- There appears to be a consensus in the literature that teeth with Class I furcation involvement can be treated successfully with non-surgical periodontal therapy and that the rate of tooth loss for these teeth is similar to that of molar teeth without furcation involvement.
- Jepsen (2020) found that Class II furcation lesions are most effectively managed with regenerative techniques. However, survival rates for these teeth when managed by non-surgical treatment range from around 70-80% over a 9-30 year period, which suggests this management strategy is applicable to teeth with Class II furcation lesions.
- While Huynh-Ba (2009) states that non-surgical treatment is not suitable for Class II and III furcation lesions, more recent reviews appear to disagree with this assessment.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline states that there is a strong patient preference for tooth retention. However, patient values and preferences are likely to vary substantially, and some patients may not wish to retain teeth that are symptomatic or of poor prognosis. Therefore, discussion with the patient about their values and preferences is important. Additionally, successful management will rely of the skill of the clinician in accessing a furcation to provide initial treatment and supportive care, the time available to the clinician and the patient's ability to achieve adequate plaque control around the furcation. Patient factors such as attendance, smoking status, systemic disease and overall oral health status are likely to influence tooth survival.

Additional considerations include the costs of maintaining a tooth in the arch compared to cost of replacement and its maintenance and the other options available to that patient if a tooth is lost e.g. availability of surgical options, implant therapy, conventional restorations or extraction.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

Non-surgical treatment in primary care is likely to be more convenient for the patient if it is performed at their usual dental practice rather than at a specialist practice or via secondary care. The patient may also prefer to be treated by their regular dental care professional.

Patients may opt for tooth extraction if non-surgical care is complex or if the outcome is uncertain due to other patient and tooth-related factors. Additionally, the costs of maintaining a tooth with furcation involvement can be considerable compared with the costs of extraction without a replacement.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Non-surgical treatment provided in an NHS primary care setting will be less expensive than that provided by a specialist, and may also incur less travel costs. While treatment in a secondary care setting may not have additional treatment costs to the patient if provided in an NHS setting, it may involve more travel costs and inconvenience.

A significant number of patients have teeth with furcation involvement and there is not the capacity to manage all of these with sophisticated surgical techniques in terms of skilled manpower. In addition, this management option is not available to all patients.

Extra training is required for surgical and regenerative procedures. Additionally, these techniques are beyond the scope of practice of DCPs.

7. Other factors

Indicate any other factors taken into account.

There appears to be a strong consensus in the literature that teeth with furcation involvement can be retained and treatment should be considered.

Teeth with furcation involvement should be managed holistically, with consideration of not only the periodontal condition but also other factors which affect tooth prognosis and may influence the decision to retain or extract teeth. The costs of retaining teeth, in terms of time, finance and clinical skill required may be substantial and should be considered on an individual patient basis.

Several prognostic indices have been proposed (McGuire and Nunn, 1996; Kwok and Caton, 2007) that incorporate consideration of both periodontal and other factors, for example pulpal vitality, existing restorations, patient age, and smoking status. These can be used to aid assessment.

A tooth of poor periodontal prognosis, but which is considered strategically important, for example to maintain occlusal function, to prevent a free end saddle situation or where it forms part of a complex restoration, may be retained and managed non-surgically, with the patient's consent, as part of a larger, overall treatment plan.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group agree that some teeth with furcation involvement can be considered for management with non-surgical therapy in primary care and that furcation involvement alone is not an indication for immediate extraction. The Group highlighted that it is important to discuss management options with the patient and to consider their values and preferences in addition to clinical factors, such as prognosis, during treatment planning.

Recommendation in updated guidance:

- For teeth with Grade I furcation involvement, provide non-surgical treatment with the aim of achieving medium/long term retention of the tooth.

- For teeth with Grade II or III furcation involvement, especially those that are holistically assessed as being of ongoing value to the patient and their dentition, provide non-surgical treatment with the aim of achieving medium/long term retention of the tooth.
    - Referral and/or surgical management might be appropriate for some patients.
    - Furcation involvement alone is not an indication for extraction.

Relevant text from main narrative:

While teeth with furcation involvement are likely to require more complex management, evidence suggests that many will respond to periodontal treatment. The response to treatment varies based on the degree of furcation involvement, with more advanced lesions more likely to lead to tooth loss.

There is consensus in the literature that teeth with class I furcation involvement can be treated successfully with non-surgical periodontal therapy and evidence suggests that the rate of tooth loss for these teeth is similar to that of molar teeth without furcation involvement. When comparing the outcomes of teeth with class II or III furcation involvement treated surgically and those treated non-surgically, there is very little difference in survival rates. A tooth survival rate of 70% has been observed in the presence of degree III furcations over a follow-up period of 5-15 years in specialist/secondary care. The certainty of the evidence is considered low due to the retrospective nature of the included studies.

The BSP-S3 guideline recommends that molars with residual pockets and associated class II and III furcation involvement receive periodontal therapy. The guideline includes a specific statement that furcation involvement is not an indication for extraction.

- Manage teeth with Grade I furcation involvement non-surgically and provide advice regarding home care and maintenance.
- For teeth with Grade II or III furcation involvement, provide non-surgical treatment and advice regarding home care and maintenance. If the tooth is holistically assessed as being of ongoing strategic value to the patient and their dentition, consider referral for specialist advice and potential surgical treatment.

Strength of recommendation (strong or conditional):

- Recommendation 1 (Grade I furcation involvement): Strong (100% agreement)
- Recommendation 2 (Grade II and III furcation involvement): Conditional (100% agreement)

References

Dommisch H, Walter C, Dannewitz B, Eickholz P, Resective surgery for the treatment of furcation involvement - a systematic review, J. Clin. Periodontol. 47 (Suppl. 22) (2020) 375–391.

Huynh-Ba G, Kuonen P, Hofer D, Schmid J, Lang NP, Salvi GE. The effect of periodontal therapy on the survival rate and incidence of complications of multirooted teeth with furcation involvement after an observation period of at least 5 years: a systematic review. J Clin Periodontol 2009; 36: 164–176.

Jepsen S, Gennai S, Hirschfeld J, Kalemaj Z, Buti J, Graziani F, Regenerative surgical treatment of furcation defects: a systematic review and Bayesian network meta-analysis of randomized clinical trials. J. Clin. Periodontol. 47 (Suppl. 22) (2020) 352–374.

Kwok V, Caton JG. Commentary: prognosis revisited: a system for assigning periodontal prognosis. J Periodontol. 2007; 78(11):2063-71.

McGuire MK, Nunn ME. Prognosis versus actual outcome. II. The effectiveness of clinical parameters in developing an accurate prognosis. J Periodontol. 1996; 67(7):658-65.

Nibali L, Zavattini A, Nagata K, Di Iorio A, Lin G-H, Needleman I, Donos N. Tooth loss in molars with and without furcation involvement – a systematic review and metaanalysis. J Clin Periodontol 2016; 43:156–166.

Treatment of periodontitis – adjunctive medication (questions 17-20)

Key Question 17

In patients with a diagnosis of periodontitis, does the use of local antimicrobial therapy (antiseptics or antibiotics), as an adjunct to professional mechanical plaque removal (PMPR), compared to PMPR alone, result in improvements in clinical parameters such as probing depth and clinical attachment level?

Recommendation in 2014 edition of guidance:

- The guidance development group does not recommend the use of local antimicrobials for the routine care and management of patients with chronic periodontitis.

Basis for recommendation:

Three systematic reviews (Hanes 2003, Pavia 2003, Pavia 2004) found low quality evidence which did not support the use of local antimicrobials as a primary periodontal therapy. Six systematic reviews (Bonito 2005, Hanes 2003, Pavia 2003, Pavia 2004, Cosyn 2006, Matesanz-Perez 2013) indicated that that local antimicrobials used as an adjunct to root surface instrumentation can result in additional statistically significant reductions in probing depth and gains in clinical attachment level. However, the clinical significance of these differences was unclear. The evidence was considered to be low quality due the number of different antimicrobials and delivery systems studied and methodological issues with the primary studies.

As the clinical significance of the improvements observed was unclear, and cognisant of concerns about antibiotic stewardship, the guidance development group agreed not to recommend the use of local antibiotics for the routine care and management of patients with chronic periodontitis. The group also noted that although locally delivered antibiotics have a smaller risk of side effects compared with those delivered systemically, some adverse events were reported.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Locally-administered antiseptics

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline recommends that locally administered sustained-release chlorhexidine may be considered as an adjunct to sub-gingival instrumentation in patients with periodontitis (recommendation grade: 0 [open]). This recommendation is based on a recent systematic review (Herrera 2020) that found low certainty evidence that locally delivered chlorhexidine as an adjunct to sub-gingival instrumentation resulted in a statistically significant improvement in probing depths at short-term follow up (6-9 months) compared to sub-gingival instrumentation alone (9 studies; WMD = 0.23, 95 % CI [0.12; 0.34], p < 0.001). However, the observed improvements to pocket depths were small, no significant difference in clinical attachment levels was observed and there was insufficient data on bleeding and pocket closure. Significant heterogeneity, most likely due to different application protocols and study designs, and a high risk of bias was detected across the included studies and there was no data on the long-term effects of the intervention.

Locally-administered antibiotics

The BSP-S3 guideline also recommends that specific locally administered sustained-release antibiotics may be considered as an adjunct to sub-gingival instrumentation in patients with periodontitis (recommendation grade: 0 [open]). This recommendation is based a recent systematic review (Herrera 2020) that found low certainty evidence that, overall, local antibiotics as an adjunct to sub-gingival instrumentation have a statistically significant benefit in terms of improved PPD and CAL compared to that achieved by sub-gingival instrumentation alone for short-term follow up periods (PPD at 6-9 months: WMD = 0.365, 95% CI [0.262; 0.468], p<0.001; CAL at 6-9 months: WMD = 0.263, 95% CI [0.123; 0.403], p<0.001). However, long-term benefits were not evident and the clinical relevance of the small improvements observed is unclear. The majority of studies were at high risk of bias, with significant heterogeneity observed, most likely due to the variation in active ingredients, application

protocols and study designs. It should be noted that there was also significant variation in the effectiveness of different active agents, with some local antibiotics showing statistically significant short-term benefits while others either did not reach the level of statistical significance or no benefit was observed.

Does the evidence differ from previously?

While there is now a more substantial body of evidence investigating the effectiveness of local antimicrobials as an adjunct to sub-gingival instrumentation, the clinical significance of the improvements observed is still unclear and there is no information whether these are sustained long term. Also, the increase in the number of relevant research studies has not resulted in an improvement in the certainty of evidence, due in part to the variety of different agents, doses, number of applications and duration of action investigated. The authors of the review which underpins the BSP-S3 guideline also noted that commercial funding (and in some cases direct involvement with the research) may have increased the risk of bias of most studies included in the review.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

There is low certainty evidence that local antimicrobials used as an adjunct to sub-gingival instrumentation result in statistically significant gains in PPD in the short term for both local antibiotics and antiseptics (6-9 months) but no improvements in CAL were observed for the latter. However, the clinical significance of the small gains observed is unclear and there is no evidence that these are sustained long term. The BSP-S3 guideline notes that no increase in adverse effects or differences in patient-reported outcome measures were observed.

Outcomes linked to many aspects of antimicrobial stewardship, for example, antimicrobial susceptibility data of the target microbial population or development of resistance at treatment site or other body sites, were not reported. The inappropriate use of both antiseptics and antibiotics may contribute to bacterial resistance locally and systemically. Although locally delivered antibiotics have a smaller risk of side effects compared with those delivered systemically, some adverse events have been reported in previous reviews.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

Studies exclusively on patients with diabetes or those who smoke were excluded from the review which underpins the BSP-S3 guideline. The authors of the systematic review also note that there is very little information to inform the choice of clinical scenarios (e.g. during initial treatment, in residual pockets or during periodontal maintenance) and profile of patients who would eventually benefit the most from this treatment option.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline does not specifically address this criterion.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

The BSP-S3 guideline does not specifically address this criterion. However, widespread antimicrobial stewardship concerns may make this intervention unacceptable to the majority of patients, dental teams and other stakeholders, especially as sub-gingival instrumentation alone is an effective treatment strategy.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

The BSP-S3 guideline notes that high economic costs and limited availability of some products should be considered. Additionally; training in the application of some locally-placed antimicrobials will be required and some of these agents require specific storage arrangements.

7. Other factors

Indicate any other factors taken into account.

Placement of local antimicrobials is not always straightforward and could occupy a significant amount of appointment time that may be better employed to ensure that the tooth/root surfaces are thoroughly cleaned

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group does not recommend the use of local antimicrobials for the routine care and management of patients with chronic periodontitis.

Considered judgement:

The Group agree that while the use of local antimicrobial therapy as an adjunct to PMPR may lead to statistically significant improvements in periodontal parameters compared to PMPR alone, the clinical significance of the small improvements observed is unclear. The group note that significant heterogeneity was observed, likely due to the different agents and dosing regimens employed, and that the risk of bias was considered high. The impact of this intervention on antibiotic stewardship is also unclear. Consequently, the Group do not recommend the use of local antimicrobial therapy as an adjunct to PMPR for the routine care and management of patients with a diagnosis of periodontitis.

Recommendation in updated guidance:

- Local antimicrobials are not recommended for the routine care and management of patients with a diagnosis of periodontitis.*

Relevant text from main narrative:

Local antimicrobials,* including disinfectants such as chlorhexidine and locally-delivered antibiotics, have been proposed as both a stand-alone therapy for the treatment of patients with a diagnosis of periodontitis and as adjuncts to professional mechanical plaque removal. Numerous delivery systems and formulations are available.

A review of evidence suggests that locally delivered chlorhexidine as an adjunct to sub-gingival instrumentation can lead to short-term improvements in periodontal pocket depths compared to sub-gingival instrumentation alone. However, the improvements were small, no significant differences in clinical attachment levels were observed and there was insufficient data on bleeding and pocket closure. The certainty of the evidence is considered low due to significant heterogeneity, risk of bias and lack of data on the long-term effects of the intervention.

A review of evidence suggests that local antibiotics as an adjunct to sub-gingival instrumentation can lead to short-term improvements in periodontal pocket depths and clinical attachment levels compared to sub-gingival instrumentation alone. However, long-term benefits were not evident and the clinical relevance of the small improvements observed is unclear. The certainty of the evidence is considered low due to risk of bias and significant heterogeneity, most likely due to the variation in active ingredients, application protocols and study designs.

Based on these findings, the BSP-S3 guideline recommends that specific locally administered sustained-release antibiotics and locally administered sustained release chlorhexidine as an adjunct to sub-gingival instrumentation in patients with periodontitis may be considered. These open/conditional recommendations reflect the uncertainty of the evidence.

However, due to the high risk of bias and heterogeneity observed in the majority of primary studies, the unclear clinical benefits of adjunctive local antimicrobial therapy and the unclear impact on antibiotic stewardship, the

intervention is not recommended in this guidance for the routine care and management of patients with a diagnosis of periodontitis.

**Note that these do not include active ingredients with antimicrobial activity that can be found in some toothpastes (e.g. stannous fluoride).*

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

*Following consultation and peer review, it was agreed to amend the wording of the recommendation to better reflect the strength of recommendation.

References

Bonito AJ, Lux L, Lohr KN. Impact of local adjuncts to scaling and root planing in periodontal disease therapy: a systematic review. Journal of Periodontology. 2005;76(8):1227-1236.

Hanes PJ, Purvis JP. Local anti-infective therapy: pharmacological agents. A systematic review. Annals of Periodontology. 2003;8(1):79-98.

Herrera D, Matesanz P, Martín C, Oud V, Feres M, Teughels W. Adjunctive effect of locally delivered antimicrobials in periodontitis therapy: A systematic review and meta-analysis. Journal of Clinical Periodontology 2020;47:239–256.

Pavia M, Nobile CG, Angelillo IF. Meta-analysis of local tetracycline in treating chronic periodontitis. Journal of Periodontology. 2003;74(6):916-932.

Pavia M, Nobile CG, Bianco A, Angelillo IF. Meta-analysis of local metronidazole in the treatment of chronic periodontitis. Journal of Periodontology. 2004;75(6):830-838.

Cosyn J, Wyn I. A systematic review on the effects of the chlorhexidine chip when used as an adjunct to scaling and root planing in the treatment of chronic periodontitis. Journal of Periodontology. 2006;77(2):257-264.

Matesanz-Perez P, Garcia-Gargallo M, Figuero E, Bascones-Martinez A, Sanz M, Herrera D. A systematic review on the effects of local antimicrobials as adjuncts to subgingival debridement, compared with subgingival debridement alone, in the treatment of chronic periodontitis. Journal of Clinical Periodontology. 2013;40(3):227-241.

Key Question 18

In patients with a diagnosis of periodontitis, does the use of systemic antibiotic therapy as an adjunct to professional mechanical plaque removal (PMPR), compared with PMPR alone, result in improvements in clinical outcomes such as probing depth and clinical attachment level?

Recommendations in 2014 edition of guidance:

- The guidance development group does not recommend the use of systemic antibiotics for the routine care and management of patients with chronic periodontitis.
- Systemic antibiotics may be appropriate in the management of aggressive periodontitis as an adjunct to meticulous self-care and professional instrumentation. However, if a diagnosis of aggressive disease is made, the patient should be referred to a specialist.

Basis for recommendation:

Five systematic reviews (Elter 1997, Haffajee 2003, Herrera 2002, Sgolastra[a] 2012, Zandbergen 2013) indicated that the use of systemic antibiotics as an adjunct to root surface instrumentation (RSI) results in statistically significant improvements in probing depth and clinical attachment level. However, the clinical significance of these improvements was unclear. The evidence was considered to be of moderate quality due to the number of studies which showed consistent results, although there were concerns about the methodological quality and possible risk of bias in the primary studies and the diverse antibiotic regimes which were studied. The evidence did not indicate which antibiotic is most effective, the most effective dose or duration of treatment and did not adequately address the threat of antibiotic resistance and the side effects which can accompany systemic antibiotic therapy. Additionally, none of the included studies were performed in primary care.

As the clinical significance of the improvements observed was unclear and given the threat of antibiotic resistance and the potential side effects of antibiotic therapy, the guidance development group agreed not to recommend the use of systemic antibiotics for the routine care and management of patients with chronic periodontitis.

One systematic review (Sgolastra[b] 2012) indicated that systemic antibiotics, specifically a regime consisting of a combination of amoxicillin and metronidazole, may be effective in treating serious, complex, aggressive cases of periodontitis.

The guidance development group felt that systemic antibiotic therapy may be appropriate for the management of patients with serious, complex or aggressive periodontitis. However, the group recommended that these patients should be referred directly to secondary care for treatment.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline does not recommend the routine use of systemic antimicrobials as an adjunct to sub-gingival instrumentation in patients with periodontitis (recommendation grade: A [strong]). The recommendation specifically states that this is due to concerns about overuse of systemic antimicrobials on individual patient health and on the wider aspects of public health.

The systematic review which underpins this recommendation (Teughels 2020), which included 28 RCTs with at least six months follow-up, found statistically significantly improved outcomes for systemically administrated antibiotics as an adjunct to sub-gingival instrumentation. The combination of amoxicillin and metronidazole as an adjunct to mechanical debridement resulted in statistically significant reductions in probing depths at six months (WMD = 0.43 mm, 95% CI [0.36; 0.51]) and 12 months (WMD = 0.54 mm, 95% CI [0.33; 0.74]). Metronidazole used as an adjunct on its own was also effective at 12 months (WMD = 0.26, 95% CI [0.13; 0.38]). Statistically significant additional pocket closure at 6 and 12 months was also observed with both antibiotic regimes, with significant CAL gain and BOP reduction also observed for amoxicillin plus metronidazole. Adjunctive

azithromycin was also found to have benefits, but these were less than observed with the amoxicillin/ metronidazole combination or metronidazole alone.

The beneficial effects were mostly confined to this limited group of antibiotics and were often more pronounced in deep rather than moderate pockets. The certainty of the evidence was considered high due to low risk of bias, low heterogeneity and the high consistency of results from the included studies. There are no relevant data on the long term (>12 months) effects of using systemic antibiotics as an adjunct to sub-gingival instrumentation.

A recent Cochrane Review (Khattri 2020) concluded that there is very low-certainty evidence (for long-term follow-up) to support the use of adjunctive systemic antimicrobials for the non-surgical treatment of periodontitis. It also states that there is insufficient evidence to determine which antibiotic regimen is most effective when used alongside mechanical debridement.

Does the evidence differ from previously?

Previously, the evidence demonstrated a statistically significant improvement to outcomes such as probing depth and clinical attachment level. However, the clinical significance of these was unclear and there was no indication regarding which antimicrobial was the most effective and at what dose. There is now more evidence that a specific regimen of amoxicillin plus metronidazole is effective and that an increased effect size of 40-50% can be achieved compared to mechanical debridement alone. However, global concerns regarding the overuse of antibiotics and the development of antibiotic resistance are perhaps even more pronounced and the developers of the BSP-S3 guideline believe that these still outweigh the evidence supporting the routine use of systemic antimicrobials. There is also a greater body of evidence to support the use of systemic antimicrobials in patients with more serious levels of disease and the BSP-S3 guideline notes that adjunctive use may be considered for special patient categories (periodontitis Grade C[1] in younger adults where a high rate of progression is documented). There is also a statement that the '*prescription of systemic adjunctive antimicrobials for the management of periodontitis should be determined by specialist or special interest periodontal practitioners*.'

[1]"Grade C" disease progression with the observation that the disease severity and progression are inconsistent with (more than would be expected) levels of plaque control and local risk factors in otherwise systemically healthy individuals.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

The Teughels 2020 review included 21 studies which reported adverse events in individuals, including nausea, vomiting, gastro-intestinal disturbance, taste disturbance, oral ulceration, dizziness, fever, headache, periodontal abscess, general malaise and allergic reactions. No adverse events were observed in 5 studies and two studies did not report on this outcome. Adverse events were more frequently reported in groups using systemic antimicrobials (0-36%) than in placebo groups (0-20%). No allergic reactions were reported in the placebo groups, whereas in the antimicrobial group, one study reported one anaphylactic shock. However, "oral ulceration," "fever" and "periodontal abscess" were more frequently reported in the placebo groups. The combination of amoxicillin and metronidazole had the highest frequency of reported side effects.

The BSP-S3 guideline states that '*global concerns regarding the overuse of antibiotics and the development of antibiotic resistance must be considered'.* It also notes that systemic antimicrobials have been shown to have long lasting impact on the body's microbiome, including respiratory, gastrointestinal and skin sites, and have led to an increase in genes associated with antimicrobial resistance. The guideline therefore states that '*due to concerns to patient's health and the impact of systemic antibiotic use to public health, its routine use as adjunct to subgingival instrumentation in patients with periodontitis is not recommended*.'

Current antimicrobial stewardship advocates that the prescribing of antibiotics must be kept to a minimum and used only when there is a clear need. The indiscriminate use of antimicrobials in primary care, including dentistry, has been identified as one of the drivers of antibiotic resistance, which is a major threat to public health. Consequently, the gains obtained from routinely using systemic antimicrobials as an adjunct to mechanical debridement do not outweigh the risk of antimicrobial resistance and possible side effects of antimicrobial therapy in most patients.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

The BSP-S3 guideline includes a specific open recommendation that the adjunctive use of specific systemic antibiotics may be considered for specific patient categories (e.g. periodontitis Grade C[1] in younger adults where a high rate of progression is documented). The guideline also notes that the decision to prescribe systemic adjunctive antimicrobials should be made by a specialist or special interest periodontal practitioner. The Group note that access to these care providers is limited or lacking in some areas of the country and that this may impact the appropriate care of this patient group.

The BSP-S3 guideline states that there may be occasions when patients with specific medical needs may require management with systemic antimicrobials but does not expand on this point.

[1] "Grade C" disease progression with the observation that the disease severity and progression are inconsistent with (more than would be expected) levels of plaque control and local risk factors in otherwise systemically healthy individuals.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline does not specifically address this criterion.

Widespread antimicrobial stewardship concerns may make the intervention less valuable to both patients and clinicians. The frequency of side effects associated with systemic antibiotic therapy may also impact on the value of the intervention to patients. However, patients with more severe disease (e.g. those presenting with severe periodontitis at a young age) may benefit from and value the intervention more.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

The BSP-S3 guideline does not specifically address this criterion. The level of side effects observed with systemic antimicrobial therapy, and the possible unintended effects on the microbiome, may not be acceptable to patients. Concerns about the overuse of antibiotics and the threat of antimicrobial resistance may impact on the acceptability of the intervention to both patients and clinicians, especially as mechanical debridement on its own is an effective treatment strategy in most cases.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Given the high proportion of the population likely to suffer from periodontitis, there is a significant cost associated with prescribing systemic antibiotics to patients on a routine basis. Specific patient categories who may benefit from systemic antibiotics (e.g. periodontitis Grade C[1] in younger adults where a high rate of progression is documented) are a much smaller group. Therefore, when used as a targeted intervention, the costs will be less significant. The BSP-S3 guideline notes that this management option should be decided by a specialist or special interest periodontal practitioner. The Group note that access to these care providers is limited or lacking in some areas of the country and that this may impact the feasibility of the recommendation and the appropriate care of this patient group.

[1]"Grade C" disease progression with the observation that the disease severity and progression are inconsistent with (more than would be expected) levels of plaque control and local risk factors in otherwise systemically healthy individuals

7. Other factors

Indicate any other factors taken into account.

The BSP-S3 guideline notes that the prescription of systemic adjunctive antimicrobials for the management of periodontitis should be determined by specialist or special interest periodontal practitioners. The Group note that access to these care providers is limited or lacking in some areas of the country.

Additionally, where antibiotics are prescribed, the diagnosis, antimicrobial(s) used, dose and duration should be recorded in the patient notes.

8. Additional information

Include any further information that is relevant to the considered judgement.

A peer reviewer noted that most of the studies included in the evidence review were performed in university settings and this may impact on the applicability of the evidence to primary care. The Group agreed that this was a valid point, and text to highlight this information was added to the narrative.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group does not recommend the use of systemic antibiotics for the routine care and management of patients with chronic periodontitis.
- Systemic antibiotics may be appropriate in the management of aggressive periodontitis as an adjunct to meticulous self-care and professional instrumentation. However, if a diagnosis of aggressive disease is made, the patient should be referred to a specialist.

Considered judgement:

The Guidance Development Group agree with the BSP-S3 guideline group's decision not to recommend the routine use of systemic antimicrobials as an adjunct to sub-gingival instrumentation in patients with periodontitis due to concerns with overuse of systemic antimicrobials on individual patient health and on the wider aspects of public health. The Group also agree that with the BSP-S3 open recommendation that the adjunctive use of specific systemic antibiotics may be considered for specific patient categories (e.g. periodontitis Grade C[1] in younger adults where a high rate of progression is documented). The Group note that the BSP-S3 guideline states that the prescription of systemic adjunctive antimicrobials for the management of periodontitis should be determined by specialist or special interest periodontal practitioners. The Group has some concerns that access to these care providers is limited or lacking in some areas of the country and that this may impact the appropriate care of this patient group.

[1] "Grade C" disease progression with the observation that the disease severity and progression are inconsistent with (more than would be expected) levels of plaque control and local risk factors in otherwise systemically healthy individuals.

Recommendation in updated guidance:

- Do not use adjunctive systemic antibiotic therapy for the routine care and management of patients with a diagnosis of periodontitis.
- Consider referral to a specialist or advanced care practitioner for those patients who may benefit from adjunctive systemic antibiotic therapy, such as those whose level of disease suggests a high susceptibility (e.g. younger patients with Grade C periodontitis who show no or little improvement after initial non-surgical treatment).

Relevant text from main narrative:

Systemic antibiotics, prescribed as an adjunct to non-surgical periodontal treatment, have been proposed to act by suppressing the bacterial species responsible for biofilm growth, leading to a less pathogenic oral environment. A review of evidence indicates that the adjunctive use of systemic antibiotics to treat periodontitis in primary care may result in clinically significant improvements to patient outcomes compared with those achieved by non-surgical periodontal treatment alone. The certainty of the evidence is considered high due to low risk of bias, low heterogeneity and the high consistency of results from the included studies. However, it should be noted that almost all included studies were performed in a university setting and the observed improvements in outcomes with adjunctive systemic antibiotics may not be achievable in primary care.

There is high certainty evidence that systemic antibiotics can be beneficial in the treatment of periodontitis. However, the balance of risk and benefits on both an individual and collective basis is an important consideration in terms of antibiotic stewardship. There is widespread acceptance that inappropriate use of antibiotic therapy is linked to the increasing incidence of bacterial resistance. There are also numerous side

effects associated with antibiotic therapy. Taking account of this, at both a patient and public health level, the BSP-S3 guideline does not recommend the routine use of systemic antibiotics as an adjunct to sub-gingival instrumentation in patients with periodontitis. Similarly, this guidance includes a strong recommendation against the routine use of this intervention.

The BSP-S3 guideline notes that the adjunctive use of specific systemic antibiotics may be considered for specific patient categories (e.g. periodontitis Grade C in younger adults where a high rate of progression is documented) but suggests that adoption of this management option should be determined by a specialist or special interest periodontal practitioners.

Strength of recommendation (strong or conditional):

- Recommendation 1 (routine care and management): Strong (100% agreement)
- Recommendation 2 (special patient groups): Conditional (85% agreement)

References

Elter JR, Lawrence HP, Offenbacher S, Beck JD. Meta-analysis of the effect of systemic metronidazole as an adjunct to scaling and root planing for adult periodontitis. Journal of Periodontal Research. 1997;32(6):487-496.

Haffajee AD, Socransky SS, Gunsolley JC. Systemic anti-infective periodontal therapy. A systematic review. Annals of Periodontology. 2003;8(1):115-181.

Herrera D, Sanz M, Jepsen S, Needleman I, Roldan S. A systematic review on the effect of systemic antimicrobials as an adjunct to scaling and root planing in periodontitis patients. Journal of Clinical Periodontology. 2002;29 (Suppl 3):136-159.

Khattri S, Nagraj SK, Arora A, Eachempati P, Kusum CK, Bhat KG, Johnson TM, Lodi G. Adjunctive systemic antimicrobials for the non-surgical treatment of periodontitis. Cochrane Database of Systematic Reviews. 2020(11)

Sgolastra[a] F, Gatto R, Petrucci A, Monaco A. Effectiveness of systemic amoxicillin/metronidazole as adjunctive therapy to scaling and root planing in the treatment of chronic periodontitis: a systematic review and meta-analysis. Journal of Periodontology. 2012;83(10):1257-1269.

Sgolastra[b] F, Petrucci A, Gatto R, Monaco A. Effectiveness of systemic amoxicillin/metronidazole as an adjunctive therapy to full-mouth scaling and root planing in the treatment of aggressive periodontitis: a systematic review and meta-analysis. Journal of Periodontology. 2012;83(6):731-743.

Teughels W, Feres M, Oud V, Martín C, Matesanz P, Herrera D. Adjunctive effect of systemic antimicrobials in periodontitis therapy: A systematic review and meta-analysis. Journal of Clinical Periodontology. 2020;47:257–281.

Zandbergen D, Slot DE, Cobb CM, Van der Weijden FA. The clinical effect of scaling and root planing and the concomitant administration of systemic amoxicillin and metronidazole: a systematic review. Journal of Periodontology. 2013;84(3):332-351

Key Question 19

In patients with a diagnosis of periodontitis, does the use of adjunctive host modulation therapy in conjunction with professional mechanical plaque removal (PMPR), compared to PMPR alone, result in improvements in clinical outcomes such as probing depth and clinical attachment level?

Recommendation in 2014 edition of guidance:

- The guidance development group does not recommend host modulation therapy as an adjunct to non-surgical periodontal treatment in patients with chronic periodontitis.

Basis for recommendation:

Two systematic reviews (Preshaw 2005, Sgolastra 2011) indicated that host modulation therapy may have long term benefits as an adjunctive treatment to RSI. However, the evidence was considered low quality due to methodological issues associated with some of the primary studies such as smoking status as a confounder and a possible high risk of bias. The methodological quality of one of the reviews was also a concern as no search strategy was reported. The guidance development group noted that issues such as patient compliance, the potential for bacterial resistance and cost effectiveness should be taken into account when considering this therapy. As a result, the Group agreed not to recommend host modulation therapy as an adjunct to non-surgical periodontal treatment in patients with chronic periodontitis.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline does not recommend the use of systemic sub-antimicrobial dose doxycycline (SDD) as an adjunct to sub-gingival instrumentation in patients with periodontitis (recommendation grade: B). This is based on a recent systematic review (Donos 2020) of eight RCTs, five of which were analysed in a meta analysis. Small but statistically significant gains in PPD (up to 0.3 mm at 9 months compared to placebo arm) were reported in moderate depth pockets, with a greater impact observed at deeper sites (0.62 mm at 9 months), with all studies reporting consistent results. However, the strict experimental protocols employed in most of the five studies, including extremely thorough debridement with 1 hour allocated per quadrant, is not generalisable to primary care. Additionally, the clinical significance of the results, particularly in moderate depth pockets, is unclear. The evidence is considered to be low certainty due to concerns about the methodology of some of the included studies, such as lack of power calculations, lack of *a priori* plans to stratify results by pocket depth and possible bias linked to industry funding.

Does the evidence differ from previously?

All of the studies in the 2020 review were published prior to 2010 so it is possible these were already assessed in the reviews which underpinned the previous SDCEP recommendation. The conclusions of the current review are not substantially different from that of previous reviews – statistically significant changes observed but the clinical significance and generalisability to primary care is unclear.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

Adverse events or dropouts attributed to medication were not reported in four of the five studies included in the meta analysis of SDD vs placebo. In the final study, elevated liver enzymes, a known side-effect of doxycycline, were observed in five patients.

While it is suggested that the low antibiotic doses utilised by this treatment regime are not associated with the development of antibiotic resistance, the BSP-S3 guideline notes that public health concerns surrounding increasing antibiotic resistance need to be taken into account when considering this intervention.

The BSP-S3 guideline notes that the sustainability of the benefits or adverse events beyond the study periods are unknown.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

Patient subgroups were not analysed in the systematic review. However, the results were stratified by pocket depth, with some evidence that SDD gives more clinically meaningful results in initially deep pocket depths compared to moderate pocket depths. It should be noted that both deep and moderate pockets may be present in the same patient.

4. Values and preferences

Summarise any evidence or information on values and preferences.

The BSP-S3 guideline does not specifically address this criterion.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

Taking medication over an extended period of time may not be acceptable to some patients.
While it is suggested that the low antibiotic doses utilised by this treatment regime are not associated with the development of antibiotic resistance, antimicrobial stewardship concerns may make this intervention unacceptable to the majority of patients, dental teams and other stakeholders, especially as sub-gingival instrumentation alone is an effective treatment strategy.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Host modulation therapy requires patients to take medication over long periods of time (e.g. nine months) and this may impact on compliance.
The cost effectiveness of host modulation therapy is unclear.

7. Other factors

Indicate any other factors taken into account.

The BSP-S3 guideline notes that while the included RCTs compared RSI+SDD to RSI+placebo, there was no comparison to the standard treatment that would be normally provided in primary care (i.e. a repeat of RSI or advance to surgical treatment), which limits the evidence for effectiveness in general dental practice.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group does not recommend host modulation therapy as an adjunct to non-surgical periodontal treatment in patients with chronic periodontitis.

Considered judgement:

The Group agree that while low certainty evidence suggests that host modulation therapy can result in statistically significant improvements to periodontal parameters, the clinical significance of this and its generalisability to primary care is unclear. There are also concerns about patient compliance, the potential impact on antibiotic stewardship and cost effectiveness. Consequently, the Group does not recommend the use of host modulation therapy for the routine care and management of patients with a diagnosis of periodontitis.

Recommendation from updated guidance:

- The use of host modulation therapy is not recommended for the routine care and management of patients with a diagnosis of periodontitis.*

Relevant text from main narrative:

Host modulation therapy uses local or systemic drugs as adjuncts to conventional periodontal treatment, with the aim of modifying the destructive aspects of the host inflammatory response to the microbial biofilm. One of the earliest and best known of these interventions utilises the anti-inflammatory properties of sub-antimicrobial dose doxycycline.

A review of evidence indicates that while host modulation therapy using sub-antimicrobial dose doxycycline may result in statistically significant improvements to patient outcomes compared to those achieved by PMPR alone, the clinical relevance of these improvements is less clear. The evidence is considered to be low certainty due to concerns about the methodology of some of the included studies, such as risk of bias and indirectness.

There is currently no evidence that the low antibiotic doses utilised by this treatment regime are associated with the development of antibiotic resistance. However, host modulation therapy requires patients to take systemic medication over long periods of time (e.g. up to nine months) and this may impact on compliance. The cost effectiveness of the therapy is unclear and side effects related to liver enzymes have also been reported.

Given the unclear clinical benefits of the intervention and the potential risks associated with it, the BSP-S3 guideline does not suggest the use of systemic sub-antimicrobial doxycycline as an adjunct to sub-gingival instrumentation.

The use of other of host modulating therapies (statins, bisphosphonates, probiotics, non-steroidal anti-inflammatory drugs, Omega-3 polyunsaturated fatty acids, metformin) was not specifically examined during the development of this guidance. However, the BSP-S3 guideline does not recommend the use of these other host modulation therapies as an adjunct to sub-gingival instrumentation.

Strength of recommendation (strong or conditional):

- Conditional* (100% agreement)

*Initially, the Group agreed that this would be considered a strong recommendation. However, following the consultation and peer review process, methodological concerns about inconsistency between the certainty of the evidence and the strength of the recommendation were raised. It was also noted that the equivalent recommendation in the BSP-S3 guideline would not be considered a strong recommendation. The group agreed that the strength of recommendation should be changed to conditional, with the wording of the recommendation amended to reflect this.

References

Donos N, Calciolari E, Brusselaers N, Goldoni M, Bostanci N, Belibasakis GN. The adjunctive use of host modulators in non-surgical periodontal therapy. A systematic review of randomized, placebo-controlled clinical studies. Journal of Clinical Periodontology. 47 (Suppl. 22) (2020) 199–238.

Preshaw PM, Hefti AF, Bradshaw MH. Adjunctive subantimicrobial dose doxycycline in smokers and non-smokers with chronic periodontitis. Journal of Clinical Periodontology. 2005;32(6):610-616.

Sgolastra F, Petrucci A, Gatto R, Giannoni M, Monaco A. Long-term efficacy of subantimicrobial-dose doxycycline as an adjunctive treatment to scaling and root planing: a systematic review and meta-analysis. Journal of Periodontology. 2011;82(11):1570-1581

Key Question 20

In patients with a diagnosis of periodontitis, what treatments are effective in reducing dentine sensitivity following professional mechanical plaque removal (PMPR)?

Recommendation in 2014 edition of guidance:

- Current evidence is insufficient to determine the most effective treatment for dentine sensitivity.

Basis for recommendation:

Four systematic reviews (Poulsen 2006, Cunha-Cruz 2011, Lin 2013, Sharif 2013) suggested that interventions to reduce dentine sensitivity, such as physical and chemical occlusion, may be effective. However, the evidence was considered low quality due to the poor quality of the primary studies and issues such as low patient numbers, short follow-up periods and variation in the methods to assess dentine sensitivity. A placebo effect was also observed in some studies. The guidance development group agreed that the evidence was insufficient to determine the most effective treatment for dentine sensitivity and chose not to make a specific recommendation. However, it was noted that advising patients to apply a desensitising toothpaste to the affected area is common practice and that there is no evidence that this is harmful. Desensitising mouthwashes may also be of benefit. For patients with acute sensitivity, other topical therapies such as high fluoride toothpaste, fluoride varnish or a dentine bonding agent may be useful.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* guideline and the *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* guideline does not include a recommendation for management of post-PMPR dentine sensitivity.

Reviews focussed on post-PMPR dentine sensitivity

An extensive literature search found only one systematic review that explicitly addresses the treatment of dentine sensitivity following PMPR. The review by de Oliveira et al. (2020) included 11 RCTs and found only low to very low certainty evidence that desensitising agents are effective in reducing dentine hypersensitivity after non-surgical periodontal therapy. The review suggested that agents that have an obliterating mechanism have a greater potential for relieving dental hypersensitivity. However, due to the limited certainty of the evidence, the authors drew no definitive conclusion on the effectiveness of desensitizing agents on dentine hypersensitivity after non-surgical periodontal therapy.

A broader review by Zhu et al. (2015) that investigated the desensitising effect of calcium sodium phosphosilicate (CSPS) included four articles that focused on post-periodontal therapy sensitivity and these were analysed independently. A narrative report of two small studies on self-administered toothpaste suggested that CSPS was effective in relieving post-periodontal therapy hypersensitivity in the short term. Both studies had an unclear risk of bias. A meta analysis of two additional studies found that professionally applied prophylaxis paste containing 15% CSPS was more effective than a negative control at preventing post-periodontal therapy hypersensitivity. The review authors classify the quality of the evidence from this meta-analysis as low due to imprecision (limited number of participants) and potential conflict of interest (industry funding and both studies were performed by the same group of authors) and note that more high-quality, non-industry-supported clinical research is required.

Reviews focussed on general dentine sensitivity

The literature search also identified systematic reviews which addressed the treatment of dentine sensitivity induced by other factors. This evidence may be indirect as sensitivity from exposed dentine caused by erosive or mechanical wear leading to loss of enamel, cementum or gingival recession is induced by a different mechanism than sensitivity induced by periodontal treatment and may be ongoing.

Marto (2019) evaluated the efficacy of dentin hypersensitivity treatments, compared to placebo or no treatment and Hu (2019) carried out a network meta-analysis on the effect of desensitizing toothpastes, compared to

placebo. Both reviews excluded periodontal post-treatment studies. Marto (2019) concluded that all treatment options demonstrated positive levels of efficacy, with glutaraldehyde plus HEMA, glass ionomer cements and lasers the most effective in-office treatments and potassium nitrate, arginine and hydroxyapatite the most effective to use at home. Hu (2019) concluded that nano-hydroxyapatite-containing toothpastes may be the best desensitizing toothpaste for the treatment of dentine hypersensitivity, followed by arginine-containing toothpastes. A significant placebo effect was observed. Risk of bias assessment identified that almost half of the studies in the Marto (2019) review were at high risk of bias, as were almost a third of studies in the Hu (2019) review. Additionally, 20 of the 30 studies included in the Hu (2019) review had an unclear risk of bias and moderate to high heterogeneity was observed for some comparisons. The authors also noted that the studies included in the network meta-analysis were sponsored by industry, and in some cases performed internally, which could result in additional bias.

West et al. (2015) investigated the efficacy of professionally and self-administered agents for the management of dentine hypersensitivity. Interventions from 105 RCTs were grouped into 11 treatment modalities and a narrative report of study findings was presented for each category. Most studies were at moderate or high risk of bias, with industry funding supporting the majority of trials. However, the body of evidence for some interventions was sufficient for the review authors to recommend them. The authors concluded that arginine, stannous fluoride, calcium sodium phosphosilicate and strontium, as self-administered toothpastes, are effective for pain reduction in dentine hypersensitivity. The certainty of the evidence is likely to be low to moderate due to lack of meta analysis, level of risk of bias in the primary studies, high levels of industry funding and inconsistency observed in results for some interventions.

The review by Zhu et al. (2015) included 7 studies that investigated the effect of CSPS on general dentine hypersensitivity. A meta-analysis of four studies assessing the efficacy of 5% CSPS toothpaste compared to negative control found that it was more effective at 2 and 6 weeks for evaporative stimulus but only at 6 weeks for thermal stimulus. The result at two weeks was not significant due to the influence of one study which did not report a significant difference. Additionally, results from industry-funded studies found via the grey literature did not show significant differences between the CSPS and control groups. The review authors assessed the quality of evidence from this meta analysis as moderate due to imprecision (limited number of participants). A final study which investigated the effects of 2.5% and 7.5% CSPS toothpastes found that the 7.5% formulation was more effective than control but the 2.5% formulation was no better than control. The review authors note that more high-quality, non-industry-supported clinical research is required.

Laser therapy for dentine hypersensitivity

Two recent systematic reviews specifically assessed the use of laser therapy for dentine hypersensitivity. A Cochrane Review (Mahdian 2021) examined the effects of in-office lasers with different radiation parameters compared to placebo laser, placebo agents or no treatment. Bellal (2022) undertook a meta-analysis of near-infrared (NIR) lasers in the treatment of dentinal hypersensitivity for healthy adults compared to placebo or no treatment. While both reviews conclude that there is evidence supporting the use of lasers to reduce dentine hypersensitivity, the certainty of the evidence is judged to be low to very low due to risk of bias, heterogeneity and imprecision. The clinical significance of the reductions in sensitivity observed are unclear and there was no comparison with other agents which target dentine hypersensitivity. Additionally, due to the range of different lasers and parameters tested, there is very little evidence to support one specific treatment regime.

Does the evidence differ from previously?

There is now evidence which directly addresses the clinical question, namely interventions to prevent/treat dentine sensitivity induced by PMPR. However, the certainty of the evidence supporting any one intervention is low or very low due to the limited number of relevant studies, their small size and the variation in both the agents tested and study design.

There is a greater body of evidence addressing the management of general dentine hypersensitivity. However, the evidence for any particular intervention is moderate at best, with concerns around both industry funding and involvement in many of the studies. Additionally, many studies have limited follow-up periods, although this may be less of an issue when considering sensitivity following PMPR, which because of the mechanism of aetiology

tends to be more transient than sensitivity caused by ongoing toothwear. Direct comparisons between desensitising agents are also lacking and a significant placebo effect was observed in many of the studies. It should be noted that the majority of at-home desensitising agents are delivered via toothpaste, with more limited evidence on the efficacy of desensitising agents delivered via mouthwashes.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

There is low to very low certainty evidence to support the use of desensitising agents to treat dentine sensitivity induced by PMPR and low to moderate certainty evidence supports the use of desensitising agents to treat general dentine hypersensitivity. Adverse events were rarely discussed in the reviews cited above. The review by Zhu (2015) noted that where adverse events were reported, these were minor and generally not orally related. The review by Mahadian (2021) noted that no adverse events were reported in the 15/23 trials that assessed this outcome, except one study which reported a temporary, reversible pain sensation occurring in 2 out of 71 patients following laser use.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

Patients with existing sensitivity and those at risk of recession after treatment are more at risk of post-PMPR sensitivity (von Troil 2002). Patients with tooth wear for other reasons may also be more at risk.

4. Values and preferences

Summarise any evidence or information on values and preferences.

Values and preferences were generally not addressed by the reviews cited. The review by Mahadian (2021) notes that individuals with dentine hypersensitivity "*tend to have substantially decreased oral health-related quality of life (OHRQoL) in comparison with the general population (Bekes 2009)*". However, none of the studies included in the review assessed this outcome.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

As toothpaste is an essential oral hygiene aid, patients are likely to find a recommendation to switch to a toothpaste that targets sensitivity acceptable.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Toothpastes and mouthwashes are easy to use and buy. However, some formulations may not be available in the UK. Toothpastes that target sensitivity are also more expensive than standard fluoride-containing toothpastes. Recommending mouthwashes that target sensitivity will be an additional cost if the patient does not currently use a mouthwash

Patients with persistent post-PMPR dentine sensitivity may need to be seen in the practice for management. The review by Mahadian (2021) notes that the cost effectiveness of using lasers to prevent/treat dentine hypersensitivity is unclear. However, lasers are uncommon in primary care.

7. Other factors

Indicate any other factors taken into account.

Patients should be warned of the possibility of post-PMPR sensitivity, especially those with existing sensitivity. Scaling techniques that aim to avoid root surface damage and over-instrumentation are important. Pre-PMPR oral hygiene practice should be optimised. Sensitivity is not managed in isolation and some patients with acute sensitivity may require in-practice treatment.

Patients should be advised to use a low abrasive toothpaste and toothbrush and their brushing style should be checked to ensure it is non-abrasive. Pressure-controlled electric toothbrushes may be useful if the patient has a

traumatic brushing technique. It is important that patients understand the correct way to use at-home desensitising agents as this can impact on their efficacy.

Consider whether there are other reasons for acute sensitivity (e.g. dental erosion, caries, pulpitis, dental abscess). Distinguish dentine and pulpal sensitivity from other causes of post-operative pain.

It is unlikely that primary care dental practice will have lasers designed for managing dentine sensitivity.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- Current evidence is insufficient to determine the most effective treatment for dentine sensitivity.

Considered judgement:

The Group agree that there is low to moderate certainty evidence the desensitising agents can be useful in treating post-PMPR sensitivity. The Group suggest that patients be advised to try at-home treatments, such as desensitising toothpastes; they note that patients may have to try a few different formulations to find one that works for them. Persistent sensitivity should be managed with professionally-applied desensitising agents.

Recommendation in updated guidance:

- For patients who experience post-PMPR dentine sensitivity, consider the use of a desensitising agent.
    - At-home treatments (e.g. desensitising toothpaste) should be tried initially, with professionally-applied desensitising agents used for persistent sensitivity.

Relevant text from main narrative:

Around 50% of patients may experience increased dentine sensitivity following professional mechanical plaque removal (PMPR), especially those with sensitive teeth prior to treatment. There are a large number of over-the-counter products available to patients that claim to reduce dentine sensitivity, such as toothpastes containing arginine, stannous fluoride, calcium sodium phosphosilicate, strontium, potassium salts and hydroxyapatite, and there is some low to moderate quality evidence that these are effective in the treatment of general dentine sensitivity. However, the applicability of this evidence to patients with increased dentine sensitivity following PMPR is unclear.

Additionally, there are various treatments that can be provided by the dental team, such as dentine bonding agents, fluoride varnish, glass ionomer cements and the use of lasers. Again, the efficacy of these agents in treating dentine sensitivity induced by PMPR is unclear, although there is some evidence of a benefit for patients with general dentine sensitivity. The evidence is considered to be of low to moderate certainty due to the limited number of relevant studies, small study size, risk of bias and the variation in both the agents tested and study design.

- Prior to carrying out periodontal therapy, explain to the patient that their teeth may become sensitive. They may also experience gingival recession following healing.
- Check that the patient uses a low-abrasive, fluoride-containing toothpaste and toothbrush and has an atraumatic brushing technique.
    - A pressure-controlled electric toothbrush may be useful if the patient's current brushing technique is too abrasive.
- During PMPR, use techniques that aim to avoid root surface damage and over-instrumentation.

- Where a patient complains of sensitivity, assess whether this is a post-PMPR effect or is related to another cause (e.g. caries, pulpitis, dental abscess, dental erosion, other post-treatment pain).
- Advise the patient that proprietary desensitising fluoride-containing toothpastes can be used to treat particular areas of sensitivity.
    - A small amount of toothpaste should be applied to the affected area with a finger after toothbrushing.
    - Alternatively, a desensitising mouthwash may be of benefit.
    - Emphasise to the patient the importance of having plaque-free dentine for the desensitising agent to be effective.
    - Patients may have to try different desensitising toothpaste or mouthwash formulations to find one that works for them.
- Advise the patient to reduce their intake of acidic food and drinks.
- Where a patient complains of acute sensitivity, consider other topical therapies in addition to desensitising toothpaste (e.g. apply fluoride varnish or a dentine bonding agent).

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Bekes K, John MT, Schaller H-G, Hirsch C. Oral health-related quality of life in patients seeking care for dentin hypersensitivity. *Journal of Oral Rehabilitation* 2009;36(1):45-51.

Bellal S, Feghali RE, Mehta A, Namachivayam A, Benedicenti S. Efficacy of near infrared dental lasers on dentinal hypersensitivity: a meta-analysis of randomized controlled clinical trials. *Lasers in medical science* Volume 37, Issue 2, pp. 733-744 (2022)

Cunha-Cruz J, Stout JR, Heaton LJ, Wataha JC, Northwest P. Dentin hypersensitivity and oxalates: a systematic review. *Journal of Dental Research* 2011;90(3):304-310.

de Oliveira RP, Alencar CdM, Silva FA, Magno MB, Maia LC, Silva CM. Effect of desensitizing agents on dentin hypersensitivity after non-surgical periodontal therapy: A systematic review and meta-analysis. *Journal of Dentistry*. 103 (2020) 103498.

Hu ML, Zheng G, Lin H, Yang M, Zhang YD, Han JM. Network meta-analysis on the effect of desensitizing toothpastes on dentine hypersensitivity. *Journal of Dentistry*. 88:103170, 2019

Lin PY, Cheng YW, Chu CY, Chien KL, Lin CP, Tu YK. In-office treatment for dentin hypersensitivity: a systematic review and network meta-analysis. *Journal of Clinical Periodontology* 2013;40(1):53-64.

Mahdian M, Behboodi S, Ogata Y, Natto ZS. Laser therapy for dentinal hypersensitivity. *Cochrane Database of Systematic Reviews* 2021, Issue 7. Art. No.: CD009434

Marto CM, Paula AB, Nunes T, Pimenta M, Abrantes AM, Pires AS, Laranjo M, Coelho A, Donato H, Botelho MF, Ferreira MM, Carrilho E. Evaluation of the efficacy of dentin hypersensitivity treatments—A systematic review and follow-up analysis. *Journal of Dentistry*. 88:103170, 2019

Poulsen S, Errboe M, Lescay Mevil Y, Glenny AM. Potassium containing toothpastes for dentine hypersensitivity. *Cochrane Database of Systematic Reviews* 2006, Issue 3. Art. No.: CD001476. DOI: 10.1002/14651858.CD001476.pub2.

Sharif MO, Iram S, Brunton PA. Effectiveness of arginine-containing toothpastes in treating dentine hypersensitivity: a systematic review. *Journal of Dentistry*. 2013;41(6):483-492.

von Troil B, Needleman I, Sanz M. A systematic review of the prevalence of root sensitivity following periodontal therapy. *Journal of Clinical Periodontology*. 2002;29 (Supplement 3):173-177.

West NX, Seong J, Davies M. Management of dentine hypersensitivity: efficacy of professionally and self-administered agents. *J Clin Periodontol* 2015; 42 (Suppl. 16): S256–S302.

Zhu M, Li J, Chen B; Mei L, Yao L, Tian J; Li. H. The Effect of Calcium Sodium Phosphosilicate on Dentin Hypersensitivity: a Systematic Review and Meta-Analysis. *Plos ONE*; Volume 10, Issue 11 (2015)

Long-term care (questions 21-22)

Key Question 21

In a patient with a diagnosis of periodontitis, does supportive periodontal care (SPC), compared to no supportive periodontal care, maintain stability of the patient's disease status?

Recommendation in 2014 edition of guidance:

This question was not considered in the first edition of the guidance. However, there was a consideration of recall intervals for dental prophylaxis and supportive periodontal therapy:

- The recall interval should be based on each patient's clinical history, an assessment of his/her risk and should take into account the needs and wishes of the patient.

Basis for recommendation:

Two systematic reviews (Worthington 2013, Elley 2000) and a review of systematic reviews, (Suvan 2005) found low quality evidence that suggested more frequent treatment may result in improved outcomes. However, there was no clear evidence regarding the most effective frequency of treatment or whether the observed improvements are clinically relevant. The evidence was considered to be low quality due to the poor quality of the primary studies which, in some cases, were at high risk of bias.

As there was insufficient evidence to determine the most effective recall interval for dental prophylaxis or supportive periodontal therapy, the guidance development group recommended that clinical judgement, including an assessment of the patient's risk, should be used to determine the recall interval for dental prophylaxis or supportive periodontal therapy, taking into account the wishes of the patient.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Effectiveness of supportive periodontal therapy

Supportive periodontal care has been standard practice for many years, based on observational studies. However, there is a lack of evidence from RCTs comparing the effectiveness of supportive periodontal care (SPC; also called supportive periodontal therapy) to no supportive therapy. A Cochrane review (Manresa 2018) which aimed to determine the effects of supportive periodontal therapy (SPT) in the maintenance of the dentition of adults treated for periodontitis did not identify any RCTs evaluating the effects of SPT versus monitoring only, or of providing SPT at different time intervals, or that compared the effects of mechanical debridement using different approaches or technologies.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline states that following completion of active periodontal therapy, successfully treated periodontitis patients remain at high risk for periodontitis recurrence/progression and require specifically designed supportive periodontal care (SPC). The guideline recommends that *adherence with supportive periodontal care should be strongly promoted, as there is excellent evidence that this is crucial for long-term periodontal stability and further improvement in periodontal status* (recommendation grade: A [strong]). This is based on a prospective study which found greater rates of tooth loss and disease progression in patients who were irregular compliers with periodontal maintenance therapy, versus patients who were regular compliers (Costa 2014) and the findings of the 2014 *European Workshop on secondary prevention of periodontitis* (Sanz 2015) which concluded that compliance with the periodontal maintenance therapy is crucial. The guideline does not include an assessment of evidence certainty for this recommendation, but it should be noted that the evidence cited is drawn from retrospective and prospective observational studies and therefore the certainty of the evidence is likely to be low.

The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) recommends provision of and adherence to regular professionally administered supportive periodontal care (SPC) to reduce tooth loss in the long term (≥5 years) (recommendation grade: A [strong]). This is based on moderate quality evidence from

a systematic review (Leow 2021) that investigated the recurrence of periodontitis during long-term SPC in a group of patients with Stage 3 or 4 disease. The review found that the proportion of patients who experienced tooth loss was 9.6% (95% CI 5%–14%; I^2=28%; 8 studies) during SPC of at least 5 years duration. There was no evidence of a significant difference in levels of tooth loss between patients who adhered to regular SPC (3 monthly) compared to those who were considered irregular adherers or were not monitored. As would be expected, levels of tooth loss increased with increasing follow-up periods. There was moderate heterogeneity observed, which may be explained by the limited number of studies in the meta-analysis, small sample sizes and differences in treatment provided as part of active or supportive care (e.g. regenerative vs. non-regenerative treatment). It is also unclear whether the tooth loss observed was due to periodontitis alone as many studies did not include information on the reasons for tooth loss. Additionally, the studies in the review were conducted either in a university setting or in private practice. The review authors note that as the mean prevalence of tooth loss in patients in SPC for 5 years or more is less than 10%, most patients enrolled in SPC following successful treatment of periodontitis should not expect to experience tooth loss which they view as encouraging.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline notes that there have been no randomised controlled trials comparing supportive periodontal care (SPC) to no SPC. It does not make a specific recommendation on the provision of supportive periodontal therapy but notes that as '*periodontitis is a chronic disease that will recur and worsen without good plaque control*', supportive periodontal care is required to support and monitor the patient.

Recall interval

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline recommends that visits for supportive periodontal care (SPC) should be scheduled for intervals of 3 to a maximum of 12 months with the frequency determined by the patient's risk profile and periodontal status after active therapy (recommendation grade: A [strong]). This recommendation is based on a systematic review (Trombelli 2020a) which concluded that an SPC programme based on 3–4 month recall intervals, each including a session of PMPR performed with ultrasonic and hand instrumentation, is effective in maintaining stable CAL levels in unstable periodontitis patients and that sites with residual or persisting diseased characteristics (e.g. deep pockets) may benefit in terms of PD reduction. The included studies were assessed as having a low to moderate quality level (scoring 3 to 7 on a 9-point scale) and this combined with other methodological weaknesses suggest that the certainty of the evidence is likely to be low. Another study included in the review found that SPC every 3 months may be sufficient to control periodontitis progression after periodontal surgery (Polak 2020). This agrees with the conclusions of the 2014 *European Workshop on secondary prevention of periodontitis* (Sanz 2015), based on the review by Trombelli (2015), which concluded that the recommended interval ranges from 2 to 4 times per year, and that it could be optimized if tailored according to patient's risk.

The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) recommends that SPC should initially be provided at 3-monthly intervals, with medium to long-term frequency personalized to each individual patient, taking into account clinical and behavioural circumstances (recommendation grade: A [strong]). This is based on moderate certainty evidence from a systematic review (Leow 2021) that found no statistically significant difference in levels of tooth loss between patients who received regular SPC (defined as 3-monthly) compared to irregular SPC (8% vs 11.9%; p=0.161; 8 studies; n=192; low to moderate heterogeneity) over follow-up periods of 5-20 years. No difference was also found for clinical attachment loss ≥2 mm in at least one site, although there is a suggestion that a higher proportion of patients undergoing regular SPC experienced attachment loss (30.2% vs 21.4%; substantial heterogeneity and imprecision observed). The authors of the review note that the prospective nature of the studies included in the review increases the risk of bias related to this evidence.

The guideline also recommends that recall intervals for supportive periodontal care (SPC) should be guided by patients' risk profile as determined by individual risk factors (e.g., smoking, hyperglycaemia) and disease-associated clinical measures, such as pocket depths and bleeding on probing (recommendation grade: A [strong]). This is based on a combination of indirect evidence, which suggests that tailoring frequency of SPC to risk profiles may prevent tooth loss in cohorts with different susceptibilities to periodontitis (Rosling 2001) and

that risk assessment tools may be used to inform the frequency of SPC recalls (Lang 2015; Trombelli 2020b), and expert opinion. The guideline does not include an assessment of evidence certainty for this recommendation.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance.

There is a lack of evidence from RCTs comparing supportive periodontal care (SPC) to no SPC. However, evidence from observational studies is available and informs recommendations from source guidelines. There is low to moderate certainty evidence that tooth loss and disease progression is lower in patients who comply with SPC and that most of these patients should not experience tooth loss in the moderate to long-term. There is inconsistent evidence about the benefits of SPC to clinical attachment levels. There is moderate certainty evidence that tooth loss in both regular and irregular SPC attenders is around 10% during SPC of at least 5 years duration. Low certainty evidence suggests that regular recall appointments (e.g. three monthly) patients beginning SPC are beneficial, with the ongoing recall interval tailored to the patient's clinical and behavioural circumstances. Accordingly, both the BSP-S3 and EFP guidelines recommend that recall intervals should be based on an assessment of the patient's risk for disease progression.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) includes an evidence-based statement that there is no evidence of clinical disadvantages to regular long-term SPC, such as gingival recession/clinical attachment loss. It notes that the possibility of these side effects cannot be excluded based on the evidence reviewed and that patients should be advised of this as part of the informed consent process.
- The EFP *Treatment of stage IV periodontitis* guideline also notes that the desirable effects of long-term regular SPC (reduced prevalence of tooth loss) would undoubtedly outweigh possible undesirable effects, such as tooth loss, and an overall consideration of the benefit versus harm of regular SPC supports regular SPC.
- Regular SPC will facilitate the identification, prevention and early treatment of further disease and enable the clinician to monitor and support the patient.
- The review by Leow (2021) notes that no superior method to manage disease recurrence was found.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- As noted in Section 1, the *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) recommends that recall intervals for supportive periodontal care (SPC) should be guided by patients' risk profile as determined by individual risk factors (e.g., smoking, hyperglycaemia) and disease-associated clinical measures (such as pocket depths and bleeding on probing).
- Individuals who have presented with and been treated for periodontitis in the past will likely benefit from increased frequency of supportive care

4. Values and preferences

Summarise any evidence or information on values and preferences.

- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that it is unclear whether long-term SPC impacts on patient-reported outcomes, such as oral health-related quality of life, masticatory function, and aesthetics.
- Tonetti (2017) notes that individuals with periodontitis are at risk of impaired nutrition due to masticatory dysfunction, which often leads to changes in dietary habits such as more starch and fats and less fresh fruit and vegetables being consumed. Periodontal treatment and supportive care will support tooth retention and may minimise the risk of masticatory dysfunction.
- Individuals with periodontitis who lose teeth may suffer increased masticatory dysfunction, which may affect their general health.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that little is known about patient preferences in relation to SPC. However, SPC has been an established intervention for oral healthcare for several decades.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- The BSP-S3 guideline notes that in a study in a private practice in Norway, the yearly cost of maintaining a tooth was estimated as 20.2 euro; the study also found that the relative costs of maintaining a periodontally-involved tooth are less than the costs of replacement with, and maintenance of, a prosthesis or implant.
- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that the cost-effectiveness of long-term SPC, when considering direct and indirect costs, is unclear.
- The EFP *Treatment of stage IV periodontitis* guideline also notes that while SPC is a routinely provided intervention in a number of healthcare systems, the regularity of visits (3–4 times per year) may be a barrier for some patients (financial and logistical).
- As SPC recall intervals based on risk may mean that some patients who are considered to be at low risk of disease development or recurrence may not require such frequent visits for maintenance.
- There are costs associated with replacing teeth that are lost due to periodontitis.

7. Other factors

Indicate any other factors taken into account.

- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that a variety of qualified and trained oral healthcare professionals can carry out the components of an SPC programme for patients with Stage IV disease but this should be overseen by a suitably qualified and trained general dentist or specialist. Support for oral hygiene instruction can be provided by suitably trained dental health educator or dental nurse.
- In the 2021 Economist Intelligence Unit (EIU) model to assess periodontitis costs and health outcomes in six European countries, the economic analysis suggested that a scenario where 90% of periodontitis cases are diagnosed and appropriately managed is one of the two most cost-effective strategies.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

This question was not considered in the first edition of the guidance. However, there was a consideration of recall intervals for dental prophylaxis and supportive periodontal therapy:

- The recall interval should be based on each patient's clinical history, an assessment of his/her risk and should take into account the needs and wishes of the patient.

Considered judgement:

The Group discussed the low certainty of the evidence presented demonstrating the effectiveness of SPC in treating periodontitis. It was noted that most relevant evidence dates from the 1980s and 1990s and may not be included in systematic reviews as the methodology of these studies would not meet inclusion criteria. These older studies do not have the robust methodology of today's studies (RCTs) but this large body of historic evidence suggests that SPC is an effective treatment. The Group acknowledged that it would not now be possible

to conduct RCTs comparing SPC with no care due to ethical concerns as the delivery of SPC is known to be effective.

The Group were initially split on the strength of the recommendation, with five voting for a strong recommendation and three for conditional. In further discussion of the relationship between the certainty of evidence and strength of recommendation, it was noted that of a large volume of low-certainty evidence collectively can upgrade the level of evidence. It was also noted that normally high to moderate certainty evidence would be needed to make a strong recommendation, but there are examples in other guidelines where strong recommendations are based only on low certainty evidence. This type of situation may occur when low certainty evidence and clinical experience is overwhelmingly in favour of recommending a particular treatment or course of action. Following this discussion, the group re-voted on the strength of the recommendation and unanimously voted for a strong recommendation. In doing so, it was noted that it should be made clear in the guidance why a strong recommendation was being made in this situation.

The Group discussed how to communicate the value of SPC and to qualify that this is referring to well treated, stabilised periodontitis patients undergoing supportive care. This was contrasted with non-engaging patients who go into "palliative care" and may lose teeth. It was subsequently agreed that the term periodontal maintenance care should be used in preference to SPC.

Recommendation in updated guidance:

- For patients with a diagnosis of periodontitis who have completed active periodontal therapy, provide regular* supportive periodontal care to maintain stability of the patient's disease status.
  *Suitable recall intervals range from 3 to a maximum of 12 months, with the frequency determined by the patient's clinical history, an assessment of their risk and the needs and wishes of the patient.

Relevant text from main narrative:

There is a substantial body of low to moderate certainty evidence from long term observational studies of the benefits of supportive periodontal care (SPC) in patients who have had periodontal treatment. This suggests that tooth loss and disease progression is lower in patients who comply effectively with SPC and that most of these patients are less likely to experience tooth loss in the moderate to long-term. There is moderate certainty evidence that tooth loss in those who attend either regularly or irregularly is around 10% during periodontal maintenance care of at least 5 years duration. Although the evidence regarding the effectiveness of supportive periodontal care is largely drawn from observational studies, there is consistency in the findings across a significant number of studies. In addition, provision of supportive care has been standard practice for many years. Consequently, this guidance includes a strong recommendation in favour of SPC, based on low to moderate certainty evidence, because of the increased risk of tooth loss if SPC is not provided.

Low certainty evidence suggests that, for patients who are moving from active therapy to maintenance, regular recall appointments (e.g. three monthly) at the beginning of periodontal maintenance are beneficial, with the ongoing recall interval tailored to the patient's clinical and behavioural circumstances.

Accordingly, recall intervals based on an assessment of the patient's risk for disease progression are recommended by both the *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline and the *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (EFP-S3).

The status of a previously stable patient during periodontal maintenance can change and deteriorate due to changes in general health (e.g. development of diabetes) or changes in other risk factors (e.g. stress level or smoking status). Therefore, at each recall visit a fresh assessment of the patient's periodontal status and risk level, taking these factors into account, should be used to determine the next recall interval.

- For patients who are moving from active treatment to maintenance, schedule regular supportive care appointments, for example at three month intervals, to gauge the ongoing stability of the patient's disease status.
- Assess the patient's risk for disease progression, based on their medical history, known risk factors, periodontal status (e.g. degree of residual periodontal pocketing, levels of

inflammation, levels of inflammation, levels of previous disease) along with levels of plaque control, and use this to inform future recall intervals for supportive periodontal care.

Strength of recommendation (strong or conditional):

- Strong (100% agreement)

References

Costa FO, Lages EJ, Cota LO, Lorentz TC, Soares RV, Cortelli JR. Tooth loss in individuals under periodontal maintenance therapy: 5 -year prospective study, J. Periodont. Res. 49 (1) (2014) 121–128.

Economist Intelligence Unit Limited. Time to take gum disease seriously. The societal and economic impact of periodontitis. (2021) https://impact.economist.com/perspectives/sites/default/files/eiu-efp-oralb-gum-disease.pdf

Elley K, Gold L, Burls A, Gray M. Scale and polish for chronic periodontal disease. A West Midlands Development and Evaluation Service Report;2000. 074421739.

Lang, N. P., Suvan, J. E., & Tonetti, M. S. (2015). Risk factor assessment tools for the prevention of periodontitis progression a systematic review. Journal of Clinical Periodontology, 42(Suppl 16), S59–S70.

Leow, N. M., Moreno, F., Marletta, D., Hussain, S. B., Buti, J., Almond, N., & Needleman, I. (2021). Recurrence and progression of periodontitis and methods of management in long-term care: A systematic review and meta-analysis. Journal of Clinical Periodontology, 49 (Suppl 24), S291-S313.

Manresa C, Sanz-Miralles EC, Twigg J, & Bravo M. (2018). Supportive periodontal therapy (SPT) for maintaining the dentition in adults treated for periodontitis. Cochrane Database of Systematic Reviews, 1, CD009376.

Polak D, Wilensky A, Antonoglou GN, Shapira L, Goldstein M, Martin C. The efficacy of pocket Elimination/ Reduction compared to access flap surgery: a systematic review and meta-analysis, J. Clin. Periodontol. 47 (Suppl. 22) (2020) 303–319

Rosling B, Serino G, Hellstrom MK, Socransky SS, & Lindhe J. (2001). Longitudinal periodontal tissue alterations during supportive therapy. Findings from subjects with normal and high susceptibility to periodontal disease. Journal of Clinical Periodontology, 28(3), 241–249.

Sanz M, Baumer A, Buduneli N, Dommisch H, Farina R, Kononen E, Linden G, Meyle J, Preshaw PM, Quirynen M, Roldan S, Sanchez N, Sculean A, Slot DE, Trombelli L, West N, Winkel E. Effect of professional mechanical plaque removal on secondary prevention of periodontitis and the complications of gingival and periodontal preventive measures: consensus report of group 4 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases, J. Clin. Periodontol. 42 (Suppl. 16) (2015) S214–220.

Suvan JE. Effectiveness of mechanical nonsurgical pocket therapy. Periodontology 2000. 2005;37:48-71.

Tonetti MS, Jepsen S, Jin L, Otomo-Corgel J. Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. J Clin Periodontol. 2017; 44: 456– 462

Trombelli L, Franceschetti G, Farina R. Effect of professional mechanical plaque removal performed on a long-term, routine basis in the secondary prevention of periodontitis: a systematic review, J. Clin. Periodontol. 42 (Suppl. 16) (2015) S221–236.

Trombelli L, Farina R, Pollard A, Claydon N, Franceschetti G, Khan I, West N. Efficacy of alternative or additional methods to professional mechanical plaque removal during supportive periodontal therapy. A systematic review and metaanalysis, J. Clin. Periodontol. 47 (Suppl 22) (2020a) 144–154.

Trombelli L, Simonelli A, Franceschetti G, Maietti E, & Farina R. (2020b). What periodontal recall interval is supported by evidence? Periodontology 2000, 84(1), 124–133.

Worthington HV, Clarkson JE, Bryan G, Beirne PV. Routine scale and polish for periodontal health in adults. Cochrane Database of Systematic Reviews 2013, Issue 11. Art. No.: CD004625.

Key Question 22

In a patient with a diagnosis of periodontitis who is undergoing supportive periodontal care (SPC), is there evidence to inform which SPC care regime is most effective at maintaining the stabilization of the patient's disease status?

Recommendation in 2014 edition of guidance:

This question was not directly considered in the first edition of the guidance. However, there was a related question regarding the effectiveness of periodic sub-gingival instrumentation compared to supra-gingival prophylaxis:

- The guidance development group recommends that clinicians actively monitor plaque and inflammation levels and the quality of the patient's oral hygiene at each recall appointment. The Oral Hygiene TIPPS behaviour change strategy is recommended for patients whose oral hygiene is inadequate and supra-gingival debridement and sub-gingival instrumentation should be performed where required.

Basis for recommendation:

One systematic review (Heasman 2002) found low quality evidence that supportive periodontal therapy regimens involving either supra-gingival prophylaxis or sub-gingival instrumentation are comparable in regard to probing depth and attachment level outcomes. The evidence is considered low quality due to the poor quality of the primary studies.

As there was insufficient evidence to determine the most effective regimen for supportive periodontal therapy the guidance development group recommended that clinicians actively monitor plaque and inflammation levels and the quality of the patient's oral hygiene at each recall appointment. The Oral Hygiene TIPPS behaviour change strategy was recommended for patients whose oral hygiene is inadequate. It was recommended that supra-gingival debridement and sub-gingival instrumentation be performed where required.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

The *BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice* (BSP-S3) guideline includes a narrative introduction to the section on supportive periodontal care that includes a description of supportive periodontal care (SPC). It notes that this should include:

- appraisal and monitoring of systemic and periodontal health
- reinforcement of oral hygiene instruction
- patient motivation towards continuous risk factor control
- professional mechanical plaque removal (PMPR) and localized subgingival instrumentation at residual pockets.

It also notes that a structured recall system, with the frequency and length of visits being customized to patient need, is required.

The BSP-S3 guideline suggests performing routine professional mechanical plaque removal (PMPR), as part of a supportive periodontal care programme, to limit the rate of tooth loss and provide periodontal stability/improvement (recommendation grade: B). This recommendation is based on evidence from observational studies in a systematic review (Trombelli, 2015) that was presented at the 2014 European Workshop (Sanz 2015). The review found that patients enrolled in a maintenance programme including PMPR had a weighted mean yearly rate of tooth loss of 0.15 and 0.09 for follow-up of 5 years and 12–14 years, respectively, with mean clinical attachment loss of less than 1 mm at follow-up ranging from 5 to 12 years. The included studies were assessed as having a quality level ranging from 3 to 7, based on a specifically designed 9-point scale for the evaluation of non-randomized observational studies, with 9 representing the highest quality (lowest risk of bias). Based on this quality assessment and other methodological weaknesses such as unclear PMPR protocols, lack of consistency in the frequency of PMPR intervals and lack of information on patient

adherence to the maintenance regimen, the certainty of the evidence is likely to be low. However, the level of tooth loss and clinical attachment loss observed suggests that periodontal maintenance programmes which include PMPR are worthwhile.

The BSP-S3 guideline does not suggest replacing the PMPR component of SPC with alternative methods, such as treatment with Er:YAG laser (recommendation grade: B). This is based on a systematic review which found only one study comparing conventional PMPR to Er:YAG laser (Trombelli 2020). No statistically significant differences in clinical attachment level were observed and the BSP-S3 guideline notes that information on cost-effectiveness and patient-reported outcomes, which is likely to be relevant to the intervention, is not available. The certainty of the evidence is likely to be low due to the single study included in the review, which was assessed as having an unclear risk of bias.

Additionally, the BSP-S3 guideline does not suggest the use of adjuncts to PMPR (such as sub-antimicrobial dose doxycycline [SDD] or photodynamic therapy) in supportive periodontal therapy (recommendation grade: B). This is based on a systematic review (Trombelli 2020) that found two relevant RCTs, one investigating SDD and another evaluating photodynamic therapy (PDT). No statistically significant differences in clinical attachment level change between intervention and control (conventional PMPR) were observed after 12 month follow-up. The certainty of the evidence is likely to be low as there was only one relevant RCT for each intervention, both had low numbers of participants (SDD n=128; PDT n=34) and there were concerns about possible risk of bias in the study investigating SDD. The guideline notes that information on cost-effectiveness and patient-reported outcomes, which is likely to be relevant to these interventions, is not available.

Other relevant recommendations in the BSP-S3 guideline for patients in supportive periodontal care, which are covered in more detail in other Considered Judgement forms, are:

- Repeated and individually tailored mechanical oral hygiene instruction, including interdental cleaning, in order to control inflammation and avoid disease progression (Recommendation grade: A [strong])
- Risk factor control interventions (Recommendation grade: A [strong])
- Promotion of diabetes control interventions (Recommendation grade: B)
- Implementation of tobacco smoking cessation interventions (Recommendation grade: A [strong])

The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) also includes a recommendation related to the components of a successful SPC programme. This expert consensus-based recommendation advises a number of components that should be included in an SPC programme:

- Interview to elicit information on periodontal health symptoms, medical and social history, risk factors including tobacco use, stress, diabetes and reported plaque control regime, patient motivation towards continuous risk factor control and PMPR/subgingival instrumentation
- Assessment of plaque and calculus deposits, periodontal health including inflammation, PPDs, and bleeding pockets, with charting where required.
- Evaluation of intervention needs, including risk factor management, oral hygiene instruction and re-treatment
- Communicating findings to patients to enhance their ownership of periodontal health and agreement on required interventions
- Oral hygiene coaching, instrumentation of supra- and sub-gingival plaque and calculus, treatment of sites with recurrence or residual periodontitis
- Planning to determine interval before next SPC visit

The recommendation also advises that SPC for patients with Grade IV disease (very severe and complex disease) can be delivered by a variety of oral healthcare professionals, under the supervision of a suitably trained general dentist or a specialist, as appropriate to case complexity. Clear two-way communication between the oral healthcare team and the patient, and between healthcare professionals (medical or dental) is also recommended. The EFP guideline also does not suggest the use of adjunctive approaches to subgingival instrumentation when treating recurrence of periodontitis during SPC (recommendation grade: B). This is based on the review by Leow, which found no significant differences between groups who had doxycycline gel applied

as an adjunct to sub-gingival instrumentation (2 studies; results not combined due to differences in study design; moderate to high risk of bias). There were also no significant differences in terms of tooth loss between groups treated with surgical compared to non-surgical therapy over a five-year period, although in both groups it was observed that those who were irregular attenders were statistically significantly more likely to lose teeth.

Public Health England's *Delivering Better Oral Health* (DBOH) does not make any specific evidence-based recommendations pertaining to supportive periodontal care (SPC) but does include some related information. It notes that periodontitis is a chronic disease that requires supportive care to prevent recurrence and that such care involves a long-term commitment from the patient along with an intensive level of support, monitoring and care from the dental team. While trials have compared different types of SPC, there is insufficient evidence to determine the superiority of different protocols or adjunctive strategies to improve tooth maintenance during SPC (Manresa 2018). Additionally, there have been no randomised controlled trials comparing SPC to no SPC (Manresa 2018). DBOH notes that components of SPC typically include (Sanz 2020):

- Setting expectations – advice about the importance of SPC and the commitment required and need for patient adherence
- Regular monitoring of plaque and gingival inflammation to guide oral hygiene advice
- Probing depths and bleeding on probing to guide:
    - evaluation of health and stability
    - treatment
- Oral hygiene advice and behaviour change interventions as appropriate
- Debridement or professional mechanical plaque removal (PMPR):
    - removal of supra and subgingival plaque and calculus (PMPR)
    - root surface debridement of pockets 5mm and deeper with bleeding on probing

It notes that patient adherence to plaque control is central to periodontal care as removal of supra and subgingival plaque and calculus is of limited value in the absence of high standards of plaque control (Lamont 2018).

Does the evidence differ from previously?

Previously, there was low quality evidence that supportive periodontal therapy regimens involving either supra-gingival prophylaxis or sub-gingival instrumentation were comparable in regard to probing depth and attachment level outcomes. There is now more evidence, albeit based on observational studies and therefore likely to be low certainty, that inclusion of professional mechanical plaque removal (PMPR) in a regime of supportive care is effective in maintaining periodontal stability. There have also been several guidelines published that outline the typical components of a programme of SPC.

Common elements of these recommended SPC regimes include:

- collecting/updating information on medical/social history and risk factors
- assessing plaque control and patient's motivation to adhere to an effective oral hygiene regime
- assessing plaque and calculus deposits and markers of periodontal health including inflammation, probing depths and bleeding pockets
- performing PMPR to remove supra- and subgingival plaque and calculus
- treatment of sites with recurrence or residual periodontitis (sites ≥5 mm with bleeding on probing)
- providing oral hygiene instruction and other behaviour change interventions as required
- discussing clinical findings with patient and agree expectations re oral hygiene and management of modifiable risk factors
- determining recall interval for next SPC visit based on individual patient need

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- The BSP-S3 guideline notes that patient reported outcome measures were not reported in any of the studies included in the review which underpins its recommendation related to the value of professional mechanical plaque removal (PMPR) as part of SPC.
- Provision of PMPR as part of a supportive care regime is unlikely to have any undesirable effects and is currently standard practice.
- The BSP-S3 guideline also notes that there is no information on patient-reported outcomes related to adjuncts to PMPR.
- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) includes an evidence-based statement that there is no evidence of clinical disadvantages to regular long-term SPC, such as gingival recession/clinical attachment loss.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- Patient subgroups are not addressed directly by the source guidelines but it is likely that the components of an individual patient's supportive care will reflect their risk factors and periodontal status. For example, diabetes-related interventions should be provided to patients with diabetes, smoking cessation interventions should be provided to patients who smoke, intensive OHI should be provided to patients with inadequate oral hygiene, periodontal treatment should be provided to those patients who show signs of disease progression.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that little is known about patient preferences with regard to design and delivery of SPC programmes. It states that clear and transparent communication between healthcare professionals and with the patient is essential for long-term patient benefit.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- The BSP-S3 guideline notes that the acceptability of SPC is demonstrated by patient compliance in long-term studies.
- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that SPC has been recommended for oral healthcare for several decades and is therefore likely to be acceptable to both patients and the dental team

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- The BSP-S3 guideline notes that in a study in a private practice in Norway, the yearly cost of maintaining a tooth was estimated as 20.2 euro; the study also found that the relative costs of maintaining a periodontally-involved tooth are less than the costs of replacement with, and maintenance of, a prosthesis or implant.
- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that the cost-effectiveness of long-term SPC, when considering direct and indirect costs, is unclear.

7. Other factors

Indicate any other factors taken into account.

- The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (2022) notes that a variety of qualified and trained oral healthcare professionals can carry out the components of an SPC programme for patients with Stage IV (very severe and complex) disease but this should be overseen by a suitably qualified and trained general dentist or specialist. Support for oral hygiene instruction can be provided by suitably trained dental health educator or dental nurse.

- Dental hygienists/therapists will be important in the delivery of care where they are available.
- The 2021 Economist Intelligence Unit (EIU) model to assess periodontitis costs and health outcomes in six European countries, the economic analysis suggested that a scenario where 90% of periodontitis cases are diagnosed and appropriately managed is one of the two most cost-effective strategies.
- Tonetti (2017) notes that individuals with periodontitis are at risk of impaired nutrition due to masticatory dysfunction, which often leads to changes in dietary habits such as more starch and fats and less fresh fruit and vegetables being consumed. Periodontal treatment and supportive care will support tooth retention and may minimise the risk of masticatory dysfunction.
- Individuals with periodontitis who lose teeth may suffer increased masticatory dysfunction, which may affect their general health

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

This question was not directly considered in the first edition of the guidance. However, there was a related question regarding the effectiveness of periodic sub-gingival instrumentation compared to supra-gingival prophylaxis:

- The guidance development group recommends that clinicians actively monitor plaque and inflammation levels and the quality of the patient's oral hygiene at each recall appointment. The Oral Hygiene TIPPS behaviour change strategy is recommended for patients whose oral hygiene is inadequate and supra-gingival debridement and sub-gingival instrumentation should be performed where required.

Considered judgement:

Based on the BSP-S3, DBOH and EFP guidelines, the Group agreed that supportive periodontal care (SPC) should include:

- Assessment of medical and social history, risk factors and patient motivation regarding plaque control
- Assessment of plaque and calculus deposits and periodontal health status, including inflammation, probing depths, and bleeding on probing
- Evaluation of immediate care needs
- Discussion with the patient to reinforce importance of SPC, discuss the findings of the clinical assessment and agree immediate care needs
- Provision of oral hygiene instruction and other risk factor-related behaviour change interventions (where required)
- Instrumentation of supra- and sub-gingival plaque and calculus, treatment of sites with recurrence or residual periodontitis

In terms of evidence certainty, it was noted that the components of the SPC programme are mostly based on expert opinion. The evidence underpinning the SPC programme is mainly drawn from observational studies but there is also some evidence from RCTs. Overall, the evidence for the SPC components is rated as low to moderate certainty.

The Group discussed the principle of including a frequency for pocket charting. It was noted that the BSP guidance on BPE screening (www.bsperio.org.uk/assets/downloads/BSP_BPE_Guidelines_2019.pdf) recommends pocket charting for patients with a diagnosis of periodontitis should be carried out and recorded at least annually. The Group agreed to include the recommended frequency period whilst making a number of observations relating to this. Current payment systems may not support pocket charting recording being carried

out every year but it was noted that it is important to base the recommendation solely on clinical considerations. It was acknowledged that evidence had not been reviewed for the inclusion of an annual frequency for recording pocket charting but this was based on BSP BPE guidance. Additionally, the inclusion of an annual frequency for charting is important in a medico-legal context.

It was subsequently agreed that the term periodontal maintenance care should be used in preference to SPC.

Recommendation in updated guidance:

- For patients with a diagnosis of periodontitis who have completed active periodontal therapy, provide a comprehensive regime of supportive periodontal care that comprises updating patient histories, assessment of risk factor control, oral tissues and care needs, and treatment, where necessary.

Relevant text from main narrative:

Low certainty evidence, based on observational studies, suggests that a regime of supportive periodontal care that includes regular professional mechanical plaque removal (PMPR) is effective in maintaining periodontal stability. Accordingly, the BSP-S3 guideline suggests performing PMPR as part of a maintenance programme, to limit the rate of tooth loss and provide periodontal stability/improvement. The BSP-S3 and EFP-S3 guidelines, along with Public Health England's *Delivering Better Oral Health* (DBOH) toolkit, also give advice on the typical components of a programme of maintenance care.

In patients who have previously received treatment for periodontitis, a comprehensive maintenance care appointment should include assessment and treatment as follows:

- Update the patient's medical and social history and assess the patient's control of modifiable risk factors (e.g. plaque control, smoking status, HbA1c levels).
- Carry out an oral examination that includes assessment of plaque biofilm and calculus deposits and periodontal heath status (i.e. level of inflammation, probing depths and bleeding on probing).
- Ensure that a full mouth periodontal assessment is performed at least annually.
- Review personal oral hygiene and, where necessary, provide personalised oral hygiene advice and instruction to assist and encourage the patient to improve their oral hygiene skills as well as their understanding of the value of good self-care routines.
- Where applicable, give advice on control of modifiable risk factors.
- Discuss the findings of the clinical examination with the patient and agree on next steps related to the clinical status at the time of examination.
    - This may include timing for the next supportive care visit, re-treatment of sites that have deteriorated or referral for specialist care.
- Carry out supra- and subgingival PMPR, where required, using an appropriate method.
    - For example, remove supra- and subgingival plaque biofilm and calculus at sites ≥4 mm with subgingival deposits or sites that bleed on probing.
- Correct local plaque retentive factors - for example, remove overhanging restorations or alter denture design.

Strength of recommendation (strong or conditional):

- Strong (88% agreement)

References

Economist Intelligence Unit Limited. Time to take gum disease seriously. The societal and economic impact of periodontitis. (2021) https://impact.economist.com/perspectives/sites/default/files/eiu-efp-oralb-gum-disease.pdf

Heasman PA, McCracken GI, Steen N. Supportive periodontal care: the effect of periodic subgingival debridement compared with supragingival prophylaxis with respect to clinical outcomes. Journal of Clinical Periodontology. 2002;29 (Suppl 3):163-172;

Zhang J, Liu J, Li J, Chen B, Li H, Yan F. The Clinical Efficacy of Subgingival Debridement by Ultrasonic Instrumentation Compared With Subgingival Air Polishing During Periodontal Maintenance: A Systematic Review. Journal of Evidence Based Dental Practice. 2019;19(4):101314.

Sanz M, Baumer A, Buduneli N, Dommisch H, Farina R, Kononen E, Linden G, Meyle J, Preshaw PM, Quirynen M, Roldan S, Sanchez N, Sculean A, Slot DE, Trombelli L, West N, Winkel E. Effect of professional mechanical plaque removal on secondary prevention of periodontitis and the complications of gingival and periodontal preventive measures: consensus report of group 4 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases, J. Clin. Periodontol. 42 (Suppl. 16) (2015) S214–220.

Sanz M, Herrera D, Kebschull M, Chapple I, Jepsen S, Beglundh T and others. Treatment of stage I-III periodontitis-The EFP S3 level clinical practice guideline. Journal of Clinical Periodontology. 2020;47 Suppl 22:4-60.

Tonetti MS, Jepsen S, Jin L, Otomo-Corgel J. Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. J Clin Periodontol. 2017; 44: 456– 462

Trombelli L, Franceschetti G, Farina R. Effect of professional mechanical plaque removal performed on a long-term, routine basis in the secondary prevention of periodontitis: a systematic review, J. Clin. Periodontol. 42 (Suppl. 16) (2015) S221–236.

Trombelli L, Farina R, Pollard A, Claydon N, Franceschetti G, Khan I, West N. Efficacy of alternative or additional methods to professional mechanical plaque removal during supportive periodontal therapy. A systematic review and metaanalysis, J. Clin. Periodontol. 47 (Suppl 22) (2020a) 144–154.

Lamont T, Worthington HV, Clarkson JE, Beirne PV. Routine scale and polish for periodontal health in adults. Cochrane Database of Systematic Reviews. 2018(12).

Manresa C, Sanz-Miralles EC, Twigg J, Bravo M. Supportive periodontal therapy (SPT) for maintaining the dentition in adults treated for periodontitis. Cochrane Database of Systematic Reviews. 2018.

Dental implants (questions 23-28)

Key Question 23

Is the risk of peri-implant disease higher in patients with a diagnosis of periodontitis before implant placement compared to patients with no previous periodontal disease?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline does not include any specific recommendations regarding the placement and maintenance of dental implants. However, it notes that a history of periodontitis appears to be a risk factor for peri-implant disease and cites the *2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions* (Berglundh 2018).

A narrative review (Schwarz 2018) that informed the *2017 World Workshop* noted that there is strong evidence from longitudinal and cross-sectional studies that a history of periodontitis constitutes a risk factor/indicator for peri-implantitis. It reports the findings of two 10-year longitudinal studies, which found that the incidence of peri-implantitis was higher in patients with a history of periodontitis compared to those without. In a further study of 80 patients presenting with mucositis at baseline, the incidence of peri-implantitis over 5 years was 31% and patients with periodontitis had significantly higher odds (OR: 9) of developing peri-implantitis when compared to individuals without periodontitis.

The Schwarz review also included a number of cross-sectional studies that report on the prevalence of peri-implantitis and analysed associations with either a history of periodontitis or current periodontitis. Most found that a history of periodontitis was strongly associated with peri-implantitis, with odds ratios ranging from 4 to 6. While the review noted that the majority of studies are in general agreement about the association between periodontitis and peri-implantitis, it also cites five studies where no significantly higher risk for peri-implantitis was demonstrated for patients either currently experiencing periodontitis and/or with a history of it. This conflicting evidence is attributed to differences in case definitions for history of periodontitis and peri-implantitis.

Dreyer (2018) undertook a systematic review which examined a range of risk factors for peri-implantitis, including a history or presence of periodontitis. As the heterogeneity of included studies was high, no effect summary was calculated so forest plots were used to describe the trend of the data. The forest plot for 11 studies which evaluated the presence of periodontitis as a risk factor for peri-implantitis suggested a strong tendency favouring patients with periodontitis as being more susceptible to peri-implantitis (evidence assessed by the authors as moderate quality). The forest plot for six studies which evaluated a history of periodontitis as a risk factor for peri-implantitis suggested a strong tendency favouring patients previously suffering from periodontitis as being more susceptible to peri-implantitis (evidence assessed by the authors as high quality).

The *Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline* (Herrera 2022) notes that substantial evidence indicates that subjects with advanced/rapidly progressing forms of periodontitis have a higher risk of implant loss and peri-implantitis, when compared with the general population, or with individuals without a history of periodontitis. The guideline recommends that when dental implants are considered in the rehabilitation of stage IV periodontitis patients, information on the increased risk for peri-implantitis and implant loss should be provided (grade of recommendation: Grade A [strong]). This expert consensus-based recommendation is based on the narrative review by Schwarz (2018) and a more recent systematic review (Carra 2021). The certainty of the evidence underpinning this recommendation is likely to be low due to the

observational nature of the included studies, which examined the presence of active disease and/or a history of periodontitis at the time of implant placement.

Carra (2021) investigated the survival (primary outcome), success and biological/mechanical complications of implant-supported fixed partial dentures in patients with history of periodontitis (HoP) versus patients with no history of periodontitis (NHoP), based on measures of implant survival, peri-implantitis and bone level changes. The meta-analysis was conducted with data from 17 studies. The risk of peri-implantitis was evaluated at the patient and implant level. Patients with HoP were three times more likely to develop peri-implantitis over the follow-up period compared to patients with NHoP; this difference was also observed at the implant level, although with greater heterogeneity. The certainty of the evidence is likely to be low due to the observational nature of the included studies, with only seven of the included studies having a prospective design, and issues such using convenience[1] samples of patients, a variety of case definitions for periodontitis and peri-implantitis and possible publication and sponsoring bias.

Another recent systematic review (Lin 2020) specifically examined whether a history of periodontitis remained a negative risk factor for peri-implant health under supportive post-implant treatment (SPT). The review was based on 13 prospective and retrospective cohort and case control studies comparing individuals with a history of periodontitis (HoP) to those with no history (NHoP). In implants with a rough surface, the HoP group had a slightly lower implant survival rate, more marginal bone loss, increased pocket depths and more bleeding on probing than the NHoP group. In implants with a machined surface, HoP also showed a more marginal bone loss compared to the NHoP group. The incidence of peri-implantitis under SPT was higher in the HoP group compared to the NHoP group at both implant and patient level (N.B. only two studies reported on this comparison). The certainty of evidence from this review is likely to be low due to the observational nature of the included studies and other methodological limitations such as variation in disease definitions, confounders such as smoking status and lack of baseline parameters.

Other Risk Factors

It is recognised that peri-implant disease is multi-factorial in nature and may be related to a number of biological and non-biological factors following implant placement. Non-biological risk factors include those associated with the placement and design of the implant/prosthesis and presence of occlusal discrepancies. The review by Lin (2020) noted that factors including implant positioning, residual cement and over contouring or improper contouring of the prothesis, making it difficult to clean, may influence the risk of peri-implant disease.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline notes that poor oral hygiene, smoking, diabetes, and lack of supportive care appear to be risk factors for peri-implant disease, along with a history of periodontitis (Berglundh 2018, Derks 2015, Sousa 2016). Smoking and diabetes are also identified as being risk factors for peri-implantitis in the systematic review by Dreyer (2018), although another review describes the evidence for these factors as being inconclusive (Schwarz 2018). DBOH notes that although the role of smoking as a risk factor for peri-implantitis has previously been unclear, there is low certainty evidence from a systematic review (Stacchi, 2016) suggesting a significant association. Poor plaque control skills and a lack of regular maintenance therapy are also identified as contributing to an increased risk of developing peri-implantitis in the review by Schwarz (2018).

Prevalence

In a recent meta-analysis that included 57 studies (Diaz 2022), the mean prevalence of peri-implant disease in the form of peri-implantitis is estimated to be approximately 20% at patient-level and 11.5% at implant-level. It should be noted that the authors observed that differences in disease definition among published studies makes the prevalence range highly variable and that only a few study protocols applied the new classification of periodontal diseases from the 2017 World Workshop (Berglundh 2018). Given this variation, cases were subdivided into four groups based on varying definitions of peri-implantitis, with various thresholds for bone loss, exposed implant threads and peri-implant pocket depths applied.

[1] A non-probability sampling method which selects individuals from a group of people easy to contact or reach.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance.

The evidence suggests that patients who have a history of periodontitis are at higher risk of implant loss and of developing peri implant disease. This is based on the findings of three systematic reviews (Carra 2021, Dreyer 2018, Lin 2020) and a narrative review (Schwarz 2018) and the certainty of the evidence is likely to be low due to the observational nature of the studies included in the reviews. Accordingly, the recent *EFP Treatment of stage IV periodontitis* guideline recommends that when dental implants are considered in the rehabilitation of stage IV periodontitis patients, information on the increased risk for peri-implantitis and implant loss should be provided.

The reported prevalence of peri-implant disease is variable, mainly due to the variation in definitions of the disease used in different studies, but is estimated to be approximately 20% at patient-level and 11.5% at implant-level. Peri-implant disease is known to be multi-factorial and other factors, both biological and non-biological, also increase the risk of the disease and implant loss.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- Patients with a history of periodontitis have an increased risk of developing peri-implant disease but this is not inevitable.
- Peri-implant disease does not necessarily lead to loss of the implant/restoration with appropriate support and care.
- In certain cases, placement of an implant in a patient with current or a history of periodontitis may be more beneficial than the option of no teeth at that site.
- In certain cases, replacement of unrestorable periodontally-involved teeth with implant supported prostheses may lead to improvements in the patient's quality of life.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- Renvert and Quirynen (2015) identified four studies which evaluated the effect of periodontitis on the development of peri-implantitis, making a distinction between moderate vs. severe, or chronic vs. aggressive periodontitis patients. In general, patients with or a history of severe/aggressive forms of periodontitis were responsible for higher rates of peri-implantitis.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- Patients with a history of periodontitis may still value implant restoration despite the potentially higher risks of peri-implant complication or failure.
- Implants are generally self-funded which may influence patients' preferences and their attitude to risk.
- Implants may remain a more appropriate option for some patients, for example for those struggling with a denture.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- The increased risk of peri-implant disease in patients with a history of periodontitis does not preclude implant placement in these patients and might be acceptable if both the dental team and the patient are aware of the increased risk and the ways in which it can be mitigated.
- The patient must consider their own attitude to risk once the increased risks related to implants are explained to them.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Roccuzzo (2010/12) conducted a 10-year follow-up study of patients categorized as not periodontally compromised, moderately periodontally compromised and severely periodontally compromised.

Treatment of peri-implantitis was found to be more time consuming in patients with a history of periodontitis.
- Patients who have a history of periodontal disease will require pre-placement treatment and counselling which will have an associated cost.
- Implant surgery in these patients may be more difficult due to poor residual bone levels.
- Maintenance costs to prevent disease of soft tissues or around the implant are likely to be greater.

7. Other factors

Indicate any other factors taken into account.

- Preventing peri implant disease in patients with a history of periodontal disease is likely to require more intensive supportive care for the patient.
- The clinician providing this maintenance care may require specific additional training/skills or equipment.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group noted that low certainty evidence suggests that patients who have a history of periodontitis are at higher risk of implant loss and of developing peri implant disease but were clear that a history or presence of periodontitis should not preclude patients from receiving implants. Periodontitis is not a contraindication for successful implant placement but indicates an elevated risk which needs to be communicated to the patient prior to the procedure, Knowledge of this risk will enable the patient and dental team to make an informed decision about proceeding with the implant and inform the measures to be taken for care of the implant. The Group emphasised the importance of ensuring those placing implants having this risk awareness conversation with periodontitis patients.

Recommendation in updated guidance:

- For patients with a diagnosis of periodontitis who are considering dental implants, ensure they are aware that they are at increased risk of peri-implant disease.

Relevant text from main narrative:

Low certainty evidence, based on observational studies, suggests that patients with a history of periodontitis have a higher risk of developing peri-implant disease. Accordingly, the EFP *Treatment of stage IV periodontitis* guideline recommends that when dental implants are considered in the rehabilitation of patients with stage IV periodontitis, information on the increased risk for peri-implantitis and implant loss should be provided.

Patients who have active periodontal disease or a history of periodontitis present specific challenges when implants are being considered, when they are placed and after they are restored. The risk of development of peri-implant diseases, along with the prognosis of any remaining teeth and the dentition overall, should be considered for each individual patient during the planning phase (see Tooth prognosis). In addition to periodontitis, patient-related risk factors to be considered during treatment planning include:

- smoking;
- diabetes;
- the likelihood of further tooth loss;
- lack of adherence to maintenance care;
- inadequate oral hygiene.

Factors related to the implant/prosthesis design and placement can also influence the risk of peri-implant disease. However, aspects of surgical and prosthodontic planning, implant design, surgical implant placement and restoration are beyond the scope of this guidance and are not discussed in detail.*

When considering dental implants, the patient should be made aware of any risk factors which may increase the risk of peri-implant disease and, where possible, these should be mitigated before implant treatment commences.

*These include iatrogenic factors such as incorrect surgical technique, incorrect positioning of the implant and foreign body reaction. In addition, aspects of the restoration which make oral hygiene and maintenance around the implants more difficult will contribute to an increased risk of peri-implant inflammation.

For patients with a diagnosis of periodontitis who are considering dental implants:

- Inform patients of their increased risk of peri-implant disease and how this can be mitigated.
- Advise patients of the need for increased maintenance care and vigilance post implant-placement.
- Control risk factors and active disease before implant placement, where possible.
- If responsible for designing the restoration, ensure the superstructure design allows for ease of access for oral hygiene and also inspection of peri implant tissues to allow detection of inflammation at an early stage.

Strength of recommendation (strong or conditional):

- Strong (100% agreement)

References

Berglundh T, Armitage G, et al. Peri-implant diseases and conditions: Consensus report of workgroup 4 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin Periodontol. 2018;45(Suppl 20): S286–S291.

Carra, M.C., Rangé, H., Swerts, P.-J., Tuand, K., Vandamme, K. and Bouchard, P. (2021), Effectiveness of implant-supported fixed partial denture in patients with history of periodontitis: A systematic review and meta-analysis. J Clin Periodontol, 49: 208-223.

Derks J, Tomasi C. Peri-implant health and disease. A systematic review of current epidemiology. Journal of Clinical Periodontology. 2015;42:S158-S71.

Diaz et al. What is the prevalence of peri-implantitis? A systematic review and meta-analysis. BMC Oral Health (2022) 22:449

Dreyer H, Grischke J, Tiede C, Eberhard J, Schweitzer A, Toikkanen SE, Glöckner S, Krause G, Stiesch M. Epidemiology and risk factors of peri-implantitis: A systematic review. J Periodontal Res. 2018 Oct;53(5):657-681. doi: 10.1111/jre.12562. Epub 2018 Jun 7. PMID: 29882313.

Herrera, D., Sanz, M., Kebschull, M., Jepsen, S., Sculean, A., Berglundh, T., Papapanou, P. N., Chapple, I., Tonetti, M. S., & EFP Workshop Participants and Methodological Consultant (2022). Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline. Journal of Clinical Periodontology, 49(Suppl. 24), 4–71.

Lin CY, Chen Z, Pan WL, Wang HL. Is History of Periodontal Disease Still a Negative Risk Indicator for Peri-implant Health Under Supportive Post-implant Treatment Coverage? A Systematic Review and Meta-analysis. Int J Oral Maxillofac Implants. 2020 Jan/Feb;35(1):52-62.

Renvert S, Quirynen, M. Risk indicators for peri-implantitis. A narrative review. Clin. Oral Impl. Res. 2015; 26 (Suppl.11):15–44.

Roccuzzo M, Bonino F, Aglietta M, Dalmasso P. Ten-year results of a three arms prospective cohort study on implants in periodontally compromised patients. Part 2: clinical results. Clin Oral Implants Res. 2012; 23:389–395.

Roccuzzo M, De Angelis N, Bonino L, Aglietta M. Ten-year results of a three-arm prospective cohort study on implants in periodontally compromised patients. Part 1: implant loss and radiographic bone loss. Clin Oral Implants Res. 2010; 21:490–496.

Schwarz, F., Derks, J., Monje, A., & Wang, H. L. (2018). Peri-implantitis. Journal of Clinical Periodontology, 45(Suppl 20), S246–S266.

Sousa V, Mardas N, Farias B, Petrie A, Needleman I, Spratt D and others. A systematic review of implant outcomes in treated periodontitis patients. Clinical Oral Implants Research. 2016;27(7):787-844.

Stacchi C, Berton F, Perinetti G, Frassetto A, Lombardi T, Khoury A and others. Risk Factors for Peri-Implantitis: Effect of History of Periodontal Disease and Smoking Habits. A Systematic Review and Meta-Analysis. Journal of Oral and Maxillofacial Research. 2016;7(3):e3.

Key Question 24

In patients with a diagnosis of periodontitis who are considering dental implant(s), what interventions carried out before implant placement, compared to no interventions, reduce the risk of peri-implant disease?

Recommendation in 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Basis for recommendation:

See above.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Pre-operative interventions

A comprehensive, systematic search of the literature failed to identify any systematic reviews directly relevant to interventions carried out before implant placement to reduce the risk of peri-implant disease.

It is noted from the considered judgement form examining the risks for peri-implant disease that the development of this complication following implant placement is multifactorial in nature and related to a number of biological and non-biological risk factors (Renvert 2015). These are discussed in more detail below.

Presence of periodontitis

Guidance on the standards of care for NHS-funded dental implant treatment (Restorative Dentistry-UK, Royal College of Surgeons of England, 2019) states that patients with a history of chronic periodontal disease should have the disease treated and stabilised for at least six months prior to the start of the implant treatment, given that these patients have a lower success rate with dental implant treatment and a higher risk of peri-implant disease.

The principle of achieving periodontal stability for those with periodontitis prior to implant placement is also recognised in a number of reviews (Renvert 2015, Salvi 2019, Patel 2020).

Public Health England's *Delivering Better Oral Health* (DBOH) guideline notes that a history of periodontitis is a risk factor for peri-implant disease (Berglundh 2018, Sousa 2016).

Systemic disease

DBOH notes that diabetes is a risk factor for peri-implant disease. Diabetes is also identified as a risk factor for peri-implantitis in the systematic review by Dreyer (2018), although another review describes the evidence for this as inconclusive (Schwarz 2018).

Smoking

DBOH notes that smoking is a risk factor for peri-implant disease (Sousa 2016). It states that although the role of smoking as a risk factor for peri-implantitis has previously been unclear, there is low certainty evidence from a systematic review (Stacchi, 2016) suggesting a significant association. Smoking is also identified as a risk factor for peri-implantitis in the systematic review by Dreyer (2018), although another review describes the evidence for this as inconclusive (Schwarz 2018).

Oral hygiene and maintenance

DBOH notes that poor oral hygiene is a risk factor for peri-implant disease (Berglundh 2018, Sousa 2016). Poor plaque control skills and a lack of regular maintenance therapy are also identified as contributing to an increased risk of developing peri-implantitis in the review by Schwarz (2018).

Effect of interventions to control risk factors

There is some evidence regarding the impact of controlling these risk factors on peri-implant disease outcomes. Specifically, the considered judgement form related to the effectiveness of implant-specific supportive care notes that there is low certainty evidence suggesting that provision of this intervention results in increased

implant survival rates and is more effective at preventing peri-implant disease compared to no supportive care (Atieh 2021, Lin 2019).

In relation to the other biological risks, previous considered judgement forms on risk assessment have established that controlling these risks can improve periodontal health outcomes. However there appears to be little evidence linking control of these risk factors to improvements in peri-implant disease outcomes. For example, Roccuzzo (2018) undertook a systematic review to examine the clinical outcomes for patients treated for peri-implantitis who subsequently received supportive care (supportive peri-implant/periodontal therapy) for at least three years. The primary outcome was implant survival, with peri-implantitis recurrence considered as a secondary outcome. Disease recurrence was not commonly discussed or defined in the 18 included studies and recession of the peri-implant mucosa following treatment was only documented in two studies.

In the absence of robust evidence assessing the effectiveness of pre-implant interventions, a review of the wider literature is helpful in indicating how peri-implant disease risk can be reduced pre-operatively. Renvert (2015) notes the potential for colonisation of implant surfaces from adjacent teeth is a risk for poorer outcomes, especially if a patient has some of the "high risk" organisms present in unstable periodontitis. This highlights the desirability of minimising the impact of these organisms by providing periodontal treatment before implant placement. Other risk-reducing actions noted in the review are controlling systemic disease (e.g. diabetes, hyperglycaemia) to reduce the overall inflammatory burden and ensuring that arrangements for ongoing implant maintenance are considered during the planning stage.

Peri-operative interventions

These interventions, provided as part of an implant-placement protocol, are most likely to be relevant to those clinicians who place dental implants.

The presence of oral biofilm is recognised as a risk in implant placement (Romanos 2019) and the use of antibiotics (Lund 2015, Daubert 2019) and antiseptics (Daubert 2019) to reduce this risk has been evaluated.

Antibiotics

Lund (2015) conducted a SR and meta-analysis to examine the use of peri-operative antibiotics. The review, including systematic reviews and primary studies, concluded that antibiotic prophylaxis in conjunction with implant placement reduced the risk for implant loss by 2%. Daubert (2019) cites a Cochrane review (Esposito 2013) that showed a slight benefit to success rates when a single dose of antibiotics was administered 1 hour prior to implant placement. There was no significant benefit with postoperative antibiotics. Daubert also notes that a systematic review by Chrcanovic (2014) found that prophylactic antibiotics do reduce implant failures, but that 50 patients must be given prophylactic antibiotics to prevent one failure. The most common preoperative antibiotic studied was Amoxicillin in a 2g dosage.

Antiseptics

Daubert (2019) notes that preoperative chlorhexidine has been evaluated for its effects on implant failure rate and infection-related complications. A surgical study evaluated levels of bacteria in bone harvested during implant surgery when 0.1% chlorhexidine was utilized as an immediate presurgical rinse compared with sterile water. Bone from the chlorhexidine group contained significantly fewer organisms versus the control group (Young 2002). A large retrospective study of 2,641 implants demonstrated that chlorhexidine use peri-operatively reduced infectious complications from 8.7% to 4.1%, and that implants which experienced an infectious complication had a 6-fold higher failure rate (12% vs. 2%) (Lambert 1997). The reduction in oral bacterial counts from chlorhexidine rinses pre- and post-operatively appears to reduce the rate of implant failure and complications, although exact protocols vary widely from study to study. The review notes that other preoperative interventions such as scaling and root planing and oral hygiene instruction, which may help reduce biofilm levels, have not been studied in regard to their effects on implant success rates.

Does the evidence differ from previously?

This question was not considered in the first edition of the guidance.

The evidence suggests that biological risk factors for peri-implant disease include a history of and current presence of unstable periodontitis, systemic disease (e.g. diabetes), smoking, poor oral hygiene and lack of

adherence to periodontal maintenance. Evidence related to interventions to address these risk factors prior to implant placement is lacking but indirect evidence relating to post-placement supportive care suggests that addressing these risk factors is beneficial, both in terms of preventing peri-implant disease and implant survival. There is more evidence to inform peri-operative interventions (antibiotics, antiseptics) to promote successful outcomes, but these are more relevant to those clinicians who place dental implants. Overall, the evidence is considered low certainty due to the lack of studies/reviews directly addressing the question.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- Addressing risk factors which may give rise to increased problems, both post-operatively and related to the ongoing retention and health of dental implants, is desirable and interventions to achieve this are evidence based (e.g. periodontal treatment, smoking cessation advice).
- There are unlikely to be any clinical disadvantages to addressing these risk factors. However, this will potentially increase total treatment time and costs to the patient.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- Patients with more advanced periodontal disease, systemic disease (e.g. diabetes) or those who smoke are more likely to benefit from these interventions.
- Clinicians should specifically assess the periodontal status during the planning phase and if active or previous periodontitis is diagnosed, discuss the risk to implant outcomes with patient

4. Values and preferences

Summarise any evidence or information on values and preferences.

- There is a lack of evidence to inform this section, but patients are likely to value interventions to reduce the likelihood of implant complications or failure.
- Clinicians are also likely to value interventions which may promote implant success rates.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Pre-operative periodontal treatment will increase total treatment time and costs and some patients may find that less acceptable

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Additional pre-placement treatment will add to overall costs of implant treatment
- Patients may not want additional time-consuming treatment which may delay the placement of implants
- There is a requirement for the clinical team to have individuals with the skills to diagnose and manage periodontal disease; training may be required.

7. Other factors

Indicate any other factors taken into account.

- Where a patient with modifiable risk factors related to increased implant complications opts for implant placement without treatment of periodontitis around teeth which will be retained, they should be warned of the increased risks of failure and complications.
- Where the implant (and restoration, where applicable) is being placed by an external clinician, it is important that there is communication between the referring practice and the external team with regard to the patient's periodontal condition, status of modifiable risk factors, ongoing supportive care after implant placement, and the role of different members of the larger overall team caring for the patient.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group were raised concerns about the potential consequences of proceeding with implant placement before periodontal disease has been stabilised. In this situation, it is not enough just to warn patients of the potential risks of having implants with active periodontitis. It was noted that the first principle of treatment planning is not to undertake advanced dentistry until disease is under control. This applies to all dental disease and not just periodontal disease. The patient should be dentally fit before receiving advanced therapy such as a dental implant.

The group discussed the minimum time period of periodontal stability required before advanced treatment can commence as this is something that patients often ask about. The EFP *Treatment of Stage IV periodontitis* guidelines do not specify a time limit before implant rehabilitation can commence but Restorative Dentistry-UK, Royal College of Surgeons of England (2019) guidance states that patients with a history of chronic periodontal disease should have the disease treated and stabilised for at least six months prior to the start of implant treatment. The Group note that it is a matter for the referring practice/those placing the implant to decide on the criteria for placing the implant rather than the referring primary care dentist.

The Group note the indirect and observational nature of the evidence and agreed that patients should be periodontally stable before implants are placed in line with good practice treatment planning i.e. all oral disease should be controlled before moving to advanced dental care (the principle of stabilisation before rehabilitation).

Recommendation in updated guidance:

- Prior to placing implants in patients with a diagnosis of periodontitis, stabilise any periodontal disease around teeth which are to be retained, address modifiable risk factors (e.g. poor oral hygiene, smoking, systemic disease) and explain the need for ongoing periodontal and implant maintenance care after placement to reduce the risk of peri-implant disease.

Relevant text from main narrative:

There is a lack of direct evidence related to interventions to address factors related to a higher risk of developing peri-implant disease prior to implant placement. However, indirect evidence relating to post-placement maintenance care suggests that addressing risk factors is beneficial, both in terms of preventing peri-implant disease and promoting implant survival. In addition, principles of treatment planning dictate that advanced treatments should not be provided until any current disease is under control. The evidence is considered low certainty due to risk of bias, indirectness and the observational nature of some studies. However, this guidance includes a strong recommendation in favour of the intervention because of the potential increased risk of peri-implant disease and implant loss if any current disease or risk factors are not addressed prior to implant placement.

For all patients considering dental implant therapy, a periodontal examination is essential during the treatment planning phase to determine the periodontal status of the patient. This will allow any existing periodontal disease to be identified and treated prior to implant placement. It will also ensure that patients can be informed of their increased risk of peri-implant disease and the need for additional ongoing maintenance care post-placement. The EFP *Prevention and treatment of peri-implant diseases* guideline recommends thorough assessment of the patient's risk profile to identify and manage modifiable risk factors prior to implant placement. This is described as primordial prevention. It also recommends treatment of any existing gingivitis

and/or periodontitis to a stable endpoint prior to implant placement and adherence to a supportive care programme afterwards.

Guidance from the Royal College of Surgeons of England states that patients with a history of periodontitis should have the disease treated and stabilised for at least six months prior to the start of the implant treatment. However, the EFP *Treatment of stage IV periodontitis* guideline does not specify a time limit between stabilisation of disease and proceeding to rehabilitation.

Treatment and control of periodontal disease prior to implant planning, placement and restoration:

- reduces the risk of peri-implant disease in those at higher risk;
- helps the clinician to more predictably assess patient response and likely prognosis of remaining teeth;
- gives the patient time to acquire skills in oral hygiene;
- supports the clinician in providing a restoration with a good long-term prognosis.

For those patients who have had extensive disease, planning should incorporate a view on prognosis and retention or extraction of other teeth in the mouth and consideration of any special challenges due to bone loss at potential implant sites which may complicate surgery. In some cases, referral to a practitioner or team with enhanced or specialist skills may be appropriate.

In patients with a diagnosis of periodontitis who are considering dental implant(s):

- Discuss the risk of peri-implant disease with the patient and explain that they are at higher risk of complications due to their history of periodontal disease.
- Explain to the patient that after the implant(s) is placed, there will be an ongoing, lifelong need for both periodontal and implant maintenance care to reduce the risk of peri-implant disease.
- Provide non-surgical (and if necessary surgical) treatment to control any active periodontal disease around teeth which are to be retained.
    - Address modifiable risk factors, such as poor oral hygiene, smoking, and systemic disease (e.g. diabetes), before implant placement, where possible.
- If the patient is referred externally for placement of the implant(s) (and restoration, if applicable), ensure that there is communication with the external team regarding the patient's periodontal condition and the status of modifiable risk factors.
- Prior to implant placement, ensure plans for ongoing maintenance care after placement are in place to prevent, and if necessary monitor, peri-implant inflammation.

Strength of recommendation (strong or conditional):

- Strong (100% agreement)

References

Atieh MA, AlAli F, Alsabeeha NHM. Outcome of supportive peri-implant therapy on the rates of periimplant diseases and marginal bone loss: a systematic review and meta-analysis. Quintessence Int. 2021; 52:122-131.

Berglundh T, Armitage G, et al. Peri-implant diseases and conditions: Consensus report of workgroup 4 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin Periodontol. 2018;45(Suppl 20): S286–S291.

Chrcanovic BR, Albrektsson T, Wennerberg A. Prophylactic anti-biotic regimen and dental implant failure: a meta-analysis. J Oral Rehabil. 2014;41(12):941-956

Daubert DM, Weinstein BF. Biofilm as a risk factor in implant treatment. Periodontol 2000. 2019 Oct;81(1):29-40. doi: 10.1111/prd.12280. PMID: 31407437.

Dreyer H, Grischke J, Tiede C, Eberhard J, Schweitzer A, Toikkanen SE, Glöckner S, Krause G, Stiesch M. Epidemiology and risk factors of peri-implantitis: A systematic review. J Periodontal Res. 2018 Oct;53(5):657-681.

Esposito M, Grusovin MG, Worthington HV. Interventions for replacing missing teeth: antibiotics at dental implant placement to prevent complications. Cochrane Database Syst Rev 2013;7:CD004152.

Lambert PM, Morris HF, Ochi S. The influence of 0.12% chlorhexidine digluconate rinses on the incidence of infectious complications and implant success. J Oral Maxillofac Surg 1997;12(Suppl 5):25-30

Lin CY, Chen Z, Pan WL, Wang HL. The effect of supportive care in preventing peri-implant diseases and implant loss: A systematic review and meta-analysis. Clinical Oral Implants Research. 2019;30(8):714-24.

Lund B, Hultin M, Tranaeus S, Naimi-Akbar A, Klinge B. Complex systematic review - Perioperative antibiotics in conjunction with dental implant placement. Clin Oral Implants Res. 2015 Sep;26 Suppl 11:1-14.

Patel RM. Dental Implants for Patients with Periodontitis. Primary Dental Journal. 2019;8(4):54-61.

Renvert, S, Quirynen, M. Risk indicators for peri-implantitis. A narrative review. Clin. Oral Impl. Res. 26 (Suppl. 11), 2015, 15– 44

Restorative Dentistry-UK, Royal College of Surgeons of England. *Guidance on the standards of care for NHS-funded dental implant treatment*. 2019, London.

Roccuzzo M, Layton DM, Roccuzzo A, Heitz-Mayfield LJ. Clinical outcomes of peri-implantitis treatment and supportive care: A systematic review. Clin Oral Implants Res. 2018 Oct;29 Suppl 16:331-350.

Romanos GE, Delgado-Ruiz R, Sculean A. Concepts for prevention of complications in implant therapy. Periodontol 2000. 2019 Oct;81(1):7-17. doi: 10.1111/prd.12278. PMID: 31407435.

Salvi GE, Zitzmann NU. The effects of anti-infective preventive measures on the occurrence of biologic implant complications and implant loss: a systematic review. Int J Oral Maxillofac Implants. 2014;29 Suppl:292-307.

Schwarz, F., Derks, J., Monje, A., & Wang, H. L. (2018). Peri-implantitis. Journal of Clinical Periodontology, 45(Suppl 20), S246–S266.

Sousa V, Mardas N, Farias B, Petrie A, Needleman I, Spratt D and others. A systematic review of implant outcomes in treated periodontitis patients. Clinical Oral Implants Research. 2016;27(7):787-844.

Stacchi C, Berton F, Perinetti G, Frassetto A, Lombardi T, Khoury A and others. Risk Factors for PeriImplantitis: Effect of History of Periodontal Disease and Smoking Habits. A Systematic Review and MetaAnalysis. Journal of Oral and Maxillofacial Research. 2016;7(3):e3.

Young MP, Korachi M, Carter DH, Worthington HV, McCord JF, Drucker DB. The effects of an immediately pre-surgical chlorhexidine oral rinse on the bacterial contaminants of bone debris collected during dental implant surgery. Clin Oral Implants Res. 2002;13(1):20-29.

Key Question 25

In patients with dental implants, does implant-specific supportive therapy, compared to no therapy, reduce the risk of peri-implant disease?

Recommendation in 2014 edition of guidance:

The question in the guidance focused on improvement in peri-implant health rather than risk reduction.

- In patients with dental implants, does implant specific supportive therapy, compared with no therapy, result in improved/sustained soft tissue health?

The guidance development group recommends that the peri-implant soft tissue, plaque levels and inflammation levels are regularly monitored, with supra-mucosal debridement and submucosal instrumentation of the implant surface where required. The Oral Hygiene TIPPS behaviour change strategy is recommended for patients whose oral hygiene is inadequate. Regular radiographs are not recommended unless clinically indicated.

Basis for recommendation:

The evidence, based on four systematic reviews (Grusovin 2010, Hultin 2007, Ong 2008, Van Assche 2007), did not identify any supportive therapy regimen as being the most effective for maintenance of soft tissue health around dental implants. The evidence was considered low quality due to a lack of well conducted or well reported studies; those which were reported were mainly non-controlled, small scale, or at high risk of bias and include significant heterogeneity in the outcomes measured. The guidance development group agreed there was very little evidence to recommend any specific supportive therapy regime for patients with dental implants. However, there was no evidence that current practice is ineffective.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

Public Health England's *Delivering Better Oral Health* (DBOH) guideline states that there is low certainty evidence, based on a systematic review (Lin 2019), that supportive periodontal care (SPC) can potentially maintain peri-implant health measured in terms of implant success rates, and prevent peri-implant mucositis, and/or peri-implantitis.

The systematic review by Lin (2019) evaluated the influence of SPC on implant survival rate and incidence of peri-implant diseases. Clinical studies were included if they employed a comparison between SPC and non-SPC groups and a follow-up period of a least a year. A meta-analysis was conducted with five retrospective studies and four prospective studies examining the effect of SPC on survival rate (n=6), peri-implantitis (n=3) and peri-implant mucositis (n=3). The SPC group significantly showed higher survival rate (RR: 1.10; $p<0.001$), lower prevalence of peri-implantitis (RR: 0.25; $p<0.001$) and peri-implant mucositis (RR: 0.57; $p<0.001$) than the non-SPC group. The authors concluded that the provision of maintenance care is better than not providing maintenance care and that a minimum common protocol of SPC should include full mouth examination and professional prophylaxis (oral hygiene instructions, plaque control and mechanical instrumentation) at least annually.

The DBOH guideline states that implants should be monitored regularly, with soft tissue health checked both visually and by probing and notes that radiographs are required to monitor bone stability over time. It suggests that at each visit, the dental team should:

- monitor plaque and marginal inflammation
- monitor probing depths and compare them to baseline (following placement of prosthesis) and previous visits, bleeding and presence of pus
- take appropriate radiographs as indicated and compare with the time of prosthesis placement and subsequent films
- debride all supra and submucosal plaque and calculus
- consider early referral to specialist for unresponsive deepened pockets with bleeding, or pus and progressive bone loss

- decide on recall interval based on peri-implant and periodontal status.

Additional evidence

A comprehensive, systematic search of the literature was conducted to identify relevant systematic reviews published after the publication of DBOH; two additional reviews were identified.

Atieh (2021) evaluated the impact of supportive peri-implant therapy (SPIT) on the rates of peri-implant mucositis and peri-implantitis and peri-implant marginal bone loss. The review covered five trials located in private practice and academic settings and included 617 patients with 1,570 implants and SPIT intervals ranging between 3 and 6 months. Meta-analysis of peri-implant mucositis occurrence rates suggested that adherence to SPIT resulted in lower rates of mucositis, which was not statistically significant at the patient level but was statistically significant at the implant level (moderate heterogeneity). Lack of SPIT was associated with higher rates of peri-implantitis at patient level (result statistically significant; no substantial heterogeneity) and at implant level (result statistically significant; substantial heterogeneity observed). For secondary outcomes, meta-analysis of two studies suggested that adherence to SPIT resulted in statistically significantly less marginal bone loss, with no heterogeneity detected. The certainty of the evidence is likely to be low due to moderate to serious risk of bias (as assessed by the ROBINS-I tool) and the lack of adjustments for confounding factors such as smoking. Another limitation of the review was the inclusion of only published data, as the search for unpublished studies did not find any results.

Tan (2022) assessed repeated periodontal therapy with air polishing devices (APDs) in comparison with hand instruments and/or power-driven instruments (conventional interventions) in supportive periodontal therapy (SPT) and implant maintenance. The review evaluated six RCT studies, with four SPT and 2 implant maintenance studies included. The results of the two implant maintenance studies were inconsistent. The first study observed statistically significant differences in PPD between groups favouring APD but non-significant differences in CAL gain. In the second study, preventive approaches were investigated in four groups of patients with dental implants who had therapy with air polishing devices or conventional instruments, with or without adjunctive use of chlorhexidine varnish. There were no statistically significant changes in PPD and BOP observed in all preventive approaches, except for the group which received adjunctive air polishing without chlorhexidine varnish where there was significant increase in PPD. The certainty of the evidence is likely to be low due to risk of bias in the primary studies, and the limited number of small studies included in the review.

Does the evidence differ from previously?

The first edition of the guidance considered a slightly different question, focussing on peri-implant health rather than risk reduction. There was no evidence to inform the most effective supportive therapy regime.

There is now low certainty evidence suggesting that provision of implant-specific supportive care results in increased implant survival rates and is more effective at preventing peri-implant disease compared to no supportive care (Atieh 2021, Lin 2019). Accordingly, Public Health England's *Delivering Better Oral Health* (DBOH) states that implants should be monitored regularly, with soft tissue health checked both visually and by probing and radiographs as indicated to monitor bone stability over time. It suggests monitoring of plaque, inflammation, probing depths (compared to baseline measurements) and removal of supra- and submucosal plaque and calculus. Recall should be based on peri-implant and periodontal status.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- Provision of, and adherence to, supportive care has been shown to result in higher survival rates and lower prevalence of peri-implantitis and peri-implant mucositis.
- Adverse events were not discussed in the reviews cited above but apart from the possibility of soft tissue damage or damage to the collar of the implant by inappropriate management during PMPR, it is unlikely that there are any undesirable effects of the intervention.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- Patients with a history of periodontitis may require more frequent and more intensive supportive care.
- Patients with complex, fixed restorations may need more oral hygiene instruction support and the clinical team supporting them may also need specific training
- Patients with poor levels or ability in homecare are likely to need extra support in homecare from the dental team, in terms of oral hygiene instruction and in-surgery visits for PMPR, to prevent inflammation developing around the implant.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- Patients are likely to value interventions that promote health of the supporting structures around the implant and the survival of their implants.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- The intervention (supportive implant care) is evidence-based current practice and is therefore likely to be acceptable to patients and the dental team.
- In circumstances where a team at different locations manage a patient having dental implants placed, communication between clinicians and the patient will be needed to establish who is responsible for providing supportive implant care and where it will take place.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- It is important that patients are made aware that dental implants require maintenance after placement and that they understand the ongoing costs of this care.
- Many providers who place and restore dental implants do not provide post-operative maintenance or supportive care.
- Specific training in implant maintenance will be required for those staff providing care for patients with dental implants i.e. general dentists and hygienists/therapists

7. Other factors

Indicate any other factors taken into account.

- Maintenance of dental implants not only involves consideration of the biological tissues supporting the implant but also maintenance of the prosthesis supported by the implant. This prosthetic maintenance should be incorporated, along with radiographic examination, if indicated, in a comprehensive implant maintenance support programme

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- This question was not considered in the first edition of the guidance.

Considered judgement:

The Group noted that there is low certainty evidence suggesting that provision of implant-specific supportive care results in increased implant survival rates and is more effective at preventing peri-implant disease compared to no supportive care. The Group discussed whether the issue of patients with poor levels or ability in

homecare (in sub-group considerations) should influence the decision to place implants. The Group were clear that this would be unethical in that it may involve rationing healthcare on the basis of a modifiable risk by insisting on good oral hygiene and compliance before implant placement.

Recommendation in updated guidance:

- For patients with dental implants, provide implant-specific maintenance care to reduce the risk of peri-implant disease.

Relevant text from main narrative:

Current evidence suggests that provision of implant-specific maintenance care results in increased implant survival rates and is more effective at preventing peri-implant disease (primary prevention) compared to no maintenance care. The certainty of the evidence is considered to be low due to the observational nature of most of the included studies. However, this guidance includes a strong recommendation in favour of the intervention because of the increased risk of peri-implant disease and implant loss if implant-specific maintenance care is not provided. In addition, regular monitoring of a patient's oral health status, with treatment provided where required, is standard practice.

The Delivering Better Oral Health (DBOH) toolkit states that implants should be monitored regularly, with soft tissue health checked both visually and by probing. It suggests monitoring of plaque, inflammation, probing depths (compared to baseline measurements), checking for bleeding and the presence of pus, and removal of supra- and submucosal plaque and calculus from the implant surfaces and restoration. DBOH also suggests the recall interval for maintenance care should be based on the peri-implant and periodontal status of the patient. The EFP *Prevention and treatment of peri-implant diseases* guideline recommends that patients should be informed of the importance of effective home care and adhering to supportive peri-implant care to reduce the risk of peri-implant diseases. It also recommends that the dental team provides regular supportive peri-implant care. Glycaemic control, smoking cessation and oral hygiene interventions are also recommended, where appropriate

As part of the ongoing care of implants, radiographs are used to monitor bone stability over time. A peri-apical radiograph aligned using the long cone paralleling technique should be taken at the time of superstructure connection. A further peri-apical radiograph, aligned using the long cone paralleling technique, should be taken at one year following this as a baseline for monitoring future changes in the bone level. Routine radiographic monitoring is not required unless there are clinical signs of infection and inflammation.

Implant-specific monitoring and maintenance should be carried out at each recall visit as detailed below:

- Assess the level of oral hygiene around an implant supported restoration.
  - Visually assess the soft tissue health and the presence or absence of inflammation around the implant.
- Probe around the implant, and restoration if it is fixed, to determine:
  - the presence of bleeding on probing and/or suppuration;
  - the presence of excess residual cement;
  - the presence of sub-mucosal plaque and calculus deposits.

  Note that topical or local anaesthetic can be used if probing around an implant is painful.
- Measure and record peri-implant probing depths, at four to six sites around the implant where possible, using fixed landmarks, and compare to baseline measurements.
  N.B. The BPE is not appropriate for the assessment of dental implants.
- Review personal oral hygiene and, where necessary, provide personalised oral hygiene advice and instruction to assist and encourage the patient to improve their oral hygiene skills as well as their understanding of the value of good self-care routines.
- Encourage the use of implant-specific oral hygiene aids such as implant floss and interdental brushes.

- Where applicable, give smoking cessation advice.
- Remove supra-mucosal and sub-mucosal plaque and calculus deposits, where present, using an appropriate method. Remove sub-mucosal excess residual cement, when possible, if this is detected. Use this opportunity to highlight to the patient areas where supra-mucosal deposits are detected.
    - Supra- and submucosal deposits can be removed using conventional instruments. Additional training may be required.
- When clinically indicated (e.g. where there is evidence of inflammation around the implant), perform radiographic examination of the implant to assess bone levels, using periapical radiographs taken using the long cone paralleling technique.
    - Routine radiographic assessment of implants is not recommended.
- Assess the patient's risk for disease progression, based on their medical history, known risk factors, periodontal status (e.g. degree of residual periodontal pocketing, levels of inflammation, levels of previous disease) along with levels of plaque control, and use this to inform future recall intervals for maintenance care.

Strength of recommendation (strong or conditional):

- Strong (85% agreement)

References

Atieh MA, AlAli F, Alsabeeha NHM. Outcome of supportive peri-implant therapy on the rates of peri-implant diseases and marginal bone loss: a systematic review and meta-analysis. Quintessence Int. 2021; 52:122-131.

Grusovin MG, Coulthard P, Worthington HV, George P, Esposito M. Interventions for replacing missing teeth: maintaining and recovering soft tissue health around dental implants. Cochrane Database of Systematic Reviews 2010, Issue 8. Art. No.: CD003069. DOI: 10.1002/14651858.CD003069.pub4.

Hultin M, Komiyama A, Klinge B. Supportive therapy and the longevity of dental implants: a systematic review of the literature. Clinical Oral Implants Research. 2007;18:50-62.

Lin CY, Chen Z, Pan WL, Wang HL. The effect of supportive care in preventing peri-implant diseases and implant loss: A systematic review and meta-analysis. Clinical Oral Implants Research. 2019;30(8):714-24.

Ong CT, Ivanovski S, Needleman IG, et al. Systematic review of implant outcomes in treated periodontitis subjects. Journal of Clinical Periodontology. 2008;35(5):438-462. Quirynen M, Abarca M,

Tan SL, Grewal GK, Mohamed Nazari, NS et al. Efficacy of air polishing in comparison with hand instruments and/or power-driven instruments in supportive periodontal therapy and implant maintenance: a systematic review and meta-analysis. BMC Oral Health 22, 85 (2022).

Van Assche N, Nevins M, van Steenberghe D. Impact of supportive periodontal therapy and implant surface roughness on implant outcome in patients with a history of periodontitis. Journal of Clinical Periodontology. 2007;39(9):805-815.

Key Question 26

In patients with peri-implant mucositis, is there evidence to support a specific intervention to recover peri-implant tissue health?

Recommendation in 2014 edition of guidance:

The guidance development group recommends supra-mucosal debridement and unscrewing of the abutment for cleaning or, if this is not possible, sub-mucosal instrumentation of the abutment surface. The Oral Hygiene TIPPS behaviour change strategy should be used to address inadequate oral hygiene. The guidance development group do not recommend the use of mouthwash or irrigation to treat peri-implant mucositis.

Basis for recommendation:

The evidence, based on two systematic reviews (Grusovin 2010, Renvert 2008), did not identify the most effective treatment for peri-implant mucositis. The evidence was considered low quality due to the primary studies being mainly short term, small scale, or at risk of bias. There was very little evidence on which to base a recommendation for the treatment of peri-implant mucositis. However, there was no evidence that self-performed oral hygiene measures plus professional instrumentation to remove plaque and calculus deposits do not improve the health of peri-implant soft tissues.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

A comprehensive, systematic search of the literature identified evidence from three consensus statements, an umbrella review of systematic reviews (SR) and two recent SRs. The evidence covers a range of adjunctive and alternative[1] interventions including antiseptics, mouth rinse, air polishing, laser and photodynamic treatment and probiotics.

Consensus Statements

The World Dental Federation (FDI) *Peri-implant Diseases Project: Consensus reports from the FDI workshop on prevention, diagnosis and treatment* (Renvert et al. 2019) noted that conventional non-surgical mechanical therapy in conjunction with oral hygiene reinforcement is the standard treatment for peri-implant mucositis, resulting in an average of 0.5–1.0 mm pocket depth reduction and 15%–40% reduction in bleeding on probing (BOP). The consensus statement, based on four position papers, concluded that the additional use of adjunctive therapies, such as antiseptic, antibiotic, antimicrobial, laser-assisted and probiotic therapies, provides only minimal clinical improvements in bleeding tendency and pocket reduction. The consensus statement notes that early detection and intervention of the disease remain key for higher success.

A working group from the *11th European Workshop on Periodontology* (2015) evaluated measures for the management of peri-implant mucositis and produced a consensus statement (Jepsen 2015) which recognised that patient measures to control oral hygiene along with professional interventions for plaque removal are used together to manage peri-implant mucositis. A review on the efficacy of patient-administered measures (Salvi & Ramseier 2015) found that although complete resolution following patient-administered measures (i.e. plaque control using a manual or powered toothbrush, adjunctive delivery of antimicrobials or triclosan-containing toothpastes) was not always reported, a reduction of clinical signs of inflammation as secondary outcome was evident in all studies. 11 RCTs, with follow-up periods ranging from 3-24 months were included in the review and most (7/11) had a moderate or high risk of bias so the results should be viewed with caution. A review on the efficacy of professionally administered plaque removal (mainly comprising oral hygiene instructions, mechanical debridement applying a variety of different hand or powered instruments and/or polishing tools) revealed a reduction in clinical signs of inflammation but resolution of BOP at the subject level was not achieved (Schwarz 2015). Adjunctive measures (antiseptics, local and systemic antibiotics, air-abrasive

[1] Adjunctive therapies are provided in addition to conventional treatment (mechanical debridement); alternative therapies are provided instead of conventional treatment.

devices) were not found to improve the efficacy of professionally administered plaque removal. Seven RCTs were included in the review, most of which were at unclear or high risk of bias. The consensus statement concludes that together, patient-administered mechanical plaque control (with a manual or powered toothbrush) is an effective preventive measure and that professionally administered plaque control procedures should include regular (based on the individual needs) oral hygiene instructions and mechanical debridement employing different hand or powered instruments with or without polishing tools.

Umbrella and Systematic Reviews

An umbrella review of SRs (Chuachamsai 2022) and two SRs (Ramanauskaite 2021, Gennai 2023) investigate various interventions for managing peri-implant mucositis. The certainty of the evidence varies but is likely to be low due to unclear or high risk of bias in most of the primary studies.

Antiseptics

There was evidence of no significant difference in BOP when compared to mechanical debridement alone in two reviews (Chuachamsai 2022, Ramanauskaite 2021). A third review (Gennai 2021) did detect a beneficial effect on BOP at three months but not at 6 months. Similarly, there is conflicting evidence across the reviews on the effects of antiseptics in reducing PD.

Chuachamsai (2022) found no significant difference in probing depth, BOP or CAL when antiseptics were used as an adjunctive to conventional treatment (based on meta analyses (MA) from 3 systematic reviews).

Ramanauskaite (2021) found no significant difference in BOP when local antiseptics (CHX) were used as an adjunct to mechanical debridement (2 RCTs; WMD= 5.30% [SE=5.04; p=0.29; 95% CI -15.06, 4.57; unit of analysis: implant]; low heterogeneity). A statistically significant difference in PD values favouring the adjunctive use of local antiseptics (i.e. CHX, sodium hypochlorite) was observed (4 RCTs; WMD -0.23 mm [SE=0.10; p=0.03; 95% CI -0.43, -0.03; unit of analysis: implant] low heterogeneity).

Gennai (2023) found that antiseptics (CHX, CHX & CPC, herbal and Delmopinol) gave a significant reduction in BOP at three months compared to control groups (N=5; subjects=229; WMD=22.72%; 95% CI 19.40–26.04; p<0.001; I^2 = 94.8%). However, there was significant heterogeneity and the smallest study seems to have had a disproportionate influence on the point estimate. The authors note that benefits for BOP were observed at 0–3 months (based on data from 5 studies low certainty evidence) but these were no longer significant at a longer follow-up of 0–6 months (1 study; moderate certainty evidence).

Antiseptic home care mouth rinse

One review (Ramanauskaite 2021) found no significant difference in BOP or PD with the use of antiseptic home care mouth rinse as an adjunct to mechanical debridement.

2 RCTs with 135 patients reported on the probing depth outcome: WMD=−0.11 mm [SE=0.12; p=0.37; 95% CI −0.33, 0.12; unit of analysis: implant, low heterogeneity. 3 reviews reported on the BOP outcome but no meta analysis was performed. The narrative states 2 RCTs found no difference while a third indicated significantly higher BOP reduction for the patients in the test group.

Probiotics

Three reviews (Gennai 2023, Chuachamsai 2022, Ramanauskaite 2021) found no difference in PD when adjunctive probiotics were used compared to mechanical debridement alone. There was inconsistent evidence on the effects of probiotics on BOP and PI across two reviews; the umbrella review (Chuachamsai 2022) did not find any differences in BOP or PI while Gennai (2023) found beneficial effects on BOP and PI in the short term, although these were not present after three months.

Chuachamsai (2022) identified one SR examining adjunctive probiotic treatment, which concluded that it was not superior to conventional treatment and two MAs which concluded that there was no significant difference between conventional non-surgical treatment and adjunctive probiotic treatment groups in terms of PD, BOP and PI.

Ramanauskaite (2021) analysed 2 RCTs and found no significant difference in PD values for adjunctive probiotics (WMD=−0.22 mm [SE=0.15; p=0.14; 95% CI -0.52, 0.08]; unit of analysis: implant, low heterogeneity).

Gennai (2023) found a significant difference in BOP favouring probiotics (*L. reuteri*) at three months (N=6; subjects=260; WMD=12.11%; 95% CI 3.20, 21.03; p=0.008; I^2 = 93.3% low certainty evidence). This effect was no longer significant at 0–6 months (moderate certainty evidence). The results also showed a tendency towards a beneficial effect of probiotics on PPD change at 3 and 6 months but the estimates were non-significant due to wide confidence intervals.

Air-polishing

Only one review investigated this intervention (Ramanauskaite 2021) and concluded that there was no significant difference in outcomes when air polishing was used compared to mechanical debridement alone. N.B. Each comparison was based on two small RCTs (54 and 35 participants respectively).

Ramanauskaite (2021) examined alternative measures for biofilm removal (3 RCTs). At both patient and implant level, the use of alternative measures (i.e. air powder abrasive device with glycine powder) for biofilm removal was no better or worse than conventional treatment in terms of PD (WMD=-0.33 mm; [SE=0.35; p=0.34; 95% CI −1.02, 0.35; 2 RCTs, 54 patients] and -0.49 mm [SE=0.17; p=0.01; 95% CI −0.82, −0.15; 2 RCTs, 35 patients] respectively; substantial heterogeneity). However the authors, in noting no beneficial effect for the use of air polishing devices at implant level, do not appear to have recognised the statistical significance of this result (p=0.01); this may be an misinterpretation of the data.

Laser and photodynamic treatment

Three reviews investigated this intervention. There was no significant difference in outcomes when adjunctive laser and antimicrobial photodynamic therapy (aPDT) were used compared to mechanical debridement alone.

The American Academy of Periodontology (AAP) consensus statement (Mills 2018), based on a review by Lin (2018), concluded that data on adjunctive laser treatment for peri-implant mucositis was scarce and that no substantial current evidence conclusively supported their use in the treatment of peri-implant mucositis.

Chuachamsai (2022) identified three SRs which reviewed laser and photodynamic treatments as separate adjuncts; these concluded that the adjunctive treatment was not superior to conventional non-surgical treatment (n=1) or that the data was inconclusive (n=2). One of the SRs conducted a MA and found that adjunctive laser therapy did not significantly differ from conventional treatment in terms of PD.

Ramanauskaite (2021) qualitatively reported on the finding of two studies using lasers as an adjunct and found no significant difference between that and mechanical debridement alone (meta analysis was not performed). They also reviewed three RCTs examining aPDT and found no significant difference between use of adjunctive aPDT compared to mechanical debridement alone in terms of BOP (WMD=−0.85% [SE=0.56; p=0.13; 95% CI −1.96, 0.26; 3 RCTs) and PD (WMD=−0.22 mm [SE=0.26; p=0.39; 95% CI − 0.72, 0.28; 2 RCTs). Heterogeneity was substantial for the BOP analysis and low for the PD analysis.

Irrigators or interdental brushes

Gennai (2023) reported one small study (N=30) which found a significant beneficial effect with the adjunctive use of irrigators and interdental brushes on BOP/mGI changes, but not on PI and PD changes, at 0–3 months (MD=54 %; 95% CI 31.21, 76.79; p < 0.001). No estimates were reported for longer follow-ups (0–6 months).

Does the evidence differ from previously?

There was limited evidence based on two RCTs to inform this question in the first edition of the guidance. There is now more evidence available across a range of interventions: air-polishing, antiseptics, mouthrinses, probiotics and laser and photodynamic treatment. The certainty of evidence is likely to be low and it should be noted that results for specific interventions are inconsistent across the primary studies and the umbrella/systematic reviews, which makes drawing definitive conclusions about the benefits of adjunctive measures difficult. Additionally, most studies appear to have considered single implants rather than large restorations supported on multiple implants. However, a consistent conclusion is that no specific alternative or adjunctive therapies significantly improve clinical outcomes when compared with non-surgical mechanical debridement alone (Mills 2018, Renvert 2019, Ramanauskaite 2021, Chuachamsai 2022). Given this, the recommended standard of care is professional intervention (mechanical debridement employing different hand or powered instruments with or without polishing tools) and support for patient performed oral hygiene instruction (Jepsen 2015).

A recent SR (Gennai 2023), prepared for the XVIII European Workshop on Periodontology, has evidenced significant clinical improvements of some clinical parameters from the adjunctive use of probiotics, topical antiseptics, systemic antibiotics, and oral irrigators and/or interdental brushes combined with professional submarginal instrumentation. The recommendations from this workshop are yet to be published.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- The use of adjunctive and alternative measures were not found to be superior to conventional treatment (i.e. non-surgical mechanical instrumentation in conjunction with oral hygiene reinforcement).
- To date, no specific adjunctive therapies have emerged as clearly superior to non-surgical mechanical debridement alone (Chuachamsai 2022).
- The widespread use of antiseptics should be balanced with the public health concerns related to the development of antimicrobial resistance (Gennai 2023)
- In the study of Delmopinol mouth rinse, a transient anaesthetic sensation in the oral mucosa was reported (Gennai 2023).
- In the two studies that used CHX as adjuvant treatment, higher levels of staining on the teeth or tongue due to its use as mouth rinse were reported (Gennai 2023).

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- Patients with a history and/or diagnosis of periodontitis, those who smoke, those with diabetes, those with cemented implants and those where oral hygiene around the restoration is difficult are likely to be at higher risk of developing peri-implant mucositis.
- Where oral hygiene around the implant is difficult for both the patient and clinician, or where residual cement cannot be removed non-surgically, adjunctive or alternative therapies may be helpful during non-surgical management.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- There is a lack of evidence to inform this section, but patients are likely to value interventions to reduce the likelihood of implant complications or failure.
- Clinicians are also likely to value interventions which may promote implant health.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Some patients might not want additional time-consuming, expensive treatment.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Promotion of effective home care, supplemented by regular professional maintenance, is key to primary prevention of disease.
- Additional non-surgical therapies will add to the costs of treatment.
- There may be a requirement for the clinical team to have individuals with additional knowledge and skills to administer alternative and adjunctive treatments, for example laser and antimicrobial photodynamic therapy (aPDT).
- It may be necessary to consider the removal of a fixed prosthesis to allow adequate access to diseased sites; this is time consuming, inconvenient for patients and can be complex.

7. Other factors

Indicate any other factors taken into account.

- When planning implant therapy, restorations should be planned which ensure that the placement of the implant and restoration allow for adequate home care and oral hygiene to prevent inflammation.
- Initial oral hygiene instruction at the time of restoration to teach the patient how to care for their implant and implant supported restoration is key to preventing development of disease.

- Regular professional maintenance is recommended for primary prevention and also to facilitate detection of disease at an early stage.
- Oral hygiene around fixed multi-unit implant restorations can be very challenging for both the patient and the clinician.
- While there is currently no evidence of a beneficial effect of alternative or adjunctive measures, the certainty of the evidence is low and further research may change the conclusions.

8. Additional information

Include any further information that is relevant to the considered judgement.

- Detection of inflammation around implants, particularly beneath fixed, multi-unit restorations can be difficult.
- Managing inflammation around implants can be very challenging particularly where the restoration contour gives limited access to the implant or abutment surface.
- Cement retained restorations are associated with higher rates of development of peri-implant inflammation. Care should be taken when placing these restorations to avoid cement being retained on the restoration or abutment surfaces.
- Where excess cement is identified, it should be removed.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

- The guidance development group recommends supra-mucosal debridement and unscrewing of the abutment for cleaning or, if this is not possible, sub-mucosal instrumentation of the abutment surface. The Oral Hygiene TIPPS behaviour change strategy should be used to address inadequate oral hygiene. The guidance development group do not recommend the use of mouthwash or irrigation to treat peri-implant mucositis.

Considered judgement:

The Group acknowledged the FDI consensus that conventional non-surgical mechanical therapy in conjunction with oral hygiene reinforcement is the standard treatment for peri-implant mucositis. The available evidence does not support the routine use of alternative and adjunctive treatments. It was noted that most studies look at single implants and most interventions did not look at complex multi-unit restorations. Consequently, the group agreed to recommend that these adjunctive interventions should not be used routinely. The Group reviewed alternative wordings for a recommendation. It was agreed to align with the evidence that was considered which evaluated the use of adjunctive or alternative measures to mechanical debridement and did not consider the efficacy of mechanical debridement on its own.

Recommendation in updated guidance:

- For patients with peri-implant mucositis, the routine use of adjunctive or alternative measures to professional mechanical plaque removal is not recommended.

Relevant text from main narrative:

A recent consensus statement from the World Dental Federation noted that conventional non-surgical professional mechanical plaque removal (PMPR), in conjunction with oral hygiene reinforcement, is the standard treatment for peri-implant mucositis. Evidence suggests that specific alternative or adjunctive therapies, such as antiseptics, antibiotics or treatment using lasers, do not significantly improve clinical outcomes when compared with PMPR alone. The certainty of the evidence is considered to be low due to risk of bias and inconsistency.

In addition, the EFP *Prevention and treatment of peri-implant diseases* guideline recommends PMPR in combination with oral hygiene re-enforcement for the management of peri-implant mucositis. PMPR can be

performed with ultrasonic or air polishing devices or with hand instruments. Short term use of patient-administered oral antiseptic rinses can be considered. The guideline does not recommend combining modes of PMPR or using lasers in combination with conventional PMPR. It also does not recommend the use of systemic or locally administered antibiotics as adjuncts to PMPR. It suggests not to use professionally administered local agents (e.g. antiseptics) or photodynamic therapy as adjuncts to PMPR.

If soft tissue inflammation is present:

- Exclude the presence of peri-implantitis by carrying out a radiographic examination of the implant to assess peri-implant bone levels compared with the baseline radiograph.
    - Peri-apical radiographs, taken using the long cone paralleling technique, are appropriate for assessing peri-implant bone levels.
    - If bone loss is observed, refer to *Treatment of peri-implantitis*.
- Check the restoration contour to ensure that patient performed oral hygiene is possible.
    - If the restoration does not allow access for home care, consider whether it is possible to recontour or replace the restoration to allow adequate oral hygiene.
- Check for the presence of retained cement around the restoration.
- Inform the patient of their diagnosis and any associated factors that increase their risk of disease.
- Provide personalised oral hygiene advice and instruction to assist and encourage the patient to improve their oral hygiene skills as well as their understanding of the value of good self-care routines.
- Encourage the use of implant-specific oral hygiene aids such as implant floss and interdental brushes.
- Where applicable, give smoking cessation advice and support.
- Carry out professional mechanical plaque removal of the restoration and implant surface.
    - Remove supra-mucosal and sub-mucosal plaque and calculus and any retained cement using an appropriate method. Local anaesthesia may be required.
- Arrange a review appointment after 1-2 months to assess the outcome of treatment.
- If inflammation is still present, repeat non-surgical treatment and:
    - Arrange review at 3 months;
    - Consider further radiographic assessment at 3-6 months to review bone levels.
- Ensure regular, risk-based recall for maintenance of the implants and their restorations is arranged.

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Gennai, S., Bollain, J., Ambrosio, N., Marruganti, C., Graziani, F., & Figuero, E. (2023). Efficacy of adjunctive measures in peri-implant mucositis. A systematic review and meta-analysis. Journal of Clinical Periodontology, 1– 27.

Chuachamsai S, Acharya A, Fischer K, Nibali L, Ho D, Pelekos G. The effectiveness of adjunctive measures in managing peri-implant mucositis: an umbrella review. Int J Implant Dent. 2022 Jun 8;8(1):26.

Grusovin MG, Coulthard P, Worthington HV, George P, Esposito M. Interventions for replacing missing teeth: maintaining and recovering soft tissue health around dental implants. Cochrane Database of Systematic Reviews 2010, Issue 8. Art. No.: CD003069. DOI: 10.1002/14651858.CD003069.pub4.

Jepsen S, Berglundh T, Genco R, Aass AM, Demirel K, Derks J, Figuero E,Giovannoli JL, Goldstein M, Lambert F, Ortiz-Vigon A, Polyzois I, Salvi GE, Schwarz F, Serino G, Tomasi C, Zitzmann NU. Primary prevention of peri-implantitis: managing peri-implant mucositis. J Clin Periodontol 2015; 42 (Suppl.16).

Lin, G-H, López del Amo, FS, Wang, H-L. Laser therapy for treatment of peri-implant mucositis and peri-implantitis: An American Academy of Periodontology best evidence review. J Periodontol. 2018; 89: 766–782.

Mills, MP, Rosen, PS, et al. American Academy of Periodontology best evidence consensus statement on the efficacy of laser therapy used alone or as an adjunct to non-surgical and surgical treatment of periodontitis and peri-implant diseases. J Periodontol. 2018; 89: 737-742.

Ramanauskaite A, Fretwurst T, Schwarz F. Efficacy of alternative or adjunctive measures to conventional non-surgical and surgical treatment of peri-implant mucositis and peri-implantitis: a systematic review and meta-analysis. Int J Implant Dent. 2021 Nov 15;7(1):112.

Renvert, S., Hirooka, H., Polyzois, I., Kelekis-Cholakis, A., Wang, H.-L. and (2019), Diagnosis and non-surgical treatment of peri-implant diseases and maintenance care of patients with dental implants – Consensus report of working group 3. Int Dent J, 69: 12-17.

Renvert S, Roos-Jansaker AM, Claffey N. Non-surgical treatment of peri-implant mucositis and peri-implantitis: a literature review. Journal of Clinical Periodontology. 2008;35(8 Suppl):305-315.

Salvi, GE, Ramseier, CA. Efficacy of patient-administered mechanical and/or chemical plaque control protocols in the management of peri-implant mucositis. A systematic review. J Clin Periodontol 2015; 42 (Suppl. 16): S187–S201.

Schwarz, F, Becker, K, Sager, M. Efficacy of professionally administered plaque removal with or without adjunctive measures for the treatment of peri-implant mucositis. A systematic review and meta-analysis. J Clin Periodontol; 2015; 42 (Suppl. 16): S202– S213.

Key Question 27

In patients with peri-implantitis, is there evidence to support a specific intervention to recover peri-implant tissue health?

Recommendation in 2014 edition of guidance:

The guidance development group recommends that patients with suspected peri-implantitis should ideally be referred back to the clinician who placed the implant. If this is not possible, the guidance development group recommends supra-mucosal debridement and sub-mucosal instrumentation of the implant surface plus the Oral Hygiene TIPPS behaviour change strategy to address inadequate oral hygiene. The condition should be monitored by the primary care dentist and if no improvement is observed then secondary care should be consulted for advice.

Basis for recommendation:

There is currently very little evidence on which to base a recommendation for the treatment of peri-implantitis. However, there is no evidence that currently used treatment regimes are ineffective. These may include oral hygiene demonstration and professional instrumentation. The evidence, based on five systematic reviews (Renvert 2008, Esposito 2012, Klinge 2002, Kotsovilis 2008, Muthukuru 2012), does not identify the most effective treatment for peri-implantitis. The evidence is considered low quality as the primary studies identified by the reviews were mainly small, often with comparisons to baseline rather than between groups and follow-up periods were short.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

(N.B. It is recognised that surgical management of peri-implantitis is often indicated. However, surgical management of peri-implantitis is beyond the scope of the guidance and will not be discussed here.)

A comprehensive, systematic search of the literature identified evidence from two consensus statements, two umbrella reviews of systematic reviews (SR) and a recent comprehensive SR. The evidence covers a range of adjunctive or alternative interventions[1] including antiseptics, mouthrinse, air polishing, laser and photodynamic treatment, and probiotics compared to conventional non-surgical treatment (i.e. mechanical debridement).

Consensus statements

The World Dental Federation (FDI*) Peri-implant Diseases Project: Consensus reports from the FDI workshop on prevention, diagnosis and treatment* (Renvert 2019) noted that

- non-surgical treatment of peri-implantitis (e.g. mechanical debridement alone) usually provides clinical improvements in terms of reduced bleeding tendency (20%–50%) and in some cases pocket reduction (≤1 mm). However, complete resolution of the disease is unlikely.
- the additional use of adjunctive therapies, such as antiseptics, antibiotics, antimicrobials and probiotics, or alternative therapies such as lasers, provides only minimal additional clinical improvements in bleeding tendency and pocket reduction.
- early detection and intervention of the disease remain key for higher success in management
- good quality non-surgical treatment, which addresses all contributing factors and includes adjunctive measures where necessary, should precede surgical procedures to facilitate assessment, improved treatment outcomes and patient compliance.

The American Academy of Periodontology (AAP) published a consensus statement (Mills 2018) on the efficacy of laser therapy used alone or as an adjunct to non-surgical and surgical treatment of periodontitis and peri-implant diseases. The statement was based on two reviews. Lin (2018) examined whether lasers used alone or as an adjunct to conventional forms of therapy provided better clinical outcomes than mechanical debridement

[1] Adjunctive therapies are provided in addition to conventional treatment (mechanical debridement); alternative therapies are provided instead of conventional treatment.

alone; The AAP statement notes that the review provides some evidence which suggests clinical benefits with adjunctive laser use in the non-surgical treatment of peri-implantitis in the short term, but no substantial evidence suggests long-term benefits. Chambrone (2018) examined the effectiveness of antimicrobial photodynamic therapy (aPDT) as an adjunct to mechanical debridement or surgery in patients with peri-implantitis (2 RCTs, 50 patients). The AAP statement notes that insufficient evidence was available for the reviewers to draw conclusions relative to the adjunctive effect of aPDT in the treatment of peri-implantitis. The AAP statement concludes that current evidence is insufficient to demonstrate a long-term benefit of adjunctive laser therapy and that more information is required to determine the clinical benefits of aPDT therapy.

Umbrella reviews

Dos Santos Martins (2022) undertook an overview of SRs of nonsurgical (NS) and surgical treatment of peri-implantitis with and without adjuncts. The quality of the six included SRs was assessed as high (3), moderate (1), low (1) and critically low (1) (AMSTAR II). The review found that the use of adjuncts to conventional non-surgical treatment (mechanical debridement) may have slightly better clinical outcomes but none of these techniques significantly reduced the bacterial load on the implant surface, with levels of pathogenic bacteria reduced for 6 months, at most. The authors also concluded that NS interventions for treating peri-implantitis have limited effects and are, most likely, not enough to stop peri-implantitis development nor to resolve it, reflecting the findings of the FDI consensus report (Renvert 2019).

In another umbrella review, Joshi (2022) examined evidence from 18 SRs looking at the efficacy of different non-surgical therapies in improving the outcomes in the treatment of peri-implantitis. The included reviews covered the use of growth factors, aPDT, glycine powder air polishing, laser treatment and non-surgical therapies compared with surgical therapies and the quality of evidence was assessed as moderate. The authors concluded that while non-surgical therapies are effective in alleviating the clinical signs of peri-implant mucositis, the majority of the reviews showed a lack of efficacy and indeterminate long-term evidence to support non-surgical therapies (i.e. mechanical debridement plus adjuncts) in the treatment of peri-implantitis and favoured the surgical approach as definitive treatment. However, the authors conclude that different non-surgical therapies can help to control or eliminate the local irritants in the peri-implant environment and therefore should be incorporated in phase one therapy to reduce inflammation and pathogenic microbiota in the treatment of peri-implant diseases.

Systematic review

Ramanauskaite (2021) undertook a SR and meta-analysis to assess the efficacy of alternative or adjunctive measures to conventional non-surgical and surgical treatment of peri-implant diseases. Nineteen studies were included; 17 RCTs were assessed as having high (8), unclear (4) or low (4) risk of bias (ROB 2 tool), the risk for two non-randomised studies was considered serious (ROBINS-I tool) and the overall certainty of evidence is likely to be low. It should be noted that in some analyses within this SR, data from studies which looked at different types of interventions and/or had different control groups was combined, which may not have been appropriate.

The results for the respective alternative and adjunctive treatments of peri-implantitis were:

Alternative measures for biofilm removal

Bleeding on probing (BOP) was reduced when alternative measures for biofilm removal (i.e. Er: YAG laser, air-powder abrasive device with glycine powder; based on 3 RCTs) were used but there was no difference between intervention and control in terms of probing depth (PD) and mucosal level (ML).

N.B. It may not have been appropriate to combine the results for lasers and air polishers for biofilm removal.

For the BOP outcome, alternative measures for biofilm removal were more effective than conventional treatment (3RCTs, 68 patients; WMD=-28.09% [SE=3.74; p=0.01; 95% CI -35.43, -20.76; unit of analysis: patient] low heterogeneity).

For the PD outcome, the difference was not significant (5 RCTs, 157 patients; WMD=-0.27 mm [SE=0.21; p=0.19; 95% CI -0.68, 0.13]; unit of analysis: patient; low heterogeneity)

For the ML outcome, the difference was not significant (2 RCTs, 50 patients; WMD=-0.21 mm [SE=0.34; p=0.55; 95% CI -0.87, 0.46; unit of analysis: patient], substantial heterogeneity).

Adjunctive local antiseptics/antibiotics

There was no significant difference in BOP, PD or ML when adjunctive antibiotics (i.e. minocycline microspheres) and local antiseptic (i.e. CHX gel or chips) were used compared to mechanical debridement alone.

N.B. It may not have been appropriate to combine the results for local antibiotics and antiseptics.

For the BOP outcome, the difference between the local use of adjunctive antibiotics and local antiseptic compared with mechanical debridement alone was not significant (3 studies,124 patients; WMD=-10.65% [SE=5.63; p=0.06; 95% CI (21.69, 0.38); unit of analysis: patient; low heterogeneity).

For the PD outcome, the difference was not significant (4 RCTs, 182 patients; WMD=-0.25 mm [SE=0.18; p=0.16; 95% CI -0.60, 0.10]; unit of analysis: patient; low heterogeneity).

For the mucosal level outcome, the difference was not significant (2 RCTs, 348 patients; WMD=-0.11 mm [SE=0.09; p=0.22; 95% CI -0.29, 0.07]; unit of analysis: patient; low heterogeneity).

Adjunctive systemic antibiotics

Adjunctive systemic antibiotics following mechanical debridement are more beneficial than conventional treatment without adjunctive antibiotics (based on 2 RCTs with 60 patients and 12 months of follow-up)

The WMD in BOP and PD was -17.35% [SE=2.56; p=0.01; 95% CI (-22.37, -2.32)]; unit of analysis: patient) and -1.46 mm [SE=0.35; p=0.01; 95% CI (-2.15, -0.77)]; unit of analysis: patient) respectively (low heterogeneity).

Adjunctive probiotics

There was no significant difference in BOP or PD when adjunctive probiotics were used compared to mechanical debridement alone.

The BOP data was not combined in a meta analysis and the findings were simply reported in the narrative. The WMD in PD was -0.15 mm (2 RCTS, 49 patients; [SE=0.16; p=0.35; 95% CI -0.47, 0.17]; unit of analysis: patient; low heterogeneity).

The authors concluded that alternative and adjunctive measures for non-surgical treatment of peri-implantitis were superior in reducing BOP compared to non-surgical mechanical treatment alone. However, it should be noted that due to the risk of bias in most of the primary studies and concerns about the methodology employed in this review, the certainty of the evidence is likely to be low.

Does the evidence differ from previously?

The previous version of the guidance noted that there was very little evidence on which to base a recommendation for the treatment of peri-implantitis but that that there was no evidence that currently used treatment regimes were ineffective. There is now more evidence examining the use of adjunctives to mechanical debridement, or alternatives to mechanical debridement, in the management of peri-implantitis. The evidence comes from consensus statements, umbrella reviews and a recent systematic review. The quality of evidence assessed ranged from moderate to low certainty. It should be noted that the studies generally look at measures related to superficial inflammation and probing depth rather than measures of bone loss and are largely short term.

A range of alternative or adjunctive interventions have been investigated, including air-abrasive polishing devices, antiseptics, antibiotics, antimicrobial, laser-assisted and probiotic therapies. The consistent finding was that some alternative or adjunctive interventions can lead to limited improvements in BOP, and to a lesser degree PD, compared with mechanical debridement alone in the initial stages of disease (Ramanauskaite 2021, Dos Santos Martins 2022). However, the number of studies assessed for each intervention is small and there are also concerns about the risk of bias in the primary studies and the methodology of the systematic reviews.

Joshi (2022) notes that there is a lack of long-term evidence for non-surgical interventions to manage peri-implantitis but that they may be employed in the initial stages of treatment to reduce inflammation and pathogenic microbiota.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- There is a lack of robust evidence to support the routine use of adjunctive or alternative therapies in controlling peri-implantitis non-surgically compared to mechanical debridement alone (Renvert 2019, Dos Santos Martins 2022, Ramanauskaite 2021, Joshi 2022)
- If lasers are not used according to proper protocols, damage can occur to neighbouring teeth, the dental implant, and/or surrounding tissues. Overheating of the tooth or implant surface and/or body is likely to be impacted by the type of laser and protocol employed (AAP Consensus Statement, Mills 2018).

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- Patients with a history and/or diagnosis of periodontitis, those with diabetes, those who smoke, those with cemented implants and those where oral hygiene around the restoration is difficult are likely to be at higher risk of developing peri-implantitis
- Patients with higher aesthetic needs may opt for a non-surgical approach to minimise the negative impact of surgical treatment but should be made aware of the potential benefits of surgical treatment
- Where oral hygiene or debridement around the implant is difficult for the patient or clinician, adjunctive or alternative therapies may be helpful during non-surgical management
- Where access around implants for conventional mechanical debridement is difficult, adjunctive or alternative therapies may be helpful.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- There is a lack of evidence to inform this section, but patients are likely to value interventions to reduce the likelihood of progressive bone loss around an implant and implant failure
- Clinicians are also likely to value interventions which promote implant health

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Some patients might not want additional, expensive time-consuming treatment
- Patients may favour non-surgical management to surgical management, especially where aesthetic or prosthodontic complications may arise following surgical intervention but patients should be made aware of the potential benefits of surgical treatment

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Additional non-surgical therapies will add to the costs of treatment
- There may be a requirement for the clinical team to have individuals with additional knowledge and skills to administer alternative and adjunctive treatments, for example laser and antimicrobial photodynamic therapy
- It may be necessary to consider the removal of a fixed prosthesis to allow adequate access to diseased sites for mechanical debridement and non-surgical management; this is time consuming, inconvenient for patients and can be complex.

7. Other factors

Indicate any other factors taken into account.

- Not controlling peri-implantitis may lead to loss of an implant
- When planning implant therapy, restorations should be planned which ensure that the placement of the implant and restoration allow for adequate home care and oral hygiene to prevent inflammation. Plans for implant maintenance should also be drawn up at this stage.

- Initial oral hygiene instruction at the time of restoration to teach the patient how to care for their implant and implant supported restoration is key to preventing development of disease.
- Oral hygiene around fixed multi-unit implant restorations can be very challenging for both the patient and the clinician
- Management of peri-implantitis is challenging and unpredictable. It is likely to require surgical management, which is unlikely to be provided in primary care. Therefore, early referral back to the team who placed the implant should be considered

8. Additional information

Include any further information that is relevant to the considered judgement.

- Detection of inflammation around implants, particularly beneath fixed, multi-unit restorations, can be difficult
- Managing inflammation around implants can be very challenging if the restoration contour gives limited access to the implant or abutment surface
- Where there are multiple implants supporting a restoration, the implications of developing peri-implantitis can be considerable for the whole restoration
- Cement retained restorations are associated with higher rates of development of peri-implant inflammation. Care should be taken when placing these restorations to avoid cement being retained on the restoration or abutment surfaces.
- Where excess cement is identified, it should be removed.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

The guidance development group recommends that patients with suspected peri-implantitis should ideally be referred back to the clinician who placed the implant. If this is not possible, the guidance development group recommends supra-mucosal debridement and sub-mucosal instrumentation of the implant surface plus the Oral Hygiene TIPPS behaviour change strategy to address inadequate oral hygiene. The condition should be monitored by the primary care dentist and if no improvement is observed then secondary care should be consulted for advice.

Considered judgement:

The Group acknowledged the recommendations in consensus statements and reviewed evidence that supports non-surgical treatment of peri-implantitis as the first step in attempting to reduce inflammation. Although the focus of the appraisal was not on comparing surgical and non-surgical treatments, it was noted that the evidence suggests that surgical treatment is more effective. There is insufficient evidence in favour of adjunctive or alternative measures to conventional mechanical debridement. It was noted that the current evidence, based on small, short-term studies, is insufficient to determine with certainty the efficacy of these treatments. However, there are situations, acknowledged in the evidence, where the use of adjunctive and alternative treatments may be helpful to sub-groups of patients, for example where access to the implant for mechanical debridement is difficult. The Group reviewed alternative wordings for a recommendation and agreed that this should focus on the evidence which was considered in answering the clinical question, that is, the use of adjunctive or alternative measures to mechanical debridement. Consequently, the group agreed to recommend that these should not be used routinely.

Recommendation in updated guidance:

- For patients with peri-implantitis, the routine use of adjunctive or alternative measures to professional mechanical plaque removal is not recommended.

Relevant text from main narrative:

A consensus statement from the World Dental Federation noted that conventional non-surgical professional mechanical plaque removal (PMPR) may result in short-term improvements in inflammatory parameters but is unlikely to resolve the disease. Evidence suggests that specific alternative or adjunctive therapies, such as antiseptics, antibiotics or treatment using lasers, do not significantly improve clinical outcomes when compared with PMPR alone. The certainty of the evidence ranges from moderate to low due to risk of bias, inconsistency and small study sizes.

Non-surgical interventions to manage peri-implantitis (i.e. the re-establishment of effective self-performed oral hygiene and professional removal of supra- and sub-mucosal plaque biofilm and calculus deposits and excess residual cement) may be helpful in the initial stages of treatment to reduce inflammation and pathogenic microbiota.

The EFP *Prevention and treatment of peri-implant diseases* guideline recommends initial non-surgical management. This includes oral hygiene instruction and motivation, risk factor control, prosthesis cleaning/removal/modification (including controlling biofilm retentive factors and evaluation of the components of the prosthesis where required and feasible), and supramucosal and submucosal PMPR around the implant. In addition, where periodontal disease is present elsewhere in the mouth, this should be treated. PMPR around the implant can be performed with ultrasonic or sonic devices or hand instruments. The guideline suggests not to use air polishers, lasers, photodynamic therapy, antiseptic gel or probiotics as monotherapies or as adjuncts to PMPR. Regarding antimicrobial therapy, the guideline does not recommend the use of systemic antibiotics as adjuncts to PMPR and suggests not to use locally administered antimicrobials as an adjunct to PMPR or as a monotherapy.

The management of peri-implantitis is difficult and unpredictable and surgical management is often required.* However, even this may not be sufficient to control the disease and in cases where there is progressive bone loss around the implant, implant removal may be a valid management option. Initial non-surgical options around implant-supported restorations can be challenging to deliver and referral to the clinical team which placed the implants, especially where complex restorations are present, may be appropriate if peri-implantitis develops.

It is recognised that referral for management of peri-implantitis may either not be possible (e.g. for example the clinical team that placed the implant cannot provide ongoing maintenance care) or may not be straightforward (e.g. local services to support the patient post-placement may not be available). In these cases, the primary care team is encouraged to provide treatment and support, within their skill mix where possible, and on an ongoing basis.

**While surgical management of peri-implantitis is often indicated, this is beyond the scope of the guidance and specific aspects and techniques will not be discussed here.*

If soft tissue inflammation is present:

- Carry out a radiographic examination of the implant using peri-apical radiographs, taken using the long cone paralleling technique, to evaluate peri-implant bone levels compared with the baseline radiograph.
- If progressing crestal bone loss is detected, refer back to the clinician who placed the implant.
    - Surgical management may be considered in these cases.
- If referral is not possible, consider whether the implant is saveable. For example, 80% bone loss around the implant indicates that it is likely to fail in the short-term.
    - If it is not clear whether the implant is saveable, discuss the situation with the patient and review the options for referral.
- If the implant is saveable, carry out initial non-surgical management.
    - Check the restoration contour to ensure that patient performed oral hygiene is possible. If the restoration does not allow access for home care, consider whether it is possible to recontour or replace the restoration to allow adequate oral hygiene.

- Check for the presence of retained cement around the restoration.
- Provide personalised oral hygiene advice and instruction to assist and encourage the patient to improve their oral hygiene skills as well as their understanding of the value of good self-care routines.
- Encourage the use of implant-specific oral hygiene aids such as implant floss and interdental brushes.
- Where applicable, give smoking cessation advice and support.
- Remove supra-mucosal and sub-mucosal plaque and calculus and any retained cement using an appropriate method. Local anaesthesia may be required.
    - If access for debridement is difficult, and there are indications not to remove the restoration, consider the use of adjunctive or alternative therapies.
- Arrange a follow-up appointment after 1-2 months to assess the outcome of treatment. Re-examine the peri-implant tissues. Where there is no improvement or in the presence of acute pain and infection, seek advice from secondary care.
- If referral to secondary care is not possible and there is persistent inflammation, discuss the situation with the patient, repeat non-surgical management and review the options for referral. In some cases, the only option may be for the primary care team to provide care to control symptoms and superficial inflammation around the implant.
- If the inflammation has settled, arrange radiographic follow-up in 6-12 months to check crestal bone levels. If bone loss is ongoing, seek advice from secondary care.
- Ensure regular, risk-based recall for maintenance of the implants and their restorations is arranged.

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Chambrone, L, Wang, H-L, Romanos, GE. Antimicrobial photodynamic therapy for the treatment of periodontitis and peri-implantitis: An American Academy of Periodontology best evidence review. J Periodontol. 2018; 89: 783– 803.

Dos Santos Martins BG, Fernandes JCH, Martins AG, de Moraes Castilho R, de Oliveira Fernandes GV. Surgical and Nonsurgical Treatment Protocols for Peri-implantitis: An Overview of Systematic Reviews. Int J Oral Maxillofac Implants. 2022 Jul-Aug;37(4):660-676.

Esposito M, Grusovin MG, Worthington HV. Interventions for replacing missing teeth: treatment of peri-implantitis. Cochrane Database of Systematic Reviews 2012, Issue 1. Art. No.: CD004970. DOI: 10.1002/14651858.CD004970.pub5

Joshi AA, Gaikwad AM, Padhye AM, Nadgere JB. Overview of Systematic Reviews and Meta-analyses Investigating the Efficacy of Different Nonsurgical Therapies for the Treatment of Peri-implant Diseases. Int J Oral Maxillofac Implants. 2022 Jan-Feb;37(1): e13-e27.

Klinge B, Gustafsson A, Berglundh T. A systematic review of the effect of anti-infective therapy in the treatment of peri-implantitis. Journal of Clinical Periodontology. 2002;29 (Suppl 3):213-225.

Kotsovilis S, Karoussis IK, Trianti M, Fourmousis I. Therapy of peri-implantitis: a systematic review. Journal of Clinical Periodontology. 2008;35(7):621-629.

Lin G-H, López del Amo FS, Wang H-L. Laser therapy for treatment of peri-implant mucositis and peri-implantitis: an American Academy of Periodontology best evidence review. J Periodontol. 2018;89:766–782

Mills, MP, Rosen, PS, et al. American Academy of Periodontology best evidence consensus statement on the efficacy of laser therapy used alone or as an adjunct to non-surgical and surgical treatment of periodontitis and peri-implant diseases. J Periodontol. 2018; 89: 737-742.

Muthukuru M, Zainvi A, Esplugues EO, Flemmig TF. Non-surgical therapy for the management of peri-implantitis: a systematic review. Clinical Oral Implants Research. 2012;23 Suppl 6:77-83.

Ramanauskaite A, Fretwurst T, Schwarz F. Efficacy of alternative or adjunctive measures to conventional non-surgical and surgical treatment of peri-implant mucositis and peri-implantitis: a systematic review and meta-analysis. Int J Implant Dent. 2021 Nov 15;7(1):112.

Renvert, S., Hirooka, H., Polyzois, I., Kelekis-Cholakis, A., Wang, H.-L. and (2019), Diagnosis and non-surgical treatment of peri-implant diseases and maintenance care of patients with dental implants – Consensus report of working group 3. Int Dent J, 69: 12-17.

Renvert S, Roos-Jansaker AM, Claffey N. Non-surgical treatment of peri-implant mucositis and peri-implantitis: a literature review. Journal of Clinical Periodontology. 2008;35(8 Suppl):305-315.

Key Question 28

- In patients with peri-implant mucositis or peri-implantitis, does the use of antibiotic therapy as an adjunct to peri-implant therapy, compared to peri-implant therapy alone, result in improved peri-implant tissue health?

Recommendation in 2014 edition of guidance:

Current evidence is insufficient to determine if adjunctive antibiotic therapy is effective in the treatment of peri-implant mucositis or peri-implantitis in primary dental care. The guidance development group does not recommend the routine use of antibiotics for the treatment of peri-implant mucositis or peri-implantitis in primary care.

Basis for recommendation:

The evidence, based on two systematic reviews (Klinge 2002, Heitz-Mayfield 2004) was insufficient to determine if adjunctive antibiotic therapy is effective in the treatment of peri-implant mucositis or peri-implantitis. The evidence was considered low quality as the primary studies identified by the reviews were small scale and short term.

1. Summary of evidence since 2014 edition of guidance

Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the certainty of the evidence. Comment on the degree of consistency demonstrated by the available evidence. Note where evidence is lacking.

A comprehensive, systematic search of the literature identified evidence from two consensus statements and five recent systematic reviews (SR).

Consensus statements

A consensus report from the World Dental Federation (FDI) *Peri-implant Diseases Project workshop on prevention, diagnosis and treatment* (Renvert 2019), recognised that peri implantitis is often multifactorial and that several factors, apart from non-surgical therapy, should be considered during management. In a narrative review, Wang (2019) considered the use of adjunctive therapies, including antibiotic and antimicrobial therapies in the management of peri implantitis. The review reported that some positive benefits in BOP and PD were reported in a small number of clinical trials with regard to adjunctive locally delivered antibiotic (minocycline microspheres). However, although clinical case studies report benefits, RCTs could not find a benefit from the adjunctive use of systemic antibiotics. The working group concluded that early detection and intervention of the disease remain key for higher success and that there was currently no substantial evidence to support the use of professionally administered antimicrobials.

A working group from the *11th European Workshop on Periodontology* (EWP) (2015) assessed measures for the management of peri-implant mucositis and produced a consensus statement (Jepsen 2015) informed by a SR and meta-analysis (MA) (Schwarz 2015) examining professionally administered plaque removal with or without adjunctives which included local and systemic antibiotics. The SR included two RCTs considered to be at high risk of bias examining the efficacy of local and systemic antibiotics in reducing bleeding on probing (BOP) and probing depth (PD). One investigated the adjunctive use of tetracycline fibres (locally delivered) compared to mechanical debridement alone and found BOP improvements in the tetracycline group at 3 months (8 patients; 24 implant sites). The other investigated the use of systemic azithromycin as an adjunct to mechanical debridement compared to mechanical debridement alone but found no differences in clinical parameters between groups at 6 months (45 patients). The meta-analysis from this review combined interventions with antibiotics and interventions with antiseptics and compared them to conventional therapy. This may not have been appropriate therefore the results of the meta-analysis are not reported here due to the heterogeneity of the analysed interventions.

The EWP consensus statement concluded that adjunctive measures, including local and systemic antibiotics, do not improve the efficacy of professionally administered plaque removal in reducing clinical signs of inflammation in patients with peri-implant mucositis.

Systematic reviews

Two systematic reviews (Ramanauskaite 2021; Gennai 2023) investigated the use of local or systemic antibiotics in the treatment of peri-implant mucositis. Most of the primary studies in the first review (Ramanauskaite 2021) were at high or unclear risk of bias which suggests the certainty of the evidence from this review is likely to be low. The second review (Gennai 2023)[1] assessed the certainty of evidence as high for BOP changes at both 3 months and 6 months and very low for PD changes at both 3 months and 6 months but it should be noted that there were a limited number of studies and participants included in the review.

Four systematic reviews (Ramanauskaite 2021; Grusovin 2022; Toledano 2021; Toledano-Osorio 2022) investigated the use of local or systemic antibiotics in the treatment of peri-implantitis. The certainty of the evidence from these reviews is likely to be low due to the inclusion of non-randomised studies, risk of bias, heterogeneity, limited follow-up periods and small sample sizes.

Management of peri-implant mucositis: Local antibiotics

No data reported

Management of peri-implant mucositis: Systemic antibiotics

Two reviews report on this intervention. One did not find a difference between intervention and control groups (Ramanauskaite 2021) while the other found a significant reduction in BOP and PI, but not PD, at 3 and 6 months (Gennai 2023). Both reviews are based on a small number of studies with limited participant numbers.

Ramanauskaite (2021) reported that administration of azithromycin (adjunctive to mechanical debridement or combined with subgingival debridement and aPDT therapy) failed to show any beneficial effect in terms of BOP or PD in 2 RCTs of 180 patients with follow-up periods of 3 to 6-months.

Gennai (2023) found a significant reduction in BOP and Plaque Index at 0–3* and 0–6¥ months in favour of adjunctive systemic antibiotics compared to mechanical debridement alone. Estimates for PD reduction between groups were non-significant at any timepoint considered.
*Data for 3 months follow-up, based on 3 studies and 101 patients: BOP WMD=5.97%; 95% CI 1.34-10.59; p=0.012; I^2=58.1%; Plaque WMD=14.74%; 95% CI 3.83-25.65; p =0.008; I^2=83.2%
¥Data for 6 months follow-up, based on 2 studies and 71 patients: BOP WMD=20.79%; 95% CI 15.24-26.34; p<0.001; I^2=0%; Plaque WMD=13.97%; 95% CI 4.10-28.35; p =0.006; I^2=30.6%

Management of peri-implantitis: Local antibiotics

Three reviews report on this intervention. One did not find a difference between intervention and control groups (Ramanauskaite 2021) while the other two reviews (Grusovin 2022, Toledano 2021) found significant improvements in PD and BOP. One review (Grusovin 2022) also found an improved success rate (i.e. peri-implantitis resolution). The findings of the first two reviews are based on a small number of studies with limited participant numbers, while the third (Toledano 2021) is informed by a moderate number of studies and participants.

Ramanauskaite (2021) combined the data for adjunctive local antiseptics and antibiotics, which may not have been appropriate, and found that the use of these adjuncts does not appear to be more beneficial than mechanical debridement alone. There were no significant differences between groups in terms of BOP (3 studies; WMD=-10.65% [SE=5.63; p=0.06; 95% CI -21.69, 0.38]; unit of analysis: patient; low heterogeneity) or PD (4 RCTs; WMD=-0.25 mm [SE=0.18; p=0.16; 95% CI -0.60, 0.10]; unit of analysis: patient; low heterogeneity).

Grusovin (2022), based on two studies with 106 patients, found that adjunctive local antibiotics improved PD (MD=0.6 mm; 95% CI 0.42–0.78), BOP (MD=0.15%; 95% CI 0.10, 0.19) and resolution of peri-implantitis (risk ratio=9.89; 95% CI 2.39–40.84).

A review by Toledano (2021) found that adjunctive local antibiotics resulted in a mean additional reduction in PD of 0.3 mm (95% CI 0.07-0.53; I^2=45%; 7 studies, 328 patients) and an odds ratio of 1.82 for BOP, indicating that the likelihood of bleeding on probing after treatment is almost halved when local antibiotics are used.

[1] This review will inform the XVIII European Workshop on Periodontology.

Management of peri-implantitis: Systemic antibiotics

Three reviews report on this intervention. One did not find significant differences between intervention and control groups in terms of BOP or PD (Toledano-Osorio 2022) while the other two reviews (Ramanauskaite 2021, Grusovin 2022) found significant improvements in BOP, PD and probing attachment level (PAL). However, no improvements in success rate (i.e. peri-implantitis resolution) or bone level were observed in one review (Grusovin 2022). The findings of the two similar reviews (Ramanauskaite 2021, Grusovin 2022) are based on a small number of studies with limited participant numbers, while the other (Toledano-Osorio 2022) is informed by a moderate number of studies and participants.

Ramanauskaite (2021) reported that the use of adjunctive systemic antibiotics appears to be more beneficial than conventional treatment for both BOP and PD outcomes, based on 2 RCTs with 60 patients
(BOP WMD=-17.35% [SE=2.56; p=0.01; 95% CI -22.37, -2.32]; unit of analysis: patient); low heterogeneity.
(PD WMD=-1.46 mm [SE=0.35; p=0.01; 95% CI -2.15, -0.77]; unit of analysis: patient); low heterogeneity.

Grusovin (2022) found no significant difference in bone level and resolution of peri-implantitis with the use of systemic antibiotics, although they appeared to improve PD at 4 months (MD=1.15 mm; 95% CI 0.31–1.99; 2 studies, 72 patients) and probing attachment level (PAL) at 1 year (MD=1.10 mm; 95% CI 0.13–2.08; 3 studies, 134 patients).

Toledano-Osorio (2022) found an odds ratio for BOP of 1.15 (95% CI 0.76-1.75, p=0.5; I^2=0%; 10 studies, 566 patients), suggesting that the likelihood of bleeding is similar with or without systemic antibiotics. The mean -PD reduction was 0.1 mm (95% CI -0.26-0.46; p=0.58; I^2=54%; 11 studies, 587 patients), indicating that the -PD is similar with or without systemic antibiotics. A number of secondary outcomes were also analysed which suggest that systemic antibiotics can lead to reduced clinical attachment loss (CAL), lower suppuration and recession, reduced bone loss and lower total bacterial counts but no meta analysis was performed for these outcomes.

Does the evidence differ from previously?

There was limited evidence, based on two systematic reviews, to inform this question in the first edition of the guidance. There is now more evidence available to assess the efficacy of adjunctive antibiotics in the treatment of peri-implant diseases from consensus statements and a number of recent SRs but there is some inconsistency in their conclusions.

Two consensus statements (Jepsen 2015, Renvert 2019) conclude that the use of adjunctive local and systemic antibiotics do not provide benefits beyond those achieved with professionally administered plaque removal to reduce clinical signs of inflammation in peri-implant mucositis and peri-implantitis.

There is some evidence from recent systematic reviews that use of adjunctive local and systemic antibiotics may improve clinical parameters, but there is disagreement in findings across reviews looking at similar interventions:

- For treatment of peri-implant mucositis with adjunctive systemic antibiotics, there are inconsistent findings from two systematic reviews and the certainty of the evidence is likely to be low to moderate.
- For treatment of peri-implantitis with adjunctive local antibiotics, there are inconsistent findings from three systematic reviews and the certainty of the evidence is likely to be low due to risk of bias, heterogeneity and small study size/participant numbers for some of the comparisons.
- For treatment of peri-implantitis with systemic antibiotics, there are inconsistent findings from three systematic reviews and the certainty of the evidence is likely to be low due to risk of bias, heterogeneity and small study size/participant numbers for some of the comparisons.

Overall, there is limited, inconsistent, evidence to support the use of local or systemic antibiotics in the management of peri-implant mucositis or peri-implantitis. Risk of bias was a concern in many of the primary studies and non-randomised studies were include in the reviews. Many of the comparisons are based on a small number of studies with limited participants and, in some cases, there may have been inappropriate pooling of data.

In addition, the clinical significance of some of the improvements observed is unclear and the impact of the intervention on antibiotic stewardship should be considered.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- Despite the small number of studies (with low participant numbers) looking at the use of local antibiotics in the treatment of peri-implantitis, some reviews report that these agents have a beneficial effect, particularly at deeper sites and where mechanical debridement could not be performed in an optimal way (Grusovin 2022).
- Local antibiotics have the advantages of achieving a high concentration in the target site, reducing risk of side effects and antibiotic resistance and being independent from patient compliance (Grusovin 2022).
- Toledano (2021) noted that no study presented adverse effects after local antibiotic administration.
- The correct prescription of antibiotics is a worldwide priority due to the increasing threat of super-infections, antibiotic resistance and side effects (Grusovin 2022).
- Toledano-Osorio (2022) noted in systemic antibiotic administration that two studies reported adverse effects, which were identified as headache, dizziness, diarrhoea with nausea, mild gastrointestinal complaints or vaginal thrush. These were resolved without intervention.

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

- Locally delivered adjunctive antibiotics could be useful for those patients when the optimal mechanical debridement cannot be obtained (Grusovin 2022) or where surgery is not desirable or possible.

4. Values and preferences

Summarise any evidence or information on values and preferences.

- There is a lack of evidence to inform this section, but patients are likely to value interventions to reduce the likelihood of progressive bone loss around an implant and implant failure.
- Clinicians are also likely to value interventions which may promote implant health.
- Referral to secondary care and surgical treatment should be considered in preference to antibiotics, where possible.
- Current antimicrobial stewardship advocates that the prescribing of antibiotics must be kept to a minimum and used only when there is a clear need. The indiscriminate use of antimicrobials in primary care, including dentistry, has been identified as one of the drivers of antibiotic resistance, which is a major threat to public health.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

- Patients may prefer not to take systemic antibiotics given the potential for adverse side-effects.
- There may be a reluctance to administer systemic antibiotics given the possible contribution to antibiotic resistance.

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

- Grusovin (2022) noted the main disadvantages of adjunctive local antibiotics are the cost and the need for professional delivery.
- Access or use of adjunctive local antibiotics in primary care may be limited
- There may be a requirement for the clinical team to have individuals with additional knowledge and skills to administer alternative and adjunctive treatments.

7. Other factors

Indicate any other factors taken into account.

- Management of peri-implantitis is challenging and unpredictable. It is likely to require surgical management, which is unlikely to be provided in primary care. Therefore, early referral back to the team who placed the implant should be considered.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2014 edition of guidance:

Current evidence is insufficient to determine if adjunctive antibiotic therapy is effective in the treatment of peri-implant mucositis or peri-implantitis in primary dental care. The guidance development group does not recommend the routine use of antibiotics for the treatment of peri-implant mucositis or peri-implantitis in primary care.

Considered judgement:

The Group noted that there is limited, inconsistent, evidence to support the use of local or systemic antibiotics in the management of peri-implant mucositis or peri-implantitis and that there are concerns about the quality of studies in this area. The Group discussed the access and availability of local antibiotics in primary care and the need to consider antibiotic stewardship in decisions to administer antibiotics. Given this the group endorsed the need to consider, where possible, referral to secondary care and surgical treatment in preference to the administration of antibiotics.

Recommendations in updated guidance:

- The routine use of local or systemic antibiotics for the treatment of peri-implant mucositis in primary care is not recommended.
- The routine use of local or systemic antibiotics for the treatment of peri-implantitis in primary care is not recommended.

Relevant text from main narrative:

Peri-implant mucositis:

A recent consensus statement from the World Dental Federation noted that conventional non-surgical professional mechanical plaque removal (PMPR), in conjunction with oral hygiene reinforcement, is the standard treatment for peri-implant mucositis. Evidence suggests that specific alternative or adjunctive therapies, such as antiseptics, antibiotics or treatment using lasers, do not significantly improve clinical outcomes when compared with PMPR alone. The certainty of the evidence is considered to be low due to risk of bias and inconsistency.

In addition, the EFP *Prevention and treatment of peri-implant diseases* guideline recommends PMPR in combination with oral hygiene re-enforcement for the management of peri-implant mucositis. PMPR can be performed with ultrasonic or air polishing devices or with hand instruments. Short term use of patient-administered oral antiseptic rinses can be considered. The guideline does not recommend combining modes of PMPR or using lasers in combination with conventional PMPR. It also does not recommend the use of systemic or locally administered antibiotics as adjuncts to PMPR. It suggests not to use professionally administered local agents (e.g. antiseptics) or photodynamic therapy as adjuncts to PMPR.

Peri-implantitis:

A consensus statement from the World Dental Federation noted that conventional non-surgical professional mechanical plaque removal (PMPR) may result in short-term improvements in inflammatory parameters but is unlikely to resolve the disease. Evidence suggests that specific alternative or adjunctive therapies, such as antiseptics, antibiotics or treatment using lasers, do not significantly improve clinical outcomes when compared with PMPR alone. The certainty of the evidence ranges from moderate to low due to risk of bias, inconsistency and small study sizes.

The EFP *Prevention and treatment of peri-implant diseases* guideline recommends initial non-surgical management. This includes oral hygiene instruction and motivation, risk factor control, prosthesis cleaning/removal/modification (including controlling biofilm retentive factors and evaluation of the components

of the prosthesis where required and feasible), and supramucosal and submucosal PMPR around the implant. In addition, where periodontal disease is present elsewhere in the mouth, this should be treated. PMPR around the implant can be performed with ultrasonic or sonic devices or hand instruments. The guideline suggests not to use air polishers, lasers, photodynamic therapy, antiseptic gel or probiotics as monotherapies or as adjuncts to PMPR. Regarding antimicrobial therapy, the guideline does not recommend the use of systemic antibiotics as adjuncts to PMPR and suggests not to use locally administered antimicrobials as an adjunct to PMPR or as a monotherapy.

Strength of recommendation (strong or conditional):

- Conditional (100% agreement)

References

Gennai, S., Bollain, J., Ambrosio, N., Marruganti, C., Graziani, F., & Figuero, E. (2023). Efficacy of adjunctive measures in peri-implant mucositis. A systematic review and meta-analysis. Journal of Clinical Periodontology, 1– 27.

Grusovin MG, Pispero A, Del Fabbro M, Sangiorgi M, Simion M, Stefanini M, Varoni EM. Antibiotics as Adjunctive Therapy in the Non-Surgical Treatment of Peri-Implantitis: A Systematic Review and Meta-Analysis. Antibiotics (Basel). 2022 Dec 7;11(12):1766.

Heitz-Mayfield LJ, Lang NP. Antimicrobial treatment of peri-implant diseases. International Journal of Oral & Maxillofacial Implants. 2004;19 (Special Suppl):128-139.

Jepsen S, Berglundh T, Genco R, Aass AM, Demirel K, Derks J, Figuero E,Giovannoli JL, Goldstein M, Lambert F, Ortiz-Vigon A, Polyzois I, Salvi GE, Schwarz F, Serino G, Tomasi C, Zitzmann NU. Primary prevention of peri-implantitis: managing peri-implant mucositis. J Clin Periodontol 2015; 42 (Suppl.16).

Klinge B, Gustafsson A, Berglundh T. A systematic review of the effect of anti-infective therapy in the treatment of peri-implantitis. Journal of Clinical Periodontology. 2002;29 (Suppl 3):213-225.

Ramanauskaite A, Fretwurst T, Schwarz F. Efficacy of alternative or adjunctive measures to conventional non-surgical and surgical treatment of peri-implant mucositis and peri-implantitis: a systematic review and meta-analysis. Int J Implant Dent. 2021 Nov 15;7(1):112.

Renvert, S., Hirooka, H., Polyzois, I., Kelekis-Cholakis, A., Wang, H.-L. and (2019), Diagnosis and non-surgical treatment of peri-implant diseases and maintenance care of patients with dental implants – Consensus report of working group 3. Int Dent J, 69: 12-17.

Schwarz, F, Becker, K, Sager, M. Efficacy of professionally administered plaque removal with or without adjunctive measures for the treatment of peri-implant mucositis. A systematic review and meta-analysis. J Clin Periodontol; 2015; 42 (Suppl. 16): S202– S213.

Toledano M, Osorio MT, Vallecillo-Rivas M, Toledano-Osorio M, Rodríguez-Archilla A, Toledano R, Osorio R. Efficacy of local antibiotic therapy in the treatment of peri-implantitis: A systematic review and meta-analysis. J Dent. 2021 Oct;113:103790.

Toledano-Osorio M, Vallecillo C, Toledano R, Aguilera FS, Osorio MT, Muñoz-Soto E, García-Godoy F, Vallecillo-Rivas M. A Systematic Review and Meta-Analysis of Systemic Antibiotic Therapy in the Treatment of Peri-Implantitis. Int J Environ Res Public Health. 2022 May 26;19(11):6502.

Wang CW, Renvert S, Wang HL. Nonsurgical treatment of periimplantitis. Implant Dent. 2019;28(2):155–60.