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Review article

BSP implementation of European S3 - level evidence-based treatment guidelines for stage I-III periodontitis in UK clinical practice

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ABSTRACT

Objectives: To adapt the supranational European Federation for Periodontology (EFP) S3-Level Clinical Practice Guideline for treatment of periodontitis (stage I-III) to a UK healthcare environment, taking into account the views of a broad range of stakeholders, and patients.

Sources: This UK version is based on the supranational EFP guideline (Sanz et al., 2020) published in the *Journal of Clinical Periodontology*. The source guideline was developed using the S3-level methodology, which combined the assessment of formal evidence from 15 systematic reviews with a moderated consensus process of a representative group of stakeholders, and accounts for health equality, environmental factors and clinical effectiveness. It encompasses 62 clinical recommendations for the treatment of stage I–III periodontitis, based on a stepwise process mapped to the 2017 classification system.

Methodology: The UK version was developed from the source guideline using a formal process called the GRADE ADOLOPMENT framework. This framework allows for the adoption (unmodified acceptance), adaptation (acceptance with modifications) and the *de novo* development of clinical recommendations. Using this framework and following the S3-process, the underlying systematic reviews were updated and a representative guideline group of 75 delegates from 17 stakeholder organisations was assembled into three working groups. Following the formal S3-process, all clinical recommendations were formally assessed for their applicability to the UK and adoloped accordingly.

Results and conclusion: Using the ADOLOPMENT protocol, a UK version of the EFP S3-level clinical practice guideline was developed. This guideline delivers evidence- and consensus-based clinical recommendations of direct relevance to the dental community in the UK.

Clinical significance: The aim of S3-level guidelines is to combine the evaluation of formal evidence, grading and synthesis with the clinical expertise of a broad range of stakeholders to form clinical recommendations. Herein, the first major international S3-level guideline in dentistry, the EFP guideline, was implemented for direct clinical applicability in the UK healthcare system.

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Commentary – UK Implementation

This guideline is the UK implementation of the S3-level guideline "Treatment of Stage I-III Periodontitis" originally developed by the European Federation of Periodontology (EFP). The implementation process in Britain followed the GRADE ADOLOPMENT framework [15].

The EFP guideline was developed by an international working group of periodontists and expert stakeholders. The guideline document was finalised and formally voted upon in a structured consensus conference format during the XVI European Workshop in Periodontology in La Granja de San Ildefonso, Segovia, Spain, on November 10th-13th, 2019. The guideline text and the underlying systematic reviews were published in open access format in a special issue of the *Journal of Clinical Periodontology [1].*

Information about the authors of the EFP guideline, their institutions, their declared interests, the workshop participants, the involved stakeholder societies and organisations, the abstract and the description of the clinical relevance can be found in chapter 8 of this guideline document.

The authors and workshop participants of the UK ADOLOPMENT project are listed below.

Workshop Participants

Neil Almond, Marie Anderson, Raimondo Ascione, Martin Ashley, Paul Baker, Leon Bassi, Sanjeev Bhanderi, Elena Calciolari, Nigel Carter, Antonio Ceriello, Iain Chapple, Marilou Ciantar, Dominic Clark-Roberton, Nick Claydon, David Cottam, Shauna Culshaw, Andrew Cundy, Francesco D'Aiuto, Thomas Dietrich, Nikos Donos, Ian Dunn, Ken Eaton, Gillian Flett, Chris Fox, Mandeep Ghuman, Jenny Godson, Gareth Griffiths, Stephen Hancocks, Peter Heasman, Debbie Hemington, Penny Hodge, Mark Ide, Matt Jerreat, Roshni Karia, Moritz Kebschull, Gerry Linden, Matt Locke, Isobel Madden, Phil Marsh, Matthew Garrett, Giles McCracken, William McLaughlin, Imogen Midwood, Mike Milward, Aidan Moran, Federico Moreno, Madeleine Murray, Rajan Nansi, Ian Needleman, Luigi Nibali, Sarifa Patel, Divyash Patel, Vipul Patel, Michael Paterson, Alexander Pollard, Philip Preshaw, Devan Raindi, Raj Rattan, Anthony Roberts, Shazad Saleem, Ross Scales (observer), Joon Seong, Praveen Sharma, Andrew Smith, Susan Smith, Jeanie Suvan, Manoj Tank, Richard Tucker, Aru Tugnait, Wendy Turner, Bobby Varghese, Jenny Walker, Nicola West, Paul Weston, Roger Yates.

Methodological Consultant

Professor Ina Kopp

Workshop Organisation

British Society of Periodontology and Implant Dentistry –
Professor Nicola West & Professor Moritz Kebschull

Scientific societies involved in the guideline development process

Association of Clinical Oral Microbiologists
British Association of Dental Therapists
British Endodontic Society
British Society of Dental Hygiene and Therapy
British Society of Periodontology and Implant Dentistry
British Society of Restorative Dentistry
Restorative Dentistry UK

Other organisations involved in the guideline development process

British Dental Association
BSP Patient Forum
Oral Health Foundation
Dental Protection
Faculty of General Dental Practice (UK)
General Dental Council (Observer)
Office of the Chief Dental Officer (OCDO) England
Public Health England
Royal College of Surgeons of England
Scottish Antimicrobial Prescribing Group

1. Introduction

1.1. The health problem

Definition

Periodontitis is characterized by progressive destruction of the tooth-supporting apparatus. Its primary features include the loss of periodontal tissue support manifest through clinical attachment loss (CAL) and radiographically assessed alveolar bone loss, presence of periodontal pocketing and gingival bleeding [2]. If untreated it may lead to tooth loss, although it is preventable and treatable in the majority of cases.

Importance

Periodontitis is a major public health problem due to its high prevalence, and since it may lead to tooth loss and disability, it negatively affects chewing function and aesthetics, is a source of social inequality, and significantly impairs quality of life. Periodontitis accounts for a substantial proportion of edentulism and masticatory dysfunction, has a negative impact on general health and results in significant dental care costs [3].

Pathophysiology

Periodontitis is a chronic multifactorial inflammatory disease associated with dysbiotic dental plaque biofilms.

Prevalence

Periodontitis is the most common chronic inflammatory non-communicable disease of humans. According to the Global Burden of Disease 2010 study, the global age-standardized prevalence (1990–2010) of severe periodontitis was 11.2 %, representing the sixth-most prevalent condition in the world [4], while in the Global Burden of Disease 2015 study, the prevalence of severe periodontitis was estimated to be 7.4 % [5]. The prevalence of milder forms of periodontitis may be as high as 50 % [6].

Consequences of failure to treat

Untreated or inadequately treated periodontitis leads to the loss of tooth-supporting tissues and teeth. Severe periodontitis, along with

dental caries is responsible for more years lost to disability than any other human disease [7]. Furthermore, periodontal infections are associated with a range of systemic diseases, which can lead to premature death, including diabetes [8] and cardiovascular diseases [9,10] and adverse pregnancy outcomes [11].

Economic importance

On a global scale, periodontitis is estimated to cost $54 billion in direct treatment costs and a further $25 billion in indirect costs [7]. Periodontitis contributes significantly to the cost of dental diseases due to the need to replace teeth lost to periodontitis. The total cost of dental diseases, in 2015, was estimated to be of $544.41 billion, being $356.80 billion direct costs, and $187.61 billion indirect costs [12].

1.2. Aim of the guideline

This guideline aims to highlight the importance of and need for scientific evidence in clinical decision making in the treatment of patients with periodontitis stages I to III. Its main objective is therefore, to support the evidence-based recommendations for the different interventions used at the different steps of periodontal therapy, based on the best available evidence and/or expert consensus. In so doing, this guideline aims to improve the overall quality of periodontal treatment in Europe, reduce tooth loss associated with periodontitis and ultimately improve overall systemic health and quality of life. A separate guideline covering the treatment of stage IV periodontitis will be published in 2022.

Target users of the guideline

Dental and medical professionals, together with all stakeholders related to health care, particularly oral health, including patients.

Targeted environments

Dental and medical academic / hospital environments, independent clinics and general dental practices.

Targeted patient population

People with periodontitis stages I to III.

People with periodontitis stages I to III following successful treatment.

Interpretation of the recommendation tables

Tables for evidence-based recommendations are linked to an individually numbered question and presented in a standardized format from section 4 onwards. The blue banner and white background component reflects the European Federation of Periodontology S3-level guidelines. The green banner and green background represents the consensus outcome of the S3-level adoloption process by the British Society of Periodontology for the UK.

Exceptions from the guideline

This guideline did not consider the health economic cost-benefit ratio, since (i) it covers multiple different countries with disparate, not readily comparable health systems, and (ii) there is a paucity of sound scientific evidence available addressing this question. This guideline did not consider the treatment of gingivitis, although management is accommodated, because it is primary prevention strategy for periodontitis and also embraced by step-4 (supportive care), or the treatment of stage IV periodontitis, necrotising periodontitis, periodontitis as a manifestation of systemic diseases and mucogingival conditions.

2. Methodology

2.1. General framework

This guideline was developed following methodological guidance published by the Standing Guideline Commission of the Association of Scientific Medical Societies in Germany (AWMF) [13] and the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group [14].

The guideline was developed under the auspices of the European Federation of Periodontology (EFP) and overseen by the EFP Workshop Committee. This guideline development process was steered by an Organizing Committee and a group of methodology consultants designated by the EFP. All members of the Organizing Committee were part of the EFP Workshop Committee.

To ensure adequate stakeholder involvement, the EFP established a guideline panel involving dental professionals representing 36 national periodontal societies within the EFP (Table 1a).

Table 1a
Guideline panel.

Scientific society/organisation Delegate(s)	Delegate(s)
European Federation of Periodontology (36 national periodontal societies)	**Organising Committee, Working Group Chairs (in alphabetic order):** Tord Berglundh, Iain Chapple, David Herrera, Søren Jepsen, Moritz Kebschull, Mariano Sanz, Anton Sculean, Maurizio Tonetti **Methodologists:** Ina Kopp (Chief Consultant), Paul Brocklehurst, Jan Wennström **Clinical Experts:** Merete Aass, Mario Aimetti, Bahar Eren Kuru, Georgios Belibasakis, Juan Blanco, Ellen Bol-van den Hil, Nagihan Bostanci, Darko Bozic, Philippe Bouchard, Nurcan Buduneli, Francesco Cairo, Elena Calciolari, Maria Clotilde Carra, Pierpaolo Cortellini, Jan Cosyn, Francesco D'Aiuto, Bettina Dannewitz, Monique Danser, Korkud Demirel, Jan Derks, Massimo de Sanctis, Thomas Dietrich, Christof Dörfer, Henrik Dommisch, Nikos Donos, Kenneth Eaton, Peter Eickholz, Elena Figuero, William Giannobile, Moshe Goldstein, Filippo Graziani, Phophi Kamposiora, Lise-Lotte Kirkevang, Thomas Kocher, Eija Kononen, Nicklaus Lang, France Lambert, Luca Landi, Paulo Melo, Bruno Loos, Rodrigo Lopez, Pernilla Lundberg, Eli Machtei, Phoebus Madianos, Conchita Martín, Paula Matesanz, Jörg Meyle, Ana Molina, Eduardo Montero, Jose Nart, Ian Needleman, Luigi Nibali, Panos Papapanou, Andrea Pilloni, David Polak, Ioannis Polyzois, Philip Preshaw, Marc Quirynen, Christoph Ramseier, Stefan Renvert, Giovanni Salvi, Ignacio Sanz-Sánchez, Lior Shapira, Dagmar Else Slot, Andreas Stavropoulos, Xavier Struillou, Jean Suvan, Wim Teughels, Daniela Timus, Cristiano Tomasi, Leonardo Trombelli, Fridus van der Weijden, Paula Vassallo, Clemens Walter, Nicola West, Gernot Wimmer
Scientific Societies:	
European Society for Endodontology	Lise Lotte Kirkevang
European Prosthodontic Association	Phophi Kamposiora
European Association of Dental Public Health European Federation of Conservative Dentistry	Paula Vassallo
Other organisations	
Council of European Chief Dental Officers	Kenneth Eaton
Council of European Dentists	Paulo Melo
European Dental Hygienists' Federation	Ellen Bol-van den Hil
European Dental Students' Association	Daniela Timus
Platform for Better Oral Health in Europe	Kenneth Eaton

Commentary – UK Implementation

The British implementation followed the GRADE ADOLOPMENT framework [15]

These delegates were nominated, participated in the guideline development process, and had voting rights in the consensus conference. For the guideline development process, delegates were assigned to four Working Groups that were chaired by the members of the Organizing Committee and advised by the methodology consultants. This panel was supported by key stakeholders from European scientific societies with a strong professional interest in periodontal care and from European organisations representing key groups within the dental profession, and key experts from non-EFP member countries, such as North America (Table 1b).

Contributors to the UK Implementation

Scientific Societies/Organisations	Clinical expert/ Representative (in alphabetical order)
Association of Clinical Oral Microbiologists	Professor Andrew Smith
British Association of Dental Therapists (BADT)	Ms Debbie Hemmington
British Dental Association (BDA)	Dr David Cottam
British Endodontic Society (BES)	Dr Sanjeev Bhanderi
British Society of Dental Hygiene and Therapy (BSDHT)	Mr Leon Bassi
British Society of Periodontology and Implant Dentistry (BSP)	Mr Dominic Clark-Roberton, Dr Ian Dunn, Professor Gareth Griffiths, Professor Giles McCracken, Professor Michael Milward, Dr Vipul Patel, Dr Michael Paterson, Dr Joon Seong, Dr Richard Tucker, Dr Aradhna Tugnait, Professor Wendy Turner, Ms Jenny Walker
BSP Patient Forum	Neil Almond, Marie Anderson, Andrew Cundy, Gillian Flett Sarifa Patel, Susan Smith
British Society of Restorative Dentistry (BSRD)	Mr Matthew Jerreat
Oral Health Foundation	Dr Nigel Carter
Dental Protection	Dr Raj Rattan
Faculty of General Dental Practice (UK)	Dr Roshni Karia
General Dental Council (GDC) (Observer)	Mr Ross Scales
Office of the Chief Dental Officer (OCDO) England	Dr Divyash Patel
Public Health England	Dr Jenny Godson
Restorative Dentistry UK	Professor Martin Ashley
Royal College of Surgeons of England	Mr Matthew Garrett
Scottish Antimicrobial Prescribing Group	Professor Andrew Smith

Table 1b
Key stakeholders contacted and participants.

Institution	Acronym	Answer*	Representative
Association for Dental Education in Europe	ADEE	no answer	
Council of European Chief Dental Officers	CECDO	participant	
Council of European Dentists	CED	participant	
European Association of Dental Public Health	EADPH	participant	
European Dental Hygienists Federation	EDHF	participant	
European Dental Students' Association	EDSA	participant	
European Federation of Conservative Dentistry	EFCD	participant	
European Orthodontic Society	EOS	no answer	
European Prosthodontic Association	EPA	participant	
European Society of Endodontology	ESE	participant	
Platform for Better Oral Health in Europe	PBOHE	participant	

*Messages sent March 20th, 2019; reminder sent June 18th.

In addition, EFP engaged an independent guideline methodologist to advise the panel and facilitate the consensus process. The guideline methodologist had no voting rights.

EFP and the guideline panel tried to involve patient organisations but were not able to identify any regarding periodontal diseases at European Level. In a future update, efforts will be undertaken to include the perspective of citizens/patients [16].

The last search was performed on 30.09.2019. Search terms used were: "periodont*" Periodontal", "Guidelines", "Clinical Practice Guidelines". In addition, content was screened by hand searches. See Table 2.

Only guidelines published in English and with full texts available were included. The methodological quality of these guideline texts was critically appraised using the AGREE II framework [31].

Most of the identified guidelines/documents were considered not applicable due to (i) their age, (ii) their methodological approach, or (iii) their inclusion criteria. The recent German S3-guideline [18] was found to be potentially relevant, scored highest in the critical appraisal using AGREE II [31] and was, therefore, used to inform the guideline development process.

Commentary – British Implementation

For the development of the UK version of the guideline, a broad range of potential addressees of the guideline from 14 organisations was asked to participate by the BSP.

In contrast to the EFP S3-level guideline, the UK version benefitted strongly from the input and advice of the BSP Patient Forum delegates.

2.2. Evidence synthesis

Systematic search and critical appraisal of guidelines

Commentary – UK Implementation

The guideline search was re-done on March 30th, 2020, in preparation for the guideline implementation process in UK.

No additional guideline documents were found in this search.

To assess and utilize existing guidelines during the development of the present guideline, well-established guideline registers and the websites of large periodontal societies were electronically searched for potentially applicable guideline texts:

- Guideline International Network (GIN)
- Guidelinecentral.com
- The National Institute for Health and Clinical Excellence (NICE)
- Canadian Health Technology Assessment (CADTH)
- European Federation for Periodontology (EFP)
- American Academy of Periodontology (AAP)
- American Dental Association (ADA)

Systematic search and critical appraisal of the literature

For this guideline, a total of 15 systematic reviews (SRs) were conducted to support the guideline development process [32–46] [The corresponding manuscripts are published within this special issue of the Journal of Clinical Periodontology] [32–46].

All SRs were conducted following the "Preferred Reporting Items for Systematic Reviews and Meta- Analyses" (PRISMA) framework [47].

Focused questions

In all 15 systematic reviews, focused questions in population, intervention, comparison, outcome (PICO(S)) format [48] were proposed by the authors in January 2019 to a panel comprising the working group chairs and the methodological consultants, in order to review and

Table 2
Results of the guideline search.

Database	Identified, potentially relevant guidelines	Critical appraisal
	Comprehensive periodontal therapy: a statement by the American Academy of Periodontology. [17]	8 years old, recommendations not based on systematic evaluation of evidence, ***not applicable***
Guideline International Network (GIN) International Guidelines Library #1	DG PARO S3 guideline (Register Number 083-029) - Adjuvant systemic administration of antibiotics for subgingival instrumentation in the context of systematic periodontitis treatment [18]	Very recent, high methodological standard, very similar outcome measures, – ***relevant***
	HealthPartners Dental Group and Clinics guidelines for the diagnosis & treatment of periodontal diseases. [19]	8 years old, unclear methodology, ***not applicable***
Guidelinecentral.com "Dentistry" category	Health Partners Dental Group and Clinics Caries Guideline [20]	***not applicable***
The National Institute for Health and Clinical Excellence (NICE) #2	No thematically relevant hits	***not applicable***
National Guideline Clearinghouse (Agency for Healthcare Research and Quality) #3	No thematically relevant hits	***not applicable***
	Periodontal Regenerative Procedures for Patients with Periodontal Disease: A Review of Clinical Effectiveness [21]	9-year-old review article, ***not applicable***
	Treatment of Periodontal Disease: Guidelines and Impact [22]	9-year-old review article, ***not applicable***
Canadian Health Technology Assessment (CADTH) #4	Dental Scaling and Root Planing for Periodontal Health: A Review of the Clinical Effectiveness, Cost-effectiveness, and Guidelines [23]	Unclear methodology (follow-up, outcome variables, recommendations, guideline group), ***not applicable***
	Dental Cleaning and Polishing for Oral Health: A Review of the Clinical Effectiveness, Cost-effectiveness and Guidelines [24]	Unclear methodology (follow-up, outcome variables, recommendations, guideline group), ***not applicable***
European Federation of Periodontology (EFP) #5	No thematically relevant hits	***not applicable***
	The American Journal of Cardiology and Journal of Periodontology Editors' Consensus: Periodontitis and Atherosclerotic Vascular Disease [25]	Unclear methodology, 10-year-old consensus- based article, only limited clinically applicably recommendations, ***not applicable***
American Academy of Periodontology (AAP) #6	Comprehensive Periodontal Therapy: A Statement by the American Academy of Periodontology [17]	Unclear methodology (follow-up, outcome variables, recommendations, guideline group), almost a decade old, ***not applicable***
	Academy Statements on Gingival Curettage [26], Local Delivery [27], Risk Assessment [28], Efficacy of Lasers [29]	Unclear methodology, 10-year-old consensus- based article, only limited clinically applicably recommendations, ***not applicable***
American Dental Association (ADA) #7	Nonsurgical Treatment of Chronic Periodontitis Guideline [30]	Outcome variable CAL (not PPD), no minimal follow-up – ***not applicable***

#1. https://g-i-n.net/home.
#2. https://www.nice.org.uk/guidance/published.
#3. https://www.ahrq.gov/gam/index.html.
#4. https://www.cadth.ca/.
#5. http://www.efp.org/publications/index.html.
#6. https://www.perio.org/publications.
#7. https://ebd.ada.org/en/evidence/guidelines.

Table 3
PICOS questions addressed by each Systematic Review.

Reference	Systematic Review title	Final PICOS (as written in manuscripts)
Suvan et al. [37]	Subgingival Instrumentation for Treatment of Periodontitis. A Systematic Review.	#1. In patients with periodontitis, what is the efficacy of subgingival instrumentation performed with hand or sonic/ultrasonic instruments in comparison with supragingival instrumentation or prophylaxis in terms of clinical and patient reported outcomes? #2. In patients with periodontitis, what is the efficacy of nonsurgical subgingival instrumentation performed with sonic/ultrasonic instruments compared to subgingival instrumentation performed with hand instruments or compared to subgingival instrumentation performed with a combination of hand and sonic/ultrasonic instruments in terms of clinical and patient reported outcomes? #3. In patients with periodontitis, what is the efficacy of full mouth delivery protocols (within 24 h) in comparison to quadrant or sextant wise delivery of subgingival mechanical instrumentation in terms of clinical and patient reported outcomes?
Salvi et al. [36]	Adjunctive laser or antimicrobial photodynamic therapy (aPDT) to non-surgical mechanical instrumentation in patients with untreated periodontitis. A systematic review and meta-analysis.	#1. In patients with untreated periodontitis, does laser application provide adjunctive effects to non-surgical mechanical instrumentation alone? #2. In patients with untreated periodontitis, does application of aPDT provide adjunctive effects to non-surgical mechanical instrumentation alone?
Donos et al. [32]	The adjunctive use of host modulators in non- surgical periodontal therapy. A systematic review of randomized, placebo-controlled clinical studies	In patients with periodontitis, what is the efficacy of adding host modulating agents instead of placebo to NSPT in terms of probing pocket depth (PPD) reduction?
Sanz-Sanchez et al. [43]	Efficacy of access flaps compared to subgingival debridement or to different access flap approaches in the treatment of periodontitis. A systematic review and metanalysis.	#1. In patients with periodontitis (population), how effective are access flaps (intervention) as compared to subgingival debridement (comparison) in attaining PD reduction (primary outcome)? #2. In patients with periodontitis (population), does the type of access flap (intervention and control) impact PD reduction (primary outcome)?
Polak et al. [41]	The Efficacy of Pocket Elimination/Reduction Surgery Vs. Access Flap: A Systematic Review	In adult patients with periodontitis after initial non-surgical cause-related therapy and residual PPD of 5 mm or more, what is the efficacy of pocket elimination/reduction surgery in comparison with access flap surgery?
Teughels et al. [45]	Adjunctive effect of systemic antimicrobials in periodontitis therapy. A systematic review and meta-analysis.	In patients with periodontitis, what is the efficacy of adjunctive systemic antimicrobials, in comparison with subgingival debridement plus a placebo, in terms of probing pocket depth (PPD) reduction, in randomized clinical trials with at least 6 months of follow-up.
Herrera et al. [40]	Adjunctive effect of locally delivered antimicrobials in periodontitis therapy. A systematic review and meta-analysis.	In adult patients with periodontitis, what is the efficacy of adjunctive locally delivered antimicrobials, in comparison with subgingival debridement alone or plus a placebo, in terms of probing pocket depth (PPD) reduction, in randomized clinical trials with at least 6 months of follow-up.
Nibali et al. [35]	Regenerative surgery versus access flap for the treatment of intrabony periodontal defects. A systematic review and meta- analysis.	#1. Does regenerative surgery of intraosseous defects provide additional clinical benefits measured as Probing Pocket Depth (PPD) reduction, Clinical Attachment Level (CAL) gain, Recession (Rec) and Bone Gain (BG) in periodontitis patients compared with access flap? #2. Is there a difference among regenerative procedures in terms of clinical and radiographic gains in intrabony defects?
Jepsen et al. [34]	Regenerative surgical treatment of furcation defects: A systematic review and Bayesian network meta-analysis (NM) of randomized clinical trials	#1. What is the efficacy of regenerative periodontal surgery in terms of tooth loss, furcation conversion and closure, horizontal clinical attachment level (HCAL) and bone level (HBL) gain as well as other periodontal parameters in teeth affected by periodontitis-related furcation defects, at least 12 months after surgery? #2. NM: to establish a ranking in efficacy of the treatment options and to identify the best surgical technique.
Dommisch et al. [39]	Resective surgery for the treatment of furcation involvement – a systematic review	What is the benefit of resective surgical periodontal therapy (i.e. root amputation or resection, root separation, tunnel preparation) in subjects with periodontitis who have completed a cycle of non- surgical periodontal therapy and exhibit class II and III furcation involvement compared to individuals suffering from periodontitis and exhibiting class II and III furcation involvement who were untreated, or treated exclusively by subgingival debridement or access flap surgery. The outcomes were 1) tooth survival (primary outcome), 2) vertical probing attachment (PAL-V) gain, and 3) reduction of probing pocket depth (PPD) (secondary outcomes) (O) evidenced by randomized controlled clinical trials, prospective and retrospective cohort studies and case series with at least 12 months of follow-up (tooth survival, PAL-V, PPD) (S), respectively.

(*continued on next page*)

Table 3 (*continued*)

Reference	Systematic Review title	Final PICOS (as written in manuscripts)
Slot et al. [44]	Mechanical plaque removal in periodontal maintenance patients. -A Systematic Review and Network Meta-Analysis-	#1. In periodontal maintenance patients, what is the effect on plaque removal and parameters of periodontal health of the following: Power toothbrushes as compared to manual toothbrushes? #2. In periodontal maintenance patients, what is the effect on plaque removal and parameters of periodontal health of the following: Interdental oral hygiene devices compared to no interdental cleaning as adjunct to toothbrushing? #3. In periodontal maintenance patients, what is the effect on plaque removal and parameters of periodontal health of the following: Different interdental cleaning devices as adjuncts to toothbrushing
Carra et al. [38]	Promoting behavioural changes to improve oral hygiene in patients with periodontal diseases: a systematic review of the literature.	What is the efficacy of behavioural interventions aimed to promote OH in patients with periodontal diseases (gingivitis/periodontitis), in improving clinical plaque and bleeding indices?
Ramseier et al. [42]	Impact of risk factor control interventions for smoking cessation and promotion of healthy lifestyles in patients with periodontitis: a systematic review	What is the efficacy of health behaviour change interventions for smoking cessation, diabetes control, physical exercise (activity), change of diet, carbohydrate (dietary sugar) reduction, and weight loss in patients with periodontitis?
Figuero et al. [33]	Efficacy of adjunctive therapies in patients with gingival inflammation. A systematic review and meta-analysis.	In systemically healthy humans with dental plaque-induced gingival inflammation (with or without attachment loss, but excluding untreated periodontitis patients), what is the efficacy of agents used adjunctively to mechanical plaque control (either self-performed or professionally delivered), as compared to mechanical plaque control combined with a negative control, in terms of changes in gingival inflammation (through gingivitis or bleeding indices)?
Trombelli et al. [46]	Efficacy of alternative or additional methods to professional mechanical plaque removal during supportive periodontal therapy. A systematic review and meta-analysis	#1. What is the efficacy of alternative methods to professional mechanical plaque removal (PMPR) on progression of attachment loss during supportive periodontal therapy (SPT) in periodontitis patients? #2. What is the efficacy of additional methods to professional mechanical plaque removal (PMPR) on progression of attachment loss during supportive periodontal therapy (SPT) in periodontitis patients?

Commentary – UK Implementation

In order to comply with the recommendations for a process of adoption/adaptation of a Clinical Practice Level at a local level [15], systematic reviews were updated, by performing an additional search up to March 30, 2020, by the original authors of the review.

For all systematic reviews, the same search (using the same databases) and screening processes was repeated. If relevant papers were identified, they were retrieved, to confirm inclusion. If that was the case, risk of bias was assessed and a critical evaluation of the possible influence of the new evidence in the already reported results was made.

Step 1 & SPT

Reference: Slot et al [44]
Title: Mechanical plaque removal of periodontal maintenance patients. A Systematic Review and Network Meta-Analysis.
Search: After elimination of duplicate hits, 5 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text, no articles were selected.
New evidence: None
Evaluation of the new evidence: No additional evidence was identified.

Reference: Carra et al [38]
Title: Promoting behavioural changes to improve oral hygiene in patients with periodontal diseases: a systematic review of the literature.
Search: After elimination of duplicate hits, 131 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text, no articles were selected.
New evidence: None
Evaluation of the new evidence: No additional evidence was identified.

Reference: Ramseier et al [42]
Title: Impact of risk factor control interventions for smoking cessation and promotion of healthy lifestyles in patients with periodontitis: a systematic review
Search: After elimination of duplicate hits, 387 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text, no articles were selected.
New evidence: None
Evaluation of the new evidence: No additional evidence was identified.

Reference: Trombelli et al [46]
Title: Efficacy of alternative or additional methods to professional mechanical plaque removal during supportive periodontal therapy. A systematic review and meta-analysis
Search: After elimination of duplicate hits, 43 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text (11), no articles were selected.
New evidence: None
Evaluation of the new evidence: No additional evidence was identified.

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Reference: Figuero et al [33]
Title: Efficacy of adjunctive therapies in patients with gingival inflammation. A systematic review and meta-analysis.
Search: After elimination of duplicate hits, 25 items were identified for the search on antiseptics, and 23 for the search on other agents.
Screening: After screening of title and abstracts and, if needed, of full text, no articles were selected.
New evidence: None.
Evaluation of the new evidence: No additional evidence was identified.

Step 2

Reference: Suvan et al [37]
Title: Subgingival Instrumentation for Treatment of Periodontitis. A Systematic Review.
Search: After elimination of duplicate hits, 907 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text articles (3), 0 articles were selected.
New evidence: None.
Evaluation of the new evidence: No additional evidence was identified.

Reference: Salvi et al [36]
Title: Adjunctive laser or antimicrobial photodynamic therapy to non-surgical mechanical instrumentation in patients with untreated periodontitis. A systematic review and meta-analysis.
Search: After elimination of duplicate hits, 65 items were identified.
Screening: After screening of title and abstracts and, if needed, of full-text, 5 articles were selected.
New evidence: Gandhi et al [52], Katsikanis et al [53], Zhou et al [54], Niazi et al [55], Sezen et al [56]. One of these studies presented evaluation of both photodynamic therapy (aPDT) and lasers Gandhi et al [52].
Evaluation of the new evidence: New limited evidence was identified [52-56]. but no influence on the results of the published systematic review was observed.

Reference: Donos et al [32]
Title: The adjunctive use of host modulators in non-surgical periodontal therapy. A systematic review of randomized, placebo-controlled clinical studies.
Search: After elimination of duplicate hits, 92 items were identified.
Screening: After screening of title and abstracts and, if needed, of full-text, two new relevant articles were selected.
New evidence: Two randomised clinical trials, one evaluating systemic melatonin [57] another *Lactobacillus reuteri*-containing probiotic [58], both as adjuncts to subgingival instrumentation, with placebo as control, and subjects followed for 6 months.
Evaluation of the new evidence: The study by Pelekos et al [58] corroborates the result of the meta-analysis presented by Donos et al [32], showing that adding probiotics instead of placebo to subgingival instrumentation does not improve probing pocket depth (PPD) changes at 6 months. The study by Tinto et al [57] provides new evidence that systemic melatonin (1 g for 1 month) as an adjunct to subgingival instrumentation might improve PPD reduction, compared to placebo, at 6 months: for 4-5 mm sites, 1.86±0.81 mm versus

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1.04±0.69 mm (p=0.00001); and for sites >5 mm, 3.33±1.43 mm versus 2.11±0.96 mm (p=0.00012). However, no meta-analysis could be performed on the oral administration of melatonin following subgingival instrumentation as this is the only study meeting the inclusion/exclusion criteria on this drug.

Reference: Herrera et al [40]
Title: Adjunctive effect of locally delivered antimicrobials in periodontitis therapy. A systematic review and meta-analysis.
Search: After elimination of duplicate hits, 164 items were identified.
Screening: After screening of title and abstracts and, if needed, of full-text, one article was selected.
New evidence: Killeen et al [59]
Evaluation of the new evidence: New limited evidence was identified [59], but no influence on the results of the published systematic review was observed, since the selected paper reports a 2-year follow up of a study, already included,, reporting 1-year data [60]. Since treatment was repeated every 6 months, the additional information could not be included in the data analysis.

Reference: Teughels et al [45]
Title: Adjunctive effect of systemic antimicrobials in periodontitis therapy. A systematic review and meta-analysis.
Search: After elimination of duplicate hits, 922 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text, no articles were selected.
New evidence: None.
Evaluation of the new evidence: No additional evidence was identified.

Step 3

Reference: Sanz-Sanchez et al [43]
Title: Efficacy of access flaps compared to subgingival debridement or to different access flap approaches in the treatment of periodontitis. A systematic review and metanalysis.
Search: After elimination of duplicate hits, 27 items were identified.
Screening: After screening of title and abstracts and, if needed, of full-text, one article was selected.
New evidence: Kumar et al [61]
Evaluation of the new evidence: New limited evidence was identified [61], but no influence on the results of the published systematic review was observed, since the selected study simply compared two different methods of suturing in modified Widman flap surgery.

Reference: Polak et al [41]
Title: The Efficacy of Pocket Elimination/Reduction Surgery Vs. Access Flap: A Systematic Review
Search: After elimination of duplicate hits, 32 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text, no articles were selected.
New evidence: None.
Evaluation of the new evidence: No additional evidence was identified.

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Reference: Nibali et al [35]
Title: Regenerative surgery versus access flap for the treatment of intrabony periodontal defects. A systematic review and meta-analysis.
Search: After elimination of duplicate hits, 23 new items were identified.
Screening: After screening of title and abstracts and, if needed, of full-text, 0 articles providing new evidence were selected.
New evidence: None
Evaluation of the new evidence: No additional evidence was identified.

Reference: Jepsen et al [34]
Title: Regenerative surgical treatment of furcation defects: A systematic review and Bayesian network meta-analysis of randomized clinical trials
Search: After elimination of duplicate hits, 309 items were identified.
Screening: After screening of title and abstracts and, if needed, of full text, no new articles were selected.
New evidence: None
Evaluation of the new evidence: No additional evidence was identified.

Reference: Dommisch et al [39]
Title: Resective surgery for the treatment of furcation involvement – a systematic review
Search: After elimination of duplicate hits, 47 items were identified.
Screening: After screening of title and abstracts and, if needed, of full-text, 2 new articles were selected Nibali et al [62] and Rudiger et al [63].
Evaluation of the new evidence: New limited evidence was identified [62,63]., but no influence on the results of the published systematic review was observed, since the outcomes of the additional references (on tunnelling) report similar survival rates as the references already included in the structured review.

approve them (Table 3). The panel took great care to avoid overlaps or significant gaps between the SRs, so they would truly cover all possible interventions currently undertaken in periodontal therapy.

Relevance of outcomes

A narrative review paper was commissioned for this guideline [49] to assess the possible outcome measures utilized to evaluate the efficacy of periodontal therapy in relation to true patient-centred outcomes like tooth retention/loss. The authors found that the commonly reported outcome variable with the best demonstrated predictive potential for tooth loss was the reduction in periodontal probing pocket depth (PPD). Therefore, for this guideline, PPD reduction was used as the primary outcome for those systematic reviews not addressing periodontal regeneration, and where tooth survival data were not reported. When reviewing regenerative interventions, gains in clinical attachment were used as the primary outcome measure. To avoid introducing bias by including possibly spurious findings of studies with very short follow-up, a minimal follow-up period of six months was requested for all reviews.

Search strategy

All SRs utilized a comprehensive search strategy of at least two different databases, supplemented by a hand search of periodontal journals and the reference lists of included studies.

In all SRs, the electronic and manual search, as well as the data extraction, was done in parallel by two different investigators.

Quality assessment of included studies

In all SRs, the risk of bias of controlled clinical trials was assessed using the Cochrane Risk-of bias tool [50]. For observational studies, the Newcastle- Ottawa-Scale was used [51].

Data synthesis

Where applicable, the available evidence was summarized by means of meta-analysis, or other tools for pooling data (network meta-analysis, Bayesian network meta-analysis) [52–63].

2.3. From evidence to recommendation: structured consensus process

The structured consensus development conference was held during the XVI European Workshop in Periodontology in La Granja de San Ildefonso Segovia, Spain, on November 10th – 13th, 2019. Using the 15 SRs as background information, evidence-based recommendations were formally debated by the guideline panel using the format of a structured consensus development conference. This consisted of small group

discussions and an open plenary where the proposed recommendations were presented, voted and adopted by consensus [64].

In the small group phase, delegates convened in four working groups addressing the following subtopics; 1) "periodontitis stages I & II"; 2) "periodontitis stage III"; 3) "periodontitis stage III with intraosseous defects and/or furcations", and 4) "supportive periodontal care". These working groups were directed by two chairpersons belonging to the EFP Workshop Committee. With the support of an expert in methodology in each working group, recommendations and draft background texts were generated and subsequently presented, debated and put to a vote in the plenary of all delegates. During these plenary sessions the guideline development process and discussions and votes were overseen and facilitated by the independent guideline methodologist (I.K.). The plenary votes were recorded using an electronic voting system, checked for plausibility and then introduced into the guideline text.

The consensus process was conducted as follows:

Plenary 1

Introduction to guideline methodology (presentation, discussion) by the independent guideline methodologist (I.K.).

Working group Phase 1

- Peer evaluation of declarations of interest and management of conflicts.
- Presentation of the evidence (SR results) by group chairs and methodology consultants.
- Invitation of all members of the working group to reflect critically on the quality of available evidence by group chairs, considering GRADE criteria.
- Structured group discussion:
  - development of draft recommendation and their grading, considering GRADE-criteria.
  - development of draft background texts, considering GRADE-criteria.
  - invitation to comment on the draft recommendations and background text to suggest reasonable amendments by the group chairs.
  - collection and merging of amendments by the group chairs.
  - initial voting within the working group on recommendations and guideline text to be presented as a group result in the plenary.

Plenary 2

- Presentation of working group results (draft recommendations and background text) by Working Group chairs.
- Invitation to formulate questions, statements and reasonable amendments of the plenary by the independent guideline methodologist /facilitator.
- Answering of questions by working group chairpersons.
- Collection and merging of amendments by independent moderator.
- Preliminary vote on all suggestions provided by the working groups and all reasonable amendments.
- Assessment of the strength of consensus.
- Opening debate, where no consensus was reached or reasonable need for discussion was identified.
- Formulation of tasks to be solved within the working groups.

Working Group Phase 2

- Discussion of tasks and potential amendments raised by the plenary.
- Formulation of reasonable and justifiable amendments, considering the GRADE framework.
- Initial voting within the working group on recommendations and guideline text for plenary.

Plenary 3

- Presentation of working group results by working group chairpersons.
- Invitation to formulate questions, statements and reasonable amendments of the plenary by the independent moderator.
- Collection and merging of amendments by independent moderator.
- Preliminary vote.
- Assessment of the strength of consensus.
- Opening debate, where no consensus was reached or reasonable need for discussion was identified.
- Formulation of reasonable alternatives.
- Final vote of each recommendation.

Commentary –UK Implementation

The UK implementation process followed the process described above.

The entire implementation process was performed using a video conference system due to the Covid-19 pandemic.

In brief, the following steps were performed:

1. Updated searches for potential new guidelines and evidence
2. Critical assessment of all clinical recommendations following the GRADE ADOLOPMENT process [51]
3. Draft proposals for the implementation of each clinical recommendation were introduced at working group level
4. Working group meeting with external, independent moderator and formal consensus process
5. Plenary sessions with formal consensus process and final voting

2.4. Definitions: rating the quality of evidence, grading the strength of recommendations and determining the strength of consensus

For all recommendations and statements, this guideline makes transparent

- the underlying quality of evidence, reflecting the degree of certainty / uncertainty of the evidence and robustness of the study results
- the grade of the recommendation, reflecting the criteria of considered judgement and the strength of consensus, indicating the degree of agreement within the guideline panel and thus, reflecting the need of implementation

Commentary – UK Implementation

The aforementioned procedures and criteria have also been used for the UK implementation.

Quality of Evidence

The quality of evidence was assessed using a recommended rating scheme [65,66].

Strength of Recommendations

The grading of the recommendations used the grading scheme (Table 4) by the German Association of the Scientific Medical Societies (AWMF) and Standing Guidelines Commission [13], taking into account not only the quality of evidence, but also considered judgement, guided by the following criteria:

- relevance of outcomes and quality of evidence for each relevant outcome
- consistency of study results
- directness regarding applicability of the evidence to the target population/PICO specifics
- precision of effect estimates regarding confidence intervals
- magnitude of the effects
- balance of benefit and harm
- ethical, legal, economic considerations
- patient preferences

The grading of the quality of evidence and the strength of a recommendation may therefore differ in justified cases.

Commentary – UK Implementation

The aforementioned procedures and criteria have also been used for the UK implementation.

Strength of Consensus

The consensus determination process followed the recommendations by the German Association of the Scientific Medical Societies (AWMF) and Standing Guidelines Commission [13]. In case, consensus could not be reached, different points of view were documented in the guideline text. See Table 5.

2.5. Editorial independence

Funding of the guideline

The development of this guideline and its subsequent publication was financed entirely by internal funds of the European Federation of Periodontology, without any support from industry or other organisations.

Commentary – UK Implementation

The UK implementation has been funded entirely by funds from the BSP.

Declaration of Interests and Management of Potential Conflicts

All members of the guideline panel declared secondary interests using the standardized form provided by the International Committee of Medical Journal Editors (ICMJE) (International Committee of Medical

Table 5
Strength of Consensus: Determination Scheme [13].

Unanimous consensus	Agreement of 100 % of participants
Strong consensus	Agreement of > 95 % of participants
Consensus	Agreement of 75–95 % of participants
Simple majority	Agreement of 50–74 % of participants
No consensus	Agreement of <50 % of participants

Table 4
Strength of Recommendations: Grading Scheme [13].

Grade of recommendation grade*	Description	Syntax
A	Strong recommendation	We recommend (↑↑) /We recommend not to (↓↓)
B	Recommendation	We suggest to (↑) /We suggest not to (↓)
0	Open recommendation	May be considered (↔)

* If the group felt that evidence was not clear enough to support a recommendation, Statements were formulated, including the need (or not) of additional research.

Editors).

Management of conflicts of interests (CoI) was discussed in the working groups, following the principles provided by the Guidelines International Network [67]. According to these principles, panel members with relevant, potential CoI abstained from voting on guideline statements and recommendations within the consensus process.

2.6. Implementation and dissemination plan

For this guideline, a multi-stage dissemination and implementation strategy will be actioned by the EFP, supported by a communication campaign.

This will include:

Commentary – UK Implementation
All participants of the implementation process were asked to declare their interests using the ICMJE form, as outlined above. Summarized accounts of the interests can be found in chapter 9.

Peer review

All 15 systematic reviews, and the position paper on outcome variables commissioned for this guideline, underwent a multi-step peer review process. First, the draft documents were evaluated by members of the EFP Workshop Committee and the methodological consultants using a custom-made appraisal tool to assess (i) the methodological quality of the SRs using the AMSTAR 2 checklist [68], and (ii) whether all PICO(S) questions were addressed as planned. Detailed feedback was then provided for the SR authors. Subsequently, all 15 systematic reviews and the position paper underwent the regular editorial peer review process defined by the *Journal of Clinical Periodontology*.

The guideline text was drafted by the chairs of the working groups, in close cooperation with the methodological consultants, and circulated in the guideline group before the workshop. The methodological quality was formally assessed by an outside consultant using the AGREE framework [31]. The guideline was subsequently peer reviewed for its publication in the *Journal of Clinical Periodontology* following the standard evaluation process of this scientific journal [1].

- Publication of the guideline and the underlying systematic reviews and position paper as an Open Access special issue of the *Journal of Clinical Periodontology*
- Local uptake from national societies, either by Commentary, Adoption, or Adaptation [15]
- Generation of educational material for dental professionals and patients, dissemination via the EFP member societies
- Dissemination via educational programs on dental conferences
- Dissemination via EFP through European stakeholders via National Societies, members of EFP
- Long-term evaluation of the successful implementation of the guideline by poll of EFP members

The timeline of the guideline development process is detailed in Table 6.

Commentary – UK Implementation
The British implementation has been peer-reviewed by an external, independent dental scientist with experience in S3-level guideline development.

Table 6
Timeline of the guideline development process.

Time point	Action
April 2018	Decision by European Federation of Periodontology (EFP) General Assembly to develop comprehensive treatment guidelines for periodontitis
May-Sept 2018	EFP Workshop Committee assesses merits and disadvantages of various established methodologies and their applicability to the field
Sept 2018	EFP Workshop Committee decides on/invites (i) topics covered by proposed guideline, (ii) working groups and chairs, (iii) systematic reviewers, and (iv) outcomes measures
December 2018	Submission of PICO(S) questions by systematic reviewers to group chairs for internal alignment Decision on consensus group, invitation of stakeholders
January 21st, 2019	Organizing and Advisor Committee meeting. Decision on PICO(S) and information sent to reviewers
March – June 2019	Submission of Systematic reviews by reviewers, initial assessment by workshop committee
June – Oct 2019	Peer review and revision process, *Journal of Clinical Periodontology*
Sept 2019	Submission of declarations of interest by all delegates
Before workshop	Electronic circulation of reviews and guideline draft
10-13.11.2019	Workshop in La Granja with moderated formalized consensus process
Dec 2019-Jan 2020	Formal stakeholder consultation, finalisation of guideline method report and background text
April 2020	Publication of guideline and underlying Systematic Reviews in the *Journal of Clinical Periodontology*

Commentary – UK Implementation

Time point	Action
April 2020	Decision by the BSP executive board to implement the EFP S3 guideline in the United Kingdom using the GRADE ADOLOPMENT framework [51]. Invitation of project leads and chairpersons, methodologists and independent moderators (Prof. Ina Kopp), and stakeholder organisations. Assessment of potential CoIs for all guideline group members.
April 2020	Update of the 15 systematic review searches (by the original authors of the reviews)
April - May 2020	Assessment of the updated evidence base and the clinical recommendations of the original guideline document by the group chairs. Draft of possible adaptations. Distribution of the draft clinical recommendations within the working groups.
May – June 2020	Working group phase – Three working groups prepared adoloped clinical recommendations with independent moderation and formal CoI management. Subsequently, all recommendations from all working groups were circulated to all guideline group members for critical assessment.
25/26 June 2020	Plenary session with independent moderation and formalised consensus process (virtual)
July – Nov 2020	Final editing
Nov – Dec 2020	Formal approval by all stakeholders and involved organisations
Early 2021	Publication and start of the dissemination phase (articles, webinars, interactive materials)

2.7. Validity and update process

The guideline is valid until 2025. However, the EFP, represented by the members of the Organizing Committee, will continuously assess current developments in the field. In case of major changes of circumstances, e.g. new relevant evidence, they will trigger an update of the guideline to potentially amend the recommendations. It is planned to update the current guideline regularly on demand in the form of a living guideline.

- defined as 10 %-30 % bleeding sites, whilst generalized gingivitis is defined a >30 % bleeding sites
- A periodontitis case is defined by the loss of periodontal tissue support, which is commonly assessed by radiographic bone loss or interproximal loss of clinical attachment measured by probing. Other meaningful descriptions of periodontitis include: the number and proportions of teeth with probing pocket depth over certain thresholds (commonly ≥4 mm with BOP and ≥6 mm), the number of teeth lost due to periodontitis, the number of teeth with intrabony lesions and the number of teeth with furcation lesions.

Commentary – UK Implementation

The UK implementation will be updated at regular intervals, following the updates of the underlying supra-national EFP S3-guideline. The authors of the implementation are in close contact with the EFP Workshop Committee to facilitate this update process.

3. Periodontal diagnosis and classification

Periodontal diagnosis has been followed according to the classification scheme defined in the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions [2,69–73].

According to this classification:

- A case of clinical periodontal health is defined by the absence of inflammation [measured as presence of bleeding on probing (BOP) at less than 10 % sites] and the absence of attachment and bone loss arising from previous periodontitis.
- A gingivitis case is defined by the presence of gingival inflammation, as assessed by BOP at ≥10 % sites and absence of detectable attachment loss due to previous periodontitis. Localized gingivitis is
- An individual case of periodontitis should be further characterized using a matrix that describes the *stage* and *grade* of the disease. *Stage* is largely dependent upon the severity of disease at presentation, as well as on the anticipated complexity of case management, and further includes a description of extent and distribution of the disease in the dentition. *Grade* provides supplemental information about biological features of the disease including a history-based analysis of the rate of periodontitis progression; assessment of the risk for further progression; analysis of possible poor outcomes of treatment; and assessment of the risk that the disease or its treatment may negatively affect the general health of the patient. The staging, which is dependent on the severity of the disease and the anticipated complexity of case management, should be the basis for the patient's treatment plan based on the scientific evidence of the different

Table 7
Criteria for defining stages of periodontitis. Taken from Tonetti et al. [72].

Periodontitis stage		Stage I	Stage II	Stage III	Stage IV
Severity	Interdental CAL at site of greatest loss	1 to 2 mm	3 to 4 mm	≥5 mm	≥5 mm
	Radiographic bone loss	Coronal third (<15%)	Coronal third (15% to 33%)	Extending to middle or apical third of the root	Extending to middle or apical third of the root
	Tooth loss	No tooth loss due to periodontitis		Tooth loss due to periodontitis of ≤4 teeth	Tooth loss due to periodontitis of ≥5 teeth
Complexity	Local	Maximum probing depth ≤4 mm Mostly horizontal bone loss	Maximum probing depth ≤5 mm Mostly horizontal bone loss	In addition to stage II complexity: Probing depth ≥6 mm Vertical bone loss ≥3 mm Furcation involvement Class II or III Moderate ridge defect	In addition to stage III complexity: Need for complex rehabilitation due to: Masticatory dysfunction Secondary occlusal trauma (tooth mobility degree ≥2) Severe ridge defect Bite collapse, drifting, flaring Less than 20 remaining teeth (10 opposing pairs)
Extent and distribution	Add to stage as descriptor	For each stage, describe extent as localized (<30% of teeth involved), generalized, or molar/incisor pattern			

The initial stage should be determined using CAL; if not available then RBL should be used. Information on tooth loss that can be attributed primarily to periodontitis – if available – may modify stage definition. This is the case even in the absence of complexity factors. Complexity factors may shift the stage to a higher level, for example furcation II or III would shift to either stage III or IV irrespective of CAL. The distinction between stage III and stage IV is primarily based on complexity factors. For example, a high level of tooth mobility and/or posterior bite collapse would indicate a stage IV diagnosis. For any given case only some, not all, complexity factors may be present, however, in general it only takes one complexity factor to shift the diagnosis to a higher stage. It should be emphasized that these case definitions are guidelines that should be applied using sound clinical judgment to arrive at the most appropriate clinical diagnosis.
For post-treatment patients CAL and RBL are still the primary stage determinants. If a stage-shifting complexity factor(s) is eliminated by treatment, the stage should not retrogress to a lower stage since the original stage complexity factor should always be considered in maintenance phase management.
CAL = clinical attachment loss; RBL = radiographic bone loss.

Table 8
Criteria for defining grades of periodontitis. Taken from Tonetti et al. [72].

Periodontitis grade			Grade A: Slow rate of progression	Grade B: Moderate rate of progression	Grade C: Rapid rate of progression
Primary criteria	Direct evidence of progression	Longitudinal data (radiographic bone loss or CAL)	Evidence of no loss over 5 years	<2 mm over 5 years	≥2 mm over 5 years
	Indirect evidence of progression	% bone loss/age	<0.25	0.25 to 1.0	>1.0
		Case phenotype	Heavy biofilm deposits with low levels of destruction	Destruction commensurate with biofilm deposits	Destruction exceeds expectation given biofilm deposits; specific clinical patterns suggestive of periods of rapid progression and/or early onset disease (e.g., molar/incisor pattern; lack of expected response to standard bacterial control therapies)
Grade modifiers	Risk factors	Smoking	Non-smoker	Smoker <10 cigarettes/day	Smoker ≥10 cigarettes/day
		Diabetes	Normoglycemic / no diagnosis of diabetes	HbA1c <7.0% in patients with diabetes	HbA1c ≥7.0% in patients with diabetes

Grade should be used as an indicator of the rate of periodontitis progression. The primary criteria are either direct or indirect evidence of progression. Whenever available, direct evidence is used; in its absence indirect estimation is made using bone loss as a function of age at the most affected tooth or case presentation (radiographic bone loss expressed as percentage of root length divided by the age of the subject, RBL/age). Clinicians should initially assume grade B disease and seek specific evidence to shift towards grade A or C, if available. Once grade is established based on evidence of progression, it can be modified based on the presence of risk factors. CAL = clinical attachment loss; HbA1c = glycated hemoglobin A1c; RBL = radiographic bone loss.

therapeutic interventions. The grade, however, since it provides supplemental information on the patient's risk factors and rate of progression, should be the basis for individual planning of care (Tables 7 and 8) [2,72]

- After completion of periodontal therapy, a stable periodontitis patient has been defined by gingival health on a reduced periodontium

1) Identifying a patient suspected of having Periodontitis
2) Confirming the diagnosis of Periodontitis
3) Staging the Periodontitis Case
4) Grading the Periodontitis Case

Commentary – UK Implementation

The UK implementation starts with a BPE screen; provisional diagnosis; further investigations (radiographs and detailed probing charts) and diagnostic statement. The diagnostic statement included definitive diagnosis, extent (localised or generalised), stage & grade, current status (stable/unstable) and risk factors.

(bleeding on probing in <10 % of the sites; shallow probing depths of 4 mm or less and no 4 mm sites with bleeding on probing). When, after completion of periodontal treatment, these criteria are met but bleeding on probing is present at >10 % of sites, then the patient is diagnosed as a stable periodontitis patient with gingival inflammation. Sites with persistent probing depths ≥4 mm which exhibit BOP are likely to be unstable and require further treatment. It should be recognized that successfully treated and stable periodontitis patients will remain at increased risk of recurrent periodontitis, and hence if gingival inflammation is present adequate measures for inflammation control should be implemented to prevent recurrent periodontitis.

3.1. Clinical pathway for a diagnosis of periodontitis

A proposed algorithm has been used by the EFP to assist clinicians with this periodontal diagnosis process when examining a new patient [73]. It consists of 4 sequential steps:

3.2. Differential diagnosis

Periodontitis should be differentiated from the following clinical conditions and can occur simultaneous (not an exhaustive list of conditions and diseases):

- Gingivitis [70]
- Vertical root fracture [71]
- Cervical decay [71]
- Cemental tears [71]
- External root resorption lesions [71]
- Tumours or other systemic conditions extending to the periodontium [71]
- Trauma-induced local recession [71]
- Endo-periodontal lesions [74]
- Periodontal abscess [74]
- Necrotising periodontal diseases [74]

3.3. Sequence for the treatment of periodontitis stages I, II and III

Patients, once diagnosed, should be treated according to a pre-established stepwise approach to therapy that, depending on the disease stage, should be incremental, each including different interventions.

An *essential pre-requisite* to therapy is to inform the patient of the diagnosis, including causes of the condition, risk factors, treatment alternatives and expected risks and benefits including the option of no treatment. This discussion should be followed by agreement on a personalized care plan. The plan might need to be modified during the treatment journey, depending on patient preferences, clinical findings and changes to overall health.

1. ***The first step in therapy*** is aimed at guiding behaviour change by motivating the patient to undertake successful removal of supragingival dental biofilm and risk factor control, and may include the following interventions:

- Supragingival dental biofilm control
- Interventions to improve the effectiveness of oral hygiene [motivation, instructions (oral hygiene instructions, OHI)]
- Adjunctive therapies for gingival inflammation
- Professional Mechanical Plaque Removal (PMPR), which includes the professional interventions aimed at removing supragingival plaque and calculus, as well as possible plaque-retentive factors that impair oral hygiene practices.
- Risk factor control, which includes all the health behavioural change interventions eliminating/mitigating the recognized risk factors for periodontitis onset and progression (smoking cessation, improved metabolic control of diabetes, and perhaps physical exercise, dietary counselling and weight loss).

This first step of therapy should be implemented in all periodontitis patients, irrespective of the stage of their disease, and should be re-evaluated frequently in order to:

- Continue to build motivation and adherence, or explore other alternatives to overcome the barriers
- Develop skills in dental biofilm removal and modify as required
- Allow for the appropriate response of the ensuing steps of therapy

2. ***The second step of therapy*** (cause-related therapy) is aimed at controlling (reducing/eliminating) the subgingival biofilm and calculus (subgingival instrumentation). In addition to this. the following interventions may be included:

- Use of adjunctive physical or chemical agents
- Use of adjunctive host-modulating agents (local or systemic)
- Use of adjunctive subgingival locally delivered antimicrobials
- Use of adjunctive systemic antimicrobials

This second step of therapy should be used for all periodontitis patients, irrespective of their disease stage, only in teeth with loss of periodontal support and/or periodontal pocket formation*.

The individual response to the second step of therapy should be assessed once the periodontal tissues have healed (periodontal re-evaluation). If the endpoints of therapy (no periodontal pockets ≥4 mm with bleeding on probing) have not been achieved and there are still deep periodontal pockets (≥6 mm) the third step of therapy should be considered. If the treatment has been successful in achieving the endpoints of therapy, patients should be placed in a supportive periodontal care (SPC) program.

3. ***The third step of therapy*** is aimed at treating those areas of the dentition not responding adequately to the second step of therapy (presence of pockets ≥4 mm with bleeding on probing or presence of deep periodontal pockets (≥6 mm)), with the purpose of gaining further access to subgingival instrumentation, or aiming at regenerating or resecting those lesions that add complexity in the management of periodontitis (intra-bony and furcation lesions).

It may include the following interventions:

- Repeated subgingival instrumentation with or without adjunctive therapies
- Access Flap Periodontal Surgery
- Resective Periodontal Surgery
- Regenerative Periodontal Surgery

When there is indication for surgical interventions, these should be subject to additional patient consent and specific evaluation of risk factors or medical contra-indications should be considered.

The individual response to the third step of therapy should be re-assessed (periodontal re-evaluation) and ideally the endpoints of therapy should be achieved, and patients should be placed in supportive periodontal care, although these endpoints of therapy may not be achievable in all teeth in severe stage III periodontitis patients.

4. ***Supportive periodontal care*** is aimed at maintaining periodontal stability in all treated periodontitis patients combining preventive and therapeutic interventions defined in the first and second steps of therapy, depending on the gingival and periodontal status of the patient's dentition. This step should be rendered at regular intervals according to the patient's needs and, at any of these recall visits, a patient may need re-treatment if recurrent disease is detected. In these situations, a proper diagnosis and treatment plan should be reinstituted. In addition, compliance with the recommended oral hygiene regimens and healthy lifestyles are part of supportive periodontal care.

In any of the steps of therapy, tooth extraction may be considered if the affected teeth have a hopeless prognosis.

The first part of this document was prepared by the steering group with the help of the methodology consultants. It was carefully examined by the experts participating in the consensus and was voted upon in the initial plenary session to form the basis for the specific recommendations [75,76].

Strength of consensus: *strong consensus* (0% of the group abstained due to potential CoI)

**In specific clinical situations, such as in the presence of deep probing depths,* (≥6 mm) *1st and 2nd steps of therapy could be delivered simultaneously (such as for preventing periodontal abscess development)*

For BSP implementation of Staging (Table 7) see below.
For BSP implementation of Grading (Table 8) see below.

BSP Implementation

Classification and diagnosis are distinct concepts but intimately linked. A classification normally provides a higher level of granularity than a diagnosis. For example, a tumour may be diagnosed as a squamous cell carcinoma, but further classified according to its size (T), the involvement of lymph nodes (N), whether it has metastasised (M). Further classification embraces the grade of the tumour histologically, according to how aggressively it behaves.

Periodontal diseases are not tumours and are not graded histologically, nor are they curable. Hence a cancer patient can be cured according to 5-years of survival and become a "cancer survivor", whereas a periodontitis patient cannot be cured and remains a periodontitis patient for life, due to the chronicity of the condition and its propensity to recur.

The 2017 World Workshop Classification (WWC) attempts to align the concepts of classification and diagnosis, the diagnosis being made as a first step, prior to staging and grading of the disease and assigning its extent [69]. The 2017 WWC system defines Stage IV periodontitis as severe periodontal destruction associated with "complicating factors". The "complicating factors" are not periodontal conditions *per se* and therefore not part of a periodontal diagnosis. The BSP implementation of the WWC classifies Stage IV periodontitis based upon the level of periodontal attachment/bone loss alone and views the management of any complicating factors as being part of the rehabilitation of the patient following periodontal therapy [69].

Therefore, the simplified BSP adolopment of the staging and grading system, replacing Table 7 and 8 above, from Dietrich et al [75] below, and their integration into a simple care pathway available at: https://www.bsperio.org.uk/assets/downloads/111_153050_bsp-flowchart-implementing-the-2017-classification.pdf [76]

Staging by BSP Implementation for Clinical Practice

	Periodontitis	Stage 1 *(Early/Mild)*	Stage II *(Moderate)*	Stage III *(Severe)*	Stage IV *(Very Severe)*
Severity	INTERPROXIMAL % BONE LOSS	<15% or <2mm*	Coronal 1/3rd of root bone loss	Mid 1/3rd of root bone loss	Apical 1/3rd of root bone loss
Extent	Localised : up to 30% of teeth Generalised: more than 30%, Molar/incisor pattern				

* If only BW available

Grading by BSP Implementation for Clinical Practice

	Progression	Grade A: Slow	Grade B: Moderate	Grade C: Rapid
Primary criteria	%BL / age	< 0.5	0.5 - 1.0	>1.0

However, despite these minor differences in implementation, the presently described S3 evidence-based treatment guidelines apply equally to the WWC stages I, II and III, as they do to the BSP stages I, II, III and IV. The management of complicating factors in both systems will form the basis of a separate S3 guideline to be developed in 2020-2021.

Strength of Consensus: *Strong Consensus* (0% abstentions due to potential CoI)

4. Clinical recommendations: first step of therapy

The first step of therapy is aimed at providing the periodontitis patient with the adequate preventive and health promotion tools to facilitate his/her adherence with the prescribed therapy and the assurance of adequate outcomes. This step not only includes the implementation of patient motivation strategies and behavioural changes to achieve adequate self-performed oral hygiene practices, but also the control of local and systemic modifiable risk factors that significantly influence this disease. Although this first step of therapy alone is insufficient to treat a periodontitis patient, it represents the foundation for optimal treatment response and long-term stable outcomes.

This first step includes not only the educational and preventive interventions aimed to control gingival inflammation, but also the professional mechanical removal of supragingival plaque and calculus, together with the elimination of local plaque retentive factors.

4.1. Intervention: Supragingival dental biofilm control (by the patient)

1.1 What are the adequate oral hygiene practices of periodontitis patients in the different steps of periodontitis therapy?

Expert consensus-based recommendation (1.1)
We **recommend** that the same guidance on oral hygiene practices to control gingival inflammation is enforced throughout all the steps of periodontal therapy including supportive periodontal care.
Supporting literature Van der Weijden and Slot [77]
Grade of recommendation Grade A – ↑↑
Strength of consensus Strong consensus [3.8% of the group abstained due to potential conflict of interest (CoI)]
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend that the same oral hygiene guidance to control gingival inflammation is practised throughout steps 1-4 of periodontal therapy including supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Supragingival dental biofilm control can be achieved by mechanical and chemical means. Mechanical plaque control is mainly performed by tooth brushing, either with manual or powered toothbrushes and with supplemental interdental cleaning using interdental brushes, dental floss, oral irrigators, wood sticks, etc. As adjuncts to mechanical plaque control, antiseptic agents, delivered in different formats, such as dentifrices and mouth rinses have been recommended. Furthermore, other agents aimed to reduce gingival inflammation have also been used adjunctively to mechanical biofilm control, such as probiotics, anti-inflammatory agents and antioxidant micronutrients.

Available evidence. Even though oral hygiene interventions and other preventive measures for gingivitis control were not specifically addressed in the systematic reviews prepared for this Workshop to Develop Guidelines for the treatment of periodontitis, evidence can be drawn from the XI European Workshop in Periodontology (2014) [78] and the systematic review on oral hygiene practices for the prevention and treatment of gingivitis [77]. This available evidence supports the following:

- Professional oral hygiene instructions (OHI) should be provided to reduce plaque and gingivitis. Reinforcement of OHI may provide additional benefits.
- Manual or power tooth brushing is recommended as a primary means of reducing plaque and gingivitis. The benefits of tooth brushing outweigh any potential risks.
- When gingival inflammation is present, inter-dental cleaning, preferably with interdental brushes (IDBs) should be professionally taught to patients. Clinicians may suggest other inter-dental cleaning devices/methods when the use of IDBs is not appropriate.

1.2 Are additional strategies in motivation useful?

Expert consensus-based recommendation (1.2)
We **recommend** emphasizing the importance of oral hygiene and engaging the periodontitis patient in behavioural change for oral hygiene improvement.
Supporting literature Carra et al [38]
Grade of recommendation Grade A – ↑↑
Strength of consensus Strong consensus (1.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend emphasising the importance of oral hygiene and engaging the periodontitis patient in behavioural change for oral hygiene improvement.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Oral hygiene instructions (OHI) and patient motivation in oral hygiene practices should be an integral part of patient management during all stages of periodontal treatment [79]. Different behavioural interventions, as well as communication and educational methods have been proposed to improve and maintain the patient's plaque control over time [80]. See additional information in the next section on "Methods of motivation".

1.3 Are psychological methods for motivation effective to improve the patient's compliance in oral hygiene practices?

Evidence-based statement (1.3)
To improve patient's behaviour towards compliance with oral hygiene practices, psychological methods such as motivational interviewing or cognitive behavioural therapy **have not** shown a significant impact.
Supporting literature Carra et al [38]
Quality of evidence Five randomised clinical trials (RCTs) (1716 subjects) with duration ≥ 6 months in untreated periodontitis patients [(4 RCTs with high and 1 RCT with low risk of bias (RoB)]
Grade of recommendation Statement – unclear, additional research needed
Strength of consensus Strong consensus (1.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *Psychological methods such as motivational interviewing or cognitive behavioural therapy have not been shown to have a significant impact on patient's compliance with oral hygiene practices.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Several different psychological interventions based on social cognitive theories, behavioural principles, and motivational interviewing (MI) have been applied to improve OHI adherence in patients with periodontal diseases. The available evidence has not demonstrated that these psychological interventions based on cognitive constructs and motivational interviewing principles provided by oral health professionals, have improved the patient's oral hygiene performance as measured by the reduction of plaque and bleeding scores over time.

Available evidence. The evidence includes two RCTs on MI (199 patients) and three RCTs on psychological interventions based on social cognitive theories and feedback (1517 patients).

Risk of bias. The overall body of evidence was assessed at high risk of bias (four RCTs high and one RCT low).

Consistency. The majority of the studies found no significant additional benefit of implementing psychological interventions in conjunction with OHI.

Clinical relevance and effect size. The reported effect size was not considered clinically relevant.

Balance of benefit and harm. Benefit and harm were not reported, and due to the fact that different health professionals were involved in

providing the interventions, no conclusion could be drawn.

Economic considerations. These studies did not assess a cost-benefit evaluation in spite of the expected additional cost related to the psychological intervention.

Patient preferences. No proper information was available to assess this issue.

Applicability. A psychological approach needs special training to be effectively performed.

Research. Focus on research capturing possible implementations in primary care/general practice should be undertaken.

4.2. Intervention: Adjunctive therapies for gingival inflammation

Adjunctive therapies for gingival inflammation have been considered within the adjunctive therapies to subgingival debridement, and therefore, they are evaluated within the second step of therapy.

4.3. Intervention: Supragingival dental biofilm control (professional)

1.4 What is the efficacy of supragingival professional mechanical plaque removal (PMPR) and control of retentive factors in periodontitis therapy?

Background

Intervention. The removal of the supragingival dental biofilm and calcified deposits (calculus) (here identified under the term "professional mechanical plaque removal", PMPR) is considered an essential component in the primary [70] and secondary [83] prevention of periodontitis as well as within the basic treatment of plaque-induced periodontal diseases [84]. Since the presence of retentive factors, either related to tooth anatomy or more frequently, due to inadequate restorative margins, are often associated with gingival inflammation and/or periodontal attachment loss, they should be prevented/eliminated to reduce their impact on periodontal health.

Available evidence. Even though these interventions were not specifically addressed in the systematic reviews prepared for this Workshop to Develop Guidelines for the treatment of periodontitis, indirect evidence can be found in the 2014 European Workshop on Prevention, in which the role of PMPR was addressed both in primary prevention [81] and in supportive periodontal care (SPC) [82]. Some additional evidence can be found to support both procedures, as part of periodontitis therapy. A split-mouth RCT, with a follow up of 450 days in 25 subjects, concluded that the performance of supragingival debridement, before subgingival debridement, decreased subgingival treatment needs and maintained periodontal stability over time [85]. In addition, supragingival debridement may induce beneficial changes in the subgingival microbiota [86]. Moreover, it has been established that retentive factors may increase the risk of worsening the periodontal condition [87–89].

Expert consensus-based recommendation (1.4)
We **recommend** supragingival professional mechanical plaque removal (PMPR) and control of retentive factors, as part of the first step of therapy.
Supporting literature Needleman et al [81], Trombelli et al [82]
Grade of recommendation Grade A – ↑↑
Strength of consensus Unanimous consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend supragingival Professional Mechanical Plaque Removal (PMPR) and control of biofilm/plaque retentive factors, as part of the first step of therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (0% abstentions due to potential CoI)

4.4. Intervention: risk factor control

1.5 In general, what is the efficacy of risk factor control in periodontitis therapy?

Evidence-based recommendation (1.5)
We **recommend** risk factor control interventions in periodontitis patients, as part of the first step of therapy.
Supporting literature Ramseier et al [42]
Quality of evidence 25 clinical studies
Grade of recommendation Grade A – ↑↑
Strength of consensus Strong consensus (1.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *As part of the first step of therapy in periodontitis patients, we recommend risk factor control interventions (e.g. for diabetes and smoking).*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Smoking and diabetes are two proven risk factors in the etiopathogenesis of periodontitis [2] and therefore, their control should be an integral component in the treatment of these patients. Interventions for risk factor control have aimed to educate and advise patients to make behavioural changes to reduce the effect of risk factors and in specific cases to refer patients for specialist medical therapy. 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

Available evidence. In the systematic review Ramseier et al. [42], the authors have identified 13 relevant guidelines of interventions for tobacco smoking cessation, promotion of diabetes control, physical exercise (activity), change of diet, carbohydrate (dietary sugar) reduction and weight loss. In addition, 25 clinical studies were found that assess the impact of (some of) these interventions in gingivitis/periodontitis patients.

Risk of bias. It is explained specifically for each intervention.

Consistency. The heterogeneity in study design precludes consistent findings, but adequate consistency may be found for studies on smoking cessation and diabetes control.

Clinical relevance and effect size. No meta-analysis was performed; effect sizes can be found in the individual studies.

Balance of benefit and harm. In addition to periodontal benefits, all the tested interventions represent a relevant beneficial systemic health impact.

Economic considerations. The various studies do not investigate a cost-benefit evaluation and one must be mindful of the additional cost related to a psychological intervention. But, the systemic health benefits that can be obtained from these interventions, if they are successful, would represent a reduced cost of health-care services in different comorbidities.

Patient preferences. The interventions are heterogeneous, but the potential systemic health benefits may favour preference for them.

Applicability. This was demonstrated with studies testing large groups from the general population; the practicality of routine use is still to be determined.

1.6 What is the efficacy of tobacco smoking cessation interventions in periodontitis therapy?

Evidence-based recommendation (1.6)
We **recommend** tobacco smoking cessation interventions to be implemented in patients undergoing periodontitis therapy.
Supporting literature Ramseier et al [42]
Quality of evidence Six prospective studies with, at least, 6-month follow up
Grade of recommendation Grade A – ↑↑
Strength of consensus Unanimous consensus (1.2% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend tobacco smoking cessation interventions to be implemented in patients undergoing periodontitis therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Periodontitis patients may benefit from smoking cessation interventions to improve periodontal treatment outcomes and the maintenance of periodontal stability. Interventions consist of brief counselling and may include patient referral for advanced counselling and pharmacotherapy.

Available evidence. In the systematic review Ramseier et al. [42], six prospective studies of 6–24 months duration performed at university settings were identified. Different interventions were tested (smoking cessation counselling, 5 A's [ask, advise, assess, assist, and arrange], cognitive behavioural therapy [CBT], motivational interviewing, brief interventions, nicotine replacement therapies). In three of the studies, the intervention was programmed in parallel with non-surgical periodontal therapy (NSPT) and followed by supportive periodontal care (SPC), in one study SPC patients were included and, in another, patients in NSPT and in SPC were compared; in one study, the methodology was unclear. The success of smoking cessation was considered moderate (4–30 % after 1–2 years), except in one study. Two studies demonstrated benefits in periodontal outcomes, when comparing former smokers to smokers and oscillators.

Additional factors have been discussed in the overall evaluation of risk factor control.

Other documents that should be taken into consideration alongside this recommendation are the NICE guidelines, Delivering Better Oral Health [90] and the SDCEP guidance on prevention and treatment of periodontal diseases in primary care [91].

1.7 What is the efficacy of promotion of diabetes control interventions in periodontitis therapy?

Evidence-based recommendation (1.7)
We **recommend** diabetes control interventions in patients undergoing periodontitis therapy.
Supporting literature Ramseier et al [42]
Quality of evidence Two 6-month RCTs
Grade of recommendation Grade A – ↑↑
Strength of consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend diabetes control interventions in patients undergoing periodontitis therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Periodontitis patients may benefit from diabetes control interventions to improve periodontal treatment outcomes and the maintenance of periodontal stability. These interventions consist of patient education as well as brief dietary counselling and in situations of hyperglycaemia, the patient`s referral for glycaemic control.

Available evidence. In the systematic review Ramseier et al. [42], two studies on the impact of diabetes control interventions in periodontitis patients were identified, both were 6-month RCTs and performed at university settings. Periodontal interventions were not clearly defined. Different interventions were tested, including individual lifestyle counselling, dietary changes and oral health education. Some improvements were observed in the intervention groups, in terms of periodontal outcomes.

Additional factors have been discussed in the overall evaluation of risk factor control.

Other documents that should be taken into consideration alongside this recommendation are the NHS Commissioning guidelines for diabetes management [92], the NICE guidelines, Delivering Better Oral Health [90] and the guidance produced by SDCEP [91].

1.8 What is the efficacy of increasing physical exercise (activity) in periodontitis therapy?

Evidence-based recommendation (1.8)
We **do not know** if interventions aimed to increase physical exercise (activity) have a positive impact in periodontitis therapy.
Supporting literature Ramseier et al [42]
Quality of evidence One 12-week RCT, one 12-week prospective study
Grade of recommendation Grade 0 – Statement: unclear, additional research needed
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not know if interventions aimed to increase physical exercise (activity) have a positive impact in periodontitis therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Overall evidence from the medical literature suggests that the promotion of physical exercise (activity) interventions may improve both treatment and the long-term management of chronic non-communicable diseases. In periodontitis patients, the promotion may consist of patient education and counselling tailored to the patient's age and general health.

Available evidence. In the systematic review Ramseier et al. [42], two 12-week studies on the impact of physical exercise (activity) interventions in periodontitis patients were identified. One RCT (testing education with comprehensive yogic interventions followed by yoga exercises) and one prospective study (with a briefing followed by physical exercises; the control group had a dietary intervention), performed at university settings. Periodontal interventions were not clearly defined, although in the yoga study, standard therapy was delivered (but not described) in periodontitis patients, while no periodontal therapy

was provided in the second study. Both studies reported improved periodontal parameters, including bleeding scores and probing depth changes, after 12 weeks (although in the yoga study, the influence on psychological stress could not be discounted).

Additional factors have been discussed in the overall evaluation of risk factor control.

1.9 What is the efficacy of dietary counselling in periodontitis therapy?

Evidence-based recommendation (1.9)
We **do not know** if dietary counselling may have a positive impact in periodontitis therapy.
Supporting literature Ramseier et al [42]
Quality of evidence Three RCTs, four prospective studies
Grade of recommendation Grade 0 – Statement: unclear, additional research needed
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based statement is **adopted**.* *We do not know if dietary counselling has a positive impact on the outcome of periodontal therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Periodontitis patients may benefit from dietary counselling interventions to improve periodontal treatment outcomes and the maintenance of periodontal stability. These interventions may consist of patient education including brief dietary advice and in specific cases patient referral to a nutrition specialist.

Available evidence. In the systematic review Ramseier et al. [42], seven studies on the impact of dietary counselling (mainly addressing lower fat intake, less free sugars and salt intake, increase in fruit and vegetable intake) in periodontitis patients (with or without other comorbidities) were identified: three RCTs (6-month, 8-week, 4-week) and four prospective studies (12-month, 24-week, 12-week, 4-week), performed at hospital and university settings. Periodontal interventions were not clearly defined, although in the 6-month RCT, periodontal treatment was part of the protocol. Some studies showed significant improvements in periodontal parameters, but the RCT with the longest follow up was not able to identify significant benefits [93].

In the systematic review Ramseier et al. [42], two studies specifically on the impact of dietary counselling aiming at carbohydrate (free sugars) reduction in gingivitis/periodontitis patients were identified, one 4-week RCT (including also gingivitis patients) and one 24-week prospective study. Periodontal interventions were not clearly defined. Both studies reported improved gingival indices.

Additional factors have been discussed in the overall evaluation of risk factor control.

2.0 What is the efficacy of lifestyle modifications aimed at weight loss in periodontitis therapy?

Evidence-based recommendation (2.0)
We do not know if interventions aimed at weight loss through lifestyle modification may have a positive impact in periodontitis therapy.
Supporting literature Ramseier et al [42]
Quality of evidence Five prospective studies
Grade of recommendation Grade 0 – Statement: unclear, additional research needed
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based statement is **adopted**.* *We do not know if interventions aimed at weight loss through lifestyle modification, have a positive impact on the outcome of periodontal therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: *Strong Consensus* (0% abstentions due to potential CoI)

Background

Intervention. Available evidence suggests that weight loss interventions may improve both the treatment and long-term outcome of chronic non-communicable diseases. In periodontitis patients, these interventions may consist of specific educational messages tailored to the patient's age and general health. These should be supported with positive behavioural change towards healthier diets and increase in physical activity (exercise).

Available evidence. In the systematic review Ramseier et al. [42], five prospective studies, in obese gingivitis/periodontitis patients, on the impact of weight loss interventions were identified, with different follow-ups (18 months, 12 months, 24 weeks and two studies of 12 weeks). Periodontal interventions were not clearly defined. Intensity of lifestyle modifications aimed at weight loss interventions ranged from a briefing, followed by counselling in dietary change, to an 8-week high-fibre, low-fat diet, or a weight reduction program with diet and exercise-related lifestyle modifications. Three studies reported beneficial periodontal outcomes and the other two no differences.

Additional factors have been discussed in the overall evaluation of risk factor control.

5. Clinical recommendations: second step of therapy

The second step of therapy (also known as cause-related therapy) is aimed at the elimination (reduction) of the sub-gingival biofilm and calculus and may be associated with removal of endotoxin-associated root surface (cementum). The procedures aimed at these objectives have received different names in the scientific literature: sub-gingival debridement, sub-gingival scaling, root planing, root surface instrumentation [94]. In this guideline, we have agreed to use the term "**sub-gingival instrumentation**" for all non-surgical procedures performed by hand (i.e. curettes) or power-driven (i.e. sonic/ultrasonic devices) instruments that are specifically designed to gain access to the root surfaces in the sub-gingival environment to remove sub-gingival biofilm and calculus. As a prerequisite, the second step of therapy requires the successful implementation of the measures described in the first step of therapy.

Furthermore, sub-gingival instrumentation may be supplemented with the following adjunctive interventions:

- Use of adjunctive physical or chemical agents.
- Use of adjunctive host-modulating agents (local or systemic).
- Use of adjunctive sub-gingival locally delivered antimicrobials.
- Use of adjunctive systemic antimicrobials.

5.1. Intervention: sub-gingival instrumentation

2.1 Is sub-gingival instrumentation beneficial for the treatment of periodontitis?

Background

Intervention. Sub-gingival instrumentation aims to reduce soft tissue inflammation by removing hard and soft deposits from the tooth surface. The endpoint of treatment is pocket closure, defined by probing pocket depth (PPD) ≤4 mm and absence of bleeding on probing (BOP).

Available evidence. One RCT on 169 patients with 3-month outcomes addressed the PICOS question. A further 11 prospective studies (n = 258) with a follow-up of ≥6 months which considered baseline measures and post- treatment reductions in probing pocket depth (primary outcome) and bleeding on probing and percentage of closed pockets (secondary outcomes) were analysed.

Risk of bias. Study quality assessment identified a low risk of bias in all but one study, which had a high risk of bias.

Consistency. Evidence was consistent across all 11 studies that were included in the pre- and post-treatment analysis and was therefore considered strong. Patient reported outcomes were inconsistently reported and adverse events, when reported, were rare. No indications of publication bias were observed but heterogeneity was high.

Clinical relevance and effect size. The evidence suggested a mean reduction of PPD of 1.7 mm at 6/8 months, a mean proportion of closed pockets of 74 % and a mean reduction of BOP of 63 %. Deeper sites (>6 mm) demonstrated a greater mean PPD reduction of 2.6 mm.

Balance of benefits and harm. An overall consideration of the benefit versus harm of sub-gingival instrumentation supports the strength of the recommendation.

Ethical considerations. Evaluation of the effectiveness and efficancy of sub- gingival instrumentation is ethically challenging as it would entail comparison with no sub-gingival intervention. Due to the lack of relevant RCTs, prospective studies were included and their data analysed.

Applicability 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 [10], with the magnitude of the effect requiring further study.

Evidence-based recommendation (2.1)
We **recommend** that sub-gingival instrumentation **be employed** to treat periodontitis in order to reduce probing pocket depths, gingival inflammation and the number of diseased sites.
Supporting literature Suvan et al [37]
Quality of evidence: One 3-month RCT (n=169 patients); 11 prospective studies (n=258) ≥6 months
Grade of recommendation Grade A - ↑↑
Strength of consensus Unanimous consensus (2.6% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend that sub-gingival instrumentation be employed to treat periodontitis in order to reduce gingival inflammation, the number of diseased sites and probing pocket depths.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

2.2 Are treatment outcomes of sub- gingival instrumentation better after use of hand, powered (sonic/ultrasonic) instruments or a combination thereof?

Evidence-based recommendation (2.2)
We **recommend** that sub-gingival periodontal instrumentation **is performed** with hand or powered (sonic/ultrasonic) instruments, either alone or in combination.
Supporting literature Suvan et al [37]
Quality of evidence: Four RCTs (n=132) with a follow-up of ≥6 months.
Grade of recommendation Grade A - ↑↑
Strength of consensus Unanimous consensus (6.2% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend that sub-gingival periodontal instrumentation is performed with hand or powered (sonic/ultrasonic) instruments, either alone or in combination.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (5% abstentions due to potential CoI)

Background

Intervention. Numerous types of instruments are available to perform sub-gingival instrumentation.

Available evidence. Four RCTs (n = 132) with a low overall risk of bias were included. Findings were evaluated at 6/8 months for PPD reduction (primary outcome) and clinical attachment level (CAL) gain (secondary outcome).

Risk of bias. Study quality assessment identified all 4 studies to be at low risk of bias.

Consistency. The evidence demonstrated that outcomes of treatment were not dependent on the type of instrument employed. The evidence was considered strong and consistent. No indications of publication bias were observed but heterogeneity was high.

Clinical relevance. No clinically or statistically significant differences were observed between the different types of instruments.

Balance of benefits and harm. The use of all types of instruments is technique-sensitive and therefore requires specific training. Patient-reported outcomes and adverse events were inconsistently reported. If present, no obvious differences between hand and powered instruments in terms of post-operative sensitivity were noted.

Ethical considerations. There is a potential ethical dilemma in that patient preference may conflict with the clinician's preference in terms of type of instrument. Patient autonomy should be respected.

Economic considerations. Cost-effectiveness has not been evaluated in these studies. Furthermore, there is no evidence that the use of one type of instrument is superior in terms of requisite treatment time.

Applicability. The majority of studies were conducted in well controlled research environments, in specifically selected populations and under local anaesthetic. Clinicians should be aware that new instrument choices (i.e. mini instruments) were not evaluated in the available studies largely related to a paucity of suitable studies investigating instrument design and utilisation. The choice of instrument should be based upon the experience/skills and preference of the operator together with patient preference.

It should be noted, however, that the outcome of therapy is dependent on the maintenance of clinical technical skill levels for both hand and powered instruments by the therapist clinician.

2.3 Are treatment outcomes of sub- gingival instrumentation better when delivered quadrant-wise over multiple visits or as a full mouth procedure (within 24 h)?

Evidence-based recommendation (2.3)
We **suggest** that sub-gingival periodontal instrumentation **can be performed** with either traditional quadrant-wise or full mouth delivery within 24 hours.
Supporting literature Suvan et al [37]
Quality of evidence: Eight RCTs (n=212) with a follow-up of ≥6 months.
Grade of recommendation Grade B - ↑
Strength of consensus Strong consensus (3.8% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We suggest that sub-gingival periodontal instrumentation can be performed either using a traditional quadrant-wise approach or a full mouth delivery using a 1 or 2 stage technique within a 24-hour period.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (2% abstentions due to potential CoI)

Background

Intervention. Sub-gingival instrumentation has traditionally been delivered during multiple sessions (e.g. quadrant-wise). As an alternative, full-mouth protocols have been suggested. Full-mouth protocols included single stage and two-stage therapy within 24 h, however protocols including antiseptics (full-mouth disinfection) were not included in this analysis.

Available evidence. Eight RCTs (n = 212) with a follow-up of ≥6 months were included demonstrating a low risk of bias. Outcome measures reported were PPD reduction (primary outcome), CAL gain, BOP reduction and pocket closure (secondary outcomes).

Risk of bias. Study quality assessment identified all 8 studies at low risk of bias.

Consistency. The evidence suggested that outcomes of treatment were not dependent on the type of delivery (protocol) employed. The evidence was considered strong and consistent. No indications of publication bias were observed, and heterogeneity was low. The results confirm the findings of a recent Cochrane systematic review [95].

Clinical relevance. Clinicians should be aware that there are systemic implications (e.g. acute systemic inflammatory response) associated with full-mouth protocols [96]. Such an approach should include careful consideration of the general health status of the patient and the potential risks of a full mouth delivery approach.

Ethical considerations. There is a potential ethical dilemma in that patient preference may conflict with the clinician's recommendation in terms of mode of treatment delivery. Patient autonomy should be respected.

Legal considerations. Potential adverse systemic effects of full mouth treatment protocols in certain risk patients should be considered.

Economic considerations. Limited evidence on the cost-effectiveness of different modes of delivery is available.

Patient preferences. Patient-reported outcomes were inconsistently reported and there is no evidence supporting one approach over the other. Reports of increased discomfort and side effects, evident in studies on full-mouth disinfection, were not included in the present analysis.

Applicability. The majority of studies were conducted in well controlled environments, included specifically selected populations and were undertaken in a number of different continents.

5.2. Intervention: Use of adjunctive physical agents to sub-gingival instrumentation

2.4 Are treatment outcomes with adjunctive application of laser superior to non-surgical sub-gingival instrumentation alone?

Evidence-based recommendation (2.4)
We **suggest not to use** lasers as adjuncts to sub-gingival instrumentation**.**
Supporting literature Salvi et al [36]
Quality of evidence: 2 RCTs (n=46, wavelengths 2780 nm and 2940 nm) and 3 RCTs (n=101, wavelength range 810-980 nm) with single laser application reporting 6-month outcomes. 2 RCTs reported mean PPD changes.
Grade of recommendation: Grade B - ↓
Strength of consensus Simple Majority (3.8% of the group abstained due to potential CoI)
BSP Implementation
This evidence-based recommendation is ***adopted****.* *We suggest that lasers are not used as adjuncts to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (2% abstentions due to potential CoI)

Background

Intervention. Lasers offer the potential to improve outcomes of sub-gingival root surface treatment protocols when used as adjuncts to traditional root surface instrumentation. Depending upon the wavelength and settings employed, some lasers can ablate sub-gingival calculus and exert antimicrobial effects. The evidence reported to inform the current guidelines has grouped lasers into two main wavelength categories: lasers with a wavelength range of 2780−2940 nm and lasers with a wavelength range of 810−980 nm.

Available evidence. Evidence was available from five RCTs (total n = 147) with a follow-up of ≥ 6 months and a single laser application. Only RCTs reporting mean PPD changes were considered and this recommendation is made in light of this approach to the systematic review.

Risk of bias. The majority of studies displayed unclear risk of bias.

Consistency. Studies differed in terms of laser type, tip diameter, wavelength, mode of periodontal treatment, number of treated sites, population and several possible combinations of these parameters.

Clinical relevance and effect size. There is insufficient evidence to recommend adjunctive application of lasers to sub-gingival instrumentation.

Balance of benefits and harm. The majority of the studies did not report on potential harm/adverse effects.

Economic considerations. The cost effectiveness of adjunctive laser therapy has not been determined.

Patient preferences. Patient-reported outcomes were rarely reported.

Applicability. The majority of studies were conducted in university settings, included specifically selected populations and were undertaken in a number of different countries.

Research. Further research is needed in this area.

2.5 Are treatment outcomes with adjunctive antimicrobial photodynamic therapy (aPDT) superior to non-surgical sub- gingival instrumentation alone?

Evidence-based recommendation (2.5)
We **suggest not to use** adjunctive aPDT at wavelength ranges of either 660-670 nm or 800-900 nm in patients with periodontitis.
Supporting literature Salvi et al [36]
Quality of evidence: 5 RCTs (n=121, wavelength range 660-670 nm and wavelength range 800-900 nm) with single aPDT application reporting 6-month outcomes. 3 RCTs reported mean PPD changes.
Grade of recommendation: Grade B -↓
Strength of consensus Consensus (1.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adapted**.* *We suggest that adjunctive aPDT is not used in patients with periodontitis.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (3% abstentions due to potential CoI)

Background

Intervention. Adjunctive antimicrobial photodynamic therapy (aPDT) is an approach used to improve the antimicrobial effects of traditional root surface decontamination methods. It functions by attaching a photosensitising dye to the normally impermeable outer cell membrane of Gram-negative bacteria, and then uses laser light to generate reactive oxygen species through the membrane- bound dye to locally destroy those bacteria.

Available evidence. Evidence was available from five RCTs (n = 121) with a follow-up of ≥ 6 months and a single aPDT application. Only RCTs reporting mean PPD changes were included in the meta-analysis and this recommendation is made in light of this approach to the systematic review. Four studies were split mouth and one was a parallel design study.

Risk of bias. The majority of studies displayed unclear risk of bias.

Consistency. Substantial heterogeneity across the studies was identified, in terms of laser type, photosensitizer, wavelength, mode of periodontal treatment, number of treated sites, population and several possible combinations of these parameters.

Clinical relevance and effect size. No benefits were observed with the adjunctive application of aPDT.

Balance of benefits and harm. The majority of the studies reported on adverse events with no harm associated with the adjunctive application of aPDT.

Economic considerations. The cost effectiveness of aPDT has not been determined.

Patient preferences. Patient-reported outcomes were rarely reported and there is no evidence supporting one approach over the other.

Applicability. All studies were conducted in well controlled university settings or specialist centres, included specifically selected populations and were undertaken in a number of different countries.

The evidence presented illustrates "efficacy" rather than "effectiveness", therefore generalisability of outcomes to general dental practice settings is unclear.

Research. Further research is needed in this area.

5.3. Intervention: Use of adjunctive host- modulating agents (local or systemic) to sub-gingival instrumentation

2.6 Does the adjunctive use of local statins improve the clinical outcome of sub-gingival instrumentation?

Evidence-based recommendation (2.6)
We **recommend not to use** local administration of statin gels (atorvastatin, simvastatin, rosuvastatin) as adjuncts to sub-gingival instrumentation.
Supporting literature Donos et al [32]
Quality of evidence: Twelve placebo controlled RCTs (n= 753), for 1.2% atorvastatin gel (6 RCTs, n= 180), 1.2% simvastatin gel (5 RCTs, n=118) and 1.2% rosuvastatin gel (4 RCTs, n= 122)
Grade of recommendation: Grade A - ↓↓
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not recommend the use of local administration of statin gels (atorvastatin, simvastatin, rosuvastatin) as adjuncts to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (2% abstentions due to potential CoI)

Background

Intervention. Statins are known to have pleiotropic pharmacological effects in addition to their hypolipidemic properties. These include antioxidant and anti-inflammatory effects, the stimulation of angiogenesis, improvements in endothelial function, and the positive regulation of bone formation pathways [97–99]. Recent evidence suggests that statins may also attenuate periodontal inflammation, as reflected by decreases in pro-inflammatory and increases in anti-inflammatory mediators within the gingival crevicular fluid (GCF) of patients with periodontitis [100].

Available evidence. 12 placebo controlled RCTs (n = 753), all derived from the same research group, assessed the effect of local statin gels in adjunctive non-surgical therapy for infrabony or furcation class II defects. PPD reduction (primary outcome) was reported at 6 and 9 months for 1.2 % atorvastatin gel (6 RCTs, n = 180), 1.2 % simvastatin gel (5 RCTs, n = 118) and 1.2 % rosuvastatin gel (4 RCTs, n = 122). Meta-analysis was performed in 9 RCTs (n = 607).

Risk of bias. There was a moderate overall risk of bias in the studies analysed. Three out of 12 studies presented with a high risk of bias in at least one domain. One study was underpowered. While pharmaceutical companies provided the statins in the included studies, the level of involvement of industry in the analysis and interpretation of the results is unclear.

Consistency. Meta-analysis of nine RCTs where statins had been applied to a single site per patient demonstrated that adjunctive local application of 1.2 % statin gels in infrabony defects led to a mean difference in PPD reduction of 1.83 mm (95 % confidence interval - CI [1.31; 2.36]) at 6 months and of 2.25 mm (95 % CI [1.88; 2.61]) at 9 months. Only one study investigated locally delivered statins in class II furcation defects. It should be noted that these included a range of statin drugs.

Clinical relevance. Although the mean estimates suggested a clinically meaningful benefit from adding statin gels to sub-gingival instrumentation, there was a large prediction interval for PPD reduction at 6 months (-0.08 mm to 3.74 mm) and the I^2 statistic indicated 95.1 % of variance due to wide heterogeneity of data. Therefore, caution needs to be adopted when assessing the efficacy of statins. Whilst the prediction interval at 9 months (1.16 mm–3.34 mm) improved over the 6-month results, the variance due to heterogeneity (I^2 statistic) of 65.4 % still indicated moderate inconsistency. Since the outcomes of the different statin gels were considered as one group during the meta-analysis, it is not possible to draw definitive conclusions on which statin offered higher efficacy.

Balance of benefits and harms. All studies included in the review reported that patients tolerated local statins well, without any complications, adverse reactions/side- effects, or allergic symptoms.

Economic considerations. There is an additional cost associated with the use of statins that is borne by the patient. The cost benefit ratio and a cost effectiveness analysis of adjunctive statin therapy have not been determined

Ethical and legal considerations. The statin formulations included in the systematic review are "off-label". Approved formulations with appropriate good manufacturing practice (GMP) quality control and patient safety validation are not available.

Patient preferences. There were no studies documenting patient reported outcomes.

Applicability. The same research group published all data within the RCTs, thereby restricting the generalizability of the results, which need to be confirmed in future larger (multicentre) RCTs by independent groups, with multi-level analyses to account for potential confounding factors (e.g. medical history, smoking history). In addition, future studies will need to clarify which type of statin is more effective.

2.7 Does the adjunctive use of probiotics improve the clinical outcome of sub-gingival instrumentation?

Evidence-based recommendation (2.7)
We **suggest not to use** probiotics as an adjunct to sub-gingival instrumentation.
Supporting literature Donos et al [32]
Quality of evidence: Five placebo controlled RCTs (n= 176) testing preparations containing *L. rhamnosus* SP1, *L. reuteri*, or the combination of *S. oralis* KJ3, *S. uberis* KJ2 and *S. rattus* JH145.
Grade of recommendation: Grade B -↓
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
This evidence-based recommendation is adopted. *We do not suggest the use of probiotics as adjuncts to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (3% abstentions due to potential CoI)

Background

Intervention. Probiotics are defined as "live microorganisms which, when administered in adequate amounts, confer a health benefit on the host" (FAO/WHO). It has been suggested that probiotics may alter the ecology of micro-environmental niches such as periodontal pockets, and as such they may disrupt an established dysbiosis. This may re-establish a symbiotic flora and a beneficial interaction with the host via several mechanisms including modulation of the immune-inflammatory response, regulation of antibacterial substances and exclusion of potential pathogens via nutritional and spatial competition [101]. This guideline does not include evidence on the use of probiotics in supportive periodontal care.

Available evidence. Five placebo controlled RCTs (n = 176) assessed the adjunctive effect of probiotics to sub-gingival instrumentation. 2 studies from the same group used a preparation containing *L. rhamnosus* SP1 (2 × 107 colony forming units). Two other RCTs from another research group used a preparation containing *L. reuteri*. One study evaluated a combination of *S. oralis KJ3*, *S. uberis KJ2* and *S. rattus JH145*. Meta-analysis was performed on PPD reduction (primary outcome) at 6 months.

Risk of bias. All studies had an overall low risk of bias. Two out of the

5 studies declared industrial sponsorship and three received the probiotics from industry.

Consistency. Meta-analysis of 5 RCTs demonstrated that, compared with placebo, treatment with probiotics resulted in a mean difference in PPD reduction of 0.38 mm (95 % CI [-0.14; 0.90]) at 6 months. The confidence interval and the I^2 statistic, which suggested considerable variance (93.3 %), due to heterogeneity for the effect of the treatment with the different formulations, cast doubt on the validity of the result.

Clinical relevance. The mean estimated difference in PPD reduction between probiotics and placebo was not statistically significant and of limited clinical relevance (difference <0.5 mm). Moreover, two groups published four out of the five RCTs included, each of them using a different probiotic formulation. Preparations containing *Lactobacillus reuteri* were the only ones to demonstrate improved PPD reductions.

Given that probiotics embrace a broad range of micro-organisms and types of preparations, combining such data within the same meta-analysis poses an interpretational challenge.

Balance of benefits and harms. All formulations appeared to be safe and patients did not report adverse effects.

Economic considerations. There is an additional cost associated with the use of probiotics that is borne by the patient.

An additional placebo controlled study by Pelekos et al. [58] corroborates the result of the meta-analysis presented by Donos et al. [32], showing that use of adjunctive probiotics with sub-gingival instrumentation does not improve probing pocket depth (PPD) reductions at 6 months

2.8 Does the adjunctive use of systemic sub- antimicrobial doxycycline (SDD) to sub-gingival instrumentation improve clinical outcomes?

Evidence-based recommendation (2.8)
We **suggest not to use** systemic sub-antimicrobial doxycycline (SDD) as an adjunct to sub-gingival instrumentation.
Supporting literature Donos et al [32]
Quality of evidence: Eight placebo controlled RCTs (14 publications, n=610). Meta-analysis on PPD reduction was performed in 5 RCTs (n= 484)
Grade of recommendation: Grade B - ↓
Strength of consensus Consensus (1.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not suggest the use of systemic sub-antimicrobial doxycycline (SDD) as an adjunct to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (3% abstentions due to potential CoI)

Background

Intervention. Sub-antimicrobial doxycycline (up to 40 mg a day) is a systemic drug employed specifically for its anti- inflammatory as opposed to its antimicrobial properties. The formulation offers anti-collagenolytic activity, which may have utility in reducing connective tissue breakdown and augmenting healing responses following sub-gingival instrumentation in periodontitis patients.

Available evidence. Eight placebo controlled RCTs (14 publications, n = 610) reported on the systemic use of a sub-antimicrobial dose of doxycycline (SDD) (up to 40 mg a day) in combination with sub-gingival instrumentation. Meta-analysis on PPD reduction (primary outcome) at 6 months post sub-gingival instrumentation was performed in five RCTs (n = 484).

Risk of bias. One study was considered to be at high risk of bias and the remaining studies presented some concerns in certain domains. Of the five studies included in the meta-analysis, three declared industrial sponsorship, one was sponsored by the academic institution and the fifth did not declare funding.

Consistency. The systematic review included data from eight RCTs, but meta-analysis was performed in five RCTs that stratified pockets into moderate (4−6 mm) versus deep (≥7 mm). The findings were consistent in all studies. The I^2 statistic indicated variance of 0% (95 % CI [0%; 64.1 %]) due to heterogeneity for both moderate and deep pockets. Two out of five RCTs included did not report a power calculation. The strict experimental protocols employed by the five studies included in the meta-analysis limits the generalisability of the outcomes.

Clinical relevance of outcomes and effect size. Additional PPD reductions reported following the use of SDD were 0.22 mm at 6 months and 0.3 mm at 9 months in moderate depth pockets. The mean prediction interval ranged from 0.06 mm to 0.38 mm at 6 months and from 0.15 mm to 0.45 mm at 9 months. At deep sites, the additional PPD reductions were more clinically relevant, with 0.68 mm mean additional PPD reductions at 6 months, and 0.62 mm at 9 months. The mean prediction interval ranged from 0.34 mm to 1.02 mm at 6 months and from 0.28 mm to 0.96 mm at 9 months. Percentage of pocket closure was not reported.

Balance of benefits and harm. Most studies in the SDD category did not report any serious adverse events or patient dropouts that were directly attributed to the medication. However, it is known that doxycycline may lead to elevations in liver enzymes, which was evident for some patients in the results of one RCT included in the systematic review [102,103]. The sustainability of the benefits or adverse events beyond the study period are unknown.

Ethical considerations. Current health policies on antibiotic stewardship and related public health concerns surrounding increasing antibiotic resistance need to be taken into account. The systemic effects of a drug taken over a 6−9-month period during the initial phase of sub-gingival instrumentation require careful consideration when extrapolating outcomes from controlled research trials into general clinical practice.

Legal considerations. SDD is not approved or available in some European countries.

Economic considerations. Whilst SDD has been approved for use in the UK and is currently available, there is a cost associated with its use [104].

Applicability. SDD is mainly effective in deep sites (≥7 mm), although SDD is used as a systemic rather than a site- specific treatment. The clinical significance in deep sites (0.68 mm at 6 months and 0.62 mm at 9 months) is small, given that re-treatment with non- surgical root debridement might yield additional PPD reductions, and local drug delivery systems may yield similar effect sizes. Moreover, the five studies that did stratify results based upon pocket depth did not present an a priori statistical plan to stratify results in that manner. There was no gold standard comparator therapy with non-surgical re-instrumentation or surgical treatment, which is the normal standard of care and therefore there is no evidence for effectiveness in general dental practice.

2.9 Does the adjunctive use of systemic/local bisphosphonates to sub-gingival instrumentation improve clinical outcomes?

Evidence-based recommendation (2.9)
We **recommend not to use** locally delivered bisphosphonate (BP) gels or systemic BPs as an adjunct to sub-gingival instrumentation.
Supporting literature Donos et al [32]
Quality of evidence: Seven placebo-controlled RCTs (n= 348), on local delivery of 1% alendronate gel (6 studies) and 0.5% zolendronate gel (1 study); two placebo-controlled RCTs (n= 90) on systemic administration of BPs (alendronic acid and risedronate).
Grade of recommendation: Grade A -↓↓
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not recommend the use of locally delivered bisphosphonate (BP) gels or systemic BPs as adjuncts to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (2% abstentions due to potential CoI)

Background

Intervention. Bisphosphonates (BPs) are a class of anti-resorptive agents that act mainly by inhibiting osteoclast activity. BPs can also directly inhibit host degradative enzymes like matrix metalloproteinases released by osteoclasts and other cells of the periodontium. There is also evidence that BPs reduce osteoblast apoptosis, thus increasing bone density as an overall therapeutic outcome. It is therefore rational to speculate that BPs may benefit the management of inflammation-mediated alveolar bone resorption in periodontitis patients [105].

Available evidence. Seven placebo controlled RCTs (n = 348), all from the same research group, on local delivery of 1% alendronate gel (6 studies) and 0.5 % zolendronate gel (1 study) in infrabony or furcation class II defects were identified.

A meta-analysis on PPD reduction at 6 months in five RCTs (n = 228) using either single or multiple sites per patient in infrabony defects was undertaken. Two placebo controlled RCTs (n = 90) evaluated systemic administration of BPs (alendronate and risedronate).

Risk of bias. Of the nine studies included, two were at high risk of bias and seven presented some concerns in at least one of the domains of the risk of bias assessment tool. One study was underpowered. All studies on local BPs were published by the same research group. While pharmaceutical companies provided bisphosphonates for local application in the included studies, the level of involvement of industry in the analysis and interpretation of the results is unclear.

Consistency. Nine RCTs were available, two involving systemic administration of BPs. No meta-analysis was therefore undertaken for systemic BPs. Out of the seven RCTs involving local application of BPs, five were on infra-bony defects (4 employed 1% Alendronate gel and 1 study used 0.5 % Zolendronate gel), whilst two were undertaken on furcation class II defects (all using 1% Alendronate gel). A meta-analysis of five studies using single or multiple sites per patient demonstrated a significant benefit in terms of PPD reduction of 2.15 mm (95 % CI [1.75; 2.54]) after 6 months from non-surgical periodontal therapy in infra-bony defects, with a low level of heterogeneity (I2 = 47.3 %).

Clinical relevance. The results of the two studies on systemic BPs were poorly comparable as they were undertaken in different populations and involved different confounding factors (e.g. smoking).

Although the mean estimates suggested adjunctive benefits from adjunctive use of BP gels, the combined use of studies considering single and multiple sites per patient in the meta-analysis should be taken into consideration.

Balance of benefits and harm. both systemic and local BPs were well-tolerated in the studies reported in the systematic review and were not associated with severe adverse reactions.

Economic considerations. There is an additional cost associated with the use of bisphosphonates that is borne by the patient. The cost effectiveness and a cost benefit analysis of BPs have not been determined.

Ethical and legal considerations. The balance of recognized potential severe risks (e.g. osteochemonecrosis of the jaws) versus benefits, resulted in a consensus that systemic administration of BPs should not be recommended in the clinical management of periodontal bone loss. It is important to note that BP gel formulations are "off-label" and approved formulations with appropriate quality control (GMP) and patient safety validation are not available.

Applicability. The same research group/centre published all data on locally delivered BPs, therefore the generalizability of the results requires substantiating in future larger (multicentre) RCTs, with multi-level analyses accounting for potential confounding factors (e.g. medical history, smoking history).

2.10 Does adjunctive use of systemic/local non-steroidal anti-inflammatory drugs to sub-gingival instrumentation improve the clinical outcomes?

Evidence-based recommendation (2.10)
We **recommend not to use** systemic or local non-steroidal anti-inflammatory drugs (NSAIDs) as an adjunct to sub-gingival instrumentation
Supporting literature Donos et al [32]
Quality of evidence: Two placebo-controlled RCTs (n= 88) on local application (1% flurbiprofen toothpaste; irrigation with 200 ml buffered 0.3% acetylsalicylic acid); two placebo-controlled RCTs (n=133) on systemic applications (celecoxib, diclofenac potassium)
Grade of recommendation: Grade A -↓↓
Strength of consensus Strong consensus (1.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not recommend the use of local or systemic non-steroidal anti-inflammatory drugs (NSAIDs) as adjuncts to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (2% abstentions due to potential CoI)

Background

Intervention. Periodontitis is an inflammatory disease in which altered immune-inflammatory responses to a dysbiotic biofilm drives connective tissue destruction and bone loss. It is reasonable therefore that non- steroidal anti-inflammatory drugs (NSAIDs), may be effective as adjunctive periodontal therapies.

Available evidence. Two placebo-controlled RCTs (n = 88) on local application, one using 1% flurbiprofen toothpaste twice daily for 12-months, and a second using sub-gingival daily irrigation with 200 mL buffered 0.3 % acetylsalicylic acid were identified. Two placebo-controlled RCTs (n = 133) on systemic applications, one RCT using systemic celecoxib (200 mg daily 6-months) and another using a cyclical regime of diclofenac potassium (50 mg 2-months, then 2-months off, then 2 months on) were included. All studies reported PPD reduction at 6 months. No meta-analysis was performed due to the limited number of studies identified and their heterogeneity.

Risk of bias. Two out of four studies were considered at high risk of bias. All studies on NSAIDs either did not provide information on sample size calculation or were underpowered. All studies declared industry funding.

Consistency. It was not possible to undertake a meta-analysis of local or systemic NSAID administration as an adjunct to sub-gingival instrumentation because the studies were heterogeneous (not comparable) in terms of the medication employed and the modality of administration.

Clinical relevance. Local NSAIDs did not enhance the clinical outcomes of sub- gingival instrumentation. Systemic NSAIDs exhibited limited clinical benefits, but their heterogeneity did not permit drawing clinically meaningful conclusions.

Balance of benefits and harm. No serious adverse events were reported.

Ethical considerations. Long-term use of systemic NSAIDs carries a well-known risk of unwanted side effects, which raises concerns over their use as adjuncts to sub- gingival instrumentation.

Economic considerations. There would be a cost to using NSAIDs which would ultimately be borne by the patient. The cost effectiveness and a cost benefit analysis have not been determined.

Applicability. We do not recommend everyday clinical use of systemic NSAIDs or future studies to test these medications in their current standard formulations or dosage regimes. No meaningful conclusions could be made regarding use of local NSAIDs. Based on the current limited evidence, local NSAIDs did not provide a clinical benefit.

2.11 Does the adjunctive use of Omega-3 polyunsaturated fatty acids (PUFA) improve the clinical outcome of sub- gingival instrumentation?

Evidence-based recommendation (2.11)
We **recommend not to** use Omega-3 PUFAs as an adjunct to sub-gingival instrumentation.
Supporting literature Donos et al [32]
Quality of evidence: Three placebo-controlled RCTs (n= 160) with 6-months administration of Omega-3 PUFAs.
Grade of recommendation: Grade A - ↓↓
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not recommend the use of Omega-3 PUFAs as adjuncts to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. The recent discovery of pro-resolving lipid mediators by Serhan and colleagues (reviewed by Serhan [106]), some of which are produced by the metabolism of two major omega-3 polyunsaturated fatty acids (PUFAs), namely eicosapentaenoic acid (EPA) and docosahexanoic acid (DHA) to E- and D-resolvins respectively, raises the potential for essential dietary PUFAs as adjunctive host-modulating therapeutics for non-surgical periodontal treatment. However, few studies have investigated their efficacy in human trials.

Available evidence. Three placebo-controlled RCTs (n = 160) with 6- months administration of Omega-3 PUFAs. Heterogeneity in study designs precluded a meta-analysis. One RCT investigated low dose omega-3 PUFAs (6.25 mg eicosapentaenoic acid -EPA and 19.9 mg docosahexaenoic acid -DHA) twice daily for 6-months; a second study employed high dose omega-3 PUFAs (3 g) in combination with 81 mg aspirin daily for 6-months; a third study used 1 g omega-3 PUFAs twice daily for 6-months. All studies showed PPD reduction at 6 months post sub-gingival instrumentation. No meta-analysis was performed due to the limited number of studies identified and their heterogeneity.

Risk of bias. One out of three studies were considered to be at high risk of bias. One study reported industry support, one was supported by a University and one did not disclose the funding source.

Consistency. No meta-analysis could be performed due to the low number of available studies and study heterogeneity in terms of proposed regime and formulation.

Clinical relevance. Since the three RCTs used different doses and preparations of omega-3 PUFAs and one out of three studies combined omega-3 with 81 mg Aspirin, it was not possible to draw clinically meaningful conclusions from the data.

Balance of benefits and harm. No adverse events were associated with the use of omega-3 PUFAs and they are essentially a relatively safe dietary supplement.

Economic considerations. There would be a cost to using omega-3 PUFAs which would ultimately be borne by the patient. The cost effectiveness and a cost benefit analysis of these therapies have not been determined.

Applicability. There is insufficient data to support or refute the use of omega-3 PUFAs, either as a monotherapy or as a combined therapeutic adjunct to sub-gingival instrumentation. The combination of omega-3 fatty acids and low dose aspirin also warrants further assessment of its use as an adjunct in the management of periodontitis.

Research. Further research is needed in this area.

2.12 Does the adjunctive use of local metformin improve the clinical outcome of sub-gingival instrumentation?

Evidence-based recommendation (2.12)
We **recommend not to use** local administration of metformin gel as adjunct to sub-gingival instrumentation.
Supporting literature Donos et al [32]
Quality of evidence: Six placebo controlled RCTs (n= 313) on locally delivered 1% metformin gel
Grade of recommendation: Grade A - ↓↓
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not recommend the use of locally administered metformin gel as an adjunct to sub-gingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (2% abstentions due to potential CoI)

Background

Intervention. Metformin is a second-generation biguanide used to manage type 2 diabetes mellitus. There is evidence suggesting that metformin decreases inflammation and oxidative stress and may also have an osteogenic effect by increasing the proliferation of osteoblasts and reducing osteoclast activity [107]. It is therefore plausible that this medication may be beneficial in treating a chronic inflammatory disease like periodontitis.

Available evidence. Six placebo controlled RCTs (n = 313) from the same research group investigated locally delivered 1% metformin gel as an adjunct to sub-gingival instrumentation. All studies reported on PPD reduction at 6 months post sub-gingival instrumentation and a meta-analysis was undertaken combining the 6 RCTs.

Risk of bias. Four out of six studies presented some concerns of risk of bias in most of the domains. All studies were published by the same research group. While pharmaceutical companies provided metformin, the level of involvement of industry in the analysis and interpretation of the results is unclear.

Consistency. Meta-analysis of six studies (four considering single

sites per patient and two considering multiple sites per patient) indicated that 1% metformin gel as adjunct to sub-gingival instrumentation led to an improved PPD reduction of 2.07 mm (95 % CI [1.83; 2.31]) at 6-months. Heterogeneity between the studies was low ($I^2 = 43$ %).

Clinical relevance. All studies reported a benefit in terms of PPD reduction when 1% metformin gel was used as an adjunct to sub-gingival instrumentation. However, studies using single and multiple sites per patient were combined.

Balance of benefits and harms. All studies included in the review reported that patients tolerated local metformin gel well, without any complications, adverse reactions/side-effects, or symptoms of hypersensitivity.

Ethical and legal considerations. The metformin formulation included in the systematic review is "off-label" and an approved formulation with appropriate quality control (GMP) and patient safety validation is not available.

Economic considerations. The cost effectiveness and a cost benefit analysis have not been determined.

There is an additional cost associated with the use of metformin that is borne by the patient.

Applicability. The same research group published all the data on local metformin; therefore, the generalizability of the results needs to be confirmed in future larger (multicentre) RCTs, with multi-level analyses accounting for potential confounding factors (e.g. medical history, smoking history).

5.4. Intervention: Use of adjunctive chemical agents to sub-gingival instrumentation

2.13 Does the adjunctive use of adjunctive chemotherapeutics (antiseptics) improve the clinical outcome of sub- gingival instrumentation?

Expert consensus-based recommendation (2.13)
Adjunctive antiseptics **may be considered**, specifically chlorhexidine mouth rinses for a limited period of time, in periodontitis therapy, as adjuncts to mechanical debridement, in specific cases.
Supporting literature da Costa et al 108]
Grade of recommendation Grade 0 - ↔
Strength of consensus Consensus (6.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *Adjunctive antiseptics may be considered, specifically chlorhexidine mouth rinses for a limited period of time, in periodontitis therapy, as adjuncts to mechanical debridement, in specific cases.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (13% abstentions due to potential CoI)

Background

Intervention. In order to control gingival inflammation during periodontal therapy, the adjunctive use of some agents has been proposed. Chlorhexidine mouth rinses have been frequently tested for this indication, and used in different clinical settings.

Available evidence. In the systematic reviews of the present European Workshop, the role of antiseptics in active periodontal therapy has not been directly addressed. However, some evidence is available based on studies on the role of chlorhexidine use after sub-gingival instrumentation [108].

Applicability. In addition, other factors should be considered

BSP comment for recommendation 2.13

BSP Implementation
- It is unclear whether this should be a general recommendation for initial therapy. - The chlorhexidine concentration available in the UK is 0.2% and 0.06%. The 0.06% chlorhexidine mouthwash has been formulated without alcohol for daily use and is designed to reduce the build-up of dental plaque. In contrast, the 0.2% chlorhexidine mouthwash is recommended for more intense use for specific clinical reasons, such as following periodontal surgery or other situations where mechanical plaque control is compromised. It should be used only for short time periods according to the manufacturer's guidelines to avoid side effects. The 0.2% mouthwash has been formulated both with and without alcohol. - The presence or absence of alcohol in the formation was not considered as part of the PICO question, however there is evidence that incorporation of alcohol in some formulations appears to confer greater efficacy. - It is necessary to optimize mechanical plaque control before considering chlorhexidine as an adjunct to sub-gingival instrumentation. - Specific cases to consider are: - the medical status of the patient. - that following non-surgical therapy adjunctive antiseptics can be advantageous to maintain oral hygiene when mechanical plaque control causes discomfort. - Adverse effects (e.g. staining, perturbed taste sensation) and cost should be considered, as well as patient acceptability. The duration of length of use is usually in the order of 1-2 weeks.

5.5. Intervention: Use of adjunctive locally administered antiseptics to sub-gingival instrumentation

2.14 Do adjunctive locally administered antiseptics improve the clinical outcome of sub-gingival instrumentation?

Background

Intervention. There is insufficient evidence on the benefits of locally administered sustained release antiseptics as an adjunct to sub- gingival instrumentation in patients with periodontitis.

Evidence-based recommendation (2.14)
Locally administered sustained-release chlorhexidine as an adjunct to sub-gingival instrumentation in patients with periodontitis **may be considered**.
Supporting literature Herrera et al [40]
Quality of evidence: 9 RCTs, 6-9 months. 718/719 patients. High risk of bias and heterogeneity among studies.
Grade of recommendation Grade 0 - ↔
Strength of consensus Consensus (10.5% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *Locally administered sustained-release chlorhexidine may be considered as an adjunct to sub-gingival instrumentation in patients with periodontitis.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (8.6% abstentions due to potential CoI)

Available evidence. The systematic review Herrera et al. [40] revealed results from studies on products containing chlorhexidine (Periochip n = 9, Chlosite n = 2). One product (Periochip) demonstrated statistically significantly greater PPD reduction following single or multiple applications as an adjunct to sub-gingival instrumentation on short-term follow-up (6−9 months) (weighted mean difference - WMD = 0.23, 95 % CI [0.12; 0.34], p < 0.001 and significant heterogeneity). There are no long-term data available. No significant differences were found regarding CAL. Data on BOP were insufficient and no data on pocket closure or on number needed to treat (NNT) were provided.

Risk of bias. High risk of bias and heterogeneity among studies.

Clinical relevance and effect size. Effect size estimated for all PPD categories indicates an increased effect of about 10 % in PPD reduction.

Balance of benefit and harm. No increase in adverse effects or differences in patient-reported outcome measures (PROMs) were observed.

Economic considerations. The cost for the product is borne solely by the patient and is determined by the clinician undertaking the treatment. The cost effectiveness could therefore vary according to the care environment. Sustained release products contain 2.5 mg chlorhexidine gluconate in the UK.

5.6. Intervention: Use of adjunctive locally administered antibiotics to sub-gingival instrumentation

2.15 Do adjunctive locally administered antibiotics improve the clinical outcome of sub-gingival instrumentation?[1]

Evidence-based recommendation (2.15)
Specific locally administered sustained-release antibiotics as an adjunct to sub-gingival instrumentation in patients with periodontitis **may be considered**. [1]
Supporting literature Herrera et al [40]
Quality of evidence: PPD-reduction (6-9 months): Atridox n=2, 19/19 patients; Ligosan: n=3, 232/236 patients; Arestin: n=6, 564/567 patients. High risk of bias and heterogeneity in the majority of studies.
Grade of recommendation Grade 0 - ↔
Strength of consensus Consensus (7.8% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.*[1] *Specific locally administered sustained-release antibiotics as an adjunct to sub-gingival instrumentation in patients with periodontitis may be considered.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (5.1% abstentions due to potential CoI)

Background

Available evidence. Of the products available on the European market, the systematic review [40] revealed statistically significantly improved PPD reduction of locally applied antibiotics as an adjunct to sub-gingival instrumentation on short-term follow-up (6−9 months) for Atridox (2 studies, WMD = 0.80; 95 % CI [0.08; 1.52]; p = 0.028), Ligosan (3 studies, WMD = 0.52; 95 % CI [0.28; 0.77]; p < 0.001) and Arestin (6 studies, WMD = 0.28; 95 % CI [0.20; 0.36]; p < 0.001). No significant adjunctive long-term effect was evident. Statistically significantly improved CAL change for products used as an adjunct to sub-gingival instrumentation on short-term follow-up (6−9 months) was identified for Ligosan: (n = 3, WMD = 0.41, 95 % CI [0.06; 0.75]; p = 0.020) and Arestin: (n = 4, WMD = 0.52; 95 % CI [0.15; 0.88]; p = 0.019). Long term data did not show significant improvement of CAL for any product. Data on BOP and pocket closure were insufficient. No information on NNT was provided. Estimated effect size indicated an increased effect of 10–30 % in PPD reduction.

Risk of bias. High risk of bias and heterogeneity in the majority of studies.

Balance of benefit and harm. No increase in adverse effects or differences in PROMs were observed.

Applicability. Ligosan is available to buy in the UK

Economic considerations. High economic costs and limited availability of products in European countries need to be considered.

[1] Potential harm vs benefit considerations on the use of antibiotics (stewardship issues) need to be considered. The review by Herrara et al [40] did not report 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. It is also extremely difficult to assess antimicrobial impact across studies that employ different agents, doses, number of applications and duration of action. No data was supplied on microbiological outcomes post treatment. Future studies should adopt good antimicrobial stewardship principles and use standardised criteria to clearly define the benefits and risks of antimicrobial therapy.

5.7. Intervention: Use of adjunctive systemically administered antibiotics to sub-gingival instrumentation

2.16 Do adjunctive systemically administered antibiotics improve the clinical outcome of sub-gingival instrumentation?[2]

Evidence-based recommendation (2.16)
A. Due to concerns about patient´s health and the impact of systemic antibiotic use to public health, its routine use as adjunct to sub-gingival instrumentation in patients with periodontitis is **not recommended**. B. The adjunctive use of specific systemic antibiotics **may be considered** for specific patient categories (e.g. generalized periodontitis Grade C in young adults).
Supporting literature Teughels et al [45]
Quality of evidence RCTs (n=28) with a double blind, placebo controlled, parallel design. Risk of bias was low for 20 of the studies, while 7 studies had a high risk. PPD reduction at 6 months; MET+AMOX: n=8, 867 patients. PPD reduction at 12 months; MET+AMOX: n=7, 764 patients, MET: n=2, 259 patients.
A. Grade of recommendation Grade A - ↓↓ ***B. Grade of recommendation*** Grade 0 - ↔
A. Strength of consensus Consensus (0% of the group abstained due to potential CoI) ***B. Strength of consensus*** Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation (A) is **adopted**.* *A. We do not 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.* *This evidence-based recommendation (B) is **adapted**.* ***B.** The adjunctive use of specific systemic antibiotics may be considered for specific patient categories (e.g. periodontitis Grade C[2] in younger adults where a high rate of progression is documented)*
Updated Evidence: No new applicable evidence was identified **Strength of Consensus**: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Available evidence. While the results from the meta-analysis Teughels et al. [45] revealed a statistically significantly improved outcome for systemically administrated antibiotics as an adjunct to sub-gingival instrumentation, the effect was confined to a limited group of antibiotics. A significantly improved PPD reduction at the 6 months follow-up was observed for metronidazole (MET) and amoxicillin (AMOX) (n = 8; WMD = 0.43, 95 % CI [0.36; 0.51]). Analysis of 12 month data revealed a significant adjunctive effect for MET + AMOX (n = 7; WMD = 0.54, 95 % CI [0.33; 0.74]) and MET (n = 2; WMD = 0.26, 95 % CI [0.13; 0.38]). The adjunctive use of MET + AMOX and MET resulted in a statistically significant additional percentage of pocket closure at 6 and 12 months. Statistically significantly greater CAL gain and BOP reduction for MET + AMOX at 6 and 12 months. The adjunctive effect of MET + AMOX on PPD reduction and CAL gain was more pronounced in initially deep than moderately deep pockets. There are no relevant data on the long term (>12 months) effect of using systemic antibiotics as an adjunct to sub-gingival instrumentation. NNT was not assessed.

Risk of bias. Low risk of bias and low heterogeneity among studies.

Consistency. High consistency of results.

Clinical relevance and effect size. Effect size estimation on PPD reduction as opposed to sub- gingival instrumentation alone indicates an increased effect of about 40–50 %.

Balance of benefit and harm. While the MET + AMOX combination had the most pronounced effects on the clinical outcomes among the different types of systemic antimicrobial therapy, the regimen was also associated with the highest frequency of side effects. Global concerns regarding the overuse of antibiotics and the development of antibiotic resistance must be considered. Benefit vs. harm analysis includes considerations on the overall use of antibiotics for the individual patient and public health. Systemic antibiotic/antimicrobial regimens have shown long lasting impact on the microbiome from many body sites, including respiratory, gastrointestinal and skin, including an increase in antimicrobial resistance genes.

Applicability. Due to concerns to patient's health and the impact of systemic antibiotic use to public health, its routine use as adjunct to sub-gingival instrumentation in patients with periodontitis is not recommended. Based on the available evidence, however, its adjunctive use may be considered for special patient categories (e.g. generalized periodontitis grade C in younger adults).

The prescription of systemic adjunctive antimicrobials for the

[2] "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.

management of periodontitis should be determined by specialist or special interest periodontal practitioners. There may be circumstances where patients with specific medical needs may require this management.

Practitioners are urged to record diagnosis, antimicrobial(s) used, dose and duration as an essential requirement for good antimicrobial stewardship. This recommendation has not been written in respect of patients with systemic problems.

Other documents that should be taken into consideration alongside this recommendation are the Nice Guidelines and the Dental antimicrobial stewardship toolkit. [109]

6. Clinical recommendations: third step of therapy

Commentary – UK Implementation

UK healthcare philosophy

Standards and protocols for periodontal care provision in the UK are founded on a substantial evidence-base for the efficacy and effectiveness of non-surgical periodontal management, as outlined in steps 1 and 2 of this guideline. Moreover, this is embedded within statutory requirements in England through the NHSE Commissioning Standard for Restorative Dentistry (OCDO 2019) [110].

. The devolved nations also embrace this approach, which defines patient complexity levels as complexity level 1 (primary care), level 2 (requires enhanced skills) and level 3 (specialist care). The complexity levels of care are underpinned by a referral process between primary, intermediate and specialist care. This is also embraced by the BSP Good Practitioners Guide to periodontal care. The evidence base for surgical periodontal management is robust, but predominantly based upon studies of efficacy rather than effectiveness, and lacks patient reported outcome measures.

The advanced procedures outlined in Step 3 of this guideline should be implemented only in the context of the UK healthcare philosophy outlined above and should also recognise that:

- Surgery is not normally undertaken following a single phase of non-surgical care. The outcome of the first phase is reviewed and non-surgical care repeated for non-responder sites in engaging patients.
- In non-engaging patients, surgery would be contraindicated because it will fail, and attempts should be made to engage the patient in behaviour change and establishing optimal levels of oral hygiene.
- There is an evidence base that sites of 5-6mm probing pocket depth that do not bleed upon probing at sequential recall visits, may be stable. In such cases, provided there is no evidence of ongoing attachment loss they would normally be monitored closely, rather than moving immediately to periodontal surgery.
- Where there is doubt in a primary care practitioner's mind about the need or otherwise for advanced periodontal care, referral to level 2 or 3 services is recommended.

Third Step of Therapy

The treatment of stage III periodontitis should be carried out in an incremental manner. The first step of therapy is the identification and control of patient risk factors together with the successful implementation of adequate oral hygiene practice. The second step of therapy is the professional non- surgical elimination or reduction of supra- and subgingival biofilm and calculus, with or without adjunctive therapies. However, this may not be achievable in periodontitis patients with probing pocket depths of ≥6 mm or complex anatomical surfaces (root concavities, furcations, infra bony pockets), and further treatment should be implemented. In instances where the 3rd step of therapy is recommended but not taken up by the patient, dental professionals should make every attempt to ensure that patients understand the significance of incompletely managed periodontitis on the chances of retaining teeth and on the impact that this might have on both oral and general health.

The patient's response to the second step of therapy should be assessed after an adequate healing period (periodontal re-evaluation). If the treatment has been successful in achieving these endpoints of therapy, patients should be placed in a supportive periodontal care (SPC) program. If the endpoints of therapy (no periodontal pockets ≥4 mm with bleeding on probing or deep pockets (≥6 mm), have not been achieved the third step of therapy should be considered according to individual patient needs/profile. A holistic approach to treatment planning should be taken including the adherence of the patient to oral hygiene, the restorative status of the tooth and treatability for periodontal surgery. If this judgement is unclear, specialist expertise and advice should be sought. At this point, it is important to indicate that the evidence in the literature suggests that teeth with advanced attachment

loss and residual deep pockets can still be maintained for many years (after steps 2 or 3) with effective SPC.

The rationale for the third step of therapy is to treat those sites that do not respond adequately to the second step of therapy. The purpose of the third step is to access non-responding sites and to regenerate or eliminate those lesions that add complexity to the management of periodontitis (intrabony and furcation lesions). It may include the following interventions:

- Repeated subgingival instrumentation with or without adjunctive therapies
- Access Flap Periodontal Surgery [113]
- Resective Periodontal Surgery
- Regenerative Periodontal Surgery [134]

Surgical approaches are subject to additional patient consent. Specific risk factors and medical contra-indications should be considered. The patient's response to the third step of therapy should be assessed after an adequate healing period (periodontal evaluation). If the treatment has been successful in achieving the recommended endpoints of therapy, i.e. no periodontal pockets ≥4 mm with bleeding on probing or deep pockets ≥6 mm, the patients should be placed in a supportive periodontal care (SPC) program (step 4). However, even following step 3 procedures, it may not be possible to achieve these endpoints of therapy for all teeth in severe stage III periodontitis patients.

Type of patients under consideration

This guideline considers the most common types of presentations of stage III periodontitis. It does not address specifically important subgroups, for example those additionally with gingival overgrowth. Such patients may require different therapeutic approaches and will be considered in future guidelines. Furthermore, such patients should be referred when possible for specialist assessment as recommended in the Clinical Commissioning Standard for Restorative Dentistry (OCDO 2019) [110].

6.1. *Intervention: access flap procedures*

The first relevant question to evaluate the relative efficacy of the surgical interventions in the third step of therapy, for the treatment of periodontitis stage III patients with residual pockets after the second step of periodontal therapy, is whether access flap procedures are more efficacious than subgingival reinstrumentation for achieving the end points of therapy [probing depth (PD) ≤4 mm without BOP].

3.1 How effective are access flaps as compared to repeated subgingival instrumentation?

Evidence-based recommendation (3.1)
In presence of deep residual pockets (PPD ≥ 6 mm) in patients with periodontitis stage III after the first and second steps of periodontal therapy, we suggest performing access flap surgery. In presence of moderately deep residual pockets (4-5 mm), we suggest repeating subgingival instrumentation.
Supporting literature Sanz-Sanchez et al [43]
Quality of evidence: 13 RCTs (500 patients) with moderate to high risk of bias. 5 studies were restricted to pockets associated with intrabony defects. Limited number of studies presented data for quantitative analyses. High consistency of results.
Grade of recommendation Grade B - ↑
Strength of consensus Consensus (1.4% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *For patients with periodontitis stage III after the first and second steps of periodontal therapy, we suggest performing access flap surgery for deep residual pockets (PPD ≥ 6 mm).* *For patients with moderately deep residual pockets (4-5 mm) after the first and second steps of periodontal therapy, we suggest repeat subgingival instrumentation.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: *Unanimous Consensus* (0% abstentions due to potential CoI)

Background

Available evidence. Statistically significantly greater PPD reduction was observed in access flaps (AF) than in subgingival debridement at 1 year. The difference was more pronounced at initially deep sites (PPD ≥ 6 mm) (4 studies, WMD = 0.67, 95 % CI [0.37; 0.97], at 1 year; WMD = 0.39; 95 % CI [0.09; 0.70] at >1 year). The relative effect was 27.5 %. These differences in PPD reduction also occurred in pockets associated with infrabony defects (4 studies; WMD = 0.49, 95 % CI [0.11; 0.86]). No statistically significant differences in CAL gain at initially deep pockets were observed between procedures. However, CAL gain was significantly greater in the subgingival instrumentation group at initially moderately deep pockets, and AF resulted in statistically significantly more attachment loss at sites with initial

PPD ≤ 4 mm. A statistically significantly higher percentage of shallow pockets was achieved with AF than with subgingival instrumentation (3 studies, WMD = 11.6 %, 95 % CI [6.76; 16.5]). The need of re-treatment (4 studies) was 8–29 % in the subgingival instrumentation group and 0–14 % in the AF. There were no statistically significant differences in PROMs between the interventions.

6.2. Intervention: different access flaps procedures

The second relevant question was whether there are specific conservative surgical procedures that are more efficacious for achieving the end points of treatment of periodontitis stage III patients.

Conservative surgical procedures have been defined as those aiming to access the affected root surfaces without eliminating significant amounts of hard and soft tissues. These procedures have been classified depending on the amounts of marginal gingiva and interdental papillary tissue removal into:

- open flap instrumentation with intra-sulcular incisions (OFD).
- flaps with para-marginal incisions, such as modified Widman flap (MWF) and
- papilla preservation flaps.

3.2 How effective are the different access flap procedures?

Evidence-based recommendation (3.2)
In cases of deep (PPD ≥ 6 mm) residual pockets and intrabony defects in patients with periodontitis stage III after adequate first and second steps of periodontal therapy, there is insufficient evidence for a recommendation on the choice of flap procedures. Access periodontal surgery can be carried out using different flap designs.
Supporting literature : Sanz-Sanchez et al [43]
Quality of evidence: Three RCTs compared MWF with OFD. One RCT compared the efficacy of papilla preservation flaps (single flap approach versus OFD) in the presence of intrabony pockets. Two RCTs compared minimally invasive surgery with conventional surgery. Moderate to high risk of bias. Limited available data.
Grade of recommendation Grade 0 - ↔
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.*
There is insufficient evidence for a recommendation on the choice of flap procedure for patients with periodontitis stage III, after the first and second steps of periodontal therapy,
with deep (PPD ≥ 6 mm) residual pockets and intrabony defects. Access periodontal surgery may be carried out using different flap designs.
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Available evidence. Out of three available studies comparing MWF with OFD, only one showed statistically significantly greater PPD reduction for MWF than OFD. There were no statistically significant differences in % PPD reduction in deep infrabony pockets between papilla preservation flap (single flap approach) and conventional flaps (one study). Two studies comparing minimally invasive surgery with conventional surgery did not demonstrate a significant added value in PPD reduction or CAL gain.

6.3. Intervention: resective flap procedures

The third relevant question was whether resective flap procedures (those that, in addition to gaining access for subgingival instrumentation, aim to change the architecture of the hard and/or the soft tissues to attain shallow probing depths) are more efficacious than conservative surgical procedures in achieving the intended end points in the

treatment of periodontitis stage III patients.

3.3 What is the efficacy of pocket elimination/reduction surgery in comparison with access flap surgery?[3]

Evidence-based recommendation (3.3)
In cases of deep (PPD ≥ 6 mm) residual pockets in patients with periodontitis stage III after an adequate second step of periodontal therapy, **we suggest** using resective periodontal surgery, yet considering the potential increase of gingival recession.
Supporting literature Polak et al [41]
Quality of evidence: 9 RCTs (4 could be used for the quantitative analysis). High risk of bias. Limited available data.
Grade of recommendation Grade B - ↑
Strength of consensus Simple Majority (2.6% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We suggest using resective[3] periodontal surgery for patients with periodontitis stage III following adequate first and second steps of periodontal therapy, who have deep (PPD ≥ 6 mm) residual pockets. The potential increase of gingival recession should be a consideration.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

*Guidance on managing deep pockets associated with intrabony defects specifically can be found in recommendation 3.7

Background

Available evidence. Resective periodontal surgery attained statistically significantly higher PPD reduction than access flaps at 6 months (WMD = 0.59 mm; 95 % CI [0.06–1.12]) and one year (WMD = 0.47 mm; 95 % CI [0.24; 0.7]). For pockets 4–6 mm differences were statistically significant at 1 year (WMD = 0.34 mm; 95 % CI [0.19; 0.48]), while pockets 7 mm or deeper showed greater difference between the groups (WMD = 0.76 mm; CI [0.35; 1.17]). The differences were lost with time (3- and 5-year follow-up). There were no differences in CAL gains between the surgical modalities in the long term (3–5 years). Post-operative recession was statistically significantly greater following resective surgery than access flaps at 1- year post-op (two studies). No differences reported at 5 years follow-up (one study). No differences in recession over time in initially shallow pockets between the two modalities.

[3] Here, the term 'resective surgery 'indicates a procedure including para-/sub-marginal incisions, split-thickness flaps and osseous surgery (osteoplasty/ostectomy) to achieve strong pocket reduction. The recommendation does not suggest to perform isolated gingivectomies.

Risk of bias. High risk of bias, scarcity of quantitative data (only 4 RCTs).

Clinical relevance and effect size. The paucity of the data on percentage of shallow pockets or incidence of re-treatment prevents assessments of the clinical relevance of the differences.

Balance of benefit and harm. **Data on PROMs, the percentage of residual pockets or the need of re-treatment were not reported in any of the studies.**

6.4. General recommendations for periodontal surgical procedures

3.4 What is the level of care required for management of deep residual pockets with or without presence of intrabony defects or furcation involvement after completion of steps 1 and 2 of periodontal therapy?[4]

Background

Intervention. Advanced periodontal surgery (regenerative and furcation management) is beyond the scope and competence of education in general dental practice [80]. Dental curricula include knowledge and familiarity with the approach but are not designed to provide competence to conduct such treatment: additional specific training is required and is available through continuing professional development and periodontal learned societies in most countries. Post- graduate periodontal education, on the other hand, is specifically designed to provide competence and proficiency towards the resolution of such complex problems [111,112].

3.5 If expertise is not available or referral is not an option, what is the minimum level of primary care required for management of residual pockets associated with or without intrabony defects or furcation

Expert consensus-based recommendation (3.4)
Surgical treatment is effective but frequently complex and **we recommend** that it is provided by dentists with additional specific training or by specialists in referral centres. **We recommend** efforts to improve access to this level of care for these patients.
Supporting literature Expert opinion
Grade of recommendation: Grade A - ↑↑
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *Surgical treatment is effective but frequently complex. We recommend:* 1. *Surgical treatment is provided by dentists with additional specific training or by specialists in referral centres[4].* 2. *Efforts to improve access to this level of care for these patients.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

[4] See Commissioning Standard for Restorative Dentistry (OCDO 2019)[110] for recommendations on treatment complexity and referral. (www.england.nhs.uk/publication/commissioning-standard-for-restorative-dentistry/).

involvement after completion of steps 1 and 2 of periodontal therapy?

skills through continuing professional development. Optimal management of stage III and stage IV periodontitis remains limited in most health systems with significant inequalities in availability and access to advanced/specialist periodontal care. There is an urgent need to improve patient access to the appropriate level of care given the high burden and costs associated with the sequelae of unmanaged severe (stages III and IV) periodontitis.

Expert consensus-based recommendation (3.5)
As a minimum requirement, **we recommend** repeated scaling and root instrumentation with or without access flap of the area in the context of high-quality step 1 and 2 treatment and a frequent program of supportive periodontal care including subgingival instrumentation.
Supporting literature Expert opinion [and systematic reviews for access flaps (Graziani et al [113], Graziani et al [96]
Grade of recommendation Grade A - ↑↑
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend as a minimum requirement in the context of high-quality step 1 and 2 treatment:* *1. Repeated scaling and root instrumentation of the area, with or without access flaps.* *2. A frequent program of supportive periodontal care that includes subgingival instrumentation*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Dental services are organized differently in various countries. Some are structured in both primary care and specialist care (usually delivered by referral to dental hospitals or specialist practices/centres); in other countries dental services are based on a single level of care and interested general practitioners acquire broader periodontal

3.6 What is the importance of adequate self- performed oral hygiene in the context of surgical periodontal treatment?

Expert consensus-based recommendation (3.6)
We recommend not to perform periodontal (including implant) surgery in patients not achieving and maintaining adequate levels of self-performed oral hygiene.
Supporting literature Expert opinion
Grade of recommendation Grade A - ↑↑
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not recommend performing periodontal (including implant) surgery in patients who do not achieve and maintain adequate levels of self-performed oral hygiene.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Proof of principle studies conducted in the 1970s have pointed to the negative effects (clinical attachment loss) of performing periodontal surgery in subjects with inadequate plaque control Rosling et al. [114], Nyman et al. [115]. Multiple RCTs on surgical periodontal intervention have shown a dose dependent effect of plaque control on healing outcomes. Similar data have been reported after implant surgery van Steenberghe et al. [116]. The level of self-performed oral hygiene is clinically assessed using a plaque control record [for an example, see O'Leary et al. [117]]. Plaque scores smaller than 20–25 % have been consistently associated with better surgical outcomes (see step 1 and SPC clinical recommendations for detailed discussions on how to facilitate achieving stringent levels of self-performed oral hygiene).

If patients are unable to conduct good oral hygiene, then appropriate recommendations need to be made on an individual basis. Plaque level should be commensurate with that of the level of disease.

SDCEP guidance [91] should be taken into consideration alongside this recommendation.

6.5. Intervention: management of intrabony defects

3.7 What is the adequate management of residual deep pockets associated with intrabony defects?

Background

Intervention. See previous sections.

Available evidence. The evidence base includes 22 RCTs with 1000 patients. The quality of the evidence was rated as high. Risk of bias. Study quality assessment identified 4 studies at low risk of bias and 15 studies at unclear risk of bias.

Consistency. Regenerative surgical therapy resulted in improved clinical outcomes (shallower pockets and higher CAL gain) compared with open flap debridement in the majority of studies. No indication of publication bias was observed. Moderate to substantial heterogeneity in the size of the adjunctive effect was observed. This could be partly explained by the use of specific biomaterials or flap designs.

Clinical relevance and effect size. The mean adjunctive benefit reported was 1.34 mm (95 % CI [0.95; 1.73]) in CAL gain and 1.20 mm (95 % CI [0.85; 1.55]) in pocket depth reduction. This represented an 80 % (95 % CI [60 %; 100 %]) improvement compared to the controls. A mean difference of this magnitude is deemed clinically relevant as it has the potential of decreasing risk of tooth loss. Observational and experimental studies reporting on tooth survival for a period of 3–20 years show improved tooth retention with periodontal regeneration in teeth under regular supportive periodontal therapy [28 RCTs summarized in unpublished data].

Balance of benefit and harm. No serious adverse event was reported in any of the studies included in the systematic review. The adverse events associated with regenerative therapy included local adverse events (wound failure) and post-operative morbidity. No specific harm has been reported after regenerative surgery. Potential risk for disease transmission from well documented human-derived or animal-derived regenerative biomaterials is considered extremely low.

Ethical considerations. The perception that regenerative treatment of deep intrabony defects results in better outcomes than access flap is commonly held in the research and clinical community. Therefore, a maximum tissue preservation flap with the application of documented regenerative biomaterials should be the standard of care. This perception is supported by the observation that only 22 of 79 RCTs included in the systematic review used access flap as the control and the majority of the body of evidence compared different regenerative techniques/biomaterials.

Evidence-based recommendation (3.7)
We recommend treating teeth with residual deep pockets associated with intrabony defects 3 mm or deeper with periodontal regenerative surgery.
Supporting literature Nibali et al [35]
Quality of evidence: 22 RCTs (1182 teeth in 1000 patients) – 4 studies at low risk of bias – there is consistency of direction of benefit but high heterogeneity for superiority of regeneration over open flap debridement.
Grade of recommendation Grade A - ↑↑
Strength of consensus Consensus (10% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend periodontal regenerative surgery for teeth with residual deep pockets associated with intrabony defects 3 mm or deeper.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (5.3% abstentions due to potential CoI)

Regulatory consideration. It is important to emphasise that only a few classes of regenerative materials are registered in Europe. In each class, only a few materials satisfy the evidence base criteria set forth by these guidelines and the considerations should not be applied to materials that have not been adequately tested. Implementation of the new EU medical device regulations will prove useful.

Economic considerations. Regenerative surgery is more expensive than access flap surgery but cheaper than tooth replacement necessary as a consequence of tooth loss. In the absence of health-economic data in RCTs included in the review, a pilot study has indicated that the initial increase in cost of regeneration is associated with lower cost of managing recurrence over a 20-year period Cortellini et al. [118].

Patient preferences. No data are available about patient preference or acceptability. Religious issues may be present for segments of the population since some of the regenerative materials are of porcine or

bovine origin. While the use for medical reasons is generally acceptable and has been approved by religious leaders, the sensitivity of individual subjects may pose a barrier.

3.8 What is the adequate choice of regenerative biomaterials for promoting healing of residual deep pockets associated with a deep intrabony defect?

Evidence-based recommendation (3.8)
In regenerative therapy, **we recommend** the use of either barrier membranes or enamel matrix derivative with or without the addition of bone-derived grafts*
Supporting literature Nibali et al [35]
Quality of evidence: 20 RCTs (972 patients) – 4 studies at low risk of bias – moderate to high heterogeneity for superiority of these biomaterials
Grade of recommendation Grade A - ↑↑
Strength of consensus Consensus (18.1% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend the use of either barrier membranes or enamel matrix derivative with or without the addition of bone-derived grafts* in patients undergoing regenerative therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (5.5% abstentions due to potential CoI)

*Clinicians should select a specific biomaterial to be used to promote regeneration at intrabony defects (or class II furcation involvements) based on satisfaction of all of the following criteria Proceedings of the 1996 World Workshop in Periodontics [119]: i) availability of solid preclinical research identifying plausible mechanism(s) of action leading to periodontal regeneration; ii) human histological evidence of regeneration in the specific application; and iii) evidence of efficacy in applicable, high quality randomized controlled clinical trials. While there are biomaterials that satisfy all these criteria, it must be understood that many biomaterials do not meet them in spite of being CE ("Conformité Européene") marked or Food and Drug Administration (FDA) approved/cleared.

Background

Intervention. See previous sections.

Available evidence. The evidence base includes 20 RCTs with 972 patients. The quality of the evidence was considered to be high.

Risk of bias. Study quality assessment identified 4 studies at low risk of bias and 15 studies at unclear risk of bias.

Consistency. Regenerative surgical therapy with a variety of biomaterials resulted in improved clinical outcomes compared with open flap debridement in the majority of studies. No indication of publication bias was observed. Moderate to substantial heterogeneity in the size of the adjunctive effect was observed.

Clinical relevance and effect size. The mean adjunctive benefit in terms of CAL gain was 1.27 mm (95 % CI [0.79; 1.74], equivalent to a 77 % improvement) for EMD and 1.43 mm (95 % CI [0.76; 2.22], equivalent to an 86 % improvement) for guided tissue regeneration (GTR) compared with OFD. The combination of membrane with bone-derived graft resulted in higher CAL gain of 1.5 mm (95 % CI [0.66; 2.34], equivalent to a 90 % improvement) compared with OFD. The comparison between EMD versus GTR resulted in no statistically significant difference in CAL gain. The choice of biomaterial or possible combinations should be based on defect configuration.

3.9 What is the adequate choice of surgical flap design for the regenerative treatment of residual deep pockets associated with an intrabony defect?

Evidence-based recommendation (3.9)
We recommend the use of specific flap designs with maximum preservation of interdental soft tissue such as papilla preservation flaps. Under some specific circumstances, we also **recommend** limiting flap elevation to optimize wound stability and reduce morbidity.
Supporting literature (Graziani et al [113], Nibali et al [35]
Quality of evidence: ancillary evidence arising from systematic reviews and expert opinion.
Grade of recommendation Grade A - ↑↑
Strength of consensus Consensus (2.8% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend that specific flap designs, such as papilla preservation techniques, are used to maximise the preservation of interdental soft tissue in regenerative treatment of residual deep pockets associated with an intrabony defect. Under some specific circumstances, we also recommend limiting flap elevation to optimise wound stability and reduce morbidity.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (1.9% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. The evidence base includes two systematic reviews.

Risk of bias. Study quality assessment identified five studies at low risk of bias and 15 studies at unclear risk of bias.

Consistency. No conclusion can be drawn.

Clinical relevance and effect size. Papilla preservation flaps have been shown to lead to increased CAL gain and PD reduction as well as reduced post-surgical recession in regenerative periodontal surgery compared with OFD.

Balance of benefit and harm. No serious adverse event has been reported after application of papilla preservation flaps in regenerative periodontal surgery performed by adequately trained clinicians. The added complexity of the surgery requires additional training.

Applicability. Anatomical considerations related to the width of the interdental space guide the choice of the preferred flap design to access the interdental area [120,121]. The location and configuration of the intrabony defect also govern the options of: i) minimizing the flap extension [122,123] ii) raising a single flap or iii) needing to fully elevate the interdental papilla [124,125]

6.6. *Intervention: management of furcation lesions*

3.10 What is the adequate management of molars with class II and

III furcation involvement and residual pockets?

Evidence-based recommendation & statement (3.10)
A. **We recommend** that molars with class II and III furcation involvement and residual pockets receive periodontal therapy. B. Furcation involvement is no reason for extraction.
Supporting literature Jepsen et al [34], Dommisch et al [39]
Quality of evidence: Regenerative treatment: 20 RCTs (575 patients) Resective treatment: 7 observational studies (665 patients) with low quality of evidence
Grade of recommendation A. Grade A - ↑↑ B. Statement
A. Strength of consensus Strong consensus (1.5% of the group abstained due to potential CoI)
B. Strength of consensus Consensus (1.5% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *A. We recommend that molars with residual pockets and associated class II and III furcation involvement receive periodontal therapy.* *B. Furcation involvement is not an indication for extraction.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. The evidence base includes 20 RCTs with 575 patients (class II buccal/lingual mandibular and maxillary buccal furcation involvement) and 7 observational studies with 665 patients (class II interproximal and class III). Previous systematic reviews have addressed the clinical effectiveness of periodontal therapy on teeth with furcation involvement [126,127].

Risk of bias. High quality of evidence of RCTs. Low quality of evidence for observational studies.

Consistency. Following treatment, moderate to substantial heterogeneity in the size of the effect (wide ranges of tooth survival) was observed. The reasons cannot be determined from the existing data.

Clinical relevance and effect size. Following treatment, reasonable survival rates were observed over 4–30.8 years. Overall, the observed tooth survival rates were better in class II furcation involvement than class III.

Balance of benefit and harm. We did not identify data about harm directly related to procedures.

Economic considerations. Simulations based on the German health system have indicated that tooth retention after complex periodontal therapy, of teeth with furcation involvement, is more cost-effective than their extraction and replacement with an implant supported fixed partial denture [128]. A study assessing the actual cost of retention of molars in the same health system showed that cost for retaining periodontally compromised molars was minimal [129].

Patient preferences. There is a strong patient preference for tooth retention [130].

Applicability. The guideline can be applied since it is independent of availability of materials and a section of the dental workforce has been trained or can be trained to deliver surgical furcation treatment in the different European health systems.

Molars presenting with class I furcation involvement should also be assessed and receive relevant periodontal therapy.

3.11 What is the adequate management of residual deep pockets associated with mandibular class II furcation involvement?

Evidence-based recommendation (3.11)
We recommend treating mandibular molars with residual pockets associated with class II furcation involvement with periodontal regenerative surgery.
Supporting literature Jepsen et al [34]
Quality of evidence: 17 RCTs ≥ 12 months (493 patients).
Grade of recommendation Grade A - ↑↑
Strength of consensus Consensus (7.6% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend treating mandibular molars with residual pockets and associated class II furcation involvement with periodontal regenerative surgery.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (3.8% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. The evidence base includes 17 RCTs with 493 patients. The quality of the evidence for the statement was assessed according to GRADE and considered to be high. In the systematic review underlying this recommendation Jepsen et al. [34], a standard meta-analysis grouping all regenerative techniques versus OFD was performed altogether with ancillary analysis. Results indicated that regenerative therapies had a significant benefit over OFD in terms of both primary and surrogate outcomes.

Risk of bias. Study quality assessment identified an unclear risk of bias for the majority of the studies, bearing in mind that six papers failed to disclose support and seven papers reported industry funding for the research.

Consistency. Regenerative treatment consistently demonstrated added benefits (in terms of furcation improvement, horizontal bone gain, horizontal and vertical attachment gain, pocket reduction) in comparison to OFD.

Clinical relevance and effect size. The mean adjunctive benefit of a regenerative treatment is clinically relevant (1.3 mm vertical CAL and greater PPD reduction) and the effect size is significant as furcation improvement showed an odds ratio (OR) of 21 (Bayesian credible interval 5.8–69.4) in favour of regenerative techniques.

Balance of benefit and harm. The benefit of regenerative therapies to promote tooth retention outweighs the adverse events which consist mainly of local wound failure.

Ethical considerations. The perception is that regenerative therapies to promote tooth retention are preferred over tooth extraction (and replacement) or open flap debridement

Regulatory consideration. All the studies reported FDA or CE-approved devices.

Economic considerations. Regenerative surgery has additional costs, which appear to be justified by the added benefits (furcation improvements).

Patient preferences. Minimal data are available.

Applicability. Teeth presenting with favourable patient, tooth and defect related conditions.

3.12 What is the adequate management of residual deep pockets associated with maxillary buccal class II furcation involvement?

Evidence-based recommendation (3.12)
We suggest treating molars with residual pockets associated with maxillary buccal class II furcation involvement with periodontal regenerative surgery.
Supporting literature Jepsen et al [34]
Quality of evidence: 3 RCTs ≥ 12 months (82 patients).
Grade of recommendation Grade B - ↑
Strength of consensus Consensus (8.5% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We suggest periodontal regenerative surgery for maxillary molars with residual pockets and associated buccal class II furcation involvement.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (5.7% abstentions due to potential CoI)

Background

Intervention. See previous sections.

3.13 What is the adequate choice of regenerative biomaterials for the regenerative treatment of residual deep pockets associated with class II mandibular and maxillary buccal furcation involvement?[5]

Evidence-based recommendation (3.13)
We recommend treating molars with residual pockets associated with mandibular and maxillary buccal class II furcation involvement with periodontal regenerative therapy using enamel matrix derivative alone or bone-derived graft with or without resorbable membranes*
Supporting literature Jepsen et al [34]
Quality of evidence: 17 RCTs ≥ 12 months (493 patients) for mandibular class II, 3 RCTs ≥ 12 months (82 patients) for maxillary buccal class II, and support from indirect evidence, expert opinion.
Grade of recommendation Grade A - ↑↑
Strength of consensus Simple majority (12.7% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend treating mandibular and maxillary molars with residual pockets and associated buccal class II furcation involvement with periodontal regenerative therapy*
using enamel matrix derivative alone or bone-derived graft, with or without resorbable membranes[5].
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Consensus*** (7.3% abstentions due to potential CoI)

Available evidence. The evidence base includes 3 RCTs with 82 patients [131–133]. The quality of the evidence for the statement was assessed according to GRADE and considered to be moderate. Of these studies only one [133] had a clear difference favouring OFD indicating an added benefit.

Risk of bias. Study quality assessment identified an unclear/high risk of bias.

Consistency. Regenerative treatment demonstrated added benefits.

Clinical relevance and effect size. This cannot be extrapolated from the available data.

Balance of benefit and harm. The benefit of regenerative therapies to promote tooth retention outweigh the adverse events which consist mainly of local wound failure.

Ethical considerations. The expert perception is that regenerative therapies to promote tooth retention are preferred over tooth extraction or open flap debridement.

Regulatory consideration. All the studies reported FDA or CE-approved devices.

Economic considerations. Regenerative surgery has costs which appear to be justified by the added benefits (furcation improvements).

Patient preferences. No data are reported.

Applicability. Teeth presenting with favourable patient, tooth and defect related conditions.

Background

Intervention. See previous sections.

Available evidence. The evidence base includes 17 RCTs with 493 patients for mandibular class II and 3 RCTs with 82 patients for maxillary buccal class II. The quality of the evidence for the statement was assessed according to GRADE and considered to be high/moderate. In the systematic review underlying this recommendation Jepsen et al. [34], a Bayesian network meta-analysis was performed to assess which treatment modalities demonstrated the highest likelihood of success. For the outcome such as HBL (gain of horizontal bone level) the highest-ranked groups were bone replacement graft, GTR with a bone replacement graft or enamel matrix derivative.

Risk of bias. Study quality assessment identified an unclear risk of bias for the majority of the studies. There is a mix of researcher and industry-initiated studies.

[5] Clinicians should select a specific biomaterial to be used to promote regeneration at intrabony defects (or class II furcation involvements) based on satisfaction of all of the following criteria [119]: i) availability of solid preclinical research identifying plausible mechanism(s) of action leading to periodontal regeneration; ii) human histological evidence of regeneration in the specific application; and iii) evidence of efficacy in applicable, high quality randomized controlled clinical trials. While there are biomaterials that satisfy all these criteria, it must be understood that many biomaterials do not meet them despite being CE marked or FDA approved/cleared.

Consistency. The procedures with the highest ranking for horizontal bone gain are bone-replacement graft, bone-replacement graft with resorbable membranes and enamel matrix derivative.

Clinical relevance and effect size. This cannot be extrapolated for the different therapies from the available data.

Balance of benefit and harm. The benefit of regenerative therapies to promote tooth retention outweigh the adverse events which consist mainly of local wound failure.

Ethical considerations. The perception is that regenerative therapies to promote tooth retention are preferred over tooth extraction and open flap debridement.

Regulatory consideration. All the studies reported FDA or CE-approved devices.

Economic considerations. Regenerative surgery has additional costs, which appear to be justified by the added benefits (furcation improvements).

Patient preferences. Enamel matrix derivative showed less post-operative swelling and pain than non-resorbable membranes.

Applicability. Teeth presenting with favourable patient, tooth and defect related conditions.

3.14 What is the adequate management of maxillary interdental class II furcation involvement?

Evidence-based recommendation (3.14)
In maxillary interdental class II furcation involvement nonsurgical instrumentation, OFD, periodontal regeneration, root separation or root resection **may be considered**.
Supporting literature Jepsen et al [134], Huynh-Ba et al [126] Dommisch et al [39]
Quality of evidence: 6 observational studies (633 patients) with low quality of evidence for non-regenerative approaches and two systematic reviews with low quality of evidence for regenerative treatment.
Grade of recommendation Grade 0 - ↔
Strength of consensus Consensus (4.3% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *Non-surgical instrumentation, open flap debridement (OFD), periodontal regeneration, root separation or root resection may be considered to treat maxillary interdental class II furcation involvement.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (2.0% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. 6 observational studies with 633 patients (maxillary class II interproximal furcations).

Risk of bias. Low quality of evidence for observational studies.

Consistency. Following non-regenerative treatment of maxillary interproximal class II furcation involvement, moderate to substantial heterogeneity in the size of the effect (wide ranges of tooth survival) was observed. The reasons cannot be determined from the existing data.

Clinical relevance and effect size. Following non-regenerative treatment of maxillary interproximal class II furcation involvement reasonable survival rates were observed over 4–30.8 years.

Balance of benefit and harm. We did not identify data about harm directly related to any of the procedures. Regarding tooth survival a benefit of root amputation/resection, root separation or tunnelling compared to SRP or OFD cannot currently be confirmed. For the individual choice of procedure, the clinician should consider criteria beyond the class of furcation involvement (e.g. the degree of bone loss and surgical accessibility for the clinician together with ensuring that the patient will be able to perform good oral hygiene).

Economic considerations. Simulations based on the German health system have indicated that tooth retention after complex periodontal therapy of teeth with furcation involvement is more cost-effective than their extraction and replacement with an implant supported fixed partial denture [128]. A study assessing the actual cost of retention of molars in the same health system showed that the cost of retaining periodontally compromised molars was minimal [129].

Patient preferences. There is a strong patient preference for tooth retention [130].

Applicability. The guideline can be applied since it is independent of availability of materials and a section of the dental workforce has been

trained or can be trained to deliver surgical furcation treatment in the different European health systems.

3.15 What is the adequate management of maxillary class III furcation involvement?

Evidence-based recommendation (3.15)
In maxillary class III and multiple class II furcation involvement in the same tooth nonsurgical instrumentation, OFD, tunnelling, root separation or root resection **may be considered**.
Supporting literature Dommisch et al [39]
Quality of evidence: 6 observational studies (633 patients) with low quality of evidence.
Grade of recommendation Grade 0 - ↔
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *Non-surgical instrumentation, open flap debridement (OFD), tunnelling, root separation or root resection may be considered to treat maxillary class III furcations and multiple class II furcations in the same tooth.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. Six observational studies with 633 patients.

Risk of bias. Low quality of evidence for observational studies.

Consistency. Following treatment of maxillary class III furcation involvement, moderate to substantial heterogeneity in the size of the effect (wide ranges of tooth survival) was observed. The reasons cannot be determined from the existing data.

Clinical relevance and effect size. Following treatment of maxillary class III furcation involvement, reasonable survival rates were observed over 4–30.8 years.

Balance of benefit and harm. We did not identify data about harm directly related to the procedures. Regarding tooth survival a benefit of root amputation/resection, root separation or tunnelling compared to SRP or OFD cannot currently be confirmed. For the individual choice of procedure, the clinician should consider criteria beyond the class of furcation involvement (e.g. the degree of bone loss and surgical accessibility for the clinician together with ensuring that the patient will be able to perform good oral hygiene).

Economic considerations. Simulations based on the German health system have indicated that tooth retention after complex periodontal therapy of teeth with furcation involvement is more cost-effective than their extraction and replacement with an implant supported fixed partial denture [128]. A study assessing the actual cost of retention of molars in the same health system showed that the cost of retaining periodontally compromised molars was minimal [129].

Patient preferences. There is a strong patient preference for tooth retention [130].

Applicability. The guideline can be applied since it is independent of

availability of materials and a section of the dental workforce has been trained or can be trained to deliver resective treatment in the different European health systems.

3.16 What is the adequate management of mandibular class III furcation involvement?

Evidence-based recommendation (3.16)
In mandibular class III and multiple class II furcation involvement in the same tooth nonsurgical instrumentation, OFD, tunnelling, root separation or root resection **may be considered**.
Supporting literature Dommisch et al [39]
Quality of evidence: 7 observational studies (665 patients) with low quality of evidence.
Grade of recommendation Grade 0 - ↔
Strength of consensus Unanimous consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *Non-surgical instrumentation, open flap debridement (OFD), tunnelling, root separation or root resection may be considered to treat mandibular class III furcations and multiple class II furcations in the same tooth.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. Seven observational studies with 665 patients (with mandibular class III furcations).

Risk of bias. Low quality of evidence for observational studies.

Consistency. Following treatment of mandibular class III furcation involvement, moderate to substantial heterogeneity in the size of the effect (wide ranges of tooth survival) was observed. The reasons cannot be determined from the existing data.

Clinical relevance and effect size. Following treatment of mandibular class III furcation involvement, reasonable survival rates were observed over 4–30.8 years.

Balance of benefit and harm. We did not identify data about harm directly related to procedures. Regarding tooth survival a benefit of root amputation/resection, root separation or tunnelling compared to SRP or OFD cannot currently be confirmed. For the individual choice of procedure, the clinician should consider criteria beyond the class of furcation involvement (e.g. the degree of bone loss and surgical accessibility for the clinician together with ensuring that the patient will be able to perform good oral hygiene).

Economic considerations. Simulations based on the German health system have indicated that tooth retention after complex periodontal therapy of teeth with furcation involvement is more cost-effective than their extraction and replacement with an implant supported fixed partial denture [128]. A study assessing the actual cost of retention of molars in the same health system showed that the cost of retaining periodontally compromised molars was minimal [129].

Patient preferences. There is a strong patient preference for tooth retention [130].

Applicability. The guideline can be applied since it is independent of availability of materials and a section of the dental workforce has been trained or can be trained to deliver resective treatment in the different European health systems

7. Clinical recommendations: supportive periodontal care

Following completion of active periodontal therapy, successfully treated periodontitis patients may fall into one of two diagnostic categories:

- Periodontitis patients with a reduced but healthy periodontium
- Periodontitis patients with gingival inflammation [69,70].

These subjects remain at high risk for periodontitis recurrence/progression and require specifically designed supportive periodontal care (SPC), consisting of a combination of preventive and therapeutic interventions rendered at different intervals which 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. These professional interventions, also referred to as periodontal maintenance, require a structured recall system with the frequency and length of visits being customized to patient need. SPC also includes modifying individual behaviours, since patients should be adherent as in recommendation 4.2, to the appropriate oral hygiene regimens and healthy lifestyles.

7.1. Supportive periodontal care: preliminary considerations

4.1 At what intervals should supportive periodontal care visits be scheduled?

Expert consensus-based recommendation (4.1)
We **recommend** that supportive periodontal care visits should be scheduled at intervals of 3 to a maximum of 12 months, and ought to be tailored according to patient´s risk profile and periodontal conditions after active therapy.
Supporting literature Sanz et al [83], Trombelli et al [82], Ramseier et al [135], Polak et al [41], Trombelli et al [46].
Grade of recommendation Grade A – ↑↑
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend that visits for supportive periodontal care (SPC) should be scheduled for intervals of 3 months to a maximum of 12 months with the frequency determined by the patient´s risk profile and periodontal status after active therapy.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Although not addressed directly in the systematic reviews underlying this guideline, evidence supports the concept of defined intervals to perform SPC visits every 3–4 months as recommended in studies selected by Trombelli et al. [46]:

- SPC every 3 months may be sufficient to control periodontitis progression after periodontal surgery [41].
- In addition, the conclusions of the 2014 European Workshop on Prevention, based on the review by Trombelli et al. [82], 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 [83].
- A recent study [135] of over 883 patients, reflected on the importance of SPC and the factors involved in its success.

4.2 Is adherence to supportive periodontal care important?

Expert consensus-based recommendation (4.2)
We recommend that adherence to supportive periodontal care should be strongly promoted, since it is crucial for long-term periodontal stability and potential further improvements in periodontal status.
***Supporting* literature** Costa et al [136], Sanz et al [83], Trombelli et al [82]
Grade of recommendation Grade A – ↑↑
Strength of consensus Unanimous consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend 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 improvements in periodontal status.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Although not addressed directly in the systematic reviews underlying this guideline, evidence supports the importance of complying with SPC visits, in which PMPR is performed:

- Greater rates of tooth loss and disease progression in patients with irregular compliance, versus patients with regular compliance have been reported [136].
- The conclusions of the 2014 European Workshop on Prevention, based on the review by Trombelli et al. [82], concluded that compliance with the preventive professional intervention is crucial, based also on retrospective observational studies [83].

7.2. Intervention: Supragingival dental biofilm control (by the patient)

4.3 Is oral hygiene instruction important? How should it be performed?

Expert consensus-based recommendation (4.3)
We **recommend** repeated individually tailored instructions in mechanical oral hygiene, including interdental cleaning, in order to control inflammation and avoid potential damage for patients in periodontal SPC.
Supporting literature Slot et al [44]
Grade of recommendation Grade A – ↑↑
Strength of consensus Unanimous consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend repeated and individually tailored mechanical oral hygiene instruction, including interdental cleaning, in order to control inflammation and avoid disease progression for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. All surfaces exposed to the formation of intraoral biofilm have to be cleaned mechanically. Some of them will not be reached by toothbrushes even under optimal conditions. Interproximal cleaning, therefore, is essential in order to maintain interproximal gingival health, in particular for secondary prevention. It may be achieved using different devices, primarily inter-dental brushes (IDB, which are not single-tufted brushes), rubber/elastomeric cleaning sticks, wood sticks, oral irrigators and floss. However, all devices have the potential for side-effects and their use has to be monitored not only with respect to efficacy but also with respect to early signs of trauma (e.g. onset of non-carious cervical lesions).

Available evidence. Due to the scarcity of studies that met the inclusion criteria for each of the oral hygiene devices and the low certainty of the resultant evidence, no strong "evidence based" conclusion can be drawn concerning any specific oral hygiene device for patient self-care in periodontal maintenance. The evidence that emerged from the search provided 16 papers reporting on 13 CCTs/RCTs, which included 17 comparisons. The differences of powered versus manual toothbrushes were evaluated in 5 comparisons, an interdental device was used as an adjunct to toothbrushing in 5 comparisons and 7 comparisons evaluated two different interdental devices. In total, the studies evaluated 607 patients.

Risk of bias. Study quality assessment identified 1 study at low risk of bias and 10 studies at high risk and two of an unclear risk of bias.

Consistency. The summary of findings table shows that the body of evidence is rather consistent.

Clinical relevance and effect size. Variable, depending on the particular comparisons.

Balance of benefit and harm. The adverse events were not evaluated. There is a moderate risk of trauma due to the use of interdental cleaning devices, when not used properly. Therefore, individual instruction and adaptation to the individual situation, by professionals, are crucial. In any case the benefits overweigh the risks by far.

Economic considerations. A manual toothbrush is less expensive than a power toothbrush. Interdental brushes and oral irrigators are more expensive than dental floss, wood sticks and rubber and silicon interdental bristle cleaners.

Patient preferences. No data on patient preference was available from the current review.

Applicability. The guideline can be applied to patients attending a periodontal maintenance program. There is an abundance of mechanical oral hygiene products available

4.4 How should we choose an appropriate design of manual, powered toothbrushes and interdental cleaning devices?

Expert consensus-based recommendation (4.4)
We recommend taking into account patients' needs and preferences when choosing a toothbrush design, and when choosing an interdental brush design.
Supporting literature Slot et al [44]
Grade of recommendation Grade A – ↑↑
Strength of consensus Strong consensus (6.9% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend taking individual patient's abilities, needs, preferences and manual dexterity into account when selecting a toothbrush and design of interdental brush.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (11.8% abstentions due to potential CoI)

Background

Intervention. See previous section.

Available evidence. Scarcity or a lack of evidence does not necessarily imply that products may not be effective. Dental care professionals in clinical practice should tailor the best oral hygiene devices and methods according to patients' skill levels and preferences because patient acceptance is crucial for sustained long-term use [137]. Clinical evidence indicates that the efficacy of interdental brushes depends on the relation between the size of the brush and the size and shape of the interdental space. Interdental spaces are highly variable regarding size and morphology and interdental brushes have to be selected specific to the individual interdental space. The number of devices has to be limited with respect to the ability of the patient to cope with an assortment of cleaning aids. To reach this goal compromises have to be found to achieve the individual optimum.

4.5 Should we recommend a powered or a manual toothbrush?

Evidence-based recommendation (4.5)
The use of a powered toothbrush **may be considered** as an alternative to manual tooth brushing for periodontal maintenance patients.
Supporting literature Slot et al [44]
Quality of evidence: 5 RCTs (216 patients) with high risk of bias
Grade of recommendation Grade 0 - ↔
Strength of consensus Strong consensus (22.5% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *The use of a powered toothbrush may be considered as an alternative to manual tooth brushing for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (21.2% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. Based on the evidence from the systematic reviews underlying this guideline, toothbrushing is effective in reducing levels of dental plaque [77]. Toothbrushes vary in size, design, and the length, hardness, and arrangement of the bristles. Some manufacturers have claimed superiority in modifications such as bristle placement, length, and stiffness. Powered toothbrushes with various mechanical motions and features are available. The evidence provided 8 papers describing 5 CCT/RCT comparisons. In total the studies evaluated 216 patients. The quality of the evidence for the statement was assessed according to GRADE.

Risk of bias. Study quality assessment showed all studies at high risk of bias.

Consistency. The summary of findings table shows that the body of evidence is rather consistent.

Clinical relevance and effect size. No differences could be found. The statistical clinical evidence was calculated for one study and showed no clinically relevant effect size.

Balance of benefit and harm. The adverse events were not evaluated.

Economic considerations. A manual toothbrush is less expensive than a power toothbrush.

Patient preferences. No data on patient preference were available from the current review.

Applicability. The guideline can be applied to patients attending a periodontal maintenance program. There is an abundance of

toothbrushes available.

4.6 How should interdental cleaning be performed?

Evidence-based recommendation (4.6)
If anatomically possible, we **recommend** that tooth brushing should be supplemented by the use of interdental brushes.
Supporting literature Slot et al [44]
Quality of evidence: 7 comparisons from 4 RCTs (290 patients) with low to unclear risk of bias
Grade of recommendation Grade A – ↑↑
Strength of consensus Unanimous consensus (5.4% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adapted**.* *We recommend that tooth brushing should be supplemented by the use of interdental brushes (where anatomically possible) for patients in supportive periodontal care.* *Expert consensus states the patient's ability and manual dexterity should be considered.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (16.1% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. The underlying systematic review [44] found evidence for a significantly better cleaning effect of interdental cleaning devices as adjuncts to tooth brushing alone, and a significantly better cleaning effect of interdental brushes than of floss. Both the descriptive analysis and the NMA (network meta-analyses; a statistical technique which allows the integration of data from direct and indirect comparisons, namely treatments compared among trials through a common comparator treatment) indicate that IDBs are the first choice for periodontal maintenance patients. Seven comparisons from 4 RCTs (290 patients) were identified.

Risk of bias. Low to unclear.

Consistency. High.

Clinical relevance and effect size. Considered as clinically relevant.

Balance of benefit and harm. There is a moderate risk of trauma due to the use of interdental brushes, when not used properly. Therefore, individual instruction and adaptation to the individual situation by professionals are crucial. In any case the benefits overweigh the risks by far.

Economic considerations. Not considered.

Patient preferences. There is clinical evidence that patients with open interdental spaces prefer the use of interdental brushes to the use of dental floss. Patient preferences need to be taken into consideration.

Applicability. The guideline can be applied since appropriate quantities and varieties of interdental brushes are available on the European market.

4.7 What is the value of dental flossing for interdental cleaning in periodontal supportive care?

Evidence-based recommendation (4.7)
We **do not suggest** flossing as the first choice for interdental cleaning in periodontal maintenance patients.
Supporting literature Slot et al [44]
Quality of evidence 6 comparisons from 4 RCTs (162 patients) with unclear to high risk of bias
Grade of recommendation Grade B – ↓
Strength of consensus Consensus (5.6% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not suggest the use of floss as the first-choice method of interdental cleaning for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (11.1% abstentions due to potential CoI)

Background

Intervention. See previous sections.

Available evidence. The underlying systematic review [44] found evidence for a significantly better cleaning effect of interdental brushes than of flossing. Both the descriptive analysis and the NMA indicate that IDBs are the first choice for periodontal maintenance patients. Six comparisons from 4 RCTs (162 patients) were identified.

Risk of bias. High to unclear.

Consistency. High.

Clinical relevance and effect size. Considered as clinically relevant.

Balance of benefit and harm. There is a moderate risk of trauma due to the use of interdental brushes or floss, when not used properly. Therefore, individual instruction and adaptation to the individual situation, by professionals, are crucial.

Economic considerations. Not considered.

Patient preferences. There is clinical evidence that patients with open interdental spaces prefer the use of interdental brushes to the use of dental floss.

Applicability. The guideline can be applied since appropriate quantities and varieties of interdental brushes are available on the European market.

4.8 What is the value of other interdental devices for interdental cleaning in supportive periodontal care?

Background

Intervention. Other interdental cleaning devices include rubber/elastomeric cleaning sticks, wood sticks, oral irrigators and dental floss. Although there are very small and fine interdental brushes available on the market, not all interdental spaces are readily accessible with interdental brushes.

Available evidence. The underlying systematic review [44] identified three RCTs assessing the use of an adjunctive oral irrigator: two out of three studies demonstrated a significant effect of the irrigator on measures of gingival inflammation, but not on plaque scores. Rubber/-elastomeric cleaning sticks are relatively newly developed instruments with an increasing market share. There is only a little evidence available in gingivitis patients that these devices are as effective in reducing inflammation as interdental brushes [138,139].

Risk of bias. High.

Consistency. Not evaluated.

Clinical relevance and effect size. Considered as moderate.

Balance of benefit and harm. So far no adverse effects have been reported.

Economic considerations. Not considered.

Patient preferences. Rubber/elastomeric cleaning sticks are readily accepted by patients as are oral irrigators.

Applicability. The guideline can be applied since appropriate quantities and varieties of interdental cleaning devices are available on the European market.

Expert consensus-based recommendation (4.8)
In interdental areas not reachable by toothbrushes, we **suggest** supplementing tooth brushing with the use of other interdental cleaning devices in periodontal maintenance patients.
Supporting literature Slot et al [44]
Grade of recommendation Grade B – ↑
Strength of consensus Consensus (4.1% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adapted**.* *We suggest the use of other interdental cleaning devices in interdental areas, not reachable by interdental brushes, for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (11.8% abstentions due to potential CoI)

4.9 What additional strategies in motivation are useful?

Background

Intervention. Other interdental cleaning devices include rubber/

Expert consensus-based recommendation (4.9)
We recommend utilizing the "First Step of Therapy" section of this guideline.
Supporting literature Carra et al [38]
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend utilising the "First Step of Therapy" section of this guideline.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Background information and the discussion of additional factors can be found in the section dealing with patients in active periodontal therapy (first step of therapy).

7.3. Intervention: Adjunctive therapies for gingival inflammation

4.10 What is the value of adjunctive antiseptics/chemotherapeutic agents for the management of gingival inflammation?

Expert consensus-based recommendation (4.10)
The basis of the management of gingival inflammation is self-performed mechanical removal of biofilm. Adjunctive measures, including antiseptics, **may be considered** in specific cases, as part of a personalized treatment approach.
Supporting literature Figuero et al [33]
Grade of recommendation Grade 0 - ↔
Strength of consensus Consensus (11.8% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *The basis of the management of gingival inflammation is self-performed mechanical removal of biofilm. Adjunctive measures, including antiseptics, may be considered in specific cases, as part of a personalised treatment approach.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (23.1% abstentions due to potential CoI)

Background

Intervention. In order to control gingival inflammation during periodontal maintenance, the adjunctive use of some agents has been proposed. These agents are mainly antiseptic agents, and can be delivered as dentifrices, as mouth rinses or both.

Available evidence. A systematic review [33] was conducted, aiming to identify RCTs of, at least, 6 months of follow up, in treated periodontitis patients or in gingivitis patients, in which antiseptics, prebiotics, probiotics, anti-inflammatory agents, antioxidant micronutrients were used as adjuncts to mechanical supragingival biofilm control. For antiseptic agents, the impact in the primary outcome, changes in gingival indices (analysed in 52 studies with 72 comparisons, including 5376 test and 3693 control patients), was statistically significant ($p < 0.001$) and the additional reduction, expressed as standardized weighted mean difference (S-WMD), was -1.3 (95 % CI [-1.489; -1.047]), with significant heterogeneity ($p < 0.001$). In treated periodontitis patients, analysed in 13 studies with 16 comparisons, including 1125 test and 838 control patients, the impact was statistically significant ($p < 0.001$) and the additional reduction, expressed as S-WMD, was -1.564 (95 % CI [-2.197; -0.931]), with significant heterogeneity ($p < 0.001$). No conclusions could be made for other, non- antiseptic, agents, since only one study was identified. Longer-term studies in treated periodontitis patients are also relevant to assess periodontal stability. In the systematic review [33], four long-term studies (1.5–3 years) were identified, and no significant impact was observed for gingival indices. However, a 3-year study demonstrated significant benefits in terms of frequency of deep periodontal pockets and in the number of sites that exhibited additional attachment and bone loss [140].

Risk of bias. The great majority of these studies were industry-funded and there was a high risk of bias both within and across studies.

Consistency. Highly consistent across studies, 72 comparisons were included in the primary analysis.

Clinical relevance and effect size. Considered as clinically relevant.

Balance of benefit and harm. At least 31 studies assessed adverse events and PROMs and staining was the only relevant finding.

Economic considerations. The issue has not been addressed. For dentifrices, it may not be relevant, since a dentifrice has to be used combined with mechanical tooth brushing; for mouth rinse, the extra cost should be taken into consideration. It should also be noted that the evidence base contains studies using products that may no longer be available.

Patient preferences. Both dentifrices and mouth rinses are widely accepted by the population.

Applicability. Demonstrated with studies testing large groups from the general population. The adjunctive use of some agents has been proposed in those subjects who are not able to effectively remove supragingival biofilms by the sole use of mechanical procedures, but there is no direct evidence to support this statement.

4.11 Should adjunctive chemotherapeutics be recommended for patients in supportive periodontal care?

Evidence-based recommendation/statement (4.11)
A. The use of adjunctive antiseptics **may be considered** in periodontitis patients in supportive periodontal care in helping to control gingival inflammation, in specific cases. B. We **do not know** if other adjunctive agents (such as probiotics, prebiotics, anti-inflammatory agents, antioxidant micronutrients) are effective in controlling gingival inflammation in patients in supportive periodontal care.
Supporting literature Figuero et al [33]
Quality of evidence 73 RCTs with, at least, 6-month follow up
A. Grade of recommendation Grade 0 - ↔ There is a need to define the term of use (e.g. 6 months?). Adverse effects should be taken into account. ***B. Grade of recommendation*** Grade 0 – Statement: unclear, additional research needed.
Strength of consensus Consensus (6.9% of the group abstained due to potential CoI)
BSP Implementation
This evidence-based recommendation is **adopted**. A. The use of adjunctive antiseptics may be considered in specific cases, to help control gingival inflammation for patients in supportive periodontal care. B. We do not know if other adjunctive agents (such as probiotics, prebiotics, anti-inflammatory agents, antioxidant micronutrients) are effective in controlling gingival inflammation in patients in supportive periodontal care.
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (26.4% abstentions due to potential CoI)

Background

Intervention. In order to control gingival inflammation during supportive periodontal care, the adjunctive use of some agents has been proposed. These agents are mainly antiseptics but some other agents, such as probiotics, prebiotics, anti-inflammatory agents and antioxidant micronutrients, can be found in the literature. These products are mainly delivered as dentifrices or mouth rinses.

Available evidence. See also previous section. The adjunctive use of antiseptic agents has been proposed in those subjects who are not able to effectively remove supragingival biofilms by the sole use of mechanical procedures. Actually, the recommendations of the XI European Workshop in Periodontology (2014) highlighted that: "For the treatment of gingivitis and where improvements in plaque control are required, adjunctive use of anti-plaque chemical agents may be considered. In this scenario, mouth rinses may offer greater efficacy but require to be an additional action to the mechanical oral hygiene regime" [78]. Recommending adjunctive antiseptics, to mechanical supragingival biofilm control, in a specific patient group, instead of in the general population, is plausible, but there is no supporting evidence to defend it. Most studies assessing the adjunctive benefits of antiseptic formulations have been performed in general populations, with statistically significant benefits in plaque and gingival indices [141]. Therefore, different factors may be considered when deciding whether to recommend the use of an adjunctive agent to control gingival inflammation in patients in supportive periodontal care. It is noted that all patients need to use a toothbrush with a fluoride toothpaste. However, in those subjects who are not able to effectively control supragingival biofilms and/or gingival inflammation by the sole use of mechanical procedures, a decision is then made whether or not to utilise a toothpaste and/or a mouth rinse that contains a specific active agent (in addition to fluoride). This decision would follow a personalized approach to patient care, and would need to consider two aspects:

- Local factors: consider levels of gingival inflammation related to plaque level, accessibility for cleaning, anatomical factors, etc.

- General factors: consider systemic factors, general health status, frailty, limited dexterity, some of which may be more relevant in elderly patients.

The most frequent delivery format for antiseptic agents is dentifrices and mouth rinses, or they can be delivered in both, simultaneously. The obvious benefit of dentifrice delivery is that no other delivery format is needed, and a dentifrice is going to be used anyway. Mouth rinse delivery offers a better distribution around the mouth [141] and better pharmacokinetic properties [142]. Some evidence suggests that the adjunctive use of mouth rinses may provide better outcomes than dentifrices alone. However, the evidence is conflicting and significant differences were only observed for the secondary outcome [33]. In addition, direct comparisons between similar agents/formulations, delivered either as dentifrice or mouth rinse, are not available.

The decision to select a specific toothpaste or mouth rinse should be based on a combination of factors:

- Patient preferences: including cost, taste.
- Unwanted effects: staining, burning sensation during use.
- Potential negative impacts on beneficial aspects of the oral microbiome highlighted in recent evidence (e.g. impact on nitric oxide pathway) [143].
- Potential negative impacts on blood pressure: one short-term (7-days) study suggested a non-statistically significant "trend" for chlorhexidine mouth rinse to cause a small elevation in systolic blood pressure from 103 mmHg to 106 mHg [143]. The clinical significance of this is unknown.

Depending on the specific agent selected, a decision must be made regarding frequency and duration of use.

4.12 Which antiseptic is the most effective in dentifrices?

Evidence-based recommendation (4.12)
If an antiseptic dentifrice formulation is going to be adjunctively used, we **suggest** products containing chlorhexidine, triclosan-copolymer and stannous fluoride-sodium hexametaphosphate for the control of gingival inflammation, in periodontitis patients in supportive periodontal care.
Supporting literature Serrano et al [141]; Escribano et al [144], Figuero et al [145], Figuero et al [33]
Quality of evidence 29 RCTs with, at least, 6-month follow up
Grade of recommendation Grade B - ↑
Strength of consensus Consensus (17.4% of the group abstained due to potential CoI)
BSP Implementation
Statement *A specific recommendation was unable to be made and further research is appropriate.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Simple Majority*** (25.0% abstentions due to potential CoI)

Background

Intervention. In order to control gingival inflammation during supportive periodontal care, the adjunctive use of some agents has been proposed. These products can be delivered as dentifrices.

Available evidence. In the systematic review [33], the adjunctive use of 14 different dentifrice formulations were evaluated for controlling gingival inflammation, with a clear heterogeneity in the number of available studies for each product. The magnitude of effect of change in gingival index, in formulations with more than one study available, was headed by stannous fluoride with sodium hexametaphosphate (n = 2, S-WMD=-1.503), followed by triclosan and copolymer (n = 18, S-WMD=-1.313), and chlorhexidine (n = 2, S-WMD=-1.278, not statistically significant), although comparing the formulations was not a specific objective of the review. Effects on plaque levels were best with chlorhexidine at high concentrations (n = 3, S-WMD=-1.512) and triclosan and copolymer (n = 23, S-WMD=-1.164). In previously published NMA, chlorhexidine and triclosan and copolymer were the most effective agents for plaque reduction, but no clear differences were observed for gingival index control [144,145].

Additional factors have been discussed in the overall evaluation of adjunctive agents. The chlorhexidine evaluated was in a gel formulation and triclosan products are not available in the UK due to concern over effects on hormone levels and the potential long-term public health risks.

4.13 Which antiseptic is the most effective in mouth rinses?

Evidence-based recommendation (4.13)
If an antiseptic mouth rinse formulation is going to be adjunctively used, we **suggest** products containing chlorhexidine, essential oils and cetylpyridinium chloride for the control of gingival inflammation, in periodontitis patients in supportive periodontal care.
Supporting literature Serrano et al [141], Escribano et al [144], Figuero et al [145], Figuero et al [33]
Quality of evidence Class of Evidence (CoE) class I – 24 RCTs with, at least, 6-month follow up
Grade of recommendation Grade B - ↑
Strength of consensus Consensus (17.9% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *If an antiseptic mouth rinse formulation is to be considered for the adjunctive control of gingival inflammation for patients in supportive periodontal care, we suggest the use of products that contain chlorhexidine, essential oils or cetylpyridinium chloride.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (20.4% abstentions due to potential CoI)

Background

Intervention. In order to control gingival inflammation during supportive periodontal care, the adjunctive use of some agents has been proposed. These products can be delivered as mouth rinses.

Available evidence. In the systematic review [33], the adjunctive use of 11 different mouth rinse formulations were evaluated for controlling gingival inflammation, with clear heterogeneity in the number of available studies for each product. The magnitude of effect in gingival index changes, in formulations with more than one study available, ranged from S-WMD=-2.248 (essential oils, n = 10), to S-WMD=- 1.499 (cetylpyridinium chloride, n = 5), and to S-WMD=-1.144 (chlorhexidine at high concentrations, n = 5), although comparing the formulations was not a specific objective of the review. In previously published NMA, chlorhexidine and essential oil mouth rinses were ranked as the most efficacious agents in terms of changes in plaque and gingival indices [144,145].

Additional factors have been discussed in the overall evaluation of adjunctive agents.

7.4. Intervention: Supragingival dental biofilm control (professional)

4.14 What is the value of professional mechanical plaque removal (PMPR) as part of SPC?

Expert consensus-based recommendation (4.14)
We **suggest** performing routine professional mechanical plaque removal (PMPR) to limit the rate of tooth loss and provide periodontal stability/improvement, as part of a supportive periodontal care program.
Supporting literature Trombelli et al [82]
Grade of recommendation Grade B - ↑
Strength of consensus Strong consensus (1.4% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We suggest the use of routine professional mechanical plaque removal (PMPR), as part of a supportive periodontal care program, to limit the rate of tooth loss and provide periodontal stability/improvement.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Professional mechanical plaque removal (PMPR) administered on a routine basis (i.e., at specific, pre-determined

intervals) as an integral part of supportive periodontal care has been shown to result in low rates of tooth loss and limited attachment level changes in both the short and long- term in patients treated for periodontitis [82,146]. In most of the studies, PMPR in SPC was often combined with other procedures (e.g., reinforcement of oral hygiene instruction, additional active treatment at sites showing disease recurrence), thus making it difficult to isolate information on the magnitude of the mere effect of PMPR on tooth survival and stability of periodontal parameters [82].

Available evidence. This issue has not been directly addressed in the systematic reviews prepared for this Workshop; however, ample evidence is available to support this statement. It has been demonstrated that professional mechanical plaque removal (PMPR), performed at defined intervals, together with the other interventions of supportive periodontal care may result in lower rates of tooth loss and attachment level changes. In a systematic review [82], presented at the 2014 European Workshop, 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, was reported; the corresponding figures for mean clinical attachment loss of less than 1 mm at follow-up ranged from 5 to 12 years. Information from this review, and also from other systematic reviews, collectively provide evidence that patients with a history of treated periodontitis can maintain their dentition with limited variations in periodontal parameters when regularly complying with a SPC regimen based on routine PMPR [83].

Risk of bias. The methodological quality was assessed with a specifically designed scale for the evaluation of non-randomized observational studies, with a quality level ranging from 3 to 7, in a 9-point scale, with 9 representing the highest quality (lowest risk of bias).

Consistency. Although no meta-analysis was possible, the primary outcome (tooth loss) was reported in 12 studies, showing no or low incidence. Clinical attachment level (CAL) changes were reported in 10 studies, which consistently showed limited alterations in CAL, frequently reported as a slight loss of CAL.

Clinical relevance and effect size. A weighted mean yearly rate of tooth loss of 0.15 for follow- up of 5 years, and 0.09 for follow-up of 12–14 years, can be considered as relevant.

Balance of benefit and harm. PROMs were not reported in the included studies.

Economic considerations. Ethics and legal aspects are not relevant for this intervention; economic aspects have not been frequently addressed. In a study in a private practice in Norway, it was demonstrated that regular maintenance was associated with less tooth loss than irregular maintenance, with follow ups of 16–26 years; the yearly cost of maintaining a tooth was estimated as 20.2 euro [147].

Patient preferences. This was demonstrated with compliance in long-term studies.

Applicability. This was demonstrated with studies testing large groups from the general population.

4.15 Should alternative methods be used for professional mechanical plaque removal (PMPR) in supportive periodontal care?

Evidence-based recommendation (4.15)
We **suggest not** to replace conventional professional mechanical plaque removal (PMPR) with the use of alternative methods (Er: YAG laser treatment) in supportive periodontal care.
Supporting literature Trombelli et al [46]
Quality of evidence 1 RCT
Grade of recommendation Grade B – ↓
Strength of consensus Strong consensus (1.4% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not suggest replacing professional mechanical plaque removal (PMPR) with alternative methods (e.g. Er: YAG laser treatment) for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (2.0% abstentions due to potential CoI)

Background

Intervention. The systematic review [82] retrieved available RCTs on any given alternative intervention to conventional PMPR (the latter including supragingival and/or subgingival removal of plaque, calculus and debris performed with manual and/or powered instruments) in the maintenance of periodontitis patients with a follow-up of at least 1 year following the first administration of the intervention/control treatment.

Available evidence. In the systematic review [46], only one RCT was identified, assessing Er:YAG laser as an alternative method to conventional PMPR. No statistically significant differences were found [148].

Economic considerations. Cost-benefit or cost-effective analyses are missing and may be very relevant when considering this specific treatment option. The same is true for PROMs.

4.16 Should adjunctive methods be used for professional mechanical plaque removal (PMPR) in supportive periodontal care?

Evidence-based recommendation (4.16)
We **suggest not to** use adjunctive methods (sub-antimicrobial dose doxycycline, photodynamic therapy) to professional mechanical plaque removal (PMPR) in supportive periodontal care.
Supporting literature Trombelli et al [46]
Quality of evidence 2 RCTs
Grade of recommendation Grade B – ↓
Strength of consensus Strong consensus (2.7% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not suggest the use of adjunctive methods (sub-antimicrobial dose doxycycline, photodynamic therapy) to professional mechanical plaque removal (PMPR) for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Strong Consensus*** (1.9% abstentions due to potential CoI)

Background

Intervention. The systematic review [82] retrieved available RCTs on any given additional intervention to conventional PMPR (the latter including supragingival and/or subgingival removal of plaque, calculus and debris performed with manual and/or powered instruments) in the maintenance of periodontitis patients with a follow-up of at least 1 year following the first administration of the intervention/control treatment.

Available evidence. In the systematic review [46], two RCTs were identified, one testing a sub- antimicrobial dose (20 mg b.i.d.) of doxycycline [149], another evaluating photodynamic therapy (PDT) with 0.01 % methylene blue as photosensitizer and a diode laser (wavelength of 660 nm) [150]. No statistically significant differences were observed in either study, although CAL gain was greater with adjunctive PDT (1.54 mm) compared with conventional PMPR alone (0.96 mm). The systematic review presented at this Workshop provided information, based on meta-analysis, of the possible effects of the alternative/adjunctive methods mentioned, with no significant difference for the primary outcome (CAL changes), after 12-month follow up, amounting to - 0.233 mm (95 % CI [-1.065; 0.598; p = 0.351), favouring the control groups.

Economic considerations. For the adjunctive use of SDD, adverse effects and cost- benefit ratio have to be considered. For the adjunctive use of PDT, a previous systematic review [151], which included 11 RCTs, found better results for PDT, but only after 3 months, with 0.13 mm of additional impact in PPD reduction. No increase in adverse events was reported. Cost-benefit or cost-effective analyses were missing and may be very relevant when considering this specific treatment option.

7.5. Intervention: risk factor control

4.17 What is the value of risk factor control in supportive periodontal care?

Expert consensus-based recommendation (4.17)
We **recommend** risk factor control interventions in periodontitis patients in supportive periodontal care.
Supporting literature Ramseier et al [42]
Grade of recommendation Grade A – ↑↑
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend risk factor control interventions for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Periodontitis patients benefit from additional risk factor control interventions to improve the maintenance of periodontal stability. Interventions include patient education which should be staged and adapted according to individual needs ranging from single brief advice to patient referral for advanced counselling and

pharmacotherapy. Smoking and diabetes are two of the main risk factors for periodontitis, and they are currently included in the grading of periodontitis [2]. Controlling these risk factors, therefore, is critical for treatment response and for long-term stability. In addition, other relevant factors, as part of healthy life-style counselling, are considered, including dietary counselling, physical exercise and weight loss. These interventions, together with those for tobacco cessation and diabetes control, are not always the direct responsibility of oral health professionals, and they may want to refer the patients to other health professionals. However, the direct/indirect role of oral health professionals in these interventions should be emphasized.

Available evidence. In the systematic review [42], the authors have identified 13 relevant guidelines for interventions for smoking cessation, diabetes control, physical exercise (activity), change of diet, carbohydrate (dietary sugar) reduction and weight loss. In addition, 25 clinical studies were found that assess the impact of (some of) these interventions in gingivitis/periodontitis patients and of these only a proportion of them included patients in supportive periodontal care.

Additional factors have been discussed in the evaluation of risk factor control in patients in active periodontal therapy.

4.18 What is the role of tobacco smoking cessation interventions in supportive periodontal care?

Evidence-based recommendation (4.18)
We **recommend** tobacco smoking cessation interventions to be implemented in periodontitis patients in supportive periodontal care.
Supporting literature Ramseier et al [42]
Quality of evidence 6 prospective studies with, at least, 6-month follow up
Grade of recommendation Grade A – ↑↑
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We recommend the implementation of tobacco smoking cessation interventions for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Periodontitis patients may benefit from the promotion of diabetes control interventions to improve the maintenance of periodontal stability. The intervention may consist of patient education including brief dietary counselling and possibly referral for specialist glycaemic control advice.

Available evidence. In the systematic review [42], none of the identified studies were performed in patients in supportive periodontal care. Indirect evidence (see section on active periodontal therapy), suggests that diabetes control interventions should be implemented in supportive periodontal care patients.

Background information and the discussion of additional factors can be found in the section dealing with patients in active periodontal therapy.

Background

Background information and the discussion of additional factors can be found in the section dealing with patients in active periodontal therapy.

4.19 What is the role of promotion of diabetes control interventions in supportive periodontal care?

Expert consensus-based recommendation (4.19)
We **suggest** promotion of diabetes control interventions in patients in maintenance therapy.
Supporting literature Ramseier et al [42]
Grade of recommendation Grade B – ↑
Strength of consensus Consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We suggest promotion of diabetes control interventions for patients in supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

4.20 What is the role of physical exercise (activity), dietary counselling, or lifestyle modifications aiming at weight loss in supportive periodontal care?

Evidence-based recommendation/Statement (4.20)
We **do not know** if physical exercise (activity), dietary counselling, or lifestyle modifications aiming at weight loss, are relevant in supportive periodontal care.
Supporting literature Ramseier et al [42]
Grade of recommendation Grade 0 – Statement: unclear, additional research needed
Strength of consensus Strong consensus (0% of the group abstained due to potential CoI)
BSP Implementation
*This evidence-based recommendation is **adopted**.* *We do not know if physical exercise (activity), dietary counselling, or lifestyle modifications aimed at weight loss, are relevant to supportive periodontal care.*
Updated Evidence: No new applicable evidence was identified
Strength of Consensus: ***Unanimous Consensus*** (0% abstentions due to potential CoI)

Background

Intervention. Overall evidence from the medical literature suggests that the promotion of physical exercise (activity) interventions may improve both treatment and long-term management of non-communicable diseases. In periodontitis patients, the promotion may consist of patient education specifically target to the patient's age and general health.

Available evidence. In the systematic review [42], none of the identified studies were performed in patients in supportive periodontal care.

Background information and the discussion of additional factors can be found in the section dealing with patients in active periodontal therapy.

8. Information about the source document, the EFP S3-Guideline

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Workshop Organisation

European Federation of Periodontology

Scientific societies involved in the guideline development process

European Federation of Conservative Dentistry
European Association of Dental Public Health
European Society for Endodontology
European Prosthodontic Association

Other organisations involved in the guideline development process

Council of European Dentists
European Dental Hygienists' Federation
European Dental Students' Association
Platform for Better Oral Health in Europe

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Conflict of Interest Statement

Individual potential conflict of interest forms were completed by all participants and are available on file at the European Federation of Periodontology and extracted in the Supporting Information, available online (Final Guideline-Supporting Information Potential conflict of interests). In addition, potential conflict of interest information of the chairs of the workshop is listed here.

Dr. Sanz, Mariano (Chair) reports personal fees from Camlog implants, Colgate, Dentium Implants, Dentsply Sirona Implants, Geistlich, GSK, Klockner Implants, MIS Implants, Mozo Grau Implants, Nobel Biocare, Procter & Gamble, Straumann, Sunstar; grants from Camlog Implants, Dentaid, Dentium Implants, Dentsply Sirona Implants, Geistlich Pharma, Klockner Implants, MIS Implants, Mozo Grau Implants, Nobel Biocare, Sunstar, Straumann AG, Sweden and Martina Implants; and other support from Dentaid, outside the submitted work.

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Abstract

Background: The recently introduced 2017 World Workshop classification of periodontitis, incorporating stages and grades of disease, aims to link disease classification with approaches to prevention and treatment, as it describes not only disease severity and extent, but also the degree of complexity and an individual`s risk. There is, therefore, a need for evidence-based clinical guidelines providing recommendations to treat periodontitis.

Aim: The objective of the current project was to develop a S3 Level Clinical Practice Guideline (CPG) for the treatment of stage I–III periodontitis.

Material and Methods: This S3 CPG was developed under the auspices of the European Federation of Periodontology (EFP), following the methodological guidance of the Association of Scientific Medical Societies in Germany [13] and the Grading of Recommendations Assessment, Development and Evaluation (GRADE) [14]. The rigorous and transparent process included synthesis of relevant research in 15 specifically commissioned systematic reviews, evaluation of the quality and strength of evidence, the formulation of specific recommendations and consensus, on those recommendations, by leading experts and a broad base of stakeholders.

Results: The S3 CPG approaches the treatment of periodontitis (stages I, II and III) using a pre-established stepwise approach to therapy that, depending on the disease stage, should be incremental, each including different interventions. Consensus was achieved on recommendations covering different interventions, aimed at: i) behavioural changes, supragingival biofilm, gingival inflammation and risk factor control; ii) supra- and sub-gingival instrumentation, with and without adjunctive therapies; iii) different types of periodontal surgical interventions; and iv) the necessary supportive periodontal care to extend benefits over time.

Conclusion: This S3 guideline informs clinical practice, health systems, policymakers and, indirectly, the public, on the available and most effective modalities to treat periodontitis and to maintain a healthy dentition for a lifetime, according to the available evidence at the time of publication.

Key words: periodontitis, stage, grade, clinical guideline, periodontal therapy, health policy, oral health

Clinical Relevance

Scientific rationale for the study

Implementation of the new classification of periodontitis should be facilitate the use of the most appropriate preventive and therapeutic interventions, depending on the stage and grade of the disease. The choice of these interventions should be made following a rigorous evidence-based decision-making process.

Principal findings

This guideline has been developed using strict validated methodologies for assuring the best available evidence on the efficacy of the interventions considered and the most appropriate recommendations based on a structured consensus process, including a panel of experts and representatives from key stakeholders.

Practical implications

The application of this S3 Level Clinical Practice Guideline will allow a homogeneous and evidence-based approach to the management of stages I-III periodontitis.

Conflicts of Interest Declarations

Supplied as a separate document for the purposes of blind review see Supplementary material.

CRediT authorship contribution statement

All authors contributed to development of the guideline. All authors contributed to the development of the manuscript, approved the final

version for submission and agreed to be accountable for the work.

Declaration of Competing Interest and Funding

Individual potential conflict of interest forms were completed by all participants and are available on file at the British Society of Periodontology and Implant Dentistry. In addition, potential conflict of interest information of the Chairs of the workshop is listed here (in alphabetical order):

Professor Chapple, Iain (Chair) reports personal fees from Procter & Gamble; grants from GSK and Unilever, outside the submitted work. In addition, Professor Chapple has filed 13 patents on saliva diagnostics issued and his wife runs Oral Health Innovations that has the license for PreViser and DEPPA risk assessment software in the UK. Prof Chapple has served as Delivering Better Oral Health guideline, Public Health England, Working group member for the 4th edition in development. Prof Chapple was also a project board member of the OCDOs "Transition to a Better Future" paper for NHSE/I and author of section 3.0 of this document.

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Professor Needleman, Ian (Chair) reports grants from GSK, grants and personal fees from Procter & Gamble/Oral-B, personal fees from Sunstar Corporation, grants from Colgate, outside the submitted work; and Scientific, research and clinical practice interest in non- surgical (+/- antimicrobials) and surgical periodontal therapy including regenerative and resective therapy. In addition, Professor Needleman is the Cochrane Oral Health, Editor. Delivering Better Oral Health guideline, Public Health England, Working group member published 3rd edition and for 4th edition in development. Part of SDCEP periodontal health guideline development group.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jdent.2020.103562.

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