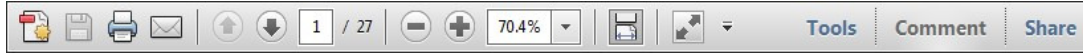
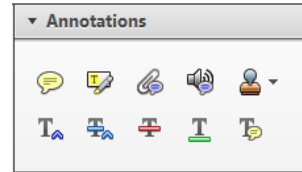


Once you have Acrobat Reader open on your computer, click on the [Comment](#) tab at the right of the toolbar:



This will open up a panel down the right side of the document. The majority of tools you will use for annotating your proof will be in the [Annotations](#) section, pictured opposite. We've picked out some of these tools below:



1. [Replace \(Ins\)](#) Tool – for replacing text.

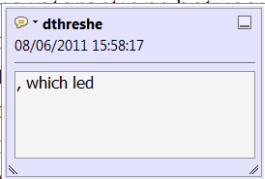


Strikes a line through text and opens up a text box where replacement text can be entered.

How to use it

- Highlight a word or sentence.
- Click on the [Replace \(Ins\)](#) icon in the Annotations section.
- Type the replacement text into the blue box that appears.

standard framework for the analysis of microeconomic activity. Nevertheless, it also led to the development of a new paradigm of strategic behavior. The number of competitors in the industry is that the structure of the industry is a main component. At the industry level, are externalities important? (Mankiw henceforth) we open the 'black b



2. [Strikethrough \(Del\)](#) Tool – for deleting text.



Strikes a red line through text that is to be deleted.

How to use it

- Highlight a word or sentence.
- Click on the [Strikethrough \(Del\)](#) icon in the Annotations section.

there is no room for extra profits as mark-ups are zero and the number of firms (net) values are not determined by market clearing. Blanchard ~~and Kiyotaki~~ (1987), perfect competition in general equilibrium. The effects of aggregate demand and supply shocks in a classical framework assuming monopolistic competition. An exogenous number of firms

3. [Add note to text](#) Tool – for highlighting a section to be changed to bold or italic.



Highlights text in yellow and opens up a text box where comments can be entered.

How to use it

- Highlight the relevant section of text.
- Click on the [Add note to text](#) icon in the Annotations section.
- Type instruction on what should be changed regarding the text into the yellow box that appears.

dynamic responses of mark-ups consistent with the VAR evidence

satisfies the standard framework. The number of competitors and the impact is that the structure of the sector



4. [Add sticky note](#) Tool – for making notes at specific points in the text.

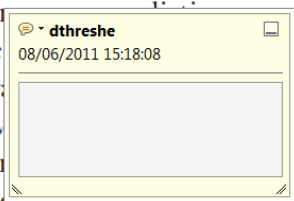


Marks a point in the proof where a comment needs to be highlighted.

How to use it

- Click on the [Add sticky note](#) icon in the Annotations section.
- Click at the point in the proof where the comment should be inserted.
- Type the comment into the yellow box that appears.

and supply shocks. Most of the standard framework. The number of competitors and the impact is that the structure of the sector



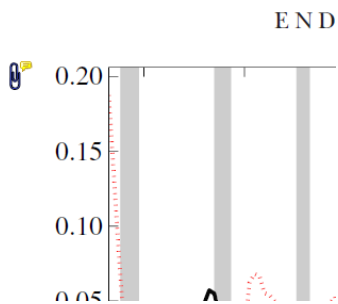
5. **Attach File** Tool – for inserting large amounts of text or replacement figures.



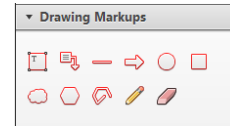
Inserts an icon linking to the attached file in the appropriate place in the text.

How to use it

- Click on the **Attach File** icon in the Annotations section.
- Click on the proof to where you'd like the attached file to be linked.
- Select the file to be attached from your computer or network.
- Select the colour and type of icon that will appear in the proof. Click OK.

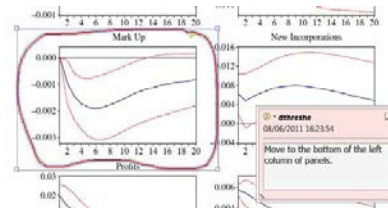


6. **Drawing Markups** Tools – for drawing shapes, lines and freeform annotations on proofs and commenting on these marks. Allows shapes, lines and freeform annotations to be drawn on proofs and for comment to be made on these marks.



How to use it

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- Double click on the shape and type any text in the red box that appears.



Effect of professional mechanical plaque removal on secondary prevention of periodontitis and the complications of gingival and periodontal preventive measures

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Sanz M. Effect of professional mechanical plaque removal on secondary prevention of periodontitis and the complications of gingival and periodontal preventive measures. J Clin Periodontol 2015; doi: 10.1111/jcpe.12367.

Abstract

Aim: The scope of this working group was to review: (1) the effect of professional mechanical plaque removal (PMPR) on secondary prevention of periodontitis; (2) the occurrence of gingival recessions and non-carious cervical lesions (NCCL) secondary to traumatic tooth brushing; (3) the management of hypersensitivity, through professionally and self administered agents and (4) the management of oral malodour, through mechanical and/or chemical agents.

Results: Patients undergoing supportive periodontal therapy including PMPR showed mean tooth loss rates of 0.15 ± 0.14 teeth/year for 5-year follow-up and 0.09 ± 0.08 teeth/year (corresponding to a mean number of teeth lost ranging between 1.1 and 1.3) for 12–14 year follow-up. There is no direct evidence to confirm tooth brushing as the sole factor causing gingival recession or NCCLs. Similarly, there is no conclusive evidence from intervention studies regarding the impact of manual versus powered toothbrushes on development of gingival recession or NCCLs, or on the treatment of gingival recessions. Local and patient-related factors can be highly relevant in the development and progression of these lesions. Two modes of action are used in the treatment of dentine hypersensitivity: dentine tubule occlusion and/or modification or blocking of pulpal nerve response. Dentifrices containing arginine, calcium sodium phosphosilicate, stannous fluoride and strontium have shown an effect on pain reduction. Similarly, professionally applied prophylaxis pastes containing arginine and calcium sodium phosphosilicate have shown efficacy. There is currently evidence from short-term studies that tongue cleaning has an effect in reducing intra-oral halitosis caused by tongue coating. Similarly, mouthrinses and dentifrices with active ingredients

Key words: dentine hypersensitivity; intra-oral halitosis; non-carious cervical lesion; oral malodour; professional plaque removal; supportive periodontal therapy; traumatic tooth brushing

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Conflict of interest and source of funding statement

Funds for this workshop were provided by the European Federation of Periodontology in part through unrestricted educational grants from Johnson & Johnson and Procter & Gamble. Workshop participants filed detailed disclosure of potential conflict of interest relevant to the workshop topics and these are kept on file. Declared potential dual commitments included having received research funding, consultant fees and speakers fee from: Colgate-Palmolive, Procter & Gamble, Johnson & Johnson, Sunstar, Unilever, Philips, Dentaïd, Ivoclar-Vivadent, Heraeus-Kulzer, Straumann. On Behalf of Working Group 4 authors are present in Appendix.

based on Chlorhexidine, Cetylpyridinium chloride and Zinc combinations have a significant beneficial effect.

The objective of this consensus report was to evaluate: (1) the effect of professional mechanical plaque removal (PMPR) on secondary prevention of periodontitis; (2) the occurrence of gingival recessions and non-carious cervical lesions (NCCL) secondary to traumatic tooth brushing; (3) the management of hypersensitivity, through professionally and self administered agents and (4) the management of oral malodour, through mechanical and/or chemical agents.

Effect of professional mechanical plaque removal (PMPR) on secondary prevention of periodontitis

Secondary prevention of periodontitis aims at preventing disease recurrence in patients previously treated for periodontitis. *Disease recurrence* relates to disease progression in a patient previously successfully treated for periodontitis. *Disease progression* is defined as the continuation of significant attachment and/or bone loss, clinically detectable by probing and/or radiographic assessment, eventually leading to tooth loss.

The optimal endpoints of active periodontal therapy (APT) in the management of periodontitis are the reduction of signs of inflammation, as defined by full mouth bleeding on probing scores ($\leq 15\%$), the elimination of deep pockets ($PD \geq 5$ mm) and the absence of signs of active infection as defined by the presence of suppuration. Whenever possible these endpoints should be reached before the patient starts supportive periodontal therapy (SPT) in order to optimize secondary prevention of periodontitis. It is, however, recognized that not all patients will achieve these endpoints, but indeed they will still benefit from SPT.

Professional mechanical plaque removal in the context of secondary prevention of periodontitis (PMPR+) is the routine professional mechanical removal of supragingival plaque and calculus with sub-gingival debridement to the depth of the sulcus/pocket. This is part of SPT, which

should also include the evaluation of oral hygiene performance, motivation and re-instruction in oral hygiene practices and, when appropriate, smoking cessation, control of co-morbidities and promotion of healthy lifestyles. As part of this intervention, a periodontal examination must be conducted with the aim of early detection of deepening pockets ($PD \geq 5$ mm), which should undergo active periodontal therapy.

Rate of tooth loss in the long-term management of periodontitis

Studies included in the systematic review (Farina et al. 2015) reported no to low incidence of tooth loss during follow-up (3 years or more). The weighted mean tooth loss rate for studies with a 5-year follow-up was 0.15 ± 0.14 teeth/year. For studies with a longer follow-up, the weighted mean tooth loss rate was 0.09 ± 0.08 teeth/year, corresponding to a mean number of teeth lost ranging between 1.1 and 1.3 over a 12–14 year period. Moreover, data derived from a systematic review (Chambrone et al. 2010) demonstrated that more than half of the patients did not lose teeth and only a minority were responsible for the majority of teeth lost during SPT.

Optimal frequency of SPT in the long-term management of periodontitis

The great majority of studies in this systematic review (Farina et al. 2015) reported a frequency of SPT of 2–4 times per year, however, there were no prospective studies addressing the selection of a specific treatment interval or the customization of this interval based on the patient risk profile. There are indications from retrospective observational studies that the frequency of recall visits based on the patient risk profile may optimize long-term tooth retention.

Importance of compliance with preventive professional intervention

Patients irregularly complying with the planned SPT regimen, including

PMPR+, have shown greater rates of tooth loss and disease progression when compared to regularly complying patients over a 5-year follow-up period (Costa et al. 2014). Data derived from retrospective observational studies support these observations.

Importance of self-performed plaque control in the efficacy of secondary prevention of periodontitis

The importance of self-performed plaque control cannot be properly inferred from the systematic review (Farina et al. 2015) since, in the majority of the studies, patient motivation and instruction in oral hygiene practices were combined with SPT. However, a substantial periodontal deterioration was observed in patients enrolled in a maintenance regimen based solely upon self-performed plaque control without SPT.

Influence of patient susceptibility in the efficacy of secondary prevention of periodontitis

Based on one prospective observational study (Rosling et al. 2001), where the frequency of recall visits was tailored to patient treatment needs, a significantly increased incidence of tooth loss and amount of attachment loss were observed for patients highly susceptible to periodontitis.

Recommendations

The available evidence and expert opinion led the working group to make the following recommendations:

- After effective active periodontal therapy (APT) patients should follow a specific supportive periodontal therapy (SPT) regimen, including PMPR+, based on 2–4 sessions per year. However, the frequency of SPT sessions should be tailored to a patient's risk
- Since the level of compliance is unpredictable in the long-term, specific measures should be adopted/implemented to improve

the level of patient adherence to the maintenance regimen in order to enhance the effectiveness of the intervention

- Patient motivation and instruction in oral hygiene practises should be combined with PMPR

Recommendations for future research

Further research is necessary to evaluate the impact of PMPR on the long-term secondary prevention of periodontitis. Areas of further research should include:

- Studies aimed to further assess the efficacy of PMPR, including evaluation of methods and instruments/devices for supragingival/subgingival periodontal debridement, as well as the frequency of sessions
- Development of reliable outcome measurements to assess the progression of periodontitis once APT has been completed

The design of RCTs to assess secondary prevention of periodontitis should include:

- Allowance for a potentially large incidence of dropouts up to >30%
- Assessment of patient compliance
- Studies of the potential impact of residual site-specific periodontal conditions (i.e., CAL, PD, BoP at completion of APT) on the long-term efficacy of routine PMPR protocols
- Adequate reporting of the intervention
- Documentation of the need for additional APT due to periodontitis progression during SPT
- Documentation of patient reported outcomes, including adverse events and complications, pain and discomfort, gingival recession, dentin hypersensitivity, aesthetic impairment
- Provision of data on the cost-effectiveness of the intervention

Evidence for the occurrence of gingival recession and non-carious cervical lesions as a consequence of traumatic tooth brushing

Traumatic tooth brushing is any form of toothbrush use that results in damage to the periodontal or dental

tissues. *Gingival recession* is the apical migration of the gingival margin below the cemento-enamel junction exposing the root surface. A *non-carious cervical lesion (NCCL)* is a loss of hard tissue from the cervical region of a tooth that is not related to caries.

Evidence that tooth brushing causes gingival recession or NCCLs

It is difficult to assess the natural history of gingival recession or NCCLs, for which best evidence suggests a multi-factorial aetiology. There is currently no direct evidence to confirm tooth brushing as the sole factor causing gingival recession or NCCLs, though it is recognised that this may occur, since the observation that tooth brushing has contributed to the development of gingival recession or NCCLs is usually made after the diagnosis.

Evidence regarding the importance of powered versus manual brushes in relation to gingival recession or NCCLs

There are no epidemiological studies that have evaluated whether there are differences between users of manual versus powered toothbrushes in relation to the development or progression of gingival recession or NCCLs. There is evidence from studies of patients with pre-existing gingival recession that users of powered toothbrushes experience greater reductions in gingival recession than users of manual toothbrushes, but the magnitude of the difference after 1 year (approximately 0.2 mm) is of minimal/no clinical relevance. There is currently no evidence from intervention studies regarding the impact of manual versus powered toothbrushes on the development or progression of NCCLs.

Evidence on the importance of tooth brushing techniques, frequency and properties of the toothbrush on gingival recession

Observational studies have associated non-complex brushing techniques (such as horizontal scrub) and increased brushing force with the development and progression of gingival recession. Increased frequencies of tooth brushing and increased bristle hardness have also been associated with gingival recession. It is acknowledged that

tooth brushing routinely involves the use of dentifrices; however, the specific effects of dentifrice were not addressed as part of this review.

Evidence regarding the importance of tooth brushing technique, frequency and properties of the toothbrush on NCCLs

While there is evidence that specific tooth brushing techniques, increased tooth brushing frequency and increased bristle hardness have been associated with development of NCCLs, the data from individual studies are conflicting, which prevents reaching clear conclusions.

Importance of local and patient-related factors on gingival recession

Local and patient-related factors can be highly relevant in the development and progression of gingival recession associated with tooth brushing, though this was not addressed specifically in the systematic review (Heasman & Preshaw 2015). Local factors can include gingival biotype, dimensions of gingiva, presence of anatomical factors such as bone dehiscence, tooth-related factors such as crowding or displacement from the arch (e.g. as a result of natural development or orthodontic treatment), presence of restorations extending close to or below the gingival margin, and dental appliances. Local factors may also promote plaque accumulation, which may increase the risk for an inflammatory aetiology of gingival recession. Patient-related factors can include compliance with oral hygiene instructions, ability to use oral hygiene products, and deleterious habits.

Importance of local and patient-related factors on NCCLs

Local and patient-related factors can be highly relevant in the development and progression of NCCLs associated with tooth brushing, though this was not addressed specifically in the systematic review (Heasman & Preshaw 2015). Local factors can include tooth-related factors such as crowding or displacement from the arch, abrasion (e.g. highly abrasive dentifrice) and gingival recession. Patient-related factors include erosion (e.g. associated with diet, frequent intake of acidic soft drinks, gastric reflux,

and environmental factors). It has also been postulated that bruxism may contribute to the development of NCCLs through abfraction, though research evidence is very limited in this regard.

Recommendations

The available evidence and expert opinion led the working group to make the following conclusions and recommendations:

- Gingival recession can result in compromised aesthetics, dentine hypersensitivity, plaque accumulation and development of caries and/or NCCLs, endodontic complications, gingival inflammation and periodontal attachment loss
- NCCLs can result in compromised aesthetics, dentine hypersensitivity, plaque accumulation and subsequent gingival inflammation, development of caries, endodontic complications and increased risk of tooth fracture
- It is recommended to instruct and motivate patients in the performance of appropriate tooth brushing techniques, tooth brushing frequency and toothbrush design, which should be tailored to accommodate local and patient-related factors

Recommendations for future research

Research is necessary to evaluate the impact of tooth brushing on gingival and dental tissues including:

- Studies to improve our understanding of the aetiology and the pathogenic factors that lead to the development of gingival recession and NCCLs
- Studies to evaluate the impact of tooth brushing factors (e.g. technique, frequency of use, bristle hardness, type of brush – powered *versus* manual)
- Studies to evaluate the impact of interventions aimed at preventing the development and progression of gingival recession and NCCLs

Management of hypersensitivity: Efficacy of professionally and self administered agents

Dentine hypersensitivity is defined as the short, sharp pain arising from

exposed dentine in response to stimuli, typically thermal, evaporative, tactile, osmotic and chemical, which cannot be ascribed to any other form of dental defect or pathology (Holland et al. 1997). In the aetiology and pathogenesis of dentine hypersensitivity, the dentine surface needs to be exposed, together with the presence of opened dentinal tubules, which are patent from the dentine surface to the pulp. The widely accepted hydrodynamic theory of dentine hypersensitivity is based on the concept that stimulus-induced fluid flow in the open dentinal tubules occurs with consequent activation of nociceptors in the pulp/dentine border area.

Dentine hypersensitivity is associated with gingival recession, traumatic tooth brushing and/or frequent acidic dietary challenge to the hard tissue. It may also occur as a consequence of root instrumentation.

Dentine hypersensitivity is diagnosed by a history of repeated, short, sharp pain, usually involving more than one tooth associated with various every day activities. Its clinical characteristics include:

- Dentine usually being visible at the cervical margin of a vital, non-carious tooth
- Short, sharp pain experienced on at least one stimulus (tactile/airblast/thermal)

Clinicians should make a differential diagnosis in order to exclude conditions such as:

- Pulpal response to caries and to restorative treatment
- Trauma including chipped teeth and fractured restorations with exposed dentine
- Teeth in traumatic occlusion due to orthodontics, restorations or periodontal disease
- Cracked tooth syndrome, often in heavily restored teeth
- Palato-gingival groove and/or enamel invaginations
- Inadequate restorations leading to nano-leakage
- Vital bleaching
- Nocebo effect (adverse effect)

Two modes of action are commonly applied in the treatment of dentine hypersensitivity: (1) dentine tubule occlusion with resistance to

removal by acidic challenges; (2) modification or blocking of pulpal nerve response.

Evidence for efficacy in pain reduction with currently available self applied agents

Dentifrices with active agents that have shown an effect on pain reduction are: arginine, calcium sodium phosphosilicate, stannous fluoride and strontium. There are, however, other available self-applied agents with minimal evidence of effectiveness (West 2015).

Evidence for efficacy in pain reduction for currently available professionally administered agents

Professionally applied products are effective in the treatment of dentine hypersensitivity however, there is insufficient evidence that one specific agent is superior to another (West 2015).

Recommendations

The available evidence and expert opinion led the working group to make the following recommendations:

- Before implementing any specific treatment, the oral healthcare professional should first confirm the diagnosis of dentine hypersensitivity

Following this, the potential aetiological factors should be addressed:

- Recording a diet and medical history to assess frequency of exposure to acid. Appropriate advice should be given and referral may be required
- Appropriate instruction in self-performed plaque control, including techniques, frequency and timing (avoid brushing straight after an acidic challenge)
- Avoid factors contributing to gingival recession (such as traumatic tooth brushing)

The second step should be the management of the dentine hypersensitivity and depending on its severity:

- Use of self applied agents with proven efficacy
- Use of professionally applied agents with proven efficacy

- When appropriate the treatment of gingival recession by root coverage surgical procedures

Recommendations for future research

Further research is necessary to evaluate dentine hypersensitivity and its management and should include studies focused on:

- A better understanding of its aetiology and physiopathological mechanisms
- Development of novel formulations and professional applications, particularly for severe dentine hypersensitivity, with superior evidence of pain reduction, which should be evaluated in RCTs
- Improved assessment methods and agreement on standard stimuli

The design for RCTs evaluating efficacy in the treatment of dentine hypersensitivity should include:

- Parallel or split mouth design when possible
- Use of two stimuli to provoke pain and two assessment criteria
- Assessment of patient reported outcomes including aspects of quality of life with validated methodologies
- Use of negative and positive control

Management of oral malodour: efficacy of mechanical and/or chemical agents

Halitosis is defined as having an offensive breath odour independently of its origin. *Intra-oral halitosis* is identical to oral malodour and describes cases where the source of halitosis lies within the mouth (e.g. tongue coating, gingivitis, periodontitis). *Extra-oral halitosis*, where the source of halitosis lies outside the mouth, is further subdivided into blood-borne and non-blood-borne halitosis (Seeman et al. 2014). *Pseudo halitosis and halitophobia* are used to describe patients who think or persist in believing they have halitosis, even after professional assessment and a diagnosis that they do not have halitosis. *Temporary, or transient halitosis* is caused by dietary factors such as garlic. *Morning bad breath*, an intra-oral halitosis upon awaking, is also transient.

The aetiology of intra-oral halitosis is primarily tongue coating and to a lesser extent gingivitis/periodontitis or a combination of these two. Other factors can contribute to intra-oral halitosis such as: xerostomia, candida infections, medication and overhanging restorations or caries. It is the result of the degradation of organic substrates by primarily anaerobic bacteria of the oral cavity. Morning bad breath is caused by the decrease in saliva production during the night (no natural cleaning mechanism). Extra-oral halitosis originates from pathologic conditions outside the mouth such as nasal, paranasal and laryngeal regions, lungs or upper digestive tract (non-blood-borne extra-oral halitosis). In the case of a blood-borne extra-oral halitosis the malodour is emitted via the lungs and originates from disorders anywhere in the body (e.g. hepatic cirrhosis).

Effectiveness of dentifrices, mouthwashes, tongue cleaning and combinations in the management of intra-oral halitosis

Based on the current available evidence, including the systematic review for this workshop (Slot et al. 2015), it can be stated that:

- Tongue cleaning has an effect in reducing intra-oral halitosis caused by tongue coating based on short-term studies
- Mouthrinses and dentifrices with active ingredients have a significantly beneficial effect. This systematic review showed a significant effect by the use of active ingredients based on Chlorhexidine, Cetylpyridinium chloride and Zinc combinations (CHX + CPC + Zn and ZnCl + CPC)

Recommendations

The available evidence and expert opinion led the working group to make the following conclusions and recommendations:

- Oral healthcare professionals (within the limitation of the respective professional legal authorities) should be aware of the fundamentals of halitosis and they have the primary responsibility for its diagnosis and management. Only a limited number of patients with

extra-oral halitosis and halitophobia (<10% together) will need to be referred to an appropriate health professional

- Diagnosis should include a proper medical history questionnaire, periodontal examination and inspection of the coating of the tongue and an organoleptic description

Once the diagnosis of intra-oral halitosis has been confirmed, the oral healthcare professional should when appropriate:

- Provide personalized advice on halitosis
- Optimize patient oral hygiene practices including tooth brushing and interdental cleaning
- Instruct and motivate in the use of a tongue cleaning device when tongue coating is present
- Provide periodontal therapy
- Recommend the use of chemical agents with proven efficacy

Recommendations for oral halitosis research

Further research is necessary to evaluate halitosis and its management. It should include studies focused on:

- A better understanding of its aetiology and pathogenesis
- The development of adequate diagnostic methods, such as organoleptic tests, self-diagnostic tests, microbiological analyses and measurements of volatile compounds.
- The development of new treatment strategies, such as the use of pre/probiotics

Ideally studies should be conducted in participants with natural intra-oral halitosis with a minimum organoleptic score of 2 (scale 0–5; Rosenberg et al. 1991). When tongue cleaning is evaluated the participants should have a certain level of tongue coating. Preferably studies should have a double blind randomized placebo controlled design. Efficacy can be tested in short-term studies but needs to be confirmed in long-term studies. The most reproducible moment to test intra-oral halitosis is during the morning. Moreover the measurement should always be performed under the same conditions (instructions of lifestyle rules). Organoleptic scores (scale 0–5 by Rosenberg

et al. 1991) should be used and preferably supported by volatile sulphur compounds (VSC) measurements. However, there is a need to standardize of the procedures of the organoleptic evaluation procedures.

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Clinical Relevance

Secondary prevention of periodontitis aims at preventing disease recurrence in patients previously treated for periodontitis. This is accomplished by routine *professional mechanical plaque removal* as part of supportive periodontal therapy, resulting in a minimal incidence of tooth loss. Although there is no direct evidence to confirm tooth brushing as

the sole factor causing gingival recession or NCCLs, effective measures should be implemented to prevent traumatic tooth brushing. There is evidence for efficacy for both self and professionally applied agents in the treatment of dentin hypersensitivity. There is evidence for efficacy for mouthrinses and dentifrices with active ingredients in the management of oral malodour.

Conclusions: The consensus developed a series of recommendations based on scientific evidence and expert opinion of group participants. The oral health care team and public health officials should implement these at the population and individual level.

Appendix

Bäumer, Amelie (D); Budunelli, Nurcan (TR); Dommisch, Henrik (D); Farina, Roberto (I); Kononen Eija (FI); Linden

Gerard (UK); Meyle Joerg (D); Preshaw, Philip (UK); Quirynen, Marc (B); Roldan, Silvia (E); Sanchez, Nerea (E); Sculean, Anton (CH); Slot Dagmar

Else (NL); Trombelli Leo (I); West, Nicola (UK); Winkel, Edwin (NL).
Industry Representatives: Rist, Anja Carina (CH); Mantzourani, Maria (UK).













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