

Primary prevention of periodontitis: managing gingivitis

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Abstract Periodontitis is a ubiquitous and irreversible inflammatory condition and represents a significant public health burden. Severe periodontitis affects over 11% of adults, is a major cause of tooth loss impacting negatively upon speech, nutrition, quality of life and self-esteem, and has systemic inflammatory consequences. Periodontitis is preventable and treatment leads to reduced rates of tooth loss and improved quality of life. However, successful treatment necessitates behaviour change in patients to address lifestyle risk factors (e.g. smoking) and, most importantly, to attain and sustain high standards of daily plaque removal, lifelong. While mechanical plaque removal remains the bedrock of successful periodontal disease management, in high-risk patients it appears that the critical threshold for plaque accumulation to trigger periodontitis is low, and such patients may benefit from adjunctive agents for primary prevention of periodontitis.

Aim: The aims of this working group were to systematically review the evidence for primary prevention of periodontitis by preventing gingivitis via four approaches: 1) the efficacy of mechanical self-administered plaque control regimes; 2) the efficacy of self-administered inter-dental mechanical plaque control; 3) the efficacy of adjunctive chemical plaque control; and 4) anti-inflammatory (sole or adjunctive) approaches.

Methods: Two meta-reviews (mechanical plaque removal) and two traditional systematic reviews (chemical plaque control/anti-inflammatory agents) formed the basis of this consensus.

Results: Data support the belief that professionally administered plaque control significantly improves gingival inflammation and lowers plaque scores, with some evidence that reinforcement of oral hygiene provides further benefit. Re-chargeable power toothbrushes provide small but statistically significant additional reductions in gingival inflammation and plaque levels. Flossing cannot be recommended other than for sites of gingival and periodontal health, where inter-dental brushes (IDBs) will not pass through the interproximal area without trauma. Otherwise, IDBs are the device of choice for interproximal plaque removal. Use of local or systemic anti-inflammatory agents in the management of gingivitis has no robust evidence base. We support the almost universal recommendations that all people should brush their teeth twice a day for at least 2 min.

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with fluoridated dentifrice. Expert opinion is that for periodontitis patients 2 min. is likely to be insufficient, especially when considering the need for additional use of inter-dental cleaning devices. In patients with gingivitis once daily inter-dental cleaning is recommended and the adjunctive use of chemical plaque control agents offers advantages in this group.



Periodontitis is a ubiquitous disease affecting over 50% of the world's adult population, and increases further with age (Petersen & Ogawa 2012). Severe periodontitis is the sixth most prevalent human disease, according to the 2010 global burden of diseases study, with a standardized prevalence of 11.2% (Kassebaum et al. 2014) and is a major cause of tooth loss. It has a negative impact upon oral health quality of life, speech, nutrition, confidence, and overall well-being and is independently associated with several systemic chronic inflammatory diseases. Severe periodontitis, therefore, represents a significant public health concern.

Gingivitis and periodontitis are a continuum of the same inflammatory disease (Kinane & Attström 2005)

and while not all patients with gingivitis will progress to periodontitis, management of gingivitis is both a primary prevention strategy for periodontitis and a secondary prevention strategy for recurrent periodontitis. The development of periodontitis is in part governed by genetic predisposition, and is also significantly dependent on lifestyle factors including smoking, type 2 diabetes, nutrition, and psychological stress. However, the most important risk factor for periodontitis is the accumulation of a plaque biofilm at and below the gingival margin, within which dysbiosis develops and is associated with an inappropriate and destructive host inflammatory immune response. Plaque removal and/or control is therefore fundamentally important in the prevention of periodontal diseases.

There is a need to systematically appraise the literature concerning mechanical and chemical methods of controlling the plaque biofilm with a view to reducing gingival inflammation as a primary endpoint. This report represents the consensus views of Working Group 2 of the 11th European Workshop in Periodontology on the primary prevention of periodontitis. The report is substantially, but not entirely based on four systematic analyses of the available and published evidence relating to mechanical and chemical methods of controlling gingival inflammation in patients with and without a history of periodontitis; it does not relate to patients with current periodontitis. Two of the underpinning papers (mechanical plaque removal) adopted a meta-review approach, whereby a systematic appraisal of existing

systematic reviews was undertaken rather than a repetition of existing systematic reviews, which would have added little to the current evidence base. The remaining two reviews (chemical plaque control and anti-inflammatory agents) adopted a traditional systematic review approach and thus differences exist in the granularity of the respective analyses. Therefore, formulation of the consensus appraisal of the meta-reviews was supplemented by re-visiting the original systematic reviews and underpinning individual articles where necessary, in order to provide additional detail for the recommendations made.

Changes in the primary outcome (gingival inflammation) were assessed as either secondary to reductions in plaque levels or directly due to anti-inflammatory properties of the active agent. The term “gingival inflammation” has been employed to avoid confusion with the clinical condition of “gingivitis”, since some analyses included the effects of anti-plaque/inflammatory agents upon inflammation at sites of effectively treated but now unstable periodontal inflammation. No studies, however, directly aimed to assess the impact of interventions on untreated periodontitis.

In the context of this consensus report the terms “efficacy” and “effectiveness” are based on the definition presented by the European Medicines Agency (Eichler 2010): efficacy is the extent to which an intervention does more good than harm under ideal circumstances; effectiveness is the extent to which an intervention does more good than harm when provided under the usual circumstances of health care practice.

The group recognized that the majority of the studies that underpinned the meta-analyses were commercially funded, and while this may impact upon the analysis of bias there is a paucity of investigator-initiated studies. Moreover, the commercially funded studies applied internationally agreed models and standards of study design, analysis, and reporting and were therefore deemed important to accommodate in the systematic review. None of the meta-analyses addressed patient-centred outcomes.

What is the Safety and Efficacy of Available Self-administered Tooth Brushing Regimes for Mechanical Plaque Removal on Plaque and Gingivitis in Adults?

Does the provision of professional oral hygiene instruction confer anti-gingivitis benefits and what are the caveats?

Six-month longitudinal studies ($n = 4$) demonstrate that a single episode of professional oral hygiene instruction leads to a small but statistically significant reduction in plaque and gingivitis (6% reduction in bleeding scores). There are, however, no systematic reviews that have analysed the efficacy of professional oral hygiene instruction compared to a “no oral hygiene instruction” (negative) control, in relation to changes in plaque and gingival indices. There is evidence to suggest that additional effects result from reinforcement of oral hygiene instruction.

How effective is manual brushing at reducing gingival inflammation and plaque and what design features impact upon their efficacy?

A single exercise of manual tooth brushing leads to reduction in plaque scores of approximately 42% (weighted mean; index-specific range 30–53%) from pre-brushing scores. While there are no data derived from meta-analyses on the impact of manual tooth brushing upon gingival inflammation, there is evidence from individual studies that conscientious manual brushing does reduce gingival inflammation. There appears to be a need for an effect estimate based on a systematic appraisal of the existing scientific evidence concerning manual toothbrushes in relation to managing gingivitis.

Reductions in plaque scores from baseline are reported as 24–47% for flat-trim bristle designs, 33–54% for multi-level bristles, and 39–61% for criss-cross designs. However, the meta-analyses did not report on inter-design differences in effectiveness in order to permit statements to be made concerning superiority of one design over another.

There are no meta-analyses exploring the impact of toothbrush design upon gingival inflammation.

What is the efficacy of power brushing in reducing gingival inflammation and plaque and what design features affect the efficacy of power brushes?

Power brushing is associated with 46% reductions in plaque scores (index-specific range 35–76%) following a single exercise of tooth brushing. Greater reductions in plaque scores are achieved with re-chargeable power brushes than for brushes with replaceable batteries, where index-specific plaque score reductions of 71% (Navy)/38% (Quigley & Hein 1962) and 61% (Navy)/33% (Quigley & Hein 1962), respectively, are reported.

Short-term data (1–3 months) support greater plaque reductions for oscillating-rotating power toothbrushes than for those employing a side-to-side action. However, differences were small and their clinical importance was unclear. The diversity of power brush designs does not permit inferences to be made about direct comparisons of individual designs and brands.

Is power brushing more effective than manual brushing (according to brushing models and home use studies) at reducing gingival inflammation and plaque levels?

In controlled studies, power toothbrushes produce statistically significantly greater short-term (28 days to 3 months; 11%) and long-term (≥ 3 months; 21%) reductions in plaque indices compared to manual brushes. The same findings are observed for reductions in gingival inflammation (6% – short-term; 11% – long-term studies). The benefits of these outcomes for long-term dental health are unclear. Importantly, in most studies the time allocated for power and manual tooth brushing was identical.

What risks are associated with the use of toothbrushes as a primary means of controlling plaque and gingival inflammation?

There are no data to support or refute an association between manual or power tooth brushing and gingival recession. Six-month studies demonstrate that in terms of gingival recession, oscillating-rotating power brushes show equivalent safety to manual brushes. The meta-analysis did not identify longer term studies

that assess the impact of tooth brushing on recession.

What is the Effect of Mechanical Inter-dental Plaque Removal in Addition to Tooth Brushing on Managing Gingivitis using Various Inter-dental Self-care Formats?

Does daily interproximal cleaning in addition to tooth brushing reduce gingival inflammation and does it also reduce interproximal plaque levels compared to tooth brushing alone?

Interproximal cleaning is essential in order to maintain interproximal gingival health, in particular for secondary prevention and may be achieved using different devices, including inter-dental brushes (IDB, which are not single-tufted brushes), floss, wood sticks, and oral irrigators.

There is moderate evidence to suggest that the adjunctive use of IDB's provides higher levels of plaque removal than manual tooth brushing alone. Other interproximal cleaning devices show very inconsistent/weak evidence for an adjunctive effect, either due to a lack of efficacy (flossing) or a lack of evidence from appropriate clinical investigations (oral irrigators and wood sticks). There is, however, limited evidence that gingival inflammation is reduced by interproximal cleaning, even when IDB's are employed. The reasons for this discrepancy are unclear, but may relate to limitations in the ability of the gingival indices employed to assess interproximal inflammation, the heterogeneity of outcome measures utilized (plaque *versus* gingival inflammation) or the heterogeneity of study designs.

Is there evidence to support the general recommendation of one inter-dental cleaning method over another?

Evidence suggests that inter-dental cleaning with IDB's is the most effective method for interproximal plaque removal. IDB's were consistently associated with higher levels of plaque removal when compared to flossing and the use of wood sticks. No comparisons are available from meta-analyses evaluating oral irrigators and information pertaining to reductions in gingival inflammation is limited. The superiority of IDB's is related to the higher efficacy in plaque removal and to the high

level of acceptance by patients, who perceive it as their preferred method.

Despite being widely advocated, it is noteworthy that the majority of available studies fail to demonstrate that flossing is generally effective in plaque removal and in reducing gingival inflammation.

Should all individuals perform inter-dental plaque removal at least once daily to prevent the onset of gingival inflammation or manage its resolution?

No RCTs were identified which assessed whether individual sites without attachment loss and no signs of gingival inflammation (healthy sites) would benefit from daily interproximal plaque control.

Strategies designed to manage resolution of inflammation need to incorporate interproximal cleaning tools/methods on a routine basis. While there is currently no optimal method for interproximal cleaning, IDB's should be the first choice. Importantly, interproximal cleaning advice requires professional training irrespective of the devices utilized.

In Humans with Gingivitis, What is the Efficacy of Chemical Plaque Control Formulations Used Adjunctively with Mechanical Plaque Control?

Do chemical anti-plaque agents within mouth rinses and/or dentifrices, used adjunctively with mechanical plaque removal provide additional improvements in gingival inflammation and plaque levels?

When used as an adjunctive therapy to conventional manual tooth brushing with a fluoridated dentifrice, the use of chemical anti-plaque agents in mouth rinses or incorporated into the fluoridated dentifrice, alone or in combination, offers clear and significant improvements in managing gingival inflammation and preventing plaque accumulation. While there was significant heterogeneity in the meta-analysis and significant variations in individual study characteristics, significant publication bias and high risk of bias in some individual studies, the outcomes are consistent. The benefits of this for long-term dental health are unclear and adverse events were not systematically evaluated in the underlying review and meta-analysis

(Serrano et al. 2015). However, the available data suggest minor adverse effects; the most frequently reported being staining. Moreover, a recent systematic review found no evidence for the presumed association between the daily use of chemical mouth rinses and oral cancer (Gandini et al. 2012).

Does the delivery format of the chemical agent employed (dentifrice and/or mouth rinses) impact upon its efficacy in reducing gingival inflammation and plaque levels?

When chemical anti-plaque ingredients were delivered in mouth rinse format, additional to tooth brushing the magnitude of the improvements in gingival inflammation and plaque levels was larger than delivered by dentifrice only. However, the lack of direct comparisons between delivery formats precludes statements of superiority. The selection of the delivery format is dependent on the choice of preferred active agent. Other relevant factors to account for when choosing the delivery format include cost, patient preference, and compliance. The evidence underpinning each of the formulations that are supported by at least one meta-analysis is summarized in Table 5 of the companion systematic review (Serrano et al. 2015).

Should adjunctive chemical anti-plaque agents (dentifrice and/or mouth rinse) be recommended in addition to mechanical oral hygiene measures for routine daily use to manage gingival inflammation and prevent plaque accumulation?

Current evidence shows that the use of anti-plaque chemical agents delivered in a mouth rinse or dentifrice format, adjunctive to tooth brushing is beneficial. Decisions on recommendation should account for the economic cost and adverse effects (e.g. staining) associated with long-term use of such agents and should also account for country-specific regulations and environmental implications.

Are Anti-inflammatory Agents Effective in Treating Gingivitis as Solo or Adjunct Therapies?

Do topical or systemic anti-inflammatory agents have a role to play in helping to reduce gingival inflammation?

There is only weak evidence that systemically administered non-steroidal

anti-inflammatory drugs (NSAIDs) have a positive effect in reducing the clinical signs of gingival inflammation expressed as bleeding on probing and a variety of gingival indices.

There is no evidence that local NSAID application impacts positively upon gingival inflammation.

One RCT has demonstrated a positive effect of systemic vitamin D intake in reducing gingival inflammation in gingivitis patients.

Clinical Recommendations

Professional 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.

Where improvements in plaque control are required re-chargeable power brushes should be considered.

When gingival inflammation is present, inter-dental cleaning, preferably with IDB's should be professionally taught to patients. Clinicians may suggest other inter-dental cleaning devices/methods when the use of IDB's is not appropriate.

Caution should be exercised in recommending IDBs at healthy sites where attachment loss is not evident and trauma may result. The use of floss may have a role to play only in this situation. Professional instruction is vital for achieving optimal effectiveness and to avoid trauma.

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 an additional action to the mechanical oral hygiene regime (for specific details see table 5 in Serrano et al. 2015).

The use of local or systemic NSAID's for the control of gingival inflammation cannot be recommended at this time due to a lack of sufficient scientific evidence.

Research Recommendations

There is a need for an effect estimate based on a systematic appraisal of the existing scientific evidence for

manual toothbrushes in relation to managing gingivitis.

The effect of toothbrush filament texture and arrangement should be systematically evaluated to determine their relative effect on the reduction of plaque and gingivitis as well as the cause of adverse events.

Investigator-initiated studies that directly compare commercially available power toothbrushes are needed to establish their relative effectiveness.

Long-term (over 12-months) RCTs are needed to evaluate the risk of gingival recession associated with tooth brushing.

RCTs stratified according to the presence or absence of inter-dental attachment loss, are encouraged for IDBs and other inter-dental cleaning devices, accepting the need to ensure the presence of adequate inter-dental space and appropriate brush sizes.

There is a need to use specific indices designed to evaluate the inter-dental zone for plaque and gingival inflammation.

We recommend standardization in the use of plaque and gingival indices for RCTs assessing interproximal plaque and bleeding, by employing the Wolffe plaque index (Wolffe 1976) for open inter-dental spaces, and the Eastman inter-dental bleeding index (Caton & Polson 1985) for open and closed inter-dental spaces. Examiners must be trained and calibrated.

Patient outcome measures should also be assessed, for example, assessment of compliance, manual dexterity, preference and oral health quality of life should also be encouraged.

Research on oral hygiene products should follow accepted guidelines and register the study protocol in a regulated database to help reduce the risk of publication bias.

In future systematic reviews there is a need to identify factors leading to the observed heterogeneity in meta-analyses.

RCTs are required to directly compare delivery formats of active ingredients.

RCT's are needed to evaluate the risks and benefits of systemic and local NSAID's for reduction of gingival inflammation before they can be recommended for clinical use.

Due to the fact that the systemic use of vitamin D for the prevention of gingival inflammation shows promise,

RCT's are needed to validate its efficacy.

Public Health Recommendations

There is a universal recommendation to brush twice daily for at least 2 min. with a fluoridated dentifrice. For periodontitis patients 2 min. is likely to be insufficient.

Daily inter-dental cleaning is strongly recommended to reduce plaque and gingival inflammation.

In patients with gingivitis, the adjunctive use of chemical agents for plaque control offers advantages.

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Clinical Relevance

Background: It is widely reported that mechanical plaque control is the mainstay of primary prevention of gingivitis and managing gingivitis as a primary preventive strategy for periodontitis. However, the exact nature of such regimes and the role of adjunctive chemical and anti-inflammatory agents require systematic evaluation.

Principal findings: The use of mechanical agents for plaque control should be underpinned by professional oral hygiene instruction

and ideally by reinforcement. In controlled studies, power brushes provide small but statistically significantly greater reductions in plaque and gingivitis, and re-chargeable devices reduce plaque levels more than battery operated power brushes. Interproximal cleaning is essential for gingival health and adjunctive use of inter-dental brushes provides higher levels of plaque removal than tooth brushing alone; however, there is a lack of evidence for the efficacy of dental floss for plaque removal or reducing gingivitis. There is evidence

for beneficial effects from adjunctive use of anti-plaque chemical agents in managing gingivitis and preventing plaque accumulation but insufficient evidence to support the use of anti-inflammatory drugs in managing gingival inflammation.

Conclusions: This consensus has developed a series of recommendations for practitioners, patients and public health bodies on self-care regimes for managing gingival inflammation by mechanical and chemical approaches to plaque control.