



# Update on the Roles of Oral Hygiene and Plaque Control on Periodontal Disease

# 17

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## Abstract

**Aim:** to provide an update of the evidence on the effect of oral hygiene instructions (OHI), dental plaque control and in the prevention and treatment of periodontitis.

**Methods:** Literature searches were performed using MeSH terms, keywords and free words and were published between 2015 and November 2020. The data from the articles were summarized in a narrative review.

**Results:** Data concerning the influence of OHI on periodontal features, the impact of OHI before periodontitis non-surgical treatment, its efficacy on periodontitis prevention and maintenance of healthy periodontium were summarized in the tables of the present narrative review.

**Conclusion:** as prevention is better than a cure, it is relevant to bring in light the role of oral hygiene instructions, the patient self-control of dental plaque as well as the professional mechanical plaque removal in the prevention of periodontitis.

## Keywords

Oral hygiene · Plaque control · Oral hygiene instruction · Periodontitis · Prevention

## Abbreviations

BOP	Bleeding on probing BOP
EFPP	European Federation of Periodontology
GH	General health
IDBs	Interdental brushes
MTB	Manual tooth brushing
NCDs	Non-communicable diseases
OH	Oral health
ORCA	European Organization for Caries Research
PNST	Periodontal non-surgical treatment
PTB	Powered tooth brushing
PTB	Powered tooth brushing
SPC	supportive periodontal care (SPC)

## Highlights

- Poor oral hygiene leads to periodontal disease
- Oral hygiene instructions should be considered as the most important part of the periodontal treatment

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- Prevention prevents periodontal disease genesis
- Maintenance and motivation aim to control the progression of periodontal disease
- Powered toothbrush in combination with interdental brushes allow to maintain a healthy periodontium

#### Considerations for Practice

- Oral hygiene instructions (OHI) should be considered as a first part of the periodontal treatment
- The effect of OHI should be evaluated at each time of periodontal treatment
- The prevention of periodontitis recurrence is limited when efficient plaque control is provided by both patient and professional

#### Patient Summary

- A good oral health begins with the control of dental plaque
- The efficient use of oral hygiene devices, explained by professional, prevents periodontal disease
- To avoid recurrence of periodontal disease, the patient should be involved in a maintenance program to evaluate his plaque control and to help him to maintain it
- The prevention of any disease is better than a cure, do not hesitate to ask your dental practitioner for a periodontal screening

## 17.1 Introduction

Oral health (OH) is multifaceted and includes namely, the ability to speak, smile, smell, chew, without pain or discomfort (Tonetti et al. 2013) being also an indicator of overall health, well-being and quality of life (Clark-Perry and Levin 2020). Among the oral health conditions, periodontitis interferes with general health as with specific non-communicable diseases (NCDs), as cardiovascular pathologies and diabetes (Jin et al. 2016; Jin 2013). Periodontitis is defined as a chronic inflammatory disease, characterized by gram negative bacteria organized in a dental bio-film, leading to a chronic non-resolving and destructive inflammatory processes inside the gingiva (Jepsen et al. 2017; Meyle and Chapple 2015). Approximately fifty percent of the adult population suffer from this chronic disease (Eke et al. 2016), and severe periodontitis affects 11.2% of the population (Kassebaum et al. 2014). The disease involves firstly the progressive destruction of the supporting tissues around teeth (Meyle and Chapple 2015; Schenkein 2006; Haffajee and Socransky 1994; Amano 2000a, b), and secondly, due to mastication and tooth brushing, periodontitis induces the dissemination of periodontal pathogens or/and their sub-products (SPs) from the pocket depth to the blood circulation (Forner et al. 2006).

This bacteremia contributes to increase the systemic inflammation and promoting the colonization of periodontal bacteria on an extra-oral site (Van Dyke et al. 2020; Loos 2005; Graziani et al. 2018a; Szulc et al. 2015; Tonetti et al. 2013; Mealey 1999; van Winkelhoff and Slots 1999) both implicated in the relationship between periodontitis and chronic NCDs (Graziani et al. 2018a; Sanz et al. 2018; Tonetti et al. 2013; Salhi et al. 2019, 2020b). In fact, as periodontal bacteria are able to translocate from periodontal niches to distant oral organ, that contribute to a negative impact on general health (GH) (Pasnik-Chwalik and Konopka 2020; Slots

2003; Kumar 2017) (called the focal infection theory (Kumar 2017)), the control of an oral microbiome is required for both periodontal health (Guerra et al. 2018) and GH. As periodontitis is largely preventable, the control of the etiological factor of the disease is needed by the control of dental plaque accumulation towards adequate personal oral hygiene (OHI) and professional care.

Therefore, the aim of this review is to bring in light the updated evidence on the relevance of plaque control in the periodontitis physiopathology, focusing on the genesis, the treatment, the maintenance, and the prevention of the disease.

## 17.2 Methods

This narrative review was focused on recent studies between 2015 and 2020. The literature search was performed on PubMed, and inclusion criteria were systematic reviews, consensus reports and randomized controlled trials assessing oral

hygiene, plaque control, oral hygiene instruction, and periodontitis prevention.

## 17.3 Results

### 17.3.1 Effect of Plaque control on Periodontal Features-Periodontitis Genesis

The effect of plaque control on periodontal features-periodontitis genesis is summarized in Table 17.1.

A recent Cochrane systematic review based on 35 studies (Worthington et al. 2019), concluded that using floss or interdental brushes in addition to toothbrushing reduce gingivitis or plaque, or both, aiming to prevent and control periodontal diseases. The conclusion of the authors was previously described in other systematic review with meta-analysis (Kotsakis et al. 2018; Lertpimonchai et al. 2017), randomized control trial (De David et al. 2018; Graziani

**Table 17.1** The effect of plaque control on periodontal features- periodontitis genesis

Authors	Study design	Conclusion
Worthington et al. (2019)	Systematic review on 35 studies	Using floss or interdental brushes in addition to toothbrushing reduce gingivitis or plaque, or both, more than toothbrushing alone. Interdental brushes reduce gingivitis more than flossing The conclusions were based on evidences characterized as low to very low-certainty, and the effect sizes observed may not be clinically important
Kotsakis et al. (2018)	Meta-analysis on 22 studies	Interdental brushes led to a reduction of 64.7% of GI water-jet led 27.4% of GI
De David et al. (2018)	Controlled study on 52 subjects that received for 30 days OH at 12-, 24- (group 1), or 48-, 72-h (group 2) interval	Oral hygiene frequencies are required to maintain gingival health, observed by plaque formation
Graziani et al. (2018b)	Randomized controlled trial on 60 periodontally healthy patients	Interdental picks were associated with reduced interdental full mouth bleeding score when compared to flossing ( $p < 0.05$ ) Use of interdental brushes or rubber picks reduces more interdental plaque in comparison with toothbrushing alone
Jepsen et al. (2017)	Consensus report	The management gingivitis required Self-performed oral hygiene and interdental cleaning Professional tooth cleaning, oral hygiene instruction and motivation
Lertpimonchai et al. (2017)	Systematic review and meta-analysis on 15 studies reported OH as categorical	OH decreases the risk of periodontitis by two- to five-fold. Regular toothbrushing and dental visits reduced the risk to periodontitis genesis

*IOH* interproximal oral hygiene, *GI* gingival index, *OH* oral hygiene

et al. 2018b) and consensus report (Jepsen et al. 2017). OH decreases the risk of periodontitis genesis by two- to five-fold (Lertpimonchai et al. 2017) and, self-performed oral hygiene and interdental cleaning was required to manage gingivitis (Jepsen et al. 2017). Interdental brush was seen to be more efficacious than the majority of the alternative oral hygiene in gingival index reduction (Worthington et al. 2019; Kotsakis et al. 2018; Richards 2018), plaque reduction (Worthington et al. 2019; Graziani et al. 2018b).

### 17.3.2 Effect of Oral Hygiene Devices on Periodontal Features

The effect of oral hygiene devices on periodontal features is summarized in Table 17.2.

Recent systematic reviews with meta-analysis (Elkerbout et al. 2020; Wang et al. 2020; Clark-Perry and Levin 2020), randomized control trials (RCT) (Starke et al. 2019a, b; Cui et al. 2017; Delaurenti et al. 2017; Schmalz et al. 2017) and consensus (Chapple et al. 2015) described that powered tooth brushing (PTB) reduced significantly dental plaque (Elkerbout et al. 2020; Wang et al. 2020; Starke et al. 2019a, b; Cui et al. 2017; Delaurenti et al. 2017; Schmalz et al. 2017), gingival bleeding (Wang et al. 2020; Starke et al. 2019a, b; Delaurenti et al. 2017; Schmalz et al. 2017) and gingival inflammation (Wang et al. 2020; Starke et al. 2019a, b; Cui et al. 2017; Delaurenti et al. 2017) than manual tooth brushing (MTB). In addition, the use of calibrated interdental brushes reduces significantly interdental bleeding and plaque when used with PTB (Chapple et al. 2015; Bourgeois et al. 2016; Sambunjak et al. 2019).

### 17.3.3 Effect of OH Before Periodontitis Non-surgical Treatment -Periodontitis Treatment

The effect of OH before periodontitis non-surgical treatment -periodontitis treatment is summarized in Table 17.3.

Recent research on controlled trials (Preus et al. 2020; Salhi et al. 2020a) demonstrated that patients who received strict oral hygiene phase prior to periodontitis treatment experienced a significant reduction of plaque, bleeding on probing BOP, and pocket depth.

### 17.3.4 Effect of OH on Periodontitis Prevention and Maintenance of Healthy Periodontium

The effect of OH on periodontitis prevention and maintenance of healthy periodontium is summarized in Table 17.4.

Recent systematic reviews (Slot et al. 2020; Figuero et al. 2017) and consensus report (Müller Campanile et al. 2019) highlighted the efficacy of combined professional and self-performed mechanical plaque removal in the prevention of periodontal diseases. Concerning the periodontal maintenance care, a recent systematic review with meta-analysis (Slot et al. 2020) on the efficacy of mechanical oral hygiene devices showed that the use of the interdental brushes (IDBs) reduced more effectively dental plaque than a manual toothbrush alone. Furthermore, in a cross sectional study on 100 patients, the authors concluded that tooth loss can be contained when patients underwent to regular maintenance (Müller Campanile et al. 2019), that findings were already previously described in the systematic review of Trombelli et al. (2015). Finally, a recent consensus (Sanz et al. 2015) on the effective prevention of periodontal and peri-implant diseases supported that, in addition to professional mechanical plaque removal, secondary prevention of periodontitis should also include the evaluation of oral hygiene performance, motivation and re-instruction in oral hygiene practices.

## 17.4 Discussion

Dental plaque accumulation, at and below the gingival margin, is the primary etiological risk factor for the development of gingivitis and further periodontitis (Mariotti 1999; Albandar et al.

**Table 17.2** The effect of oral hygiene devices on periodontal features

Authors	Study design	Conclusion
Elkerbout et al. (2020)	Systematic review and meta-analysis on 17 studies	Based on 28 comparisons assessed toothbrushing efficacy according to the plaque index score (Q & HPI and RMNPI): PTB showed a significant effect compare to MTB, the difference was −0.14 ( $P < 0.001$ ; 95%CI [−0.19; −0.09]) for the Q & HPI and, −0.10 ( $P < 0.001$ ; 95%CI [−0.14; −0.06]) for the RMNPI
Wang et al. (2020)	Systematic review and meta-analysis on 21 studies	PTB more effective in reducing dental plaque, gingivitis and bleeding compared with MTB
Clark-Perry and Levin (2020)	Systematic review and meta-analysis on respectively 15 and 12 studies	OR PTB reduced statistically plaque index ( $p < 0.01$ ) and number of bleeding sites ( $p < .001$ ), than other PTB
Starke et al. (2019a)	Randomized controlled study on 148 patients Effect of PTB or MTB on gingivitis and plaque following two and four weeks of home use PTB, n = 74 MTB, n = 74	PTB was statistically significantly superior to MTB in reducing gingival inflammation, gingival bleeding, and plaque
Starke et al. (2019a)	Randomized controlled study on 2188 patients evaluating the effect of PTB and MTB on plaque and gingivitis	PTB was statistically significantly superior to MTB in reducing gingival inflammation, gingival bleeding, and plaque
Sambunjak et al. (2019)	Systematic review on 12 studies	Flossing in addition to toothbrushing reduces gingivitis compared to toothbrushing alone.
Cui et al. (2017)	Randomized controlled trial on 42 patients	PTB reduced plaque and gingivitis more than MTB
Delarenti et al. (2017)	Randomized controlled trial on 144 patients, using twice-daily home use of PTB, n = 77 MTB, n = 77	PTB was statistically significantly more effective than MTB in reducing supragingival plaque, gingival inflammation, and gingival bleeding following
Schmalz et al. (2017)	Randomized clinical study on 72 patients, influence of different devices on periodontal clinical parameters OR, n = 24 SA, n = 24 MTB, n = 24	SA significantly reduced the bleeding compared to OR and MTB ( $P < 0.01$ ). OR significantly improved in the plaque removal than MTB ( $P = 0.01$ ). SA significantly reduced the probing pocket depth compared to MTB
Bourgeois et al. (2016)	Randomized controlled trial on 46 patients Standard manual toothbrush twice daily and an interdental brush daily (n = 23) Standard manual toothbrush (n = 23)	Daily use of calibrated interdental brushes reduces interdental bleeding
Chapple et al. (2015)	Workshop with 2 meta-reviews (mechanical plaque control) and 2 systematic reviews (chemical plaque control/anti-inflammatory agents)	PTB provide small but statistically significant additional reductions in gingival inflammations and plaque scores Interdental brushes are the device of choice for the interproximal plaque removal Flossing cannot be recommended it, unless the interdental brushes will not pass through the interproximal area without trauma Use of systemic or anti-inflammatory agents in the management of gingivitis has no robust evidence base

Q & HPI Quigley-Hein plaque, RMNPI index or the Rustogi modified Navy plaque index, PTB powered toothbrush, MTB manual toothbrush, OR oscillating-rotating, SA sonic-active

**Table 17.3** The effect of oral hygiene before periodontitis non-surgical treatment -periodontitis treatment

Authors	Study design	Conclusion
Preus et al. (2020)	Randomized controlled trial on 44 patients Strict oral hygiene phase 3 months prior to periodontitis treatment Did not receive any instructions or motivation On oral hygiene prior to periodontitis treatment	Strict oral hygiene phase prior to periodontitis treatment reduced plaque, BOP and pocket depth ( $p < 0.001$ )
Salhi et al. (2020a)	Controlled study on 34 non-, 25 former- And 32 current- smokers Effect of OHI and periodontitis non-surgical treatment	OHI led to a significant decrease of PD, BOP, and PISA only in non-smokers and former smokers ( $p < 0.0001$ )

**Table 17.4** The effect of oral hygiene on periodontitis prevention and maintenance of healthy periodontium

Authors	Study design	Conclusion
Slot et al. (2020)	Systematic review and meta-analysis on 17 studies	Interdental brushes (IDBs) reduced plaque scores more effectively than a manual toothbrush alone
Müller Campanile et al. (2019)	Cross sectional study on 100 patient treated for periodontitis	Tooth loss and periodontal tissue damage can be contained over prolonged periods if periodontal disease is treated and patients attend regular maintenance care
Figuro et al. (2017)	Systematic review on 27 studies	Combined professional and self-performed mechanical plaque control significantly reduces plaque index ( $p = 0.003$ ) and ( $p = 0.002$ )
Tonetti et al. (2015)	Consensus report	Repeated and individualized oral hygiene instruction and professional mechanical plaque removal are important components of preventive programs
Sanz et al. (2015)	Consensus report	Professional mechanical plaque removal in the context of secondary prevention of periodontitis should also include the evaluation of oral hygiene performance, motivation and re-instruction in oral hygiene practices.
Trombelli et al. (2015)	Systematic review on 19 studies	Professional plaque removal may limit the incidence and yearly rate of tooth loss as well as the loss in clinical attachment in patients treated for periodontitis.
Van der Weijden and Slot (2015)	Meta review on 10 systematic review	Tooth brushing is effective in reducing levels of dental plaque. With respect to gingivitis power toothbrushes have a benefit over manual toothbrushes

1998). Although not all cases of gingivitis evolve to periodontitis, the calculus removal and the management of gingivitis by daily effective self-performed mechanical plaque control and the motivation of oral health by professional are a fundamental in the prevention and the maintenance of periodontitis (Jepsen et al. 2017; Worthington et al. 2019). This narrative review discloses the updated evidences on the effect of plaque control on the prevention of periodontitis genesis (Table 17.1), the efficacy of oral hygiene

devices (Table 17.2), the effect of OH on the treatment of the disease (Table 17.3), as well as the maintenance of periodontal health and the prevention of the disease (Table 17.4) (Chapple et al. 2015; Ramseier et al. 2017).

Since management of gingivitis is considered as the main prevention of periodontitis (Chapple et al. 2015), both oral hygiene instructions and motivation provided by dental professionals, and patient self-performed mechanical plaque control are required to the control of dental biofilm and

gingivitis. Recent systematic review (Worthington et al. 2019; Richards 2018) and meta-analysis (Kotsakis et al. 2018) support that oral hygiene lowers the risk of gingivitis and plaque accumulation. Additionally, the frequency of OH (Lertpimonchai et al. 2017; De David et al. 2018) as well the use of interdental brushes (Worthington et al. 2019; Kotsakis et al. 2018; Richards 2018) are efficient to maintain gingival health. These evidences have been already described in the consensus report of the joint European Federation of Periodontology and European Organization for Caries Research (EFP/ORCA) (Jepsen et al. 2017) which concluded that self-performed oral hygiene and interdental cleaning, as well as professional oral hygiene instructions are essential to the management of gingivitis. When focusing on the efficacy of dental devices in the reduction of plaque control and bleeding on probing, recent systematic reviews (Elkerbout et al. 2020; Wang et al. 2020; Clark-Perry and Levin 2020) and randomized controlled trials (Starke et al. 2019a, b; Cui et al. 2017; Delaurenti et al. 2017; Schmalz et al. 2017) supported the benefit of powered tooth brush (PTB) over to manual ones. According to Chapple et al. (2015), powered toothbrushes present greater short- and long-term reductions in plaque indices and gingival inflammation when compared to manual ones. In addition to PTB, the use of daily interdental brushes reduces interdental bleeding (Bourgeois et al. 2016; Sambunjak et al. 2019).

Nevertheless, regarding the effect of oral hygiene on periodontitis non-surgical treatment (PNST), only few studies evaluated and quantified OH as an individual component of the PNST. Preus et al. (2020) and Salhi et al. (2020a) concluded that strict oral hygiene phase prior to periodontitis treatment significantly decreased plaque, bleeding on probing as well as pocket depth. The combination of professional and self-performed mechanical plaque control reduces the plaque index, and therefore contributes to the maintenance of a healthy periodontium and the secondary prevention of periodontitis (Slot et al. 2020; Figuero et al. 2017). In addition to the role of mechanical plaque control, the motivation, and the promotion of oral health by professional can

participate to improve the oral health care and education, consolidating the periodontal treatment (Nakata et al. 2019; Garyga et al. 2019; Stenman et al. 2018).

This evidence has been supported in the conclusions of the 11th consensus report of the European Workshop on Periodontology (2015) on effective prevention of periodontal and peri-implant diseases (Sanz et al. 2015).

After active periodontal therapy, patients can fall in two different categories: patients with reduced but healthy periodontium and patients with gingival inflammation. The first group presents a risk on recurrence and the second one a risk of progression. Yet, the risks of disease recurrence after periodontal therapy are a reality and the control of systemic and local risk factors highly important. Firstly, the constant self-motivation of the periodontal compromised patient is always a challenge in maintaining plaque control, smoking cessation, keeping a balanced diet and maintaining control of diabetes (Chapple et al. 2013). Secondly, the supportive periodontal care (SPC) performed by dental health professionals, remains strictly important in the detection of disease recurrence and resurgence of subgingival biofilm (Müller Campanile et al. 2019). Ideally, supportive periodontal therapy should be optimized to the specific patient's risk profile and to the periodontal conditions after active therapy (Sanz et al. 2020). The importance of adherence to the SPC is crucial for long term periodontal stability, further improvements in the periodontal status. Irregular compliances are intimately related with more tooth loss and disease progression (Costa et al. 2014).

Nevertheless, it is relevant to not forget the precursors of the reflection on the impact of oral hygiene on periodontal disease. In the past century, Lövdal (Lovdal et al. 1958) and Arno (Arno et al. 1958) explained, in 1958, the existence of a close correlation between periodontal destruction and oral debris. These findings will then evidence, in 1964, by Theilade (1964) who demonstrated microscopically that an intimate anatomical relationship exists between bacteria and the gingival tissues. Further clinical observations supporting the observation of the pio-

neers raised, with the combined effect of subgingival scaling and controlled oral hygiene on the incidence of gingivitis (Lovdal et al. 1961) and, with the production of an experimental gingivitis by Loe et al. (1965). Therefore, there is a need to continue research of our fathers with the influence of oral hygiene on periodontal disease prevention, genesis, and treatment.

## 17.5 Conclusion

Despite, the lack of recent evidence literature based on the effect of OHI on periodontal non-surgical treatment, the clinical evidence of the negative relationship between dental plaque exists. Therefore, the control of oral hygiene and plaque accumulation by both professional and patient contribute to healthy periodontium and should be considered as the most important part of the periodontal treatment.

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