

What are the optimum plaque control methods for patients with fixed orthodontic appliances?

Learning outcomes

After reading this article, the reader should:

- understand the risks associated with fixed orthodontic appliances;
- be familiar with the current best available evidence regarding the effectiveness of various oral hygiene practices for patients with fixed orthodontic appliances; and,
- appreciate how modern technology may be beneficial in promoting behavioural change in patients with fixed orthodontic appliances.

Introduction

Orthodontics is concerned with treating malocclusions to improve dentofacial aesthetics, correct occlusal function, and eliminate features that may cause harm to the dentition over time. The ultimate goal is to achieve the aforementioned objectives without compromising the pre-existing health of the dentition and periodontium. Fixed appliances (FAs) are an integral facet of contemporary orthodontics, affording the clinician a greater range of tooth movements and precision than is achievable with other appliances. The placement of fixed attachments and auxiliaries upon a tooth surface increases the risk of plaque accumulation (**Figure 1**). This occurs through disruption of the oral cavity's natural self-cleaning mechanism, and such appliances act as both a barrier to oral hygiene and local retentive factors, thereby hindering hygiene practices.¹

The consequences of inadequate plaque control during FA therapy are twofold. The presence of plaque deposits in/around FA brackets, coupled with a diet high in fermentable carbohydrates, results in enamel demineralisation, which is seen in the early stages as white spot lesions (WSLs) of the enamel and which, if left unabated, can progress to frank cavitation.² The majority of patients also experience some degree of gingival inflammation during therapy.¹ While effects appear to be mild and transient, the progressive accumulation of plaque ultimately contributes to periodontal inflammation, resulting in hyperplastic gingivitis and periodontal breakdown.³

The prevalence of enamel demineralisation and periodontal inflammation in patients with FAs has prompted research into the efficacy of available methods that aim to reduce plaque levels and sustain effective oral hygiene before, during and after orthodontic FA therapy. While careful patient



FIGURE 1: Poor oral hygiene around fixed appliances.

selection and a non-cariogenic diet are critical to reducing risk, this article presents an evidence-based overview of currently available methods to facilitate plaque control during FA therapy in orthodontics, in a bid to reduce unfavourable outcomes.

Methods of oral hygiene in patients with fixed appliances

Mechanical

Toothbrushing

Effective and regular removal of biofilm during orthodontic FA therapy is pivotal to maintaining the health of the dentition given that plaque is the principal aetiological factor driving cariogenic and periodontal diseases. The presence of archwires, ligatures, and fixed brackets makes it more difficult for orthodontic patients to clean thoroughly around appliances.⁴ The large collection of various types of toothbrushes on the market, however, may create confusion regarding the efficacy of various designs.

Several studies have investigated the efficacy of manual and electric toothbrushes (**Figures 2a and 2b**). Some authors have found electric to be more effective than manual models,⁵ while others could not reproduce these conclusions. Conversely, the opposite has also been demonstrated.⁶ A recent systematic review and meta-analysis on this topic emphasised the equivocal nature of the current evidence.⁷ Various manual toothbrush designs have also



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FIGURES 2a and 2b:
Electric toothbrushing
technique around
fixed appliances.



FIGURES 3a and 3b:
Manual toothbrushing
technique with fixed
appliances.



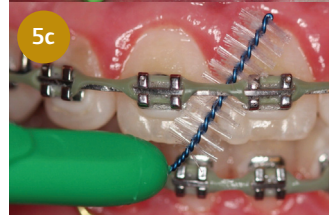
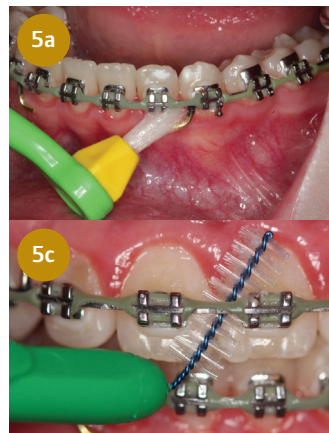
FIGURE 4: Flossing technique with fixed appliances.

been investigated (**Figures 3a and 3b**). Research has found no significant difference in plaque removal effectiveness between different manual designs.⁸ There is some evidence that new models of electric toothbrushes may be more effective than traditional ones.

The current consensus is that there is insufficient evidence to advocate for the use of electric over manual toothbrushes, or for any one manual design, for improving plaque control in FA patients. Therefore, the dental team should aim to improve patients' knowledge and awareness, in conjunction with other aids, rather than focusing on the type of brush used.

Interdental cleaning

It has been demonstrated that brushing alone is insufficient to clean all surfaces of the tooth.⁹ Adjunctive interdental cleaning aids are therefore recommended, including floss, interdental brushes (IDBs), and water flossers. The most appropriate aid used should depend on the morphology of the interdental space and manual dexterity.



FIGURES 5a, 5b and 5c: Interdental
brush technique with fixed appliances.

There are a limited number of studies examining the use of interdental aids specifically for FAs, however. A Cochrane review addressed the question of whether IDBs provide additional benefits to patients with FAs but failed to identify any eligible studies to support the use of IDBs in addition to standard toothbrushing.¹⁰

Floss

Research advocates for an improvement in gingival health when flossing is incorporated into oral hygiene routines (**Figure 4**).¹¹ Zannata *et al.* found that there are small but statistically significant benefits to using dental floss in FA patients.¹ In contrast to this, other studies have found insufficient evidence that routine instruction in floss use should be provided to all patients.¹²

Interdental brushes

IDBs are reported to be the most effective method of cleaning interproximal surfaces (**Figures 5a, 5b and 5c**). The evidence suggests superior plaque removal

when compared to both toothbrushing alone and toothbrushing combined with floss.¹³ The added benefit is their ease of use in the presence of FAs, allowing for cleaning around appliances, and therefore increasing compliance. IDBs as adjuncts to toothbrushing are recommended by several authors given their ability to more effectively remove plaque than brushing alone.¹⁴

Water flosser

Water flossers/picks/oral irrigators are a more recent addition to interdental cleaning for routine home care and are designed for easy use. They function using pulsation and pressure action to aid in the disruption of plaque biofilm and loosely adhered debris. The literature relating to the use of water flossers with FAs reports similar effectiveness when compared to floss in reducing plaque scores in patients with fixed appliances.¹⁵ It can be inferred therefore that irrigators may be a useful adjunct to improve oral hygiene in patients with FAs.

Chemical control of plaque

Dentifrices

Toothbrushing is commonly combined with a dentifrice to aid in mechanical plaque removal and for chemical plaque control, via the addition of excipients. The incorporation of antiplaque agents creates a powerful formulation for daily plaque control. While the presence of fluoride is unlikely to affect the plaque ecosystem, certain derivations, such as stannous fluoride, have demonstrated anti-plaque effects *in vivo*, owing to the stannous component.¹⁶ In addition, it has the added benefit of preventing demineralisation and arresting carious lesions from developing and progressing.

Mouth rinses

The challenges encountered with mechanical plaque removal often result in the prescription of co-adjutant chemical agents. Mouth rinses are commonly prescribed to exert an antimicrobial effect on supragingival plaque. There is evidence to suggest that the use of rinses during FA therapy has the potential to reduce plaque levels.¹⁷ Daily sodium fluoride (0.05%) mouth rinses are often recommended for patients with FAs, as there is evidence to support their effectiveness in reducing WSLs in other areas of dentistry, although it must be acknowledged that there is currently no robust evidence to suggest their effectiveness in reducing WSLs in these orthodontic patients.¹⁸

Chlorhexidine is a broad-spectrum antiseptic, commonly used in mouth rinses. A Cochrane review found high-quality evidence to suggest that its use in addition to toothbrushing leads to a significant reduction in plaque build-up.¹⁹ However, prolonged use can result in undesirable local effects, such as staining and taste disturbances.

Cetylpyridine chloride (CPC) is a quaternary ammonium compound found in dentifrices and mouth rinses. While evidence for its effectiveness is limited, current research suggests that when compared with chlorhexidine, CPC was equally effective in terms of plaque removal, but with fewer side effects.²⁰

Professional plaque control

While self-administered oral hygiene practices are fundamental to prevent plaque-related risks with FAs, patients must be aware of the importance of regular review with their dentist/hygienist to sustain high-quality oral hygiene throughout treatment.

The incorporation of a professional prophylaxis programme as an integral component of the oral hygiene protocol for FA patients has been advocated by

the literature.²¹ Research shows that regular professional cleaning can help to maintain a high standard of oral hygiene during FA therapy.²²

Routine hygienist/therapist visits are advisable alongside routine orthodontic checks to monitor the patient's oral hygiene efforts and to intercept any adverse effects. Recall periodicity may be modified based on the patient's risk category.

Patient motivation

Compliance with oral hygiene practices have been reported to be suboptimal during FA therapy. Oral hygiene decreases rapidly following the placement of FAs, according to Cantekin *et al.*⁴ Clinicians therefore require skills in behavioural management and must provide frequent reinforcement of oral hygiene instruction and motivation. Such reinforcement must occur throughout orthodontic treatment and not just in the early stages, as it has been shown to improve attitudes and patient compliance.²³

To improve recall of information, supplementation of standard verbal oral hygiene information in written format may also improve compliance with oral hygiene practices.

New technologies to aid in plaque control

The use of mobile applications to provide instruction, motivation and reminders to orthodontic patients has recently been investigated. Farhadifard *et al.* concluded that the use of smartphone applications, as reminder and motivation tools, can aid in improvements in oral hygiene compliance in patients with FAs.²⁴ Social media has been investigated as a tool to promote improvements in oral hygiene for FA patients. A recent systematic review on the subject concluded that there is limited, low-level evidence to suggest whether social media-based interventions are effective in producing positive behavioural changes in patients with FAs.²⁵

These technologies may be useful adjuncts but do not obviate the ultimate responsibility of the clinician to provide regular, tailored and appropriate oral hygiene advice, and to monitor for signs of poor compliance and adverse effects.

Management of cases with poor plaque control

FA therapy is elective. Therefore, if treatment is to be of benefit to the patient, the advantages should outweigh the adverse effects. Appropriate patient selection is a critical process in orthodontic treatment planning to prevent deleterious side effects. Before commencing FA, the associated risks should be discussed as part of the informed consent process. Where the decision is made to begin treatment, clinicians must be vigilant for loss of adherence and poor oral hygiene at subsequent review appointments, and should provide repeated motivation and education to patients.

In cases where poor oral hygiene is compromising the health of the dentition, a decision must be made as to whether early cessation of treatment may be in the best interests of the patient, even in cases where the desired treatment outcomes are achieved only in part, or not at all.

Conclusion

FA therapy can be associated with deleterious effects on the dentition. Given the duration of treatment, there is considerable potential for damage to occur. Current evidence suggests that self-administered mechanical plaque control via toothbrushing alongside an interdental aid is important to reduce the likelihood of adverse effects associated with plaque accumulation during FA treatment. Chemical agents can be used as adjuncts where appropriate.

Professional cleaning as part of the overall treatment protocol can further improve levels of plaque control. Tailored and specific oral hygiene instruction alongside motivation are also important components to consider when attempting to elicit positive behavioural change. The dental team must reinforce the importance of maintaining excellent oral hygiene, and must educate patients, not merely about what oral hygiene aids are available, but how to use them correctly. Where technology is considered, it should be used only to supplement established protocols.

References

1. Zanatta FB, Moreira CHC, Rösing CK. Association between dental floss use and gingival conditions in orthodontic patients. *Am J Orthod Dentofacial Orthop.* 2011;140(6):812-821.
2. Bishara S, Ostby A. White spot lesions: formation, prevention, and treatment. *Seminars in Orthodontics.* 2008;14(3):174-182.
3. Karkhanechi M, Chow D, Sipkin J, et al. Periodontal status of adult patients treated with fixed buccal appliances and removable aligners over one year of active orthodontic therapy. *Angle Orthod.* 2013;83(1):146-151.
4. Cantekin K, Celikoglu M, Karadas M, Yildirim H, Erdem A. Effects of orthodontic treatment with fixed appliances on oral health status: a comprehensive study. *Journal of Dental Sciences.* 2011;6(4):235-238.
5. Clerehugh V, Williams P, Shaw WC, Worthington HV, Warren P. A practice-based randomised controlled trial of the efficacy of an electric and a manual toothbrush on gingival health in patients with fixed orthodontic appliances. *J Dent.* 1998;26(8):633-639.
6. Trimpeneers LM, Wijgaerts IA, Grognaard NA, Dermaut LR, Adriaens PA. Effect of electric toothbrushes versus manual toothbrushes on removal of plaque and periodontal status during orthodontic treatment. *Am J Orthod Dentofacial Orthop.* 1997;111(5):492-497.
7. ElShehaby M, Mofti B, Montasser MA, Bearn D. Powered vs manual tooth brushing in patients with fixed orthodontic appliances: a systematic review and meta-analysis. *Am J Orthod Dentofacial Orthop.* 2020;158(5):639-649.
8. Hickman J, Millett DT, Sander L, Brown E, Love J. Powered vs manual tooth brushing in fixed appliance patients: a short term randomized clinical trial. *Angle Orthod.* 2002;72(2):135-140.
9. Sander FM, Sander C, Toth M, Sander FG. Dental care during orthodontic treatment with electric toothbrushes. *J Orofac Orthop.* 2006;67(5):337-345.
10. Goh HH. Interspace/interdental brushes for oral hygiene in orthodontic patients with fixed appliances. *Cochrane Database Syst Rev.* 2007;(3):CD005410.
11. Graves RC, Disney JA, Stamm JW. Comparative effectiveness of flossing and brushing in reducing interproximal bleeding. *J Periodontol.* 1989;60(5):243-247.
12. Berchier CE, Slot DE, Haps S, Van der Weijden GA. The efficacy of dental floss in addition to a toothbrush on plaque and parameters of gingival inflammation: a systematic review. *Int J Dent Hyg.* 2008;6(4):265-279.
13. Poklepovic T, Worthington HV, Johnson TM, et al. Interdental brushing for the prevention and control of periodontal diseases and dental caries in adults. *Cochrane Database Syst Rev.* 2013;(12):Cd009857.
14. Arici S, Alkan A, Arici N. Comparison of different toothbrushing protocols in poor-toothbrushing orthodontic patients. *Eur J Orthod.* 2007;29(5):488-492.
15. Sawan N, Ben Gasseem A, Alkhayyal F, Albakri A, Al-Muhareb N, Alsagob E. Effectiveness of super floss and water flosser in plaque removal for patients undergoing orthodontic treatment: a randomized controlled trial. *Int J Dent.* 2022;2022:1344258.
16. White DJ. Effect of a stannous fluoride dentifrice on plaque formation and removal: a digital plaque imaging study. *J Clin Dent.* 2007;18(1):21-24.
17. Pithon MM, Sant'Anna LI, Baião FC, dos Santos RL, Coqueiro Rda S, Maia LC. Assessment of the effectiveness of mouthwashes in reducing cariogenic biofilm in orthodontic patients: a systematic review. *J Dent.* 2015;43(3):297-308.
18. Benson PE, Parkin N, Dyer F, Millett DT, Germain P. Fluorides for preventing early tooth decay (demineralised lesions) during fixed brace treatment. *Cochrane Database Syst Rev.* 2019;2019(11):CD003809.
19. James P, Worthington HV, Parnell C, et al. Chlorhexidine mouthrinse as an adjunctive treatment for gingival health. *Cochrane Database Syst Rev.* 2017;3(3):CD008676.
20. Oo MMT, Oo PH, Saddki N. Efficacy of 0.05% cetylpyridinium chloride mouthwash as an adjunct to toothbrushing compared with 0.12% chlorhexidine gluconate mouthwash in reducing dental plaque and gingival inflammation: a randomized control trial. *Int J Dent Hyg.* 2023;21(1):195-202.
21. Ramaglia L, Sbordone L, Ciaglia RN, Barone A, Martina R. A clinical comparison of the efficacy and efficiency of two professional prophylaxis procedures in orthodontic patients. *Eur J Orthod.* 1999;21(4):423-428.
22. Migliorati M, Isaia L, Cassaro A, et al. Efficacy of professional hygiene and prophylaxis on preventing plaque increase in orthodontic patients with multibracket appliances: a systematic review. *Eur J Orthod.* 2015;37(3):297-307.
23. Huang J, Yao Y, Jiang J, Li C. Effects of motivational methods on oral hygiene of orthodontic patients: a systematic review and meta-analysis. *Medicine (Baltimore).* 2018;97(47):e13182.
24. Farhadifard H, Soheilifar S, Farhadian M, Kokabi H, Bakhshaei A. Orthodontic patients' oral hygiene compliance by utilizing a smartphone application (Brush DJ): a randomized clinical trial. *BDJ Open.* 2020;6(1):24.
25. Al-Moghrabi D, Alkadhimi A, Tschlakai A, Pandis N, Fleming PS. The influence of mobile applications and social media-based interventions in producing behavior change among orthodontic patients: a systematic review and meta-analysis. *Am J Orthod Dentofacial Orthop.* 2022;161(3):338-354.