

Hygienics of Clear Aligners: A Scoping Review

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Abstract

Today, patients are keenly opting for clear aligner therapy for their orthodontic treatment. Although aligners are meant to be discarded every couple of weeks, they still need cleaning. If not cleaned properly, one can have a smelly or dirty set of aligners to put on every day. Rinsing with water may make the aligners appear clean visually but nothing has been done to address the bacterial build up that could happen on the aligner surfaces. This article reviews various studies conducted using chemical approaches, mechanical approaches, or a combination of both the approaches.

Keywords: Aligners, Clear aligner therapy, Disinfection, Sterilization.

INTRODUCTION

In 1999, clear aligner therapy (CAT) began in earnest when Invisalign became commercially available by Align Technology. Today, plenty of companies around the World are manufacturing aligners, with the number getting larger every year, due to an increase in demand for highly esthetic and comfortable orthodontic treatment. Several studies have been conducted to discover the relationship of the aligners with that of the oral environment. For oral hygiene maintenance, several procedures and protocols have been published and are being followed; yet, the protocol for an immaculate aligner still remains unclear.

Periodontal health and CAT

Gracco *et al.*, demonstrated chemical and physical changes on aligners when they were worn: After 14 days, aligners were abraded and displayed microcracks and delaminated areas conducive to bacterial adhesion and growth, as well as localized calcified biofilm deposits with loss of transparency.^[1] Low *et al.*, studied the ultrastructure and morphology of biofilms on aligners in “fast” and “slow” plaque formers.^[2] In accordance with the studies conducted by Rossini *et al.*, Levri *et al.*, and Jiang *et al.*, encouraging results have been obtained in terms of the plaque index and gingival health control compared to classic fixed orthodontic treatment and bacteria can form oral biofilms on the surface of the aligners.^[3-5]

Tektas *et al.*, have demonstrated that the initial microbial adhesion and biofilm formation of aerobic and anaerobic

oral species were similar between enamel, metal orthodontic brackets, and aligner materials. Moreover, bacterial adhesion to aligners appears to be increased by the shape of the aligner, which contains grooves and ridges.^[6]

Considering all the findings and conclusions mentioned above, the protocol and procedure for maintenance of the aligners' sanitization and cleanliness must be made a priority.

Cleansers and disinfectants used for clear aligners in various comparative studies

Mechanical approach

1. Brushing
2. Vibrating bath
3. Warm Tap Water/Cold Tap Water/Aqua Dest Water
4. Saline Buffer
5. Sonic Bath-TCS Fresh, 5800 Hz
6. Ultrasonic Bath-iSonic F3900, 42000 Hz.

Chemical approach

1. Fluoridated toothpaste
2. 0.12% Chlorhexidine mouthwash/chlorhexidine gluconate gel

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3. Cleaning crystal solution-sodium sulfate (60%), sodium carbonate (30%), sodium tripolyphosphate (7.5%), sodium dichloroisocyanurate (2%), and sodium lauryl sulfate (0.15%), which act as a pH neutralizer (e.g., sodium sulfate), disinfectant (e.g., sodium dichloroisocyanurate), and detergent (e.g., sodium lauryl sulfate)
4. Non-abrasive Toothpaste
5. Effervescent tablets-sodium carbonate and sulfate crystals
6. Anionic detergent-TCS Fresh.
7. Cationic detergent-benzalkonium chloride, Caelo
8. Fresh Guard Soak Crystals
9. Corega-sodium bicarbonate, citric acid, potassium caroate (potassium monopersulfate), sodium carbonate, sodium carbonate peroxide, taed, sodium benzoate, peg-180, sodium lauryl sulfate, vp/va copolymer, aroma, subtilisin, cellulose gum, ci 42090, and c.i. 73015
10. Retainer brite-potassium monopersulfate, sodium perborate monohydrate, sodium sulfate, soda ash, sodium bicarbonate, sodium tripolyphosphate, peppermint oil, sodium lauryl sulfoacetate ethylenediaminetetraacetic acid, and tetrasodium
11. Kukis
12. 5% White vinegar
13. 1.25% Cupral
14. Fresh Guard
15. Smart Guard Retainer and Aligner Cleaner.

Efficacy of various cleaning agents and procedures used on clear aligners

In 2014 Chang *et al.*,^[7] evaluated the effective means of cleaning methods and summarized that brushing with fluoride toothpaste was confirmed as an effective method of cleaning retainers. The use of chlorhexidine gel or mouth wash is recommended in patients where bacterial infection has to be avoided due to immunosuppression or other reasons. Shpack *et al.*, examined the ability of a removable thermoplastic appliance (RTA) to adsorb hygienic solutions and inhibit bacterial growth along with the efficacy of three hygiene protocols in reducing bacterial biofilm adherence to RTA. The study recommended the use of a vibrating bath with cleaning crystals solution (VBC; Align Technology) protocol. In addition, biofilm deposits on the RTA, especially on incisal edges and attachment dimples, could lead to inadequate tooth/RTA and attachment/RTA overlap and consequently impair tooth alignment.^[8]

In 2015, Levrini *et al.*, conducted a comparative study to find out the most effective method of cleaning removable orthodontic aligners. The study also analyzed the growth of dental plaque as observed under scanning electron microscopy. The best results were obtained with brushing combined with the use of sodium carbonate and sulfate crystals; brushing alone gave slightly inferior results.^[9]

In 2016, Luca *et al.*, conducted a study to quantify the bacteria concentration on the surface of orthodontic clear aligners using three different cleaning methods. Furthermore, the objective

was to validate the efficacy of the bioluminometer in assessing the bacteria concentration. It was found that the highest bacteria concentration was found on aligners cleaned using only water (583 relative light units); a value of 189 relative light units was found on aligners cleaned with brushing and toothpaste. The lowest bacteria concentration was recorded on aligners cleaned with brushing and toothpaste and the use of sodium carbonate and sulfate tablets. The authors concluded that the mechanical removal of the bacterial biofilm proved to be effective with brushing and toothpaste. The best results in terms of bacteria concentration were achieved by adding the use of sodium carbonate and sulfate tablet.^[10]

In 2017, Albanna *et al.*, compared effectiveness of brushing an Essix retainer with water only followed by soaking in one of the three cleansing tablets. Bacterial quantification tests demonstrated non-significant statistical differences between the control and test side of cleaning tablets. Using chemical cleansing tablets after mechanical cleansing did not significantly reduce the bacterial count in Essix retainer. However, the tablets seem to be effective against the cocci bacterial spectrum.^[11] Lombardo *et al.*, did a comparative SEM analysis of nine F22 aligner cleaning strategies. A significant difference in the efficacy of the cleaning strategies was detected. Specifically, rinsing with water alone was significantly less efficacious, and a combination of cationic detergent solution and ultrasonication was significantly more efficacious than the other methods. Of the nine cleaning strategies examined, only that involving 5 min of ultrasonication at 42 k Hz combined with a 0.3% germicidal cationic detergent was observed to be statistically effective at removing the bacterial biofilm from the surface of F22 aligners.^[12]

In 2019, Meto *et al.*, investigated the ability of a copper-calcium-hydroxide-based compound to remove microbial plaque naturally produced onto orthodontic clear aligners. A commercially available dental paste, named Cupral, based on copper-calcium-hydroxide, was used. Confocal microscopy revealed abundant plaque irregularly distributed onto the aligner surface. Following Cupral treatment, a drastic decrease occurred in plaque thickness and matrix presence. As assessed by the CFU assay, total microbial load approached 10^[9] CFUs/aligner, with slight differences in aerobiosis and anaerobiosis culture conditions; six macroscopically different types of colonies were detected and identified by matrix-assisted laser desorption ionization-time of flight mass spectrometry. Exposure of clear aligners to Cupral results in the elimination of contaminating microorganisms; the antimicrobial activity is retained up to 1.25% concentration. Overall, the authors described a novel use of Cupral, a copper-calcium-hydroxide-based compound, in daily hygiene practices with promising results.^[13] Ismah *et al.*, compared the efficacy of chlorhexidine and denture cleanser tablets against Gram positive bacteria. A significant difference was found in the bacterial numbers between the groups. The authors concluded that the disinfectant use was effective in decreasing the load of Gram positive bacteria on thermoplastic retainers.^[14] Akgün *et al.*, evaluated

the efficacy of different cleaning methods for orthodontic thermoplastic retainers in terms of bacterial colonization *in vivo*. All VFRs used by the volunteers were cleaned using three different cleaning methods in a sequence and concluded that the application of PBCTs and Vinegar to VFRs at sequential time intervals resulted in similar bacterial counts. The higher LB counts and similarly higher SM counts on the VFR samples indicate that mechanical cleaning only is not adequate to obtain hygiene.^[15] Pilloni used commercial retainer cleaner to remove biofilm from thermoplastic retainers. The results confirmed that all cleaners removed the biofilm.^[16]

CONCLUSION

Based on the data, a combined mechanical and chemical approach to clean and disinfect an aligner is the best, though further research is needed to identify the most accurate method.

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