



LIMITATIONS OF CLEAR ALIGNERS IN ORTHODONTIC TREATMENT- A REVIEW

Dr. Vaibhav Vashishta*

Associate Professor, Department Of Orthodontics & Dentofacial Orthopedics, Sardar Patel Post Graduate Institute Of Dental & Medical Sciences, Lucknow *Corresponding Author

Dr. Ankita Singh

Associate Professor, Department Of Oral Pathology And Microbiology, Babu Banarasi Das College Of Dental Sciences, Lucknow

Dr. Tushant Rastogi

Assistant Professor, Department Of Orthodontics And Dentofacial Orthopaedics, Sardar Patel Post Graduate Institute Of Dental And Medical Sciences, Lucknow

Dr. Stuti Raj

Assistant Professor, Department Of Orthodontics And Dentofacial Orthopaedics, Sardar Patel Post Graduate Institute Of Dental And Medical Sciences, Lucknow

ABSTRACT

Clinical orthodontics has shown a drastic shift from conventional braces to innovative technologies like invisible aligners. In clear aligners therapy, sequence of clear trays were worn by patients to straighten their teeth. They were designed so for the purpose of aesthetic, as teenagers these days would shy away from essential correction of malocclusion wearing conventional fixed orthodontic appliances. Being more aesthetic and comfortable option, clear aligners have gained immense popularity over the last decade. With increasing popularity in orthodontics, limitations do exist with use of clear aligners. The purpose of this article is to discuss some limitations and potential hazards associated with invisible clear aligners.

KEYWORDS : Clear Aligners, Aesthetic, Orthodontics

INTRODUCTION

Invisible retainers was developed originally by Robert Ponitz of Ann Arbor, Michigan. It is formed from a sheet of thin biocryl or other similar material that is heated and forced by suction or pressure on to a working model of the dentition.^{1,2}

Increased need for aesthetic orthodontic correction, peer pressure and social stigma from wearing metal braces for correction of malocclusion in young adults, have led to increase in popularity of clear aligners in field of orthodontics.³

Apart from aesthetics, it is easy to maintain good oral hygiene with aligners and they are less traumatic to gingiva and soft tissues and shorter in-office appointments.⁴

Although gaining popularity and its use in complex type of cases,^{5,6} questions still remains concerning about the proper use and limitations of clear aligners due to the characteristics of the material and the thermoforming process, which in specific cases can limit use of clear aligners.

Cytotoxic Properties Of The Materials Used In Aligners

Clear aligners are exposed to degradation in oral environment due to extreme changes of temperature, mechanical wear, changes in pH and enzymes, bacteria and salivary activity, thereby raising the release of toxic materials. Biocompatibility is a topic of debate due to the lack of scientific literature, and there is a need to assess the cytotoxicity of the materials, which are used by different brands. Components of almost all the aligners are synthetic polymers like polyurethanes, polyamides, polycarbonates, polyethylene family, but the most common one is polyurethane. Most of the 3D printable materials are resin and Bisphenol-A. One of the by-products resulting from degradation of such resins, can act as a steroid hormone, which causes biological effects like premature puberty in girls, ovarian cancer, or disruptive maturation of male reproductive organs. In oral environment, aligners are continuously subject to mechanical and chemical assaults. In orthodontics, potential materials for BPA

(Bisphenol A) release are plastic materials and auxiliaries such as adhesives, polycarbonate brackets and aligners.⁴

Bis phenol A, has shown to be increased in alkaline environments. At high temperature, the intraoral conditions might expose these aligners to transient heat shock on consumption of hot liquids.⁷

Materials used in the manufacture of aligners have substances associated with leaching, degradation and estrogenic properties.⁴

BPA has been classified as category 3 toxic substance and has significant risk factor in human fertility. Exposure to BPA derivate-based composite resins can affect the psychosocial health of children.⁸

Some significant morphological differences have been found in used invisalign aligners in relation to the new ones, which involved- abrasion at the cusp tips and localized calcification of the biofilm developed during intraoral use.⁹

Biocompatibility of clear aligners is still an open research field due to the lack of scientific literature and only few studies have been performed.

Clear Aligners And Root Resorption

It is known that fixed orthodontic appliances can generate excessive pressure at the apical level, causing external the apical root resorption. Few studies have assessed root resorption caused by thermoplastic aligners. A systematic review with only three studies, conducted in 2017 concluded that aligners could also cause root resorption at the end of orthodontic treatment. However, incidence and severity are lower as compared to fixed appliances. One of the study by Gay et al. stated that, 41.81% of teeth showed signs of apical root resorption, with upper and lower incisors being the most affected teeth, after treatment with clear aligner.¹⁰ It can therefore be concluded that root resorption is still a risk associated with aligners in orthodontic treatment.

Clear Aligners And Oral Hygiene

Clear aligner trays are usually prescribed to be worn for about 22 hours a day for satisfactory results. These plastic aligner serves as a protective environment which limits the flow of saliva, negating saliva's natural cleansing, buffering, and remineralizing properties. Usual cleansing activities of lips, cheeks, and tongue are also interrupted, allowing further development of plaque under the appliances.¹¹

These devices must be removed during meals or when drinking hot drinks since it could spot or cause deformation, and may affect oral hygiene maintenance at home.¹²

Any food allowed to accumulate within the plastic trays can be quickly converted into acid producing plaque. Without removing aligners, patients drink liquid, sometimes highly acidic, flavoured drink or sugary cariogenic drinks causing pooling of liquid beneath trays.¹¹

Birdsall J and Robinson S demonstrated significant decalcification and caries in normally self-cleansing areas, such as cusp tips and incisal edges in patients who consumed 5-6 soft drinks per day.¹³ These factors combined with poor oral hygiene, can cause rapid demineralization, which may often occur in areas not normally considered prone to caries, which can result in greater dental damage than those found in a non-compliant brusher with fixed appliances.

Aligners limit ability of saliva to cleanse, buffer, and remineralize the tooth surfaces, in addition to preventing mechanical actions of the tongue and cheeks in removing plaque. Tight/fitting plastic aligners introduce new surfaces for the potential adhesion of plaque. These plaque forms not only on the surface of enamel, but also on the inner surfaces of plastic, where it accumulates, especially in cusp tips and incisal edges. This explains the unusual appearance of demineralized areas. Few cases reported by Moshiri M et al have shown obvious decalcification after wearing clear aligners by the patients.¹¹

However it depends on patients also, whether they are removing or wearing their aligners while having food or for how much time they are wearing these aligners, apart from time prescribed by orthodontics.

Studies have shown irregular inside surfaces of aligners and indentations-for attachments, which often offer areas for bacterial colonization and consequent biofilm formation, especially cusp tips.¹⁴

Clear Aligners And Periodontal Status

Fixed orthodontic appliances complicate the oral hygiene procedures,¹⁵ but the clear aligners can be easily removed during meals and oral hygiene procedures, allowing patients to control gingival biofilm.^{16,17} Therefore, they presumably maintain a healthier periodontal condition. This is important for adults, who have a higher prevalence of periodontitis, seeking orthodontic treatment.

As more individuals opt for transparent aligners, some researches stated that this treatment had a detrimental periodontal effect.^{18,19}

Han JY discovered that with careful oral hygiene education and consistent plaque management, patients who were treated with fixed appliance and transparent aligners, both demonstrated equivalent gingival and plaque indices.¹⁸

To the current state of knowledge, the impact of orthodontic treatment with clear aligners and fixed appliances on periodontal health should be considered comparable, and there is not much clear evidence to support the choice of clear

aligners as first treatment option in patients who are at risk for gingivitis or periodontitis.²⁰

Clear Aligners And Masticatory Musculature And Stomatognathic System

According to Sultan Abdulrahman Almalki et al, impact of clear aligner therapy on the masticatory musculature and stomatognathic system is a crucial in orthodontics. Findings had indicated that clear aligners had caused a short-term change in the muscle activity, which had reverted to baseline values in subsequent follow-ups. With clear aligner treatment, pain notably increased and significant reduction in bite force had been observed. Also, transient increase in muscle activity aligns along with occlusal changes observed. But due to limited number of studies, robust research recommended to fully understand potential impact of aligner treatment on the muscle activity and Temporomandibular disorders (TMDs) during treatment planning processes.²¹

Clear Aligners And White Spot Lesions

The complex design of fixed orthodontic appliances makes it difficult for patient to perform proper oral hygiene, so white spot lesions becomes three times more prevalent in patients wearing orthodontic appliances.

As clear thermoplastic aligners are removable, they allow better oral hygiene maintenance with less incidence of white spot lesions when compared with fixed orthodontic appliances.

White spot lesion in clear aligners could be attributed to the practice of having composite attachments which covers a significant portion of the tooth surface. Thus, regardless of the type of appliance used, a periodic reinforcement by the orthodontist to maintain good oral hygiene practice is necessary, and thus, it leads to prevention of White Spot Lesion (WSL).²²

Deepak Singh et al in their review concluded that the incidence of white spot lesions was less in patients under clear aligner group compared to fixed orthodontic. The size of the white spot lesion was larger in subjects with clear aligner therapy when compared with the subjects with traditional braces. Also, mineral loss associated with clear aligners were lesser than fixed appliances.²³ This review further concluded that, low risk of bias studies with proper methodological qualities needs to be conducted in future in order to strengthen the conclusive evidence.

Feridun Abay, S. Kutlumis Buyuk, Yasemin Nur Korkmaz, reviewed that clear aligner treatment showed a lower rate of new WSL when compared to fixed orthodontic treatment. Also, a lower prevalence of WSL may have been found in evaluated studies and systematic reviews due to risk of bias. Patients having poor oral hygiene or existing WSLs, treatment using a clear aligner may be recommended to further reduce the incidence of WSL, but many factors such as location, size of added attachments, cleanliness of aligner, and the duration of its use, needs further evaluation.²⁴

CONCLUSION

Clear aligners offer better choice and convenient solution, with minimal limitations, for correcting tooth misalignments when compared to fixed orthodontic appliance. However, aligners should be worn under proper guidelines set by orthodontics, to avoid risks -like non maintenance of oral hygiene by the patients, thereby affecting dental and periodontal health. To fully understand limitations of clear aligners, more prospective studies or randomised controlled trials with large sample size should be conducted, on factors like-WSLs, masticatory muscle activity, periodontal effects, root resorption risk, and biocompatibility of clear aligners, as

these factors still lack scientific literature and only few studies have been performed.

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