

**Results of Treatment with Fixed Appliances And Orthodontic Aligners - Systematic Review**

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**Type of Publication:** Review Article

**Conflicts of Interest:** Nil

**Abstract**

**Study aim:** This systematic review aimed to determine the outcome of orthodontic aligners and fixed appliances as well as the impact on oral health.

**Method:** In accordance with PRISMA, we built this systematic review. In order to locate every peer-reviewed research article released between 2017 and 2022, four Authors independently conducted a comprehensive literature search across three electronic databases: PubMed, PLOS ONE, and Google Scholar databases. Information from randomized controlled trials and cohort studies published in English was required for this review, including information on fixed appliances, orthodontic aligners, oral health, clear aligners, and Invisalign.

**Results:** Overall we collected 966 articles, and finally 9 unique articles were included in our review. Out of the 9 included studies 3 discussed the assessment of efficiency of fixed appliances and Invisalign and 6 discussed the

effects of fixed appliances therapy with clear aligner or Invisalign in oral health. Four of the studies discussed the oral health effect used fixed labial appliances as comparator. The fixed appliances group had more plaque buildup, and the Invisalign system had no improved effects on the oral flora.

**Conclusion:** When compared to fixed appliances, orthodontic therapy with aligners is linked to inferior treatment outcomes for adult patients. In the short term, less dental hygiene is linked to aligner orthodontic therapy; however, the strength of the data supporting this association is not strong.

**Keywords:** PRISMA, Dental Hygiene, Orthodontic Aligners

**Introduction**

Due to strong marketing initiatives by manufacturers, the use of successive transparent aligners to treat malocclusion has increased dramatically in recent decades. As a result, there has been a growing interest in

these methods of invisible orthodontics, particularly among adult patients (Li et al., 2015). According to a 2013 survey of orthodontists in Australia, more than two thirds of participants had treated at least one case with aligners in the previous year, with a median of eight instances (Miles, 2013). According to a comparable survey conducted in 2014 among orthodontists in Ireland, about one fifth of them frequently treated adult patients with aligners (McMorrow & Millett, 2017).

According to a significant 2014 survey of orthodontic specialists in the United States, 89% of them had treated at least one case with aligners, with a median of 22 cases treated annually (Keim et al., 2014). However, only a small percentage of orthodontists used aligners for cases involving premolar extraction. Furthermore, according to a different poll conducted among European Aligner Society members, almost half of orthodontists thought that aligners limited the results of orthodontic treatment (although this belief was shared by only 5% of general dentists) (d'Apuzzo et al., 2019). Based on long-term outcomes, these statistics may suggest that the initial surge of aligner treatment during its early years of fame has now given way to a more mature evaluation of this treatment technique.

In contrast to many other medical specialties, orthodontics frequently adopts newly promoted products and treatment philosophies based on advertising policies, often without the necessary clinical data to support the manufacturers' claims (O'Brien & Sandler, 2010). In any event, it is crucial that any alternative treatments provided to orthodontic patients are supported by credible data regarding the modality's clinical efficacy in addition to the clinical knowledge of the physician. Treatment choices should ideally be supported by carefully considered treatment efficacy and side effect evaluations, as well as well-designed, well-reported

comparative clinical trials on human subjects and systematic reviews/meta-analyses thereof (Papageorgiou & Eliades., 2019). There is currently a wealth of empirical data demonstrating the significance of appropriate study design and methodological elements that could lead to bias (Papageorgiou et al., 2015). In this review we aimed to found the results of treatment with fixed appliances and orthodontic aligners and the effect on oral health.

### **Method**

In accordance with PRISMA, or "Preferred Reporting Items for Systematic Reviews," we conducted this systematic review (Page et al., 2021).

### **Search strategy**

In order to locate every peer-reviewed research article published between 2017 and 2022, four Authors independently conducted a comprehensive literature search across three electronic databases: PubMed, PLOS ONE, and Google Scholar databases. We searched all databases using relevant MeSH Terms from PubMed, PLOS ONE, and Google Scholar. MeSH terms, full-arch orthodontic treatment with aligners, fixed appliances and oral health were used. Every reference to the research that satisfied the evaluation criteria was thoroughly searched for further relevant papers.

### **Inclusion and exclusion criteria**

Information from randomized controlled trials and cohort studies published in English was required for inclusion, including information on fixed appliances, orthodontic aligners, oral health, clear aligners, and Invisalign.

We excluded review articles, case series/case reports, study protocols, symposium/conference proceedings, commentaries/editorials/letters, views/opinions, papers not in English, and articles whose full texts were not accessible.

**Data review and evaluation**

After reviewing the abstracts and revising the complete texts of the included articles, the relevant data was extracted. The design of the study, characteristics of the patients, goal of the study, main conclusions, name of the author, and the year of publication, Comparator and Intervention are among the details that were taken out. The extracted values were edited in an Excel spreadsheet prior to being imported into a table that had already been built.

**Results**

We collected 966 articles overall, 961 researches obtained by electronic search and 5 records obtained by manual search, 617 duplicated articles removed, and then 349 articles were screened, 61 articles were removed from reading title and abstract, 288 full text articles were assessed for eligibility criteria, 279 articles were removed after assessment of eligibility (Fig 1). Finally 9 unique articles were included in our review. Four studies were published in 2020, one in 2019, three in 2018 and one study in 2017. Out of the 9 included studies 3 discussed the assessment of efficiency of fixed appliances and Invisalign and 6 discussed the effects of fixed appliances therapy with clear aligner or Invisalign in oral health (Table 1). According to Gu et al., 2017 study the Invisalign and fixed appliance groups' treatment outcomes, lengths of time, and improvements were compared in the study. Lanteri et al., 2018 study found that 90% of the Invisalign treated participants had a significant improvement, thirteen percent of the patients reported requiring extra aligners after Invisalign

and fixed conventional treatments, fixed bonded retainers appear to be an effective alternative for preventing tooth recurrence. Additionally in the study conducted by Yi et al., 2018 in patients who do not require extractions, clear aligner therapy may be more effective than fixed orthodontic treatment at minimising external apical root resorption (Table 1).

Sifakakis et al., 2018; Mulla et al., 2020 and Albhaisi Z et al., 2020 used clear aligners in intervention, while Dallel I et al., 2020, Mummolo et al., 2020 and Wang et al., 2019 used Invisalign. Four of the studies discussed the oral health effect used fixed labial appliances as comparator. According to Albhaisi et al., 2020 the fixed appliances group produced more new lesions with greater severity but smaller area, and the clear aligners group generated larger but shallower white spot lesions. Compared to the group using transparent aligners, the fixed appliances group had more plaque buildup. And according to Wang et al., 2019 the Invisalign system had no improved effects on the oral flora.

Figure 1: Consort Chart The Selection Process

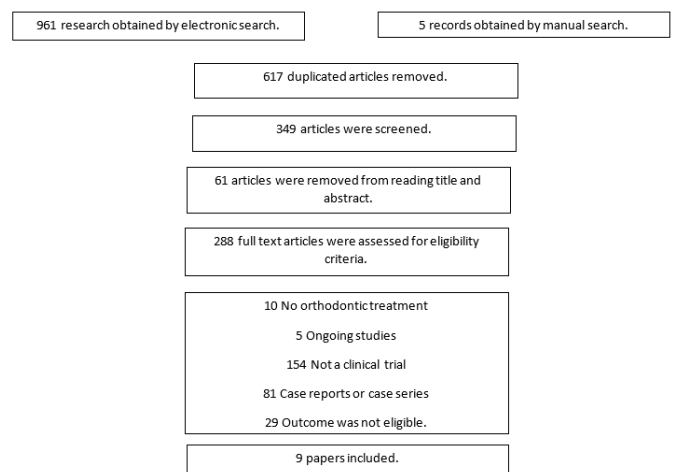


Table 1: characteristics of studies included in the review

Author And Year	Study Aim	Sample Size And Study Participants	Comparator	Intervention	Results	Other information's
Gu et al 2017	To assess the efficacy and efficiency of treating orthodontic patients with mild to moderate malocclusions using the Invisalign system vs traditional fixed appliances.	48 patients using fixed appliances 48 patients using Invisalign and	Fixed appliance	Invisalign	The malocclusion was improved with fixed appliances and Invisalign. Patients with Invisalign completed their treatment more quickly than those with fixed appliances. But it seems like fixed appliances would work better than Invisalign to provide "great improvement" in a malocclusion.	The Invisalign and fixed appliance groups' treatment outcomes, lengths of time, and improvements were compared in the study.
Lanteri et al., 2018	To compare the effectiveness of fixed appliances and Invisalign in a sizable patient sample.	One hundred patients received Invisalign treatment in the test group, while the control group received traditional fixed appliance treatment.	Fixed appliance	Invisalign	90% of the Invisalign treated participants had a significant improvement. Thirteen percent of the patients reported requiring extra aligners. After Invisalign and fixed conventional treatments, fixed bonded retainers appear to be an effective alternative for preventing tooth recurrence.	A 0.0175-inch multistranded stainless steel wire was employed as the retainer.
Yi et al., 2018	To assess the degree of external apical root resorption in individuals undergoing fixed orthodontic treatment or clear aligner therapy who do not require extractions.	8 non-extraction patients in all.	Fixed orthodontics treatment	Clear aligner	In patients who do not require extractions, clear aligner therapy may be more effective than fixed orthodontic treatment at minimising external apical root resorption.	The length of the incisor roots and crowns was measured using panoramic radiography both before and after treatment.
Albhaisi Z et al., 2020	To compare orthodontic fixed appliance therapy with clear aligner therapy and look into the association between the development of white spot lesions.	49 patients in all (mean age $\pm$ SD: 21.25 $\pm$ 3 years; 10 males, 39 females)	Fixed labial appliances	clear aligners	Enamel demineralization was brought on by orthodontic treatment using fixed equipment and transparent aligners. While the fixed appliances group produced more new lesions with greater severity but smaller area, the clear aligners group generated larger but shallower white spot lesions. Compared to the group using transparent aligners, the fixed appliances group had more plaque	The Jordan University of Science and Technology postgraduate orthodontic clinic served as the venue. Class I malocclusion with mild-to-moderate crowding (less than or equal to 5 mm), healthy patients of both sexes (ages 17 to 24), no extraction treatment plan, and optimal oral hygiene prior to treatment as assessed by clinical

					buildup.	examination were among the eligibility requirements.
Dallel I et al., 2020	To assess how orthodontic appliances affect changes in salivary parameters related to physicochemical, biochemical, and oxidative stress throughout treatment	112 people in good health. Saliva samples were collected prior to therapy, one month after treatment began, and nine months later.	Anderson activator type 2 and fixed labial appliances.	Invisalign	Among the salivary parameters that were evaluated enzymes, electrolytes, and markers of oxidative stress a statistically significant difference was found.	Every participant used toothpaste containing fluoride at the same concentration. Throughout the research period, no additional fluoride was administered.
Mulla et al., 2020	To evaluate the gingival characteristics of the three other bracket types—metal self-ligating, conventional ceramic, and the clear aligner treatment	STUDY Included eighty patients receiving orthodontic treatment and coming in for routine visits.	conventional brackets, conventional ceramic brackets	clear aligner	When compared to the conventional brackets and conventional ceramic brackets groups, the clear aligner treatment group's periodontal parameter values are superior, and there is no discernible difference with the SL brackets group.	Patients who are involved in the study should have skeletal relationships classified as Class II or Class III and be receiving fixed orthodontic equipment for a minimum of six months.
Mummolo et al., 2020	To compare the salivary concentrations of patients wearing fixed versus removable orthodontic appliances in terms of S. mutans, certain Lactobacilli, and plaque index (PI).	The study included a sample of 90 orthodontic patients, 56 of whom were male and 34 of whom were female. Mean age 21.5 years	Removable positioner and fixed appliances	Invisalign	When all the data were compared, it was found that only about 10% of CA patients and 13.3% of RP patients had a microbial colonization after six months, which may indicate a high risk of caries development. However, about 40% of MB patients and 20% after three months demonstrated a high level of vulnerability to developing caries, indicating the need for additional strategies to be used for plaque control and microbial colonisation.	Thirty patients wore a detachable positioner, thirty participants had treatment with removable clear aligners, and thirty cases involved fixed multibracket appliances.
Wang et al., 2019	to look into how individuals using permanent appliances or the Invisalign system have changed their oral microbiome	Five patients with fixed appliances, five patients using Invisalign, and five healthy controls made up the fifteen subjects that were enrolled.	fixed labial appliances	Invisalign	Invisalign and fixed orthodontic treatments both caused the oral microbiota to become dysbiotic. When compared to fixed appliances, the Invisalign system had no improved effects on the oral flora. The Invisalign system's beneficial effects on oral	Saliva samples were obtained, and 16S rRNA gene-based high-throughput pyrosequencing was carried out.

					health may be attributed more to the ease of maintaining dental hygiene than to modifications in the oral flora.	
Sifakakis et al., 2018	To determine the prevalence of the cariogenic bacteria <i>Lactobacillus acidophilus</i> , <i>Streptococcus sanguinis</i> , and <i>Streptococcus mutans</i> in the saliva of teenagers receiving orthodontic treatment with fixed appliances or thermoplastic aligners.	Thirty teenage patients, with a mean age of 13.8, 17 girls and 13 boys included.	fixed labial appliances	Clear aligners	Adolescents receiving one month of treatment with self-ligating appliances or thermoplastic aligners did not differ in their salivary counts of <i>L. acidophilus</i> or <i>S. mutans</i> . Conversely, compared to patients treated with self-ligating appliances, patients treated with aligners exhibited lower amounts of <i>S. sanguinis</i> in their saliva.	Every patient had whole stimulated saliva obtained from them three times: at baseline, two weeks later, and one month later.

**Discussion**

Due to cosmetic considerations and patients' perceptions of the therapy treatments' comfort and ease, aligner treatment has grown in popularity among patients. Throughout the course of therapy, maintaining a suitable level of oral cleanliness is crucial to preventing any negative effects linked to the loss of tooth integrity and periodontal health.

Taking into account all the constraints of the current investigation and the combined information, there is some indication that orthodontic therapy with aligners could be advantageous, particularly for adult patients, at least initially. One of the few systematic reviews that takes into account the most recent data on periodontal, microbiological, and early caries/white spot lesions as well as other oral hygiene parameters connected to aligner orthodontic treatment is the current study. Thus, it is a thorough and worldwide assessment of how well-suited modern orthodontic appliances are to assisting patients in maintaining excellent dental hygiene during treatment.

Prior research in the areas of dental hygiene and competing orthodontic tooth movement intervention

techniques has either found that clear aligner treatment is more successful or that there is a dearth of data, based on a relatively small number of early reports up until 2015 (Rossini et al., 2015). The research, which focused specifically on periodontal health, was still inconsistent and of low quality (Jiang et al., 2021). Eliades et al., 2020 came to the conclusion that periodontal health status was superior. However, the quality of the evidence was not very strong, mostly because of the possibility of bias and inconsistent results.

Notably, the pooled estimate for adult BOP and other types of odontal inflammation did not strictly reflect the results from microbiological and plaque-related factors due to higher variability in synthesized data. This could therefore suggest that, at least in adult patients, the first disruption of oral hygiene parameters soon after the start of orthodontic therapy was reversible. However, results from individual studies investigating how teenagers respond to orthodontic appliances support a more comprehensive short-term disruption of oral health parameters. As a result, some patient groups may be more likely to have poor oral hygiene compliance and meet the criteria for high-susceptibility status during standard orthodontic treatment.

Adolescent patients appear to benefit from additional oral hygiene reinforcement measures (Jiang et al., 2021). On the other hand, a single study found no statistically significant variations in periodontal markers between fixed and aligner therapy, suggesting that patients with these conditions maintain their dental hygiene better (Han et al., 2015). To reinforce the present data, however, additional and comprehensive investigations are required in this area.

Considering the long-term nature of orthodontic therapy and the retention period, the type of appliance and treatment plan for orthodontic tooth movement should be chosen clinically to maximise treatment result and safety. It has recently been shown that adult patients receiving orthodontic treatment using aligners had less successful treatment results in terms of reaching occlusal goals than those receiving treatment with gold-standard permanent appliances (Papageorgiou et al., 2020). Therefore, before starting a treatment, one should carefully consider the clinical outcomes, any potential short-term side effects, the length of the treatment, and the patient's values, making sure the patient is well-informed and involved in the treatment planning process (Eliades et al., 2020).

### Conclusion

When compared to fixed appliances, orthodontic therapy with aligners is linked to inferior treatment outcomes for adult patients. The clinical use of aligners as a therapy modality that is as effective as the gold standard of braces is not supported by the available studies. In the short term, less dental hygiene is linked to aligner orthodontic therapy; however, the strength of the data supporting this association is not very solid.

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