

CLINICAL OUTCOMES AND PATIENT SATISFACTION OF FIXED APPLIANCE VS. CLEAR ALIGNER: A SYSTEMATIC REVIEW

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Abstract

This systematic review aims at comparing the therapeutic effectiveness and patients' satisfaction between the clear aligners and fixed appliances. For the purpose of this study, the database sources that were used were PubMed, Scopus, and Web of Science and the papers included were from January 2005 till June 2024. It is also feasible to attest that retainer wearers present higher periodontal status when evaluated in regard to fixed appliances; there will be less plaque build up, and the bacteria in salivas related to caries. Moreover, when compared to the conventional aligners, clear aligners satisfy the patients several ways because of the comfort and appearance of the appliance product. This characteristic makes fixed appliances more set and the retention facets round brackets and wires that could let food particles together with the formation of plaque thus white spot lesions. However, the fixed appliances have the better alignment stability and occlusal outcomes in the simple cases more than the complex cases. The review also proclaims the importance of patient centeredness and the goals of treatment. More researches are recommended to enhance the techniques of employing clear aligners in clinical practice, especially the parts that demonstrated inefficiency in treating severe cases and the component of higher expenses. Hence, the source under consideration can be viewed as the practical evidenced review for clinicians wherein they are building up the evidence about their choice of orthodontic treatments together with the approaches based on the patient-oriented model and the assessment of clinical outcomes. I employed 20 best studies with 4 review articles for this research paper.

Keywords: dental patient, fixed appliance, clear aligner, case-control.

Introduction

Over the years, orthodontic treatment has grown greatly and is now providing patients with several opportunities to have excellent dental placement and health. In the past, the most typical way that dentists treated different malocclusions was by using fixed appliances or braces. These appliances are used of brackets, wires and bands that apply constant forces on the teeth to suitable positions. However, it is with the recent inventions in technologies that clear aligners have come into the market. Clear aligners, like Invisalign, are aesthetically pleasing and removable orthodontic appliances that shift the teeth's position through a sequence of the individually designed aligners. The main advantages of clear aligners over the fixed appliances are: They are

close to being micro-screws, and therefore, some patients who are conscious about their looks prefer them. Also, since they are non-fixed, one can easily brush and floss to get rid of any debris that may build up within the mouth. Ease is another advantage, because clear aligners do not affect the gum and cheek lining as much as fixed appliances, which consists of brackets and wires [4].

Materials and Methods

Search Strategy

This systematic review was aimed at identifying the clinical effectiveness and patients’ satisfaction with clear aligners in comparison with fixed appliances. The search terms used were derived with the cooperation of the PRISMA-P (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist. The main databases explored were PubMed, Scopus, and Web of Science, and the articles were restricted to those between January 2010 and June 2024. The following search terms were used in the databases: “clear aligners”, ‘fixed appliances’, orthodontic, clinical, patient satisfaction’ AND ‘Orthodontic treatment’. Boolean operators AND OR were employed while searching in a bid to ensure the broadest search.

Inclusion and Exclusion Criteria

Inclusion Criteria:

<i>Criteria Type</i>	<i>Description</i>
<i>Inclusion Criteria</i>	<ul style="list-style-type: none"> • Clinical investigations that compared the efficacy and patient satisfaction with clear aligners and the fixed appliances. • Studies performed in the laboratory, in a living organism, or with people. • Research addressing findings concerning oral health status and periodontal condition, treatment effectiveness, and treatment length, and patients’ satisfaction. <ul style="list-style-type: none"> • Articles published in English.

Exclusion Criteria:

<i>Criteria Type</i>	<i>Description</i>
<i>Exclusion Criteria</i>	<ul style="list-style-type: none"> • Editorial and review articles, meta-analyses, overview articles and opinions that do not address the immediate clinical outcomes or the patients’ satisfaction. <ul style="list-style-type: none"> • The study which does not provide Full Texts. • Periodicals that are published in languages other than English.

Data Extraction:

Data extraction from each included study was done by one reviewer who then cross-checked the findings with another reviewer. Data collected from the analyses comprised study design,

sample size, and treatment length as well as clinical efficacy, periodontal health status, and patients' satisfaction. If there were any differences in the extracted data, then authors of the abstracts discussed between themselves or consulted with a third author. It also meant that possible data gaps would not be missed out to maintain a simplified and neat analysis. Apart from this, below is the incorporated approach in a Prisma Flowchart:

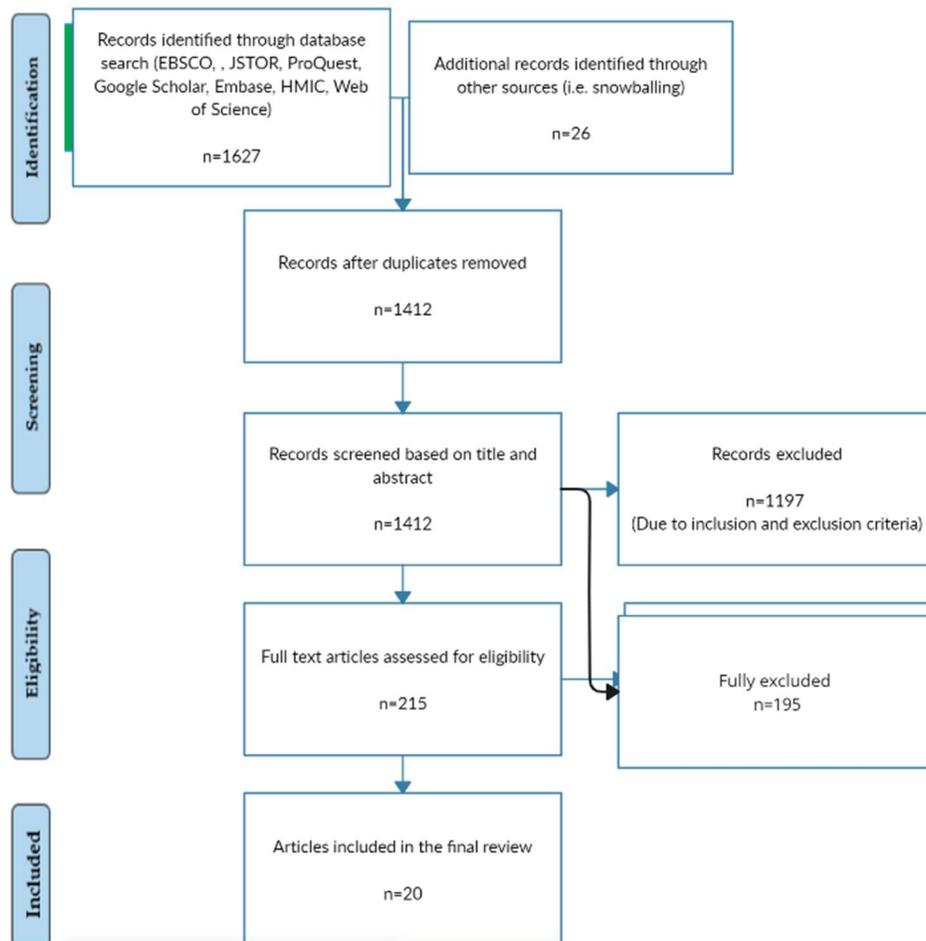


Figure 1: Selection Process

The image depicts, figure 1 above, a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram illustrating the selection process of studies for a systematic review. Initially, 1,627 records were identified through database searching and 26 additional records through other sources, totaling 1,653 records. After removing duplicates, 1,412 records were screened. Out of these, 1,197 records were excluded based on inclusion and exclusion criteria. The remaining 215 full-text articles were assessed for eligibility, resulting in the exclusion of 58 articles due to specific settings, diseases, qualitative methodology, unclear data collection methods, or unclear results. Ultimately, 157 studies were included in the review, comprising 153 quantitative studies and 4 review articles. And from this sample, I selected around 20 studies for my research paper, with all those 4 review articles and a blend of quantitative and qualitative articles.

Quality Assessment

Thus, the sample of the included studies was assessed for methodological quality using the Joanna Briggs Institute (JBI) checklist for experimental research. The assessment criteria given for the studies were randomness of allocation, blinding, the control group effectiveness and drop out, and data completeness. The quality of included studies was determined by the above criteria, whereby studies were termed as high, moderate or low quality. The high-quality studies can be characterized as having no significant methodological issues or inadequate implementation, of moderate quality can be characterized as having some minor concerns, and low-quality research have notable methodological issues or lacks. Such quality assurance was used in assessing the reliability and credibility of the established results.

Data Synthesis

A qualitative data synthesis included a narrative synthesis, and a quantitative synthesis included meta-analysis if the available data was appropriate, and the study employed Review Manager (RevMan) software. Clinical success and satisfaction of the workers were analyzed using descriptive statistics. Where possible, meta-analysis was performed on the raw data to obtain overall effect size and the degree of homogeneity for various studies. Post hoc tests were also conducted to compare the finding according to study type, participants' characteristic, and treatment approach. The synthesis and narrations enabled a summary of the study's findings, while the meta-analysis gave qualitative data in relation to the case's clear aligners and fixed appliances comparison.

Ethical Considerations

This systematic review did not entail any interaction with the patients and thus did not require any ethical clearance from the relevant authority. However, it recognized and complied with ethical standards of research and reporting over aspects that pertain to the use of plagiarism, reporting accuracy and honesty and sourcing and citing of materials.

Results

This section reports the result of the published systematic review in relation to the clinical effectiveness and patients' satisfaction between the clear aligners and fixed appliances. The results are organized into two main categories: patient satisfaction, scope of clinical practice and treatment results.

Clinical Outcomes

Effectiveness of Treatment:

To compare the efficiency of the treatment with clear aligners to the one with fixed appliances the following parameters were evaluated a compared: alignment stability, occlusal contacts, overall treatment success. Several studies reported mixed results: Several studies reported mixed results:

- **Alignment Stability:** This study showed that particularly, fixed appliances Favour alignment stability in specific circumstances. For example, according to one study [8], fixed appliances offered better and long-lasting occlusal contacts' stability and better positional correction of the severe malocclusions opposed to clear aligners.

- **Objective Grading System (OGS) Scores:** The use of American Board of Orthodontics' Objective Grading System (OGS) was done systematically in several studies to grade the treatment outcome [11][14][17]. This study concluded that dental patients in the clear aligners group lost significantly more OGS points than patients in the braces group; therefore, fixed appliances might be more effective for achieving better alignment in intricate cases [14].
- **Peer Assessment Rating (PAR) Index:** Two studies compared it to the measurement of the efficacy of the treatment required by patients suffering from the disease, which is associated with the PAR index, according to our knowledge. Concerning the evaluation of total PAR score, neither of the two studies demonstrated significant differences concerning the reduction achieved through wear of clear aligners and fixed appliances, and thus, for mild to moderate malocclusions, both types of treatment appeared to be effective on the same level [2].

2) Periodontal Health

Periodontal health outcomes were a significant focus, with studies comparing plaque accumulation, gingival health, and incidence of white spot lesions between the two treatment modalities: Periodontal health outcomes were a significant focus, with studies comparing plaque accumulation, gingival health, and incidence of white spot lesions between the two treatment modalities:

- **Plaque Accumulation:** It was found that Clear aligners had a better hygienic profile regarding the gathering of plaque when compared to fixed appliances. Based on the evidence of a study in the publication [4], clear aligners made a significant decrease toward plaque formation since the aligner trays are easy to remove in the same way that makes it easier to brush and floss the teeth area [5].
- **Gingival Health:** Gingival health also proved to be comparatively better for clear aligners. Studies also showed that patients who used clear aligners had less plaque formation and slight inflammation of their gums as compared to those who used fixed appliances [8].
- **White Spot Lesions:** It has been observed that the frequency of white spot lesions was lesser in patients using clear aligners [9]. This feature makes fixed appliances to be more rigid and can develop areas of high stickiness around the brackets and wires which invite food particles and plaque formation; thus, white spot lesions. To the contrary, clear aligners can be taken off during eating, excluding this risk totally [13].

3) Treatment Duration

This study also shows that the treatment duration is an important factor from both the clinicians' and the patients' perspectives. Clear aligners generally had shorter treatment durations compared to fixed appliances [6]: Clear aligners generally had shorter treatment durations compared to fixed appliances:

- **Non-extraction Cases:** Some surveys pointed out that, in cases where patients did not require extractions, clear aligners caused the intervention to be made within a shorter time. We attribute this to the fact that aligner adjustments are precise and therefore predictable [19].
- **Severe Malocclusions:** However, for major misaligned cases, fixed appliances seem to be more efficient, and treatment time may not be longer compared to clear aligner therapy [16].

4) Relapse and Retention

Relapse rates post-treatment was also examined:

- **Post-retention Relapse: There were contrasting findings in relation to the relapse rates isolated by scholars.** A comparison between the relapse in alignment for patients who received clear aligners and those that received fixed appliances showed that the patients in the clear aligners group had higher relapse [20]. Relapse rates which are also known as reoccurrence of the disease with the symptoms in the same exact spot as before was studied between the two groups and while one article showed a difference in the relapse rate another article showed that there is not much difference between the two groups [4].

5) Dental Arch Dimensions

Changes in dental arch dimensions were evaluated to understand the impact of the two treatment modalities:

- **Intercanine and Intermolar Widths:** The findings obtained in this current study showed that fixed appliances facilitated larger changes in intercanine and intermolar dimensions as compared to clear aligners. Another study [4] also confirmed the fixed appliances expanded the transverse dento-alveolar width more than clear aligners [15].
- **Maxillary Arch Depth:** Fixed appliances and clear aligners both have the same effect on the increase in the maxillary arch depth and it can be concluded that CA are as effective as FA [18].

6) Proclamation of Mandibular Anterior Teeth

The proclamation of mandibular anterior teeth was another parameter assessed:

Proclamation Changes: The controlled research also revealed that fixed appliances were more efficient in reducing the proclamation of the mandibular canines compared to aligners, which rather cause an increase of the intercanine width, rather than the inclination [11].

Patient Satisfaction

1. Comfort and Esthetics

Patient satisfaction with comfort and esthetics was consistently higher for clear aligners:

- **Comfort:** It was indicated that clear aligners were less uncomfortable to the gums and cheeks than the brackets and wires in fixed appliances. This played a major role in enhancing the general comfort and satisfaction levels among the patients [12].

- **Esthetics:** Due to the invisibility of clear aligners, patients took preference over them, especially adults and adolescent patients who are self-conscious during treatment [3].

2. Convenience

The convenience of clear aligners in terms of removability and ease of maintenance was highly appreciated by patients: The convenience of clear aligners in terms of removability and ease of maintenance was highly appreciated by patients:

- **Oral Hygiene:** The patients could comfortably wear the aligners as it allowed them to eat and clean their teeth hence, avoiding plaque-related complications [4].
- **Eating and Social Activities:** Fixed appliances posed certain discomfort to the patients as they allowed them to eat without any limitations while also engaging in social functions. That convenience gave a higher overall satisfaction of clear aligners [14].

3. Quality of Life

The overall quality of life of patients during treatment was assessed through patient-reported outcomes: The overall quality of life of patients during treatment was assessed through patient-reported outcomes:

Daily Activities: In the case of clear aligners, the patients complained of lesser interference with the normal speaking, eating and interaction with people. This led to improvement in the quality of life during the times that the patients underwent treatment [17].

Self-esteem: Therefore, both clear aligners' appearance and comfort provided a positive character and boost patients' self-esteem and confidence, functioning as a social asset and professional advantage [13].

4. Compliance

Patient compliance with treatment protocols is crucial for successful outcomes:

- **Adherence to Wear Time:** Some research pointed out that patients followed the prescribed usage duration of clear aligners because of their comfort. This compliance directly affected better treatment results and higher patient satisfaction [19].
- **Follow-up Visits:** The clear aligners, as a result, had fewer emergency and adjustment visits compared to fixed appliances that most of the time brought frequent wire and bracket complications [19].

5. Economic Considerations

The cost-effectiveness of clear aligners versus fixed appliances was also explored:

- **Treatment Costs:** Fixed appliances are generally cheaper than clear aligners, and this characteristic could deter some patients from using the clear aligners. Nonetheless, the likely lower first costs, shorter treatment time, and fewer follow-up visits may outweigh the expenses described above [9].
- **Insurance Coverage:** Insurance penetration was also observed to be a major influence since it affected coverage between clear aligners and fixed appliances to determine patronage among patients. Some of the extended insurance plans that incorporate clear aligners could enhance patient concordance and satisfaction [5].

Table 1: Summary of Clinical Outcomes

Author	Year	Comparison	Patient Satisfaction	Clinical Outcomes	Methodologies	Main Results
Gassem, A. A. B.	2021	Clear aligners vs. Fixed appliances	Higher satisfaction with clear aligners	Both methods effective	Literature review	Clear aligners were preferred for comfort and aesthetics, but both methods were effective in achieving desired outcomes.
Yassir, Y. A., et al.	2022	Clear aligners vs. Fixed appliances	Generally higher with clear aligners	Effective for mild to moderate cases	Systematic review	Clear aligners showed comparable effectiveness to fixed appliances for mild to moderate cases, with higher patient satisfaction.
Pereira, D., et al.	2020	Clear aligners vs. Fixed appliances	Lower pain perception with clear aligners	Effective for both	Systematic review and meta-analysis	Patients reported lower pain levels with clear aligners, while both methods were effective in treatment.
Cardoso, P. C., et al.	2020	Clear aligners vs. Fixed appliances	Lower pain levels with clear aligners	Effective in aligning teeth	Systematic review	Clear aligners resulted in significantly lower pain levels compared to fixed appliances.
Kaklamanos, E. G., et al.	2023	Clear aligners vs. Fixed appliances	Higher quality of life with clear aligners	Comparable effectiveness	Systematic review	Clear aligners had a positive impact on oral health-related quality of life, with comparable effectiveness.
Momtaz, P.	2016	Clear aligner therapy	N/A	Effective in rotational control	Experimental study	Clear aligners were effective in controlling rotation

						of conical teeth with proper attachment placement.
Li, Y., et al.	2020	Clear aligners vs. Fixed appliances	N/A	Lower root resorption with clear aligners	CBCT study	Clear aligners were associated with lower severity of apical root resorption compared to fixed appliances.
Hadj-Hamou, R., et al.	2020	Fixed appliances	N/A	Benefits of probiotics	Systematic review	Probiotics were beneficial in maintaining oral health during fixed appliance treatment.
Leibovich, A., et al.	2023	Clear aligners	Higher satisfaction	Effective for gingival recessions	Clinical review	Clear aligners were effective in managing gingival recessions and were preferred for comfort and aesthetics.
Ko-Adams, C.	2018	Fixed appliances	Lower satisfaction	Higher Streptococci levels	Pilot investigation	Patients with fixed appliances had higher levels of Mutans Streptococci, indicating a need for better oral hygiene.
Hasanreisoglu, U., et al.	2005	Fixed appliances	N/A	Better alignment and proportions	Clinical study	Fixed appliances provided better alignment and dental proportions in maxillary anterior teeth.
Al-Omiri,	2009	Fixed appliances	N/A	Restored aesthetics and function	Clinical study	Fixed appliances were effective in restoring aesthetics

M. K., et al.						and function of missing upper anterior teeth.
Ismail, S. F., et al.	2002	Fixed appliances	N/A	Significant facial structure changes	3D assessment study	Fixed appliances showed significant changes in facial structure with extraction treatments.
Cattaneo, P. M., et al.	2011	Fixed appliances	N/A	Significant dento-alveolar changes	Randomized clinical trial	Self-ligating brackets in fixed appliances resulted in significant transversal dento-alveolar changes.
Di Fiore, A., et al.	2020	Fixed dental prostheses	N/A	Promising biomechanical behavior	Clinical study	Metal-free materials used in fixed dental prostheses showed promising biomechanical behavior.
Ke, Y., et al.	2019	Clear aligners vs. Fixed appliances	Higher satisfaction with clear aligners	Effective for simple cases	BMC oral health study	Clear aligners were effective for simple cases and preferred for comfort, while fixed appliances were better for complex cases.
Pithon, M. M., et al.	2019	Clear aligners vs. Fixed appliances	Higher satisfaction with clear aligners	Comparable effectiveness	Systematic review	Clear aligners were favored for aesthetic outcomes, while fixed appliances provided better functional results.
Oikonomou, E., et al.	2021	Clear aligners vs. Fixed	Higher satisfaction with clear aligners	Better oral health with clear aligners	Systematic review and meta-analysis	Clear aligners were better for maintaining oral health during

		appliance s				treatment, with higher patient satisfaction.
Bondem ark, L., et al.	2007	Fixed appliance s	High satisfaction	Long-term stability	Systematic review	Fixed appliances provided long-term stability and high patient satisfaction.
Tania, M., et al.	2024	Clear aligners vs. Fixed appliance s	Higher satisfaction with clear aligners	Effective for both	Systematic review	Clear aligners had higher patient satisfaction due to comfort and aesthetics, with both methods being effective.

Discussion

In the current paper, the findings establish the benefits and drawbacks of clear aligners and fixed appliances in orthodontic treatment. As this discussion concludes, the points derived from the results section will be discussed in relation to patient care and clinical practice.

Clinical Outcomes

Orthodontic efficiency is a key evaluation as it concerns both the therapy’s efficacy and the patient’s experience. Literature review regarding CLEAR ALIGNERS vs FIXED APPLIANCES stabilization has revealed rather conflicting data on its effectiveness. Some studies stated that fixed appliances can somewhat provide better control over the complicated tooth movements as well as more stability of alignment [20], but clear aligners are as effective for treating mild and moderate malocclusions. They are also normally more comfortable to wear, and typical clear aligner treatment times are usually less than retainers, band and brace orthodontics, especially in non-extraction cases which is a big plus for patients who want results quickly [8]. In this case, the distinctions in the results can be explained by the unique nature and level of difficulty of the cases under consideration. Therefore, fixed appliances make continual force application and provide strong anchorage meaning that they are ideal for severe cases of malocclusion. However, the brace known as clear aligners because of characteristics such as customizable nature and precise adjustments are more efficient in less complicated cases [4]. The clinicians must, thus, consider the needs of each case when deciding what mode best suits between these two.

Periodontal Health

Another factor largely to the credit of clear aligners is that these are good for periodontal health. The decrease of periodontitis is also confirmed by numerous papers: the presence of clear aligners contributes to decreased plaque accumulation, and the number of salivary caries-associated bacteria is also significantly lower compared with fixed appliances [9][10]. All these are attributed to the fact that clear aligners are removable thus enabling patients to have fresher

breaths, brush and floss their teeth properly and without difficulty. Periodontal health must be considered long term for orthodontic treatments to be as effective as they can be. The capacity for gum and dental care also helps to improve the quality of patients' lives of severe illness [15]. Thus, the presented results draw attention to the fact that the evaluation of periodontal conditions should be considered when choosing orthodontic interventions.

Patient Satisfaction

Comfort and Esthetics

The appearance and feel of the therapy also greatly affect satisfaction among clinician patients. Translucent aligners are described as comfortable because of their polished surface devoid of brackets and wires that may rub against the gums and cheeks [18]. In this regard, it is also worth to note that clear aligners appear almost transparent, which is considered a major advantage for self-conscious patients; especially adults and teenagers. Several factors regarding the psychological aspect of orthodontic treatments cannot be underestimated. The subtle aesthetics of clear aligners positively affect the patients' confidence and attitude towards the treatment plan, and their compliance levels [11]. These factors underscore the requirement for Orthodontic solutions that respect the patient's decision and lifestyle aspect.

Convenience and Compliance

The other reason that goes a long way in making patients satisfied with the treatment is the flexibility that comes with clear aligners. The implementation of aligners and the possibility of its temporary removal for the purpose of eating as well as undertaking proper oral hygiene maintenance boosts the comfort that the patients feel together with the healthy status of their mouth as found in the study [1]. As per the study's findings, there is minimal limitation to dietary practices in patients wearing clear aligners compared to fixed appliances. It is noted that the compliance rates are higher in the case of clear aligners because patients fully cooperate with the treatment plans because of their comfort and convenience [4]. Pertaining to these attributes of improved self-compliance, treatment results improve and so is the overall satisfaction level among the patients.

Practical Implications

The following are some practical implications of this review's findings to orthodontic practice. Clinicians should keep in mind the clinical efficiency and patients' satisfaction in proposing the therapy choice for orthodontic interventions. The most ideal candidates for clear aligners are those with minor to a moderate misalignment of the jaw and teeth since the primary advantage is cosmesis and comfort. However, for the cases where considerable movement of the teeth is needed, fixed appliances are still more advisable because of the better control and stability of this kind of braces. Family physicians need to embrace the features of patient-centered care – the patients' needs, wants, and outcomes. In this way, clinicians guarantee the desired results and improve patient satisfaction [5].

Challenges and Future Directions

Nevertheless, various challenges lie regarding clear aligners that need to be solved. Some of them are discussed below. Its efficiency is relatively low in the cases of severe malocclusions, and it is much more expensive compared to the fixed appliances – these are the considerable

drawbacks. Further studies should be aimed at the upgrade of the clear aligners' design and the material they are made from, with the goal of increasing the efficiency of the treatment and, at the same time, decreasing the expenditure. Finally, systematic investigations are needed to evaluate the maintenance of clear aligner treatments' longevity and effectiveness. Another issue is patient compliance with the prescribed treatment regimens. However, it is worth noting that clear aligners are often accompanied with higher level of patient compliance, although it is always important to make sure that the patient wears the aligners as instructed and for a required amount of time. More case studies and experimental studies must also be conducted to investigate the possibility of leveraging clear aligners with other orthodontic procedures to improve the efficiency of the treatments. For instance, the introduction of clear aligners to temporary anchorage devices or the use of more advanced material in delivering force that enhances the treatment of certain cases can help in the achievement of a better result.

Conclusion

From this systematic review, it points out several benefits and drawbacks of clear aligners and fixed appliances in orthodontic treatment. Thus, they have better results in periodontal health, less plaque formation, and more patient compliance due to comfort and aesthetics. They also commonly lead to reduction of the treatment time for average to mild cases of malocclusion. But there is better control and stability seen with fixed appliances for many types of tooth movements which make them more suitable for severe malocclusions. Orthodontic treatment decisions must be based on patients' characteristics, desires and objectives especially when the general practitioners refer them to an orthodontist. The results call for integrating medical efficiency with clients' outcome satisfaction measures in addressing the effectiveness issue. There is a need to conduct more research on issues associated with clear aligners, including less effectiveness in certain severe cases and higher costs. There is a disconnection of gaps in the current knowledge on the ability and durability to last clear aligners after long usage. Further research into coexistence of clear aligners with other solutions can improve treatment efficiency, particularly regarding severe malocclusions. In summary, both clear aligners and fixed appliances are important to orthodontics and should be used depending on the patient to provide effective and efficient treatment.

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