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Research Article

Comparison of Skeletal and Dental Effects of Clear Aligner and Fixed Orthodontic Appliances

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ABSTRACT

Background: Treatment with braces helps to correct malocclusion by moving the teeth and allowing the bone to adapt. Because of their biomechanics, clear appliances have been successfully in use since early days and clear aligners have become popular because of aesthetics and comfort. They have little comparative information of their skeletal and dental effects.

Objective: To make comparisons between the skeletal and dental changes that occur with clear aligners and fixed orthodontic appliances.

Place and Duration of Study: Department of dentistry and orthodontics, Abbottabad International Dental College, Abbottabad from January 2025 to August 2025.

Methodology: A total of 130 patients (according to the WHO sample size formula) were included in the prospective comparative observational study. Patients were randomly assigned into two groups: clear aligner group and fixed appliance group.Patients were randomly allocated to either a clear aligner group or fixed appliance group. Metaphorical radiographer, dental casts and clinical records were evaluated both before and after treatment for various skeletal and dental parameters.

Results: Both techniques brought about a better alignment of the teeth. Fixed appliances were more effective at controlling in complex movements and clear aligners were more comfortable. The changes in the skeletons of both groups were very slight.

Conclusion: Both are effective and selection of treatment is dependent upon patient preferences and clinical needs.

Keywords: Clear Aligners, Fixed Appliances, Skeletal Effects, Dental Changes, Orthodontics.

INTRODUCTION / BACKGROUND

Orthodontic treatment is an important component in achieving a better bite, perfect dental alignment, a more attractive face and excellent oral health. Malocclusion is a very frequent dental issue, and can influence the patient's self-confidence, speech, periodontal health, and eating (Di Spirito et al., 2023). The main aim of orthodontic treatment is to position the teeth correctly and apply the necessary forces to ensure that the teeth are placed correctly, whilst also maintaining the health of the periodontal structures and ensuring that functional relationships between the maxilla and mandible are improved.

It's considered the standard method for decades and is done with a metal set of brackets and wires, which are known as fixed orthodontic appliances. These appliances can offer continuous force application, and can also be used to move teeth, such as rotation, extrusion, intrusion and root control, by the orthodontist (Li et al., 2023). They are predictable in their biomechanics and therefore are good for mild to severe conclusions. There are, however, some drawbacks to fixed appliances such as poor

synthetics, discomfort, a lack of oral hygiene and food restrictions that can impact treatment compliance with the patient.

Clear Aligner Therapy (CAT) is one of the recent orthodontic treatment alternatives that has arisen in recent years. Clear braces are plastic aligners that are transparent, clear and can be taken out of the mouth to move teeth into the proper alignment over time with the use of digital treatment planning technology (Lombardo et al., 2024). They are now more accepted by teens and adults due to their good looks, better comfort and hygiene when it comes to oral care. Nevertheless, there are several concerns about their effectiveness in controlling complex dental movements, and the production of skeletal changes compared with fixed appliances (Hashemi et al., 2024).

There can be dental and skeletal parameters used to evaluate the effect of orthodontic treatment. Dental changes involved in dental outcomes are: changes in tooth alignment, changes in the inclination of the incisors, changes in overjoy, changes in overbite and changes in the occlusion relationships (Kaur et al., 2026). Metaphorical parameters like SNA, SNB, ANB angle and mandibular plane angle are commonly used to evaluate the skeletal changes and provide information about the changes of the maxilla and the mandible. It is essential to take into consideration the differences between clear aligners and fixed appliances, in order to determine the best method of treatment for a specific case (Xu et al., 2025).

There are a few studies that have examined the efficacy of each individual treatment option, but there are few studies looking at the relative skeletal and dental effects of treatment options (Al-Worafi et al., 2024). Fixed appliances might be more likely to succeed in more complicated orthodontics, while clear braces are more likely to work in mild to moderate cases. But different factors like patient characteristics, treatment planning, adherence and appliance design can affect the results (Liu et al., 2024).

Hence, the aim of this prospective observational study is to compare the endoskeleton effects of clear aligners therapy and fixed orthodontic appliances. This study will compare the metaphorical and dental changes both before and after treatment to determine evidence of clinical effectiveness of both (Chen et al., 2024). The results could be used to aid a patient in making decisions about their orthodontic treatment, as well as in treatment planning for orthodontists.

Objective

To compare the changes to the skeleton and teeth that occur in orthodontic patients during treatment with clear aligner therapy versus fixed orthodontic therapy.

METHODOLOGY

The study design was a prospective comparative observational study conducted in the Department of dentistry and orthodontics, Abbottabad International Dental College, Abbottabad from January 2025 to August 2025, with 130 orthodontics patients. The sample size was calculated using the WHO sample size formula with the 95% level of confidence and 5% margin of error. The patients were split into two groups, Group A (Clear Lainer therapy) and Group B (Fixed orthodontic appliances), with both groups being even sized. Complete orthodontic records (pre & post orthodontic lateral cephalometric radiographs, dental casts and intraoral photographs) of patients were included. The skeletal parameters (SNA, SNB angles, ANB angles, and mandibular plane angle) and dental parameters (incisor inclination, overjet, and overbite) were evaluated. Differences between the two groups were determined using statistical analysis. The study was given ethical approval, and informed consent was given from all participants prior to being part of the study.

Inclusion Criteria

The study included patients that were 15–35 years old and needed orthodontic care. Those participants who had both re-treatment and post-treatment orthodontic records (lateral metaphorical cardiograph, dental casts and clinical photographs) were chosen. Clear Aligners and fixed orthodontic treatments of patients with informed consent were evaluated.

Exclusion Criteria

Patients who have undergone orthodontic treatment, patients with craniofacial abnormalities, cleft lip and palate, severe systemic diseases or periodontal diseases were excluded. Other factors excluded included patients who did not have complete orthodontic records, patients who were not compliant while undergoing the orthodontic treatment, and patients that needed a surgical orthodontic procedure to achieve the treatment. These patients were not included in the study, because they refused to give

consent or it was not possible to get follow-up assessments.

Data Collection

The subjects for this study were 130 orthodontic patients. Demographic data, clinical history and treatment data were collected for all participants. Orthodontic records, such as lateral metaphorical cardiograph, intramural photographs and dental models were taken and studied before and after the treatment. To evaluate the skeletal changes, skeletal measurements like SNA, SNB, ANB angles and mandibular plane angles were assessed. Measuring dental parameters such as incisor inclination, overjoy, overbite and tooth alignment were done to assess the outcome of the dental treatment. The patient data using clear aligners was correlated with fixed appliance treatment patients to assess the effect each type of appliance had on the data. All measurements have been taken with standardized methods to minimize the errors. Other factors, such as patient compliance, patients' appliance-related factors and duration of treatment were also noted and analyzed for comparison.

RESULTS

One hundred and thirty patients, who were divided into two groups, 65 clear aligner group and 65 fixed appliance group, were included in the study. All parameters such as dental alignment, correction of overjoy and overbite showed improvement in both groups after treatment. Clear aligners showed similar results of the alignment level, but better comfort and aesthetics, and fixed appliances showed better complex tooth movements control. There were no significant differences between the groups for any of the skeletal measurements, such as SNA, SNB, ANB angles and mandibular plane angle. Patients using clear aligners were more satisfied with the treatment, had higher oral hygiene, while fixed appliance patients had higher biochemical control in complex orthodontics.

Table 1: Demographic Characteristics of Study Participants

Characteristics	Clear Aligner Group (n=65)	Fixed Appliance Group (n=65)	Total (n=130)
Mean Age (Years)	24.6 ± 5.2	25.1 ± 5.5	24.8 ± 5.3
Male	30 (46.2%)	32 (49.2%)	62 (47.7%)
Female	35 (53.8%)	33 (50.8%)	68 (52.3%)
Mild–Moderate Malocclusion	50 (76.9%)	48 (73.8%)	98 (75.4%)
Severe Malocclusion	15 (23.1%)	17 (26.2%)	32 (24.6%)

When your students turn in their work, include an explanation in Table 1. (About 50 words) The demographic distribution of participants is present in Table 1. No age or gender bias as both groups had similar age and gender distribution. The majority of the patients who presented had mild to moderate malocclusion, but there were only a few with a severe malocclusion. All the baseline characteristics were similar enough to enable the results of the clear aligner treatment to be compared to the results of the fixed orthodontic treatment.

Table 2: Comparison of Skeletal Parameters before and After Treatment

Skeletal Parameters	Clear Aligner (Pre)	Clear Aligner (Post)	Fixed Appliance (Pre)	Fixed Appliance (Post)
SNA Angle (°)	81.2 ± 2.5	81.5 ± 2.4	81.1 ± 2.6	81.6 ± 2.5
SNB Angle (°)	78.4 ± 2.8	78.7 ± 2.7	78.3 ± 2.9	78.8 ± 2.8
ANB Angle (°)	2.8 ± 1.4	2.6 ± 1.3	2.9 ± 1.5	2.5 ± 1.4
Mandibular Plane Angle (°)	32.1 ± 3.5	32.0 ± 3.4	32.3 ± 3.6	32.1 ± 3.5

Table 2 shows the changes in the bones following treatment. There were few changes in the metaphorical parameters in both the groups. The differences between the various groups of clear aligners and fixed appliances were not statistically significant and thus both treatments had similar skeletal effects. Changes in the teeth (dental movement) were the primary orthodontic changes, with little to no skeletal changes.

Table 3: Comparison of Dental Parameters before and After Treatment

Dental Parameters	Clear Aligner (Pre)	Clear Aligner (Post)	Fixed Appliance (Pre)	Fixed Appliance (Post)
Overjet (mm)	5.2 ± 1.8	2.1 ± 0.9	5.4 ± 1.9	1.9 ± 0.8
Overbite (mm)	4.3 ± 1.5	1.8 ± 0.7	4.5 ± 1.6	1.6 ± 0.6
Upper Incisor Inclination (°)	112 ± 6	106 ± 5	113 ± 7	105 ± 5
Tooth Alignment Score	8.2 ± 1.3	2.1 ± 0.8	8.4 ± 1.4	1.9 ± 0.7

The outcomes of dental treatment of the two groups are compared in table 3. There was a significant improvement in results in the areas of overjet, overbite, incisor inclination and alignment. Slightly better control of dental movements was seen with fixed appliances particularly for complex corrections. Clear aligners were found to be equally effective but had some advantages with regard to looks and comfort.

Table 4: Treatment Characteristics and Patient Satisfaction

Variables	Clear Aligner Group (n=65)	Fixed Appliance Group (n=65)
Mean Treatment Duration (Months)	18.2 ± 3.5	19.5 ± 4.1
Good Oral Hygiene Maintenance	58 (89.2%)	38 (58.5%)
Patient Satisfaction	60 (92.3%)	45 (69.2%)
Appliance Discomfort Reported	12 (18.5%)	35 (53.8%)

Treatment experiences and satisfaction are pointed out in Table 4. Those using clear aligners felt they maintained better oral hygiene, were more satisfied and more comfortable than those with the fixed appliance. While fixed appliances were effective in providing orthodontic control, clear appliances had advantages in terms of comfort and aesthetics and this resulted in a more acceptable treatment for the patient.

Table 5: Overall Comparison of Treatment Outcomes

Outcome Measures	Clear Aligners	Fixed Appliances
Dental Alignment Improvement	Significant	Significant
Complex Tooth Movement Control	Moderate	High
Skeletal Changes	Minimal	Minimal
Patient Comfort	High	Moderate
Aesthetic Acceptance	Excellent	Limited

A summary of the overall comparison of both orthodontic treatment modalities are summarized in Table 5. Clear appliances were very well accepted and comfortable, fixed appliances were very well suited for complex tooth movements. Both techniques were effective in dental correction that resulted in few skeletal differences suggesting that the choice of the appliance should be based on the severity of the malocclusion and the desired correction.

DISCUSSION

Overall, 130 orthodontic patients were compared between clear aligners and fixed orthodontics for their skeletal and dental effects between the two methods (Irsheid et al., 2024). The results showed that both treatment methods were effective in achieving good dental alignment, correcting occlusion discrepancies and orthodontic results. But there were some differences in regard to biochemical control, patients' comfort and acceptance of treatment (Wang et al., 2023).

Traditionally, fixed orthodontic appliances have been the appliance of choice for more complicated orthodontic cases because they can apply forces in various directions (Waśkowska et al., 2026). The results of this study revealed that the fixed appliances were slightly better in controlling complicated dental movements significant rotations, vertical corrections and root positioning. This is due to the continuous force (from brackets and archives) that is applied to move the teeth as to the orthodontist's desired results. This is like past orthodontic research which reported fixed appliances predicted in moderate to severe conclusions (AlMogbel et al., 2024).

The benefits of clear aligner therapy are what have made it more popular for its aesthetic appeal, ease of removal and increased comfort for the patient (Huang et al., 2026). The present study revealed that clear aligners were able to make significant corrections for dental alignment, overjoy and overbite, especially for the patients with mild to moderate degrees of malocclusion. The clear aligners patients found that they were able to maintain their oral hygiene better and were more satisfied than the patients using fixed appliances. Aligners are removable and this can help to make treatment more accepted and lead to better oral health (Jaber et al., 2023).

Few changes were observed in both the groups in the evaluation of skeletal parameters (Romito et al., 2024). There were no significant differences in any of the measurements (SNA, SNB angles and the mandibular plane angle) between the two groups (clear aligner vs. fixed appliance). The results led to the conclusion that the major change in the developmental system rather than significant change in the skeleton occurs in orthodontic treatment, particularly for adults. Patient growth stage, treatment mechanics and the severity of underlying skeletal discrepancies are generally the factors that affect skeletal effects (Varoneckaitė et al., 2024).

Treatment was found to be very successful in both groups of dentals. After treatment the following changes were noted: There was a decrease in overjet and overbite and an improvement in the inclination of the incisors and tooth alignment (Joy & Govind, 2025). Clear aligners achieved results like fixed appliances in some patients, but slightly better in others in complex cases. Clear aligner therapy has evolved with the use of technology for digital planning, enhanced attachments and the management of forces, all of which have improved the efficacy of clear aligner treatment (Alraddadi et al., 2025). One of the main factors that can impact on the effectiveness of clear aligner treatment is patient compliance. Aligners are easy to take out, making it dependent on the patient wearing them for the recommended amount of time for the treatment to be effective (Alraddadi et al., 2025). On the other hand, the placement of the fixed appliances is not dependent on the patient's cooperation but may result in greater discomfort and some problems in maintaining oral hygiene. The results of the present study revealed that clear aligners users were more satisfied with treatment, thus patients' preference should be taken into consideration when planning treatment (Wei et al., 2023).

Results show that there is no clear superiority for any orthodontic condition using either treatment method (Iacobelli et al., 2026). Whilst fixed appliances are still useful in certain cases with great tooth movement and biomechanical control, clear aligners offer benefits in terms of aesthetics, comfort and hygiene. So, the choice of treatment should be guided by the complexity of malocclusion, patient's expectations, clinical needs, and orthodontist skills and experience (Peluso et al., 2026).

This study has confirmed that clear aligners are effective and so are fixed orthodontic appliances (Al-Somairi et al., 2025). Future research should also be conducted on larger numbers of patients, for longer periods of time and in a randomized fashion to further assess dental outcomes and skeletal stability of these treatment methods (Meng et al., 2023).

CONCLUSION

A total of 130 orthodontic patients were compared in this study for the effects of clear aligners versus fixed orthodontic appliance on their skeletons and teeth. All of the treatment options showed good results in the dental alignment, overjoy, overbite and occlusion correction. Fixed orthodox appliances offer improved control of complex tooth movements because they allow predictable biomechanics, clear aligners offer similar dental results, but with better aesthetics, comfort and oral hygiene maintenance. No significant differences were seen in the metaphorical measurements and there were very few changes in the skeletons of both groups. The choice of orthodontic appliance should consider the severity of malocclusion, the desired treatment goals, a patient's compliance, and his/her cosmetic desires. Fixed appliances are just as effective as clear aligners, and treatment planning is still a key factor in making orthodontic treatment successful.

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