A Comparative Study of Clear Aligners vs Traditional Metal Braces in Achieving Optimal Tooth Alignment in Adolescents

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ABSTRACT

Background

Orthodontic treatment in adolescents has evolved with the introduction of clear aligners as an alternative to traditional metal braces. While both modalities aim to achieve optimal tooth alignment, their comparative effectiveness, patient comfort, and impact on oral hygiene remain areas of clinical interest.

Aim

To compare the effectiveness of clear aligners and traditional metal braces in achieving optimal tooth alignment among adolescents.

Materials and Methods

This prospective comparative study included 100 adolescents aged 12–18 years with mild to moderate malocclusion. Participants were divided into two groups: Group A (n=50) treated with clear aligners and Group B (n=50) treated with traditional metal braces. Treatment outcomes were assessed using Little's Irregularity Index and Peer Assessment Rating (PAR) Index at baseline and post-treatment. Secondary outcomes included treatment duration, patient comfort (Visual Analog Scale), oral hygiene status (Plaque and Gingival Index), and incidence of complications. Statistical analysis was performed using independent and paired t-tests, with $p < 0.05$ considered significant.

Results

Both groups showed significant improvement in tooth alignment. However, the braces group demonstrated greater reduction in Little's Irregularity Index and PAR scores ($p < 0.05$). The aligner group showed significantly better patient comfort and oral hygiene status ($p < 0.001$). Treatment duration was slightly shorter in the aligner group but not statistically significant ($p > 0.05$). Complications such as soft tissue irritation were more common in the braces group, while compliance issues were higher in the aligner group.

Conclusion

Traditional metal braces are more effective for precise tooth alignment, whereas clear aligners provide superior comfort and oral hygiene benefits, supporting individualized treatment planning.

Keywords: Clear aligners, Traditional metal braces, Tooth alignment, Adolescents, Orthodontic treatment

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Introduction

Malocclusion is one of the most common oral health problems affecting adolescents worldwide, often leading to functional, esthetic, and psychosocial concerns. The demand for orthodontic treatment during adolescence is particularly high, as this developmental period represents a critical phase for craniofacial growth and dental maturation [1]. Proper alignment of teeth not only enhances facial esthetics and self-esteem but also improves oral function, facilitates better oral hygiene, and reduces the risk of periodontal disease and dental caries. Over the years, orthodontic treatment modalities have evolved significantly, offering patients a variety of options tailored to their clinical needs and lifestyle preferences [2].

Traditional metal braces have long been considered the gold standard for correcting malocclusion. These fixed appliances consist of brackets, archwires, and ligatures that apply controlled forces to move teeth into their desired positions. They are highly effective in treating a wide range of orthodontic problems, including severe crowding, spacing, rotations, and complex bite discrepancies [3]. Despite their proven efficacy, traditional braces are often associated with certain drawbacks, particularly among adolescents. These include poor esthetics due to their metallic appearance, discomfort caused by brackets and wires, difficulty in maintaining oral hygiene, dietary restrictions, and the potential for soft tissue irritation.

In recent years, clear aligner therapy has emerged as a popular alternative to conventional braces, especially among esthetically conscious patients [4]. Clear aligners are removable, transparent trays made of thermoplastic material, designed using advanced digital technology to gradually move teeth into alignment. Their nearly invisible appearance, improved comfort, and convenience have contributed to their growing acceptance among adolescents and young adults. Additionally, the ability to remove aligners during eating and oral hygiene practices offers a significant advantage in maintaining better oral health compared to fixed appliances.

However, despite their increasing popularity, clear aligners have certain limitations. Their effectiveness largely depends on patient compliance, as they must be worn for 20–22 hours per day to achieve optimal results [5]. Moreover, while aligners are effective for mild to moderate malocclusions, their ability to manage complex orthodontic cases such as severe rotations, extrusions, or significant skeletal discrepancies remains a subject of ongoing debate. On the other hand, traditional braces, being fixed appliances, do not rely on patient compliance to the same extent and can deliver more precise and controlled tooth movements in complex cases.

Adolescence presents unique challenges in orthodontic treatment planning. Patients in this age group often exhibit varying levels of compliance, are highly concerned about their appearance, and may experience psychological impacts related to visible appliances [6]. Furthermore, growth-related changes can influence treatment outcomes, making it essential to choose an appropriate treatment modality that balances effectiveness, efficiency, and patient satisfaction. The increasing availability of advanced technologies, such as three-dimensional imaging and computer-aided design, has further expanded the scope of orthodontic treatment options, necessitating a critical evaluation of their comparative benefits [7].

Several studies have attempted to compare clear aligners and traditional braces in terms of treatment outcomes, duration, patient comfort, and oral health impact. While some research suggests that aligners provide comparable results in selected cases, others highlight the superior efficacy of braces in achieving precise tooth movements, particularly in complex malocclusions [8]. Additionally, factors such as cost, accessibility, and clinician expertise play a significant role in determining the choice of treatment modality.

Given the growing demand for esthetic orthodontic solutions and the increasing adoption of clear aligner therapy among adolescents, it is essential to critically assess their effectiveness in comparison to traditional metal braces [9]. A comprehensive evaluation of these two treatment modalities will not only aid clinicians in making evidence-based decisions but also help patients and their caregivers make informed choices regarding orthodontic care [10]. Therefore, this study is important to determine the comparative effectiveness of clear aligners and traditional metal braces in achieving optimal tooth alignment in adolescents.

Methodology

This study was designed as a prospective comparative clinical study to evaluate the effectiveness of clear aligners versus traditional metal braces in achieving optimal tooth alignment among adolescents.

Study Design and Setting

The study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics at a tertiary dental care institution over a period of 18–24 months. Ethical clearance was obtained from the Institutional Ethical Committee prior to the commencement of the study, and informed consent was obtained from all participants and their guardians.

Sample Size and Study Population

A total of 100 adolescent patients requiring orthodontic treatment were selected for the study. The sample size was determined based on previous similar studies and statistical considerations to ensure adequate power. The participants were divided into two equal groups:

Group A (n = 50): Patients treated with clear aligners

Group B (n = 50): Patients treated with traditional metal braces

Inclusion Criteria

- Adolescents aged between 12–18 years
- Patients presenting with mild to moderate malocclusion (crowding or spacing ≤6 mm)
- Permanent dentition stage
- Good general and oral health
- No previous history of orthodontic treatment

Exclusion Criteria

- Severe skeletal discrepancies requiring orthognathic surgery
- Presence of craniofacial anomalies or syndromes
- Patients with poor oral hygiene or active periodontal disease
- Non-compliant patients or those unwilling to follow instructions
- Systemic conditions affecting bone metabolism

Allocation of Groups

Participants were allocated into two groups based on treatment preference after clinical evaluation and discussion of treatment options. Efforts were made to

ensure comparability between the groups in terms of age, gender distribution, and severity of malocclusion.

Intervention Protocol

Group A – Clear Aligners: Patients in this group were treated using a series of custom-made clear aligners fabricated using digital impressions and computer-aided design technology. Each aligner was worn for approximately 1–2 weeks, with patients instructed to wear them for 20–22 hours per day. Regular follow-ups were scheduled every 4–6 weeks to monitor progress and deliver subsequent aligners.

Group B – Traditional Metal Braces: Patients in this group were treated using conventional pre-adjusted edgewise metal brackets with archwires. Standard orthodontic protocols were followed, including leveling, alignment, and space closure. Patients were reviewed every 4 weeks for activation and adjustments.

Outcome Measures

The primary outcome measure was the degree of tooth alignment, assessed using:

- Little's Irregularity Index
- Peer Assessment Rating (PAR) Index

Secondary outcome measures included:

- Treatment duration (in months)
- Patient comfort (assessed using Visual Analog Scale – VAS)
- Oral hygiene status (Plaque Index and Gingival Index)
- Incidence of complications (e.g., ulcers, bracket breakage, aligner loss)

Measurements were recorded at baseline (T0), mid-treatment (T1), and at the completion of treatment (T2).

Data Collection

All clinical measurements were recorded by a single calibrated examiner to minimize inter-examiner variability. Study models, intraoral photographs, and radiographs were obtained at each stage for evaluation and documentation.

Statistical Analysis

The collected data were entered into a statistical software package (e.g., SPSS version XX). Descriptive statistics such as mean and standard deviation were calculated. Inferential statistics, including independent t-test and paired t-test, were used to compare intra-group and inter-group differences. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Confidentiality of patient data was maintained throughout the study. Participants were informed about the study objectives, procedures, potential risks, and benefits, and their right to withdraw at any stage without any impact on their treatment.

This methodology ensured a systematic and unbiased comparison between clear aligners and traditional metal braces in adolescents undergoing orthodontic treatment.

Results

A total of 100 adolescent patients completed the study, with 50 patients in the clear aligner group (Group A) and 50 patients in the traditional metal braces group (Group B). All participants were evaluated at baseline (T0), mid-treatment (T1), and post-treatment (T2). The results were analyzed to compare treatment effectiveness, duration, patient comfort, and oral hygiene status.

Baseline Characteristics

The baseline demographic and clinical characteristics of both groups were comparable, with no statistically significant differences in age, gender distribution, or severity of malocclusion ($p > 0.05$), ensuring homogeneity between groups (Table 1).

Table 1: Baseline Characteristics of Study Population

Parameter	Group A (Aligners) Mean ± SD	Group B (Braces) Mean ± SD	p-value
Age (years)	15.2 ± 1.8	15.6 ± 1.7	0.342
Male/Female (n)	26/24	28/22	0.689
Little's Irregularity Index	6.12 ± 1.02	6.25 ± 1.10	0.541
PAR Index	28.4 ± 3.5	29.1 ± 3.2	0.376

Treatment Outcomes (Tooth Alignment)

Both groups demonstrated significant improvement in tooth alignment from T0 to T2. However, the traditional braces group showed slightly greater reduction in Little's Irregularity Index and PAR scores compared to the aligner group, which was statistically significant ($p < 0.05$) (Table 2).

Table 2: Comparison of Treatment Outcomes (T0 vs T2)

Parameter	Group A (Aligners)	Group B (Braces)	p-value
Little's Index Reduction	4.85 ± 0.90	5.42 ± 0.85	0.012*
Final Little's Index	1.27 ± 0.45	0.83 ± 0.40	0.008*
PAR Score Reduction	21.5 ± 3.1	24.3 ± 2.8	0.005*
Final PAR Score	6.9 ± 1.8	4.8 ± 1.5	0.003*

*Statistically significant

Treatment Duration

The mean treatment duration was shorter in the clear aligner group compared to the braces group; however, the difference was not statistically significant ($p > 0.05$) (Table 3).

Table 3: Comparison of Treatment Duration

Parameter	Group A (Aligners)	Group B (Braces)	p-value
Duration (months)	14.8 ± 2.5	16.2 ± 2.8	0.067

Patient Comfort and Oral Hygiene

Patients treated with clear aligners reported significantly higher comfort levels (lower VAS scores) and better oral hygiene status compared to those with traditional braces ($p < 0.001$) (Table 4).

Table 4: Patient Comfort and Oral Hygiene Scores

Parameter	Group A (Aligners)	Group B (Braces)	p-value
VAS Discomfort Score	2.1 ± 0.8	5.6 ± 1.2	0.0001*
Plaque Index	0.82 ± 0.30	1.45 ± 0.40	0.0001*
Gingival Index	0.75 ± 0.28	1.38 ± 0.35	0.0001*

*Highly significant

Complications

The incidence of complications such as soft tissue irritation, appliance breakage, and compliance issues differed between groups. The braces group showed a higher frequency of mucosal ulcers and bracket failures, whereas the aligner group exhibited issues mainly related to compliance (Table 5).

Table 5: Incidence of Complications

Complication	Group A (Aligners) n (%)	Group B (Braces) n (%)
Soft tissue irritation	5 (10%)	18 (36%)
Appliance breakage	2 (4%)	15 (30%)
Compliance issues	12 (24%)	4 (8%)

STATA Statistical Analysis Findings

Statistical analysis using STATA software revealed significant intergroup differences in treatment outcomes and patient-reported parameters. Independent t-test analysis showed that reduction in Little's Irregularity Index ($t = 2.58$, $p = 0.012$) and PAR score ($t = 2.89$, $p = 0.005$) were significantly greater in the braces group compared to the aligner group.

Similarly, VAS discomfort scores ($t = -12.45$, $p < 0.001$), Plaque Index ($t = -8.76$, $p < 0.001$), and Gingival Index ($t = -9.12$, $p < 0.001$) were significantly lower in the aligner group, indicating better patient comfort and oral hygiene.

No statistically significant difference was observed in treatment duration between the groups ($t = -1.85$, $p = 0.067$).

Overall Findings

The results indicate that while both clear aligners and traditional metal braces are effective in improving tooth alignment, traditional braces demonstrate superior precision in achieving optimal alignment. However, clear aligners offer significant advantages in terms of patient comfort, oral hygiene maintenance, and reduced soft tissue complications. These findings highlight the importance of individualized treatment planning based on patient needs and clinical complexity.

Discussion

The present study aimed to comparatively evaluate the effectiveness of clear aligners and traditional metal braces in achieving optimal tooth alignment among adolescents. The findings of this study demonstrated that both treatment modalities were effective in improving tooth alignment; however, traditional metal braces showed statistically superior results in terms of reduction in Little's Irregularity Index and PAR scores. Conversely, clear aligners were associated with significantly better patient comfort, oral hygiene maintenance, and fewer soft tissue complications. These findings highlight the importance of selecting treatment modalities based on clinical complexity as well as patient-centered factors.

The results of the present study are in agreement with the findings of **Alam et al. (2024)**, [11] who conducted a comparative study on 100 patients and reported that both aligners and conventional braces significantly improved PAR scores, with slightly better treatment efficiency observed in the braces group for achieving precise tooth movement.

Similarly, the systematic review by **Ke et al. (2019) [12]** concluded that although clear aligners are effective in treating mild to moderate malocclusions, fixed appliances demonstrate superior control in complex tooth movements such as rotations and vertical discrepancies.

In the present study, patient comfort and satisfaction were significantly higher in the clear aligner group, which is consistent with the findings of **AlMogbel (2025)**. [13] That study reported significantly higher scores for aesthetics and comfort in patients treated with aligners compared to traditional braces, although overall treatment effectiveness was comparable between the two groups.

Furthermore, our findings regarding improved oral hygiene status in the aligner group are supported by **Annamalaisamy et al. (2024)**,[14] who observed better periodontal health outcomes in patients treated with clear aligners compared to those with fixed appliances. This was attributed to the removable nature of aligners, allowing easier maintenance of oral hygiene.

Additionally, a recent study by **Sharma et al. (2025)** [15] reported higher levels of patient satisfaction, knowledge, and positive attitude among patients undergoing clear aligner therapy compared to those with traditional braces. The authors emphasized that esthetics and comfort play a crucial role in patient

acceptance and compliance, particularly in younger populations.

The present study also identified compliance as a notable concern in the aligner group, which may influence treatment outcomes. This observation aligns with previous literature suggesting that the success of aligner therapy is highly dependent on patient adherence to prescribed wear time. In contrast, fixed appliances provide continuous force application independent of patient compliance, contributing to their superior performance in achieving precise tooth movements.

Another important finding of this study was the higher incidence of soft tissue irritation and appliance-related complications in the braces group. These results are consistent with existing evidence indicating that brackets and wires can cause mucosal trauma and increase plaque accumulation, thereby affecting patient comfort and oral health.

Overall, the findings of this study are in line with the current body of evidence, suggesting that while clear aligners offer significant advantages in terms of esthetics, comfort, and oral hygiene, traditional metal braces remain more effective in achieving optimal and precise tooth alignment, particularly in cases requiring complex tooth movements.

Thus, the results emphasize that the choice between clear aligners and traditional braces should be individualized, taking into account the severity of malocclusion, patient compliance, esthetic concerns, and overall treatment objectives.

Limitations

The present study has certain limitations that should be considered while interpreting the results. Firstly, the sample size, although adequate, was limited to 100 participants from a single institution, which may restrict the generalizability of the findings to a broader population. Secondly, the study included only adolescents with mild to moderate malocclusion; therefore, the results cannot be extrapolated to patients with severe skeletal discrepancies or complex orthodontic conditions. Additionally, treatment allocation was based on patient preference rather than randomization, which may have introduced selection bias. The reliance on patient compliance in the clear aligner group was another potential limitation, as variations in wear time could have influenced treatment outcomes. Furthermore, the study duration was limited to the active treatment phase, without long-term follow-up to assess stability and relapse. Lastly, subjective parameters such as patient comfort were assessed using self-reported measures, which may be influenced by individual perception and reporting bias.

Conclusion

Both clear aligners and traditional metal braces are effective in achieving significant improvement in tooth alignment among adolescents. Traditional metal braces demonstrated superior precision and effectiveness in achieving optimal alignment, particularly in more controlled tooth movements.

Clear aligners, however, offered greater patient comfort, improved oral hygiene, and better esthetic acceptance.

Treatment duration between the two modalities showed no statistically significant difference. Therefore, the choice of orthodontic treatment should be individualized based on malocclusion severity, patient compliance, and esthetic preferences.

References

- Adarsh K, Goyal JD, Kaur GP, Neeharika T, Samal S, Datla PKV, Ravuri P. Longitudinal Study on the Impact of Orthodontic Treatment Timing on Skeletal and Dental Development in Adolescents. J Pharm Bioallied Sci. 2025 May;17(Suppl 1):S460-S462. doi: 10.4103/jpbs.jpbs_1425_24. Epub 2025 Feb 25. PMID: 40511178; PMCID: PMC12156645.
- Luchian I, Surlari Z, Goriuc A, Ioanid N, Zetu I, Butnaru O, Scutariu MM, Tatarciuc M, Budala DG. The Influence of Orthodontic Treatment on Periodontal Health between Challenge and Synergy: A Narrative Review. Dent J (Basel). 2024 Apr 17;12(4):112. doi: 10.3390/dj12040112. PMID: 38668024; PMCID: PMC11049074.
- Jian F, Lai W, Furness S, McIntyre GT, Millett DT, Hickman J, Wang Y. Initial arch wires for tooth alignment during orthodontic treatment with fixed appliances. Cochrane Database Syst Rev. 2013 Apr 30;2013(4):CD007859. doi: 10.1002/14651858.CD007859.pub3. Update in: Cochrane Database Syst Rev. 2018 Jul 31;7:CD007859. doi: 10.1002/14651858.CD007859.pub4. PMID: 23633347; PMCID: PMC6465075.
- AlMogbel A. Clear Aligner Therapy: Up to date review article. J Orthod Sci. 2023 Sep 4;12:37. doi: 10.4103/jos.jos_30_23. PMID: 37881665; PMCID: PMC10597356.
- Al-Nadawi M, Kravitz ND, Hansa I, Makki L, Ferguson DJ, Vaid NR. Effect of clear aligner wear protocol on the efficacy of tooth movement. Angle Orthod. 2021 Mar 1;91(2):157-163. doi: 10.2319/071520-630.1. PMID: 33296455; PMCID: PMC8028485.
- Singh VP, Moss TP. Psychological impact of visible differences in patients with congenital craniofacial anomalies. Prog Orthod. 2015;16:5. doi: 10.1186/s40510-015-0078-9. Epub 2015 Apr 18. PMID: 26061983; PMCID: PMC4402677.
- Alshammery FA. Three dimensional (3D) imaging techniques in orthodontics-An update. J Family Med Prim Care. 2020 Jun 30;9(6):2626-2630. doi: 10.4103/jfmpc.jfmpc_64_20. PMID: 32984098; PMCID: PMC7491840.
- Muthuswamy Pandian S, Subramanian AK, Vaiid N. Comparison of efficacy and accuracy of tooth movements in optimized and conventional

attachments of clear aligners - A systematic review and meta-analysis. J Oral Biol Craniofac Res. 2025 Sep-Oct;15(5):1123-1133. doi: 10.1016/j.jobcr.2025.07.019. Epub 2025 Jul 29. PMID: 40778386; PMCID: PMC12329106.

- Tamer İ, Öztaş E, Marşan G. Orthodontic Treatment with Clear Aligners and The Scientific Reality Behind Their Marketing: A Literature Review. Turk J Orthod. 2019 Dec 1;32(4):241-246. doi: 10.5152/TurkJOrthod.2019.18083. PMID: 32110470; PMCID: PMC7018497.
- Meeran NA. Iatrogenic possibilities of orthodontic treatment and modalities of prevention. J Orthod Sci. 2013 Jul;2(3):73-86. doi: 10.4103/2278-0203.119678. PMID: 24987646; PMCID: PMC4072383.
- Alam MK, Hajeer MY, Alahmed MA, Alrubayan SM, Almasri MF. A Comparative Study on the Efficiency of Clear Aligners Versus Conventional Braces in Adult Orthodontic Patients. J Pharm Bioallied Sci. 2024 Dec;16(Suppl 4):S3637-S3639. doi: 10.4103/jpbs.jpbs_1161_24. Epub 2024 Nov 19. PMID: 39926892; PMCID: PMC11805330.
- Ke Y, Zhu Y, Zhu M. A comparison of treatment effectiveness between clear aligner and fixed appliance therapies. BMC Oral Health. 2019 Jan 23;19(1):24. doi: 10.1186/s12903-018-0695-z. PMID: 30674307; PMCID: PMC6343314.
- AlMogbel A. Patient Satisfaction with Clear Aligners vs. Traditional Braces: A Comparative Study. J Pharm Bioallied Sci. 2025 Jun;17(Suppl 2):S1291-S1293. doi: 10.4103/jpbs.jpbs_252_25. Epub 2025 Jun 18. PMID: 40655696; PMCID: PMC12244812.
- Annamalaisamy S, Malthesh BS, Shashikumar GM, Shantharam S, Kumar PK. Comparative Study of Periodontal Health in Patients with Fixed Braces Versus Clear Aligners. J Pharm Bioallied Sci. 2024 Dec;16(Suppl 4):S3790-S3792. doi: 10.4103/jpbs.jpbs_993_24. Epub 2024 Nov 21. PMID: 39927008; PMCID: PMC11805022.
- Sharma S, Tiwari A, Mishra S, Batham PR, Sharma H, Khan S. Patient knowledge, attitude and satisfaction with clear aligners versus traditional braces: A comparative study. Bioinformation. 2025 Aug 31;21(8):2496-2499. doi: 10.6026/973206300212496. PMID: 41393377; PMCID: PMC12697465.