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Comparative Evaluation of Expected and Actual Treatment Outcomes for Overjet and Overbite Correction with Clear Aligners: A Retrospective Clinical Study

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KEYWORDS

Aligners, Invisalign, Predicted Overjet, Predicted Overbite, Actual Overjet, Actual Overbite, Efficacy

ABSTRACT:

Introduction: Clear aligners offer numerous advantages over traditional braces, including superior aesthetics, improved oral hygiene, fewer emergency visits, and enhanced patient comfort.Their removability allows patients to maintain better periodontal health throughout treatment, reducing the risk of decalcification and carious lesions associated with fixed appliances. Moreover, the transparent appearance of aligners addresses a major psychological barrier for adult patients, many of whom are reluctant to undergo visible orthodontic treatment. By comparing planned movements in the digital setup with the actual clinical outcomes, this study will provide insights into the real-world performance of clear aligner therapy in specific clinical scenarios Aim: The aim of the study is to evaluate and compare Expected and Actual Treatment Outcome for Overjet and Overbite on digital models of those individuals who have undergone treatment with Clear Aligners Methodology: The retrospective study comprises of 38 patients treated with aligners. The pretreatment, expected post treatment and actual post treatment overjet and overbite were evaluated and efficacy for aligners to treat overjet and overbite was calculated in terms of percentage Results: The mean pretreatment overjet was 4.31 ± 0.83 mm and overbite was 4.21 ± 0.81 mm, with an efficacy rate of 47.59 ± 8.01% for overbite and 51.59 ± 6.78% for overjet. The results indicate that while clear aligners can effectively reduce overjet and overbite, the achieved corrections were often less precise than predicted by digital treatment planning. Conclusion: Clear aligners can reduce overjet and overbite, but their predictability for the same is less. Clinicians must prioritize case selection, biomechanical planning, and patient compliance to optimize outcomes.

1. Introduction

Orthodontics has witnessed substantial evolution over the past few decades, with a marked shift from purely functional correction toward a comprehensive approach that includes aesthetics, comfort, and oral hygiene.[1] Modern orthodontic patients, particularly adults, increasingly seek discreet and efficient treatment modalities that integrate seamlessly with their lifestyles. This growing demand has catalyzed the development of innovative orthodontic appliances designed to offer both effective tooth movement and enhanced patient satisfaction.

Clear aligners offer numerous advantages over traditional braces, including superior aesthetics, improved oral hygiene, fewer emergency visits, and enhanced patient comfort.[2] The foundation of modern aligner therapy was laid in 1998 with the introduction of Invisalign by Align Technology.[3] This system represented a paradigm shift by integrating digital technology into orthodontics, utilizing three-dimensional imaging and computer-aided design to allow clinicians to plan and visualize tooth movements before initiating treatment.

Despite advancements in materials, attachment design, and treatment protocols, questions persist regarding the predictability and efficiency of clear aligners compared to traditional fixed appliances. A systematic review by Papadimitriou et al.[5] found that aligners can successfully

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treat mild to moderate malocclusions but highlighted significant limitations in cases requiring bodily movements, closure of extraction spaces, and management of larger anteroposterior or vertical discrepancies.

Robertson et al.[6] evaluated Invisalign outcomes compared to traditional fixed appliances and found that while acceptable clinical results could be achieved, the predictability of certain tooth movements was lower compared to braces. The need for mid-course corrections and refinement aligners was commonly reported, suggesting that initial treatment plans often required adjustments to achieve desired outcomes.

Vertical control remains particularly challenging in clear aligner therapy. Krieger et al.[7] compared pre-treatment and post-treatment intraoral scans with planned ClinCheck simulations and found that while most discrepancies between predicted and achieved outcomes were clinically insignificant, overbite correction showed a notable 0.71 mm average discrepancy.

Kravitz et al.[8] conducted a prospective clinical study evaluating the accuracy of Invisalign in anterior tooth movement and found that overall accuracy of tooth movements was approximately 41%, with lingual constriction showing the highest predictability (47.1%) and anterior extrusion showing the lowest (29.6%).

Given the ongoing debate regarding the capabilities and limitations of clear aligners, the present study seeks to evaluate and compare expected and actual treatment outcomes for overjet and overbite correction with clear aligners, providing insights into the real-world performance of clear aligner therapy.

Need for the Study

After thorough search of literature till 10-02-2025 from PubMed, Google scholar and science direct, there has been lack of evidence in the literature regarding the comparative evaluation of Expected and Actual Treatment Outcome for Overjet and Overbite with Clear Aligners. Understanding the ability of clear aligners to achieve the targeted overjet and overbite can help practitioners select appropriate cases for treatment, comprehend the amount of over-correction required, decrease the number of refinements and overall reduce the treatment duration.

Therefore, additional studies assessing the Expected and Actual Treatment Outcome for Overjet and Overbite with Clear Aligners are required. Hence, this retrospective study has been taken up. The null hypothesis is that there is no difference between expected and actual Treatment Outcome for Overjet and Overbite with Clear Aligners.

2. Materials and Methods

Study Design

This retrospective cross-sectional study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, K.M. Shah Dental College and Hospital, Sumandeep Vidyapeeth, Piparia, Vadodara, after obtaining ethical approval from the Sumandeep Vidyapeeth Institutional Ethical Committee.

Selection Criteria

Inclusion Criteria: Patients >18 years of age; both maxillary and mandibular arches treated with Invisalign; availability of pretreatment, expected post-treatment, and actual post-treatment ClinCheck scans; non-extraction cases; patients with increased overjet and overbite >2 mm; complete permanent dentition; patients compliant with prescribed Invisalign wear protocols.

Exclusion Criteria: Poor scans with uncaptured teeth; patients requiring orthognathic surgery or restorative build-ups; patients who switched to braces; cleft lip and cleft palate or other craniofacial syndromes; bone metabolism-altering medications.

Sample Size

Sample size was calculated based on the study by Blundell et al.[22] With an alpha error of 5%, power of 80%, expected standard deviation of 0.22, and clinically significant difference of 0.1, the required sample size was 38 patients.

Data Collection

Proformas for collecting pretreatment, expected post-treatment, and actual post-treatment overjet and overbite measurements were provided to clinicians at participating dental centers. The clinicians gathered data from ClinCheck software and returned filled proformas to maintain patient confidentiality.

Efficacy Calculation

The efficacy of aligner correction was calculated as: **Efficacy = (Actual Outcome / Expected Outcome) × 100**

Where Actual Outcome = difference between actual post-treatment and pretreatment measurements; Expected Outcome = difference between software-obtained post-treatment and pretreatment measurements.

Statistical Analysis

Unpaired t-tests were used to evaluate differences between expected and actual treatment outcomes, with $p < 0.05$ considered statistically significant.

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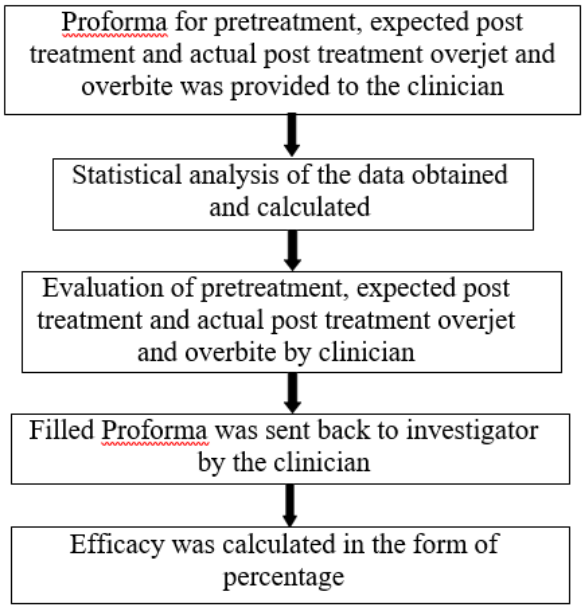

3. Results

Table 1. Demographic Details

Sr. No.	Age (in years)	Gender
Mean and Standard Deviation	27.02 ± 4.23	16 males, 22 females

Table 2. Overjet: Pretreatment & Efficacy

Sr. No.	Pre treatment	Difference between Pre-treatment and Expected treatment outcome	Difference between Pre-treatment and Actual treatment outcome	Efficacy
1.	3.6	1.7	0.9	52.94
2.	3.1	1.2	0.7	58.33
3.	5.1	3.2	1.5	46.87
4.	4.66	2.77	1.56	56.31
5.	5.24	3.24	1.36	41.97
6.	3.6	1.5	0.6	40
7.	4.5	2.6	1.4	53.84
8.	3.55	2.1	1.12	53.33
9.	4.65	2.65	1.31	49.43
10.	3.1	1.9	0.8	42.1
11.	4.22	2.27	1.43	62.99
12.	5.3	2.8	1.52	54.28

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13.	3.25	1.37	0.75	54.74
14.	3.98	2.31	1.2	51.94
15.	5.2	3.2	1.39	43.43
16.	3.21	1.77	1.09	61.58
17.	4.56	2.58	1.34	51.93
18.	5.65	2.45	1.15	46.93
19.	3.45	1.65	0.91	55.15
20.	4.23	2.24	1	44.64
21.	3.65	1.96	1.11	56.63
22.	5.11	2.61	1.22	46.74
23.	4.78	2.89	1.22	42.21
24.	5.45	3.35	1.47	43.88
25.	4.26	2.7	1.61	59.62
26.	3.99	1.99	1.01	50.75
27.	6.23	3	1.69	56.33
28.	4.22	2.88	1.67	57.98
29.	3.45	1.7	0.8	47.05
30.	4.55	3.21	1.33	41.43
31.	3.24	1.26	0.59	46.82
32.	5.22	3.32	1.72	51.8
33.	4.23	2.58	1.13	43.79
34.	5.45	3.46	2.05	59.24
35.	3.67	2.01	1.17	58.2
36.	4.66	2.69	1.41	52.41
37.	4.67	2.78	1.57	56.47
38.	2.98	1.32	0.88	66.66
Mean and Standard Deviation	4.31 ±0.83			51.59± 6.78

Table 3. Overbite: Pretreatment & Efficacy

Sr. No.	Pre treatment	Difference between Pre treatment and Actual treatment outcome	Difference between Pre treatment and Expected treatment outcome	Efficacy
1.	4.1	1.5	2.7	55.55
2.	3.68	1.01	2.14	47.19

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3.	5.3	1.1	2.3	47.82
4.	5.3	1.6	3.3	48.4
5.	3.3	0.8	1.8	44.44
6.	4.95	1.62	3.9	41.53
7.	4.59	1.59	3.78	42.06
8.	3.21	0.69	1.71	40.35
9.	4.53	1.73	3.03	57.09
10.	3.56	0.78	1.67	46.7
11.	5.2	1.7	3.22	52.79
12.	4.83	1.43	4.04	35.39
13.	4.88	1.66	3.38	49.11
14.	3.8	1.1	2.4	45.83
15.	4.45	0.67	1.8	37.22
16.	4.72	1.61	3.89	41.38
17.	5.21	0.68	1.71	39.76
18.	4.78	1.61	3.99	40.35
19.	4.22	1.21	2.22	54.5
20.	4.22	1.1	3.33	33.03
21.	4.66	1.71	3.81	44.88
22.	5.1	0.9	1.6	56.25
23.	2.32	0.77	1.37	56.2
24.	3.55	2.25	2.3	54.3
25.	3.4	0.9	1.9	47.36
26.	4.84	1.63	4	40.75
27.	5.22	1.11	2.72	40.44
28.	3.1	0.85	1.5	56.66
29.	4.32	1.04	1.75	59.42
30.	4.62	1.12	2.82	39.71
31.	3.98	1.31	2.33	56.22
32.	3.26	1.13	2.37	47.67
33.	4.68	1.61	3.83	42.03
34.	2.89	1.3	2.1	61.9
35.	4.23	1.3	2.13	48.82
36.	2.85	1.27	1.88	67.55
37.	5.22	1.24	3.27	37.92

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38.	3.22	0.96	1.92	50
Mean and Standard Deviation	4.21±0.81			47.59±8.01

Table 4. Comparison between Expected overjet change and Actual overjet

Sr. No.	P value
Overjet	0.000
Overbite	0.000

The study included 38 participants, 16 males and 22 females with mean age of 27.02 ± 4.23years.

The pretreatment overjet and overbite is 4.31 ±0.83mm and 4.21±0.81 mm respectively.

The efficacy of aligners in treating overjet is 51.59± 6.78%

The efficacy of aligners in treating overjet is 47.59±8.01%

Unpaired t test was used to evaluate difference between expected overjet and overbite reduction and actual overjet and overbite reduction and p value <0.05 was considered statistically significant. Here, the p value obtained for both is 0.000

4. Discussion

The present study aimed to evaluate the efficacy of clear aligner therapy in correcting overjet and overbite by comparing digital treatment predictions (ClinCheck) with actual clinical outcomes. The findings provide critical insights into the capabilities and limitations of clear aligners in managing vertical and sagittal discrepancies, contributing to the ongoing debate about their effectiveness relative to traditional fixed appliances.

The study analyzed 38 patients with a mean age of 27.02 ± 4.23 years, consisting of 16 males and 22 females. The mean pretreatment overjet was 4.31 ± 0.83 mm, and overbite was 4.21 ± 0.81 mm, with an efficacy rate of 47.59 ± 8.01% for overbite and 51.59 ± 6.78% for overjet. These results indicate that while clear aligners can effectively reduce overjet and overbite, the achieved corrections were often less precise than predicted by digital treatment planning.

Notably, the efficacy rates varied widely among patients, with some cases achieving near-ideal corrections while others required refinements. This variability underscores the importance of case selection, biomechanical planning, and patient compliance in clear aligner therapy.

Our findings align with existing literature on the predictability of clear aligners. The 47.59% efficacy in overbite correction found in our study closely mirrors the findings of Krieger et al.[10], who reported a 0.71 mm average discrepancy in vertical movements. Both studies highlight the persistent challenge of vertical control with aligner therapy. However, our results show marginally better performance than those of Robertson et al[6], who found only 38-42% accuracy in deep bite correction.

Our results demonstrating 51.59% efficacy in overjet reduction compare favorably with Kravitz et al[8], who reported 41% overall accuracy in anterior tooth movement. However, our outcomes show slightly better performance, potentially attributable to advancements in aligner technology since their study. The introduction of optimized attachments and SmartTrack material in contemporary systems appears to have improved sagittal correction capabilities. This improvement is particularly notable when compared to early aligner systems studied by Boyd[11], which showed only 30-35% accuracy in anterior-posterior movements. Papadimitriou et al. [5] concluded that clear aligners are effective for mild to moderate malocclusions but struggle with complex movements such as deep bite correction and significant anteroposterior discrepancies. Our results support this conclusion, as the 47.59% efficacy in overbite reduction suggests that aligners alone may be insufficient for severe vertical discrepancies. Simon et al[12] demonstrated 58% improvement in overjet reduction accuracy, 22% reduction in refinements need, Better root control with Auxiliary mechanics, such as elastics and bite ramps. However, Grünheid et al[13]cautioned that even with improvements, 43% of cases still required mid-course corrections, Average 0.8mm discrepancy remained for overjet ≥5mm and Canine retraction remained particularly challenging. Additionally, Charalampakis et al.[14] observed that rotational movements and incisor

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intrusion were less predictable with aligners, which correlates with our findings on overbite correction. The difficulty in achieving precise vertical control may be attributed to the material properties of aligners and their reliance on intermittent force application rather than the continuous forces provided by fixed appliances.

There are many factors which may be responsible for Influencing Treatment Efficacy with aligners. Unlike fixed appliances, which use brackets and archwires to apply controlled, continuous forces, aligners depend on plastic deformation to generate tooth movement. This makes bodily movements, root torque, and extrusion inherently less predictable. The thickness of aligner material can also interfere with occlusal contacts, potentially leading to unintended posterior intrusion—a phenomenon noted in previous studies [10].

Secondly, Patient Compliance is an utmost factor in treatment with Clear aligners. It needs to be worn 20–22 hours daily to be effective. Poor compliance (e.g., inconsistent wear or improper seating of aligners) can significantly reduce force delivery, leading to incomplete tooth movement. Studies[15] suggest that real-time wear monitoring devices (e.g., compliance indicators) may improve patient adherence and treatment accuracy.

With aligners careful Case Selection and Treatment Planning should be done. Patients with severe overjet (>5 mm) or deep bite (>5 mm) may not be ideal candidates for aligner-only treatment. Hybrid approaches (e.g., aligners with limited fixed appliances or temporary anchorage devices) may yield better outcomes. [16]

Clinicians should educate patients about the limitations of clear aligners, particularly in complex cases. Emphasizing the potential need for refinements or mid-course corrections. [17]

With Enhanced force systems through optimized attachment design, Improved material properties (SmartTrack), More sophisticated digital treatment planning algorithms, precision cuts, interproximal reduction and better understanding of staging protocols, aligner performance has been enhanced and predictability has improved.[1,8] Elastics and bite ramps can improve overbite correction by facilitating anterior intrusion or posterior extrusion.

Study Limitations

The retrospective design limits control of variables influencing treatment outcomes. Multi-center data collection may have introduced variability in treatment protocols. Patient compliance was assessed through clinician reports rather than objective monitoring.

5. Conclusion

This study demonstrates that clear aligners can effectively reduce overjet and overbite, but their predictability for the same is less. Clinicians must prioritize case selection, biomechanical planning, and patient compliance to optimize outcomes. Future advancements in aligner materials, digital treatment planning, and auxiliary mechanics may further enhance their efficacy in complex malocclusions. The findings suggest that while aligners are now suitable for a broader range of cases than previously thought, their optimal use requires careful consideration of their specific strengths and limitations relative to alternative treatment modalities.

Human and Animal Rights

No human rights were violated in the present study.

Consent for Publication

Consent for publication was obtained by each patient, by the patients' parents and legal representatives.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise

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Declared none.

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