

TRUE INCISOR INTRUSION IN DEEP BITE CORRECTION WITH CLEAR ALIGNERS

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ABSTRACT

Background: Deep bite correction with clear aligners may occur through several mechanisms, including true anterior intrusion, relative intrusion, incisor proclination, and posterior dentoalveolar changes (Moshiri et al., 2021; Kravitz et al., 2020). Because these mechanisms differ biomechanically, overbite reduction alone does not necessarily indicate genuine intrusion (Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2020). **Objective:** To evaluate the effectiveness and predictability of true incisor intrusion during deep bite correction with clear aligners. **Methods:** A focused qualitative synthesis was conducted using studies from PubMed, ScienceDirect, and Scopus published in English between January 2020 and February 2026. Eligible studies involved human deep bite treatment with clear aligners and reported intrusion-related outcomes, including true anterior intrusion, mandibular or upper incisor intrusion, or cephalometric/CBCT findings distinguishing intrusion from other bite-opening mechanisms. Case reports, reviews, conference abstracts without full text, in vitro, finite-element, animal, and syndromic/cleft studies were excluded. **Results:** Seventeen studies were included, though fewer directly quantified true intrusion. Predictability of intrusion was consistently moderate rather than high. Reported accuracy ranged from 45.54% to 53.3% across adult and CBCT-based studies, while mandibular incisor intrusion was more accurate in adolescents than adults (63.5% vs 45.3%) (Kravitz et al., 2024). Findings suggest that clinically observed bite opening often reflects mechanisms other than pure intrusion, particularly proclination and dentoalveolar adaptations. **Conclusion:** Clear aligners can achieve true incisor intrusion and contribute to deep bite correction, but outcomes are moderately predictable and commonly smaller than digitally planned. Treatment should therefore include realistic expectations, likely refinement, and recognition that improved overbite does not always represent pure bodily intrusion.

Keywords: Clear Aligner; Deep Bite; True Intrusion; Anterior Intrusion; Overbite Correction; Predictability

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INTRODUCTION

Deep bite is a common vertical malocclusion characterized by excessive overlap of the anterior teeth. Clinically, it may be associated with palatal trauma, incisal wear, functional limitation, esthetic concerns, and compromised long-term occlusal stability. Clear aligner therapy is increasingly used in deep bite patients because of its esthetics, removability, and growing clinical acceptance. However, vertical control remains one of the more challenging aspects of aligner biomechanics (Moshiri et al., 2021; Kravitz et al., 2020).

A central interpretive problem in the literature is that deep bite correction may be achieved through several mechanisms. These include true anterior intrusion, relative intrusion, incisor proclination, posterior extrusion, and other dentoalveolar adaptations (Moshiri et al., 2021; Kravitz et al., 2020). Among these, true incisor intrusion is especially important because it reflects genuine apical displacement of the anterior teeth rather than apparent bite opening caused by crown tipping or compensatory changes elsewhere in the dentition (Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2020). This distinction is clinically relevant because reported overbite reduction may overstate the amount of true vertical correction actually achieved (Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023).

Although previous studies have shown that clear aligners can reduce overbite, the degree to which they produce genuine anterior intrusion remains less clear (Blundell et al., 2021; Shahabuddin et al., 2023). The available evidence is heterogeneous in design, patient selection, and outcome measurement, and many studies rely on overall overbite reduction rather than direct assessment of intrusion (Haouili et al., 2020; Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025). Therefore, the purpose of this proceeding paper was to evaluate the effectiveness and predictability of true incisor intrusion during deep bite correction with clear aligners.

LITERATURE REVIEWS AND RESEARCH METHODOLOGY

This proceeding paper is based on a focused qualitative synthesis of studies identified through a systematic search of PubMed, ScienceDirect, and Scopus. The search covered publications from January 2020 to February 2026 and used combinations of the terms clear aligner, intrusion, relative intrusion, proclination, deep bite, correction, and effectiveness. The review question was structured according to the PICOS framework and the study selection process followed PRISMA principles.

Studies were eligible when they met the following criteria: human studies involving deep bite treatment with clear aligners; permanent dentition; and reporting intrusion-related treatment outcomes, such as true anterior intrusion, mandibular or maxillary incisor intrusion, CBCT- or cephalometric assessment of intrusion, or findings that allowed intrusion to be distinguished from proclination or other bite-opening mechanisms (Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025). Randomized, prospective, retrospective, and non-randomized comparative designs were considered.

Studies were excluded if they were case reports, literature reviews, opinion papers, conference abstracts without full text, animal studies, finite-element studies, in vitro studies, or investigations of syndromic or cleft patients. Only English-language studies were considered. Because the literature used heterogeneous definitions of deep bite, no single retrospective cutoff was imposed across all included studies; instead, the original study definitions were retained and interpreted in relation to intrusion-specific outcomes.

Titles and abstracts were screened after duplicate removal, followed by full-text assessment against the eligibility criteria. Data extraction included study design, sample characteristics, aligner protocol, outcome measures, and principal intrusion-related findings. Particular attention was given to CBCT and cephalometric outcomes because these methods were more

informative for distinguishing true intrusion from apparent bite opening caused by tipping or other dentoalveolar effects (Al-Balaa et al., 2021; Yan et al., 2023). Studies reporting overbite reduction alone were retained as contextual evidence but were not treated as direct proof of true intrusion (Blundell et al., 2021; Shahabuddin et al., 2023).

Most included studies were non-randomized, so methodological quality was primarily assessed using ROBINS-I. This tool evaluates bias due to confounding, participant selection, classification of interventions, deviations from intended interventions, missing data, outcome measurement, and selection of the reported result. Two reviewers assessed risk of bias independently, with disagreements resolved by discussion. In the broader review set, 15 of 17 studies were judged to have serious risk of bias and 2 were judged moderate risk.

RESEARCH RESULTS

Overview of the evidence base

The broader review included 17 studies examining clear aligners in deep bite correction. Most were retrospective and non-randomized, with sample sizes ranging from 22 to 355 participants (Haouili et al., 2020; Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025). Invisalign was the most frequently evaluated system, although not all studies specified a commercial brand. Because many studies reported overall overbite change rather than direct intrusion outcomes, the evidence base specifically addressing true intrusion was smaller than the total number of included studies. Overall methodological quality was limited, with serious risk of bias predominating.

Intrusion-focused findings

Table 1 Summary of key studies reporting intrusion-related outcomes in deep bite correction with clear aligners

Study	Design / sample	Intrusion-related outcome	Main finding
Han et al., 2025	Retrospective; n = 33	Incisor intrusion accuracy in adult female non-extraction deep bite cases	Mean intrusion accuracy during the initial phase was 45.54%; completed overbite correction averaged 41.18%; refinement provided limited additional improvement.
Al-Balaa et al., 2021	Retrospective CBCT; n = 22	Predicted vs actual true anterior intrusion	Mean precision of true anterior intrusion was 51.19%.
Yan et al., 2023	Retrospective multivariate analysis; n = 51	Upper incisor intrusion in Class II division 2	Intrusion predictability was 53.3%, whereas proclination predictability was 69.8%.
Jin et al., 2025	Retrospective; n = 24	Overcorrection design and anterior intrusion	Mean overbite reduction was 3.3 mm; overall intrusion accuracy was 52.2%; incisor intrusion accuracy ranged from 47.3% to 55.0%.
Kravitz et al., 2024	Prospective comparative; n = 58	Mandibular incisor intrusion by age	Accuracy was higher in adolescents than adults (63.5% vs 45.3%); mean achieved intrusion was 1.7 mm vs 0.9 mm.
Haouili et al., 2020	Prospective; n = 38	Overall aligner tooth movement efficacy	Overall mean movement accuracy was 50%; mandibular incisor

Study	Design / sample	Intrusion-related outcome	Main finding
			intrusion was among the less predictable movements.

As shown in Table 1, the available evidence consistently suggests that true anterior intrusion with clear aligners is achievable but only moderately predictable. Reported accuracy values repeatedly clustered around the 45% to 53% range rather than approaching full expression of the digitally planned movement. Han et al. reported mean intrusion accuracy of 45.54% in adult non-extraction cases, whereas Al-Balaa et al. found 51.19% precision for CBCT-assessed true anterior intrusion. Jin et al. reported 52.2% overall intrusion accuracy in an overcorrection study, and Yan et al. found 53.3% predictability for upper incisor intrusion in Class II division 2 patients (Al-Balaa et al., 2021; Yan et al., 2023; Han et al., 2025; Jin et al., 2025).

A notable pattern across studies is that clinically improved overbite did not necessarily correspond to equivalent amounts of true bodily intrusion. In Yan et al., proclination was more predictable than intrusion, suggesting that part of the observed bite opening may have resulted from incisor inclination changes rather than pure vertical displacement (Yan et al., 2023). This helps explain why some studies reported meaningful clinical correction despite persistent gaps between planned and achieved intrusion (Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023; Han et al., 2025; Jin et al., 2025).

Age may also influence predictability. Kravitz et al. found higher mandibular incisor intrusion accuracy in adolescents than in adults, with achieved intrusion of 1.7 mm and 0.9 mm, respectively (Kravitz et al., 2024). While this finding suggests better expression in younger patients, the evidence is still limited and does not justify treating age as a single decisive factor independent of biomechanics, malocclusion severity, or treatment design.

Why predicted and achieved intrusion differ

The discrepancy between digital planning and clinical reality appears to be multifactorial. First, vertical movements are biomechanically demanding in aligner therapy, and true intrusion likely requires more precise force systems than movements such as proclination or some linear crown changes (Kravitz et al., 2020). Second, several studies indicate that digital treatment setups may overestimate the amount of bite opening that can actually be expressed intraorally. In the broader evidence base, ClinCheck frequently overestimated achieved overbite reduction, and refinement often remained necessary (Blundell et al., 2021; Shahabuddin et al., 2023; Han et al., 2025).

Third, the way outcomes were measured may partly account for the apparent variability between studies. CBCT- and cephalometric studies are better suited to detecting true vertical tooth movement, whereas studies based primarily on overbite change may capture a composite outcome produced by intrusion, proclination, arch depth change, or posterior dentoalveolar effects (Al-Balaa et al., 2021; Yan et al., 2023). This methodological difference may explain why intrusion-specific studies tend to show only moderate predictability even when overall clinical bite improvement appears acceptable (Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023; Moshiri et al., 2021; Kravitz et al., 2020).

Finally, protocol-related factors may contribute, but current evidence does not support a simple solution. Overcorrection designs may improve expression to some extent, but they do not eliminate the discrepancy (Jin et al., 2025). Likewise, bite ramps, attachments, and elastics have not shown consistent ability to overcome the broader biomechanical limitation (Blundell et al., 2021; Han et al., 2025; Moshiri et al., 2021; Kravitz et al., 2020).

DISCUSSION & CONCLUSION

Discussion

This proceeding paper focused specifically on true incisor intrusion because overbite reduction alone can obscure the actual mechanism of correction. The present evidence indicates that clear aligners can produce genuine anterior intrusion, but the movement is usually expressed only partially relative to the digital plan. Across the most directly relevant studies, predictability remained moderate, commonly around one-half of the intended movement rather than approaching complete clinical translation (Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025).

The most important clinical implication is interpretive caution. A reduction in overbite should not automatically be regarded as evidence of successful bodily anterior intrusion. Some of the achieved correction may instead reflect proclination, relative intrusion, arch adaptation, or posterior dental effects (Yan et al., 2023; Kravitz et al., 2020). This point is not merely semantic; it affects how treatment success is judged and how digital setups should be planned. When the primary objective is precise vertical control, reliance on overbite change alone may overestimate what aligners actually accomplished biomechanically (Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023).

The available evidence also helps explain why the observed predictability rates are not uniform. Higher accuracy in adolescent patients may reflect more favorable biologic response, different compliance patterns, or case characteristics, but that interpretation remains tentative because the comparative evidence is still limited (Kravitz et al., 2024). Similarly, the somewhat different values reported across Han, Al-Balaa, Jin, and Yan likely reflect variation in patient populations, intrusion targets, imaging methods, and whether the studies measured pure intrusion or intrusion occurring within a broader treatment protocol (Al-Balaa et al., 2021; Yan et al., 2023; Han et al., 2025; Jin et al., 2025). These differences do not weaken the overall conclusion; rather, they reinforce that intrusion with aligners is real but not highly predictable under diverse clinical conditions.

From a practical standpoint, the evidence supports realistic planning rather than pessimism. Clear aligners remain clinically useful for deep bite correction, particularly when improvement rather than absolute expression of every programmed movement is the main goal (Blundell et al., 2021; Shahabuddin et al., 2023). However, clinicians should anticipate underexpression of true intrusion, possible need for overcorrection, and frequent refinement (Han et al., 2025; Jin et al., 2025). Cases demanding maximum biomechanical certainty or large amounts of precise vertical change may still be more challenging for aligners than for fixed appliances (Kravitz et al., 2020).

This paper has limitations consistent with the underlying literature. Most included studies were retrospective, most carried serious risk of bias, and definitions of deep bite were heterogeneous (Haouili et al., 2020; Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025). In addition, not all studies separated true intrusion from other bite-opening mechanisms. Therefore, the present conclusions should be interpreted as a focused synthesis of current evidence patterns rather than a definitive quantitative estimate.

Conclusion

Clear aligners can produce true incisor intrusion and contribute to deep bite correction, but the movement is only moderately predictable (Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025).

Across the currently available evidence, achieved intrusion is generally smaller than digitally planned and often coexists with other mechanisms of bite opening (Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025).

The most balanced interpretation is that true intrusion with clear aligners is clinically feasible but incomplete; accordingly, treatment should be planned with realistic expectations, likely need for refinement, and careful interpretation of whether observed overbite reduction truly reflects bodily anterior intrusion (Blundell et al., 2021; Shahabuddin et al., 2023; Al-Balaa et al., 2021; Yan et al., 2023; Kravitz et al., 2024; Han et al., 2025; Jin et al., 2025; Kravitz et al., 2020).

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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