



Short Communication

# Contemporary approaches to orthodontic treatment in complex mixed dentition cases: A comparison of clear aligners and traditional fixed appliances



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## KEYWORDS

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Temporary anchorage devices

**Abstract** This study examined orthodontic treatment strategies for patients in the mixed dentition phase, with a focus on the advantages and limitations of clear aligners and traditional fixed appliances in addressing complex tooth movements. Herein, three cases were reported to illustrate the complementary strengths of these treatment modalities. In Case 1, presurgical orthodontics for a patient with a cleft lip and palate was performed using clear aligners, resulting in successful rotation correction and optimal alignment. In Case 2, a non-invasive approach involving a transpalatal arch and fixed appliances was used to manage a high labially impacted central incisor without the use of temporary anchorage devices (TADs). In Case 3, a combination of clear aligners and braces were used to resolve severe crowding and an impacted canine, achieving the desired outcomes without extractions. The findings underscore the ability of clear aligners to enhance oral hygiene and enable precise tooth movement through software simulations. The integration of clear aligners and fixed appliances demonstrated improved treatment efficiency and patient comfort. Additional clinical trials are warranted to refine rotation correction techniques and evaluate the efficacy of TAD-assisted traction for impacted teeth.

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## Introduction

Orthodontic treatment in patients with mixed dentition presents notable challenges for clinicians, not only in correcting malocclusion but also in managing patient compliance and behavior. Advances in clear aligner technology have ensured access to more comfortable treatment modalities for an increasing number of patients, potentially enhancing both patient acceptance and therapeutic outcomes.<sup>1</sup> Clear aligners offer versatility in expanding dental arches,<sup>2</sup> guiding the eruption of permanent teeth,<sup>3</sup> and facilitating mandibular advancement<sup>4</sup> through specially designed features. However, some clinicians remain skeptical regarding their efficacy in addressing rotations,<sup>5</sup> extrusions, and other complex tooth movements. This study explored the efficacy boundaries of clear aligners, delineated optimal solutions for various types of malocclusions, and identified areas for further research in the biomechanics of clear aligner therapy.

## Materials and methods

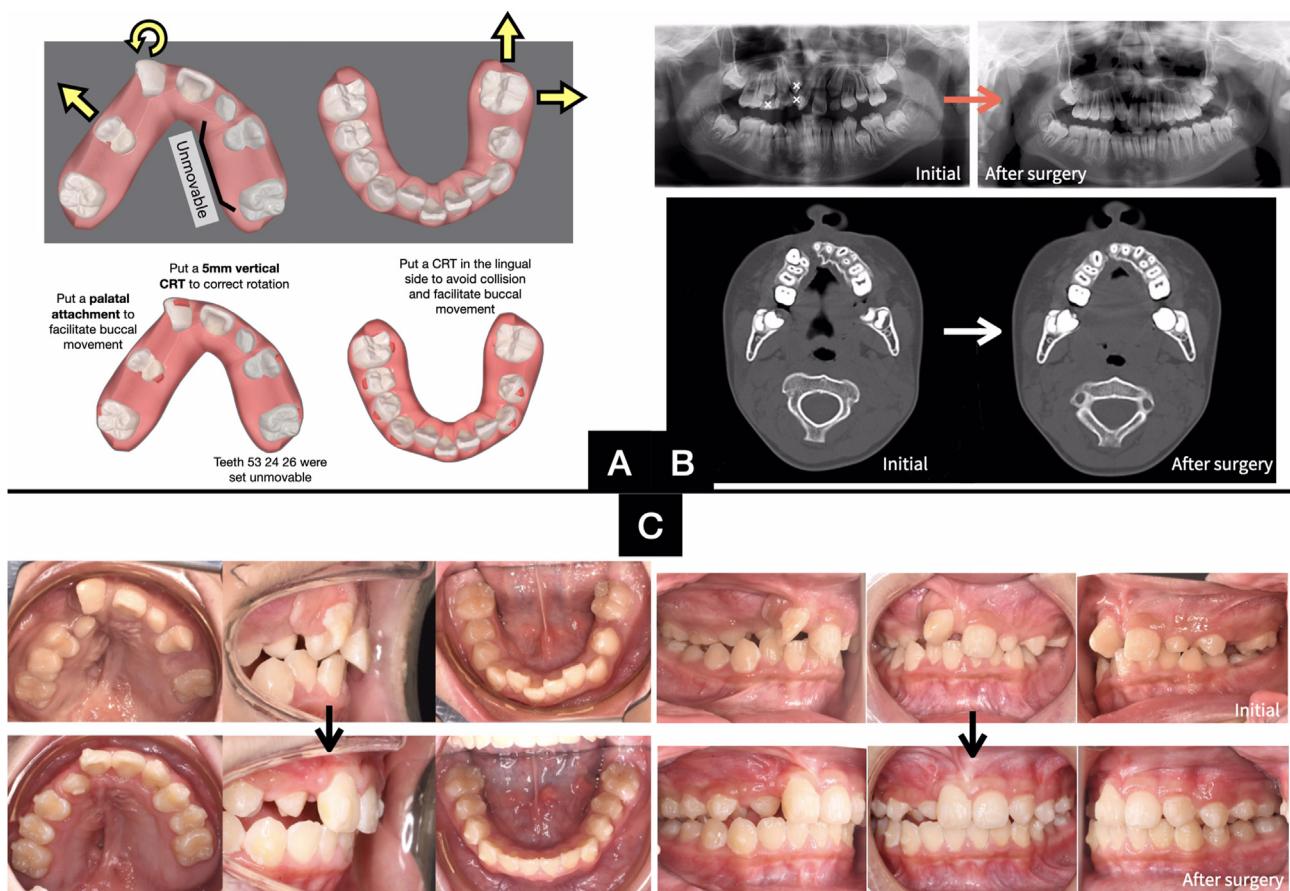
Herein, three mixed dentition cases were presented to highlight the advantages and limitations of clear aligners and traditional fixed appliances. By leveraging the

strengths of both these systems, orthodontists could achieve more efficient and predictable outcomes in mixed dentition treatment. The first case involved presurgical orthodontic treatment for a patient with a cleft lip and palate. The second case involved the successful noninvasive management of a high labially impacted central incisor without the use of temporary anchorage devices (TADs). The third case involved the successful combined use of clear aligners and traditional fixed appliances. This study helps clinicians address challenging tooth movements and elucidates the mechanisms that are most suitable and effective in achieving the desired therapeutic outcomes.

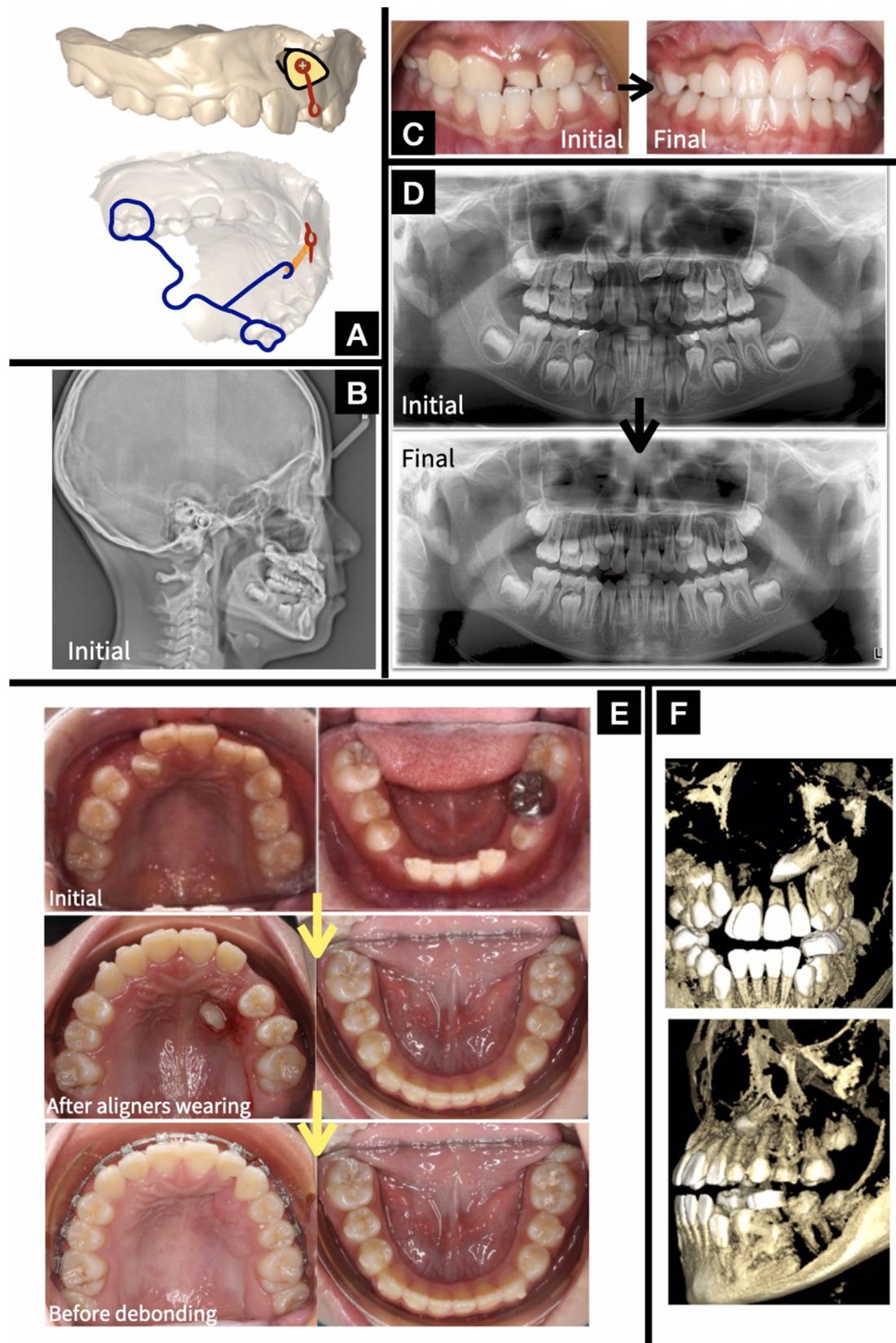
## Results

### Case 1. Presurgical orthodontics in a patient with a cleft lip and palate

A 10-year-old boy was referred by a plastic surgeon for dental alignment prior to extensive gingivoperiosteoplasty (GPP). In patients with a cleft lip and palate, phase I orthodontic treatment is typically initiated when the maxillary canines are nearing eruption, with the primary objective of aligning teeth adjacent to the cleft to facilitate alveolar bone grafting (ABG) or extensive GPP. Research indicates no significant differences in outcomes between ABG and extensive GPP procedures.<sup>6</sup>



**Figure 1** Records of Case 1. (A) Designs of tooth movements and attachments. (B) Preoperative and postoperative panoramic radiographs and CBCT images, demonstrating improved root parallelism and enhanced bone proximity. (C) Preoperative and postoperative intraoral photographs.



**Figure 2** Records of Cases 2 and 3. (A) Schematic illustrating the design of the modified transpalatal arch and traction of the impacted tooth. (B) Initial cephalometric radiograph of Case 2, depicting the high position of the impacted incisor and anterior crossbite. (C) Preoperative and postoperative panoramic radiographs depicting successful traction of the impacted tooth and correction of the crossbite. (D) Preoperative and postoperative panoramic radiographs depicting improved root parallelism. (E) Initial and progressive intraoperative photographs depicting occlusal views of Case 3. (F) Cone-beam computed tomography showing the position of the impacted canine.

The patient presented with severely rotated right maxillary central incisors (Fig. 1A), an impacted right maxillary lateral incisor, a congenitally missing left maxillary lateral incisor, an impacted left mandibular second premolar, and lingual and mesial tilting of the left mandibular first molar (Fig. 1B). Additional challenges included a right-side crossbite and left-side occlusal interference, with a complete buccal crossbite of the left maxillary first molar (Fig. 1C).

The patient was treated using Invisalign First, with the objectives being presurgical alignment around the cleft area, impacted tooth correction, and optimization of occlusion. Following the initial round of aligners, the successful correction of the severe rotation of the maxillary incisors and near-perfect alignment were achieved. Distalization of the left mandibular first molar created adequate space for the eruption of the impacted second premolar, ultimately achieving functional guidance (Fig. 1C). Two additional sets of aligners were used for finishing and detailing. This approach resulted in optimal occlusion, with bilateral maxillary canines substituting for lateral incisors and first premolars serving as canines.

#### **Case 2. Noninvasive management of a high labially impacted central incisor**

An 8-year-old boy presented with a high labially impacted left maxillary central incisor, as confirmed by cone-beam computed tomography. Additional findings included a crossbite of the maxillary central incisor (Fig. 2B), edge-to-edge occlusion of the primary maxillary left central incisor, and malalignment of the lower anterior teeth.

A noninvasive treatment approach was implemented by using a modified transpalatal arch (TPA) for anchorage (Fig. 2A). After the delivery of the TPA, traditional brackets ( $0.018 \times 0.025$ -inch slots) were bonded to the upper incisors to facilitate a  $2 \times 4$  mechanical system. Sequential leveling and alignment of the upper anterior teeth were achieved using 0.014-inch nickel-titanium (NiTi), 0.016-inch NiTi, and  $0.016 \times 0.022$ -inch NiTi archwires. Open coiled springs were placed between the right maxillary central incisor and left maxillary lateral incisor to create adequate space for the impacted tooth while simultaneously correcting the anterior crossbite and edge-to-edge bite.

Power elastics were employed to gradually reposition the impacted tooth into the dental arch. Once the impacted incisor was aligned, a  $0.016 \times 0.022$ -inch stainless steel wire with bends was used for torque adjustment and occlusal adjustment. Notably, the malalignment of the lower anterior teeth resolved spontaneously following the removal of occlusal interferences. With a single arch  $2 \times 4$  mechanics system, the treatment yielded substantial improvements in 16 months without the need for TADs (Fig. 2C and D).

#### **Case 3. Combined use of clear aligners and traditional fixed appliances**

A 9-year-old girl in the mixed dentition phase presented with substantial crowding in both arches and an impacted left maxillary canine (Fig. 2E and F). The patient was initially treated with Invisalign First. Arch expansion and interproximal reduction were performed to create space for alignment. The aligners' guidance function facilitated

better positioning of erupting teeth, which is particularly beneficial for patients with mixed dentition. Most dental irregularities were resolved after the first round of aligners, supplemented by two additional sets of aligners (Fig. 2E). Following the clear aligner phase, traditional fixed appliances were employed to address the high-positioned impacted canine. The entire treatment spanned approximately 40 months, comprising 24 months of clear aligner therapy and 16 months of fixed appliance therapy. The combined approach avoided the need for extractions, despite the complexity of the case involving severe crowding and a high-positioned impaction. By leveraging the respective strengths of clear aligners and fixed appliances, the treatment achieved optimal outcomes while minimizing invasiveness and preserving patient comfort.

## **Discussion**

The use of clear aligners minimized oral hygiene challenges, particularly in patients with mixed dentition, by reducing the risk of periodontal inflammation and dental caries. A notable advantage of clear aligners is that they enable clinicians to designate specific teeth as stationary, allowing for precise and selective tooth movements. This level of control is considerably more difficult to achieve with traditional fixed appliances. In Case 1, a targeted expansion of the first quadrant was planned to correct the crossbite while maintaining a stable occlusion on the left side.

Although clear aligners have been employed for over two decades, achieving substantial tooth movements, particularly severe rotations and extrusions, remains challenging. Current recommendations suggest that orthodontists employ auxiliary appliances to aid in correcting rotations exceeding  $40^\circ$ .<sup>5</sup> However, Case 1 demonstrated that an  $87^\circ$  rotation of a maxillary incisor was successfully corrected using clear aligners alone, without auxiliary appliances. This finding demonstrates that the severity of rotation is not the sole determinant of successful correction. Several additional factors influence the efficacy of rotation correction, including binding, root morphology, bone density, and other biomechanical considerations.<sup>5</sup> Further clinical trials are necessary to provide orthodontists with a deeper understanding of the mechanisms underlying rotation correction in clear aligner therapy.

Both *Cases 2 and 3* involved impacted teeth located near the nasal floor, a condition for which treatment with TAD-assisted traction is typically recommended when clear aligners are used.<sup>7</sup> However, research has indicated that mini-implant failure rates are higher in children under the age of 12 years,<sup>8</sup> and the invasiveness of repeated procedures may cause psychological distress. Although clear aligners are generally considered a more comfortable option treatment option compared with traditional fixed appliances, their application in these cases presented unique challenges. Specifically, the use of clear aligners with TAD-assisted traction appeared to be more aggressive than traditional fixed appliances combined with a TPA.

In conclusion, clear aligners were highly effective in achieving arch expansion, a common requirement in mixed dentition to achieve treatment objectives. In Case 1,

unilateral arch expansion was successfully accomplished using clear aligners. In [Case 3](#), arch expansion facilitated by clear aligners created the necessary space for subsequent traction of the impacted canine. Traditional fixed appliances remain highly effective in addressing impacted teeth without the use of TADs. In [Case 2](#), a modified TPA and traditional braces were used to successfully align an impacted incisor. Similarly, in [Case 3](#), traditional braces were employed to guide an impacted canine into proper alignment.

### Declaration of competing interest

The authors declare that have no conflicts of interest relevant to this article.

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