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Interceptive orthodontics in mixed dentition: Correction of central incisor malalignment with a 2×4 appliance: A case report

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Abstract
Background: Early recognition and correction of developing malocclusions during the mixed dentition period play a vital role in achieving a stable and harmonious occlusion. The 2×4 fixed appliance is a simple yet effective interceptive orthodontic tool that allows precise control of anterior tooth movement, alignment, and incisor inclination.
Case Presentation: This case report describes the management of a 10-year-old child presenting with malalignment of the left maxillary central incisor in the mixed dentition phase. Diagnosis revealed a retained deciduous tooth. Interceptive orthodontic therapy was initiated using a 2×4 fixed appliance comprising bands on the first permanent molars and bonded brackets on the maxillary incisors. Sequential alignment was achieved with light nickel–titanium archwires. The appliance successfully corrected the incisor malalignment within 4 months, resulting in improved aesthetics and alignment.
Conclusion: The 2×4 appliance provides an effective interceptive approach for anterior tooth correction in mixed dentition, minimizing the need for complex fixed orthodontic treatment later.

Keywords: Mixed dentition, interceptive orthodontics, 2×4 appliance, central incisor malalignment, pediatric dentistry

Introduction

Malocclusion developing during mixed dentition often signifies the early stage of more complex orthodontic problems if left untreated. Interceptive orthodontics, an integral part of pediatric dental care, aims to recognize and correct developing discrepancies during this transitional stage to prevent future malocclusion and functional disturbances. [1]

The 2×4 fixed appliance, consisting of bands on the first permanent molars and bonded brackets on the four maxillary incisors, offers three-dimensional control of tooth movement while maintaining simplicity and minimal invasiveness. [2] It serves as a versatile appliance for managing anterior crossbite, rotation, or spacing issues efficiently in growing children. [3]

This case report highlights the interceptive management of central incisor malalignment in a mixed dentition patient using the 2×4 fixed appliance, emphasizing its biomechanical advantages, simplicity, and effectiveness.

Treatment objectives:

The primary objectives of treatment were:

1. To align the displaced maxillary central incisor into the arch.
2. To achieve proper incisor inclination and arch symmetry.
3. To restore facial and dental aesthetics while maintaining space and arch integrity.

Case presentation

A 10-year-old child reported to the Department of Pediatric and Preventive Dentistry with the chief complaint of irregularly placed upper front teeth. The child was in the mixed dentition stage, and the parents expressed concern about the aesthetics of the smile.

Clinical examination

Intraoral examination revealed malalignment of the maxillary left central incisor, characterized by lingual displacement and mild rotation. The molar relationship was Angle's Class I, with a reverse overjet and overbite with respect to tooth 21. The adjacent teeth showed normal eruption sequence and morphology. No deleterious oral habits were reported.

Fig 1: pre-operative image

Cephalometric evaluation and model analyses confirmed the presence and normal morphology of the permanent teeth, with sufficient space available for alignment. The diagnosis was anterior crossbite of the maxillary central incisor in mixed dentition due to retained deciduous tooth. (Figure.1) After a thorough discussion of the treatment options with

the patient's parents, written consent was obtained. An interceptive orthodontic approach was planned using a 2×4 fixed appliance.

Fig 2: Pre-operative image after extraction (1-month follow-up)

To initiate treatment, retained tooth was extracted under local anaesthesia. In next appointment after 21-days, oral prophylaxis was done. Orthodontic molar band with buccal tubes were cemented on the maxillary first molar bilaterally. Subsequently, metal bracket (MBT system, 0.22" slot) were bonded to the labial surface of the four maxillary permanent incisors. (Figure. 2)

The initial alignment was carried out using a 0.016" round nickel–titanium (Ni-Ti) archwire.

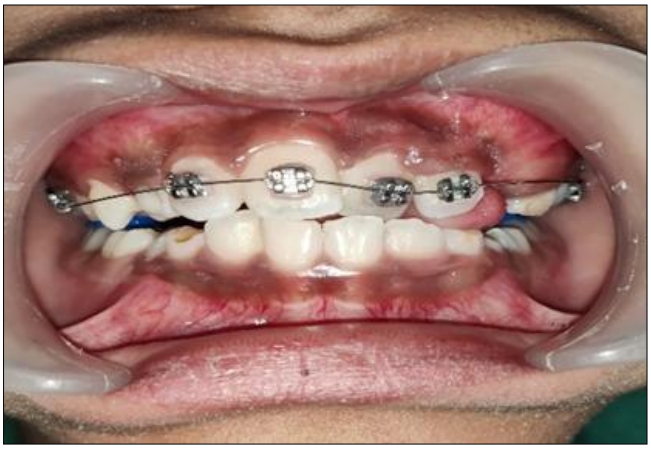

Fig 3: Placement of 0.016" round nickel–titanium (Ni-Ti) archwire (2 month follow up)

A 2 mm composite (Anabond Blu-Bite) buildup was used as posterior bite ramps on the mandibular first permanent molar bilaterally. This was done to disocclude the occlusion and thereby achieve a 2 mm incisal clearance. The archwire was stabilized in position using elastic modules. (Figure.3)

After one month, 0.016" round NiTi was replaced with 0.016-inch rectangular stainless steel for alignment and stabilization before the brackets were debonded. (Figure.4) Light continuous forces were applied to minimize root resorption and ensure physiologic tooth movement. Periodic reviews were conducted every 4 weeks to monitor progress and maintain oral hygiene.

Fig 4: Placement of 0.016" rectangular ss archwire (3-month follow-up)

After debonding, the anterior crossbite was successfully corrected, and the four maxillary incisors were aligned in their proper clinical positions.

Fig 5: Post-operative image (4-month follow-up)

A retainer was not required, as correction of a single-tooth crossbite is self-retentive. After approximately 4 months, satisfactory alignment of the maxillary central incisor was achieved. (Figure.3) The final results showed:

- Well-aligned maxillary anterior segment,
- Normal overjet and overbite, and
- Improved aesthetics and smile harmony

Discussion

Interceptive orthodontics plays a crucial role in recognizing and correcting developing malocclusions during the mixed dentition stage, thereby minimizing the need for complex orthodontic treatment at a later age. [4] Early intervention allows utilization of the child's inherent growth potential and the flexibility of developing dentoalveolar structures. [1] Removable orthodontic appliances have long been advocated as an effective approach for correcting anterior tooth malposition, resolving lingually displaced teeth, and expanding constricted maxillary arches. However, their main limitation lies in providing limited control over tooth movement, as they primarily exert single-point forces, which often result in mere tipping rather than bodily movement of teeth. Moreover, repeated insertion and removal by patients can lead to stress fractures of retaining components, reducing appliance retention and patient compliance. [5, ,6] Ninou and Stephens [5] identified patient

cooperation and appliance retention as the primary challenges associated with removable expansion appliances. These limitations can be effectively overcome by using fixed sectional appliances such as the 2×4 appliance, which offers precise three-dimensional control of anterior tooth movement and more efficient tooth alignment. As a sectional fixed system, it allows simultaneous correction of rotations, diastemas, and axial inclinations of teeth with superior control compared to removable options. [6-9]

The design, consisting of bands on the first permanent molars and bonded brackets on the four maxillary incisors, provides excellent three-dimensional control of anterior tooth movement.[2] This design facilitates correction of rotations, alignment of ectopically erupting incisors, and control of axial inclination with light, continuous forces.[10] Lee, *et al*.[6], suggested that while choosing an appropriate treatment modality, clinicians should evaluate the availability of adequate space in the arch, sufficient overbite to retain the corrected position, and the apical position of the tooth in crossbite relative to its Class I alignment.

The 2×4 appliance offers several advantages, including minimal dependence on patient cooperation, shorter treatment duration, no laboratory fabrication, and the capacity to perform versatile orthodontic tooth movements. The MBT prescription brackets incorporated in this system possess ideal tip and torque values, ensuring optimal axial positioning of the incisors. Nevertheless, the appliance may pose some disadvantages, such as the risk of wire irritation during mastication or brushing and potential plaque accumulation around bands and brackets. These drawbacks can be minimized through reinforcement of good oral hygiene practices. [10]

Previous studies have highlighted the versatility and predictability of the 2×4 appliance in interceptive orthodontics. McKeown, *et al*., [2] Park and Kim [11], emphasized its biomechanical advantages, noting that it allows controlled tipping, rotation, and limited root movement while being simple to fabricate and well-tolerated by young patients. Verma and Ahuja [12] reported its success in correcting anterior crossbites and minor crowding without the need for comprehensive fixed orthodontic treatment. As highlighted by McKeown and Sandler [2], the 2×4 appliance remains a simple, efficient, and highly versatile tool for managing developing anterior malocclusions in mixed dentition.

Conclusion

Overall, the presented case demonstrates that the 2×4 appliance is a practical, time-efficient, and patient-friendly treatment modality. Its ability to correct malalignment with minimal patient cooperation, while ensuring stability and aesthetic improvement, makes it a valuable interceptive approach in pediatric orthodontic management.

The 2×4 fixed appliance is a highly effective and conservative interceptive orthodontic modality for managing anterior tooth malalignment during the mixed dentition phase. In this case, early intervention successfully restored normal alignment, improved esthetics, and prevented the need for comprehensive orthodontic therapy later. Timely diagnosis and management during mixed dentition are essential to prevent progression into more complex malocclusions.

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