

VERSATILITY OF THE 2×4 FIXED ORTHODONTIC APPLIANCE IN MANAGING  
ANTERIOR CROSSBITE AND INCISOR PROCLINATION DURING MIXED  
DENTITION: A CASE SERIES<sup>1</sup>\*Dr. Satish Maran, <sup>2</sup>Dr. Anaya Kulkarni Kale, <sup>3</sup>Dr. Saarikha Suresh, <sup>4</sup>\*Dr. Sahiba Khan, <sup>5</sup>Dr. Pooja Bhoyar, <sup>6</sup>Dr. Preksha Khare<sup>1</sup>Professor and HOD, Department of Pediatric and Preventive Dentistry, People's Dental Academy, Bhopal, Madhya Pradesh, India.<sup>2,3</sup>Reader, Department of Pediatric and Preventive Dentistry, People's Dental Academy, Bhopal, Madhya Pradesh, India<sup>4,5,6</sup>Postgraduate Student, Department of Pediatric and Preventive Dentistry, People's Dental Academy, Bhopal, Madhya Pradesh, India.**\*Corresponding Author: Dr. Sahiba Khan**Postgraduate Student, Department of Pediatric and Preventive Dentistry, People's Dental Academy, Bhopal, Madhya Pradesh, India. DOI: <https://doi.org/10.5281/zenodo.21702138>**How to cite this Article:** <sup>1</sup>\*Dr. Satish Maran, <sup>2</sup>Dr. Anaya Kulkarni Kale, <sup>3</sup>Dr. Saarikha Suresh, <sup>4</sup>\*Dr. Sahiba Khan, <sup>5</sup>Dr. Pooja Bhoyar, <sup>6</sup>Dr. Preksha Khare, (2026). Versatility of The 2×4 Fixed Orthodontic Appliance In Managing Anterior Crossbite and Incisor Proclination During Mixed Dentition: A Case Series. European Journal of Pharmaceutical and Medical Research, 13(8), 266–271.

This work is licensed under Creative Commons Attribution 4.0 International license.



Article Received on 24/06/2026

Article Revised on 14/07/2026

Article Published on 01/08/2026

**ABSTRACT**

**Background:** The mixed dentition period presents an optimal opportunity for interceptive orthodontic management of developing malocclusions. Anterior crossbite and maxillary incisor proclination, if left untreated, can lead to significant dental, periodontal, and skeletal complications. **Case Description:** This case series presents three cases in the mixed dentition stage managed using the 2×4 fixed orthodontic appliance. Involving a single-tooth anterior crossbite and one case involving proclination of the maxillary central incisor, this case series presents three cases in the mixed dentition stage, managed using a 2×4 fixed orthodontic appliance with a diagnosis of Angle's class 1 malocclusion. Treatment was initiated with orthodontic molar bands cemented on the maxillary first permanent molars and MBT brackets bonded on the four maxillary permanent incisors. A progressive NiTi archwire sequence was followed, and posterior bite raising was performed wherever required to achieve adequate incisal clearance. Satisfactory correction of the presenting malocclusion was achieved in all three cases within a treatment duration of 3 to 6 months. **Conclusion:** The 2×4 appliance proved to be a versatile, effective, and well-tolerated interceptive treatment modality for anterior crossbite and incisor proclination in mixed dentition. Its ability to provide three-dimensional tooth movement control with minimal patient compliance requirements makes it a valuable tool in pediatric dental practice.

**KEYWORDS:** 2×4 appliance, anterior crossbite, incisor proclination, interceptive orthodontics, mixed dentition, pediatric dentistry.

**INTRODUCTION**

The mixed dentition period, occurring between the ages of 6 and 12 years, represents a critical transitional phase in a child's oral development where primary and permanent teeth coexist simultaneously. This period presents a unique opportunity for early identification and interception of developing malocclusions before they progress into more complex skeletal or dental discrepancies. Early orthodontic intervention during this phase can positively influence jaw growth, guide tooth

eruption, and significantly reduce the need for more extensive orthodontic treatment in the future.<sup>[1]</sup>

Among the various malocclusions encountered during mixed dentition, anterior crossbite and maxillary incisor proclination are two of the most frequently observed conditions requiring timely interceptive management. Anterior crossbite, with a documented prevalence of approximately 4–5% in the mixed dentition<sup>[2]</sup>, if left untreated, is a self-perpetuating condition that can lead to gingival recession, alveolar bone thinning,

temporomandibular joint dysfunction, and ultimately the development of a true skeletal Class III malocclusion requiring combined orthodontic and surgical intervention.<sup>[3]</sup> The aetiology is multifactorial, encompassing dental causes such as supernumerary teeth, retained primary teeth, ectopic tooth positioning, trauma, and arch length inadequacy.<sup>[3]</sup>

Maxillary incisor proclination, characterized by excessive labial inclination of the upper anterior teeth, is another common mixed dentition malocclusion often associated with oral habits such as thumb sucking or tongue thrusting. If uncorrected, it compromises facial aesthetics, self-esteem, and predisposes the child to trauma and periodontal problems, making early interception essential.<sup>[4]</sup>

Historically, removable appliances have been the most commonly used modality for managing these malocclusions. However, they are associated with significant limitations, including limited three-dimensional control of tooth movement, dependence on patient compliance, risk of appliance loss, and the possibility of unwanted tooth movements.<sup>[5]</sup> These shortcomings have led to growing interest in sectional fixed appliance therapy as a more reliable alternative.

The 2×4 appliance is a simple yet versatile sectional fixed orthodontic appliance consisting of bands cemented on the first permanent maxillary molars and brackets bonded on the four erupted maxillary permanent incisors, connected by a continuous archwire. The "2" refers to the two molar bands providing posterior anchorage, while the "4" refers to the four incisor brackets.<sup>[6]</sup> This design enables light, continuous, and well-controlled forces for incisor derotation, alignment, levelling, and torque control.<sup>[4]</sup> The appliance has been widely documented for its efficacy in managing anterior crossbite, incisor malalignment, proclination, midline diastema, and space regaining, with the distinct advantage of minimal patient cooperation, reduced treatment time, no laboratory costs, and true three-dimensional tooth movement control.<sup>[3]</sup>

The present case series aims to highlight the versatility and clinical effectiveness of the 2×4 appliance through three cases managed in the mixed dentition period — two cases of single-tooth anterior crossbite and one case of maxillary central incisor proclination — thereby reinforcing its role as a valuable interceptive tool in pediatric dental practice.

### CASE REPORT 1

An 11-year-old boy reported to the Department of Pediatric and Preventive Dentistry with a chief complaint of irregularly placed teeth in the upper front region. There was no significant family or medical history. Extraoral examination revealed a bilaterally symmetrical face with a convex profile. On intraoral examination, the maxillary right central incisor was labially placed in comparison to 21. The patient is in a mixed dentition stage with the first permanent molars in a Class I relationship.

Diagnosis- Angle's class 1 malocclusion with proclination in relation to 11.

### TREATMENT

Following a thorough discussion of the treatment options with the patient's parents, informed consent was obtained. To initiate treatment, orthodontic buccal tubes were cemented on the maxillary first molars bilaterally. Subsequently, metal brackets, MBT system 0.022" slot, were bonded to the labial surfaces of the four maxillary permanent incisors. A 0.012" round nickel-titanium (Ni-Ti) archwire was inserted into the bracket slots and engaged in the molar tubes bilaterally. The wire was stabilised in its position using elastic modules. The patient was recalled after 15 days, and the wire was replaced. A 0.014" round nickel-titanium (Ni-Ti) archwire was inserted into the bracket slots and engaged in the molar tubes bilaterally. The patient was again recalled after 15 days and observed that all four incisors had been aligned in the proper position. Then, the brackets were debonded. The patient is kept on follow-up for 6 months.



### CASE REPORT 2

A 9-year-old boy reported to the Department of Pediatric and Preventive Dentistry with a chief complaint of irregularly placed teeth in the upper front region. There was no significant family or medical history. Extraoral examination revealed a bilaterally symmetrical face with

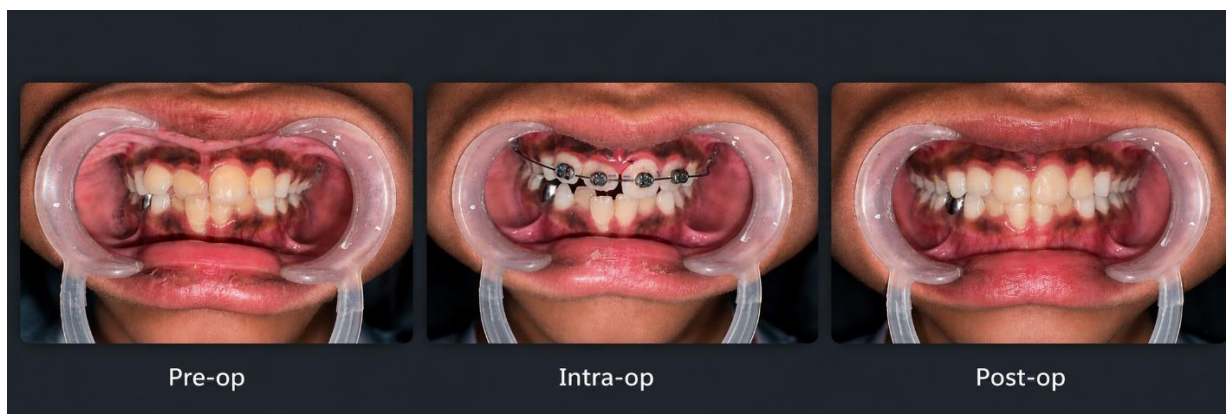
a convex profile. On intraoral examination, the maxillary right central incisor was palatally placed, resulting in an anterior cross bite. The patient is in a mixed dentition stage with the first permanent molars in a Class I relationship.

Diagnosis- Angle's class 1 malocclusion with anterior crossbite in relation to 11.

#### TREATMENT

Space analysis using Moyer's mixed dentition analysis showed the availability of adequate space within the arch for realignment of teeth. After discussing the treatment modalities with parents, we selected a short-span wire-fixed orthodontic treatment with 4 pre-adjusted edgewise brackets with a 0.022 slot. The brackets were bonded on the labial aspects of the four maxillary permanent

incisors. A short-span nickel-titanium (Ni-Ti) 0.014 round archwire is cut equally on both sides of the centreline and placed into the bracket slots. The wire was stabilised in its position using elastic ties. The patient's bite was raised using 2 mm thickness of composite placed on the occlusal aspects of both the mandibular 1st permanent molar tooth. At 15 days review, the incisor teeth were in positive overjet. All four incisors had been aligned in the proper position. Then, the brackets were debonded, and the bite-raising composite was also removed. The patient is kept on follow-up for 6 months.



#### CASE REPORT 3

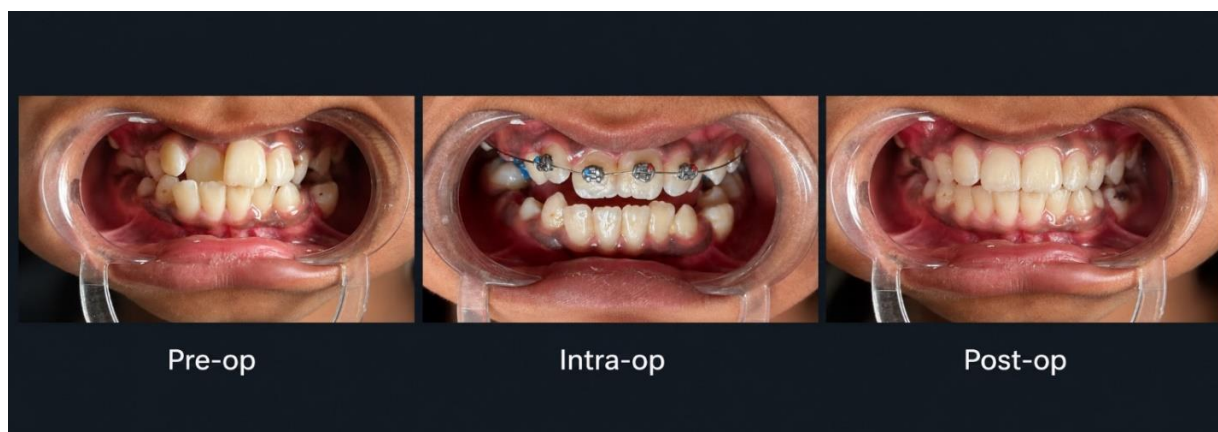
A 11-year-old boy reported to the Department of Pediatric and Preventive Dentistry with a chief complaint of irregularly placed teeth in the upper front tooth region. There was no significant family or medical history. Extraoral examination revealed a bilaterally symmetrical face with a convex profile. On intraoral examination, the maxillary right central incisor was palatally placed, resulting in an anterior cross bite. The patient is in mixed dentition stage with the first permanent molars in a Class I relationship.

Diagnosis- Angle's class 1 malocclusion with anterior crossbite in relation to 11.

#### TREATMENT

Space analysis using Moyer's mixed dentition analysis showed the availability of adequate space within the arch

for realignment of teeth. After discussing the treatment modalities with parents, we selected a short-span wire-fixed orthodontic treatment with 4 pre-adjusted edgewise brackets with a 0.022 slot. The brackets were bonded on the labial aspects of the four maxillary permanent incisors. A short-span nickel-titanium (Ni-Ti) 0.014 round archwire is cut equally on both sides of the centreline and placed into the bracket slots. The wire was stabilised in its position using elastic ties. The patient's bite was raised using 2 mm thickness of composite placed on the occlusal aspects of both the mandibular 1st permanent molar tooth. At 15 days review, the incisor teeth were in positive overjet. All four incisors had been aligned in the proper position. Then, the brackets were debonded, and the bite-raising composite was also removed. The patient is kept on follow-up for 6 months.



## DISCUSSION

The mixed dentition period represents a critical window for interceptive orthodontic management, as untreated malocclusions during this phase can evolve into more severe skeletal and dental discrepancies requiring complex treatment in the future. Delaying treatment until a later stage of maturity may lead to more complicated treatment options, including the risk of severe space loss, migration of adjacent teeth, and even tooth mobility due to gingival recession by the time orthodontic correction is initiated.<sup>[4]</sup> The role of the pediatric dentist in this context is not to achieve perfect alignment, but rather to minimize the negative effects of malocclusion during the developmental stage and facilitate a smooth transition to comprehensive orthodontic care.<sup>[7]</sup> Collaborating with orthodontists is crucial to ensure that achievable interceptive orthodontics are implemented during the growth phases of dentition,<sup>[8]</sup> and knowing fixed orthodontic mechanics enables pediatric dentists to develop alternative treatment approaches when removable appliances become limited.<sup>[9]</sup>

The present case series demonstrated the clinical versatility of the 2×4 appliance in managing two distinct types of malocclusion encountered during the mixed dentition stage — anterior crossbite and maxillary incisor proclination — both of which, if left untreated, carry significant functional, periodontal, and aesthetic consequences for the growing child.

Anterior crossbite is defined as an abnormal labiolingual relationship between one or more maxillary and mandibular incisor teeth, presenting as a reverse overjet, with a prevalence of approximately 4–5% in the mixed dentition.<sup>[10]</sup> It is a self-perpetuating condition that, if not treated early, has the potential to grow into skeletal malocclusion and might at a later stage require major orthodontic treatment combined with surgical procedures.<sup>[11]</sup>

The aetiology of anterior crossbite is multifactorial, with contributing factors classified into skeletal, dental, and functional categories depending on the underlying nature of the malocclusion.<sup>[13]</sup> Possible causes of dental-related anterior crossbite include the presence of supernumerary teeth, odontomas, trauma to the primary predecessor, ectopic position of the permanent tooth germ, retained primary teeth, anomalies in tooth shape and size, arch length inadequacy, and upper lip biting habit.<sup>[3]</sup> In both crossbite cases presented in this series, the crossbite was of dentoalveolar origin with no underlying skeletal component identified on cephalometric assessment, making them ideal candidates for early fixed appliance intervention.

Several treatment modalities are available for the correction of anterior crossbite, including removable appliances with Z-springs, Hawley appliances, Catlan's appliance, and the 2×4 fixed appliance.<sup>[12]</sup> A comparative evaluation of the 2×4 appliance, Catlan's appliance, and

the removable finger-spring appliance demonstrated that all three are effective in correcting anterior crossbite; however, the 2×4 appliance resulted in the highest patient satisfaction and minimal pain, requiring only three weeks of treatment with three follow-up visits.<sup>[14]</sup> Removable appliances, while economical, present certain limitations primarily due to their limited control over tooth positioning, typically applying single-point forces resulting in simple tipping movements rather than precise tooth movement, and patient compliance and appliance retention remain primary challenges associated with their use.<sup>[14]</sup>

Regarding the management of bite interference — a prerequisite for successful crossbite correction — the use of a posterior bite ramp or composite buildup is essential to disengage the occlusion and allow free labial movement of the palatally placed incisor. Glass ionomer cement buildup used as posterior bite ramps on the mandibular permanent molars is ideal for creating a bite ramp due to its temporary nature and ease of removal once treatment is finished, with the goal of achieving approximately 2 mm of incisal clearance to allow free tooth movement.<sup>[18]</sup> This technique was similarly employed in both crossbite cases in the present series and proved effective in providing the necessary occlusal disengagement, resulting in successful crossbite correction within a short treatment duration.

Maxillary incisor proclination is another commonly encountered malocclusion during the mixed dentition stage, characterized by excessive labial inclination of the upper anterior teeth. It is frequently associated with oral habits such as thumb sucking, tongue thrusting, or mouth breathing, as well as lip incompetence and underlying skeletal discrepancies. Early correction of proclination during the mixed dentition stage, therefore, prevents these long-term sequelae and improves the overall prognosis of any future orthodontic treatment.

The 2×4 appliance has been documented as an effective modality for mild proclination correction in the mixed dentition stage. The shape memory property of the NiTi archwire plays a central role in retroclining proclined incisors by exerting light, continuous, and biologically favourable forces that guide the teeth back into their ideal axial inclination within the arch.<sup>[4]</sup> In the proclination case presented in this series, initial alignment was achieved using a 0.012" NiTi wire, followed by progression to a 0.014" NiTi wire, which enabled torque control and proper root positioning in addition to crown-level correction. The use of a fixed anterior bite plane, in conjunction with the 2×4 appliance, facilitated the eruption of the posterior teeth. It aided in the correction of the associated deep bite, further contributing to the overall treatment outcome. Post-treatment results showed complete levelling and alignment of the anterior teeth within a satisfactory treatment duration, consistent with the findings reported by Kalisipudi *et al.* (2023)<sup>[4]</sup>, who similarly used the 2×4



appliance for proclination correction and achieved favourable results within six months.

Across all three cases in this series, the 2×4 appliance demonstrated consistent clinical effectiveness. As a sectional fixed appliance, it results in more effective and efficient positioning of teeth, as three-dimensional control is possible during correction of malaligned anterior teeth; therefore, diastemas, rotations, and improper inclinations of teeth can be treated easily and quickly using this technique.<sup>[16]</sup> The wire sequence employed in the 2×4 technique plays a critical role in the biomechanics of tooth movement. Initial archwires ranging from 0.012" to 0.016" NiTi are employed, followed by 0.016" stainless steel wires, and finally rectangular wires of 0.017" or 0.018" × 0.025", with archwires changed every two to four weeks.<sup>[9]</sup> Since the appliance is fixed and cannot be removed by the patient, issues related to appliance dislodgement, treatment compliance, and loss of the appliance are largely eliminated, which is of particular significance when treating young pediatric patients.<sup>[9]</sup>

Before selecting the 2×4 appliance as a treatment approach, certain prerequisite criteria must be evaluated. Lee et al.<sup>[2]</sup> outlined four important factors to consider: adequate space in the dental arch to reposition the tooth; sufficient overbite to hold the tooth in position following correction; an apical position of the tooth in crossbite that aligns with its position in Class I occlusion; and the overall dental and skeletal status of the patient. In all three cases presented here, space analysis confirmed adequate arch length and the malocclusions were of purely dental origin with no skeletal component identified on cephalometric assessment, satisfying the necessary prerequisites for 2×4 appliance therapy.

### Limitations and Considerations

Despite its many advantages, clinicians must be aware of the limitations of the 2×4 appliance. The placement of bands on the maxillary first permanent molars may be problematic if the molar has not fully erupted or has a short clinical crown height. Additionally, the long span of flexible NiTi archwire extending from the molar bands to the incisors may dangle and become dislodged during eating or brushing, which is of particular concern in young pediatric patients. Furthermore, plaque retention around the bands and brackets necessitates diligent oral hygiene maintenance, and the appliance may not be effective if there are only a few teeth available in the dentition.<sup>[4]</sup> Follow-up of the patient was done for 6 months. The limitation of the study is limited follow-up. Overall, the present case series adds to the growing body of clinical evidence supporting the 2×4 appliance as a reliable, efficient, and well-tolerated treatment modality for interceptive orthodontic correction of both anterior crossbite and incisor proclination in the mixed dentition stage, with outcomes that are functionally, aesthetically, and psychologically satisfactory.

### CONCLUSION

The above case reports demonstrate the versatility and effectiveness of the 2×4 appliance in managing mixed dentition malocclusions. Although it may require slightly more chairside time, it eliminates laboratory costs associated with removable appliances. Its advantages include bodily tooth movement for space creation, effective root torque control to improve aesthetics and reduce relapse, and efficient derotation of incisors. A major advantage of the 2×4 appliance is its ability to produce rapid and predictable results within a relatively short treatment period. In addition to achieving functional correction, the appliance offers significant psychological benefits, making it a simple and reliable option for treating challenging mixed dentition problems.

### REFERENCES

1. Dipalma G, Marinelli G, Casamassima L, Nardelli P, Ciccarese D, Sena PD, Inchingolo F, Crincoli V, Palermo A, Bordea IR, Carbonara A. Effectiveness and Clinical Indications of 2× 4 Fixed Orthodontic Therapy in Regard to Mixed Dentition: A Systematic Review. *Children*, Jul. 7, 2025; 12(7): 897.
2. Lee BD. Correction of crossbite. *Dental Clinics of North America*, Oct. 1, 1978; 22(4): 647-68.
3. Gupta S, Das A, Patra A, Singh U. 2× 4 appliance for correction of anterior crossbite: a case series. *UNIVERSITY JOURNAL OF DENTAL SCIENCES*, Sep. 21, 2023; 9(4): 1-4.
4. Kalisipudi S, Lanka M, Punithavathy R, Martha S, Amudala N, Sadik MA, Anudeep M. Enhancing Pediatric Orthodontics with the 2x4 Appliance: Benefits and Considerations. *Journal of Medical and Dental Science Research*, 2023; 10(9): 38-45.
5. Gawali P, Jadhav G, Shigli A, Vaidya P. 2X4 appliance: effective treatment modality for anterior crossbite. *Ann Int Med Dent Res.*, 2019; 5(5): 1-2.
6. Verma J, Ahuja V. Interception of developing anterior malocclusion due to supernumerary tooth by "2 x 4 Appliance": A clinical case report. *J Dent Panacea.*, Jun. 15, 2021; 3(1): 40-5.
7. İlisulu C, Uz S, Koruyucu M, Seymen F. Early interceptive orthodontic treatments: case series. *Journal of Emergency Health Care.*, Sep. 10, 2019; 8(3): 104-11.
8. Sockalingam SN, Zakaria AS, Khan KA, Azmi FM, Noor NM. Simple Orthodontic Correction of Rotated Malpositioned Teeth Using Sectional Wire and 2× 4 Orthodontic Appliances in Mixed-Dentition: A Report of Two Cases. *Case reports in dentistry*, 2020; 2020(1): 1-5.
9. Garrocho-Rangel A, Hernandez-Garcia G, Yanez-Gonzalez E, Ruiz-Rodriguez S, Rosales-Berber M, Pozos-Guillen A. 2× 4 appliance in the mixed dentition stage: a scoping review of the evidence. *J Clin Pediatr Dent.*, Jan. 3, 2023; 47(1): 1-8.
10. Prakash P, Durgesh BH. Anterior Crossbite Correction in Early Mixed Dentition Period Using Catlan's Appliance: A Case Report. *ISRN Dent.*, 2011; 2011: 298-9.

11. White L. Early orthodontic intervention. American journal of orthodontics and dentofacial orthopaedics, Jan. 1, 1998; 113(1): 24-8.
12. Yermalkar GS, Gaonkar N, Shashikiran ND, Gugawad S, Hadakar SG, Waghmode S, Maurya A, Gugawad Sr S. Correction of single-tooth crossbite using a 2x4 appliance: a clinical case report. Cureus, Oct. 18, 2024; 16(10): 1-5.
13. Vithanaarachchi SN, Nawarathna LS. Prevalence of anterior cross bite in preadolescent orthodontic patients attending an orthodontic clinic. Ceylon Medical Journal, Sep. 25, 2017; 62(3): 1-4.
14. Vishnu G, Ramesh R. Comparative clinical outcomes in the treatment of anterior crossbite using three different appliances: a case series. Cureus., Sep. 5, 2024; 16(9).
15. Schatz JP, Ostini E, Hakeberg M, Kiliaridis S. Large overjet as a risk factor of traumatic dental injuries: a prospective longitudinal study. Progress in orthodontics, Nov. 9, 2020; 21(1): 41-46.
16. Dowsing P, Sandler PJ. How to effectively use a 2× 4 appliance. Journal of orthodontics, Sep. 1, 2004; 31(3): 248-58.
17. Hägg U, Tse A, Bendeus M, Rabie AB. A follow-up study of early treatment of pseudo Class III malocclusion. The Angle Orthodontist, Aug. 1, 2004; 74(4): 465-72.
18. Mashouf KL, Mashouf CK, Laraway S. Mixed-Dentition Orthodontic Treatment: Outcomes and Timing. Journal of the California Dental Association, May 1, 2018; 46(5): 307-13.