

## International Journal of Dental Science and Innovative Research (IJDSIR)

# IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume - 7, Issue - 4, July-2024, Page No. : 15 - 21

Two-by-Four Appliance Therapy in Mixed Dentition: A Case Series

<sup>1</sup>Dr Supriya Bhatara, Post-Graduate Student (MDS), Department of Paediatric and Preventive Dentistry, ITS Dental College, Hospital and Research Centre, Greater Noida, Uttar Pradesh 201310

<sup>2</sup>Dr Mousumi Goswami, Head and Professor, Department of Paediatric and Preventive Dentistry, ITS Dental College, Hospital and Research Centre, Greater Noida, Uttar Pradesh 201310

<sup>3</sup>Dr Aditya Saxena, Professor, Department of Paediatric and Preventive Dentistry, ITS Dental College, Hospital and Research Centre, Greater Noida, Uttar Pradesh 201310

**Corresponding Author:** Dr Supriya Bhatara, Post-Graduate Student (MDS), Department of Paediatric and Preventive Dentistry, ITS Dental College, Hospital and Research Centre, Greater Noida, Uttar Pradesh 201310

**Citation of this Article:** Dr Supriya Bhatara, Dr Mousumi Goswami, Dr Aditya Saxena, "Two-by-Four Appliance Therapy in Mixed Dentition: A Case Series", IJDSIR- July – 2024, Volume –7, Issue - 4, P. No. 15 – 21.

**Copyright:** © 2024, Dr Supriya Bhatara, et al. This is an open access journal and article distributed under the terms of the creative common's attribution non-commercial License. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given, and the new creations are licensed under the identical terms.

Type of Publication: Case Report

**Conflicts of Interest: Nil** 

## Abstract

**Background:** Dental crossbites in children can lead to complications like periodontal issues, abnormal tooth wear, and temporomandibular joint dysfunction. Early diagnosis and correction are essential to prevent these problems.

**Methods:** This case series reports on the use of the twoby-four (2x4) appliance therapy for correcting malocclusions in children with mixed dentition. The 2x4 appliance involves bands on the first permanent molars and brackets on the erupted maxillary incisors, connected by a continuous archwire for controlled tooth movement.

## **Case Series**

Case 1: An eight-year-old girl with anterior cross bite and irregular lower teeth received 2x4 appliance therapy, achieving a positive overjet and aligned lower incisors in 9 weeks. Case 2: A seven-year-old girl with anterior crossbite and rotated incisors underwent extraction and 2x4 therapy, resulting in proper alignment. Case 3: A seven-year-old boy with a palatally placed incisor received surgical intervention followed by 2x4 therapy, achieving correction in 6 weeks. Case 4: A twelve-year-old boy with a buccally placed tooth and mesiodens underwent extraction and 2x4 therapy, leading to proper alignment in 2 months.

**Conclusion:** Malocclusion impacts dental-maxillofacial functions and aesthetics in children. Early intervention with 2x4 appliance therapy corrects dental anomalies, guides jaw growth, and prevents severe malocclusions, ensuring predictable results and minimizing treatment time. Early orthodontic intervention with the 2x4 appliance is crucial for managing malocclusion in children, promoting long-term oral health, and reducing

future treatment needs, thereby providing functional and aesthetic benefits.

**Keywords:** Mixed Dentition [MeSH], Crossbite, Interventional Orthodontics, Malocclusion [MeSH]

### Introduction

Dental crossbites in children refer to a misalignment where one or more teeth are positioned abnormally in relation to the opposing teeth, either buccally, lingually, or labially. This condition can be categorized as dental, skeletal, or functional based on the underlying cause(1). Anterior crossbites, clinically seen as a reverse overjet in which one or more maxillary teeth are positioned palatal to the mandibular incisor teeth when the patient closes his mouth into centric occlusion are a matter of concern in growing children as they can potentiate adverse growth influences on the mandible and the anterior portion on the maxilla, involving not just the teeth and alveolar processes, but skeletal structures of the mandible and maxilla(2). Therefore, early diagnosis and correction of dental crossbites are crucial to prevent complications such as periodontal issues, abnormal wear of teeth, temporomandibular joint dysfunction, impacted permanent teeth, and severe malocclusions. Detecting and intervening in dental crossbites at an early age in children is critical for preventing long-term complications. Early diagnosis allows for timely treatment, which can prevent irreversible damage to the periodontal tissues and bone structure due to the lateral forces associated with crossbites. Additionally, early intervention helps in avoiding adverse effects on the developing jaws, such as mandibular displacement and abnormal growth patterns(3).

One effective treatment method for correcting dental crossbites in the mixed dentition phase is the two-byfour (2x4) appliance therapy. This fixed appliance system involves the placement of bands on the upper first permanent molars and brackets on the erupted maxillary incisors, connected by a continuous archwire. The 2x4 appliance is particularly beneficial for early intervention, allowing for controlled and precise movement of the anterior teeth, which is essential for correcting rotations and achieving proper alignment.(4)The appliance typically utilizes a sequence of nickel-titanium (NiTi) archwires, progressing from flexible to more rigid wires to achieve the desired tooth movements. The treatment often includes a posterior bite plane to disocclude the anterior teeth if necessary, thereby enhancing the stability and effectiveness of the correction(5). Implementing the 2x4 appliance therapy in children has shown to be effective in achieving stable results, minimizing the need for extensive future orthodontic treatments, and promoting better oral health and aesthetics. This fixed appliance system is specifically designed to address dental malocclusions in the mixed dentition phase, typically involving children aged 6 to 12 years. This setup allows for precise control and movement of the teeth, essential for correcting misalignments and rotations. Regular follow-ups and adjustments ensure the success and stability of the treatment outcomes, making this method a reliable option for managing dental crossbites in paediatric patients(4).

This article aims to report a case series of the correction of malocclusion, including anterior crossbites in children with mixed dentition using two-by-four appliance therapy.

## **Case Series**

The following Case Series, prepared per the CARE Guidelines(6) (Supplementary material 1), is a clinical observation of children presenting to the Department of Paediatric and Preventive Dentistry, ITS Dental College, Hospital and Research Centre, Greater Noida, between 2021 – 2024.

Case 1: An eight-year-old girl reported with the chief complaint of irregularly placed lower teeth. No reported history of trauma or decayed primary teeth. Intra-oral clinical examination revealed a mixed dentition with irregularly placed lower anterior teeth and 11 21 in anterior crossbite with 41 31 respectively. Upon radiographic examination via an OPG, no other dental anomalies were detected. The treatment was initiated by placing a posterior bite block on the lower first permanent molars for 2 weeks. Simultaneously, two-byfour appliance therapy was initiated. Metal brackets MBT were bonded on the labial aspects of the four maxillary permanent incisors. A nickel-titanium (Ni-Ti) 0.012" round archwire was placed into the bracket slots and then into the molar tube on both sides. The wire was stabilised in its position using elastic ties for 3 weeks. At the 1-month follow-up, after a Moyer's space analysis, 74 and 84 were extracted to allow for self-correction of the lower incisors. The NiTi wires were sequentially changed to 0.016" at 3-week intervals, and a positive overjet with all four incisors was observed at 9 weeks when the brackets were debonded. The lower permanent incisors also appeared aligned in the arch.



Figure 1: Case 2: A -E: Pre-Operative Clinical Pictures, F: Orthopantomogram, G-I: Initiation of 2\*4 Appliance Therapy and Bite Blocks, J-K: Intra-operative Clinical Pictures before Debonding, L-N: Post-Operative Clinical Pictures

Case 2: A seven-year-old girl reported to the department with a chief complaint of irregularly placed front teeth preventing her from smiling and conversing with peers in school. An intraoral clinical examination revealed a crossbite wrt 112, 22 and rotated 11 21 with mesial rotation. Retained 52 was also observed. Extraction of 52 under 2% Lignocaine was done followed by initiation of two-by-four appliance therapy along with opening the bite with GIC bite blocks on the first permanent molars. The treatment protocol was begun with a nickel-titanium (Ni-Ti) 0.012" round archwire, stabilised in its position using elastic ties for 3 weeks. The NiTi wires were sequentially changed to 0.016" at 3-week intervals. Upon achievement of the correct alignment of the upper permanent incisors and the correction of the crossbite, a Hawley's retainer was given. (Figure 2)



Figure 2: Case 2: A -D: Pre-Operative Clinical Pictures, E: Initiation of 2\*4 Appliance Therapy, F-G: Intraoperative Clinical Pictures before Debonding, H-J: Post-Operative Clinical Pictures, K-L: Hawley's Retainer **Case 3:** A seven-year-old boy reported with the chief

concern of two teeth in the upper left front tooth region. Upon clinical and radiographic examination, a supplementary lateral incisor was observed wrt 22. The impacted supplementary tooth was extracted after surgical gingival exposure. The child was advised tongue blade therapy to correct the palatally placed 22, however, due to poor compliance, at the six-month follow-up 22 was observed to be in crossbite with 32. After laser-assisted gingivectomy, brackets were placed

. . . . . . . . . . . . .

on the maxillary permanent incisors and two-by-four appliance therapy was initiated with 0.012" round archwire, stabilised with elastic ties. At the 6-week visit, a positive overjet was achieved and debonding was done.



**Figure 3:** Case 3: A -D: Pre-Operative Clinical Pictures, E: IOPA – Supplementary Lateral Incisor, F: Sutures placed after Supplemental Lateral Incisor Extraction, G: Laser-Assisted Crown Exposure wrt 22, H-I: Pre-Operative (Before 2\*4 Appliance Therapy) Clinical Pictures, J-L: Initiation of 2\*4 Appliance Therapy, M-N: Post-Operative Clinical Pictures

**Case 4:** A twelve-year-old boy reported with the chief complaint of a buccally placed upper left front tooth. Upon clinical and radiographic investigation, a mesiodens was observed between 11 and 21, secondary to which a buccally placed 21 was present. After the extraction of the mesiodens, two-by-four appliance therapy was initiated with metal brackets and 0.012" round NiTiarchwire, progressing to 0.016", changed every 3-4 weeks. Due to the severe malposition, the first wire was stabilised by ligature ties for the first 2 weeks to control the force after which it was replaced by elastic ties. At the 2-month follow-up, with the alignment of the permanent maxillary incisors in the arch, the brackets were debonded.



Figure 4: Case 4: A -D: Pre-Operative Clinical Pictures (After Mesiodens Extraction), E-F: Initiation of 2\*4

Appliance Therapy, G-K Post-Operative Clinical Pictures

### Discussion

Malocclusion, identified by the World Health Organization as one of the top three oral health issues, significantly affects the dental-maxillofacial functions, esthetics, and the growth and development of children. The term refers to any deviation from a normal occlusion, such as misaligned teeth, incorrect jaw positioning, or both, which can lead to difficulties in chewing, speaking, and maintaining oral hygiene, as well as esthetic concerns and psychosocial distress.(7)

The developmental implications of malocclusion in children are profound. Abnormal dental and facial development due to malocclusion can lead to altered chewing patterns, impaired speech, and other functional deficiencies. These functional challenges are often accompanied by psychological impacts due to altered facial aesthetics, which can affect the child's self-esteem and social interactions.(8)

One common manifestation of malocclusion in children is the anterior crossbite, which involves one or more maxillary teeth occluding lingually to the corresponding mandibular teeth, as seen in cases 1 and 2. This condition, if not addressed early, can lead to a selfperpetuating malocclusion that may require extensive orthodontic and possibly surgical correction later in life(9). Another significant issue is ectopic eruption, where teeth do not follow their normal eruption path, often due to dental developmental abnormalities such as abnormal tooth size, shape, or position. This can result in occlusal interference, where the path of one tooth's eruption or position affects another, leading to a domino effect of dental misalignments(10). This phenomenon was evident in cases 3 and 4.

The benefits of early orthodontic intervention for conditions like anterior crossbites and ectopic eruptions are substantial. Early treatment not only aims to correct the existing dental anomalies but also to guide the growth and development of the jaws and dental arches, thus preventing the progression of malocclusion. Such interventions can alleviate immediate symptoms like chewing difficulties and speech impediments, and set a foundation for healthier oral development, potentially reducing the need for more invasive treatments in the future.(7)

Early orthodontic intervention operates on several principles. The first is the timing of the intervention, which is critical and should ideally be implemented during a child's peak growth phases to maximize the effectiveness of treatment. The intervention strategy should be comprehensive, considering not only the correction of the malocclusion but also the management of contributing factors such as oral habits and muscle functions.(11) The choice of appliance—whether fixed or removable—is also dictated by the specific needs of the child, including the type of malocclusion, the child's compliance and ability to maintain oral hygiene, and economic factors that may influence treatment choices.(12)

Among the various appliances used in early orthodontic treatment, the "2x4 appliance" therapy is noteworthy, particularly during the mixed dentition stage. This therapy involves the use of a sectional fixed appliance that allows for the correction of malocclusions involving the anterior teeth by providing three-dimensional control over tooth movement. The "2x4" name reflects the configuration of the appliance, typically involving bands on the first permanent molars and brackets on the four upper incisors.(4)

Studies(13) have shown that 2x4 appliance therapy is particularly effective for correcting rotational misalignments, closing diastemas, and managing mild to moderate malocclusions involving the anterior teeth. The appliance provides more predictable results due to the active and controlled tooth movement it facilitates, compared to removable appliances which require high patient compliance and may have limitations in controlling tooth movement. Furthermore, the use of fixed appliances like the 2x4 appliance can significantly shorten treatment time compared to other methods, making it a preferred option for both clinicians and parents looking for efficient treatment solutions.(14)

By addressing the crossbite early, the 2x4 appliance helps prevent the development of more severe malocclusions that might require more complex and prolonged treatments later on. Early intervention with the 2x4 appliance can decrease the complexity and duration of future orthodontic treatments. By achieving proper alignment early on, it often eliminates the need for extensive corrective procedures later, as was seen in Case 1. The irregularly placed lower incisors could potentiate space discrepancy in the mandible leading to ectopic eruption of the permanent teeth. At the same time, due to the hindrance to the maxillary incisors, a limitation of the maxilla achieving its complete growth potential can be anticipated(15).

The 2x4 appliance is designed to be tolerable for children, causing minimal discomfort. Its fixed nature reduces the need for patient cooperation compared to removable appliances, ensuring consistent and effective treatment progress.(16) This is especially essential in cases dealing with children with poor compliance, as was the situation in case 3.

However, while the 2x4 appliance offers several advantages, it also has its limitations. Placement of

molar bands on not fully erupted molars or those with short clinical crowns can be challenging and uncomfortable for the patient. Another challenge is the optimum placement of brackets in teeth which maybe placed irregularly or have overgrown gingiva. As seen in Case 3, due to the palatally placed 22, the gingival overgrowth made it difficult to place the brackets and so, laser-assisted gingivectomy helped expose the adequate tooth structure for bracket bonding. Additionally, long spans of flexible wires required in some configurations can lead to issues with wire stability and may increase the risk of plaque accumulation, emphasizing the need for meticulous oral hygiene during treatment.

Some of the recent literature exploring the use of twoby-four appliance therapy suggests the effective use of it. A recent study(17) reporting the correction of a single tooth anterior crossbite concluded that the 2x4 appliance effectively corrected the crossbite and provided complete control over anterior tooth positioning with excellent patient acceptance. A recent comparison(18) between clear aligners and 2x4 mechanics in mixed dentition for correcting maxillary incisor position irregularities found that both clear aligners and 2x4 appliances displayed similar efficacy and efficiency, with the choice of appliance guided by clinician and family preference. The study by Cruz et al.(19) found that the 2x4 appliance was effective in increasing the arch perimeter and depth through distal movement of upper molars, maintaining the incisor position.

## Conclusion

In conclusion, early orthodontic treatment plays a crucial role in managing malocclusion in children. By addressing conditions such as anterior crossbites and ectopic eruptions early on, these interventions not only help in correcting dental anomalies but also contribute to overall dental and facial development. Using the 2x4 appliance therapy not only addresses the immediate alignment issues but also sets the foundation for longterm oral health and optimal dental development. The timely and effective correction provided by this appliance ensures children can enjoy both functional and aesthetic benefits as they grow while reducing their treatment needs ultimately contributing to a decreased burden of disease.

#### References

- Prakash P, Durgesh BH. Anterior Crossbite Correction in Early Mixed Dentition Period Using Catlan's Appliance: A Case Report. ISRN Dent. 2011 Nov 23;2011:1–5.
- Ulusoy A, Bodrumlu E. Management of anterior dental crossbite with removable appliances. Contemp Clin Dent. 2013;4(2):223.
- Almarhoumi A, Alwafi MM. Early Interceptive Correction for Anterior Crossbite Using a Removable Appliance: A Pediatric Case Study. Cureus. 2024 Mar;16(3):e56072.
- Fiona McKeown H, Sandlerd J. The Two by Four Appliance: A Versatile Appliance. Dent Update. 2001 Dec 2;28(10):496–500.
- Qais Raisan N, Nahidh M. Bite Raisers in Orthodontics: A review. Mustansiria Dent J. 2022 Dec 28;18(2):318–36.
- Gagnier JJ, Kienle G, Altman DG, Moher D, Sox H, Riley D, et al. The CARE guidelines: consensusbased clinical case reporting guideline development. BMJ Case Rep. 2013 Oct 23;bcr2013201554.
- Zhou C, Duan P, He H, Song J, Hu M, Liu Y, et al. Expert consensus on pediatric orthodontic therapies of malocclusions in children. Int J Oral Sci. 2024 Apr 16;16(1):32.

- Zou J, Meng M, Law CS, Rao Y, Zhou X. Common dental diseases in children and malocclusion. Int J Oral Sci. 2018 Mar 13;10(1):7.
- Ceyhan D, Akdik C. Taking a Glance at Anterior Crossbite in Children: Case Series. Contemp Clin Dent. 2017;8(4):679–82.
- American Academy on Pediatric Dentistry Clinical Affairs Committee-Developing Dentition Subcommittee, American Academy on Pediatric Dentistry Council on Clinical Affairs. Guideline on management of the developing dentition and occlusion in pediatric dentistry. Pediatr Dent. 2008 2009;30(7 Suppl):184–95.
- Schneider-Moser UEM, Moser L. Very early orthodontic treatment: when, why and how? Dent Press J Orthod. 2022;27(2):e22spe2.
- Elhussein M, Sandler J. Fixed versus removable appliances – which one to choose? Dent Update. 2018 Oct 2;45(9):874–81.
- Quinzi V, Ferro R, Rizzo FA, Marranzini EM, Federici Canova F, Mummolo S, et al. The Two by Four appliance: a nationwide cross-sectional survey. Eur J Paediatr Dent. 2018;(2):145–50.
- Dowsing P, Sandler PJ. How to effectively use a 2×4 appliance. J Orthod. 2004 Sep;31(3):248–58.
- 15. Dos Santos CCO, Da Rosa Moreira Bastos RT, Bellini-Pereira SA, Garib D, Normando D. Spontaneous changes in mandibular incisor crowding from mixed to permanent dentition: a systematic review. Prog Orthod. 2023 May 8;24(1):15.
- 16. Garrocho-Rangel A, Hernández-García G, Yáñez-González E, Ruiz-Rodríguez S, Rosales-Berber M, Pozos-Guillén A. 2 × 4 appliance in the mixed dentition stage: a scoping review of the evidence. J Clin Pediatr Dent. 2023 Jan;47(1):1-8.

- Maheshkumar K, Chowdhary N, Manjula KT, Anuraaga AT, Shaji NE, Nandini A. Single Anterior Tooth Crossbite Correction in Mixed Dentition using Versatile 2x4 Appliance Along with Posterior Bite Plane: A Case Report. Asian J Pediatr Res. 2023 Jul 14;13(2):41–6.
- 18. Da Silva VM, Ayub PV, Massaro C, Janson G, Garib D. Comparison between clear aligners and 2 × 4 mechanics in the mixed dentition: a randomized clinical trial. Angle Orthod. 2023 Jan 1;93(1):3–10.
- Cruz JD, Nova GV, Crosato M, Paiva JB, Rino Neto J. EFFECTS OF 2x4 APPLIANCE AND NiTi OPEN SPRING ON MIXED DENTITION. Rev Contemp. 2023 Jul 13;3(07):8093–112.