Quest Journals
Journal of Medical and Dental Science Research
Volume 10~ Issue 9 (2023) pp: 38-45
ISSN(Online) : 2394-076X ISSN (Print):2394-0751
www.questjournals.org

Research Paper

Enhancing Pediatric Orthodontics with the 2x4 Appliance: Benefits and Considerations.

Kalisipudi Sandeep[1], Meghana Lanka[1], Punithavathy R[2], Satyam Martha[3], Nikhila Amudala[4], Mohammad Abdul Sadik[5], Mupparapu Anudeep[6].

[1]*Senior lecturer, Department of Pedodontics and Preventive Dentistry, Lenora Institute of Dental Sciences, Rajahmundry, Andhra Pradesh, India.*
[2,3]*Professor, Department of Pedodontics and Preventive Dentistry, Lenora Institute of Dental Sciences, Rajahmundry, Andhra Pradesh, India.*
[5]*Senior lecturer, Department of Pedodontics and Preventive Dentistry, GSL Dental college, Rajahmundry, Andhra Pradesh, India.*
[1,6]*PG Students, Department of Pedodontics and Preventive Dentistry, Lenora Institute of Dental Sciences, Rajahmundry, Andhra Pradesh, India.*
***Corresponding Author**: Dr Kalisipudi Sandeep, P.G student Department of Pedodontics and Preventive Dentistry, Lenora Institute of Dental Sciences Rajahmundry, Andhra Pradesh, India – 533294.*

Abstract:
Correcting orthodontic anomalies to maintain arch integrity presents the most difficult challenge for pediatric dentists throughout the mixed dentition phase. Failure to address this problem may result in deleterious effects on the developing dentition which in turn complicate orthodontic treatment in the future. Factors such as the severity of malocclusion, age of the patient, patient's compliance in accepting the treatment, location of a discrepancy, periodontal condition, retention and stability considerations, patient expectation, limitation in specific functions of the selected appliance, availability of bone and space and eruption status of the tooth may dictate the success of the treatment. The combined use of removable appliances and 2 × 4 orthodontic appliances has been shown to produce a positive effect. The appliance assists in leveling and aligning malposed teeth and realigning their position into the arch. In the present article, a 2/4 appliance is used for the correction of proclined teeth, midline diastema closure, spacing created due to tongue thrusting habit, orthodontic extrusion of an unerupted tooth, correction of anterior tooth crossbite, arch expansion and helps in archiving of healthy and esthetic smile which improves the confidence of the child in early stages of life.
***Keywords:** 2/4 appliance, Malocclusion, Midline diastema, Crossbite, Proclined tooth, Orthodontic extrusion of an unerupted tooth.*

***R**eceived 08 Sep., 2023; **R**evised 19 Sep., 2023; **A**ccepted 21 Sep., 2023 © The author(s) 2023.*
P**ublished with open access at **www.questjournals.org

I. Introduction:

In recent years, there has been a notable transformation in the field of pediatric dentistry, as it has evolved from a conservative-restorative approach towards a more comprehensive approach that focuses on the total pediatric patient care. A critical aspect of this approach is the guidance of eruption and development of primary, mixed, and permanent dentitions, which plays a crucial role in providing complete oral healthcare to pediatric dental patients and contribute to the development of a permanent dentition that is in a stable, functional, and aesthetically acceptable occlusion.[1] During the mixed dentition phase, parents often have aesthetic and functional concerns regarding their child's growth.[2] However, many children with malocclusion in this stage are not treated until all permanent teeth have erupted or are given only removable appliances that provide limited tooth movement and less patient compliance.[3] It is the responsibility of pediatric dentists and orthodontists to guide the developing dentition towards normalcy, taking into account the stage of oral-facial growth and development.[4] This period of mixed dentition presents the best opportunity for intercepting malocclusion and providing occlusal guidance. Delaying treatment \until a later stage of maturity may lead to more complicated treatment options. [5]

Interceptive treatment is often carried out to reduce the severity of developing malocclusion. However, the timing of orthodontic treatment has long been a topic of debate. Majority of malocclusions can be corrected without surgical intervention or extraction of permanent teeth, making early interception particularly beneficial. Providing treatment to younger children in the early mixed dentition stage offers several advantages, including greater stability and a reduced risk of future complications. This can lead to improved self-esteem and aesthetic appearance, ultimately enhancing the child's overall personality. (Tung et al., 1998).[6]

Additionally, complex malocclusions can be modified through a two-step approach. The first step involves correcting mild malocclusions with a fixed partial appliance called a 2x4 appliance, while the second step involves complete treatment (Profitt et al., 1986).[7]

In the present case series, 2/4 appliance is used in conjugation with removable appliances for correction of Angles class 1 malocclusion associated with Crossbite, Midline Diastema, Proclination, and Orthodontic extrusion of an unerupted tooth. All the below cases attended in department of Paediatric dentistry. All the diagnostic tests were done before the treatment such as Orthopantomogram to evaluate the eruption pattern and malocclusion, Lateral Cephalogram to know the growth and airway space and Model Analysis to analyse the space available.

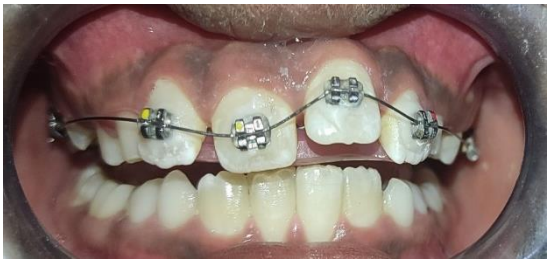
II. Case series:

Case 1:

A 12-year-old male reported with a chief complaint of upper front teeth protrusion for the past 2 years. There was no significant family or medical history, nor were there any associated habits. Clinical examination revealed that the patient had a dolichocephalic head, leptoprosopic face, convex profile with slight posterior divergence, and incompetent lips. Examination of dentition revealed a Class 1 molar and canine relationship on both sides, with the upper central incisor (21) being buccally placed and an anterior deep bite. The overjet was 6mm, and the overbite was 4mm. The patient was diagnosed with Angle's Class I malocclusion, with upper anterior proclination and deep bite. (FIGURE-1)

The treatment plan included a 2x4 fixed orthodontic treatment with a fixed anterior bite plane. Initial alignment was achieved using 0.014 NiTi wires followed by 0.016 NiTi wires. Post-treatment results showed complete leveling and alignment of all teeth into the arch within 6 months. The shape memory of the NiTi wire helped in leveling the incisors backward, and the use of the anterior bite plane caused the eruption of posterior teeth, resulting in the correction of the deep bite.


PREOPERATIVE INTRA ORAL VIEW




INTRA OPERATIVE INTRA ORAL VIEW

POST OPERATIVE INTRA ORAL VIEW

Figure:1- Showing preoperative, interoperative and post operative pictures of Case -1

Case2:

A 13year old male reported with a chief complaint of irregularly placed upper front teeth since 5 years. There was no significant family or medical history. There was no associated history of habits. On Clinical examination**,** the patient was found to have a dolichocephalic head, leptoprosopic face, convex profile, and competent lips. Intraoral examination raveled that 5x5 mm fibrous growth is seen on the labial mucosa of the upper lip. Examination of dentition revealed class I molar and canine relationship on both sides with ectopically erupted 21. Upon measuring overjet is 2mm and overbite is 2mm. Model analysis shows inadequate space is available for the eruption of 21. The treatment planned was excision of fibrous growth, space regaining with an open coil spring, and orthodontic extrusion of 21 for alignment into the arch. Results of post-treatment 6-month follow-up showed that leveling of 21 into arch. Post treatment lingual fixed retainer is used for retention.(FIGURE : 2)

The open coil spring placed between the teeth helps in regaining the space. The shape memory of NiTi wire helps in leveling and alignment of the tooth in position.

PREOPERATIVE INTRA ORAL VIEW

INTRA OPERATIVE INTRA ORAL VIEW

POST OPERATIVE INTRA ORAL VIEW

figure :2- Showing preoperative, interoperative and post operative pictures of Case -2

Case 3:

A 13year old female reported with a chief complaint of spacing between upper front teeth since 5years. There was no significant family or medical history. There was no associated history of habits. **On clinical examination,** the patient was found to have a mesocephalic head, mesoprosopic face, straight profile, and competent lips. Examination of dentition revealed class 1 molar and canine relationship on both sides with unerupted 21 seen in the radiograph. Upon measuring overjet is 2mm and overbite is 1mm. Model analysis shows inadequate space available for the eruption of 21. The treatment planned was 2/6 appliance along with an open coil spring for space regaining along with surgical exposure of unerupted 21 followed by orthodontic extrusion of 21 for alignment into the arch. Results of post-treatment follow-up showed that complete levelling and alignment of 21 into arch along with space closure is achieved after 7 months.

The open coil spring creates the space for the eruption of 21 whereas the NiTi plays role in levelling and alignment of 21 into the arch.

PREOPERATIVE INTRA ORAL VIEW

INTRA OPERATIVE INTRA ORAL VIEW

POST OPERATIVE INTRA ORAL VIEW

Figure 3 showing preoperative, intraoperative and post operative pictures of Case-3

Case 4:

A 13year old female reported with a chief complaint of spacing between upper front teeth since 3 years. There was no significant family or medical history. There was no associated history of habits. **On clinical examination,** the patient was found to have a mesocephalic head, mesoprosopic face, straight profile, and competent lips. Upon examination of the dentition, a Class 1 molar and canine relationship was observed on both sides, with an anterior crossbite concerning tooth 21.

Model analysis shows adequate space is available for complete space closure. The treatment planned was 2/4 appliance along with elastics for midline diastema alignment tooth in the arch. In this case, NiTi wire helps in leveling and alignment whereas elastics help in the closure of space between the teeth.

PREOPERATIVE INTRA ORAL VIEW

INTRA OPERATIVE INTRA ORAL VIEW

POST OPERATIVE INTRA ORAL VIEW

Figure 4 showing preoperative, intraoperative and post operative pictures of Case-4

Case5:

An 11 years old female reported with a chief complaint of the irregularly placed upper front tooth since 4 years. There was no significant family or medical history. There was no associated history of habits. On clinical examination**,** the patient was found to have a mesocephalic head, mesoprosopic face, straight profile, and competent lips. Examination of dentition revealed class 1 molar and canine relationship on both sides with anterior crossbite concerning 21. The treatment planned was 2/4 appliance with bite rising with a blue bite to relieve the horizontal stop. Results of post-treatment follow-up showed that complete leveling and alignment of 21 into arch after 3 months.

In this case, blue bite helps in rising the bite and gave clearance for the free movement of 21 forward whereas the elastic property of the NiTi wire pulls the tooth forward.

Preoperative intraoral view

Bite rise along brackets and 0.014 wire placed

Post treatment after 2 weeks follow up

Post operative extraoral view

Figure 5 showing preoperative, intraoperative and post operative pictures of Case-5

Case 6:

A 11 years old male reported with a chief complaint of spacing between the upper front tooth since 2years. In the history of presenting illness, the patient gives a history of trauma due to self-fall during playing resulting in tooth loss. There was no significant family or medical history. On clinical examination, the patient was found to have a dolichocephalic head, leptoprosopic face, convex profile, and competent lips. Examination of dentition revealed class 1 molar and canine relationship on both sides with spacing in the anterior region between 11 and 22. Model analysis shows inadequate space is available for prosthetic replacement. The treatment planned was a 2/4 appliance along with an open coil spring for space regaining. Post-treatment follow-up showed 3mm space was regained and a removable partial denture was inserted to preserve the space within 2 months span.

In this case, 2/4 along with an open coil spring helps in regaining the lost space for 21.

Preoperative intra oral images

Insertion of 2/4 appliance

Space regained after 2 weeks

Post treatment Rpd insertion

Figure 6 showing preoperative, intraoperative and post operative pictures of Case-6

III. Discussion:

Dentists encounter several challenges in treating malposed teeth, especially in young and growing patients. These challenges may include patient treatment compliance, parental expectations, and selecting an appropriate appliance for treatment. Some dentists choose not to treat malpositioned teeth until a later stage when orthodontic correction is necessary. However, delaying treatment often results in prolonged and complicated orthodontic treatment due to severe space loss and the migration of adjacent teeth. In some cases, opposing teeth may become mobile due to gum recession by the time orthodontic treatment begins, especially in cases where treatment is delayed.

Due to the potential negative impact of malocclusion on dentition, children in the mixed dentition stage need to undergo orthodontic screening to identify any related issues on time.[8]

Pediatric dentists are not tasked with the responsibility of achieving perfect teeth alignment and aesthetics during the developmental stage of dentition.[9] Rather, their role is to minimize the negative effects caused by malocclusion during this phase and facilitate a smooth transition to orthodontic care later on. Collaborating with orthodontists is crucial to ensure that achievable interceptive orthodontics are implemented during the growth phases of dentition.[10] Knowing fixed orthodontic mechanics is also beneficial for pediatric dentists as it enables them to develop alternative treatment approaches when the use of removable appliances becomes limited.[11] In this article, we have highlighted a method of teeth alignment: the sectional wire orthodontic appliance method i.e., the 2 × 4 fixed orthodontic appliance method for correction of Angles Class 1 Malocclusion associated with different mal alignments. The 2X4 appliance is a fixed orthodontic appliance composed of bands that are placed on the first permanent molars with molar tubes, brackets that are attached to

the four permanent incisors, and continuous arch wires that work to maintain a proper arch form. The orthodontic wires employed in the 2 × 4 technique must be thin in diameter to appropriately provide light, continuous and well-controlled forces over the incisors. These light orthodontic forces are applied for incisor derotations, alignment, and leveling, and are considered clinically safe and effective; according to the identified literature, initial archwires can be "0.012" to "0.016" NiTi (Nickel-Titanium alloy or Nitinol) (Titanium-Molybdenum-Titanium Alloy (TMA) wires can also be used) ; in a second phase, "0.016" stainless steel wires are employed; and finally, rectangular wires ("0.017" or "0.018" × "0.025") are placed. These arch wires are changed every two to four weeks[12]. It is used in the correction of anterior crossbite[13], mild to moderate rotations in anterior teeth[14], mild proclination correction, and space closure [15], helps in space regaining when used along with springs, and helps in repositioning the unerupted permanent teeth[16]. The 2×4 orthodontic appliance also allows a well-controlled three-dimensional tooth movement; however, this appliance may not be effective if there are only a few teeth available in the dentition. Fewer teeth will not allow proper sitting of the long-span archwire, which may dangle and dislodge from its brackets or cause discomfort to the patient. In the described cases, 2×4 fixed orthodontic appliances to control tooth alignment and retention. These treatment modalities enable patients to become accustomed to orthodontic treatment, starting with simple procedures and progressing to more complex ones. The use of these appliances does not interfere with the daily activities of patients, including mastication, speech, and oral comfort. Since fixed appliances cannot be removed by the patient, there are typically no major issues related to appliance dislodgement, treatment compliance, or loss of the appliance [12-16].

IV. Conclusion:

The 2 × 4 appliance is a versatile and effective option for patients with mild to moderate malocclusions in the mixed dentition stage. This fixed orthodontic device utilizes light, continuous, and well-controlled forces, making it particularly useful when removable appliances are not feasible. It can be utilized in various clinical situations with minimal modifications and only a few drawbacks compared to traditional removable approaches. The 2 × 4 appliance has been well-documented for its clinical efficacy in early orthodontic management of common malocclusions such as incisor crowding or rotations, orthodontic extension, anterior and posterior crossbites, ectopic eruption of upper incisors, and midline diastemas.

References:

[1]. Jeffrey A. Dean, David R. Avery, Ralph E. Mc Donald. Dentistry for the child and adolescent. 11th ed. Elsevier publishers; 2022.
[2]. F. Al-Sehaibany and G. White, "A three-dimensional clinical approach for anterior crossbite treatment in early mixed dentition using an Ultrablock appliance: case report," Journal of Clinical Pediatric Dentistry, vol. 23, no. 1, pp. 1–8, 1998.
[3]. Anterior Crossbite Correction in Early Mixed Dentition Period Using Catlan's Appliance: A Case Report. ISRN Dent. 2010; 2011:298931.
[4]. I. Kocadereli, "Early treatment of posterior and anterior crossbite in a child with bilaterally constricted maxilla: report of case," Journal of Dentistry for Children, vol. 65, no. 1, pp. 41–46, 1998.
[5]. C. S. Tse, "Correction of single-tooth anterior crossbite," Journal of Clinical Orthodontics, vol. 31, no. 3, pp. 188–190, 1997.
[6]. Rohilla M, Bodh M, Kumar A, Namdev R. Early Interception Using 2x4 Appliance: A Case Series. International Journal of Advances In Case Reports, 4(7), 2017,226-229.
[7]. Dr. Parikrama J. Solanki, Dr. Shantanu R. Choudhari, Dr. Chirag M. Vaghela and Dr. Sandip I. Saxena. 2017. "Use of Two by Four Appliance: A Treatment Modality for the Correction of Malaligned Maxillary Anterior Teeth during Mixed Dentition Period.", International Journal of Development Research, 7, (12).
[8]. February 2020, https://orthodonticsaustralia.org.au/benefits-of-early treatment /accessed.4 Case Reports in Dentistry.
[9]. C. İlisulu, S. Uz, M. Koruyucu, and F. Seymen, "Early interceptive orthodontic treatments: case series," International Journalof Medical Investigation, vol. 8, no.3, pp.104–111,2019.
[10]. Sockalingam, S. N. M. P., Zakaria, A. S. I., Khan, K. A. M., Azmi, F. M., & Noor, N. M. (2020). 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, 2020,1–5.
[11]. Arturo Garrocho-rangel, Gabriela Hernández-garcía, Esthela Yáñez-gonzález, Socorro Ruiz-rodríguez, Miguel Rosales-berber, Amaury Pozos-guillén. 2 × 4 appliance in the mixed dentition stage: a scoping review of the evidence. Journal of Clinical Pediatric Dentistry. 2023. 47(1);1-8.
[12]. Arturo Garrocho-Rangel, Gabriela Hernández-García, Esthela Yáñez-González, Socorro RuizRodríguez, Miguel Rosales-Berber, Amaury Pozos-Guillén. 2 × 4 appliance in the mixed dentition stage: a scoping review of the evidence. Journal of Clinical Pediatric Dentistry. 2023; 47(1).
[13]. Yordanova G, Mladenov M, Gurgurova G. Cross-bite treatment and problems during the early stages of developing of the dentition in the frontal area. International Journal of Science and Research. 2016; 5: 1506–1510.
[14]. Kumari N, Saini N, Garg S, Namdev R. Interceptive segmental orthodontic: role in early mixed dentition. International Journal of Health Sciences and Research. 2020; 10: 303–08.
[15]. Hussain U, Ayub A, Farhan M. Etiology and treatment of midline diastema: a review of the literature. Pakistan Orthodontic Journal. 2013; 5: 27–33.
[16]. Dowsing P, Sandler J. How to effectively use a 2×4 appliance. Journal of Orthodontics. 2004; 31: 248–258.