Innovations

Trihelix Appliance: A Novel Alternative for Expansion- A Case Report

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Abstract: *Maxillary transverse discrepancies affecting approximately 7.7% of children during primary and mixed dentition stages, present significant challenges due to their complex nature and the necessity for individualized treatment. Factors such as patient age, skeletal maturity, severity of the discrepancy, and associated syndromes must be considered to prevent these deficiencies from progressing into adulthood, where they can lead to pronounced functional and aesthetic issues. Maxillary constriction impacts dental alignment and the overall facial profile, often resulting in occlusal disharmony and aesthetic concerns. Functionally, it can narrow the pharyngeal airway, leading to compromised breathing patterns and increased nasal resistance affecting airflow efficiency. Additionally, maxillary constriction can alter tongue posture, contributing to retrognathic tongue positioning and mouth breathing. Severe crowding due to maxillary constriction complicates oral hygiene, increasing the risk of periodontal problems like gingivitis and periodontitis. Pierre Robin sequence, characterized by mandibular micrognathia, glossoptosis, and often cleft palate, exemplifies the complexity of treating maxillary transverse discrepancies in syndromic contexts. This sequence, first described in 1891 and further characterized by Pierre Robin in 1923 and 1934, begins with an underdeveloped lower jaw, leading to tongue displacement and preventing palatal shelf fusion during intrauterine growth. About 50% of patients with Pierre Robin sequence have an incomplete cleft of the palate, adding to the treatment complexity.*

A case report of a fourteen-year-old female patient with Pierre Robin sequence illustrates the multifaceted approach required for successful treatment. The patient had mandibular micrognathia, aglossia, a constricted maxillary arch, retained deciduous teeth, and severe dental crowding. Her treatment plan involved extracting retained deciduous teeth, followed by maxillary and mandibular expansion, mandibular advancement, speech therapy, and surgical rehabilitation for aglossia. Due to restricted mouth opening, a custom trihelix appliance was used for slow maxillary expansion, activated every 15 days over six months. This approach resulted in significant improvements in interpremolar and intermolar widths, demonstrating successful maxillary expansion. This case underscores the importance of a tailored and multidisciplinary approach in treating maxillary transverse discrepancies, particularly in patients with complex syndromic conditions. Early intervention and comprehensive management are crucial to improving patient outcomes and quality of life.

Keywords: *Pierre Robin Syndrome, Maxillary Constriction, Maxillary Expansion, Quad Helix Appliance.*

Introduction:

Maxillary transverse discrepancies pose a significant challenge for clinicians due to their complex nature and the need for tailored treatment approaches. Addressing these discrepancies often requires careful consideration of various factors such as the patient's age, skeletal maturity, severity of the discrepancy, presence of any associated conditions or syndromes, and treatment goals. Clinicians may employ a range of orthodontic and orthopedic techniques to address maxillary transverse deficiencies. The prevalence of maxillary transverse deficiency varies across populations and age groups. In general, it is estimated that approximately 7.7% of children exhibit transverse discrepancies during their primary and mixed dentition stages. However, prevalence rates may differ based on factors such as genetics, environmental influences, and underlying health conditions. As individuals transition into adulthood, these deficiencies can become more pronounced, highlighting the importance of timely intervention and management strategies. [1,2]

Maxillary constriction indeed presents various challenges, encompassing both dental and functional aspects. Occlusal disharmony and esthetic concerns are common manifestations, affecting not only the alignment of teeth but also the overall facial profile. However, the implications extend beyond aesthetics to functional difficulties. Narrowing of the pharyngeal airway can lead to compromised breathing patterns, while increased nasal resistance can impact nasal airflow and breathing efficiency. Moreover, alterations in tongue posture due to maxillary constriction can contribute to retrognathic positioning of the tongue,

further exacerbating airway narrowing and potentially resulting in mouth breathing. Addressing maxillary constriction requires a comprehensive approach aimed at correcting both dental and functional aspects to optimize patient outcomes and overall well-being.[3,4]Additionally, a constricted maxillary arch can lead to difficulties in maintaining oral hygiene due to severe crowding. This crowding often results in periodontal problems for patients with transverse arch discrepancies, as the tight spaces between teeth can harbor plaque and bacteria, increasing the risk of gingivitis and periodontitis. Effective management of maxillary constriction is crucial to alleviate these issues and promote better oral health.

Formerly referred to as Pierre Robin syndrome, anomalad, or complex, it is now known as Pierre Robin sequence because the underdeveloped lower jaw initiates a sequence of events: micrognathia leads to glossoptosis, which in turn prevents the palatal shelves from fusing during intrauterine growth. Decades earlier,the sequence was first described in 1891. Pierre Robin, a French stomatologist at the French School of Stomatology, first defined this syndrome in an infant in 1923, characterizing it by mandibular micrognathia, glossoptosis, and respiratory distress. In 1934, Robin revised the syndrome's characteristics to include cleft palate as an additional possible feature. An incomplete cleft of the palate is associated with Robin sequence in approximately 50% of these patients.[5,6]

Case report:

A fourteen-year-old female patient presented to the outpatient clinic at the Department of Pediatric Dentistry, Thai Moogambigai Dental College and Hospital, with a chief complaint of malaligned teeth. Upon examination, she reported difficulties in speech and mastication and had a previous diagnosis of Pierre Robin Syndrome. Clinical examination revealed mandibular micrognathia, aglossia, and a severely constricted maxillary arch. Intraoral examination indicated retained deciduous teeth 51, 62, 75, and 85, missing lower anterior teeth, and grossly decayed 36. The patient exhibited a severely constricted maxillary arch with an interpremolar width of 19 mm and an intermolar width of 20 mm.

The contemporary treatment plan was to extract the retained deciduous teeth followed by maxillary and mandibular expansion, mandibular advancement, speech therapy and surgical rehabilitation for aglossia.

The treatment plan involved slow maxillary expansion to address the constricted arch. A custom impression tray was made due to the restricted mouth opening, and both maxillary and mandibular impressions were taken using elastomeric impression material. After obtaining a study model, the preferred appliance was a quad helix. However, due to challenges in incorporating helices

in the anterior region, a trihelix wire component was created using 19-gauge stainless steel wire. This component included one helix in the anterior region and two in the posterior, soldered to prefabricated bands. The appliance was then luted onto the maxillary permanent molars using type 1 glass ionomer cement (GIC).

Oral hygiene instructions were provided to the patient, and she was scheduled for recall visits every 15 days for appliance activation. During each visit, the appliance was removed, all three helices were activated, and then the appliance was luted back in place using type 1 GIC. After six months of treatment, there was a significant improvement, with an increase in the interpremolar width by 7 mm and the intermolar width by 8 mm. This demonstrates successful maxillary expansion and progress towards achieving the treatment goals for the patient's malocclusion associated with Pierre Robin Syndrome.

Follow up:

After 6 months of wearing the trihelix appliance, the patient transitioned to a jackscrew appliance with a posterior bite plane for further expansion. The parent was instructed to activate the appliance by turning it one-quarter turn twice a day to achieve optimum expansion. After 2 months, once the desired amount of expansion was reached, the patient began fixed orthodontic therapy to align the teeth. Additionally, the retained deciduous tooth 53 was extracted, and pulpotomy was performed on tooth 36, which was then restored with a stainless steel crown to facilitate further treatment.

Discussion:

Pierre Robin Sequence (PRS) (MIM 261800) is named after the French stomatologist Pierre Robin, who first described the condition in 1923 and further detailed it in 1934. PRS is characterized by a combination of congenital abnormalities including micrognathia (undersized jaw), glossoptosis (downward displacement or retraction of the tongue), and often a cleft palate. The prevalence of PRS is approximately 1 in 8500 live births. [7]Recent genetic studies have shed light on the underlying causes of PRS, highlighting the association between the dysregulation of the genes SOX9 and KCNJ2. Specifically, a familial translocation with a breakpoint located in the gene-empty region between SOX9 and KCNJ2 has been identified. Additionally, reduced expression of these genes has been observed in non-translocated patients with PRS. These findings suggest that disruptions in the regulation of SOX9 and KCNJ2 play a significant role in the development of PRS, providing new avenues for understanding and potentially treating this congenital condition.[8] In the case of PR anomalad, the primary defect lies in the arrested development and ensuing hypoplasia of the mandible, ultimately producing the characteristic "bird facies." [9]

The Quad Helix appliance, developed by Robert Ricketts in 1975, is used to achieve maxillary expansion through both orthodontic and orthopedic movements. This appliance is designed to correct dental and skeletal discrepancies by gradually widening the upper jaw. Unlike rapid expansion techniques, the Quad Helix appliance operates over several months, allowing for a slower and more controlled expansion process.[10]The gradual nature of this expansion helps to minimize discomfort and promotes more stable, long-term results. The Quad Helix appliance is often utilized to correct issues such as crossbites, crowding, and other malocclusions by creating additional space in the upper arch, thereby improving overall dental alignment and function.The quadhelix is an orthodontic appliance designed for the expansion of the dental arch. It is typically a fixed device that employs the principle of spring action to apply continuous force on the teeth, aiding in their movement. The quadhelix appliance is often used in combination with other orthodontic systems to achieve desired dental corrections.The evolution of the quadhelix can be traced back to the "W" spring, a type of spring used in removable orthodontic appliances. This original design was described by Dr. Walter H. Coffin in 1881. Coffin's work laid the groundwork for the development of more sophisticated appliances like the quadhelix, which incorporates multiple helices to deliver more effective and controlled expansion forces. [11]

The quadhelix consists of four helices or loops that can be activated to provide various degrees of expansion. It is particularly effective in treating issues such as crossbites, crowding, and the need for arch width expansion. Its fixed nature ensures that the forces are consistently applied over time, which can lead to more predictable and stable outcomes in orthodontic treatment.

Magnifico et al., introduced an asymmetrical quad helix which is a variant of the standard quadhelix orthodontic appliance characterized by an asymmetrical design. While one side retains the traditional configuration with a normal lateral arm and double-end terminal serving as the anchorage side, the active side featured a single wire terminal instead of the usual double-end setup. This asymmetry allowed for more targeted and controlled tooth movement, facilitating specific orthodontic adjustments while minimizing unwanted effects. [12]

Fayeez et al. employed a reverse quad helix expander in conjunction with active orthodontic therapy to address Class 3 malocclusion.[13] Yaseen et al. utilized a hexa-helix appliance, incorporating six helices, to correct both anterior and posterior crossbites. [14]

In this particular case, the orthodontic appliance design was likely adapted to suit the specific needs of the patient, leading to an improved treatment outcome. Modifications to the appliance design could involve adjustments such as altering the size, shape, or configuration of the components based on factors like the severity and type of malocclusion, the patient's dental anatomy, and treatment objectives. By customizing the appliance to the patient's individual status,

orthodontists aim to optimize its effectiveness in addressing the unique challenges presented by the case, ultimately resulting in a more successful treatment outcome. This personalized approach highlights the importance of tailoring orthodontic interventions to meet the specific requirements of each patient, ensuring the best possible results.

Conclusion:

Early detection of orthodontic issues allows for timely intervention, which can prevent further complications and reduce treatment duration. Orthodontic problems, if left untreated, can worsen over time, leading to more complex and costly treatments later on. By integrating proper diagnosis, personalized treatment plans, timely intervention, leveraging technological advances, and promoting patient awareness, we can optimize outcomes, enhance patient satisfaction, and contribute to overall dental health and well-being.

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Figures:

Figure 1: Preoperative Photographs a) Frontal View b) Maxillary occlusal view c) mandibular occlusal view

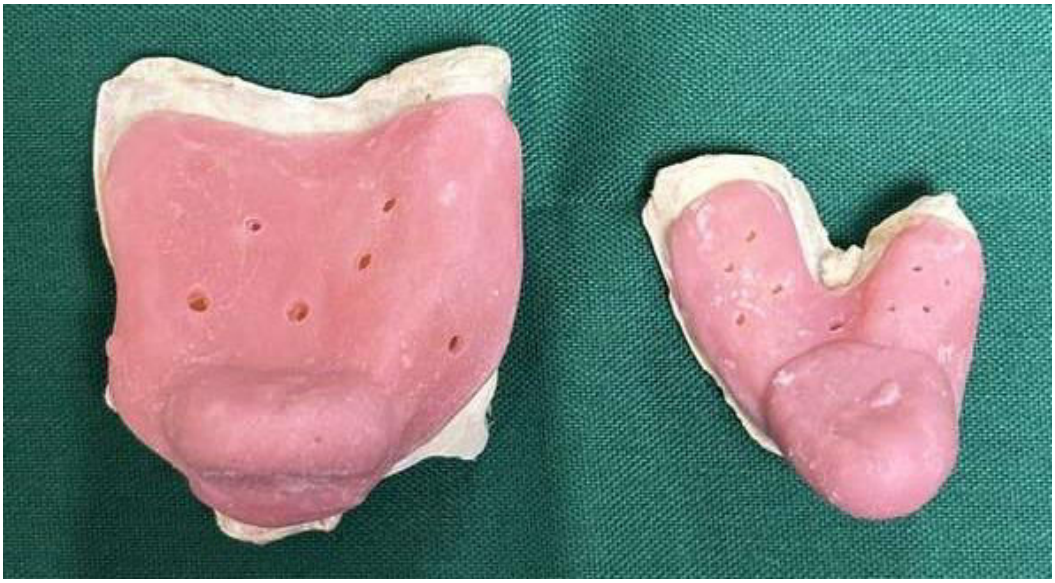

Figure 2: custom tray fabrication

Figure 3: Maxillary cast showing constricted maxillary arch with deep palatal vault

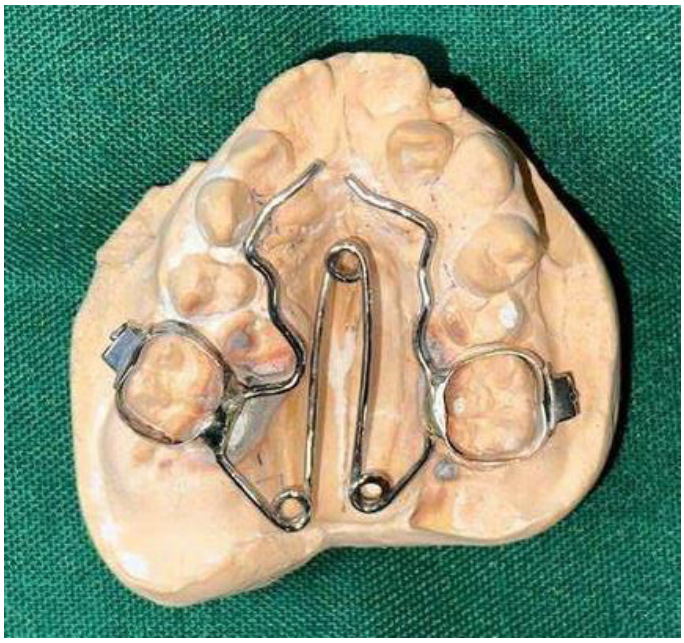

Figure 4: Fabricated Trihelix Appliance

Figure 5: Immediate Postoperative Photograph after appliance insertion

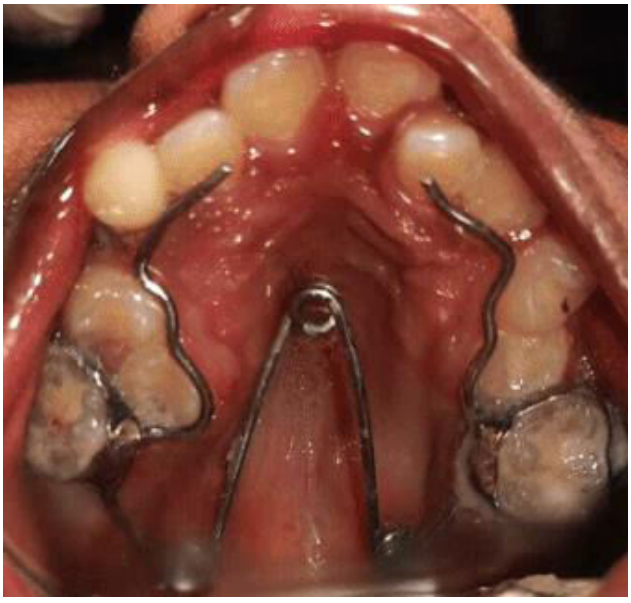

Figure 6: After 6 months, there is a marked increase in both inter-premolar and intermolar width

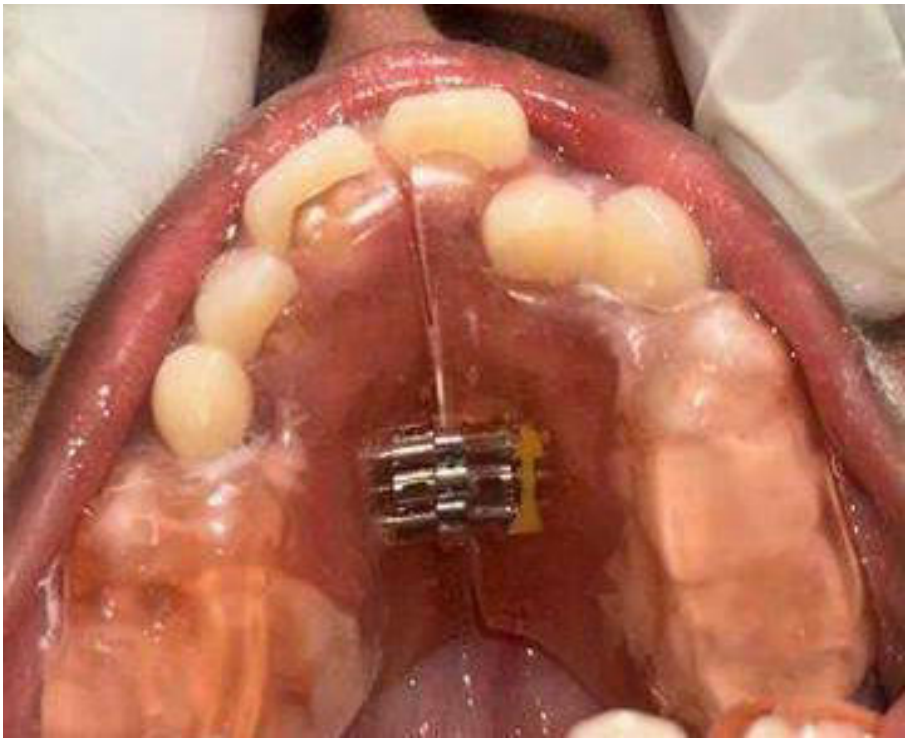

Figure 6: Jackscrew appliance with posterior bite plane given to the patient

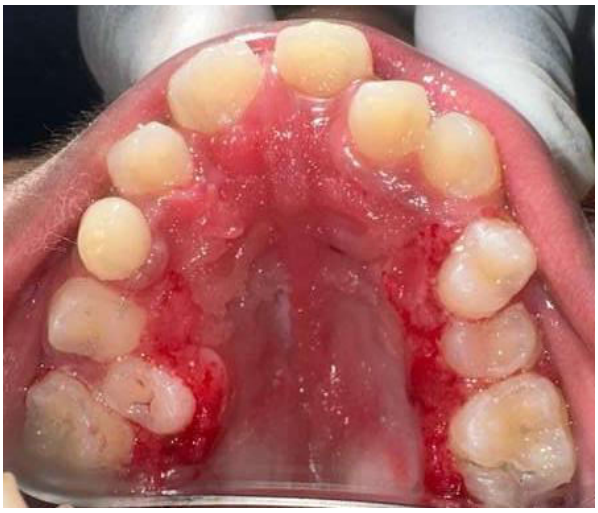

Figure 7: Post Operative photograph of maxilla and mandible after 8 months of treatment

Figure 7: Fixed orthodontic therapy. Frontal and Maxillary view