Unlocking Premolars with the Pendulum Appliance Approach in Mixed Dentition: A Case Report

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ABSTRACT

Impaction or ectopic eruption of premolars can also occur due to space loss caused by the early loss of primary molars, often requiring early management. Timely intervention can reduce or eliminate the need for more complex and costly fixed orthodontic treatment, alleviating parental anxiety about future complications and financial burden. The pendulum appliance is an intraoral device used for molar distalization and space regaining with minimum compliance required. This case report explores the utilization of a pendulum appliance for space regaining in a patient with a locked premolar due to premature loss of primary molars resulting in mesial migration of maxillary first permanent molar. The appliance effectively facilitated controlled distalization of the molar, creating sufficient space for the eruption of locked premolar and achieving proper tooth alignment. This improved facial aesthetics, and enhanced self-image, boosting the child's confidence. Hence, it offers a predictable, efficient, and patient-friendly approach to managing space deficiencies in the mixed dentition phase.

Keywords: *Distalization, mixed dentition, pendulum, space regainer.*

INTRODUCTION

Preventing impaction or misalignment of erupting teeth in the mixed dentition requires careful management of space deficiencies. Traditional approaches rely on patient compliance, but Hilgers' 1992 invention of the pendulum appliance offers a clinician-controlled solution.[1] The appliance uses a large Nance acrylic button for palatal anchorage and 0.032″ titanium–molybdenum alloy (TMA) springs to deliver a continuous light force to distalize the maxillary first molars, producing a broad pendulum of force from the midpalate to the molars.[1] This approach is particularly effective in cases of mixed dentition with blocked premolars, horizontal growth, mild to moderate space deficiencies and an end-on or Class II molar relationship in a skeletal Class I pattern.[1]

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Citation

Gupta S, Dali M, Koirala B. Unlocking Premolars with the Pendulum Appliance Approach in Mixed Dentition: A Case Report. J Nepal Assoc Pediatr Dent. 2024;5(1): 21-5.

CASE REPORT

We report a case of a 9-year-old healthy female patient, presenting with mixed dentition and insufficient space for the eruption of the locked second premolar on the right side, visited for routine dental care at the Department of Pedodontics and Preventive Dentistry, BPKIHS, Nepal (Figure 1). The patient exhibited a horizontal growth pattern, convex profile and end-on molar relationship on right side by 3 mm (Figure 2A) and Angle's class I molar relationship on left side (Figure 2B). Orthopantomogram revealed precocious eruption of maxillary premolars and insufficient space for its eruption on maxillary right

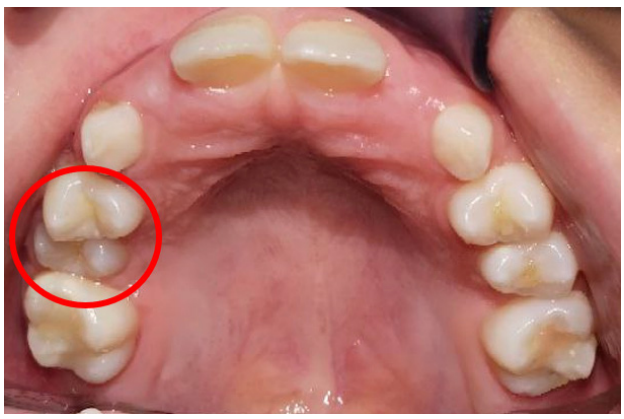

Figure 1. Precocious eruption of 14 and 15 with locked 15.

quadrant (Figure 3). Tanaka and Johnston prediction equations were applied for space analysis which revealed 3 mm and 0.5 mm arch length deficiency in the maxillary right and left quadrants, respectively.[2] Hence, space regaining for 15 by molar distalization was planned.

Molar distalization increases arch length through rearward movement of the molar, but achieving this, especially for maxillary molars, can be challenging.[3] While headgear has been a common method for molar distalization, its success is heavily reliant on patient compliance, and many patients find extraoral appliances unesthetic.[3] As a result, headgear often fails due to non-compliance. The difficulties in predicting patient behavior and the subjectivity of treatment outcomes have prompted many clinicians to develop appliances that minimize patient reliance, and are controlled by the clinician.[1] This shift has led to the preference for intraoral distalizing appliances, such as the Jones jig, magnets, distal jets, and the pendulum, which require minimal compliance and are not a concern esthetically.[3] Each appliance has specific indications, contraindications, and mechanics, with selection often based on the practitioner's preference.[3] Compared to the distal jet and Jones jig appliances, the pendulum provides greater distalization and space while offering better molar control by minimizing tipping.[3] In contrast, the distal jet and Jones jig tend to cause more mesial movement, greater mesial tipping, and extrusion of maxillary premolars.[4] Clinicians have noted that the pendulum is more effective for distalization with less second premolar anchorage loss.[3,5] Additionally, the pendulum appliance provides high patient tolerance, minimal reliance on patient compliance, ease of fabrication, and a lower cost compared to other distalizing appliances.[3,6] Therefore, pendulum appliance approach was planned for distalization of 16 to regain the space for 15. The pendulum appliance is used in the first

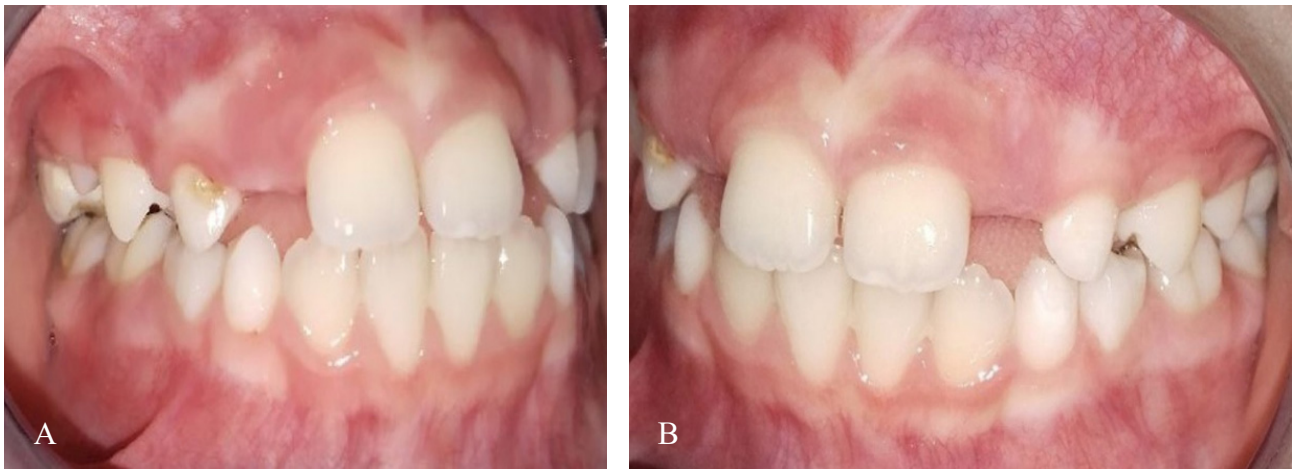

Figure 2. Pre-operative: A - Right lateral view, B - Left lateral view

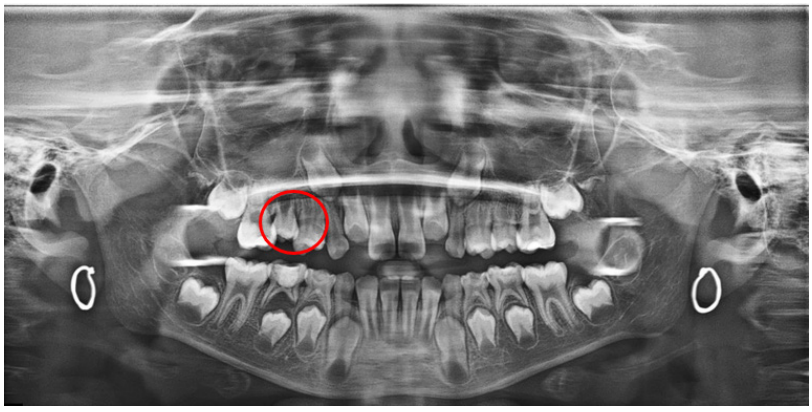

Figure 3. Orthopantomogram showing locked 15

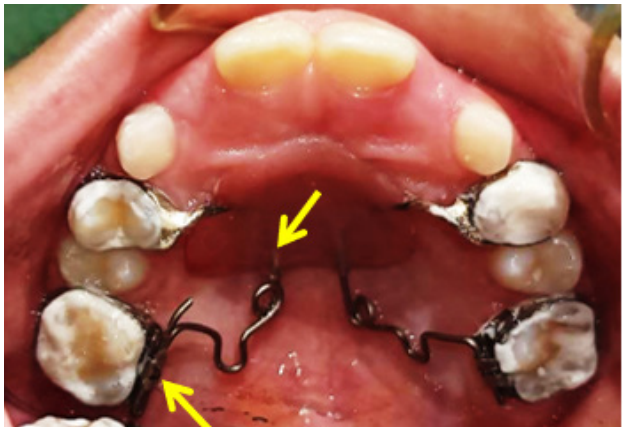

Figure 4. Extra-oral pre-activation of TMA spring on right side with mesial end inserted into the needle guide sleeve and distal end into the lingual sheath of molar bands

Figure 5. Activation of wire in follow up visit

phase of orthodontic treatment for unilateral or bilateral distalization of maxillary first molars to correct end on or Class II molar relationship in noncompliant patients, regain space in cases of mesial drift of upper first molars due to early loss of primary molars, and facilitate non-extraction treatment of mild to moderate crowding.[1]

For the appliance fabrication both the maxillary first permanent molars and first premolars were banded and impression made. The appliance design included an anterior acrylic Nance palatal button for anchorage, which was secured in position by soldering it to the first premolar bands, and two posteriorly extending 0.032" Titanium Molybdenum Alloy (TMA) springs which were inserted within the hollow barrel of a 20 ml syringe needle, serving as a guide sleeve embedded in the acrylic portion bilaterally (Figure 4). This setup allowed the TMA springs to slide in and out efficiently for easy reactivation. The TMA spring consisted of a recurved molar insertion wire to be inserted into the lingual sheath of the molar band, a small horizontal adjustment loop, a closed helix, and a retention loop inserted into the guide sleeve embedded in the acrylic button. The TMA spring for maxillary right quadrant was pre-activated extra-orally by bending them to 90 degrees, with approximately 30 degrees lost during insertion, resulting in 60 degree activation for distalizing the molars. The mesial end of the TMA spring was then inserted into the guide sleeve, and the distal end was placed into the lingual sheath of the molar bands, ensuring secure engagement and optimal force application for controlled molar distalization (Figure 4).

The patient was followed up in every three weeks, and the spring was activated by opening the helix extra-orally after removing it from the guide sleeve and lingual sheath and again reinserting it (Figure 5).

RESULT

The pendulum appliance achieved successful distalization of the maxillary first molar, with a total movement of 3.5 mm observed over a three months treatment period. This was accomplished through two separate activations of the appliance every three weeks, resulting in an average monthly distalization rate of approximately 1.2 mm.

The gained space allowed for proper eruption and alignment of the previously impacted maxillary second premolar (Figure 6). The treatment also produced a favorable change in occlusal relationship, with correction from an end-on molar relationship to a Class I molar relationship on the right side (Figure 7). Post operative OPG was taken which showed 15 having adequate space in the arch (Figure 8).

Given the minimal space deficiency present in this case, no retention appliance was deemed immediately necessary following treatment. However, a Nance palatal arch remains a viable option for maintaining the achieved molar position for long-term stabilization if required.

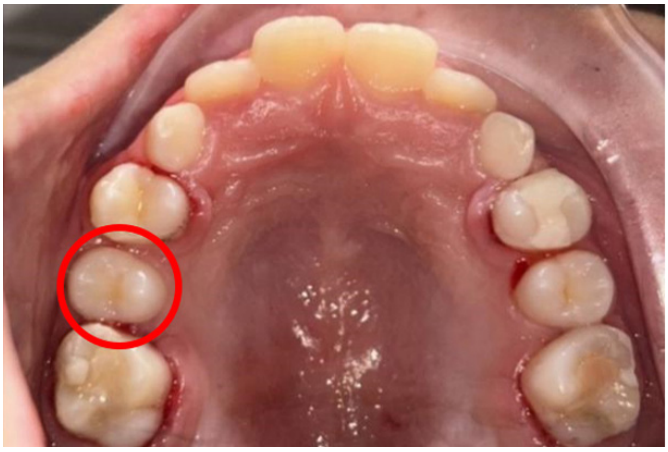

Figure 6. Post-operative after 3 months - Showing unlocked 15 with distalization of 16

Figure 7. Post-operative at three months follow up: A - right lateral view, B - left lateral view.

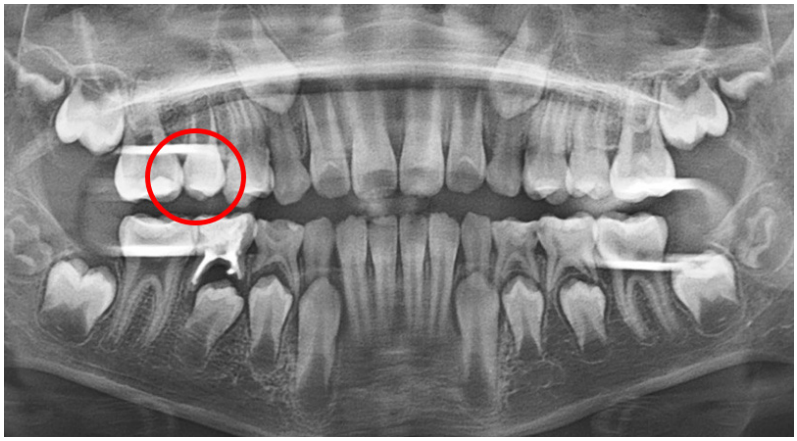

Figure 8. Post-operative orthopantomogram showing unlocked 15

DISCUSSION

Molar distalization using the pendulum appliance is one of the non-extraction therapy for creating space and establishing a Class I molar relationship.[7] In this case, the distalization was achieved through a bodily movement, unlocking the second premolar 15 and allowing it to erupt naturally (Figure 6). Consequently, proper Class I molar relationship was achieved from an end-on molar relationship on the right side. By the third month, 3.5 mm of excess space was regained in the maxillary right quadrant, measured by Tanaka and Johnston space analysis.

Complete eruption of the premolars was observed by the sixth month, confirming the appliance's efficiency. These findings align with previous studies demonstrating the efficacy of the pendulum appliance in achieving controlled molar movement with minimal patient discomfort.[1,3]

Byloff and Darendeliler[8] reported that the pendulum appliance moves molars at an average rate of 1.02 mm per month with an initial force of 200–250 g, making it more effective than the headgear, which typically requires 9–12 months for molar distalization with a force of 250 g per side.[7-8] Other distalization methods, such as the Jones jig, distal jet, and magnetic repelling forces, are alternatives, but compliance issues often limit their effectiveness.[3] The pendulum appliance, being intraoral and noncompliance-dependent, offers greater control, higher patient tolerance, and lower cost, making it a preferred choice among the clinicians.[3]

One key advantage of the pendulum appliance is its ability to provide better molar control by minimizing excessive tipping and promoting bodily movement.[3] It is most effective when used before the eruption of the second permanent molar, maximizing the efficiency of distalization.[1,3] Hilgers (1992) demonstrated that when the appliance is placed prior to the eruption of the second molars, two-thirds of the space gained results from molar distalization, while one-third is attributed to the forward shift of the anterior teeth.[7] In this case, as the second permanent molars were unerupted, the favorable conditions for distalization were met, ensuring maximum efficiency in space creation.

Hilgers also reported that the pendulum appliance can achieve up to 5 mm of distal molar movement within 3–4 months, with an average distalization rate of 1.2 mm per month.[7-8] Similarly, in this case, 3.5 mm of space was regained within 3 months, as measured by space analysis. This included 3 mm of distalization of 16, aligning its position from an end-on molar relationship to a proper Class I molar relationship and 0.5 mm of space was regained due to the mesial movement of 14, demonstrating the appliance's effectiveness in achieving rapid and predictable molar movement.

CONCLUSIONS

The successful treatment of a locked maxillary right second premolar using a pendulum appliance demonstrates the effectiveness of early intervention in managing space loss during the mixed dentition period. By achieving 3.5 mm of space through the distalization of the maxillary right first molar at a rate of 1.2 mm per month, this approach not only facilitated proper eruption but also corrected the molar relationship to Class I, reducing the need for more complex fixed orthodontic treatment. This case highlights the importance of early diagnosis and the use of biomechanically efficient appliances in pediatric dentistry to optimize treatment outcomes and simplify future orthodontic management.

ACKNOWLEDGMENTS

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Conflict of Interest: None

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