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Maxillary Expansion in a Skeletally Mature Patient Using a Modified Expander and Temporary Anchorage Devices (TADs) – A Case Report

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Abstract

Aim: Maxillary transverse deficiencies pose significant challenges in orthodontics, necessitating effective treatment methods. Traditional approaches like rapid maxillary expansion (RME) have demonstrated limitations, especially in skeletally mature patients. Skeletal anchorage-based expansion methods, such as miniscrew-assisted rapid maxillary expansion (MARME), have emerged as viable alternatives, offering advantages in terms of reduced dental side effects and improved stability.

Report of a Case: A 14-year-old female presented with a severely constricted maxillary arch and intricate occlusal issues. This case report details the utilization of MARME as a treatment modality. Miniscrews were strategically placed by an orthodontist specialist, and the expansion process was carefully monitored. Post-treatment outcomes revealed a significant increase in midpalatal suture opening width, showcasing the effectiveness of MARME. Cone beam computed tomography images demonstrated a notable expansion of the transverse dimension, leading to improved occlusal relationships.

Conclusion: Skeletal anchorage-based expansion, particularly MARME, stands out as a preferred method for addressing maxillary constriction in adolescents. This case serves as an illustration of the feasibility and distinctive advantages of Temporary Anchorage Devices (TADs) in the context of maxillary expansion for skeletally mature patients.

Keywords: Maxilla, Expansion, Temporary Anchorage Devices,

Background

Maxillary constriction poses a challenge in orthodontics, and various techniques such as slow orthodontic expansion (SME), rapid maxillary expansion (RME), surgically assisted rapid maxillary expansion (SA-RME), and two- or three-segmented Le Fort I-type osteotomy have been employed for correction (1, 2). RME, particularly effective for severe maxillary transverse deficiencies and posterior crossbites, exerts considerable force, up to 900–4500 grams, capable of splitting the midpalatal suture in young patients (3). However, difficulties arise as the midpalatal suture interlocks in late adolescence and fuses in adulthood, hindering separation. Notably, there is a sex-based recommendation for surgical assistance in RME, advising intervention in girls two years earlier than in boys (3).

Despite its efficacy, RME comes with inherent risks, including loss of pulp vitality, extrusion, root resorption, bony dehiscence, and buccal tipping of anchor teeth (4). An orthopedic expansion study demonstrated that skeletal movement accounted for only 50% of young children and 35% of adolescents, with the rest attributed to dental movement (5).

In response to the limitations of traditional tooth-borne expansion devices, alternatives have emerged to mitigate negative side effects, minimize dental tipping, and maximize skeletal expansion. A pilot study comparing a surgically assisted, bone-anchored rapid palatal expander (RPE) to a traditional tooth-borne RPE revealed that the bone-anchored expander induced more skeletal than dental changes. Specifically, teeth exhibited 6-9° less tipping than the alveolar process, and complications such as root resorption, bony dehiscence, and buccal tipping were mitigated (6).

This article focuses on bone-borne expansion with support from miniscrew implants, providing a less

invasive alternative with advantages over traditional methods. The subsequent case presentation illustrates the application of a pure bone-borne appliance for rapid palatal expansion in a carefully selected case. This appliance stands out as the preferred choice over traditional miniscrew-anchored expanders. Its distinctive advantage lies in its fabrication within the laboratory, offering a cost-effective alternative without incurring additional expenses compared to traditional expanders. Moreover, its complete construction using tools readily available to orthodontic specialists and laboratories ensures convenient accessibility, establishing it as a potentially preferred choice in orthodontic practice.

Appliance Fabrication

Four self-drilling Dual-Top miniscrews (Jeil Medical Corporation, Korea) with a slot-form head design (code of production: 16-G1-8, 1.6 mm in diameter, G1,8 mm length) were precisely inserted perpendicular to the palatal shelves on both sides. The mesial miniscrews were positioned between the first and second premolars, while the distal ones were placed between the first and second molars on the right side and between the second premolar and first molar on the left side (accounting for increased palatal soft tissue thickness between molars). After a two-week healing period, an impression of the maxillary arch was taken and sent to the laboratory.

In the laboratory, the technician shaped 0.018-inch stainless steel orthodontic wires (DENTAURUM GmbH & Co. KG) to conform to the palatal anatomy between the two miniscrews on each side. The arms of the Hyrax expander (DENTAURUM GmbH & Co. KG) were then connected to the lateral wires through soldering. In the clinic, the orthodontist adjusted the lateral wires to snugly fit into the slot of the miniscrews. After adjustment, the fitted lateral wires were secured in the slot using ligature wires (DENTAURUM GmbH & Co. KG). Finally, the screw heads were coated with Light-Cure flowable composite (Dentsply International Inc, York, Pa) to enhance stabilization.

To activate the appliance, one 90° turn was applied, resulting in an immediate, pronounced increase in tension. The patient was instructed to activate the expander every other day by turning it 90° until the desired width was achieved (see Fig. 1). Following the completion of the expansion, the expander was retained in place for approximately three months.

The initial step in the detachment of the appliance involved removing the composite from inside the screw head using a Weingart Universal Plier (DENTAURUM GmbH & Co. KG) until the screw head became visible. Subsequently, ligature wires were cut and removed, allowing for the complete and easy removal of the expander. The miniscrews could then be removed or repurposed for other orthodontic procedures, such as molar distalization or intrusion. The following case presentation illustrates the utilization of a novel pure bone-borne Hyrax expander in an adolescent patient.

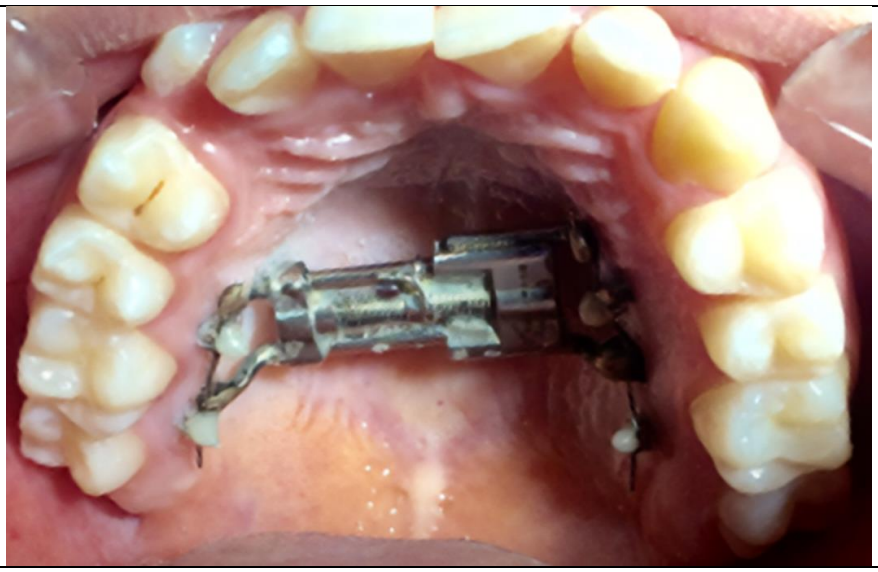

Figure 1. Appliance after achieving overcorrection.

Case Presentation

A 14-year-old female presented with a pronouncedly constricted maxillary arch, displaying class II molar and canine relationships on the left side and a class II occlusion on the right molar, accompanied by buccally impacted right canine. Additionally, mild mandibular anterior crowding was observed (refer to Fig. 2). Since skeletal anchorage-based expansion methods are most suitable for adolescents within the age range of 12 to 16 years, a miniscrew-assisted rapid maxillary expansion (MARME) approach was adopted (7). To address these concerns, four miniscrews (1.6 mm × 8 mm) were strategically placed in the palate by an orthodontic specialist. Notably, the miniscrew insertion process did not require surgical intervention or replacement by a surgeon. Subsequently, an impression was taken to fabricate a pure bone-borne expander, which was then secured to the miniscrews using ligature wires and flowable composite, as previously described.

The activation protocol involved a systematic adjustment of the expander by one 90° turn every other day, continuing until achieving a half cusp overcorrection on each side (refer to Fig. 3). After the active expansion phase, the expander was retained for an additional three months to optimize stabilization.

To visualize the structural changes resulting from the treatment, coronal slices of cone beam computed tomography images pre- and post-expansion are depicted in Fig. 4. The opening width of the midpalatal suture, as illustrated in Fig. 4, underwent a substantial transformation, escalating from 0.2 mm before expansion to an immediate post-miniscrew-assisted rapid palatal expansion measurement of 3.7 mm. Concurrently, the distance between the central fossa of the maxillary first molars demonstrated a noteworthy increase of 5.8 mm. This significant alteration is predominantly attributed to the expansion of the maxilla in the transverse dimension and is minimally associated with the dental effects due to the small changes observed in the angulation and buccal tipping of the upper molars.

Figure 2. a. Frontal view of the patient's smile, **b.** at rest, **c.** intraoral view of the severely constricted maxillary arch, blocked-out upper right canine, and mild crowding of the mandibular arch before expansion.

Figure 3. a. Frontal view of the patient's smile, **b.** at rest, **c.** intraoral view of maxillary constriction post-treatment following the expansion period.

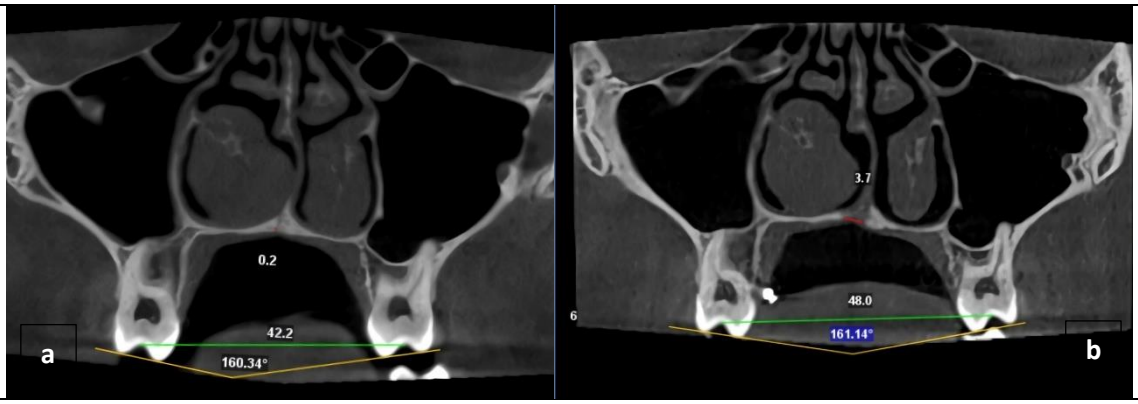

Figure 4. Pre-expansion (a) and post-expansion (b) cone-beam computed tomography images (coronal slice) show that buccal dental tipping is less than 1° (160.34° vs. 161.16°).

Discussion

Rapid palatal expansion (RPE) presents a feasible solution for maxillary constriction in growing patients, extending its applicability to young adults. However, in skeletally mature individuals, the challenges associated with mechanical maxillary expansion intensify (8). Studies have reported complications such as ulcerations, failure to expand, pain, and swelling in over half of mature patients (9). A survey among German orthodontists revealed prevalent issues, with 64.5% reporting buccal tipping of anchorage teeth, 36.1% confirming pain, and

33.6% expressing concerns about the high risk of relapse. Other observed side effects included increased mobility of anchorage teeth (20.2%) and rare occurrences of nosebleeds (1.1%) post-RPE insertion (10).

In contrast, the implementation of pure bone-borne anchorage for expanders mitigates undesirable dental effects such as root resorption and buccal tipping since it relies on bone support (11). Furthermore, a systematic review and meta-analysis comparing the efficacy and side effects of miniscrew-assisted rapid maxillary expansion (MARME) with conventional RME for treating transverse maxillary deficiency provided additional confirmation. The findings affirmed that the utilization of miniscrews resulted in a heightened opening of the palatal suture, an increased palatal width, and a reduced buccal tooth inclination (12).

Notably, the placement and removal of miniscrews necessitate neither intricate surgical procedures nor general anesthesia, rendering the process straightforward and feasible for orthodontists to perform independently. The bone-borne expander further facilitates concurrent fixed-appliance treatment during both the expansion and retention phases. From a patient's perspective, bone-borne expanders offer enhanced aesthetics compared to the visible bands on conventional Hyrax expanders (13). Furthermore, in an investigation evaluating the Oral Health-Related Quality of Life (OHRQoL) of patients following MARME, the findings revealed that MARME represents a generally well-tolerated expansion treatment. Notably, there was an initial temporary decline in OHRQoL and the experience of moderate pain at the start of the expansion process. However, this was succeeded by a subsequent recovery of OHRQoL and the occurrence of very mild pain throughout the remaining duration of the treatment (14).

An additional advantage of bone-borne RPE is its efficacy even in cases where teeth typically used for anchorage are missing or lost. This characteristic proves particularly beneficial in adult patients.

Clinical observations substantiate that bone-borne RPE represents an effective method capable of mitigating some of the negative side effects associated with tooth-borne conventional Hyrax expanders. The adoption of this approach marks a promising advancement in orthodontic practice, offering a more refined and patient-friendly alternative for maxillary expansion.

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