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Microimplant-Assisted Rapid Palatal Expansion Appliance (MARPE) for correction of transversal maxillary deficiency in an adult patient: a case report

Aparat do szybkiego rozszerzania szczęki wspomagany mikroimplantami ortodontycznymi (MARPE) do korekcji niedoboru poprzecznego szczęki u pacjenta dorosłego: opis przypadku

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ABSTRACT

The management of maxillary transverse deficiency has been a challenge in orthodontics. Traditional methods of palatal expansion in adults and older adolescents often face limitations. This case report presents the treatment of a 19-year-old patient with maxillary transverse deficiency using Microimplant-Assisted Rapid Palatal Expansion (MARPE).

Keywords: MARPE, posterior crossbite.

STRESZCZENIE

Leczenie niedoboru poprzecznego szczęki od lat stanowi wyzwanie dla ortodontów. Rozbudowa podniebienia u dorosłych i starszej młodzieży tradycyjnymi metodami często napotyka na ograniczenia. W niniejszym opisie przypadku przedstawiono leczenie 19-letniej pacjentki z poprzecznym niedoborem szczęki za pomocą szybkiej ekspansji podniebienia wspomaganej mikroimplantami (MARPE).

Słowa kluczowe: MARPE, zgryz krzyżowy boczny.

Introduction

The management of maxillary transverse deficiency has long been a challenge in orthodontics, particularly in adults and older adolescents whose skeletal growth is complete. Traditional methods of palatal expansion, such as the use of rapid palatal expanders (RPE), often face limitations in non-growing patients due to the fusion of the midpalatal suture. The introduction of Microimplant-Assisted Rapid Palatal Expansion (MARPE) has revolutionized the treatment of such cases by combining the advantages of skeletal anchorage with conventional RPE techniques. This case report presents the successful treatment of a 19-year-old patient with maxillary transverse deficiency using MARPE.

Case Presentation

Patient History

A 19-year-old female presented to our orthodontic clinic with the chief complaint of a narrow upper arch and difficulty in breathing through the nose. The patient reported dental crowding, mild discomfort during mastication, and frequent nasal congestion. Upon clinical examination, the patient had a Class I malocclusion, with a significant maxillary arch constriction (evident in both the upper dental arch and the palatal width) and moderate crowding in the upper and lower anterior region. The intraoral examination revealed an overjet of 2 mm and a crossbite in the posterior region on the right side and anterior crossbite on tooth 12 (Figures 1–4).



Figure 1. Intra-oral patient's examination. (A) front view, (B) occlusal view of the maxillary arch, (C) occlusal view of the mandibular arch (D) right lateral occlusion, (E) left lateral occlusion

Rycina 1. Zdjęcia wewnątrzustne: (A) widok przedni, (B) zdjęcie okluzyjne szczęki, (C) zdjęcie okluzyjne żuchwy, (D) strona prawa pacjentki, (E) strona lewa pacjentki



Figure 2. Extra-oral patient's examination. (A) right lateral profile at rest, (B) frontal view rest, (C) frontal view while smiling

Rycina 2. Zdjęcia zewnątrzustne: (A) prawy profil w spoczynku, (B) zdjęcie en face, (C) zdjęcie w uśmiechu

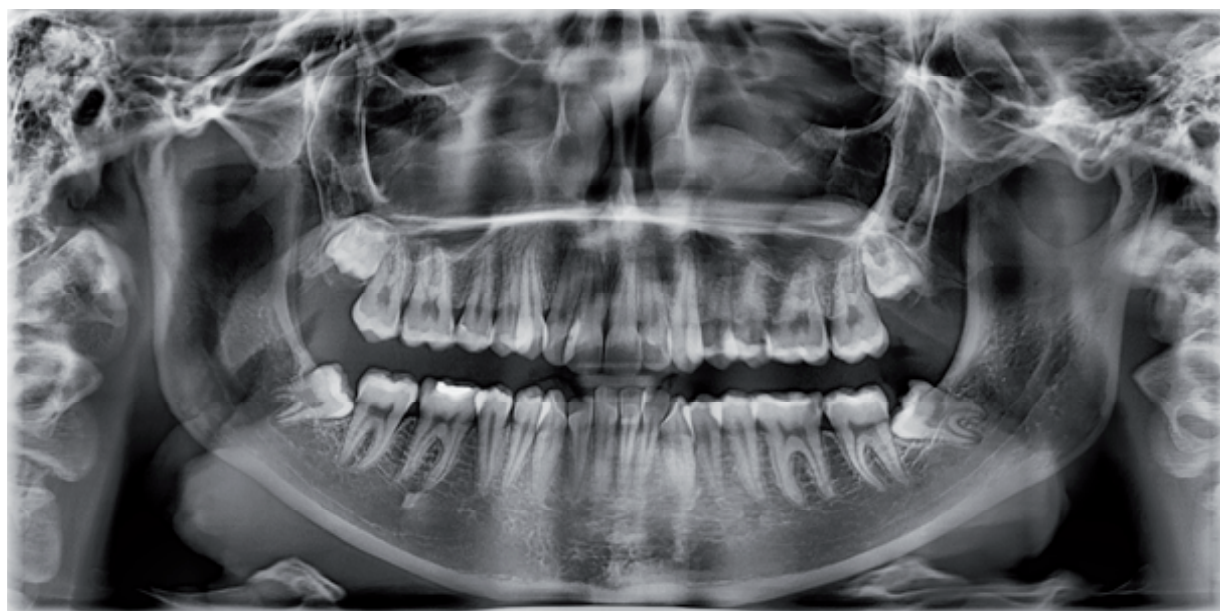


Figure 3. Panoramic X-ray
Rycina 3. Zdjęcie pantomograficzne



Analiza Segnera-Hasunda			
Parametr	Norma	Odchylenie	Wartość
SNA	82,0°	±3,0	78,5°
SNB	80,0°	±3,0	77,5°
ANB	2,0°	±2,0	1,0°
SNPg	81,0°	±3,0	79,7°
NSBa	132,0°	±4,0	129,4°
GntgoAr	122,0°	±7,0	125,2°
NL-NSL	8,0°	±4,0	3,3°
ML-NSL	28,0°	±5,0	32,6°
ML-NL	20,0°	±7,0	29,3°
H	9,0°	±3,0	6,9°
1+:-1-	133,0°	±8,0	128,3°
1+:-NA	21,0°	±4,0	28,2°
1-:-NB	24,0°	±4,0	22,4°
nos-warg	110,0°	±7,0	117,0°
Pg:NB	2,3	±2,0	3,9
1+:-NA(mm)	3,7	±2,0	6,7
1-:-NB(mm)	3,8	±5,0	3,9
Wits	0,0	±2,0	1,4
Indeks	80,0	±7,0	79,2
Prognozy			
	Przed leczeniem	Prognoza bez leczenia	Prognoza z leczeniem
ANB	1,0	??	??
Pg:NB(mm)	3,9	??	??
1+:-NA(mm)	6,7	??	??
1+:-NA°	28,2	??	??
1-:-NB(mm)	3,9	??	??
1-:-NB°	22,4	??	??
H	6,9	??	??
Diagnozy			
	Norma	Opis	Wartość
Kl. szkieletowa	0° + 4°	I	ANB = 1,0
Kl. szkieletowa	-2° + 2°	I	WITS = 1,4
Typ twarzy	79° + 85°	retrognatyczny	SNA = 78,5

Figure 4. Cephalometric X-ray and Segner-Hasund analysis
Rycina 4. Zdjęcie cefalometryczne oraz analiza cefalometryczna Segnera-Hasunda

Diagnosis

Radiographic analysis revealed a narrow maxillary arch with a transverse discrepancy and the study of the palatine suture morphology and maturation according to Angelieri presented type C of palatine suture morphology [1]. The suture appeared

partially integrated: on CBCT (Cone Beam Computed Tomography) there were two parallel, jagged, high-density lines, that were very close together, separated by small spaces and alternating with low bone density areas (**Figure 5**). The CBCT scan confirmed the absence of significant vertical dis-

crepancies and demonstrated the need for palatal expansion. Considering the patient's age and the initial diagnosis of stage C of palatine suture morphology, traditional RPE would likely fail to achieve desired results. Therefore, a Microimplant-Assisted Rapid Palatal Expansion (MARPE) approach was recommended.

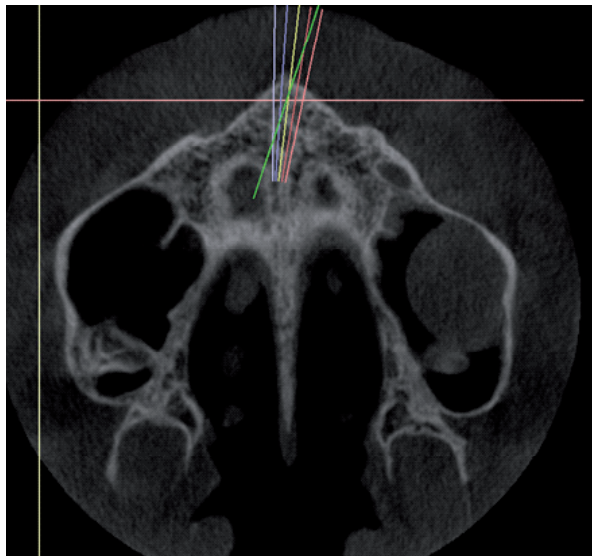


Figure 5. The palatine suture morphology and maturation
Rycina 5. Ocena morfologii i mineralizacji szwu podniebiennego

Treatment Plan

The treatment plan was to achieve transverse maxillary expansion using MARPE technique. This would involve the placement of microimplants with surgical guide to provide additional anchorage during the expansion process. The specific steps included:

1. Extraction of teeth 18, 28, 38, 48.
2. Microperforation and Microimplant Placement: Ten microperforation of both cortical laminae among the palatal suture would be done using surgical guide and four microimplants would be placed in the palatal alveolar bone using surgical guide under local anesthesia. These implants would provide the necessary skeletal anchorage to facilitate expansion.
3. Rapid Palatal Expansion Appliance: The hybrid hyrax appliance would be fabricated by the laboratory. The appliance would be designed to activate the expansion gradually over a period of 3 to 5 weeks.

4. Follow-Up Care: Once a week controls would be made, with frequent follow-ups to monitor the patient's progress, assess any discomfort, and ensure that the expansion was proceeding as planned.
5. Fixed appliance treatment: When the desired transversal expansion would be achieved, the fixed appliance treatment would be done using American Orthodontic 022 MBT brackets.
6. Retention: After finishing fixed appliance treatment, both fixed and removable retention would be made.

Treatment Procedure

Microimplant Placement

The first step of the treatment was the planification of surgical guides for microperforation and microimplant placement in Blue Sky Plan software [2] (**Figure 6**). This step was carefully done to avoid damaging vital structures and to ensure bicortical placement of the microimplants. After one week, when surgical guides were printed, patient came to our clinic for the procedure. Firstly, ten perforation of both cortical laminae among all palatal suture using surgical guide were made under local anesthesia. Then, the clinician placed four microimplants in the palate (Ortho traiding BENEfit® microimplants; 2 mm in diameter and 11 mm in length). After that, scans of the maxilla were made and send to the technician containing specific instructions of the construction of hybrid hyrax appliance (**Figure 7**). Postoperative care instructions were given to the patient, and no significant discomfort was reported during the procedure [3].

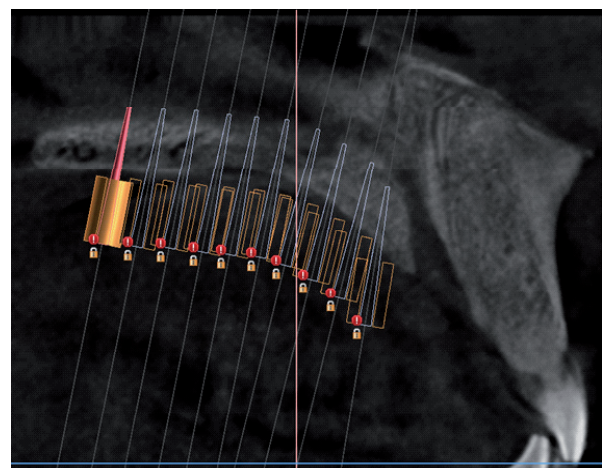


Figure 6. Microperforations planification in Blue Sky Plan software

Rycina 6. Planowanie mikroperforacji szwu podniebiennego w programie Blue Sky Plan

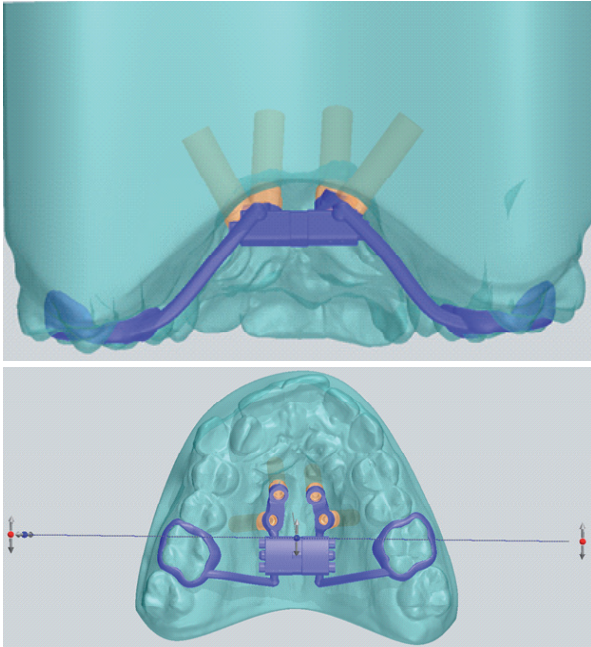


Figure 7. Hybrid Hyrax Appliance planification
Rycina 7. Planowanie aparatu Hybrid Hyrax

Hybrid Hyrax Appliance Placement

After two weeks a hybrid hyrax appliance was made by the technician. The device consisted of a palatal expander framework with a central screw mechanism. The appliance was designed to fit securely on the maxillary arch and engage the microimplants, providing the necessary anchorage to initiate expansion. Once fabricated, the appliance was fitted to the patient's maxilla (**Figure 8**).

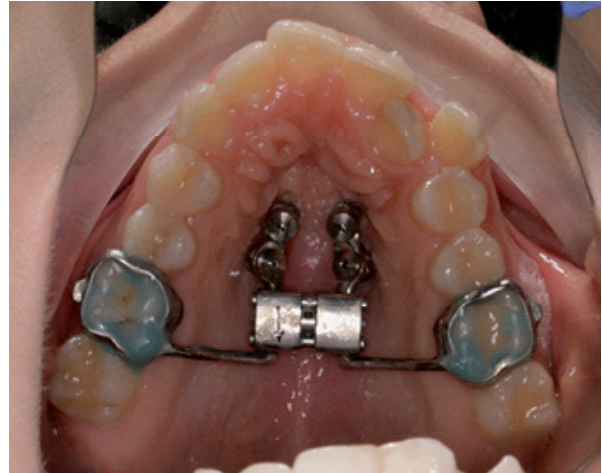


Figure 8. Hybrid Hyrax Appliance Placement
Rycina 8. Montaż aparatu Hybrid Hyrax

Activation of the Expander

The expansion began after the appliance was placed. The patient was instructed to activate the expander by turning the screw twice a day. Each turn of the screw was 0,25 mm and incrementally increased the distance between the maxillary halves, effectively widening the arch. Initially, the patient experienced mild pressure, but this was manageable with over-the-counter pain relief medication. After 8 days of activation – a diastema appeared. After that, patient was instructed to activate the expander by turning the screw once a day (**Figure 9**).



Figure 9. Post expansion intra-oral examination: (A) front view, (B) right lateral occlusion, (C) left lateral occlusion

Rycina 9. Fotografie wewnętrzne po ekspansji szczęki: (A) widok przedni, (B) prawa strona pacjentki, (C) lewa strona pacjentki

Over the course of 3 weeks, a desired expansion was achieved, and the screw was blocked by the clinician. The expansion was carefully monitored through clinical evaluations to avoid complications such as excessive skeletal opening or soft tissue trauma.

Fixed appliance treatment

Post-expansion, patient was transitioned to fixed appliances for further alignment of the dental arches. The process began with cleaning and conditioning the teeth to ensure good adhesion. Brackets (022 MBT, American Orthodontics) were then bonded to each tooth using a GC Ortho Connect adhesive. The archwire was secured with ligatures.

After the appliance was placed, the patient did regular visits for adjustments, usually every 4–5 weeks. During these visits, the orthodontist changed the archwires and replaced ligatures and elastics.

Completion of Treatment

After 12 months of treatment, once the desired teeth movement was achieved, the fixed appliance and the microimplants were removed. After removing the appliance, the patient was provided with two vacuum-formed, removable retainers (one in the upper and one in the lower arch). A fixed retainer was bonded to the lingual surfaces of lower incisors and canines to maintain the new positions of the teeth and prevent relapse (**Figures 10, 11**).



Figure 10. Intra-oral post-treatment: (A) right lateral occlusion, (B) front view, (C) left lateral occlusion, (D) occlusal view of the maxillary arch, (E) occlusal view of the mandibular arch

Rycina 10. Fotografie wewnątrzustne po leczeniu: (A) prawa strona pacjentki, (B) widok przedni, (C) lewa strona pacjentki, (D) widok okluzyjny szczęki, (E) widok okluzyjny żuchwy



Figure 11. Extra-oral post-treatment: (A) right lateral profile at rest, (B) frontal view rest, (C) frontal view while smiling

Rycina 11. Zdjęcia zewnętrzne po leczeniu: (A) prawy profil w spoczynku, (B) zdjęcie en face, (C) zdjęcie w uśmiechu

Results

The outcome of the MARPE treatment was highly successful. The patient exhibited significant improvement in the maxillary transverse dimension, with the expansion visible both clinically and radiographically. The crossbite on the right side was corrected, and there was a noticeable improvement in the upper arch's width. The crowding in the anterior region was also alleviated, contributing to a more harmonious occlusion. The patient's ability to breathe through the nose improved significantly, and she reported reduced discomfort during chewing.

Discussion

Microimplant-Assisted Rapid Palatal Expansion (MARPE) represents a significant advancement in the treatment of maxillary transverse deficiency, especially for adult patients [4]. Traditional methods, such as conventional RPE, often encounter difficulties in adult patients with a fused midpalatal suture, as these methods rely on the suture's ability to open under pressure. In contrast, the use of microimplants provides additional skeletal anchorage, which can overcome this limitation [5].

The advantages of hybrid hyrax appliance include:

- Increased efficiency: The procedure accelerates the expansion process, requiring fewer adjustments and less discomfort.
- Minimal bone loss or damage: Microimplants engage the bone directly, limiting the need for tissue expansion and reducing the risk of damaging the surrounding structures [6].
- Enhanced stability: Studies have shown that expansion achieved through skeletal anchorage is more stable over time, reducing the likelihood of relapse after treatment.
- Availability to combine different orthodontic movements using one appliance: for example expansion with distalization, intrusion or anterior traction (**Figures 12, 13**).

However, MARPE does require a higher level of expertise in both microimplant placement and appliance design. Additionally, potential risks include infection at the implant sites, failure of the implants, or damage to adjacent teeth and structures.

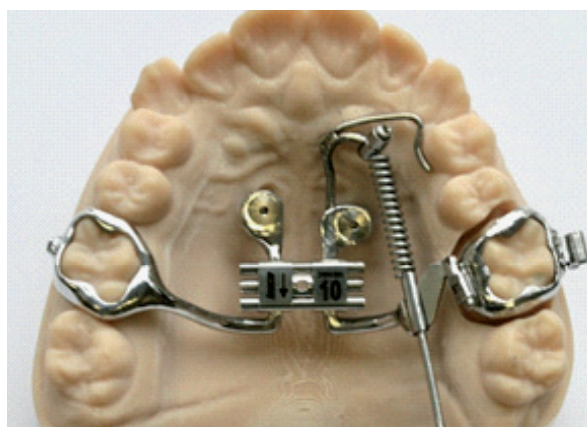


Figure 12. Hybrid hyrax – distalizer – an appliance which allows expansion and distalization

Rycina 12. Hybrid hyrax – dystalizator – aparat umożliwiający jednocześnie ekspansję i dystalizację

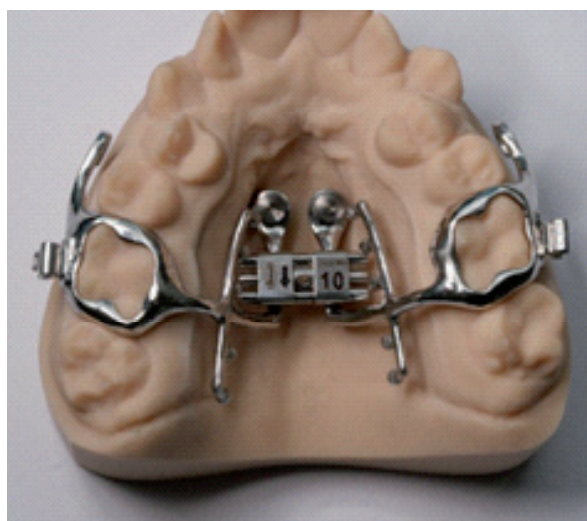


Figure 13. Hybrid hyrax for anterior traction and intrusion

Rycina 13. Aparat Hybrid Hyrax służący do ekspansji, intruzji zębów bocznych oraz ciągnięcia doprzedniego szczęki

Conclusion

Microimplant-Assisted Rapid Palatal Expansion (MARPE) is a valuable tool in modern orthodontics, offering a reliable and effective solution for patients with maxillary transverse deficiency. This case report demonstrates the successful use of MARPE in an adult patient with a previously fused midpalatal suture. The results indicate that MARPE can provide excellent functional and aesthetic outcomes, offering an alternative to more invasive surgical interventions. Further research and clinical trials will continue to refine the technique and expand its applications for a broader range of patients.

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Conflict of interest statement

The authors declare no conflict of interest.

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