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CEPHALOMETRIC EVALUATION OF SAGITTAL AND VERTICAL DIMENSION CHANGES AFTER MINI-SCREWS ASSISTED RAPID PALATAL EXPANSION: A CASE SERIES STUDY

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ABSTRACT

Transverse maxillary deficiency (TMD) is characterized by a narrow palate, posterior crossbite, crowding, and reduced nasal cavity volume. In early adolescence, rapid palatal expansion is the preferred treatment, while in late adolescence and adulthood, mid-palatal sutures fuse, making expansion more difficult and potentially causing side effects. Mini-screw assisted rapid palatal expansion (MARPE) has recently introduced as an alternative to surgically assisted rapid palatal expansion (SARPE). TMD may be observed in both Class II and Class III malocclusions, and maxillary expansion may alter the anteroposterior relationship of the jaw.

Study Objective: The study aimed to evaluate changes in anteroposterior and vertical dimensions through cephalometric analysis after MARPE treatment.

Methodology : Ethical approval was obtained from Cairo University's local research ethics committee, Ten patients (4 males, 6 females) underwent treatment using four mini-screws supported hybrid hyrax appliances. Pre- and post-expansion photographs and lateral cephalometric radiographs were taken. Statistical methods included mean, standard deviation, median, and range.

Results: ANB angle increased by 1.2 ± 0.2°, attributed to a increase in SNA angle (0.9 ± 0.3°) and a decrease in SNB angle (–0.3 ± 1.7°), al though results were statistically insignificant. The mandible showed a slight backward rotation, indicated by a decrease in SNB angle and an increase in mandibular plane angles.

Conclusion: MARPE treatment led to a mild backward rotation of the mandible, resulting in a minor increase in ANB and reduced anterior facial height and to a statistically insignificant advancement of the maxilla .

KEYWORDS: Maxillary transverse deficiency,cephalometric,MARPE

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INTRODUCTION

Transverse maxillary deficiency is a common finding characterized by a narrow arched-palate, posterior cross bite, and may be associated with crowding and decreased nasal cavity volume.[1]

Crossbite is defined as a buccolingual discrepancy between upper and lower teeth, it could be of dental or skeletal origin or due to functional shift.[2] Cross bite should be treated as early as possible once diagnosed to achieve a proper inter-arch and intra-arch coordination, prevention of functional shift, and wear of teeth, in addition to prevention of dentofacial asymmetry and tempro-mandibular disorders. [3,4]

Different appliances and treatment protocols have been introduced to treat transverse maxillary constriction. The maxillary expansion could be performed surgically and non-surgically.[5] The rapid palatal expansion involves non-surgical separation of mid-palatal sutures and movement of maxillary shelves apart.

In early adolescence, the conventional rapid palatal expansion is the preferable appliance to treat maxillary constriction.[6] In contrast, in late adolescents and adults, mid-palatal suture starts to fuse and become more resistant to expansion[6]. It may cause undesirable side effects, such as buccal crown tipping of the posterior teeth, pain, tissue swelling, root resorption, marginal bone loss, gingival recession, limited skeletal expansion, failure, and post-expansion relapse.[7]

In adults (16 years and onward) surgically assisted rapid palatal expansion (SARPE), used to be recommended.[5] However, recently mini-screws assisted rapid palatal expansion (MARPE), was evolved as a substitute for SARPE due to its invasiveness, associated risks of surgical operation, high expense, and hospitalization.[5,8]

Mini-screw assisted rapid palatal expansion (MARPE) might be of 1) bone-anchored maxillary expansion (BAME), which is a pure bone-borne type with no tooth attachment, and 2) hybrid design or tooth-bone-anchored maxillary expansion, has both bone and tooth support.[10,11] MARPE may consist of two or four mini-screws, and may also be mono-cortical or bi-cortical mini-screw anchorage.[12,13]

An increased success rate of mid-palatal suture split in young adults was reported by recent evidence, which ranged from 71–92%.[5,9,10,15,16] However, there is some evidence that reported failure of the mid-palatal suture split and risk of asymmetric expansion.[10] The mid-palatal suture separation pattern by MARPE differed from that of conventional RPE. Most of the studies reported a parallel pattern of the mid-palatal suture in patients treated with MARPE. [10,14,15,18,19]

Moreover, it could create a non-surgical split between the medial and lateral pterygoid plates which is detectable in 53–84% of patients. [18,19] Even though many study reports evaluated the skeletal and dental effects of MARPE in adults, its effectiveness is still controversial. [22] The previous studies were retrospective with a restricted sample size.[5, 10, 16,17,20,21] and only two studies had a prospective design.

Transverse maxillary deficit can be observed in both class II and class III malocclusions [22]. However, expanding the maxilla can potentially alter the anteroposterior relationship. According to McNamara [23], expanding the maxilla alone, without using a facemask therapy, can result in the correction of the anterior crossbite and an underlying class III malocclusion spontaneously. The overjet was decreased during rapid palatal expansion (RPE) in class II division 1 patients during the early mixed dentition stage [24]. Furthermore, Wertz and Dreskin [25] documented that the maxilla displayed a downward and forward displacement following the expansion of the suture.

This study aimed to assess the changes in the sagital and vertical dimensions cephalometrically.

MATERIALS AND METHODS

Trial registration, settings, eligibility criteria, and inclusion criteria:

- This study was approved by the local research ethics committee of Cairo University (14623)
- Participants were selected from the patients seeking orthodontic treatment at the orthodontic department in the faculty of dentistry at Cairo University between the period of March 2023 to April 2024, based on the following inclusion criteria: adults male or female patients from 18-30 years with skeletal Maxillary constriction, unilateral or bilateral Dental posterior crossbite, mid-palatal suture maturation (Grade C, D) according to F Angelieri classification, good oral hygiene, no functional crossbite due to premature contacts, no previous orthodontic treatment, no buccal crossbite, no craniofacial anomalies or syndromes.

Informed consent was obtained from the patients who agreed to participate in the study.

Interventions

- Every patient was examined for any systemic disease or dental hard or soft tissue pathology, and eligibility for previously mentioned criteria was checked.
- The purpose of the study and the details of the intervention were explained to the patient.

They were asked whether they were willing to participate in the study and signed an informed consent accordingly.

- Pre- and post-expansion photographs and lateral cephalometric radiographs were taken to evaluate anterioposterior and vertical dimensional changes.

Clinical Procedure steps:

Separator and band selection were performed and alginate impressions were taken for the upper arch with bands on the first molar, then demarcations were drawn on the cast to facilitate accurate placement of the eyelets whereby the anterior eyelets extended anteriorly to lie between canine and first premolar and posterior eyelets not extending beyond the first molars.

Band (3M™ Unitek™ General Purpose Molar Bands) and eyelets (tomas®-RPE eyelet) were soldered to the body of the hyrax (hyrax® Medium – 10, straight), then appliance finished and polished.

Before cementation, the appliance was inserted to check its stability (was passively inserted without rocking), and then the appliance was cemented using band cement (BracePaste® Band and Build LC Band Cement).

After giving a few drops of local anesthesia bilaterally through the eyelets opening, a 10 x 1.8mm mushroom head dentaurum screw was inserted (tomas®-pin) using a manual 3-M contra-angle driver (Unitek™ TAD Contra Angle Driver (504-315).

After checking the primary stability of the screws, the appliance was turned by an average of five-quarter turns with a total of 1.25mm.

Then the patient was instructed to activate the appliance by turning it once per day, if any turns were missed due to any reason; the patient was informed to substitute it the following day. The full activation of a 7mm hyrax gave 34 turns equivalent to 8.5 mm of transverse expansion, and the patient was also instructed to follow a thorough oral hygiene protocol.

Post-expansion records

Photographs and cephalometric radiographs were immediately taken post-cross bite correction or appearance of midline diastema. The cephalogramic

images were imported into Dolphin software (Dolphin Imaging Systems LLC), and the analysis was conducted by a single operator and revised by another operator.

Statistical methods:

Data were statistically described in terms of mean standard deviation (± SD), median, and range when appropriate. Because of the small sample sizes, a comparison between pre- and post-values was done using the Wilcoxon signed rank test for paired (matched) samples. Two-sided p-values less than 0.05 were considered statistically significant. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used for all statistical analyses

RESULTS

A total of ten patients including four males and six females were recruited and treated with four mini-screws supported hybrid hyrax. Table 1 shows the demographic data of the included patients.

TABLE (1)

ATEGORY	**SEX**	**AGE/YEAR**
1	F	20.3
2	F	21
3	F	23.7
4	F	22.4
5	F	26.3
6	M	22.7
7	M	21.3
9	M	27.2
10	M	21.2

Table 2 shows the malocclusion category of the included patients

The mean maxillary expansion time was 3.5 months ±1.3 months

The cephalometric evaluations performed at the beginning (T1), and at the end (T2) of the treatment are shown in the Table-3 all measurements were statistically insignificant

TABLE (2)

Category of mal-occlusion	**Number of patients**	**Comments**
Class-I	4	With and without crowding
Class-II	1	Had a deficient mandible for which will undergo an orthognathic surgery after expansion
Class-III	5	One patient had both posterior and anterior crossbite

TABLE (3)

Variable	T1		T2		Sig (p-value)
	Mean	SD	Mean	SD	
Skeletal					
SNA °	80.86	3.329	81.79	3.066	0.72
A-Na per	2.131	4.71	0.908	3.109	0.44
SNB °	78.29	5.750	78.00	4.08	0.57
Pg-Na Perp	-0.61	12.40	-3.87	8.64	0.44
ANB °	2.637	4.68	3.8	4.49	0.13
Convexity					
(NA-APo) °	4.07	9.86	5.09	8.62	0.33
SN-PP °	9.29	3.27	8.59	3.24	0.72
PP-MP °	27.51	7.19	28.73	7.37	0.33
SN-MP °	36.84	7.08	37.17	8.96	0.79
Anterior Face eight					
(NaMe)	136.2	22.03	122.26	12.52	0.20
Dental					
U1-PP °	117.2	6.66	114.69	5.68	0.12
U1-nasion perp	5.69	2.54	4.958	3.24	0.307
L1 – NB	7.4	3.29	6.548	3.82	0.30
L1-MPA °	92.1	12.54	102.84	268.75	0.44

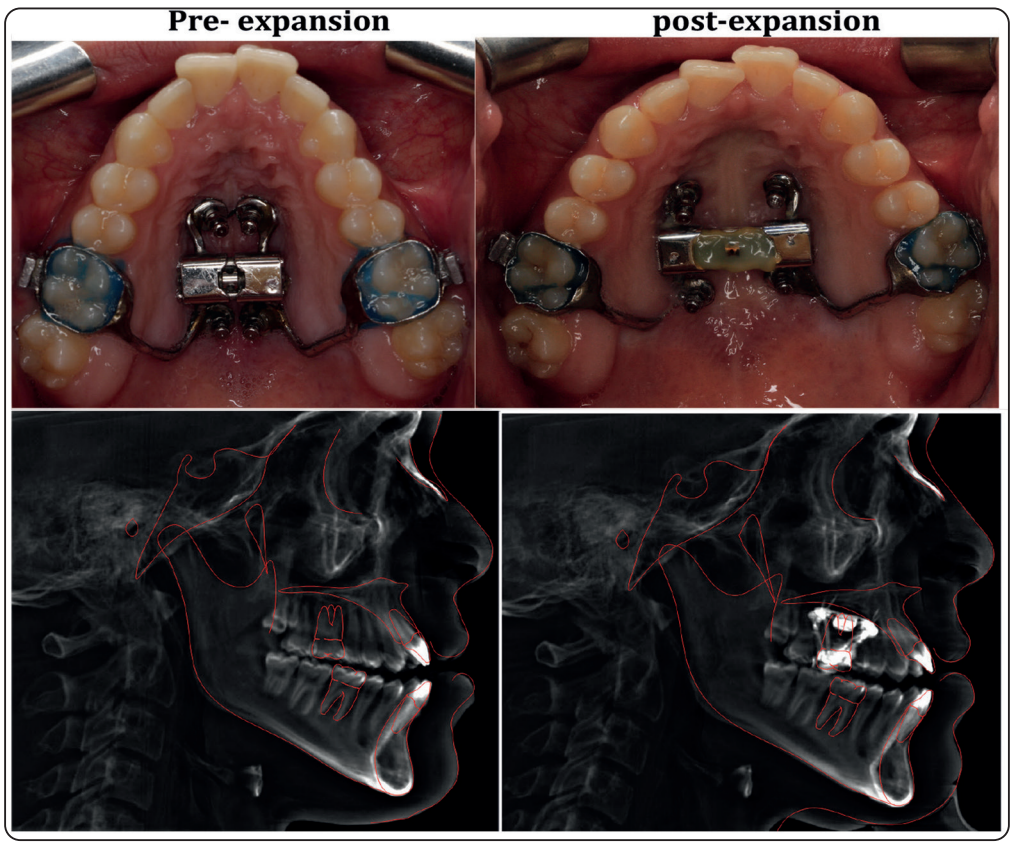

Fig. (1)

DISCUSSION

In our study, the ANB increased by 1.2 ± 0.2°, which was due to an increase in the SNA angle (0.9 ± 0.3°) and a decrease in the SNB angle (–0.3 ± 1.7°), however, the results were statistically insignificant. In agreement with previous studies, which reported that the maxilla might move downward and usually forward after maxillary expansion using conventional rapid palatal expanders.[24, 25, 26,27].

Yılmaz et al studied and performed a comparison between MARPE and two types of conventional expanders, and reported that ANB remarkably increased in the MARPE and the banded groups. However, the SNA angle statistically increased in the MARPE group [28]

Forward movement of the maxilla during the expansion may be of privilege, especially since five of the patients enrolled in the study presented with skeletal Class III malocclusion at the beginning of the treatment [28].

In previous reports of several studies, conventional rapid palatal expander might lead to a downward and backward rotation of the mandible and an increase in the vertical dimension [25,26,29–31]. In our reports, the mandible showed a backward rotation as represented by the decrease of SNB (–0.3 ± 1.7°) and the increase in mandibular plane angle (SN-MP:+.033 ± 1.9°, PP-MP: +1.2 ± 0.2°) after MARPE treatment.

Two possible explanations for the backward rotation of the mandible. Firstly, the drop of the posterior region of the palatal plane after RPE causes a minor anticlockwise rotation [32].

Second, related to the buccal flaring of the upper first molars causing overhanging of the palatal cusps after RPE [30,31]

CONCLUSION

Treatment with MARPE led to a mild backward rotation of the mandible which accounts for a 1.2 ± 0.2° increase in ANB, and decrease in anterior facial height, and statistically insignificant advancement of the maxilla.

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