Original Article

Miniscrew-assisted slow palatal expansion with bone borne expander in adult patients: a case control study on consecutively treated patients

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ABSTRACT

Objectives: To compare a slow, rapid activation protocol for miniscrew-assisted maxillary expansion in adults.

Materials and Methods: Fifteen consecutive adult patients underwent miniscrew-assisted slow palatal expansion (MASPE) using a bone borne device. A control group treated with miniscrew-assisted rapid palatal expansion (MARPE) was matched for initial demographic data and expansion need.

Results: No statistically significant differences in bispinal expansion were observed between the MASPE and MARPE groups at the anterior, middle, or posterior levels.

Conclusions: MASPE successfully achieved skeletal expansion of the maxilla in 86.7% of adult patients treated. The expansion pattern and results were comparable to MARPE. (*Angle Orthod*. 2025 ;00:000–000.)

KEY WORDS: Miniscrew; Slow expansion; Palatal expansion; Skeletal anchorage; Anchorage

INTRODUCTION

Maxillary transverse deficiency (MTD) can easily be corrected in growing patients with well-known appliances and procedures such as tooth-anchored rapid palatal expansion (RPE).[1–3] MTD affects patients with different malocclusions.[4–5] Surgically assisted rapid palatal expansion (SARPE) offers a predictable method for skeletal expansion in adults, although complications such as discomfort, side effects, and treatment failures may occur.[6]

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In recent years, miniscrew-supported expanders were proposed to treat adult patients with MTD. Evidence on the success rate of miniscrew-assisted rapid palatal expansion (MARPE) was demonstrated between 70% and 90% in different reports.[7–11]

Failure and side effects are relatively common with MARPE.[12] There are no reliable prognostic factors to predict success even though some studies have tried to identify important variables to consider when planning MARPE.[13]

Various expander designs have been proposed based on anchorage units used, or for planning of bone-guided devices, as Wilmes and coauthors described.[14] The standard rapid protocol aims to induce a fracture or distraction of the median palatal suture, relying on heavy forces to achieve transverse skeletal increase. A polycyclic approach, on the other hand, uses a different activation protocol and a dynamometer to measure the actual force of screw expansion to avoid excessive force activation.[10] Another approach includes rapid activation and a subsequent pause, allowing the stress applied to the maxillary complex to be absorbed.[15]

Although the slow activation protocol has been shown to be effective in growing patients,[16,17] this approach has never been reported on adult patients. A slow activation protocol typically utilizes continuous low-force systems applied over a longer period of time compared to rapid activation. Animal studies have demonstrated[18,19] the potential for bone remodeling to

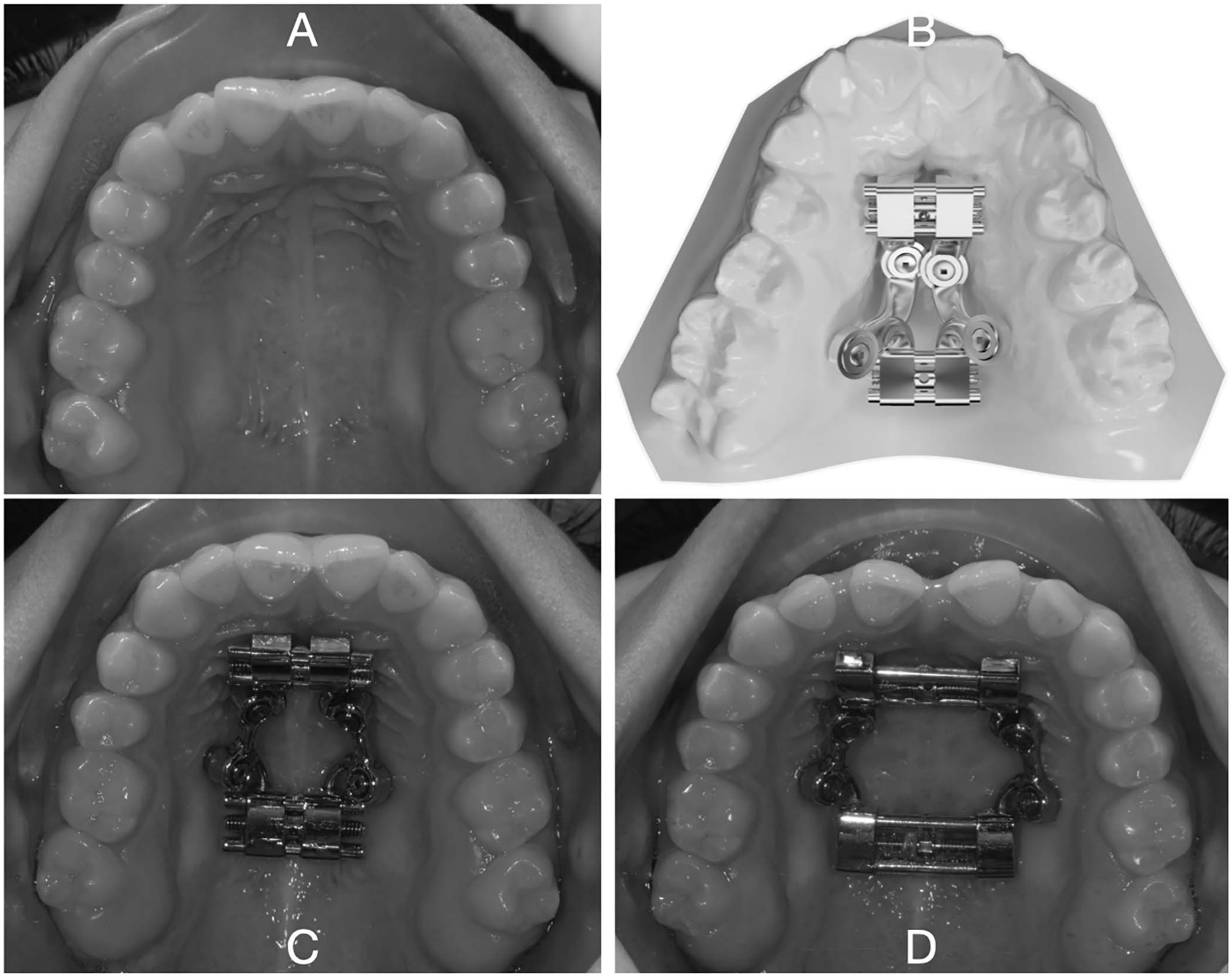

Figure 1. (A) Intraoral occlusal pre-expansion. (B) Expansion device example. (C) Intraoral occlusal with appliance. (D) Intraoral occlusal post-expansion.

open mature sutures, suggesting an alternative to mechanical fracture. Potential advantages of slow activation include reduced pain intensity/prevalence during the first week compared to rapid activation,[17] minimal or absent inter-incisal diastema formation during activation, and increased time for skeletal and device structures to adapt to expansion forces.[15]

The aim of the present study was to test the null hypothesis that miniscrew-assisted slow palatal expansion (MASPE) would result in no skeletal maxillary expansion in adult patients.

MATERIALS AND METHODS

Population

This observational comparative study involved consecutively treated patients. The sample included data collected from two different centers. Participants at the test center included a total of 15 patients treated with MASPE (10 female and five male). Two of these patients were excluded from analysis due to expansion failure with failure defined as no visible opening of an anterior diastema. The control group included a retrospective sample of 13 patients treated with MARPE at another center by another clinician, matched for age, gender, and amount of expansion needed with the test group patients (8 female and 5 male).

The mean age was 28.5 years (SD: 7.9) and 27.1 years (SD: 6.5) for MASPE patients and MARPE patients, respectively. Ethical committee approval n° 2022/51 was obtained by the Genova University.

MASPE patients were treated from April 2020 to June 2024. The following inclusion criteria were used: absence of systemic diseases, no previous orthodontic treatment, no alteration of bone metabolism or use of drugs altering bone metabolism, MTD as evaluated

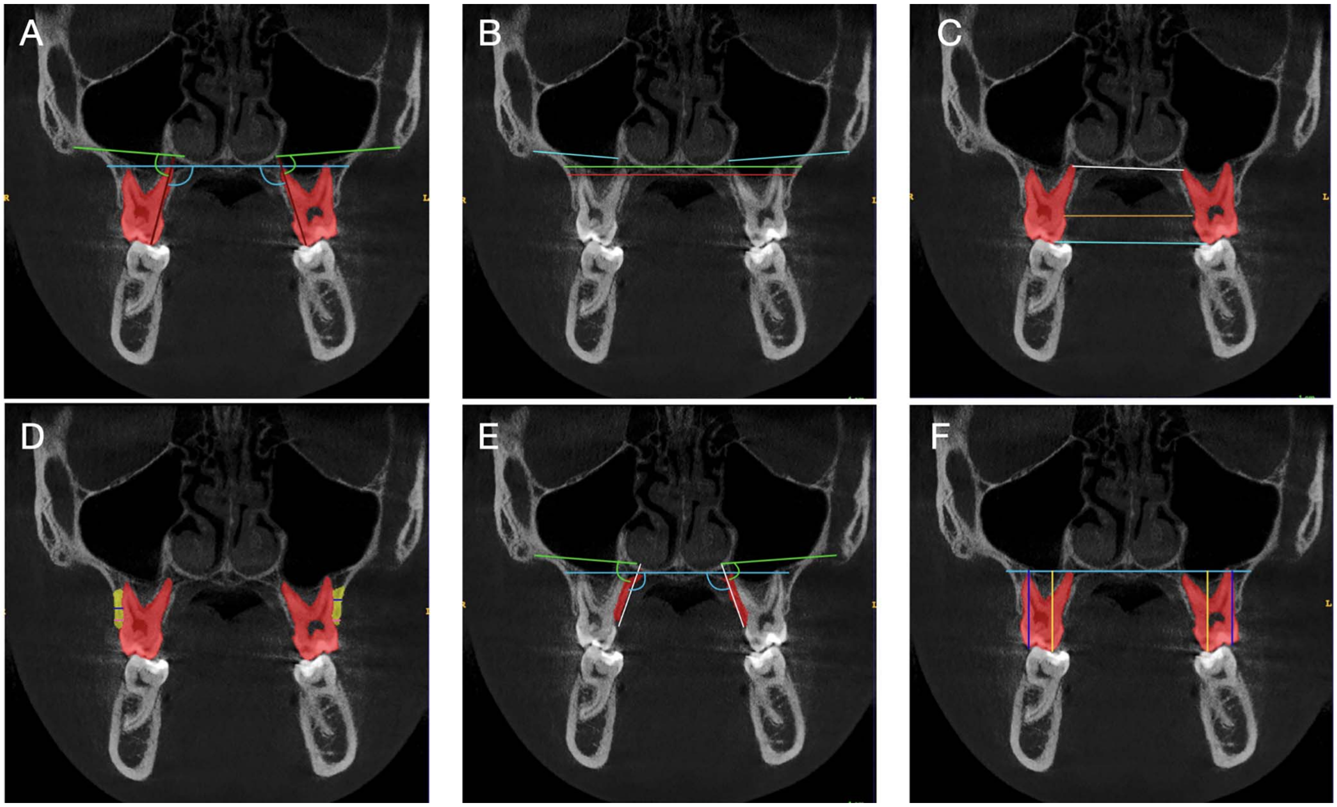

Figure 2. (A) Tooth axis: green line, Maxillary Plane; blue line, Nasal Floor. (B) Maxillary width: blue line, Maxillary Plane; green line, Nasal Floor; red line, Hard Palate. (C) Transverse tooth distance: white line, apex; yellow line, CEJ; blue line, palatal cusp. (D) Buccal Bone width. Buccal bone thickness measured at two different levels: pink line, 3 mm; blue line, 6 mm. (E) Alveolar inclination: blue line, Nasal Floor; green line, Maxillary Plane. (F) Vertical dental height: yellow line, mesial cusp; blue line, buccal cusp.

using the University of Pennsylvania Cone-Beam CT Transverse analysis PENN analysis,[20] permanent dentition including second molar eruption, and no surgical or other treatment during the expansion period that might influence the outcome of rapid maxillary expansion (RME).

Average maxillary transverse discrepancy at T0 was −0.5 mm and 0.4 mm for MASPE and MARPE group patients, respectively.

A pre-insertion cone beam computed tomography (CBCT) scan was obtained (T0) and a second CBCT was required at the end of the activation period (T1).

Intervention

Test group. The device used in the MASPE patient group was described by Maino et al.[11] with four minsicrews placed in the palate and two expansion screws (activation: 0.2 mm) (Figure 1). The procedure consisted of two steps: insertion of the miniscrew first, and a second appointment to deliver the appliance. Digital miniscrew planning was used to study insertion sites: after scanning, a digital model (stereolithography file) of the upper arch was superimposed onto the CBCT scan, and eXam Vision (KaVo Dental, Italy) and Rhinoceros (Robert McNeel & Associates, Seattle, USA) software were used to identify the best anatomical insertion sites in terms of available bone.[21]

Two anterior and two posterior mini screws were planned. After, two 3D printed insertion guides (Keyguide, Keystone Industries GmbH, Germany) were produced to place 2-mm diameter miniscrews (Spiderscrew, HDC, Italy), with different lengths (9–13 mm) as necessary to ensure adequate bone-screw contact and bicortical and tricortical engagement. Once the mini screws were inserted, two intraoral scans were acquired with a scan body fixed to the miniscrew head. During the second appointment, the expander was fixed to the head of the miniscrews with connector screws. Patients were instructed to activate the anterior and posterior expansion screw once every 3 days (each activation: 0.2 mm). During follow-up appointments, the clinician (NA) evaluated correction of the initial maxillary deficiency clinically.

Control group. Data for the control group were collected from a sample of patients treated using a bone borne appliance. The appliance included four miniscrews as in the test group, and one expansion screw.

Table 1. Differences at Baseline Between Groups[a,b]

	MARPE	MASPE	P
Maxillary Width			
NF	61.4 ± 4.81	64.3 ± 3.46	.11
HP	58.7 ± 3.84	61.2 ± 3.84	.14
Right_MP	26.7 ± 2.75	26.9 ± 2.44	.87
Left_MP	27.1 ± 3.36	27.7 ± 4.31	.74
Alveolar Inclination			
Right_ProcAlv_NF	101.4 ± 4.71	94.3 ± 7.85	.018*
Right_ProcAlv_MP	86.6 ± 6.56	93.5 ± 12.18	.11
Left_ProcAlv_NF	103.2 ± 5.66	97.8 ± 8.13	.08
Left_ProcAlv_MP	82.3 ± 6.15	92.4 ± 7.26	.003*
Tooth Axis			
Right_To_NF	97.5 ± 9.25	98.5 ± 10.04	.81
Right_To_MP	88.9 ± 3.75	87.8 ± 11.46	.79
Left_To_NF	99.2 ± 6.69	101.3 ± 8.63	.52
Left_To_MP	88.4 ± 8.67	88.6 ± 13.79	.98
Vertical Dental Height			
Right_cuspV_NF	21.7 ± 2.10	23.8 ± 3.09	.86
Right_cuspP_NF	22.8 ± 2.39	24.7 ± 2.73	.11
Left_cuspV_NF	21.9 ± 2.21	24.3 ± 2.86	.036*
Left_cuspP_NF	22.6 ± 1.99	25.5 ± 3.06	.012*
Buccal Bone Width			
Right_CEJ_bone3	1.3 ± 0.71	1.3 ± 1.25	.98
Right_CEJ_bone6	1.4 ± 0.45	1.2 ± 1.01	.54
Left_CEJ_bone3	1.1 ± 0.49	1.3 ± 1.02	.48
Left_CEJ_bone6	1.6 ± 0.50	1.3 ± 0.97	.38
Transverse Distances of Tooth			
MOLARapex	32.2 ± 1.71	29.9 ± 2.07	.012*
MOLARCEJ	32.3 ± 2.29	31.9 ± 2.17	.68
MOLARcuspid	37.7 ± 2.88	37.8 ± 1.84	.99
PREMOLapex	30.3 ± 2.71	28.8 ± 3.12	.27
PREMOLCEJ	25.1 ± 2.56	25.8 ± 2.08	.52
PREMOLcuspid	27.1 ± 3.05	28.6 ± 2.53	.27

[a] Student's *t*-test for independent samples.
[b] HP indicates hard plate; MARPE, miniscrew-assisted rapid palatal expansion; MASPE, miniscrew-assisted slow palatal expansion; MP, maxillary plane; NF, nasal floor.

The expansion screw and miniscrews were the same type and brand as used in the test group. The digital planning and insertion procedure were described in a previously published report.[22] The activation protocol was one turn per day until desired expansion was achieved. Patients in the control group were matched according to gender, age, and initial maxillary transverse discrepancy to have two comparable samples of adult patients with maxillary skeletal constriction.

3D Analysis of Outcomes

Data were analyzed using ITK-SNAP and 3D-Slicer software. To set an identical reference plane in the T0 and T1 records, CBCTs were oriented along the palatal suture (x-plane), parallel to the palatal plane (y-plane), and tangent to the nasal floor (z-plane) using 3D slicer software, and working with the transformation tool.

The size of the CBCT (number of cuts on the x-, y-, z-axes) and the volume of the voxels were changed with the 3D-Slicer CMF tools to obtain isotropic voxels in all of the examined CBCTs. Using the downsize image-spacing function, voxels were set to the same size in the x-, y-, and z-axes. After that, CBCTs were exported in the Guys Imaging Processing Laboratory (GIPL) format.

All measurements were blindly performed using ITK-SNAP software on the first molar and first premolar area of the maxilla. All evaluations were carried out at the first molar furcation level in the coronal slice[9] (Figure 2). All

Table 2. Differences at T1 Between Groups[a,b]

	MARPE	MASPE	P
BispinaleANTmm	4.3 ± 1.30	4.1 ± 1.54	.78
BispinaleMEDmm	4.3 ± 1.35	4.1 ± 1.62	.78
BispinalePOSTmm	2.8 ± 1.54	2.1 ± 1.53	.29

[a] Student's *t*-test for independent samples.
[b] MARPE indicates miniscrew-assisted rapid palatal expansion; MASPE, miniscrew-assisted slow palatal expansion.

Table 3. Differences in Changes (T1-T0) Between Groups

	MARPE	MASPE	P
Maxillary width (mm)			
Delta_NF	2.6 ± 1.63	2.5 ± 1.74	.82
Delta_HP	2.6 ± 1.52	2.6 ± 2.04	.99
Delta_Right_MP	−0.2 ± 0.69	0.7 ± 2.84	.44
Delta_Left_MP	−0.2 ± 1.46	1.1 ± 2.67	.25
Alveolar inclination (°)			
Delta_Right_ProcAlv_NF	2.9 ± 3.82	4.3 ± 5.48	.50
Delta_Right_ProcAlv_MP	−1.1 ± 3.21	1.1 ± 4.52	.20
Delta_Left_ProcAlv_NF	3.4 ± 4.03	1.7 ± 4.63	.37
Delta_Left_ProcAlv_MP	−2.2 ± 3.76	−1.8 ± 6.10	.85
Tooth axis (°)			
Delta_Right_To_NF	2.7 ± 5.30	6.1 ± 9.58	.31
Delta_Right_To_MP	0.4 ± 5.28	0.5 ± 7.44	.96
Delta_Left_To_NF	1.9 ± 2.87	−0.1 ± 11.10	.56
Delta_Left_To_MP	−3 ± 4.00	−0.8 ± 14.50	.67
Vertical dental height (mm)			
Delta_Right_cuspV_NF	−0.3 ± 1.10	−1.5 ± 2.41	.13
Delta_Right_cuspP_NF	−0.6 ± 0.92	−0.9 ± 1.41	.53
Delta_Left_cuspV_NF	−0.5 ± 1.26	0.5 ± 1.21	.06
Delta_Left_cuspP_NF	−0.5 ± 0.95	0.2 ± 1.08	.14
Buccal bone width (mm)			
Delta_Right_CEJ_bone3	−0.4 ± 0.58	−0.2 ± 0.69	.44
Delta_Right_CEJ_bone6	−0.1 ± 0.75	1.1 ± 3.28	.24
Delta_Left_CEJ_bone3	−0.2 ± 0.60	0.3 ± 0.53	.037*
Delta_Left_CEJ_bone6	−0.5 ± 0.69	0 ± 0.66	.13
Transverse distances of tooth (mm)			
Delta_MOLARapex	4 ± 1.66	4.5 ± 2.97	.61
Delta_MOLARCEJ	5 ± 2.14	5.1 ± 2.80	.95
Delta_MOLARcuspid	4.7 ± 2.44	5.1 ± 3.64	.77
Delta_PREMOLapex	4 ± 2.17	4.2 ± 1.63	.84
Delta_PREMOLCEJ	5.2 ± 2.08	5.1 ± 1.11	.99
Delta_PREMOLcuspid	4.9 ± 2.29	5.8 ± 1.26	.28

[a] Student's *t*-test for independent samples.
[b] MARPE indicates miniscrew-assisted rapid palatal expansion; MASPE, miniscrew-assisted slow palatal expansion.

Table 4. Changes T0 to T1 Within the MARPE Group[a,b]

	T0	T1	*P*
Maxillary width (mm)			
NF	61.4 ± 4.81	64 ± 5.27	<.001*
HP	58.7 ± 3.84	61.3 ± 4.05	<.001*
Right_MP	26.7 ± 2.75	26.6 ± 2.52	.45
Left_MP	27.1 ± 3.36	26.9 ± 2.98	.60
Alveolar inclination (°)			
Right_ProcAlv_NF	101.4 ± 4.71	104.3 ± 4.80	.025*
Right_ProcAlv_MP	86.6 ± 6.56	85.5 ± 4.89	.25
Left_ProcAlv_NF	103.2 ± 5.66	106.6 ± 7.18	.014*
Left_ProcAlv_MP	82.3 ± 6.15	80.1 ± 6.80	.07
Tooth Axis (°)			
Right_To_NF	97.5 ± 9.25	100.1 ± 6.80	.11
Right_To_MP	88.9 ± 3.75	89.3 ± 7.65	.80
Left_To_NF	99.2 ± 6.69	101.2 ± 6.57	.039*
Left_To_MP	88.4 ± 8.67	85.4 ± 6.10	.025*
Vertical dental height (mm)			
Right_cuspV_NF	21.7 ± 2.10	21.5 ± 2.10	.44
Right_cuspP_NF	22.8 ± 2.39	22.2 ± 2.41	.048*
Left_cuspV_NF	21.9 ± 2.21	21.4 ± 2.59	.18
Left_cuspP_NF	22.6 ± 1.99	22.1 ± 2.42	.13
Buccal bone width (mm)			
Right_CEJ_bone3	1.3 ± 0.71	0.9 ± 0.72	.030*
Right_CEJ_bone6	1.4 ± 0.45	1.3 ± 0.70	.64
Left_CEJ_bone3	1.1 ± 0.49	0.8 ± 0.53	.19
Left_CEJ_bone6	1.6 ± 0.50	1.1 ± 0.63	.035*
Transverse distances between teeth (mm)			
MOLARapex	32.2 ± 1.71	36.2 ± 2.23	<.001*
MOLARCEJ	32.3 ± 2.29	37.3 ± 2.94	<.001*
MOLARcuspid	37.7 ± 2.88	42.5 ± 4.05	<.001*
PREMOLapex	30.3 ± 2.71	34.4 ± 3.39	<.001*
PREMOLCEJ	25.1 ± 2.56	30.2 ± 3.32	<.001*
PREMOLcuspid	27.1 ± 3.05	32 ± 3.94	<.001*

[a] *Paired-samples test.*
[b] MARPE indicates miniscrew-assisted rapid palatal expansion.

Table 5. Changes T0 to T1 Within the MASPE Group[a,b]

	T0	T1	*P*
Maxillary width (mm)			
NF	64.3 ± 3.46	66.8 ± 4.12	.001*
HP	61.2 ± 3.84	63.8 ± 3.99	.002*
Right_MP	26.9 ± 2.44	27.6 ± 3.38	.52
Left_MP	27.7 ± 4.31	28.8 ± 3.75	.30
Alveolar inclination (°)			
Right_ProcAlv_NF	94.3 ± 7.85	98.6 ± 6.16	.048*
Right_ProcAlv_MP	93.5 ± 12.18	94.6 ± 9.17	.49
Left_ProcAlv_NF	97.8 ± 8.13	99.5 ± 9.70	.24
Left_ProcAlv_MP	92.4 ± 7.26	90.6 ± 5.83	.41
Tooth axis (°)			
Right_To_NF	98.5 ± 10.04	104.6 ± 6.47	.09
Right_To_MP	87.8 ± 11.46	88.4 ± 11.90	.84
Left_To_NF	101.3 ± 8.63	101.2 ± 9.84	.98
Left_To_MP	88.6 ± 13.79	87.8 ± 9.45	.87
Vertical dental height (mm)			
Right_cuspV_NF	23.8 ± 3.09	22.3 ± 2.73	.10
Right_cuspP_NF	24.7 ± 2.73	23.8 ± 2.79	.09
Left_cuspV_NF	24.3 ± 2.86	24.8 ± 2.72	.19
Left_cuspP_NF	25.5 ± 3.06	25.7 ± 2.92	.55
Buccal bone width (mm)			
Right_CEJ_bone3	1.3 ± 1.25	1.1 ± 0.68	.39
Right_CEJ_bone6	1.2 ± 1.01	2.2 ± 3.21	.33
Left_CEJ_bone3	1.3 ± 1.02	1.6 ± 0.87	.11
Left_CEJ_bone6	1.3 ± 0.97	1.2 ± 0.60	.87
Transverse distances between teeth (mm)			
MOLARapex	29.9 ± 2.07	34.4 ± 4.08	.002*
MOLARCEJ	31.9 ± 2.17	37 ± 3.65	.001*
MOLARcuspid	37.8 ± 1.84	42.9 ± 4.01	.003*
PREMOLapex	28.8 ± 3.12	33.1 ± 3.63	<.001*
PREMOLCEJ	25.8 ± 2.08	30.9 ± 3.02	<.001*
PREMOLcuspid	28.6 ± 2.53	34.4 ± 2.88	<.001*

[a] *Paired-samples test.*
[b] MASPE indicates miniscrew-assisted slow palatal expansion.

measurements were taken at T0 and T1, using CBCTs for every patient.

The bispinal distance was measured in the axial view at three points (anterior, medium, posterior) only on the T1 CBCT: anterior was at the most anterior point where the cortices were visible; medium was between upper second premolar (5 mm) and first molar (6 mm); and posterior was at the most posterior point where the cortices were visible.

Statistical Analysis

After verifying a normal distribution of the data, differences in parameters between the two groups (Table 1) were explored using student's *t*-test for independent samples at baseline, and to compare values recorded at T1 and the changes at T1 relative to baseline, ie, the delta values (Tables 2 and 3). Finally, Table 4 and 5 highlight independently for each group, whether there was a significant change over time (T1 vs T0), using a paired-samples test.

The sample size estimation calculated that nine patients per group would achieve a power of 0.80 to detect a difference of 2.0 mm in the median bispinal distance, with a significance level (alpha) of 0.05 and standard deviation of 1.44 mm with a two-sided *t*-test.

The results of the analyses were expressed through *P* values, with values less than .05 considered significant.

Measurement Reliability

For one-third of the total sample, measurements were repeated and analyzed using intraclass correlation coefficient (ICC). Comparing linear and angular values, ICC values ranged from 0.94 to 0.96, respectively.

RESULTS

In two out of 15 MASPE patients, maxillary expansion failed. This represented a 13.3% failure rate.

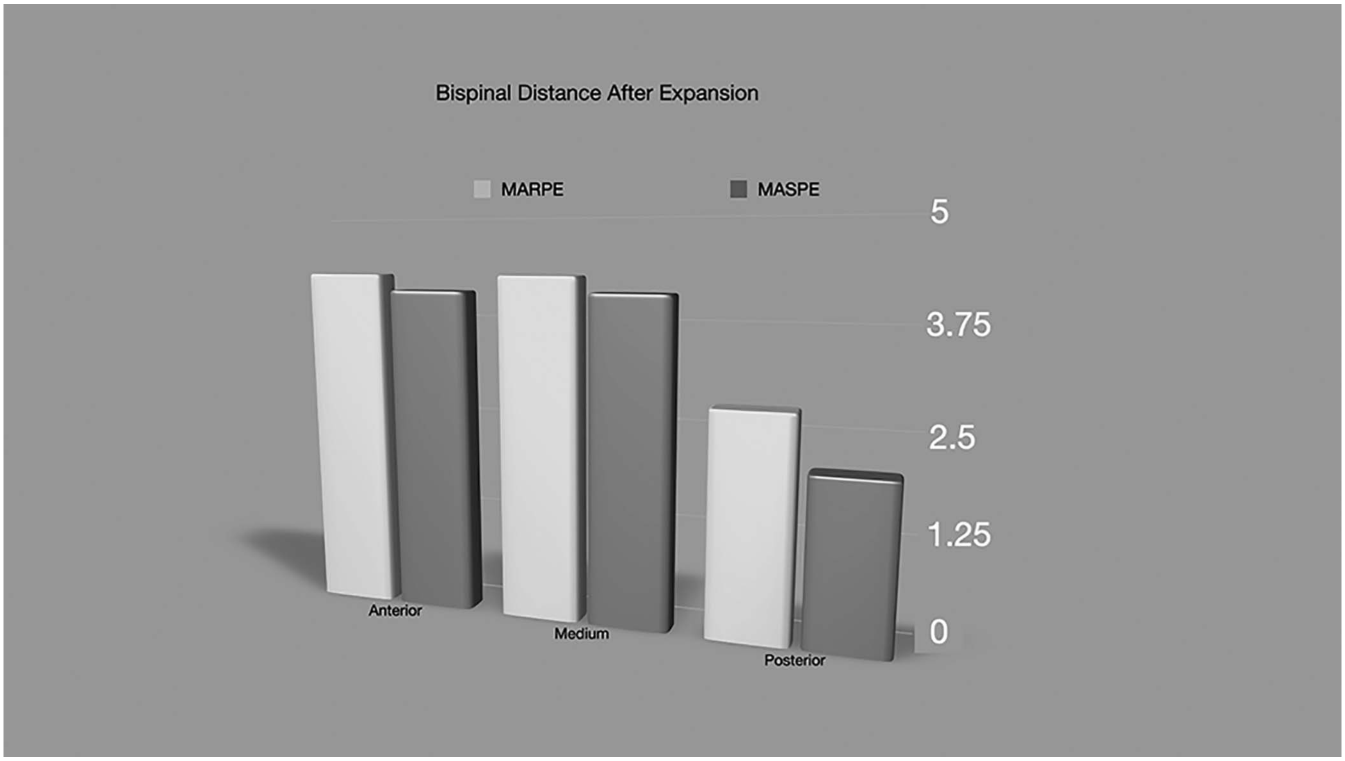

Figure 3. Bispinal distance after expansion.

Baseline differences between groups revealed a statistically, but not clinically, significant difference (Table 1).

Baseline comparison for maxillary transverse discrepancy showed no statistically significant difference (−0.5 mm and 0.8 mm for the MASPE and MARPE groups, respectively, $P = .19$).

Differences for bispinal expansion values between groups at the anterior, medium, and posterior level showed no statistically significant differences (Table 2) (Figure 3). Longitudinal difference analysis between groups showed no statistically significant differences except for Left cementoenamel junction (CEJ) bone value at 3 mm (0.5 mm difference between groups, Table 3). In Tables 4 and 5, analysis of intragroup before to after changes are reported.

DISCUSSION

Maxillary expansion in adult patients using bone-borne appliances has been reported with different success rates.[7–10] Although slow activation protocols have demonstrated positive transverse effects in growing patients with similar and predictable results compared to rapid expansion protocols,[16,23–26] their use in adult patients remains relatively unexplored.

Slow expansion activation results in intermittent forces with lower intensity over a longer duration, potentially reducing tissue resistance in the maxillary sutures and promoting bone formation, while reducing the detrimental high mechanical stress of rapid maxillary expansion.[3] Use of tri-cortical anchorage planned for posterior screws enhances appliance stability and stress distribution as shown in a recent Finite Element Analysis (FEM) study.[27]

The present study aimed to select two groups with similar characteristics (demographic and initial MTD), and sought to investigate the influence of different activation protocols on skeletal results after maxillary expansion. The mean initial age was slightly higher in the MASPE group compared to the MARPE group ($P = .70$; no statistical differences). As age is considered a potential risk factor for nonsurgical palatal expansion, this difference should be noted.[28]

Skeletal Effect

Skeletal expansion resulted in significant transverse correction, meaning that the null hypothesis was rejected. This indicated that patients in the MASPE group exhibited skeletal expansion. Expansion was characterized by a triangular suture opening with greater expansion in the anterior region. No clinically or statistically significant differences between the rapid and slow expansion protocols were observed, except for buccal bone width at 3 mm, without a clinically significant difference.

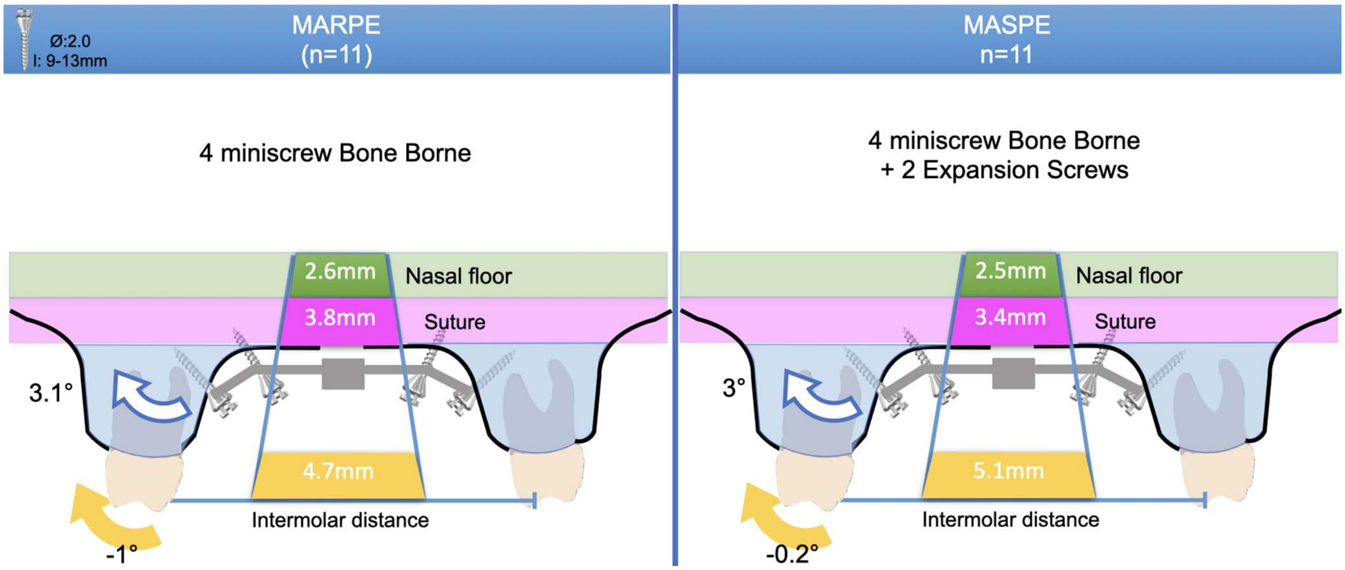

Figure 4. MARPE and MASPE transverse effects of expansion. Suture width values represent the mean of the anterior, middle, and posterior suture expansion measurements.

In younger patients, similar results were found though the posterior expansion values are generally higher with RPE.[24] All data regarding alveolar inclination showed no clinical or statistical differences between groups: alveolar inclination was greater when measured at the nasal floor compared to the values observed at the maxillary plane for both groups. The negative values of alveolar inclination measured to the maxillary plane described the same movement to the buccal side of the patient, describing movement of the maxillary complex with a slight buccal inclination.

Minimal molar tipping was observed in both groups, likely attributed to the absence of dental support in the expander device. Transverse dental changes were comparable between groups at the molar and premolar levels (Figure 4).

Patient-Related Data

Regarding pain, significantly lesser pain was reported from slow maxillary expansion compared to RME, but only in the first week.[17] Patients treated with MASPE reported no pain or discomfort due to the expansion procedure in the present study, with some reporting mild nasal pressure, similar to what patients may experience with traditional appliances. Anterior diastema opening typically occurred after 15–18 activations, with some variation among patients.

Failures

In the present study, two cases in the MASPE group were described as failures. The observed MASPE failure rate in this study was similar to that reported for rapid expansion and other activation protocols.[10–22] A consistent failure rate of 10%–15% across various studies suggests that patient-related factors, rather than treatment methodology, may be the primary influence on treatment outcomes.[15,29,30]

Clinical Considerations

Previous studies have shown clinical efficiency of slow activation in growing and adolescent patients,[25,26] and current findings showed similar results even in adult patients. MASPE may offer a significant, viable alternative to other activation protocols. Because slow expansion allows for gradual force adaptation during the activation period, it enables prompt clinical intervention if side effects occur and, for example, interrupts or delays further activation. The stress created during expansion can produce side effects, to anatomical structures and to the device itself. A slow approach can ideally reduce these side effects, allowing for gradual adaptation and a biological response instead of mechanical fracture.[10,18] Therefore, given the reliable, predictable outcome of MARPE in growing and young adult patients, slow activation may be a reasonable approach for adult patients aged 25 and older, in whom side effects and failures are potentially more frequent.

Limitations of the Study

This study had a relatively small sample size. However, the findings demonstrated a potential benefit for adult patients requiring maxillary expansion. Although the miniscrew insertion planning and operators differed between the two groups, this could actually be considered as a strength of the study as it allowed for a comparison of different approaches. The control group selected may be seen as a potential bias, but no specific selection criteria were applied beyond matching the test group for age, gender, and the required amount of maxillary expansion. Further studies comparing similar devices and different activation protocols would be desirable.

CONCLUSIONS

Within the limitations of the present study, the following conclusions can be drawn:

- The null hypothesis was rejected: miniscrew-assisted slow palatal expansion was successful in 86.7% of the adult sample observed.
- Skeletal outcomes, including suture opening were similar to that observed for MARPE.
- Similar effects were also observed for all measured dental and skeletal parameters with no significant differences between MASPE and MARPE.

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