Effects of surgically assisted rapid palatal expansion with and without pterygomaxillary disjunction on dental and skeletal structures: a retrospective review

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Objective. The aim of this study was to evaluate and compare dental and skeletal changes in surgically assisted rapid palatal expansion (SARPE) patients with (+PP) and without (−PP) pterygomaxillary disjunction.

Study Design. The study casts of 18 maxillary constriction patients indicated for SARPE formed the sample of this retrospective review. The sample was divided into 2 groups. Twenty linear and 2 angular measurements were performed on the study models.

Results. All transversal measurements increased after expansion in both the +PP and −PP groups. The −PP group showed greater expansion at the midpalatal and gingival levels, while the +PP group exhibited a greater increase of 0.78 mm at the apical base level and 11.25° less tipping in the molar teeth. A greater expansion of nearly 0.7 mm was measured in the premolar region of the +PP group.

Conclusions. Both SARPE techniques resulted in significant maxillary expansion. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115:167-174)

Transverse maxillary discrepancy is one of the most common dentoskeletal problems encountered in clinical orthodontics. Maxillary expansion was first introduced by Angell[1] in 1860 to overcome maxillary constriction. Since then, it has been used for the correction of posterior crossbites. Skeletal expansion of the maxilla can easily be accomplished before closure of the midpalatal suture, but it is not feasible for adults owing to the increasing resistance of the midpalatal and lateral maxillary sutures.[2] The timing of midpalatal suture closure varies from age 16 to 35 years,[3] and relapse of rapid maxillary expansion has been shown in older patients.[4] Techniques of surgically assisted maxillary expansion (SARPE) with the use of bone cuts to reduce these resistances without completely freeing the maxillary segments have been developed to overcome such age limitations.[5] Various combinations of maxillary, pterygopalatine, lateral nasal, septal, and palatine osteotomies have been used based on the different theories regarding the locations of resistance to expansion.[6] Some of the initial reports indicated that the zygomatic buttress and pteryomaxillary junction are the main areas of resistance,[7,8] and some reports have recommended the sectioning of almost all articulating maxillary structures.[9-11] On the other hand, Glassman et al.[12] demonstrated minimal morbidity and postoperative complications without pterygomaxillary detachment. A number of reports avoided surgical separation of the pterygomaxillary junction, achieving a noninvasive surgical technique.[13-16] There is currently no consensus on pterygoid plate separation in SARPE; therefore, the aim of the present study was to evaluate and compare the dental and skeletal changes between SARPE patients with (+PP) and without (−PP) pterygomaxillary disjunction.

MATERIALS AND METHODS

This retrospective clinical study was based on the study casts of 18 patients (2 male, 16 female) treated with

Statement of Clinical Relevance

Surgically assisted rapid palatal expansion (SARPE) techniques resulted in significant maxillary expansion. Greater expansion was achieved at the premolar region with and at the molar region without pterygomaxillary disjunction. Maxillary expansion with SARPE is mainly a lateral rotation of the 2 maxillary halves.

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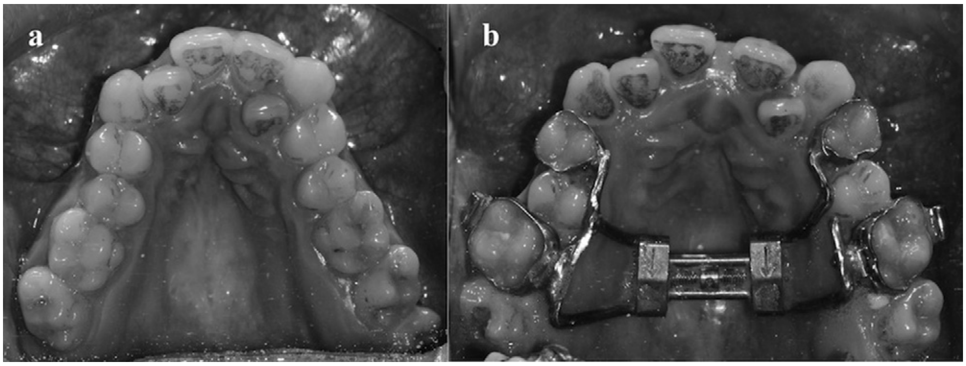

Fig. 1. Bonded SARPE appliance **(a)** before operation and **(b)** after activation.

SARPE from 2007 to 2010. The sample was divided into 2 groups. The first group consisted of 10 patients (−PP; mean age 20.1 ± 3.10 years, range 17-26 years; 2 male, 8 female) who underwent SARPE. The second group consisted of 8 patients (+PP; mean age 21.56 ± 3.43 years; range 17-24 years; 8 female). All of the patients were informed about the surgery protocols, and signed informed consent was obtained from the parents of the patients under 18 years of age.

Patient selection criteria were as follows: constricted maxilla with a maxillary-mandibular transversal difference of >5 mm; good oral hygiene and healthy periodontal structures; fused midpalatal suture as determined from occlusal films; good quality of dental casts available before and after expansion; no requirement for orthognathic surgery; and absence of craniofacial anomalies, such as cleft lip and palate.

To ensure standardization, the same interdisciplinary team treated all subjects included in this study. A tooth-borne fixed hyrax-type palatal expansion screw appliance (G&H Wire Co.) was used (Figure 1). The arms of the expansion screws were soldered to the bands of the first premolar and first molar teeth, and the appliance was cemented 1 or 2 days before the surgery.

All of the patients were also operated on by the same surgical team (A.A. and E.K.). The surgical protocol was performed with piezoosteotomy (Piezosurgery; Mectron Medical Technology) under local anesthesia. Bilateral incisions were made in the depth of the buccal vestibule from the region of the distal aspect of the canine to the mesial aspect of the first molar, and maxillary osteotomies were performed through the cortical bone from the pyriform rim to the pterygomaxillary fissure. After incising the mucosa between the apices of the central incisors, a sagittal osteotomy was performed interdentally between the roots of the upper central incisors through the posterior nasal spin with the use of a piezosurgical saw tip and subsequent posterior malleting of an osteotome. Unlike in the −PP group, in the +PP group the pterygoid fissures were separated on both sides with a curved osteotome to release the pterygoid plates. After activation of the appliance with a total widening of 1.5 mm, symmetric expansion was evaluated and the soft tissues closed. All of the patients were discharged from the hospital on the same day of their surgeries and were prescribed antibiotic, antiinflammatory, and analgesic drugs together with a chlorhexidine rinse and called back after 5 days for the initiation of expansion at a rate of 0.6 mm/d. When enough expansion was achieved, the hyrax screw was fixed with a ligature wire. The appliances remained in situ for 4 months. The study models were obtained before treatment (T0) and before fixed appliance treatment began (T1). Twenty linear and 2 angular measurements were taken.[17] Direct measurements on the study models were taken to the nearest 0.1 mm with Vernier calipers. All measurements were performed by 1 author (B.K.).

Measurements

The width of the maxillary dental arch was measured between the right and left vestibular and palatal cusp tips of the canine and first and second premolar teeth and between the right and left mesiobuccal and mesiopalatal cusp tips of the first molar teeth (Figure 2).

The clinical crown height of the first and second premolar and first molar teeth were measured on the vestibular side from the buccal cusp tip to the most apical point of the gingival margin. The change in crown height from T0 to T1 was used to measure the buccal attachment loss (Figure 3).

To measure the maxillary first molar axial angulation, the maxillary model base was trimmed to measure the angle between the intersecting lines drawn across the mesial buccal and mesial lingual cusp tips of both the right and left first molars (Figure 4).

The palatal vault angle was formed by the lines drawn tangential to the middle two-thirds of the right and left palatal surfaces (Figure 5, a). Palatal depth from the gingival height was measured as the shortest

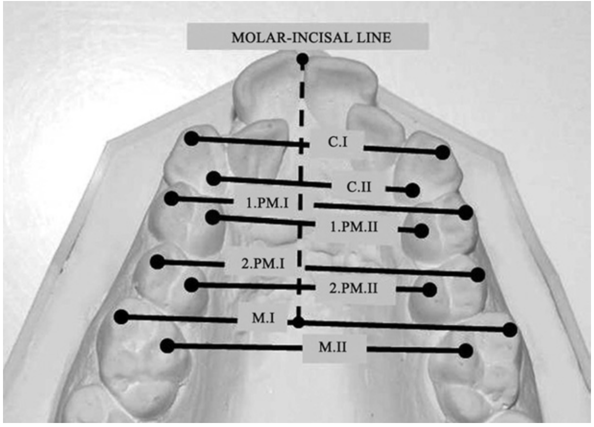

Fig. 2. Linear dental width and length measurements.

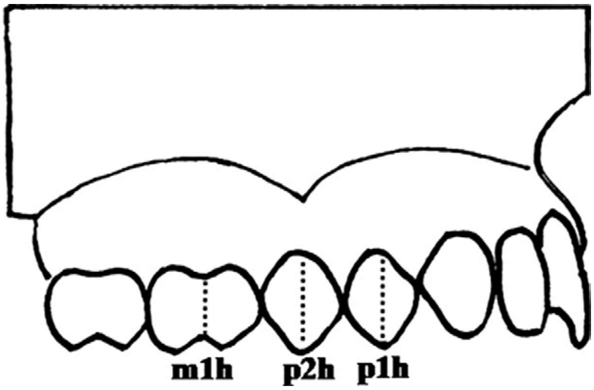

Fig. 3. Clinical crown height measurements on dental cast.

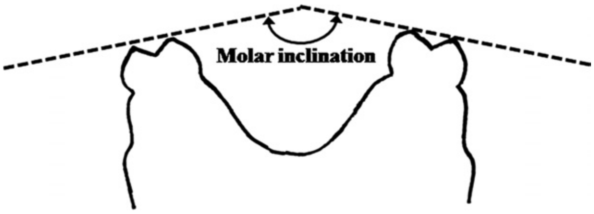

Fig. 4. Maxillary first molar axial angulations measured on dental cast (following Handelmann[17]).

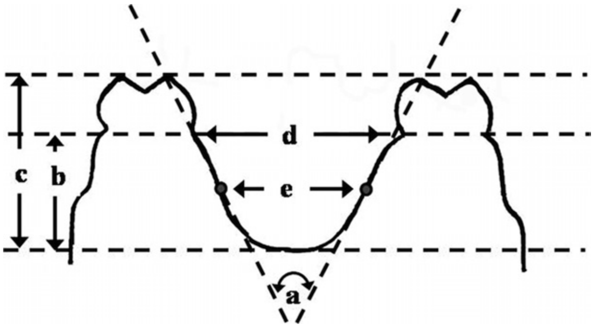

Fig. 5. **a**, Palatal vault angle; **b**, palatal depth from gingival height; **c**, palatal depth from molar cusp; **d**, palatal width at gingival height; **e**, palatal width at midpalate.

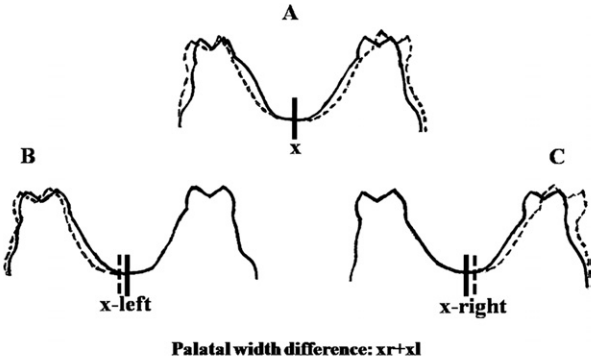

Fig. 6. Palatal width difference. **A,** T0 and T1 contour tracings were superimposed on the midpalatal raphe with the occlusal lines parallel. **B,** The palatal contour tracings from T0 and T1 were superimposed first on the left palatal outline. **C,** Then contour tracings were superimposed on the right side. The sum of the amount of displacement of the midpalatal raphe per side is the total palatal width (following Handelmann[17]).

distance from the midpalatal raphe to a line connecting the point on the gingival crest adjacent to the first molars (Figure 5, b). Palatal depth from the molar cusp was measured as the shortest distance from the midpalatal raphe to a line connecting the occlusal surfaces of the first molars (Figure 5, c). Palatal width at the gingival height was measured between the first molars at the height of the palatal gingiva (Figure 5, d). Palatal width at midpalate was the length of the line drawn perpendicular to the halfway point between the height of the palatal vault and the gingival height line (Figure 5, e).

The palatal width difference describes the expansion at the height of the palatal vault. The palatal contour tracings from T0 and T1 were superimposed first on the left palatal outline and then on the right palatal outline while remaining parallel to the occlusal plane. The amount of displacement of the midpalatal raphe per side was summed and the total difference in palatal width measured (Figure 6).

Statistical analysis

All statistical analyses were performed using the Statistical Package for Social Sciences software package (for Windows 98, version 10.0; SPSS, Chicago, IL, USA). The Shapiro-Wilks normality test and the Levene variance homogeneity test were applied to the data. The data were normally distributed, and there was homogeneity of variance among the groups. Therefore, the statistical evaluation was performed with the use of parametric tests. For each variable, the arithmetic mean and SD were calculated. When the P value was $<.05$, the statistical test was determined to be significant.

Table I. Group 1 (+PP) and group 2 (−PP) pretreatment values and statistical comparisons

		+PP (T0)			−PP			
	Measurement	*Mean*	*SD*	*SEM*	*Mean*	*SD*	*SEM*	*P value*
1	C.I	30.91	2.44	0.86	30.80	3.14	0.99	.936
2	C.II	25.36	1.40	0.49	24.51	2.79	0.88	.446
3	1. PM.I	35.71	3.75	1.33	36.04	2.80	0.89	.831
4	1. PM.II	25.98	3.27	1.16	26.15	2.94	0.93	.905
5	2. PM.I	41.32	3.45	1.22	41.43	3.84	1.22	.953
6	2. PM.II	31.45	2.80	0.99	32.50	5.34	1.69	.622
7	M.I	46.68	3.64	1.29	46.93	3.42	1.08	.883
8	M.II	35.86	2.42	0.85	35.42	3.20	1.01	.754
9	Molar-incisor line	27.25	4.87	1.72	26.15	3.11	0.98	.568
10	a	61.50	16.17	5.72	66.50	6.42	2.03	.382
11	b	15.25	3.33	1.18	16.10	1.58	0.50	.592
12	c	19.13	2.77	0.98	19.69	1.30	0.41	.574
13	d	31.63	3.24	1.15	30.00	2.84	0.90	.273
14	e	21.69	4.57	1.61	18.65	3.08	0.98	.112
15	Right m1h	5.15	0.77	0.27	5.30	0.79	0.25	.691
16	Right p2h	6.34	0.98	0.35	6.17	0.71	0.22	.679
17	Right p1h	7.19	1.17	0.41	6.89	0.87	0.28	.545
18	Left p1h	7.24	0.95	0.34	7.14	0.67	0.21	.801
19	Left p2h	6.25	0.90	0.32	6.10	0.89	0.28	.655
20	Left m1h	5.25	0.63	0.22	5.27	0.83	0.26	.956
21	Molar inclination	164.75	7.19	2.54	159.20	13.94	4.41	.323

An independent-sample *t* test was used to compare the initial measurements of the treatment and control groups. A paired-samples *t* test was used to evaluate the treatment changes within each group. An independent-sample *t* test was performed to compare the changes observed in both groups.

RESULTS

No paresthesia, sinus healing complications, root resorption, or loss of tooth vitality was observed in the study groups. A minor postoperative nosebleed occurred in only 1 patient from group 1 (+PP). Postoperative pain was minimal in all cases, and none of the patients reported excessive discomfort.

Comparison of +PP and −PP groups at T0

Group 1 (+PP) and group 2 (−PP) showed no significant differences before expansion (Table I); thus, the similarity of the pretreatment values of the study groups was equivalent.

Comparison of T0 and T1 in group 1

All width measurements increased. The differences were statistically significant ($P < .001$) with the exception of palatal width at the gingival height and at the midpalate (Table II). The palatal vault angle increased significantly ($P < .01$) and molar inclination decreased significantly ($P < .01$), indicating lateral tipping of the maxillary halves. Other measurements did not show any significant changes (Table II).

Comparison of T0 and T1 in group 2

All transversal dimensions exhibited statistically significant increases. The palatal vault angle increased significantly ($P < .001$), and the molar inclination showed a significant decrease ($P < .01$). Palatal depth from the molar cusp decreased significantly ($P < .05$). No significant changes were observed in palatal depth at the gingival height or in clinical crown height measurements (Table III).

Comparison of groups 1 and 2 at T1

No statistically significant differences were found among the study groups. Although the differences between the +PP and −PP groups were insignificant, in the −PP group greater expansion was observed at the midpalatal and gingival levels, whereas the +PP group exhibited a 0.78-mm greater increase at the apical base level (palatal depth measurement) and 11.25° less tipping in the molar teeth (molar inclination). Moreover, in the SARPE group with pterygomaxillary disjunction, at least a 0.7-mm greater expansion was measured in the premolar region (Table IV).

DISCUSSION

Surgical technique

No consensus exists for SARPE regarding the best surgical procedure, and the preference of the surgeon often determines the choice.[18] The areas of resistance for maxillary expansion have been classified as follows: anteriorly, piriform aperture pillars; laterally, zygomatic buttresses; posteriorly, pterygoid junctions; and medially, midpalatal synostosed suture.[18] Betts and Ziccardi[19] recommended a total bilateral maxillary osteotomy from the piriform aperture to the pterygomaxillary fissure with a midpalatal split from the anterior to the posterior nasal spines. Those authors suggested the

Table II. Group 1 (+PP) values before (T0) and after (T1) treatment

	Measurement	T0			T1			
		Mean	SD	SEM	Mean	SD	SEM	P value
1	C.I	30.91	2.44	0.86	35.43	2.33	0.82	<.001‡
2	C.II	25.36	1.40	0.49	29.91	1.81	0.64	<.001‡
3	1. PM.I	35.71	3.75	1.33	44.49	2.79	0.99	<.001‡
4	1. PM.II	25.98	3.27	1.16	34.51	2.91	1.03	<.001‡
5	2. PM.I	41.32	3.45	1.22	49.37	3.05	1.08	<.001‡
6	2. PM.II	31.45	2.80	0.99	39.55	2.78	0.98	<.001‡
7	M.I	46.68	3.64	1.29	53.50	3.43	1.21	<.001‡
8	M.II	35.86	2.42	0.85	42.18	2.36	0.84	<.001‡
9	Molar-incisor line	27.25	4.87	1.72	27.19	3.89	1.38	.921
10	a	61.50	16.17	5.72	72.75	17.51	6.19	.004†
11	b	15.25	3.33	1.18	15.50	2.94	1.04	.813
12	c	19.13	2.77	0.98	18.34	3.13	1.11	.162
13	d	31.63	3.24	1.15	34.31	4.05	1.43	.313
14	e	21.69	4.57	1.61	23.44	5.00	1.77	.547
15	Right m1h	5.15	0.77	0.27	5.04	0.87	0.31	.639
16	Right p2h	6.34	0.98	0.35	6.36	0.89	0.31	.904
17	Right p1h	7.19	1.17	0.41	7.20	0.88	0.31	.97
18	Left p1h	7.24	0.95	0.34	7.39	1.05	0.37	.704
19	Left p2h	6.25	0.90	0.32	6.41	0.65	0.23	.641
20	Left m1h	5.25	0.63	0.22	5.64	0.71	0.25	.195
21	Molar inclination	164.75	7.19	2.54	157.50	8.69	3.07	.004†

†$P < .01$; ‡$P < 0.001$.

Table III. Group 2 (−PP) values before (T0) and after (T1) treatment

	Measurement	T0			T1			
		Mean	SD	SEM	Mean	SD	SEM	P value
1	C.I	30.80	3.14	0.99	35.16	3.02	0.96	<.001‡
2	C.II	24.51	2.79	0.88	29.12	2.90	0.92	<.001‡
3	1. PM.I	36.04	2.80	0.89	42.62	2.03	0.64	.002†
4	1. PM.II	26.15	2.94	0.93	33.84	3.80	1.20	<.001‡
5	2. PM.I	41.43	3.84	1.22	48.76	2.65	0.84	.002†
6	2. PM.II	32.50	5.34	1.69	39.81	4.54	1.44	.002†
7	M.I	46.93	3.42	1.08	55.06	2.54	0.80	<.001‡
8	M.II	35.42	3.20	1.01	43.76	2.39	0.75	<.001‡
9	Molar-incisor line	26.15	3.11	0.98	25.85	2.67	0.84	.297
10	a	66.50	6.42	2.03	75.10	7.68	2.43	<.001*
11	b	16.10	1.58	0.50	19.69	1.30	0.41	.125
12	c	19.69	1.30	0.41	19.27	1.13	0.36	.01*
13	d	30.00	2.84	0.90	36.25	3.43	1.09	<.001‡
14	e	18.65	3.08	0.98	22.50	3.99	1.26	<.001‡
15	Right m1h	5.30	0.79	0.25	5.27	0.99	0.31	.898
16	Right p2h	6.17	0.71	0.22	6.13	0.93	0.29	.747
17	Right p1h	6.89	0.87	0.28	6.74	0.66	0.21	.491
18	Left p1h	7.14	0.67	0.21	7.26	0.92	0.29	.484
19	Left p2h	6.10	0.89	0.28	6.32	0.91	0.29	.57
20	Left m1h	5.27	0.83	0.26	5.47	0.79	0.25	.446
21	Molar inclination	159.20	13.94	4.41	140.70	25.17	7.96	.009*

*$P < .05$; †$P < .01$; ‡$P < 0.001$.

sectioning of all articulations, areas of resistance, and anterior, lateral, posterior, and median support of the maxillary arch. They also recommended releasing the nasal septum and the pterygoid plates. Lehman et al.[20] did not recommend a palatal split, stating that the removal of the resistance from the zygomatic buttress is sufficient to remove resistance to expansion.

Bays and Greco[21] and Northway and Meade[22] recommended not separating the maxilla from the pterygoid plates, to avoid invasion into the pterygomaxillary junction. According to them, such a separation requires extreme force and usually causes the plates to fracture.[18] Pogrel et al.[23] recommended only a midpalatal cut in addition to the sectioning of the lateral support.

Table IV. Group 1 (+PP) and group 2 (−PP) treatment difference values (T1 − T0) and standard deviations of measurements and statistical comparisons

		+PP			−PP			
	Measurements	*Mean*	*SD*	*SEM*	*Mean*	*SD*	*SEM*	*P value*
1	C.I	4.53	1.40	0.50	4.37	1.44	0.46	.818
2	C.II	4.55	1.81	0.64	4.61	1.11	0.35	.933
3	1. PM.I	8.78	2.70	0.95	6.58	1.98	0.62	.069
4	1. PM.II	8.54	2.31	0.82	7.68	3.45	1.09	.557
5	2. PM.I	8.05	1.94	0.69	7.33	1.76	0.56	.421
6	2. PM.II	8.10	1.81	0.64	7.31	5.20	1.64	.505
7	M.I	6.82	1.36	0.48	8.13	2.15	0.68	.154
8	M.II	6.32	1.11	0.39	8.33	3.03	0.96	.095
9	Molar-incisor line	−0.06	1.72	0.61	−0.30	1.27	0.40	.891
10	a	11.25	7.42	2.62	8.60	4.55	1.44	.364
11	b	0.25	1.63	0.58	0.50	0.88	0.28	.237
12	c	−0.79	1.43	0.50	−0.42	0.41	0.13	.963
13	d	2.69	6.02	2.13	6.25	2.35	0.74	.104
14	e	1.75	5.18	1.83	3.85	2.31	0.73	.266
15	Right m1h	−0.11	0.65	0.23	−0.03	0.72	0.23	.804
16	Right p2h	0.03	0.57	0.20	−0.04	0.38	0.12	.775
17	Right p1h	0.01	0.91	0.32	−0.15	0.66	0.21	.667
18	Left p1h	0.15	1.07	0.38	0.12	0.52	0.17	.939
19	Left p2h	0.16	0.94	0.33	0.22	0.71	0.22	.884
20	Left m1h	0.39	0.49	0.18	0.20	0.79	0.25	.563
21	Molar inclination	−7.25	4.77	1.69	−18.50	17.49	5.53	.130
22	Palatal depth	4.85	0.48	0.17	4.07	1.54	0.49	.147

In the present study, both separation and nonseparation of the pterygomaxillary junction were achieved during SARPE. The surgical operations were performed under local anesthesia with the use of the advantages of piezosurgery (minimal vibration, intraoperative bleeding, postoperative swelling, and thermal damage to maxillary bone)[24]; however, detaching the pterygoid plates with osteotomes is the most painful and inconvenient phase of the surgery for the patients. The patients who underwent SARPE before 2009 had a sectioning of virtually all of the maxillary boney articulations with the pterygomaxillary junction. The patients felt pain and discomfort only during the release of the pterygoid plates. In light of the articles recommending not separating the maxilla from the pterygoid plates to avoid invasion into the pterygomaxillary junction, the patients who were treated after 2009 underwent SARPE −PP. Therefore, we aimed to retrospectively compare both dental and skeletal changes for two SARPE techniques.

Transverse dimensions

It can be stated that pterygomaxillary disjunction leads to greater posterior expansion than SARPE without pterygomaxillary disjunction. However, comparison of the current literature indicates the opposite.[25] Bays and Greco[21] reported that separation of the pterygoid processes can lead to greater posterior expansion. They suggested that SARPE −PP can lead to greater anterior and proportionally less posterior expansion with toothborne devices.

Han et al.[26] studied 2 groups who received toothborne devices and who underwent subtotal Le Fort I osteotomy and an anterior midpalatal osteotomy with and without a pterygomaxillary disjunction. The measurements were taken from study casts before surgery and again after the removal of the appliance. Greater posterior widening was found in the −PP group, with an interdental maxillary width of 77% in the canines, 78% in the first premolars, and 86% in the first molars after retention. Widening in the +PP group also increased in a more posterior direction but to less extent after retention, with an increase of 70% in maxillary interdental width in the canines, 95% in the first premolars, and 77% in the first molars. In contrast to Bays and Greco,[21] Han et al.[26] found greater posterior widening in patients with SARPE −PP. In our study, a comparison of the changes in the maxilla between +PP and −PP groups showed no statistically significant differences. Similarly to the results of Han et al.,[26] greater expansion was calculated in the molar teeth in the −PP group, and a greater width increase was observed in the premolar teeth in the +PP group. The −PP group also exhibited a greater increase at the midpalatal and gingival levels.

The palatal vault angle exhibited an increase of 11.25 ± 7.42° in the +PP group and 8.60 ± 4.55° in the −PP group. Seeberger et al.[27] evaluated the long-term effects of surgically assisted rapid maxillary expansion without performing osteotomy of the pterygoid plates. They found that a transverse shift of the segments can be achieved over the whole bony palate even when no osteotomy of the pterygomaxillary suture is performed. Kurt et al.[28] performed the SARPE without pterygoid detachment and without palatal separation. The results of their study confirmed that expansion with SARPE is mainly a lateral rotation of the 2 maxillary halves. The authors concluded that both skeletal and dental widths were stable after 3-year follow-up, with some relapse with a noninvasive surgical protocol.

Both study groups showed significant lateral molar tipping. Magnusson et al.[29] concluded that pterygoid detachment could not fully eliminate the posterior resistance and that buccal tipping of the molars can still be observed. Wertz[30] stated that flaring or tipping of the maxillary molars was a demonstrable and expected response to expansion.

On the other hand, the +PP group exhibited 0.78 mm greater increase at the apical base level (palatal depth measurement) and 11.25° less tipping in the molar teeth (molar inclination) compared with the −PP group. Although the differences in these changes between groups were not significant, an advantage of pterygomaxillary disjunction may be in obtaining greater skeletal expansion at the maxillary base rather than dental expansion at the molar teeth region as found in the −PP group.

Periodontal structures

Thin gingiva may show a tendency toward recession after traumatic or surgical interventions.[18] Histologic studies of the periodontal tissues of extracted teeth that were initially used as appliance anchors have shown strong inflammatory responses during maxillary expansion. Orthodontic tooth movement can have a detrimental effect on the mucogingival complex, especially when the keratinized tissue and underlying bone are thin.[18] In the present study, no significant changes were found in clinical crown heights in either group. This may be a result of using a banded expansion device, which may be more hygienic than bonded acrylic appliances. Moreover, significant molar inclination changes were observed in both study groups. Tipping of teeth in the lateral or vestibular direction can cause bone resorption in the enamel-cement area, so unharmful tipping of posterior teeth after both surgical expansion procedures did not induce gingival recession on the vestibule sides of the premolar and molar teeth.

In their study, Laudemann et al.[25] examined whether pterygomaxillary disjunction leads to a marked posterior widening and whether it can be avoided in patients <20 years old because of their incompletely ossified pterygomaxillary suture. They concluded that pterygomaxillary disjunction should be based on patient age and individual requirements, i.e., SARPE −PP in patients <20 years old and SARPE +PP in patients >20 years old. Because no consensus exists about the optimum procedure for SARPE, the extent of surgery ideally should depend on the areas of resistance, with some individualization.[18]

CONCLUSION

1. SARPE with and without pterygomaxillary disjunction are both effective in dental and skeletal expansion of maxilla.
2. No clinical crown height change was observed after either SARPE procedure.
3. More expansion was achieved at the premolar region in the +PP group and at the molar region in the −PP group.
4. Although both study groups showed significant molar tipping, it was higher in the −PP group.
5. Although statistically not significant compared with the −PP group, more maxillary apical base expansion was observed in the +PP group.
6. With or without pterygomaxillary disjunction, expansion with SARPE is mainly a lateral rotation of the 2 maxillary halves.
7. More studies are needed with larger samples and with long-term follow-ups for evaluating the effects of the 2 different SARPE surgery techniques.

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