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Nasal soft tissue changes after two different approaches for surgically assisted rapid maxillary expansion

Y. Fındık, T. Baykul, T. Yazıcı
Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Süleyman Demirel University, Isparta, Turkey

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Abstract. The aim of the study was to evaluate the nasal soft tissue changes in patients who underwent surgically assisted rapid maxillary expansion (SARME) using two different surgical approaches. Thirty-two patients were included in the study, and divided into two groups according to the type of surgical approach: in group A ($n = 17$), SARME performed with standard Le Fort I circumvestibular approach with alar base cinch and anterior nasal spine (ANS) exposure; and in group B ($n = 15$) operations were performed with the same standard Le Fort I circumvestibular approach with only alar base cinch. Measurements of height and width of the philtrum, nasal and subnasal width, and columella width were taken from three-dimensional facial images obtained before surgery (T1), after the distraction phase (T2) and 6 months postoperatively (T3). The mean maxillary expansion was 7.3 ± 0.7 mm for group A and 7.5 ± 1.5 mm for group B, without any significant difference between groups ($P = 0.59$). Both groups presented an increase in all vaules in T2 and T3. The approach used in group A resulted in smaller changes in the columella width. The results of the present study show that there is no need for intraoperative releasing of the soft tissues around the anterior nasal spine during SARME if columella width is sufficient. However, further randomized studies based on large patient groups are needed before final conclusions on this topic can be reached.

Key words: surgically assisted rapid maxillary expansion; nasal soft tissue; columella width; alar base cinch; anterior nasal spine.

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Surgically assisted rapid maxillary expansion (SARME) has been widely used to expand the narrow maxillary arch[1–3]. SARME affects both the hard and soft tissues of the maxillla and nasal area. The nasal region is one of the most important parts of the face, therefore, it is important to analyse the effect of a SARME procedure on the nasal region[4,5]. Several studies have reported that SARME affects the nasal area, such as by alar base widening, which is aesthetically undesirable in patients with a wide nose[6–9]. In order to analyse this widening, many surgeons use different incision techniques or some su-

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ture techniques such as cinch suture, whose counteracting effect and stability have been studied, but whose effectiveness remains controversial. Several techniques have been reported regarding the SARME operations in the literature for evaluating the soft tissues around the nasal area. Authors evaluated the nasal soft tissues with two-dimensional (2D) imaging, cone beam computed tomography (CBCT) scans or 3D techniques[10]. The use of 3D imaging techniques in oral and maxillofacial surgery has evolved rapidly over the past decade, therefore authors generally evaluated the nasal soft tissues with 3D techniques. Thus, the objective of the present study was to assess differences in the nasal soft tissues after SARME with two different surgical approaches.

Materials and methods

Study design and ethical considerations were approved by the Ethical Committee of Süleyman Demirel University, Faculty of Medicine, Turkey, and an informed consent was signed by all patients. No patients had any clefts, syndromes, or history of trauma. Patients with congenital malformations were excluded. The study sample consisted of 32 patients with a transverse maxillary deficiency of more than 5 mm (19 female and 13 male), aged between 16 and 29 years at the time of surgery (mean age 21.2 years). Thirty-two patients were divided into two groups according to the kind of surgical approach: in group A ($n = 17$), SARME was performed with a standard Le Fort I circumvestibular approach with alar base cinch and anterior nasal spine exposure; and in group B ($n = 15$) operations were performed with the same standard Le Fort I circumvestibular approach with only alar base cinch.

Surgical technique

SARME was performed under general anaesthesia, without pterygomaxillary disjunction and with midpalatal suture osteotomy. After a latency period of 7 days, each patient was instructed to activate the expansion device at a rate of 0.25 mm twice a day until the desired expansion was obtained. The expansion device was left in place to serve as a retention device during the measurements. A coil spring was placed to maintain the diastema between the maxillary incisors during the retention period.

Vestibular incision was performed from the right first molar to the left first molar. The mucoperiosteum was reflected, exposing the posterior maxilla and the anterior nasal floor. In group A ($n = 17$), standard Le Fort I circumvestibular approach with alar base cinch and anterior nasal spine (ANS) exposure was performed (Fig. 1). In this group, all soft tissue around the ANS was reflected as in Lefort I osteotomy operations. In group B ($n = 15$), operations were carried out with the same standard Le Fort I circumvestibular approach with only base cinch.

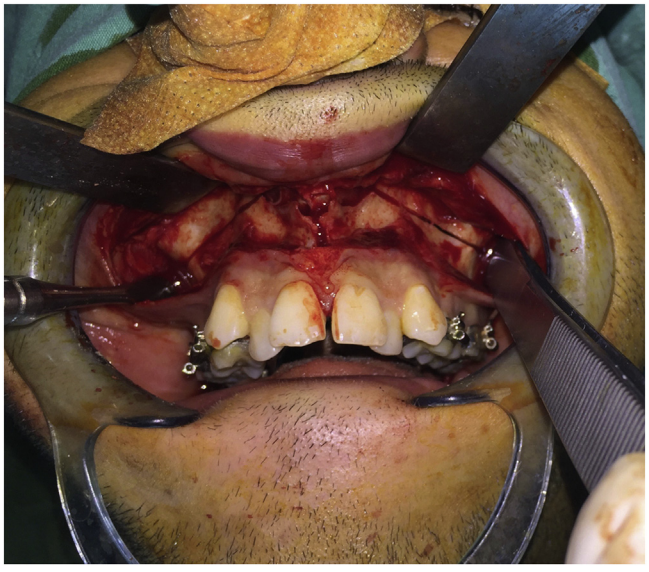

Fig. 1. In group A ($n = 17$), standard Le Fort I circumvestibular approach with alar base cinch and anterior nasal spine (ANS) exposure was performed.

(Fig. 2). ANS was not seen, soft tissues around the ANS was not elevated. In this group, bone structure of the ANS was not seen during the operation. A horizontal osteotomy was made at Le Fort I level, 5 mm above the root apices, and then midpalatal suture was seperated by a chisel. The distraction device was activated until a 1-mm midline diastema was achieved. The mucosa was readapted and sutured with resorbable sutures. All patients received prophylactic antibiotics intraoperatively. After expansion, the devices were locked and kept in position for 6 months.

Image analysis

Three-dimensional photographs of all patients and controls were acquired using the 3DMD stereophotogrammetry facial system (3dMDFace, 3dMD, Atlanta, GA, USA). All subjects were photographed while seated, with their head in a natural position, with relaxed facial musculature, eyes open, and loosely closed lips. The acquired 3D photographs were imported into the 3DMDPatient software (3dMDPatient, 3dMD). Measurements of height and width of the philtrum, nasal and subnasal width, and columella width were taken from 3D facial images obtained before surgery (T1), after the distraction phase (T2) and 6 months postoperatively (T3) (Figs 3–5).

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 20.0 (IBM Corp, Armonk, NY, USA). All measurements were made twice by the authors and the mean value used for the analysis. The changes were evaluated using a mixed models analysis of variance (ANOVA), with a Bonferroni test ($P < 0.05$).

Results

No problems were observed during the activation of the distraction device, such as oedema, or haematoma, and wound healing and sufficient expansion occurred in all patients. Toothborne distractors were used in all patients. The mean maxillary expansion was 7.3 ± 0.7 mm for group A and 7.5 ± 1.5 mm for group B, without any significant difference between groups ($P = 0.59$).

In groups A and B, a significant increase in nasal and subnasal width was

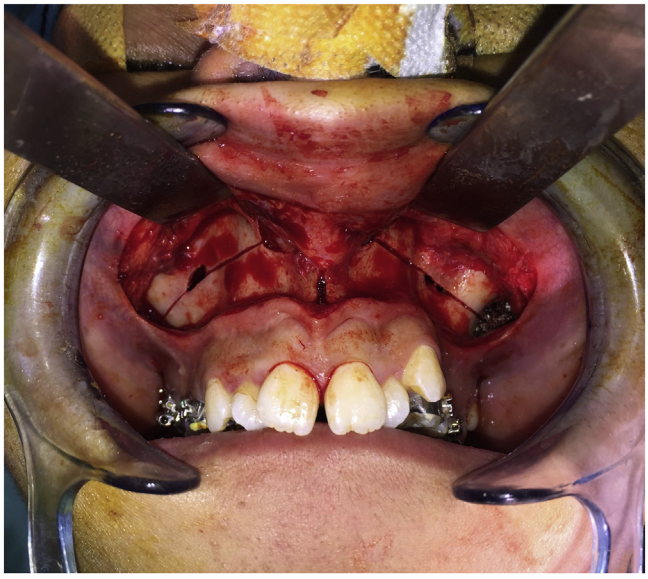

Fig. 2. In group B ($n = 15$) operations were performed with same standard Le Fort I circumvestibular approach with alar base cinch only.

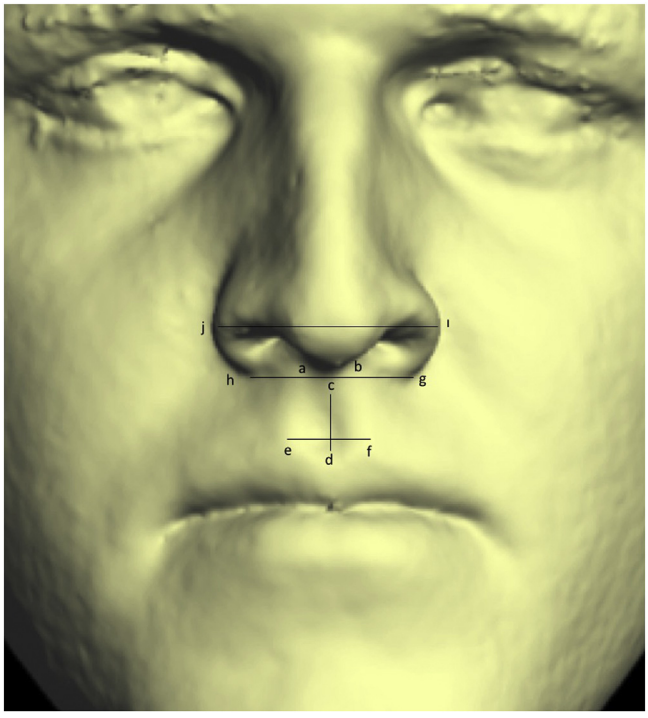

Fig. 3. Soft tissue anatomical landmarks and measurements marked on the three-dimensional reconstruction in the frontal view; height of the philtrum (c–d), width of the philtrum (e–f), nasal width (i–j), subnasal width (h–g) and columella width (a–b).

observed. Although both groups presented an increase in nasal and subnasal width as a result of maxillary expansion, no statistically significant difference was found between the two groups. The height and width of the philtrum and columella width showed no significant changes at all time levels. However, group B presented a larger increase for the columella width than group A. In both groups A and B, no differences were found, between the T1 and T2 time level measurements of the nasal and subnasal width (Table 1).

Discussion

SARME is an effective and relatively safe technique used for widening the narrow maxilla[11,12]. However, after the distraction phase, many soft and hard tissue changes such as nasal soft tissue changes may occur after the surgical procedure. In the literature, several methods have been shown for the evaluation of facial soft tissues after the surgical procedure, such as conventional measurements, 3D stereophotographs, and tomography[5,6,13–20]. Stereophotography has the advantage of allowing evaluation of skeletal and related soft tissue changes before and after the surgical procedures compared to other techniques. Three-dimensional stereophotogrammetry is a realistic and noninvasive imaging technique for evaluating the soft tissue changes after the surgical operations. These advantages make 3D stereophotogrammetry a worthy technique for the collection of wide 3D facial data, especially after orthognathic surgery. In our study, we used the 3D stereophotogrammetry to compare the two different operation techniques.

In the literature, many studies have described widening of the nasal soft tissues after SARME. In a study, Alves et al. measured the changes in the width and length of the nasal tissues before surgery (T1) and 6 months postoperatively (T2) using cone beam tomographic Images[16]. Both groups presented an increase in the alar base width postoperatively. Berger et al., Magnusson et al. and Assis et al. also observed an increase in the dimensions of the nose 6 months after SARME[4,13,17]; all of these studies used the traditional Le Fort I circumvestibular incision. The differences described in the literature are related to the amount of expansion, and surgical technique. This study found the same results as in the literature: nasal and subnasal width values increased after the maxillary expansion. But between the groups no statistically significant differences were found. The height and width of the philtrum and columella width showed no significant changes in both groups and at all time levels. However, group B presented a larger increase for the columella width than group A. In group B, muscle attachments around the anterior nasal spine were preserved, so it was possible that the attached soft tissues around the ANS expanded the columella much more than in group A, following the expansion of maxilla. In group A, soft tissues were detached they tent to readapt to the ANS during the latency period and the distraction phase,

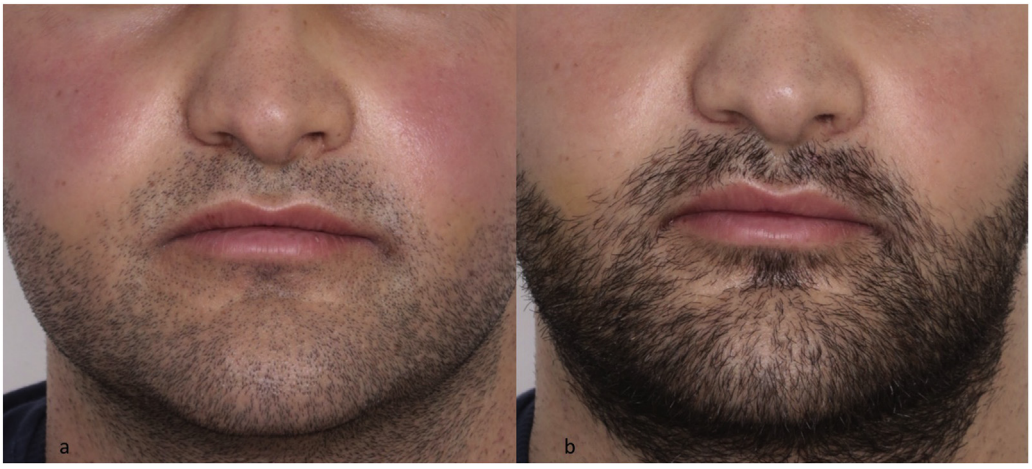

Fig. 4. Group A patient before and 6 months after the surgery.

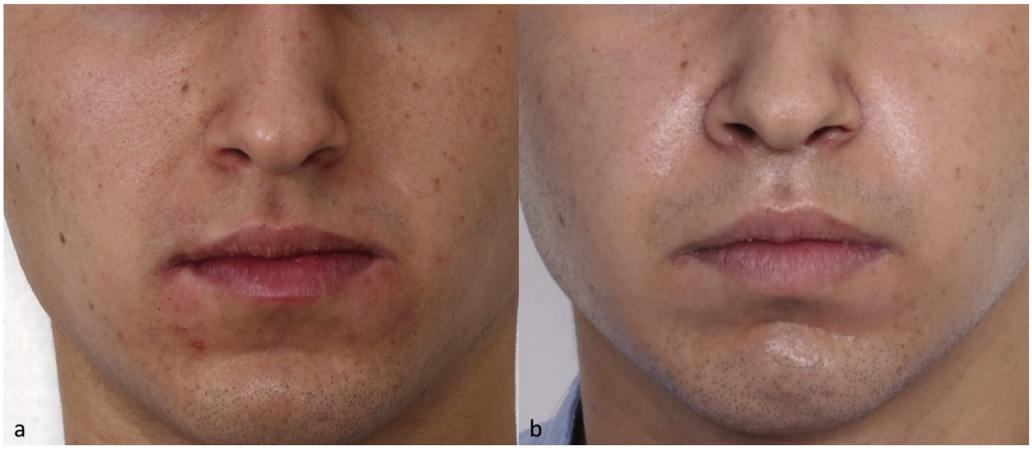

Fig. 5. Group B patient before and 6 months after the surgery.

Table 1. Dimensions in Groups A and B at different time points.

	T0	T1	T2	T0–T1 (*P*)	T1–T2 (*P*)	T0–T2 (*P*)
Group A						
Height of the philtrum	14.37 + 1.67 mm	15.04 + 2.18 mm	14.69 + 2.18 mm	0.053	0.064	0.074
Width of the philtrum	11.56 + 1.6 mm	12.24 + 1.5 mm	12.36 + 1.27 mm	0.058	0.059	0.067
Nasal width	33.37 + 2.11 mm	35.95 + 2.02 mm	35.48 + 2.25 mm	0.045	0.089	0.035
Subnasal width	17.18 + 2.11 mm	18.72 + 1.75 mm	18.55 + 1.64 mm	0.037	0.082	0.07
Columella width	7.2 + 1.11 mm	7.59 + 0.56 mm	7.60 + 1.1 mm	0.063	0.067	0.075
Group B						
Height of the philtrum	14.62 + 1.36 mm	15.12 + 2.1 mm	15.01 + 1.69 mm	0.056	0.065	0.068
Width of the philtrum	11.63 + 1.5 mm	12.42 + 1.3 mm	12.32 + 1.2 mm	0.055	0.064	0.087
Nasal width	32.35 + 1.1 mm	34.83 + 2.2 mm	34.48 + 2.03 mm	0.034	0.092	0.037
Subnasal width	17.63 + 2.2 mm	18.54 + 1.63 mm	18.45 + 1.13 mm	0.041	0.088	0.029
Columella width	7.4 + 1.18 mm	7.79 + 0.72 mm	7.75 + 1.18 mm	0.078	0.056	0.066

therefore columella width was not enlarged as much as in group B.

The results of the present study indicate that there is no need for intraoperative ANS exposure for widening the maxilla. In conclusion, despite the limited sample sizes of the study groups, it is concluded that the surgical technique applied in group B is more effective than that in group A for widening the columella at all time levels. If researchers choose to widen the columella or if width of the columella is not sufficient, the surgical technique as applied in group B is an effective method for achieving the desired columellar width. However, further randomized studies based on large patient groups are needed before final conclusions on this topic can be reached.

Funding

None.

Competing interests

None.

Ethical approval

Study design and ethical considerations were approved by the ethical committee of Suleyman Demirel University, Faculty of Medicine, Turkey.

Patient consent

Informed consent was signed by all patients.

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Address:
Yavuz Fındık
Department of Oral and Maxillofacial Surgery
Faculty of Dentistry
Süleyman Demirel University
Isparta
Turkey
Tel.: +90 246 211 3251
Fax: +90 246 237 0607
E-mail: yavuzfindik32@hotmail.com