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ORIGINAL ARTICLE

Evaluation of the palatal split pattern in surgically rapid maxillary expansion—comparison of two techniques

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Abstract
Purpose Surgically assisted rapid maxillary expansion is performed to correct transverse deficiencies of the maxilla, and it is indicated in specific clinical situations. The literature presents different opinions in several aspects, mainly regarding the effect of disjunction of the pterygoid plates. The aim of this study was to evaluate the pattern of maxillary expansion obtained with two surgical techniques, with and without disjunction of the pterygoid plates.*Methods* Twenty patients treated with surgically assisted rapid maxillary expansion for correction of transversal discrepancies were included in this retrospective study and divided into two groups: (G1) patients operated without disjunction of pterygoid plates and (G2) patients treated with release of the pterygoid plates.
Results There were seven male and 13 female patients, and the mean age was 29.9 years. Cone beam computed tomography images obtained after final activation of the expansion device were evaluated and complete disjunction of the midpalatal suture (type I) was present in 75 % of the patients whereas incomplete disjunction of the midpalatal suture (type II) was observed in 25 %. Chi-square test showed no statistically significant difference between groups ($p = 0.606$).
Conclusion No difference was found in relation to the maxillary disjunction pattern irrespective of the treatment given to pterygoid plates.

Keywords Palatal expansion technique · Le Fort I osteotomy · Maxilla · Cranial sutures · SARME

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Introduction

Almost 30 % of adult orthodontic patients present transverse maxillary deficiency [1]. The modern orthodontic treatment is successful to correct this deficiency in children up 15 years, depending on gender, but it is inefficient when ossification of the midpalatal suture occurs [2]. Surgically assisted rapid maxillary expansion (SARME) is indicated to patients who already achieved maturity of the suture and must reach a maxillary expansion greater than 5 mm [3, 4].

The SARME technique proposed by Bell and Jacobs [5] consists in osteotomies of the zygomaticomaxillary buttress and the midpalatal suture, in order to weaken those structures and allow the maxillary expansion to proceed by activation of the orthodontic expansion device. The release of the pterygoid plates should be realized when expansion greater than 7 mm is required [6, 7].

Even so, the technique is controversial in relation to the real benefits of releasing (+LPP) or not (−LPP) the lateral pterygoid plates and possibility of complications due to lesion of anatomical structures in that region [7–9]. The current discussion is about the pattern of maxillary expansion. Several authors report that the uniform and complete palatal split (anterior to posterior) is more likely to happen when the SARME + LPP is performed [3, 6]. However, there are some studies that deny

those conclusions and state that the same type of expansion is obtained with both techniques [10, 11].

Pereira et al. [12] published a study that evaluated the palatal bone split using computed tomography to classify the bone split as complete or incomplete (up to the palatine bone). The present study aims to use this classification method to compare the maxillary expansion techniques with (+LPP) or without (−LPP) release of pterygoid plates and verify if the separation of the pterygoid plates makes a difference in the palatal bone split.

Material and method

A retrospective analysis was performed on the database of patients submitted to SARME in descending chronological order. To be included in the sample, medical records of patients with transverse maxillary deficiency greater than 7 mm were selected. Cone beam computed tomography (CBCT) scans obtained preoperatively and after completion of the activation of the expansion device had to be available. Syndromic patients, those presenting orofacial clefs, patients who underwent previous maxillary surgery, or who had medical records without CBCT were excluded.

The subjects were divided into two groups according to the surgical technique applied: (G1) SARME without the disjunction of pterygoid plates (−LPP) and (G2) SARME with disjunction of pterygoid plates (+LPP). All patients were operated by trained oral and maxillofacial surgeons.

In G1, the surgical technique was performed just as described by Bell and Jacobs [5]. In G2, the procedure included the disjunction of the pterygoid plates using a curved chisel as described by Betts et al. [13]. Both groups had the same postoperative expansion protocol. The distraction device used was the Hyrax (Dentaurum, 802–602) anchored to the first premolars and the first molars by orthodontic bands. The activation was initiated in the 7th postoperative day and was performed by the patient under professional supervision. The activation followed the pattern of one quarter of turn three times per day, totalizing 0.75 mm daily. After the activation period, when the desired expansion was achieved, the distractor was locked for osseous consolidation for at least 4 months.

The postoperative CBCT scan obtained after completion of the activation was evaluated by a single calibrated blinded individual with the Osirix® software used to classify the palatal bone split pattern according to Pereira et al. [12], as follows:

– Type I: Complete disjunction of midpalatal suture from the anterior nasal spine to the posterior nasal spine (Fig. 1);

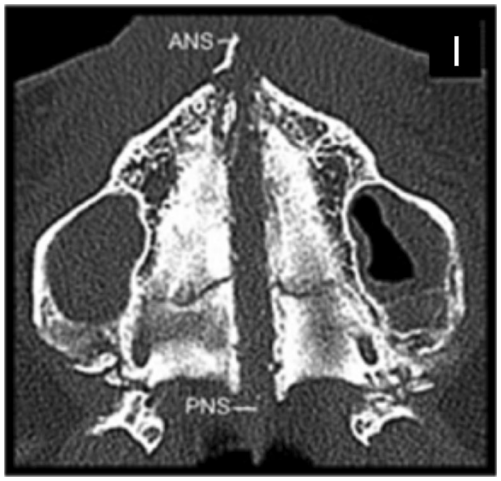

Fig. 1 Type I palatal split pattern: Complete disjunction of the midpalatal suture from the anterior nasal spine to the posterior nasal spine. *ANS* anterior nasal spine, *PNS* posterior nasal spine

– Type II: Incomplete disjunction of the midpalatal suture, from the anterior nasal spine to the transverse palatal suture, with small or no posterior split and thus not including the palatine bone (Fig. 2).

The association of the surgical technique with the palatal bone split pattern was evaluated by the chi-square test ($p < 0.05$).

Results

The study included 20 patients submitted to SARME, 13 females and seven males, with a mean age of 29.9 years. Group I included three male and seven female patients, mean age of 30.6 years, and Group II had four male and six female

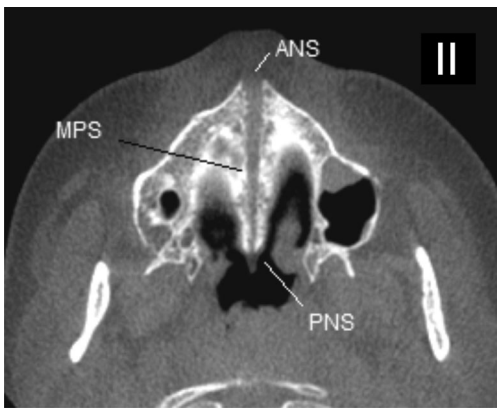

Fig. 2 Type II palatal split pattern: Incomplete disjunction of the midpalatal suture, from the anterior nasal spine to the transverse palatal suture, with small or no posterior split and thus not including the palatine bone. *ANS* anterior nasal spine, *MPS* midpalatal suture, *PNS* posterior nasal spine

patients, mean age of 29.3 years. The mean of bone expansion in anterior nasal spine area was 5.75 ± 1.44 mm in G1 and 5.61 ± 1.51 mm in G2. The center area of palate was 3.31 ± 1.27 mm in G1 and 3.03 ± 1.48 mm in G2.

According to the CBCT scan images, 75 % of the individuals had palatal type I split pattern and 25 % presented the type II, considering both groups together. Viewing G1 and G2 separately, a higher prevalence of type I split pattern was found in G1, in which the disjunction of pterygoid plates was not performed (Table 1).

The analysis of the palatal split pattern through the chi-square test did not show statistic significant difference between the groups (p = 0.606). The direct comparison between groups resulted in tendency for both to the type I palatal split pattern.

Discussion

Although SARME is a widely employed procedure for treatment of transverse maxillary deficiency, it still divides authors in several aspects. Some believe that the separation of the pterygoid plates is of great matter to obtain a homogeneous maxillary bone split and others believe that it does not change the split pattern.

The palatine suture was considered the most important one when the orthopedic maxillary expansion techniques were created, but nowadays, the role of the pterygopalatine, nasomaxillary, frontomaxillay, zygomaticmaxillary, frontonasal, frontalzygomatic sutures, and the cranial base is clear [11, 14–17]. Although there is no consensus about the effectiveness of pterygoid plate separation, some studies show the important role of the lateral wall of the maxilla, palatine suture, and pterygopalatine suture in the distribution of load to the facial skeleton and skull base during the SARME activation period [18, 19].

Holberg et al. [20] using finite elements analysis to evaluate midfacial and cranial stress distribution in SARME+LPP and SARME–LPP considered that the disjunction of pterygoid plates is a reasonable and necessary additional measure to protect the cranial base from undesirable side effects, such as high and concentrated stress.

Table 1 Distribution of palatal split pattern according to surgical technique

Group	Palatal split pattern		Total
	Type I	Type II	
G1	8	2	10
G2	7	3	10
Total	15	5	20

Some authors consider that the more conservative approach (−LPP), which removes the resistance from the zygomaticomaxillary buttress, is enough for adequate maxillary expansion [11, 21–23]. However, several authors associate the SARME–LPP technique with complications such as augmented pain during the activation period, relapse, lesser amount of expansion, and torque effect over teeth. The high stress created in cranial base due to the –LPP technique can result in rare but major complications, such as blindness or ophthalmoplegia, as a result of optic or abducens nerve injury [3, 9, 24, 25].

Racey [26] reports that the +LPP technique is rarely necessary to obtain maxillary expansion, but when not performed, the result tends to be a "V" pattern of expansion, with a greater opening in the anterior maxilla and less expansion in the posterior area. In the present study, that did not happen. Both SARME techniques showed similar pattern of expansion.

Pereira et al. [12] used a new method of classification to study the palatal split pattern in two different groups of patient, G1 that used the Hass distractor and G2 that used the Hyrax distractor, both submitted by SARME+LPP technique. Their result showed global prevalence of partial maxillary expansion (type II). These results are in opposite to those obtained in the present study where the type I of pattern was more prevalent in both groups.

In the present study, there were no statistical differences between the groups, so the palatal split pattern was not modified by the separation of the pterygoid plates. The most prevalent palatal split pattern was the type I, where the disjunction was complete, from anterior to posterior nasal spine. However, being a retrospective study of a relatively small sample size, randomized clinical trials are necessary to further study the matter.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

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