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Segment tilting associated with surgically assisted rapid maxillary expansion

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Abstract. This study aimed to evaluate, via computed tomography, the direction and magnitude of the segmental tilting that may occur after surgically assisted rapid maxillary expansion (SARME) in patients with a transverse maxillary deficiency. Thirty adult patients with a transverse maxillary deficiency greater than 5 mm were treated by SARME. The procedures consisted of bilateral zygomatic buttress and midpalatal osteotomies combined with the use of a tooth-borne orthopaedic device postoperatively. Axial and coronal images were obtained before and 6 months after SARME to evaluate the segment tilting. The greatest expansion occurred in the most inferior (5.4 ± 1.1 mm) and anterior (4.0 ± 1.3 mm) regions of the maxilla. The expanded segment tilted outward inferiorly and anteriorly in coronal and axial images, respectively. The segment tilting was 2.0 mm (2.3%) inferiorly and 3.1 mm (12.8%) anteriorly. It can be concluded that an outward tilting occurs in the most inferior and anterior portions of the maxilla during SARME procedures. Hence the direction and magnitude of such segmental tilting must be considered preoperatively when determining the surgical objectives.

Key words: maxillary deficiency; SARME; segmental tilting.

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Transverse maxillary deficiency is common among patients seeking orthodontic treatment. This deformity has a multifactorial aetiology. The correction of such conditions is highly important to obtain a stable and functional occlusion.[1,2]

Treatment of the transverse maxillary deficiency depends to some degree on the age and skeletal maturity of the patient. In children and adolescents younger than 15 years, rapid maxillary expansion using an orthodontic appliance alone can expand the maxilla by opening the midpalatal suture. However, the orthopaedic expansion is usually unsuccessful in adults because of the resistance of the maxillary articulations. Resistance to expansion, pain during expansion, displacement of the teeth laterally through the alveolus, and relapse are common with the orthopaedic expansion in adults.[3–5] To avoid such problems, a surgical procedure is necessary to eliminate the bone resistance and allow expansion of the maxilla smoothly using an expander appliance. This procedure is named surgically assisted rapid maxillary expansion (SARME). SARME is also indicated for patients who have had unsuccessful rapid orthopaedic expansion.[6–8]

The main goal of the treatment is to expand the maxilla without segmental tilting.[9] In the literature, various maxillary osteotomies have been tried in SARME, including corticotomy, lateral maxillary osteotomy, midpalatal osteotomy, Le Fort I maxillary osteotomy, and a combination of different techniques.[10–16] There is no consensus regarding the minimum number of osteotomies required to allow a uniform and parallel maxillary expansion. Many clinicians prefer using a Hyrax appliance

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(a tooth-borne orthopaedic device) combined with bilateral zygomatic buttress and midpalatal osteotomies for the treatment of transverse maxillary deficiencies in adults.[17]

In recent years, the use of computed tomography (CT) has been considered a reliable method for evaluating the changes in maxillary dimensions after SARME.[18–20] However, data in the literature regarding the direction and magnitude of the segmental tilting accompanying SARME are scarce.[21] The main aim of the present study was to evaluate (using CT) the direction and magnitude of the segmental tilting that may occur after SARME in patients with a transverse maxillary deficiency.

Patients and methods

Thirty patients (22 females and 8 males) with a transverse maxillary deficiency participated in this study. They attended the Department of Oral and Maxillofacial Surgery for correction of the maxillary deficiency before undergoing orthodontic treatment. They ranged in age from 20 to 29 years, with an average age of 24 years. The preoperative protocol included orthodontic photographic documentation, cephalograms (frontal and lateral), and study models. Prior to surgery, a tooth-borne expander (Hyrax-type appliance) with a 13-mm screw was prepared on the study models and cemented to the first maxillary premolars and first molars in all patients.

The inclusion criteria were: skeletally mature patients with a total bilateral transverse maxillary deficiency of more than 5 mm, without a history of trauma or any craniofacial syndromes. Prior to the trial, every patient was informed of the treatment plan and the aim of the study. Signed informed consent was obtained from all patients. Patients who had photographs taken as part of the methodology of this study gave additional permission for publication of their photographs in both printed and electronic versions of scientific journals. This study had research ethics committee approval.

Surgical technique

SARME was carried out under general naso-endotracheal anaesthesia. All patients had bilateral zygomatic buttress and midpalatal osteotomies (Fig. 1). The malar buttress osteotomy did not extend forward to the piriform aperture or posteriorly to the pterygomaxillary fissure. It was about 2 cm in length and perpendicular to the outer surface of the bone. A fine osteotome was inserted into the midline of the maxillary alveolus and anterior nasal spine regions, through a small vertical incision at the midline, to separate the hemi-maxillae. A finger was placed on the palate to protect the mucosa during separation of the palatal suture by gentle malleting of the osteotome. Following the osteotomies, the screw of the expansion appliance was activated, up to eight turns, until 1 mm of separation was obtained in the maxillary central incisors. The wounds were irrigated copiously and closed. A single dose of hydrocortisone (300 mg) was administered intraoperatively. All patients were operated by the same surgical team.

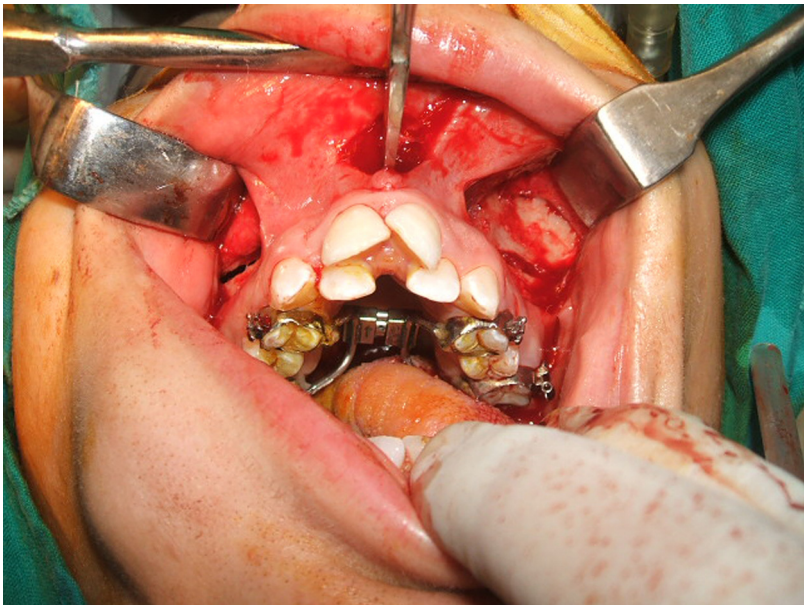

Fig. 1. An intraoperative photograph showing bilateral zygomatic buttress and midpalatal osteotomies.

Postoperative antibiotics (amoxicillin) and non-steroidal anti-inflammatory drugs (ibuprofen) were prescribed for 1 week, with a special emphasis on home care. Also, all patients were instructed to apply intermittent extraoral cold fomentations to the operated areas for 24 h in order to minimize the postoperative oedema and pain. The sutures were removed 10 days after surgery.

Expansion protocol

No expansion was attempted for 5 days postoperatively to facilitate patient comfort. Thereafter, all patients were instructed to turn the appliance a one-quarter turn (0.25 mm) twice daily, morning and evening. Patients were examined weekly until the desired expansion was achieved. The expansion was finalized when an over-correction of 2 mm was achieved at the maxillary molar level on each side. Upon completion of the expansion, the appliance was secured with an orthodontic wire and left in place for 3 months as a retainer and then replaced with a transpalatal arch for an additional 3 months. All patients underwent conventional orthodontic therapy thereafter.

Tomographic evaluation of segment tilting

Axial and coronal images were obtained for every patient before and 6 months after SARME via a multi-slice helical CT unit (Somatom Plus, Siemens Co., Germany). The head position was adjusted and standardized in accordance with Goldenberg et al.[9] in order to obtain comparable preoperative and postoperative images. Maxillary expansion in the coronal images was measured at the level of the palatine process of the maxilla (C1) and at the inferior palatine margin of the alveolar process of the maxilla (C2) (Fig. 2). In the axial images, the expansion was measured at the level of the greatest convexity of the medial walls of maxillary sinus (A1) and at the greater palatine foramen (A2) (Fig. 3). The absolute (mm) and relative (%) differences before and after maxillary expansion at C1 and C2 in the coronal images, and at A1 and A2 in the axial images, were evaluated. Also, the differences between preoperative and postoperative measurements of the *C* and *A*