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Anterior open bite correction by Le Fort I osteotomy with or without anterior segmentation: which is more stable?

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Abstract. A retrospective cohort study was conducted to analyze the relapse rate of anterior open bite (AOB) correction comparing Le Fort I osteotomy with and without anterior segmentation. The risk factors that might contribute to relapse were also assessed. Lateral cephalograms obtained at six different times were analyzed. A total of 81 patients with AOB were recruited. Thirty-five patients underwent Le Fort I osteotomy without anterior segmentation and 46 patients underwent anterior segmentation. Le Fort I osteotomy with anterior segmentation resulted in significantly more AOB relapse when compared to that without anterior segmentation at 7 weeks postoperative (15.2% vs. 0%, $P = 0.016$). During the early postoperative period, factors that contributed to AOB relapse in Le Fort I osteotomy with anterior segmentation were AOB closure $\geq$4 mm and inferior positioning of the anterior segment >2 mm. Over the long term, AOB closure $\geq$4 mm and intraoral vertical ramus osteotomy as the only mandibular procedure were factors identified as causing more AOB relapse in those treated by Le Fort I osteotomy with anterior segmentation. In conclusion, Le Fort I osteotomy without anterior segmentation was found to be more stable in the surgical correction of AOB in the early and late postoperative periods.

Key words: anterior open bite; Le Fort I osteotomy; maxillary surgery; anterior segmentation; cephalometric analysis.

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Anterior open bite (AOB) malocclusion is a complex morphological and functional anomaly that can be defined as the lack of vertical overlapping in the upper and lower incisors when the posterior teeth are in maximum occlusion[1]. It is impossible to consider AOB as a single entity as its aetiology is often multifactorial. Depending on age at presentation, treatment options may include the redirection of facial skeletal growth, habit control, and orthodontic tooth movements. However, severe cases of AOB in adults usually require more complex management that involves orthodontic treatment and orthognathic surgery.

Relapse after the treatment of AOB is relatively high when compared to other dentofacial deformities[2,3]. Systematic reviews and meta-analyses looking into the relapse rate of surgical and non-surgical

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AOB correction have reported rates varying from as low as 0% to 70%[4,5]. However, there is no general consensus in regard to the surgical treatment for AOB that would minimize the relapse rate.

A common aetiology of AOB is the posterior vertical maxillary excess, which interferes with the closure of the mandible. This causes a clockwise rotation of the mandible, thereby producing an anterior open bite, regardless of the presence or absence of an abnormal mandible. It usually presents with a flat maxillary occlusal plane and sometimes an exaggerated curve of Spee in the maxillary arch[6–8]. The Le Fort I osteotomy is usually necessary to correct the vertical height of the maxilla by differentially impacting the maxilla and allowing anticlockwise rotation of the mandible with or without mandibular surgery[6,9]. In some cases, anterior segmentation of the Le Fort I osteotomy may be helpful to allow independent repositioning of the anterior and posterior segments of the maxilla. It is also indicated to correct reversed occlusal curves and protruded anterior dentoalveolar segments[10–12]. The segmentation of a Le Fort I osteotomy requires additional surgical time and skill, and carries the risk of increased morbidity, such as avascular necrosis and damage to the tooth roots at the osteotomy site[13]. In AOB cases, the relapse rate with or without anterior segmentation of the Le Fort I osteotomy remains unclear.

The aims of this study were to evaluate the relapse rate of AOB correction comparing Le Fort I osteotomies with and without anterior segmentation, and to assess the risk factors that might contribute to the relapse in these two treatment modalities.

Materials and methods

Study sample

This was a retrospective study of patients with AOB treated by orthognathic surgery. The inclusion criteria were: (1) age 18 years and above, (2) medically fit, (3) presenting an anterior open bite (i.e., lack of vertical contact between the incisors), (4) treated by bimaxillary orthognathic surgery, and (5) at least 24 months of postoperative follow-up. Patients who underwent single-jaw surgery, had undergone previous orthognathic surgery, had pathological lesions in the oral and maxillofacial region such as fibrous dysplasia and condylar resorption, or who had syndromic diseases affecting the craniofacial region such as cleft lip and palate were excluded.

Eligible patients were divided into two groups depending on the maxillary procedure they received. Patients in group A had a Le Fort I osteotomy without anterior segmentation (i.e., in one piece or two pieces with a midline split). Patients in group B had a Le Fort I osteotomy with anterior segmentation (i.e., in four pieces where the midline split is followed by segmentation behind the canines) (see Surgical procedure). The mandibular surgeries that the patients received were recorded. All patients underwent pre-surgical and post-surgical orthodontic treatment.

Surgical procedures

A mucosal incision was made 5 mm above the attached gingiva from the zygomatic buttress on one side to the other. A mucoperiosteal flap was raised to expose the lateral wall of the maxilla to the infraorbital foramen superiorly, the piriform aperture, and the pterygomaxillary fissure posteriorly. A retractor was placed to engage the pterygomaxillary fissure. The mucoperiosteum from the lateral nasal wall to the inferior turbinate bone was raised and protected. An osteotomy was performed along the lateral wall of the maxilla with a bur and completed with an osteotome to reach the pterygoid process. A lateral nasal osteotomy was performed. The mucoperiosteum along the nasal floor and latero-inferior surface was raised and the nasal septum osteotomized. A posterior osteotomy was made through the tuberosity at the site of the extraction sockets of the upper third molars or distal to the last molars. The maxilla was then down-fractured and mobilized.

For group A (without anterior segmentation) (Fig. 1), the maxilla was fitted into the wafer in one piece, or was segmented at the midline into two pieces. For group B (with anterior segmentation) (Fig. 2), a midline split followed by osteotomies behind the canines (through extraction sockets of the first premolars or spaces created orthodontically distal to the canines) were performed to create a Le Fort I in four pieces. The segments were mobilized to establish the occlusion with a surgical guide and a custom-made arch bar. Four titanium miniplates with 6-mm screws on each side were used for fixation at the piriform rims and zygomatic buttresses on each side.

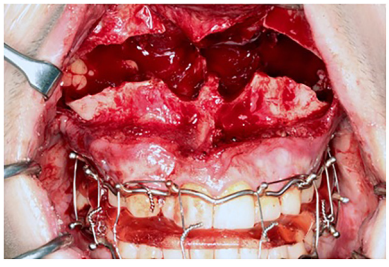

Fig. 1. Le Fort I osteotomy without anterior segmentation.

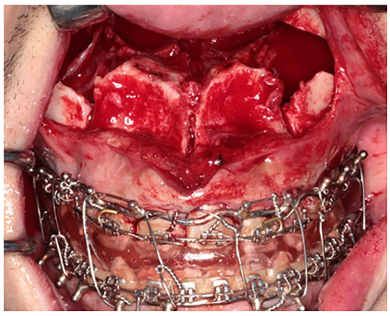

Fig. 2. Le Fort I osteotomy with anterior segmentation.

With regard to the mandibular procedures, the patients received a mandibular ramus osteotomy with or without anterior mandibular surgery (anterior subapical osteotomy and/or genioplasty). An anterior subapical osteotomy was mainly performed for a body setback movement or uprighting of the anterior mandibular segment. In accordance with the study centre protocol, the bilateral sagittal split ramus osteotomy (SSRO) with miniplate fixation was used for mandibular advancement, while the bilateral intraoral vertical ramus osteotomy (IVRO) with intermaxillary fixation was used for mandibular setback.

Study variables and data collection

Standardized lateral cephalometric radiographs were taken pre-surgery (T1), immediately postoperative (T2), and postoperatively at 7 weeks (T3), 6 months (T4), 12 months (T5), and 24 months (T6). Cephalometric tracings were performed on acetate paper by one examiner. The cephalometric tracings from the same patient at the different follow-up time points were superimposed at the cranial base. Landmarks for tracing included sella (S), nasion (N), posterior nasal spine (PNS), anterior nasal spine (ANS), incisal edge of the upper incisor (U1), upper incisor root apex (U1-A), tip of the mesial cusp of the last fully erupted upper molar (UM) and lower molar (LM), incisor edge of the lower incisor (L1), and root apex of