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Reaching the vertical versus horizontal target position in multi-segmental Le Fort I osteotomy is more difficult, but yields comparably stable results to one-segment osteotomy

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Abstract. This retrospective cohort study evaluated the postoperative outcomes of preoperatively planned positional changes for Le Fort I osteotomy in 77 patients (average age 26.6 years). Movement relapse and planning accuracy were evaluated by lateral cephalometric analysis, with an average follow-up of 257 days. In one-segment osteotomy cases, 73% of the horizontal movements were positioned within 2 mm of the surgical plan. With posterior–inferior repositioning of the maxilla, results fell within 2 mm of the prescribed plan in 60% of cases. Maxillary advancement and superior repositioning proved more stable than inferior maxillary repositioning. Relapse did not differ between three-piece and one-piece osteotomies for any movements; however, in three-piece cases, only half of the positional changes on average stayed within 2 mm of the prescribed surgical plan. Relapse did not vary with bone grafting among the groups. To summarize, in most Le Fort I osteotomy cases, the surgical plan is achieved within 2 mm, with posterior extrusion of the maxilla showing the greatest deviation both in reaching the target and maintaining the result achieved. Although maxillary segmentation makes the surgical plan more difficult to achieve, the results are at least as stable as those of one-piece osteotomies.

Key words: orthognathic surgery; Le Fort I osteotomy.

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Accurate and realistic orthognathic treatment planning has been developed by combining measurements from cephalometric tracing with patient data. To outline treatment objectives, Downs started with the radiographic analysis of the dentofacial profile[1,2]. Following this, the tracings were also used after surgery to check whether the predicted surgical results had been achieved[3].

The correction of dentofacial deformities is often achieved by single- or double-jaw orthognathic surgery. When orthodontic treatment alone is not enough, repositioning of the maxillomandibular complex is the best treatment option. Over the years, these procedures have become standard of care for achieving satisfactory functional and aesthetic results. Anteroposterior discrepancies are corrected by advancement or setback of the jaws, while vertical discrepancies require superior or inferior repositioning of the maxillomandibular complex.

Numerous studies have described the stability of these surgical movements by radiographic analysis[4,5]. The results of the surgery can be maintained by rigid internal fixation (RIF)[6]; however, inferior repositioning of the maxilla is considered to be relatively unstable, with reported relapse rates of 37% to 100%[7,8]. Although interpositioning of bone grafts has been suggested to reduce this tendency to relapse[9], other studies have been unable to confirm an association between bone grafting and skeletal stability[6]. In addition, there is no general consensus regarding the difference in relapse between single-piece and three-piece maxillary osteotomies[5,10].

Several studies have investigated the relationship between planned positional changes in the hard tissue and actual outcomes[11–16], but few have analyzed accuracy and relapse according to the type of planned surgical movement[4]. The aim of this study was to evaluate the immediate postoperative outcome of preoperatively planned positional changes and assess the long-term skeletal stability of different maxillary movements via lateral cephalometric analysis.

Materials and methods

Patients

This study followed the Declaration of Helsinki regarding medical protocol and ethics and was approved by the Ethics Committee of the University Hospitals Leuven. A retrospective cohort study design was used to evaluate whether the planned surgical movement was achieved and to assess the skeletal stability of patients who had undergone a Le Fort I maxillary osteotomy in the Department of Oral and Maxillofacial Surgery at University Hospitals Leuven.

The initial study sample consisted of all patients who had undergone a Le Fort I surgical procedure between 2013 and September 2016. Of the 208 patients initially identified, 77 were included. The main reason for the exclusion of a large number of these patients was that only patients for whom standardized digital lateral images were obtained with the same X-ray machine (Planmeca ProMax) were considered, in order to guarantee the accuracy of the digital superimposition. During the investigation period, an additional X-ray machine was installed in the department, leading to some additional data withdrawal.

Inclusion criteria encompassed patients who had undergone a Le Fort I surgical procedure (single-piece or three-piece) between January 1, 2013 and September 1, 2016, including patients planned for monomaxillary and bimaxillary surgical procedures. Patients with craniofacial anomalies such as cleft lip and palate, those who had undergone mandible-first procedures, and those who had experienced pre- or postoperative trauma were excluded. All patients were treated by one surgeon (CP) using the same orthognathic surgery protocol. Adequate radiographic and clinical documentation was ensured before inclusion.

All patients received pre- and postoperative fixed orthodontic appliances. Only RIF with miniplates (KLS Martin) was used. Predictor variables were the length of follow-up, sex, magnitude of the movement, use of a bone graft, and type of movement. Outcome variables were skeletal relapse and whether or not the planning was achieved. Planning accuracy and lateral cephalometric changes were investigated using data from the preoperative (T0), immediate postoperative (T1), and $\geq$6 months postoperative (T2) assessments.

Image acquisition

It was ensured that every lateral cephalogram was taken with the same X-ray machine. Standardized digital lateral cephalograms were obtained using a Planmeca ProMax 2D S2 (68 kV, 10 mA) X-ray machine.

Image analysis

Images from each of the three time points were used. The digital images were imported into the image analysis software program OnyxCeph (Image Instruments GmbH, Chemnitz, Germany), where they were traced using the same protocol (Figs 1 and 2); superimposition was then achieved over the cranial base. Every image was calibrated to a reference line.

Cephalometric landmarks used for maxillary assessment were A-point, posterior nasal spine (PNS), upper incisor crown tip (U1), and mesial cusp of the maxillary first molar (U6). In total, 408 tracings were done. To evaluate planning accuracy, the movement of U1 and U6 between T0 and T1 was studied and compared to the anterior and posterior planning in the horizontal and vertical dimensions. The movement of A-point and PNS between T1 and T2 was studied to evaluate average relapse.

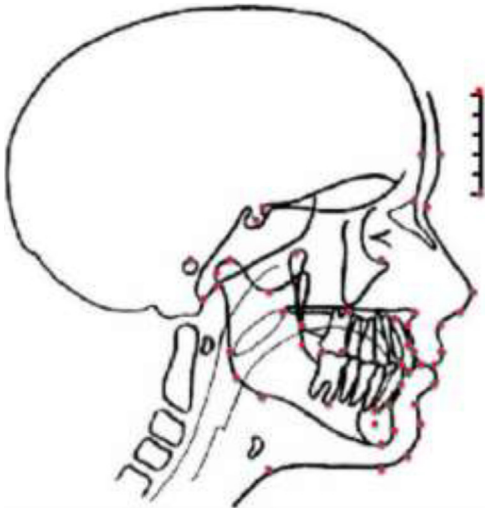

Fig. 1. The different landmarks used for lateral cephalometry.