Intraoperative measurement of maxillary repositioning in a series of 30 patients with maxillomandibular vertical asymmetries

Vertical asymmetry of the maxilla can determine the inclination of the occlusal plane and result in a lack of internal reference points usually employed to measure surgical movements. Maxillary repositioning is therefore based upon surgical planning, which is commonly elaborated on dental casts and model surgery. The absolute precision of surgical planning is not guaranteed by dental casts and model surgery, and the intraoperative assessment of maxillary repositioning is considered to be of paramount importance in such cases. This article describes a simple, noninvasive intraoperative technique that is useful in measuring the vertical dimension of the maxilla and helps to indicate precise repositioning. It illustrates the technique and reports the results obtained in a series of 30 patients treated surgically for maxillomandibular malformations with vertical asymmetries and occlusal plane inclination from January to December 2000 at the Maxillofacial Surgery Department of “La Sapienza” University in Rome, Italy.

According to several authors, absolute precision cannot be guaranteed when model surgery is performed and a facebow is employed.6,7 As previously reported,8-14 an intraoperative measurement of the maxillary vertical dimensions is required in such cases to clearly assess whether the repositioning is in fact symmetric.

The aims of this paper are to describe a simple, noninvasive intraoperative technique that is useful to measure and to compare the vertical dimension of the maxilla and to report the results reached following the application of this method in a series of 30 patients treated surgically for maxillomandibular malformations with vertical asymmetries and occlusal plane inclination from January 2000 to December 2000 at the Maxillofacial Surgery Department of the “La Sapienza” University of Rome.
Materials and methods

A series of 30 patients affected by maxillomandibular malformations with a unilateral vertical deficit of the maxilla, together with occlusal plane inclination, underwent orthognathic surgery between January 2000 and December 2000. The patient group was composed of 11 males and 19 females, with ages ranging from a minimum of 20 to a maximum of 33 (mean age 25.7 years).

To assess clinically the 3-dimensional functional and esthetic alterations of each patient and to plan the most suitable presurgical orthodontic treatment, all 30 patients were examined presurgically and underwent cephalometric radiography. Dentoskeletal Class III, with vertical asymmetry of both jaws, was diagnosed in all 30 patients. Presurgical orthodontic therapy resulted in adequate dental alignment and was based on the examination of cast models and on the 3-dimensional clinical assessment of the occlusion. At the end of the orthodontic therapy, a second set of cephalometric radiographs was obtained for each patient, and a new esthetic clinical 3-dimensional assessment was performed.

The surgical planning was based upon the integration of the esthetic treatment plan, based on the ultimate 3-dimensional clinical assessment of soft tissues, together with the skeletal treatment plan, obtained by cephalometric measurements, and on the study of recent cast models with the facebow. In all cases, the surgical repositioning of the vertical dimension of the maxilla was planned through the study of cast models with the facebow to achieve complete symmetry. Maxillary vertical dimensions were measured bilaterally on cast models by means of a caliper from the vestibular cuspsids of teeth and the articulator base, corresponding to Frankfort horizontal.

All patients underwent surgical treatment consisting of bimaxillary repositioning by means of a bilateral sagittal split osteotomy BSSO and Le Fort I osteotomy. A new, simple, noninvasive technique was employed intraoperatively to measure the anterior and posterior vertical heights of the maxilla jaw bilaterally. For each patient, 4 measurements were collected, ie, 120 measurements in the entire patient sample. The indications for surgical repositioning planned with dental casts and the facebow were compared with the indications obtained from direct intraoperative assessments in each patient.

Through a vestibular incision, subperiosteal detachment was carried out to clearly expose the inferior margin of the infraorbital nerve. Subsequently, the actual vertical dimensions of the maxilla were measured by means of a caliper positioned between the inferior margin of the infraorbital nerve (ION) at the right side and the neck of the maxillary canine and
the maxillary first molar on the right side (Figs 1 and 2). The aforementioned measurements were repeated with the same technique on the left side (Figs 3 and 4).

The measurements obtained on the 2 sides were compared with the values obtained from cast models in each patient to ensure perfect vertical maxillary symmetry and to detect imperfections in the surgical planning. Eventually, indications from treatment planning were corrected by indications from intraoperative measurements. Subsequently, following Le Fort I osteotomy, the maxilla was precisely repositioned in 3 dimensions. Fixation was accomplished by means of 1 osteosynthesis wire and 1 suspension wire positioned posteriorly on each side of the maxilla, and an L-shaped titanium plate fixed with four 5-mm titanium screws was positioned anteriorly on each side of the maxilla.

After BSSO was carried out, the mandible was repositioned correctly with the maxilla, and a Class I occlusion, slightly overcorrected (ie, tending to Class II malocclusion), was obtained in all 30 patients. Fixation of the mandible was carried out by 3 bicortical screws positioned at each mandibular angle.

All 30 patients underwent postsurgical follow-up consisting of clinical evaluations and radiographic examinations 1 week, 4 weeks, 6 months, and 12 months after surgery.

Results

In 102 out of 120 intraoperative measurements, corresponding to 51 sides out of the total 60 sides and to 26 of the 30 patients, a perfect correspondence between presurgical planning, based on cast models, and intraoperative findings was observed. In the remaining 18 anterior and posterior maxillary vertical measurements, a slight discrepancy of 2 mm was noticed from the analysis of the corresponding model casts. In 4 patients the discrepancy involved both anterior and posterior maxillary vertical dimensions on each side, and in 1 patient this involved anterior and posterior maxillary vertical dimensions on 1 side only. Postsurgical study of model casts in the aforementioned 18 cases revealed asymmetric teeth extrusions and/or intrusions and asymmetric vestibular or lingual shifts resulting from the orthodontic treatment. Such dental asymmetries, although very modest, have caused important errors in the surgical planning obtained from measurements of model casts.

In 26 patients of our series, the intraoperative assessments of the maxillary vertical dimensions were carried out by measuring the distance between the inferior margin of the ION and the neck of the maxillary canine and first molar. In the remaining 4 patients, asymmetric retraction of the gingival neck at the maxillary canine and first molar region was detected, and...
an alternative landmark was required for measuring the proper maxillary vertical symmetry. The maxillary vertical height was assessed on both sides of the 4 aforementioned patients by measuring the distance between the inferior margin of the ION and the cementoenamel junction of the maxillary canine and first molar, which was a valid alternative reference.

The clinical assessments and radiologic examinations carried out in the 30 patients at follow-up revealed optimum esthetic and functional results, and perfect symmetry was observed in all the 60 sides. No postsurgical temporomandibular joint problems were encountered in 12 months of follow-up, and no complications were encountered.

Discussion and conclusions

Facial asymmetries of the vertical dimension may be caused by several congenital malformations, such as hemifacial microsomia, Franceschetti syndrome, and Goldenhar syndrome, or by alterations in bone development as noticed in unilateral temporomandibular joint ankylosis, hypercondilia, and hemimandibular elongation. They can be observed in dentoskeletal Class II or III patients with a vertical asymmetric component as well.1,3,5,15–18

The treatment of these pathologies is based on an orthopedic-functional approach in growing patients, while surgical therapy is reserved for adult patients.1,3,16 Corrective surgical treatment of the aforementioned malformative pathologies consists of the repositioning of the maxilla and mandible. As reported in the literature, the 3-dimensional position of the maxilla represents a reference guide to obtain both adequate mandibular surgical repositioning and correct dental occlusion.1,2,5,7 Therefore, asymmetries resulting from imprecise surgical repositioning of the maxilla will involve both jaws and will result in esthetic and functional problems.

To obtain a functionally correct and esthetically acceptable restoration, careful planning of the exact maxillary movement must be performed. Facial vertical asymmetries are characterized by the absence of reliable internal reference points (IRPs) and by the inclination of the occlusal plane. This makes it impossible to easily reestablish the correct vertical dimensions by means of a simple symmetric upward repositioning of the maxilla. A careful evaluation of the surgical movements at each side of the maxilla is always required to obtain a successful treatment of facial asymmetries.

According to several authors,6,7 model surgery and surgical planning based upon cast models may lead to errors in the vertical maxillary repositioning. As reported by several authors over the past few years,8–14 it could be wiser to measure intraoperatively the precision and the symmetry reached in the maxillary repositioning to clearly assess the vertical restoration. In our experience, errors from surgical planning with model casts were observed in 18 measurements, corresponding to 9 of the 60 sides and to 5 of the 30 patients in our series.

Asymmetric teeth extrusions and/or intrusions and asymmetric shifts in a vestibular or lingual direction can result from orthodontic treatment and may cause imprecision in model cast measurements and consequently in surgical planning. In our experience, in accordance with previous reports,8–14 vertical repositioning of the maxilla must be assessed intraoperatively to ensure the absolute precision of the surgical restoration and the right degree of surgical correction.

During surgical treatment, the maxillary vertical dimension and the subsequent measurement of the skeletal repositioning are usually determined by making use of reference points traced astride the Le Fort I osteotomy line (IRPs). The results of the studies presented by Polido et al,8 Stanchina et al,9 and Van Sickels et al10 have revealed a high degree of imprecision in maxillary surgical repositioning measured on the basis of IRPs, with significant differences appearing in the vertical dimension between the planned skeletal movements and those actually accomplished. The exact determination of the maxillary vertical movement was the topic of a series of surveys by Speculand and Jackson in 1983,12 Ellis and Gallo in 1984,13 Johnson in 1985,7 Van Sickels et al in 1986,16 and Kanherberg et al in 1990.4 The aforementioned methods
took into account the measurement of the distance between the incisive edge and an external reference point, represented by the glabella or soft tissue nasion and, therefore, they were unable to reveal discrepancies between the 2 sides of the maxilla. The methodology proposed by Manna and Berger in 1996 was consistent of measuring in atraoperatively the distance between the archwire and 2 microscrews positioned at the edges of each piriform rim area. The technique is able to measure bilaterally the maxillary dimensions and therefore allows comparison of the vertical heights also in case of occlusal plane oscillation, but it does not allow comparison of the anterior and posterior heights of the maxilla.

The methodology presented in this study allowed us to determine exactly the degree of maxillary asymmetry by comparison of the height of the maxilla between 2 fixed reference points—the inferior margins of the infraorbital nerve and the dental neck of the maxillary canines and first molars. The alveolar margin just below the adherent gingiva, which corresponds to the cementoenamel junction of the maxillary canines and first molars, was employed on 8 sides in 4 patients because of asymmetric retraction of the dental neck due to periodontal disease. This technique proved to be easy to perform, not invasive, and very reliable in patients with maxillo-mandibular asymmetries. In patients with cranio-maxillofacial malformations, the possible involvement of the malar bone may lead to asymmetry of the inferior margin of the infraorbital nerve between the 2 sides; therefore, the technique cannot guarantee a stable and reliable reference point in such cases.

The technique described in this paper permits careful evaluation of the vertical dimensions of the maxilla during surgical treatment and, therefore, allows the surgeons to eventually correct the planning from model surgery. In our experience this technique supported the optimal surgical correction of the middle and lower third of patients with facial vertical asymmetry and proved to be simple and noninvasive.

References