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Stability after maxillary segmentation for correction of anterior open bite: A cohort study of 33 cases

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ABSTRACT

The aim of this cohort study was to evaluate the stability after multi-segmentation of the maxilla for correction of anterior open bite deformities. A total of 33 patients who underwent segmented maxillary osteotomy between 1994 and 2006 were included in the study. Rigid fixation with plates and post-surgical intermaxillary fixation for 6 weeks was applied to each patient. All patients were then followed in a standardized examination procedure at months 6, 12, 18 and up to 30 months postoperatively. Vertical and horizontal relation of the incisors was measured both clinically and on cast models. The main finding was that statistically significant relapse was found vertically, whereas the horizontal relationship to the mandible was unchanged. The vertical relapses were predominantly seen in patients with severe open bite evident preoperatively.

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1. Introduction

Anterior open bite can be caused by lack of eruption of anterior teeth, excessive eruption of the posterior teeth, but most often it is linked to rotation of the jaws during growth, and/or is a genetically determined malformation of the maxilla-midface or mandible. On cephalometric analysis, the major indicators of a skeletal relationship that predispose an individual to open bite are a short mandibular ramus and downward rotation of the posterior maxilla. Both tend to produce a downward-backward rotation of the mandible that increases the facial height and separates the incisors between the upper and lower jaw (Proffit et al., 2000). Many different aetiologies for open bite have been identified such as abnormal tongue, lip or cheek activity during mastication, swallowing and speech, thumb sucking or mouth breathing due to adenoidal abnormalities. The background in most of these patients is likely to be multifactorial with no single factor clearly causative. Today, maxillary intervention, most commonly maxillary Le Fort I impaction either alone or in conjunction with mandibular osteotomy, is the most frequently used technique for correction of an open bite (Kahnberg et al., 1994; Espeland et al., 2008). Orthognathic surgery is unique in its nature because, in the vast majority of the cases, it involves not only the surgical procedure but also the preoperative orthodontic treatment. The lengthy duration of

treatment and the change in facial appearance are two potential factors that can immensely affect the satisfaction of patients (Khattak et al., 2012). Bimaxillary procedures to correct anterior open bite appear to be less stable than a maxillary procedure alone (Espeland et al., 2008). Open bite can also be corrected in the mandible only. This is usually indicated when the rami are short and better prominence of the angle is a primary goal (Stansbury et al., 2010). A prerequisite is that the maxillary arch is normal and it usually involves longer periods with appropriate elastics to counteract the mandibular muscle forces.

At the Department of Oral and Maxillofacial Surgery, The Sahlgrenska Academy, University of Gothenburg, Le Fort I osteotomy together with multi-segmentation of the maxilla has been used for many years for correction of open bite. The technique gives the surgeon options to adjust the pre-maxilla in relation to the posterior segments and at the same time a transversal correction can be achieved. There is a degree of relapse after Le Fort I osteotomy and slightly more if combined with other surgery, for example sagittal split (Hoppenreijns et al., 1997). Factors that have been implicated for instability after Le Fort I osteotomies include presurgical orthodontics, inadequate mobilization, inappropriate or no bone grafting, increased masticatory forces, inadequate methods of fixation, type and amount of movement, soft tissue tension, and presence of cleft (Ueki et al., 2011). In this study only patients treated with segmented Le Fort I osteotomies were included. The aim was to analyze the vertical and horizontal stability beyond 30 months postoperatively after a segmented Le Fort I in patients with anterior open bite.

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2. Material and methods

All patients treated with a segmented Le Fort I osteotomy between 1994 and 2006 in the Department of Oral and Maxillofacial Surgery, The Sahlgrenska Academy, University of Gothenburg, Sweden formed the study population. The main diagnosis was skeletal anterior open bite and in some patients other diagnoses such as mandibular/bimaxillary retrognathia, long face syndrome, facial/mandibular asymmetry and micrognathia (Table 1) were relevant. The initial number of participants was 96. After exclusion of those patients who did not attend 2.5 years follow-up or those whose procedure did not fit the study specification (e.g. treated with additional sagittal split or by non-segmental Le Fort I), 33 study patients remained; 22 women and 11 men. The mean age at surgery was 23 years, the mean age for the men being 22 years and for the women 24 years. The number of maxillary segments varied between 2 and 6 segments with 4-pieces most commonly performed (Table 2). All patients had been examined and analyzed according to a standardized routine developed at the Department of Oral and Maxillofacial Surgery, Gothenburg including radiographic (cephalometry), and clinical examination. Analysis and treatment planning were made on plaster casts (Kahnberg and Widmark, 1988). Every patient in the study was subject to presurgical orthodontics, including decompensation and levelling of the dental arches for approximately 18 months and postsurgical orthodontics for approximately 6 months. An acrylic wafer designed to govern the correct mandibular position was used during the first 6 weeks of healing. Postsurgical stabilization was achieved by intermaxillary fixation using elastics. All patients had a standardized examination timed at 6, 12, 18 and up to 30 months postoperatively, including clinical assessment and radiographic analysis. In addition to clinical records comprising measurements of jaw functions, cast dental models were taken and analyzed.

2.1. Inclusion criteria

- Skeletal anterior open bite on cephalometric analysis
- Anterior open bite of at least 2 mm measured clinically
- Anterior open bite as the main diagnosis
- Patients treated between 1994 and 2006 at Department of Oral and Maxillofacial Surgery, Gothenburg

Table 1

A summary of the diagnoses of the 33 patients subjected to multi-pieced Le Fort I osteotomy. The figure refers to the number of each diagnosis. Many patients had more than one diagnosis.

| Diagnosis | Number of each diagnosis |
|--|--------------------------|
| Anterior open bite | 33 |
| Additional diagnosis/co-diagnosis | |
| Mandibular retrognathia | 10 |
| Long face syndrome | 4 |
| Bimaxillary retrognathia | 10 |
| Mandibular/facial asymmetries | 2 |
| Micrognathia | 3 |

Table 2

Number of patients treated with a 2-pieced to 6-pieced maxilla. The figure shows that a 4-pieced maxilla was most common.

| Pieces | Number of patients |
|--------------|--------------------|
| 2 | 1 |
| 3 | 5 |
| 4 | 17 |
| 5 | 2 |
| 6 | 8 |
| Total | 33 |

- Patients treated with a Le Fort I osteotomy, segmented to at least 2 pieces
- Patients attending the follow-up visits until 2.5 years after surgery.

2.2. Exclusion criteria

- Patients with other facial deformities as a main diagnosis
- Patients treated with additional surgery (other than chin modification procedures)
- Patients treated with a non-segmented Le Fort I osteotomy.

2.3. Surgical procedure

The surgical procedure has previously been described in detail (Kahnberg, 2007). Briefly, the maxillary osteotomy was made through a conventional vestibular incision followed by careful lifting of the nasal mucosa. The nasal septum was then osteotomized as were the walls of the lateral nose to the pterygoid process. Cuts were made vertically through the alveolar process with a small fissure bur, most frequently between the canine and the first premolar. The maxilla was fractured downwards after separation of the pterygoid process and maxillary tuberosity. After downfracture and mobilization of the maxilla, the interdental osteotomies were joined by a transverse osteotomy from the nasal aspect through the palatal bone down to but not through the palatal mucosa. The maxilla was then segmented and adjusted to fit into the surgical wafer and secured with ligatures. The maxilla was repositioned and fixed firmly using 2 mm bone plates (Walter Lorentz, Biomet Ltd, Florida, USA). Most patients were treated by superior displacement of the posterior maxilla, whereby the anterior maxilla remained unchanged vertically. The closure of anterior open bite was then achieved by increased rotation of the mandible. Segmentation permitted the achievement of the optimal curve of Spee and adjustment of the transverse relationship of the jaws.

As the facial harmony of each patient demands special attention, some variations in actual maxillary movements are inevitable. The occlusal splint was removed after 6 weeks of healing and at this time the orthodontist also replaced the segmented arch wires with a continuous wire. The surgical procedure was uncomplicated in all patients and good initial surgical stability was achieved in all patients.

2.4. Measurements

The anterior open bite was measured as the distance between the incisal edges of the upper and lower incisors. Measurements of overbite (vertical distance) and overjet (horizontal distance) have been made both clinically and on cast models using a vernier caliper. The clinical measurements were performed during initial examination, 6 weeks postoperatively, 6 months postoperatively, 1.5 years postoperatively and 2.5 years postoperatively. The cast model measurements were taken during initial examination, preoperatively, 6 months postoperatively, 1.5 years postoperatively and 2.5 years postoperatively. The stability of the results after completed treatment was determined as the difference between clinical measurements obtained at baseline, 6 weeks postoperatively, and measurements registered after 6 months, 1.5 years and 2.5 years.

2.5. Statistics

The standard deviation was calculated for each measurement. Statistical analysis was performed by SPSS for Windows software (SPSS Inc., Chicago, Illinois, USA). Non-parametric Mann–

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