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Surgical treatment of class II dento-facial deformity during adolescence: Long-term follow-up

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ABSTRACT

Purpose: The purpose of this study is to evaluate the long-term stability of patients operated during adolescence on the base of clinical measurements and cephalometric analysis. Although, the potential benefits of early orthognathic surgery are known to be a reduction in treatment times and a greater healing potential leading to a better adaptation and stability of the occlusion, muscles, bones and joints, no consensus can be found in literature on the minimum age for surgical correction.

Materials and methods: In this study, thirty patients (age $\leq$ 15) with a class II dento-skeletal malocclusion were selected, of which 11 having a hyperdivergent (II,1) and 19 a hypodivergent (II,2) growth pattern, representing 2 distinct groups with a different treatment plan and long-term behavior.

Results and conclusion: Observing the performance of all parameters over-time, it is seen that subjects belonging to division II,2 have a modification of the growth vectors maintaining the harmonious development between the jaws and the facial aesthetics. Less predictable is the trend in hyperdivergent patients, which are more prone to relapse in the long-term. Early surgery in these patients should be considered in the light of the degree of deformity and its influence felt by the patient on his development of self-image and interpersonal relationship.

1. Introduction

Orthognathic surgery can be seen as a means of correcting an abnormal growth in the facial area through the harmonization of the jaws. Identification of the altered growth patterns responsible for the deformity is important, particularly in the adolescent patient who still has a high growth potential. There is a gradient of movement during puberty, with a trend toward cranio-caudal growth. At the level of the face, there is an acceleration of growth in the lower jaw with respect to the maxilla, which results in differential growth (Bergman et al., 2014). Nanda et al. followed the growth of the jaws in a longitudinal study of 50 patients 6–18 years of age, all with skeletal class I deformities, who had not been subjected to any orthodontic treatment (Nanda et al., 2012). Their study clearly demonstrated that the development of the transverse diameter of the face increases steadily for females between ages 6 and 11 years and peaks at age 14, whereas in males, the development is constant up to 13 years, with a peak at the age of 15. The growth was completed at 17.5 years for females and 18 years for males. The growth at the level of the jaws shows a peak with the development of the molars. At age 12, females have achieved 98% of the adult size of the maxilla, and males have achieved 95% of the size.

There have been a multitude of studies on the long-term stability of orthognathic surgery in adult patients with a class II dental–skeletal pattern (de Lir Ade et al., 2013; Moen et al., 2011; Joss and Thüer, 2008; Joss and Vassili, 2009; Mobarak et al., 2001). However, it is more difficult to find a consensus in the literature regarding surgery in adolescent patients, where there is still a component of postpubertal skeletal growth. Although the results of surgery in a growing patient are not completely understood, the potential

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benefits include a reduction in treatment times by avoiding the orthopedic–orthodontic treatment phase, and a greater healing potential in the adolescent patient, leading to a better adaptation and stability of the occlusion, muscles, bones, and joints.

The purpose of this study was to evaluate the long-term stability of patients surgically treated for a class II dental–skeletal malocclusion during adolescence. Subjects with a skeletal class II malocclusion having a hyperdivergent (II,1) or a hypodivergent (II,2) growth pattern represent two distinct groups with different treatment plans and long-term behavior. The patients were evaluated in the light of this distinction in order to study the long-term results of surgical treatment and to compare the stability and performance in patients with remaining growth.

2. Material and methods

2.1. Patient selection

This research consists of a retrospective case–control comparison of the postoperative trends in patients with class II divisions 1 and 2 malocclusion who underwent an osteotomy of one or both jaws at age ≤15 years and who had reached the end of growth in 2014. Patients who had previously undergone surgery for rapid palatal expansion with positioning of a bony distractor and/or had undergone surgically assisted expansion of the lower jaw with a dental anchored distractor were included. However, patients with congenital and syndromic conditions were excluded from the study.

The study population consisted of 30 patients of white ethnicity, including 25 females and five males. Eleven patients had a skeletal class II division 1 malocclusion, whereas the other 19 patients had a skeletal class II division 2 malocclusion. The average age of the patients at the time of mono- or bimaxillary surgery was 14.5 ± 0.5 years, and the average age at follow-up was 18.9 ± 1.6 years (Table 1).

A preoperative evaluation was performed to assess the anthropometric measurements, the inclination of the mandibular plane, the overbite and overjet, the dental exposure at rest, and the gummy smile. The treatment plan was then determined according to the findings. In the class II division 1 group, eight patients underwent a bimaxillary osteotomy (bimax), four of whom also received genioplasty. Two bimaxillary osteotomy surgeries were preceded by an expansion of both jaws, whereas the other two were performed using only a palatal expansion. Three patients underwent a bilateral sagittal split osteotomy (BSSO) of the mandible. In the class II division 2 group, 17 patients received a BSSO, two of which included advancement genioplasty. In six cases, the procedure was preceded by palatal expansion, and in one case, the surgery was preceded by expansion of both the maxilla and mandible. Two patients in the division 2 group underwent a bimaxillary osteotomy.

2.2. Surgical procedure

During the bimaxillary osteotomy surgery, a Le Fort I-type osteotomy of the maxilla was executed, and the fixation was performed using titanium plates and screws (2.0 mm Mini System, KLS Martin). The bilateral sagittal split osteotomy was performed during both single and double jaw surgeries. The distal segment was advanced and the fixation was performed using three positioning bicortical screws per side. The mandibular condyle was pushed back and upward in the glenoid fossa. The screw fixation was performed with the interposition of a spacer between the proximal and distal segments to prevent the occurrence of compression and torsion of the condyles. There was no rigid intermaxillary fixation used after surgery; however, an elastic guide was applied immediately postoperatively. All patients were treated by the same surgeon (N.N.) and were discharged on the first postoperative day.

2.3. Data collection

The data collected for this study comprised the direct measurements obtained using a caliber during consultation and the cephalometric measurements obtained from the radiographic images.

All clinical measurements were performed at three different time points: t_0 = 2 weeks before surgery, t_1 = 1 year postoperatively, and t_2 = after a long-term follow-up. The variables were gathered by the same investigator at t_0 and t_1, whereas the long-term variables were recorded by another investigator from the same team. The direct measurements used throughout this study were the overbite, overjet, frontal dental exposure at rest, frontal gummy smile, premolar gummy smile, and interlabial gap.

For the cephalometric measurements, the angular variables and ratios were used to avoid the influence of magnification factors present in different radiographic images, which were obtained using different machines over the years. Preoperatively, a cone beam computed tomography (CBCT) scan was acquired for all patients in a natural head position using the i-CAT™ (Imaging Sciences International, Hatfield, PA, USA.) scanner with a voxel size of 0.4 mm. A lateral cephalogram was reconstructed from the three-dimensional dataset. During the postoperative period, a lateral cephalometric

Table 1
Information on the studied patient group operated for a class II dental-skeletal malocclusion.

Gender	*Total = 30*	
Male	5 (17%)	
Female	25 (83%)	
Age (yr)	*Mean ± SD*	
at surgery	14.5 ± 0.5	
at follow-up	18.9 ± 1.6	
Class II,1	*Total = 11 (37%)*	
BSSO	3 (28%)	incl. 1 TPD & 1 TPD + TMD
BSSO + chin	/	
Bimax	4 (36%)	incl. 1 TPD & 1 TPD + TMD
Bimax + chin	4 (36%)	incl. 1 TPD & 1 TPD + TMD
Class II,2	*Total = 19 (63%)*	
BSSO	15 (78%)	incl. 5 TPD & 1 TPD + TMD
BSSO + chin	2 (11%)	incl. 1 TPD
Bimax	2 (11%)	
Bimax + chin	/	

TPD = Trans palatal distraction; TMD = Trans mandibular distraction.