



## Predicted versus executed surgical orthognathic treatment



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### ABSTRACT

**Objectives:** This study aimed to analyse combined surgical-orthodontic treatment plans, compare them with the actual surgery performed, and define factors resulting in changes of the original plan during orthodontic pre-surgical preparation.

**Study design:** The clinical files of 312 orthognathic surgery patients, operated between January 2008 and December 2010, were retrospectively reviewed. Of these 312 patients, 129 had a bimaxillary operation. One hundred sixty patients had osteotomy of the lower jaw only and 23 had osteotomy of the upper jaw only. Factors analysed in the study include Angle Class malocclusion, patient sex, and age. Lip-to-incisor relationship, overjet, overbite and midline deviations of the upper and lower jaw were recorded. Effects of surgical assisted rapid palatal expansion (SARPE) on the eventual surgery were also investigated. Reasons for changing the original treatment plan at the time of the finished pre-surgical-orthodontic alignment were analysed.

**Results:** The original treatment plan was changed in 42 of the 312 patients (13.5%). Changes occurred generally in case of a larger interval between set-up of the first treatment plan and the eventual operation (average 22.4 versus 16.4 months for patients with changed versus unchanged treatment plan, respectively). All Class I patients had surgery performed as planned. Class III patients had a significantly higher rate of altered treatment plan (27.3%) than Class II patients (7.6%). More men (52.4%) saw their treatment plan changed, although there were more women than men in the study population (59.6 versus 40.4%).

**Conclusion:** One in seven patients (13.5%) had a different operation than was planned at the start of treatment. Class III patients with small overjet and overbite commonly have a treatment plan for a monomaxillary operation that, after decompensation, needs to be adapted to a bimaxillary operation.

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### 1. Introduction

In the 1950s and 1960s, unfortunate facial outcomes were associated with isolated orthodontic treatment (Sarver, 1998). Proffit and White defined the envelope of discrepancy, showing the limitations of orthodontic treatment alone (Proffit and White, 1991). Since most patients seek treatment from an orthodontist to correct irregular teeth and jaws, it is generally accepted that it is the orthodontist's task to discuss the possible need for a surgical procedure (Reyneke, 2003). An interdisciplinary treatment recommendation results in treatment decisions that are

communicated with the patient as part of the informed consent requirements. Usually, some form of orthodontic pre-operative preparation is needed before surgery is performed. Depending on the school of thought, the majority of orthodontic alignment is done before (Proffit and White, 1991; Reyneke, 2003; Bell et al., 1980) or after (Epker et al., 1995; Arnett and McLaughlin, 2004) the orthognathic surgical procedure. When orthodontic alignment occurs before surgery, it is important to know to what extent this influences the actual surgical treatment plan. Knowledge of the factors that influence a change in the surgical treatment plan will possibly enhance the predictability of surgical-orthodontic treatment plans by including these factors, and are furthermore important in communicating with the patient within the framework of the informed consent requirements.

Many authors (Proffit and White, 1991; Reyneke, 2003; Bell et al., 1980; Arnett and McLaughlin, 2004) define their treatment plan by describing dento-facial deformities and classify these

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according to the Angle classification. Subsequently, they indicate the nature of the deformity, which further is defined into sagittal, transversal, and vertical problems of the upper and/or lower jaw. Besides bony parameters, soft tissue and airway parameters and patients' desires influence the treatment plan. Using this data, they create an orthodontic and/or surgical treatment plan with pre-operative orthodontic alignment of teeth.

Changes that occur during the orthodontic decompensation phase result in a better view of the nature and extent of the underlying dento-facial deformity, sometimes altering the final surgical procedure. These changes characterise the dual aspect of the orthognathic treatment.

Final results of orthognathic surgery depend largely on cooperation between orthodontists and maxillofacial surgeons and their mutual agreement on indications for the orthognathic treatment. To improve the surgical-orthodontic treatment of patients with dento-facial deformities, interdisciplinary consults with orthodontists and the orthognathic surgeon have been proposed (Fridrich et al., 1994).

This retrospective study investigated the treatment plans of all patients that had an orthognathic operation between January 2008 and December 2010. Patients in whom the original plan was changed were evaluated and factors inducing these changes were investigated. The results of this investigation should result in improved surgical-orthodontic treatment plan predictions.

## 2. Materials and methods

Medical records of 312 consecutive patients operated on between 2008 and 2010 were retrospectively reviewed. All patients had undergone either a bimaxillary, Le Fort 1, or bilateral sagittal split ramus osteotomy (BSSO) performed by one senior staff member of the Department of Oral and Maxillofacial Surgery at St. John's hospital in Genk. Patients' records were only included if the same pre-operative clinical measurements were recorded by the same surgeon and the same operative technique was used.

Treatment plans were discussed in an interdisciplinary consult with at least one of the two consulting orthodontists, the patient's orthodontist, and the maxillofacial surgeon. We only investigated treatment plans made by the same surgeon in dialogue with the patient's orthodontist. This way, indications and attitude towards the indications for orthognathic surgery showed limited variation. Standard procedure before any orthognathic operation always involves at least three consultations. At the first consultation, 2D radiographs and 2D and 3D clinical photographs, impressions of both jaws, and a wax bite are taken. At the second consultation a thorough dento-facial clinical examination is performed and patient history is taken. Preparation of the third consultation involves cephalometric analysis. The final diagnosis is made at the third session, which is a joint consultation by the orthodontist and the maxillofacial surgeon, based on clinical examination of the patient and investigations of the previous consultations, including a treatment plan that addresses the problem list and the expectations of the patient. In cases of asymmetry, a 3D simulation based on cone beam computed tomography and 3D stereophotogrammetry is included. If necessary, other technical investigations are performed in advance of the final treatment plan.

Once the orthodontic pre-surgical alignment is completed, 2D and 3D clinical photographs and 2D radiographic photos are taken, a cone beam computed tomography (Galileos, Sirona, Germany) is performed, and both digital and plaster casts are made. Study cast surgery is performed to determine the eventual operative plan. In the course of the orthodontic alignment, an intermediate contact between the orthodontist and surgeon sometimes takes place to evaluate and resolve alignment problems. At the surgical set-up, the surgeon decides on the final surgical treatment procedure.

We evaluated the following patient parameters: age, sex, interval between planning and operation, Angle classification, lip-to-incisor relationship at rest (LI rest) and during smiling (LI smiling), overjet, overbite, lip competence, and midline deviations in the upper and lower jaw. Among patients with an altered treatment plan we tried to identify key factors resulting in the eventual changes.

Possible changes are:

- Monomaxillary planning (Le Fort I only or BSSO only) to bimaxillary procedure (Le Fort I + BSSO),
- Bimaxillary planning to monomaxillary procedure (Le Fort I + BSSO to BSSO only or Le Fort I + BSSO to Le Fort I only),
- Interjaw change (BSSO only to Le Fort I only or Le Fort I only to BSSO only).

SARPE is considered to be a procedure that is part of the orthodontic alignment phase, since SARPE is performed early on or even before the orthodontic alignment. In case of SARPE a minimum interval of 12 months was maintained between SARPE and the orthognathic surgical procedure to allow sufficient time for possible relapse.

The institutional review board approved this retrospective study. The study was conducted in compliance with the Helsinki Declaration guidelines.

Since the purpose of the study was to evaluate decision behaviour, a retrospective rather than a prospective design was favoured in order to avoid bias, guaranteeing the necessary blinding of both surgeon and orthodontist. It is common to use a posteriori analysis in decision-making processes (Borel et al., 2012; Palmer et al., 2010; Lindfors et al., 2006).

### 2.1. Statistical methodology

The Biostatistics Department of Leuven University performed statistical analysis. Descriptive statistics (frequencies and percentages for categorical covariates and medians and interquartile ranges for continuous ones) are given per status (change of plans or not).

All factors are investigated by means of a logistic regression analysis after correction for days since planning. *P*-values are determined from a likelihood ratio test and are corrected for multiple testing by controlling the false discovery rate using the method of Benjamini and Hochberg (Benjamini and Hochberg, 1995).

A multivariable model with predefined factors of days since planning, Angle Class, and overjet was fitted to the data.

## 3. Results

We reviewed the medical records of 312 consecutive Caucasian Belgian or Dutch patients with orthognathic surgery, including 186 females (59.6%) and 126 males (40.4%), carried out over a 3-year period and focused on a variety of potential problems that occur during the orthodontic preparation phase before surgery.

One hundred and sixty patients (51.3%) had a BSSO operation, 129 (41.3%) had a bimaxillary operation, and 23 (7.4%) had a Le Fort I osteotomy.

Forty-two of these 312 patients (13.5%) had an alteration of the treatment plan, including 20 females (10.8% of all female patients) and 22 males (17.5% of all male patients). This difference between both genders was not significant ( $p = 0.09$ ).

Of the 312 patients, 16 had an Angle Class I malocclusion, 197 had a Class II malocclusion, and 99 had a Class III malocclusion (Table 1). Unilateral asymmetries were allocated to either Class II or

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