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ABSTRACT

Introduction: Advances in surgical techniques aim to enhance safety, predictability, and reduce morbidity in orthognathic surgery. However, as with any surgical procedure, there are risks of complications during and after the intervention. **Objective:** To identify intraoperative complications and postoperative complications in orthognathic surgery procedures performed at the University Hospital of the Federal University of Juiz de Fora (HU-UFJF) and the Santa Casa Hospital in Juiz de Fora. **Material and Methods:** This cross-sectional study analyzed medical records, from February to December 2020, containing surgical descriptions and imaging exams of patients undergoing orthognathic surgery at HU-UFJF and Santa Casa Hospital during the same period. **Results:** Out of 100 medical records assessed, 18% exhibited intraoperative complications, and 70% presented postoperative complications. There was no significant association between age and the presence of intraoperative ($p = 0.843$) or postoperative complications ($p = 0.694$). Similarly, no association was observed between gender, intraoperative complications, and postoperative complications ($p = 0.298$ and $p = 0.383$). There was a significant association between complications and the type of osteotomy ($p = 0.001$), but not with intraoperative complications ($p = 0.021$). **Conclusion:** There are a wide variety of complications associated with orthognathic surgery, which must be recognized and treated in a timely manner to prevent severe consequences. The most frequent intraoperative changes recorded in this study involved the maxillary gap with the need for bone grafting in the osteotomy at Le Fort I level and difficulty in fixing the bone segments, associated with the sagittal osteotomy of the bilateral ramus of the mandible and chin. The most common complication was transient paresthesia of the inferior alveolar nerve associated with bilateral sagittal osteotomy of the mandibular ramus in combined or exclusive surgeries on the lower third of the face.

Keywords: Orthognathic Surgery; Postoperative Complications; Osteotomy.

RESUMO

Introdução: Avanços nas técnicas cirúrgicas visam aprimorar a segurança, previsibilidade e redução de morbidade na cirurgia ortognática. No entanto, como em qualquer procedimento cirúrgico, existem riscos de complicações durante e após a intervenção. **Objetivo:** Identificar intercorrências transoperatórias e complicações pós-operatórias em procedimentos de cirurgia ortognática realizadas no Hospital Universitário da Universidade Federal de Juiz de Fora (HU-UFJF) e no Hospital Santa Casa de Misericórdia de Juiz de Fora. **Material e Métodos:** Este estudo transversal analisou prontuários, no período de fevereiro a dezembro de 2020, que continham descrições cirúrgicas e exames de imagens de pacientes submetidos à cirurgia ortognática no HU-UFJF e no Hospital Santa Casa de Misericórdia, executadas no mesmo período da análise. **Resultados:** Dos 100 prontuários avaliados, 18% apresentaram intercorrências transoperatórias e 70% apresentaram complicações pós-cirúrgicas. Não houve associação significativa entre a idade e a presença de intercorrência ($p = 0,843$) ou complicações ($p = 0,694$). Da mesma forma, não foi observada associação entre gênero, intercorrências e complicações ($p = 0,298$ e $p = 0,383$). Houve uma associação significativa entre complicações e o tipo de osteotomia ($p = 0,001$), mas não com intercorrências ($p = 0,021$). **Conclusão:** Existe uma grande variedade de complicações associadas à cirurgia ortognática, que devem ser reconhecidas e tratadas em tempo hábil para prevenir consequências severas. As alterações transoperatórias mais frequentes registradas neste estudo envolveram o gap maxilar com necessidade de enxerto ósseo na osteotomia em nível Le Fort I e dificuldade de fixação dos segmentos ósseos, associadas à osteotomia sagital do ramo da mandíbula bilateral e mento. Enquanto a complicação mais comum, foi a parestesia transitória do nervo alveolar inferior associada à osteotomia sagital bilateral do ramo mandibular em cirurgias combinadas ou exclusivas no terço inferior da face.

Palavras-chave: Cirurgia Ortognática; Complicações Pós-operatórias; Osteotomia.



INTRODUCTION

Facial harmony is highly valued today and it involves the proper connection between the various components of the stomatognathic system, such as muscles, bones, organs, and joints.¹ For that reason, it has become a priority to treat orofacial disorders by combining function and aesthetics, which is where orthognathic surgery finds its place.^{1,2}

Surgical treatment of dentofacial deformities is recommended in cases where orthodontic therapy alone is insufficient to resolve occlusal problems. These are associated with jawbone disproportion affecting facial aesthetics and impairing the proper functioning of the stomatognathic system.²

Several studies, such as Prado and Salim² and Chiapasco et al¹, reported modifications and improvements in the traditional surgical techniques to make orthognathic surgery safer, more predictable and with the lowest morbidity rate possible. However, like any surgical technique, this one is not free of surgical complications.^{1,2} Therefore, it is of the utmost importance that patients receive detailed guidance on the risks of the surgical procedure, as well as its positive or negative long-term impact on their health.³

In surgical procedures performed on the maxilla, the most common complications reported in literature are pseudoarthrosis, infections, and injury to the palatine and infraorbital nerves.^{4,5} In a study conducted by Friscia and colleagues in 2017, which included 51 cases using the Le Fort 1 technique, 14 of them presented some kind of complication. These included one case of infraorbital nerve injury, three cases of dental injury, and three cases of osteotomy fixation failure (pseudoarthrosis).⁶

In mandibular orthognathic surgery cases, the most frequently reported complications and intercurrents include undesirable fractures of the proximal or distal segment, infection, delayed union, displacement of fragments, bone fragment sequestration, and, more commonly, neurosensory changes involving the inferior alveolar nerve.³ In a study conducted by Santos et al in 2012, the most prevalent intraoperative and postoperative complications were damage to the inferior alveolar nerve (6.5%) and improper fractures during bone segment separation (6.5%).⁷

Given the vast possibility of complications inherent in this surgical modality, this study was aimed at identifying intraoperative and postoperative complications associated with orthognathic surgical procedures performed at the University Hospital of the Federal University of Juiz de Fora (HU-UFJF) and the Santa Casa Hospital in Juiz de Fora.

MATERIAL AND METHODS

This is a cross-sectional study that analyzed medical records and imaging exams of patients who underwent orthognathic surgery in the HU-UFJF and in the Hospital Santa Casa de Misericórdia of Juiz de Fora and was approved by the Research Ethics Committee under protocol number 4.825.869.

From February to December 2020, the researchers analyzed medical records properly filled with reports containing surgical descriptions of patients who underwent orthognathic surgery in the same period, together with attached imaging exams. The study began in February 2020 and was carried out despite the reduction in elective surgical procedures due to the COVID-19 pandemic, therefore not interfering with the analysis of the cases under study.

The sample included adequately completed patient records which contained attached pre- and postoperative imaging exams. In addition, among the range of procedures that were included within this surgical approach, only isolated maxillary and mandibular surgeries, combined maxillary and mandibular surgeries, and combined mandibular, maxillary, and chin surgeries were included for evaluation. Patients with post-surgical complications unrelated to the surgical procedure in question were excluded from the sample.

Based on this, 100 cases were selected from those that met the inclusion criteria, from which the following variables were analyzed: gender, age, type of osteotomy, intercurrents and complications, "intercurrents" being events that happened during the surgery, and "complications" those that happened in the post-surgery.

The osteotomy types were regrouped into five groups, according to the need for surgical intervention in treating each patient's dentoskeletal deformities, namely: (i) Sagittal osteotomy of the bilateral mandibular ramus; (ii) Le Fort I; (iii) sagittal osteotomy of the bilateral mandibular ramus and chin; (iv) sagittal osteotomy of the bilateral mandibular ramus and Le Fort I/Le Fort I and chin; (v) sagittal osteotomy of the bilateral mandibular ramus, Le Fort I and chin. This classification aimed to facilitate the application of association tests, as individualized osteotomy analyses would not allow such testing.

A descriptive analysis of the data was performed for the following variables: age, type of osteotomy, intercurrents, and surgical complications. The variables "intercurrents" and "surgical complications" were dichotomized into "present" and "absent" for the studied cases. To assess the association between the qualitative variables "intercurrents and surgical complications" and "age, sex, and type of osteotomy," Pearson's chi-square test and Fisher's exact test were applied when necessary.

The collected data were organized using Microsoft Excel 2016 MSO (version 2110 Build 16.0.14527.20234), and statistical analysis was conducted using the

Statistical Package for Social Sciences (IBM SPSS Statistics, version 22.0). A significance level of 5% was adopted.

RESULTS

A total of 100 medical records were analyzed, out of which 50% were from the female sex. Age ranged between 16 and 63 years, with a mean of 31.48 (± 10.68) years, while 42% of the sample was between 21 and 30 years old. The sample distribution by age group is presented in Table 1. The descriptive data of osteotomy types and their distribution is detailed in Table 2.

Surgery interurrences were observed in 18 of the 100 medical records evaluated (Table 3). There was no significant association between age and the presence of interurrences ($p = 0.843$), nor between gender and these interurrences ($p = 0.298$).

A significant association ($p = 0.021$) was observed between the presence of interurrences and the type of osteotomy. It can also be seen that sagittal osteotomy of the bilateral mandibular ramus and chin accounted for 33.3% of interurrences, followed by sagittal osteotomy of the bilateral mandibular ramus (22.3%) and sagittal osteotomy of the bilateral mandibular ramus and Le Fort I/Le Fort I and chin (22.2%), as can be seen in Table 4.

The complications detected after the orthognathic surgery occurred in 70% of the cases, the transient paresthesia of the inferior alveolar nerve being the most frequent (Table 5). There was no significant association between age and the presence of postoperative complications ($p = 0.694$), nor between gender and these complications ($p = 0.383$).

There was a significant association between the presence of complications and the type of osteotomy ($p = 0.001$). It can also be seen the sagittal osteotomy of bilateral mandibular ramus and Le Fort I/Le Fort I and chin accounted for 42.8% of complications, followed by

the sagittal osteotomy of bilateral mandibular ramus, which accounted for 28.6% of complications (Table 4).

DISCUSSION

Studies have suggested changes and improvements in surgical techniques, aiming to make orthognathic surgery safer and more predictable, with minimal morbidity. However, like any other surgical procedure, it is not free from complications and interurrences.^{1,2} In this study, a frequency of 18% of intraoperative interurrences and a high rate of postoperative complications (70%) were observed in patients undergoing orthognathic surgery.

The most frequently observed intraoperative complications were maxillary gaps due to maxillary rotation or bone repositioning requiring bone grafting, followed by difficulty in stabilizing bone segments, hemorrhage, and undesirable mandibular fractures (bad split).

When performing Le Fort I osteotomy, the most reported interurrences were undesirable fractures, hemorrhages, damage to the nasolacrimal and ocular systems and, more rarely, ischemic necrosis, which reinforces the data found in this study. In this perspective, the difficulty in stabilizing bone segments can be related to the osteotomy design and to the planned bone movement when Le Fort I osteotomies are performed.^{4,5}

Surgical gaps are spaces in the bone that can be filled with a particulate or block bone graft. Xenografts of bovine origin and alloplastics, such as synthetic hydroxyapatite, are biomaterials capable of contributing to bone repair due to their high osteoconductive properties, and can be used in these cases.⁶

Regarding hemorrhages, it is known that during any surgical procedure intraoperative bleeding is inevitable under normal conditions. However, when the acceptable bleeding levels are exceeded, a dangerous and worrying situation is detected, even in young patients without comorbidities and classified as ASA 1. Abnormal intraoperative hemorrhages may be the result of a traumatic injury during surgery, related to a large artery or vein. If important vessels are affected, such as the facial arteries, inferior alveolar arteries or, in extreme cases, the external carotid artery, surgical intervention becomes considerably more difficult and can cause

Table 1: Sample distribution by age group.

Age group	N	%
16 to 20 years	14	14
21 to 30 years	42	42
31 to 40 years	22	22
41 to 60 years	22	22

Table 2: Sample distribution by types of osteotomies.

Osteotomy	N	%
Sagittal osteotomy of the bilateral mandibular ramus	30	30
Le Fort I	7	7
Sagittal osteotomy of the bilateral mandibular ramus and chin	11	11
Sagittal osteotomy of the bilateral mandibular ramus and Le Fort I/ Le Fort I and chin	38	38
Sagittal osteotomy of the bilateral mandibular ramus, Le Fort I and chin	14	14

Table 3: Descriptive distribution of intraoperative intercurrents.

Intercurrences	N	%
Absent	82	82
Undesirable fracture (Bad Split)	2	2
Displacement of the articular disc	1	1
Difficulty in stabilizing occlusion	1	1
Difficulty in stabilizing bone segments	3	3
Space between osteotomies (GAP) in the maxilla requiring grafting	4	4
Need for paranasal grafting	1	1
Hemorrhage	1	1
Need for Weber-Ferguson access	1	1
Need for anterior subapical osteotomy	1	1
Epistaxis	2	2
Need for occlusal adjustment	1	1

Table 4: Dichotomization between osteotomies, intraoperative intercurrents and postoperative complications in orthognathic surgery.

Osteotomy	Dichotomized intercurrents (%)			Dichotomized complications (%)		
	Absent	Present	p	Absent	Present	p
Sagittal osteotomy of the bilateral mandibular ramus	31.7	22.3		33.4	28.6	
Le Fort I	6.1	11.1		23.3	0.0	
Sagittal osteotomy of the bilateral mandibular ramus and chin	6.1	33.3	0.021	3.3	14.3	
Sagittal osteotomy of the bilateral mandibular ramus and Le Fort I/Le Fort I and chin	41.5	22.2		26.7	42.8	
Sagittal osteotomy of the bilateral mandibular ramus, Le Fort I and chin	14.6	11.1		13.3	14.3	

Table 5: Descriptive distribution of post-surgical complications.

Complication	N	%
Absent	30	30
Need for delayed intubation	1	1
Prolonged paresthesia	3	3
Graft exposure	1	1
Transient paresthesia	61	61
Blood loss	1	1
Infection	1	1
Need for occlusal adjustment	1	1
Epistaxis	1	1

harm to the patient.¹ In cases of maxillary surgery, care must be taken not to injure major vessels, such as the descending palatine artery and the pterygoid venous plexus.^{6,8} In the Le Fort I technique, these vessels are more likely to be injured. In addition, preserving the

descending palatine artery is of paramount importance for adequate blood perfusion in the maxilla, as this artery is the source/origin of most postoperative bleeding episodes.^{8,9,10,11}

It is thought that the cases of epistaxis

observed in this study could be due to increased tension levels in the postoperative period, as well as insufficient hemostasis before bone fixation or the presence of injuries to the descending palatine artery. Therefore, in these cases, they could be related to nasal bleeding (Figures 1 and 2).^{8,9,11}

In the current study, there were two undesirable mandibular fractures (bad split), as can be seen in Figures 3 and 4. Undesirable mandibular fractures occur mainly



Figure 1: A 50-year-old patient who underwent Le Fort I osteotomy, sagittal mandibular osteotomy, and mentoplasty. He presented epistaxis in the intraoperative period and was treated with bilateral nasal packing (Merocel ®).

due to sudden movements and inadequate osteotomies, affecting the distal segment of the mandibular body, and are one of the intercurrents with the most difficult solution. These fractures generally occur at the level of the second molar, where the bone is thinner, and may be associated with condylar or coronoid apophysis fractures. These fractures are usually the result of an incomplete or excessively high horizontal mandibular osteotomy.¹² Therefore, to minimize the likelihood of complications during a sagittal osteotomy of the mandibular ramus, careful planning, meticulous surgical execution and individualization of details according to the movement to be performed are necessary.^{2,13,14,15}

Among the postoperative complications, the most common was paraesthesia of the inferior alveolar nerve. This reinforces the findings in the scientific literature, in which 83% of inferior alveolar nerve disorders were observed after sagittal osteotomy of the mandible.¹⁶ This complication becomes more common when the inferior alveolar nerve is trapped in the proximal bone segment (Figure 5).

Despite its versatility and wide use, sagittal



Figure 2: Nasal packing soaked in saline and blood after removal in 48 hours.



Figure 3: Panoramic radiographic examination of a 35-year-old patient with mandibular prognathism. The patient had an undesirable fracture (bad split) in the left mandibular ramus during the sagittal osteotomy of the bilateral mandibular ramus, which was treated with semi-rigid fixation with bicortical



Figure 4: Panoramic radiographic examination in a 43-year-old patient presenting mandibular prognathism. An undesirable fracture occurred in the right mandibular ramus during the sagittal split osteotomy in the mandibular ramus, which was treated with bone screws and plates (B).

osteotomy of the mandibular ramus can present several important interurrences and complications, the main one being neurosensory disturbance, related to alterations in the inferior alveolar nerve. In the present study, 61% of the patients presented transient paresthesia and there were 3 cases of prolonged paresthesia. Patients affected by this condition can vary from a temporary reduction in sensitivity in the regions of the chin, lower lip and gingival mucosa, to complete and permanent paresthesia throughout the entire distribution of the inferior alveolar nerve.^{2,18} However, the incidence of neurosensory damage can vary from 0 to 100%, depending on the accuracy of the tests used and the time of follow-up and preservation of patients

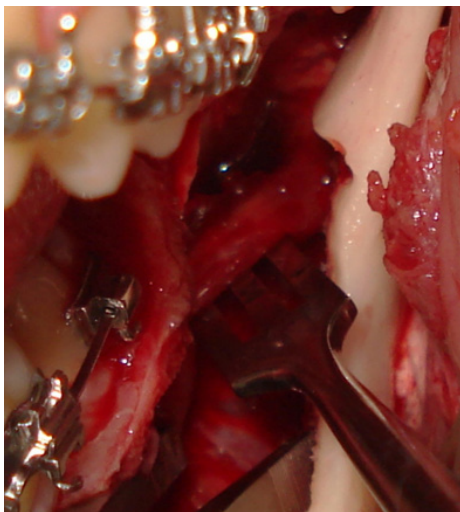


Figure 5: Entrapment of the inferior alveolar nerve in the proximal segment resulting in increased likelihood of paresthesia due to surgical manipulation.

who underwent orthognathic surgery.¹⁸

It is believed that the manipulation of bone segments, as well as the patient's bone thickness, its exposure and intraoperative manipulation directly influence the occurrence of paresthesia.^{2,19} The inferior alveolar nerve can be damaged either directly through the use of saws or chisels in osteotomy, or indirectly through postoperative hematoma and edema.²⁰ With the alveolar resorption over the years, the inferior alveolar nerve becomes more superficial and, consequently, more prone to injuries during the surgical procedure. Aiming to minimize this type of complication, it is important to perform adequate surgical planning and observe the nerve pathway. Furthermore, bone manipulation should be performed gently and safely, with the option to use piezoelectric surgical ultrasound in critical areas that are more susceptible to inferior alveolar nerve damage.^{2,12}

Although the range of detectable complications is wide, there are few reports in the literature on the real incidence of complications in all orthognathic surgery modalities. In order to optimize results while minimizing complications and performing procedures safely, it is prudent for surgeons to periodically evaluate their approach.^{18,21}

The frequency and type of complication are generally associated with the surgical site, the surgical technique, the severity of the deformity, the time of surgery, contamination, the patient's general health and psychological conditions and the surgeon's skills. To all this, anatomical variations can be added.^{22,23}

With the aim of minimizing interurrences and complications resulting from orthognathic surgery, virtual surgical planning has been used. The conventional

method of planning leaves room for discrepancies and errors, being totally dependent on the surgeon's skills and experience. In this context, virtual planning emerged as an alternative to reduce the probability of interurrences.^{20,23} Therefore, virtual planning has been used, whenever possible, to perform orthognathic surgeries that take place at HU-UFJF.

Limitations of this study include the fact that the research was conducted during the COVID-19 pandemic, which led to the suspension of elective surgeries to prevent the spread of the virus. This event ended up limiting the sample size of this study. A second point to be considered is the fact that, as this is a cross-sectional study, it was not possible to monitor the presence of late complications.

CONCLUSION

There is a wide variety of complications associated with orthognathic surgery, which must be recognized and treated in good time to prevent severe outcomes. The most frequent postoperative changes recorded in this study involved the maxillary gap requiring bone grafting in the Le Fort I osteotomy and difficulty in stabilizing bone segments associated with the sagittal osteotomy of the bilateral mandibular ramus and chin. The most common complication was transient paresthesia of the inferior alveolar nerve, associated with bilateral sagittal osteotomy of the mandibular ramus in combined or isolated surgeries in the lower third of the face.

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