Complications in Orthognathic Surgery: A Literature Review

Caio Cesar de Souza Loureiro,¹ and Luiz Fernando Lobo Leandro²

¹Oral and Maxillofacial Surgeon, Hospital Santa Paula — São Paulo — Brazil. Member of the Brazilian Society of Surgery and Maxillofacial (SOBRACIBU)
²Oral and Maxillofacial Surgery Section — Hospital Santa Paula and Hospital Santa Cecilia (São Paulo — Brazil). Effective member of the American Society of TMJ Surgeons. Member of the executive committee — IAOMS

Correspondence to:
Caio Cesar de Souza Loureiro
E-mail: csloureiro@gmail.com

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Abstract
Recently, orthognathic surgeries are being increasingly performed to correct dento-facial deformities. However, complications related to this procedure in the trans— and postoperative periods may result in a poor outcome or lead to serious local or systemic changes. The aim of this study is to describe the major complications related to orthognathic surgery, with special emphasis on the main causes and methods to avoid or treat them.

Introduction
In the recent decades, orthognathic surgery is more commonly being performed to correct dento-facial deformities, which are genetic, sequelae of trauma or pathologies, thus improving the esthetics and stomatognathic function. Despite the constant development of surgical techniques and materials that make the procedure safer, complications such as bleeding, nerve damage, infections, and others may occur in the trans— and postoperative periods. Oral and maxillofacial surgeons should be able to recognize them and take necessary measures for their resolution and better patient recovery. In this paper, we present a literature review on the various complications of orthognathic surgery, with possible causes and methods of prevention or treatment.

Literature Review
Injury and Nerve Changes
Injuries or nerve changes are relatively common in patients undergoing orthognathic surgery and almost all patients have some temporary neurosensorial disorder after the procedure (1). This is due to the close proximity of the infra-orbital, lingual and inferior alveolar nerve bundles to the sites where ostotomies are performed (2). The nerve damage that occurs during orthognathic surgery is usually caused by direct or indirect mechanical damage or nerve resection, as a result of excessive force applied mainly on the inferior alveolar or the infra-orbital nerve, when using retractors, Lindemann drills, and chisels during bone separation, compression, and fixation of segments. Other changes may result from inflammation and swelling after surgery (3–5). Nerve damage in any way negatively affects the level of facial sensation, as well as the patient’s ability to translate altered and weak patterns of neuronal activity into functionally significant motor activities (1).

Although the infra-orbital nerve may also be affected, the inferior alveolar nerve is most susceptible to injury because of its anatomical position; it lies in the inner portion of the mandibular body, which is moved during sagittal osteotomy of the mandible. Injury or even rupture may occur during intraoperative instrumentation (2). As a result of this complication, patients usually complain of transient or even permanent postoperative paresthesia, especially after mandibular surgery, although temporary or permanent sensitivity of the infra-orbital nerve may also occur, more commonly in elderly patients (2–5). In the case of nerve bundle rupture, rapprochement and tension-free suture through the epineurium with 6–0 or 7–0 wires increases the chance of recovery, at least in part, of neurological function (2).

Although extremely rare, facial nerve injury can
also occur in cases of mandibular orthognathic surgery, resulting in gustatory changes and paralysis of the muscles of facial expression. This may occur because the distance between the posterior border of the mandibular ramus and the nerve bundle is less than 1 cm during the procedure with the patient’s mouth open (6, 7). This change is observed in most cases associated with mandibular retraction procedures, particularly when medial dissection along the ascending ramus is difficult, subperiosteal instrumentation is not adequate, or simply when the retractor is forced too posteriorly pressing the nerve fibers against the mastoid process (7). Potential compression of the facial nerve also occurs as a result of edema or postoperative extensive haematoma in the perimandibular region (6, 7). The lesions associated with sagittal osteotomy can involve the main trunk, or be more selective in the branches involved, depending on the aetiology of the lesion. Most injuries will result in traction or compression of the nerve bundle, but nerve section may also occur. The type of injury has important implications in the potential spontaneous recovery of normal facial nerve function over time (6).

The management and treatment of facial nerve injury have been widely discussed. There is no evidence of efficacy of administration of corticosteroids during the trans- and postoperative periods in the improvement of nerve function. Other studies, however, affirm the efficacy of prednisolone (1 mg/kg–70 mg/day) in synergistic action with injections of vitamin B 12. In cases of facial paralysis, the use of ophthalmic ointment prevents damage to the eyes during nerve recovery. Along with these measures, physical therapy is essential to accelerate the healing process (7).

**Infection**

Generally, the prevalence of infection after osteotomies of the jaws is low, with reported rates ranging from 1% to 33% (8, 9). When it occurs, however, it can lead to major complications such as airway obstruction, loss of teeth or bone, osteomyelitis, septicaemia, cavernous sinus thrombosis and meningitis. Severe infections may require drainage in 0.4% and 1.4% of cases (10).

Several factors can influence the incidence of infections, for example, patient age, the duration of surgery, type of procedure, smoking, presence of third molars, diabetes and the use of prophylactic antibiotics (8, 9). In addition, previously infected or irradiated tissues show greater potential for postoperative infection, as well as tissues showing deficiency in blood supply or the presence of foreign bodies (2). The placement position of the fixation plates, particularly in osteotomies of the mandible, also affects the development of infections (8).

Clinical manifestations of postoperative infections may arise in a few days or even 5 years after surgery. They usually occur within the first 3 months after the procedure, delaying the process of bone union and tissue healing (8, 9). Studies indicated that although infectious diseases occurred, the incidence of procedures for removal of synthesis materials was very low, since the infection could be controlled with antibiotics (8).

However, the prophylactic and/or postoperative use of antibiotics has been a subject of controversy. While some recent studies investigating the use of prophylactic antibiotics in orthognathic surgery concluded that routine use during the pre- and postoperative period was unnecessary, other studies confirmed the effectiveness of medication in preventing or reducing the incidence of infection, which makes their use optional for the surgeon depending on their surgical protocols (8–10).

**Haemorrhage**

Haemorrhage during orthognathic surgery rarely becomes an emergency, although bleeding from larger vessels can occasionally be difficult to control due to limited access to the damaged artery or vein (2). Bleeding during surgery can be the result of laceration of the inferior alveolar, facial, maxillary and palatine arteries. Damage to the maxillary artery during mandibular sagittal ramus osteotomy is rare because it can be easily avoided by careful dissection of the periosteum on the lateral side of
mandible (2, 11). On the other hand, the inferior alveolar artery is the focus of frequent severe haemorrhage due to accidental rupture by instruments during osteotomy or its disruption by the distal bone fragments during the procedure (2).

In case of serious bleeding during Le Fort I osteotomy, one must pay special attention to the maxillary artery and its terminal branches, the sphenopalatine and descending palatine arteries. Other large vessels to consider include the pterygoid venous plexus and internal carotid artery (2, 10).

Some studies showed that blood loss was significantly correlated with the duration of the operation rather than the type of procedure (1). However, some studies demonstrated that segmentation of the maxilla appeared to be more associated with blood loss; it could be up to two times that of conventional Le Fort I osteotomy (12). Although the incidence of severe bleeding requiring transfusion is low, ranging from 1% to 12.5%, it is essential to consider blood transfusion during lengthy surgical procedures (10, 13). As an aid in controlling transoperative bleeding, general anaesthesia is essential, since it induces hypotension during the procedure which decreases the incidence of blood loss to up to 40% and reduces surgical time (12, 13). Although useful, this manoeuvre does not eliminate the need for direct control of bleeding which requires direct visualization of the region, making rapid completion of the osteotomy necessary to allow application of direct pressure, vascular clips, or electrocautery (2). In extreme cases, procedures such as embolization or even external carotid artery ligation may be necessary (10).

**Airway Obstruction**

Although rare, airway obstruction leading to respiratory distress is an emergency and recognition of signs and symptoms of respiratory distress is essential, allowing swift action to minimize or solve the problem (2).

The causes for this complication include laryngospasm due to mechanical or chemical action, acute pharyngeal edema and even aspiration of blood clots after surgery (10). The use of oropharyngeal tampon, postoperative oral aspiration and extubation in a timely manner can minimize or prevent airway obstruction (10).

At the end of the procedure, attention should be paid to signs such as unusual breath sounds, change in respiratory frequency and intensity (14). The appearance and skin temperature are also indicative of respiratory changes, starting with sweating and evolving into paleness, cyanosis and hypothermia (7). The patient may also verbally express pain and tightness in the chest, and paresthesia (numbness and tingling) of the hands, feet and/or lips (2). In case of occurrence of any of these signs or symptoms, the surgical and anaesthetic team should be on high alert since breathing difficulty associated with a feeling of suffocation can lead to stress, exacerbating the problem and complicating eventual re-intubation (2).

**Undue Fractures During Osteotomy and Bone Mobilization**

One of the most common complications in orthognathic surgery is the undue fracture of bone segments during the course of the osteotomies and mobilization of the fragments. The occurrence is more common during mandibular osteotomies, with an incidence ranging from 1.9% to 20%, or during the release of the lateral pterygoid plate during Le Fort I osteotomy (2, 10, 15). The occurrence of these fractures may also interfere in surgical fixation, and lead to infection, bone sequestration, delayed bone healing, fibrous union of the bone fragments, or even in non-union bone (2, 15).

The most common undue fractures are those affecting the vestibular cortical board of the proximal segment, the lingual cortical board of the distal segment and those directed toward the condyle (10). This is mainly due to the anatomical feature of the mandible, where the cortical bone distal to the second molar is usually thin and therefore acts as a zone of weakness (15). Another major factor is the presence of third molars or their extraction performed in the pre-surgical period, which further weakens the mandibular angle region (2, 15).

Although the presence of third molars increases
the risk of fractures, the decision regarding when to perform the extraction surgery is still controversial. While some studies show an incidence of undue fractures up to three times lower when the extraction is performed at the same time when the osteotomy is performed, other studies suggest that the extraction should be performed at least nine months prior to orthognathic surgery to promote adequate alveolar filling and new bone formation, especially in cases of impacted teeth where additional bone removal is required (15).

**Nausea and Vomiting After Surgery**

Postoperative nausea and vomiting (PONV) remains one of the most common complications in patients undergoing several types of surgery (16). Although PONV is not usually a complication of high risk, persistence may result in adverse consequences such as dehydration, esophageal perforation, wound dehiscence, bleeding, haematoma, aspiration of gastric contents, and even death (16, 17).

According to the literature, this event is related to a variety of independent factors that can be divided into: 1) non-anesthetic factors, which relate exclusively to patient age, sex, smoking, medical history or previous episodes of PONV, 2) factors associated with anesthetics, such as type of anesthetic, intraoperative administration of opioids and hydration of the patient and 3) factors associated with surgery such as, type, duration and medications administered in the postoperative period (14, 17–20).

Orthognathic procedures involving osteotomies of the maxilla present higher risk of resulting in PONV; this is due to the greater tendency of postoperative bleeding and subsequent blood ingestion, irritating the gastric mucosa. Anaesthetic hypotension frequently performed during this procedure may also play a role in the induction of PONV (16). The administration of inhaled anesthetics, compared to general intravenous anaesthesia, also results in a higher incidence of PONV (21). Nausea in the postoperative period is usually accompanied by intense pain status and can be controlled by administration of opioid analgesics (16).

**Vascular Disorders**

The occurrence of vascular disorders is rare and often is the result of inadequate planning or execution of the surgical procedure. Exaggerated mucosa dislocation, disruption of the periosteum or excessive bone segmentation may limit vascularity of the surgical bed and consequently induce avascular necrosis, leading to loss of bone segments (16, 22). Furthermore, inattention during osteotomy can also lead to devascularization or even sectioning of the dental roots causing resorption. In this case, endodontic treatment of the teeth affected may be required. This can be avoided by performing the osteotomy 5 mm or more away from the root tips (10, 16).

**Conclusion**

Surgical procedures for correction of dento-facial deformities are more commonly performed nowadays, with the improvement of techniques and materials. Yet, complications may occur during and after the procedure, delaying or hindering bone repair and tissue healing, and the expected result may therefore not be achieved. Literature shows that these episodes occur, among other reasons, due to anatomical or systemic conditions of patients, factors inherent to the procedure, for example, the procedure time, or even inadequate planning or execution of the surgery. With regard to treatment of these complications, the available information is often contradictory, making it difficult to decide which is the best option, and so, surgeons must rely on their own clinical protocols and drug armamentarium.

**References**


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