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Our experience in complications of orthognathic surgery: a retrospective study on 3236 patients

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Abstract. – BACKGROUND AND OBJECTIVES: From 1989 to 2009, at the Department of Cranio-Maxillo-Facial Surgery, Umberto I Polyclinic, "Sapienza" University of Rome, 3236 patients affected by maxillo-mandibular malformations were submitted to orthognathic surgery, by means of rigid internal fixation. Follow-up highlighted the surgical complications and the possible functional and/or esthetical disorders in the treatment of those pathologies. The data collected have been compared with the ones reported in the literature.

MATERIALS AND METHODS: 3236 patients were evaluated clinically and radiographically. The X-rays have been performed before the study, after 24-48 hours, at 6 months and year after surgery.

RESULTS: The most frequent surgical complication was the mandibular nerve sensitivity deficit (19%), irreversible only in 2% of the cases. Temporomandibular joint disorders (TMD), which are widely reported in the international literature, have been relevant in our study too. In particular, TMD occurred in those patients who were already affected by the disorder (from 28.3% to 18.1%); besides, in 11% of cases the symptom appeared after surgery and was treated by means of splint or physiotherapy. Infectious complications occurred in 2% of cases and fractures of the bone elements in 1.5% of cases. The other complications quoted internationally occurred in an irrelevant percentage in our study.

CONCLUSIONS: We believe that orthognathic surgery complications are quite rare and the percentages reported both in our study and in the literature have to be considered as surgical mistakes related to the surgeon experience or as real complications of the orthognathic surgery. Furthermore, as the success of this kind of surgery depends upon many factors, surgical complications represent only one of the causes of the failure. Other causes could be mistakes in planning, unsuitable orthodontic treatment and, finally, an unsuitable assessment of the patients' esthetical and functional problems.

Key Words:

Orthognathic surgery, Surgical complication, Temporo-mandibular disorder, Nerve injuries.

Introduction

Le Fort I osteotomy and bilateral sagittal split osteotomy (BSSO) are the most common surgical techniques performed in patients with maxillo mandibular malformations and, therefore, submitted to orthognathic surgery. Since 1989, with the introduction of internal rigid fixation, in our Department, it was possible to achieve a more comfortable procedure for the patient allowing the surgeons to obtain a better skeletal stability too, concerning the mandible in particular[1]. Nevertheless, as shown in our case load and in the international literature, surgical complications related to the use of wire ostheosynthesis and intermaxillary fixation have changed over time[2,3]. The aim of this study is represented by the evaluation of such complications and their prevalence on a wide sample of patients, comparing our data with the international literature.

Materials and Methods

From 1979 to 2009, at the Department of Cranio-Maxillo-Facial Surgery, Umberto I Polyclinic, Sapienza University, Rome, more than 5700 patients have been submitted to orthognathic surgery excluding all those patients who did not perform the rigid internal fixation. Clinical and radiological data of 3236 patients were, hence, collected and we proceeded to the analysis of all the complications occurred after surgery, in particular immediately after or during the follow-up.

Common features of the sample, as for the kind of surgery performed, are the following: (1) patients at the end of growth; (2) no history of maxillofacial trauma; (3) exclusion of patients affected by congenital maformations; (4) facial muscles relaxation during X-Rays execution; (5) assessment of soft tissues changes in the lateral evaluation; (6) no combined or previous surgery;

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(7) same soft tissue incisions and suture technique; (8) no bone remodeling (i.e. anterior nasal spine remodeling); (9) use of rigid internal fixation; (10) almost 1 year follow-up.

The mean age of the patients at the moment of surgery was of 30.5, the median was of 27 with a range of age between 15 and 60 years. The patients included in this study were 1917 women and 1319 men. Most of the patients (98%) received orthodontic treatment before surgery.

Concerning the kind of malformation, as showed in Table I, 69% of patients were affected by a class III of Angle, 12% by a class II and in a lower percentage other malformations.

The total number of operations was 3236.

Concerning the surgical techniques, the majority of patients has been treated throughout a combined Le Fort I osteotomy and BSSO, 10% Le Fort I and 14% a BSSO only. Only 1% of the patients has been treated with segmental maxillary osteotomies (PSMO).

Concerning the upper maxillary fixation techniques, at the beginning of the study, 2 L-shaped miniplates anteriorly and 1 wire osteosynthesis posteriorly have been used for each side. This practice has been gradually abandoned, according to the international literature, using 2 L-shaped miniplates anteriorly and 2 straight miniplates posteriorly. Besides, the BSSO fixation has been performed through 3 bicortical screws on each side.

Concerning the radiographic assessment, the orthopantomography, the lateral and postero-anterior cephalometric radiograms and the TMJ stratigraphy were performed before and after surgery and during the follow-up period 6 and 12 months after surgery and at the end of the therapy.

In particular, we paid great attention to the articular symptoms performing a complete structural, functional and postural evaluation in those cases which suffered from TMD. Thus, we thought it was important to make a difference between the cases without joint disorders before surgery and the ones which showed joint disorders only after the primary diagnosis in order to better understand TMJ complications following orthognathic surgery.

All patients received antibiotic therapy after surgery consisting in amoxicillin and clavulanic acid or, in allergic patients, ciprofloxacin in order to prevent the risk of infections: in particular, the first dose of antibiotics was administered during surgery and three times per day every 8 hours during the next 7 days.

Table I. Distribution of patients for diagnosis.

Diagnosis	Percentage	No.
Angle class III	69%	2214
Angle class II	12%	390
Open bite	9%	293
Haemifacial microsomia	6%	198
Palatoschisis	3%	102
Angle class I	1%	39
Total		**3236**

Results

According to the data collected, 2407 among 3236 (74.4%) of patients, who were submitted to surgery, had a normal post-operative period without any complications in during the follow-up too. Besides, in 829 (25.6%) of cases, one or more surgical complications occurred.

As shown in Table II, regarding all the sample, 19% showed neurosensory deficit related to the mandibular nerve, 11.17% showed post-operative TMD, 2% developed infections and 1.5% showed an incongruent mandibular fracture.

Other complications, occurred with a total prevalence of less than 0,5% and were represented by: dental injuries (0.15%), pseudoarthrosis (0.09%), vascular hemorrhage (0.05%), septum dislocation (0.05%), bone necrosis (0.03%), oronasal fistulae (0.03%), chronic sinusitis (0.03%).

Discussion

Nerve Injuries

In our study, the sensory deficit of the alveolar nerve appeared to be the most frequent complication following orthognathic surgery: in particular, 616 patients (19%) showed a sensory deficit. Among these patients, only 153, as for the per-

Table II. Frequency of complications after orthognathic surgery.

Complications	Percentage	No.
Nerve injuries	19.03%	616
TMJ dysfunctions	11.17%	259
Infection	2%	67
Fracture	1.5%	49
Others complications	0.41%	14

sisting of the symptomatology over 6 months, decided to evaluate such deficit by means of the inferior alveolar nerve evoked potentials.

Besides, in the international literature, the frequency of neurosensory deficit has a range of 8% to 32%[2,3-7], our result lying in the middle.

The neurosensory deficit is perceived from the patients as a sensation of paresthesia or as a reduced sensitivity over the anatomic district innervated by the inferior alveolar nerve. Nevertheless, such phenomenon represents a temporary event generally followed by a total recovery between 6 months and 1 year after surgery.

We evaluated that 494 of patients among 616 (80.19%) recovered the normal sensitivity within 6 months after surgery while 108 patients (17.53%) recovered the sensitivity within 1 year. Only 14 cases (2.28%) suffered from a permanent sensitivity. In 14 cases the neurosensory complication was due to a surgical mistake and the damage was assessed throughout the evoked potential exams. Finally, our results totally match with the ones of the international literature[8].

During the evaluation of the data collected, we noticed that the lesion of the inferior alveolar nerve occurs above all during the splitting of the sagittal osteotomy (97.6% of the cases), instead of during the fixation (2.4% of the cases). This result totally match with the international literature as several studies confirmed the high risk of neurosensory deficit during the BSSO[6,9]. According to Kenji et al[10], the alveolar nerve lesions are usually caused by direct or indirect mechanical traumatic events or by the nerve damage, as the result of excessive forces applied during the osteotomy. Furthermore, additional damages might occur for inflammatory phenomena, bleeding and/or hematomas sorrounding the mandibular canal.

Therefore, we believe that this complication should be highlighted in the informed consensus, as suggested by several Authors[2,9].

TMJ Dysfunctions

Common matter of debate is represented by the correlation between orthognathic surgery and TMJ complications[11-19]. Several Authors tried to evaluate the frequency of TMD in a population with maxillo-mandibular deformities treated throughout orthognathic surgery. Till now, about 500 articles have been published on TMJ complications as a consequence of orthognathic surgery. Nevertheless, as Abrahamson et al[17] suggest, such studies are poorly scientific because of the heterogeneity of the methods used and the ambiguous results.

The results and the conclusions of the various Authors differ substantially because the follow-up period is different[11,15,20] as well: in particular, the study of Onizawa et al[15] evaluates only a 6 months period of follow-up and, it is too short to let the physiologic recovery of the patient. The study of Panula et al[11], instead, even if with a good follow-up period (4 years), lacks in the sample of patients as the control group is too small (only 20 patients) compared to the group examined (60 patients).

In our study, we reckoned to subdivide the sample in 2 groups: Group A, composed of 918 patients, as 28.3% of the total amount of patients affected by TMD, related as click, pain or functional limitation before surgery, and Group B, composed of 2318 patients that did not suffer from TMJ symptoms before surgergy.

In the first Group (A), as Cascone et al[18] refer, a good improvement of TMJ symptoms occurred after surgery and those patients who still had symptoms became 167, as the 18.1% of the cases. These patients, during the surgery, used a splint and repositioning plates of the mandibular ramus.

In the second Group (B), TMD occurred in 259 cases (11.17%), an inferior percentage in comparison with the international literature. Among these patients, 248 patients (96%) were treated using functional therapy or physiotherapy and 11 patients (4%) needed surgery twice. In 7 cases such operation consisted of a revision of the sagittal osteotomy, while in 4 cases it was necessary to perform an arthroplasty.

Therefore, our data related to TMJ and orthognathic surgery seem to be encouraging, even if we believe it is suitable to highlight that TMD are not only represented by click, pain and functional limitation but also by hemicranias, cervical pain, postural disturbs and, finally, we need also to consider the psychological aspects.

We believe that if we want to draw reliable scientific conclusions, we should have a homogeneous sample in terms of pathology, skeletal deformity and TMJ symptoms. Furthermore, all patients should be treated by the same surgeon and submitted to suitable clinical and radiographic follow-up. Anyway, it is quite difficult to realize all these conditions.

Infections

2% of cases developed an infectious complication in the immediate post-operative period. Saliva, residual food and blood might accumulate

over the surgical wound and create the ideal conditions for infection[20,21]. In spite of the 7 days antibiotic therapy in the post-operative period and the dressings made during the hospitalization, infectious events occurred and seemed to be related to a poor oral hygiene and/or cigarette smoking which strongly decrease the right healing of the surgical wound.

Most of these infections have been positively treated by antibiotic therapy only and just in 0.2% of cases it was necessary to perform a drainage or a surgical toilette of the infectious area.

Only in 9 cases (0.3%) infectious complications occurred more than 6 months after surgery. In these cases the infection was caused by reactive phenomena against the fixation materials. Such event, in several cases, was treated throughout antibiotic therapy, while in 4 cases it was necessary to remove plates and screws.

Antibiotic therapy played a very important role preventing infectious complications but the prevalence of such events seems to be the 3.1%-7.4%[22-25] in the international literature. In a recent study, Chow et al[25] showed that the prevalence of infections in orthognathic surgery might be up to 17.3% in those patients who received just one dose of antibiotic in the post-operative period.

As recommended in several studies, antibiotic therapy should be effective against the most common pathogens that cause infections. The most common microorganisms for the trans buccal techniques in maxillo-facial surgery are: streptococci, anaerobes Gram+ and Gram-; while, for the trans-cutaneous techniques, the microorganisms who most commonly cause infections are the cutaenous stafilococci[24]. As suggested by Patel et al[25], the probability of an infection to occur is higher when a trans-buccal approach is performed for the sagittal osteotomy fixation.

Bone Fracture

Unsuitable fractures of the upper maxilla, as described in the literature[1], have not been found in our caseload. Nevertheless, in 49 cases (1.5%) incongruent fractures of the mandibular ramus or angle occurred during the sagittal split osteotomy (SSO). The risk of causing a fracture seems to become higher for the presence of a third molar[26]. In several studies[21,26-30] mandibular fractures during the sagittal split osteotomy (SSO) occur with a frequency between 3% and 23%. The "ideal" split could be difficult to realize as it is conditioned by many anatomical variations of the mandibular ramus and by the ability to properly draw the osteotomy[29]. The extraction of the third molars in the same surgical time might cause the incongruent fracture of the bone fragments that is why we suggest to extract the dental elements at least 6 months before surgery.

As highlighted in Table III, the other complications found in our study had a very low frequency: only 14 patients among 3236 (0.41%).

In 4 cases (0.14%) the dental elements were damaged. In 2 of these 4 cases (50%) a dentist was required in order to perform the endodontic treatment. It should be highlighted that all those patients who showed such complication received a segmentary osteotomy.

Pseudoarthrosis occurred in 3 cases (0.08%) during the follow-up period.

In our caseload, dislocations of the nasal septum occurred in 2 cases (0.05%) during the upper movement of the maxilla during surgery or anesthesiological maneuvers.

Important vascular hemorrhages appeared only in 2 cases (0.05%) in patients affected by coagulation cascade defects and in both cases blood transfusions were not necessary

One case of bone-necrosis (0.03%), 1 case of oronasal fistula (0.03%) and 1 case of chronic sinusitis (0.03%) occurred.

Conclusions

Failure in orthognathic surgery is not only caused by surgical complications but it depends on several factors too: the most important is a proper diagnosis followed by a proper orthodontic and surgical planning. It's very important that the orthodontist performs the suitable orthodontic planning in order to obtain the correct occlusal relationships after surgery.

Table III. Frequency of other compication.

Complications	Percentage	No.
Dental injuries	0.14%	4
Pseudoartrosis	0.08%	3
Vascular hemorrhage	0.05%	2
Septum dislocation	0.05%	2
Bone necrosis	0.03%	1
Oronasal fistulae	0.03%	1
Chronic sinusitis	0.03%	1
Total	**0.41%**	**14**

Furthermore, it is very important, during the surgical assessment, to know the limits to respect in order to obtain stable results. We know that planning maxillary or mandibular advancements up to 6 mm exposes to higher risks of recurrency even if the internal rigid fixation[31-33] is used. In cases of Open Bite it is often necessary to perform a proper retrusion of the maxilla in order to obtain the right occlusion.

Concerning the complications related to orthognathic surgery and to TMD, it would be necessary, in order to draw really significant considerations, to study an homogeneous group of cases with the same dental-skeletal anomalies, the same joint dysfunctions, treated by the same surgeon and performing a very accurate evaluation pre- and post- operative, followed by an adequate follow-up. We believe that, also in our caseload, the scientific results obtained are not completely sufficient to evaluate the real effects of the orthognathic surgery on TMJ, even if the data obtained are encouraging.

Furthermore, it is important to consider that the data shown and also the ones quoted in the literature refer to University and/or Hospital Departments, where surgery is not only performed by experienced surgeons but, very often, by trainees who require time to learn properly the surgical techniques. Therefore, if we want to discuss about scientifically significant data concerning orthognathic surgery complications we should analyze an homogeneous sample in terms of skeletal pathology and treated by only one well experienced surgeon.

In conclusion, orthognathic surgery is a quite secure surgery, some of the surgical complications found are related to the surgeon experience and not strictly to the risks of the operation itself. In fact, surgery is only a step of the treatment of these patients as it begins with an accurate diagnosis and a proper planning that has to progress as long as it is needed in order to obtain the best result from surgery.

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