

Review Article

Complications in orthognathic surgery: a literature of review

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ABSTRACT

The orthodontic-surgical treatment involves interaction of numerous professionals. A patient with skeletal malocclusion develops dental compensations, precluding or restricting the surgical correction. In this review we attempt to summarize the current knowledge of complications in orthognathic surgery. Based on the literature, temporomandibular disorders, challenging outcomes of orthognathic surgery in class 3 patients and unfavorable splits with the bilateral sagittal split osteotomy are known as the most complications. In conclusion, most published studies related to the surgery-first approach were mainly on orthognathic correction of skeletal Class III malocclusion. Both the surgery-first approach and orthodontics-first approach had similar long-term outcomes in dentofacial relationship. However, the surgery-first approach had shorter treatment time. There are relatively few reports concerning intraoperative complications relating to mandibular osteotomies. So, the aim of the current study was to determine complications in orthognathic surgery using the PubMed and Medline database English literature by the terms: "Orthognathic surgery", "complications", "Bone density".

Keywords: Orthognathic surgery, Complications

INTRODUCTION

Surgical-orthodontic treatment is universally recognized as the best therapeutic option for the adult patient with dental and skeletal conflict (Farronato et al. 2008). Orthognathic surgery is not merely a surgical procedure; it is described as

a procedure combining orthodontia and maxillofacial surgery, which attempts to correct skeletal discrepancies (Robinson and Holm, 2010). Problems related to oral and maxillofacial region greatly impede masticatory function, lead

to lack of patient satisfaction with their oral conditions and compromised quality of life (Souza et al. 2010). Some conditions may indicate the need for orthognathic surgery. Numerous reports exist on the complications of orthognathic surgery. However, little has been added in the recent literature regarding the range or types of complications. So, the aim of the current study was to determine complications in orthognathic surgery.

MATERIAL AND METHODS

The keywords used for the literature search for this review was peer-reviewed articles following key-words: Orthognathic surgery × Complications × Bone density × Fracture. The search was done and almost 88 abstract and papers collected which the keywords included in them. Among them, the papers were fit the criteria selected and available full-text articles read. Related articles were also scrutinized. Hand search was also driven. The search was carried out using Biological abstracts, Chemical abstracts, and the data bank of the PubMed and Medline database updated to 2016. The references found in the search were then studied in detail.

Aspects of the orthognathic surgery

Orthognathic surgery consists of osteotomy methods performed in the masticatory system for correction of the maxillary discrepancies to achieve facial and cranial balance (Francisco and Jaramillo, 2009). Orthognathic surgery is performed by aligning the maxilla and the mandible to correct facial and maxillomandibular irregularities and to provide correct dental positioning (Chow et al. 2007). Thus, orthognathic surgery is a procedure combining orthodontia and maxillofacial surgery, which attempts to correct skeletal discrepancies (Souza et al. 2012). Orthognathic surgery treatment is organized into 4 phases: presurgical orthodontic therapy, orthognathic surgery, postsurgical orthodontic therapy and retention (Van den

Braber et al. 2006). These steps are essential for the success of orthognathic surgery (Espeland et al. 2008).

Complications in orthognathic surgery

There are numerous reports of rare complications associated with orthognathic surgery. It is not possible to evaluate the incidence of these case reports, and the etiology is often unclear or speculative. Many of these complications are mentioned but not elaborated in this article for the sake of completeness (Bays and Bouloux, 2003). The main problems in orthognathic patients are difficulties chewing or speaking, chronic maxillomandibular pain, excessive dental crowding, difficulty in opening the mouth, open bite, lack of balance of facial features, congenital defects, retracted chin, protruded mandible, difficulty in keeping lips closed effortlessly, chronic mouth breathing with xerostomia and sleep apnea (Wee and Poon, 2014).

Temporomandibular disorders

The malocclusion has role in temporomandibular disorders. Studies support the notion that orthognathic surgery decreases the prevalence of temporomandibular disorders (Bays and Bouloux, 2003). Based on the literature, mean improvement ranges was 48% while worsening of preexisting temporomandibular disorders was 13% (Egermark et al. 2000). The post-surgical stability has improved with the use of internal fixation because it accelerates the bone repair, allows the immediate restoration of the function, decreases complications from maxillomandibular fixation and facilitates the acceptance of treatment.

Challenges in skeletal class III malocclusion

A developing skeletal class III malocclusion is one of the main challenging difficulties confronting the practicing orthodontists. In comparison to class I and II, a true class III malocclusion is rare (Kapur et al. 2008). The class III malocclusion is a growth-related problem that often becomes severe if left untreated and should be corrected as soon as its

initial signs are recognized, such as edge to edge bite or cross bite (Stojanovi et al. 2013). Jaw growth is a slow and gradual process and in some individuals, the upper and lower jaws may grow at different rates affecting chewing, speech, long-term oral health and appearance (Westwood et al. 2003). The correction of class III malocclusion by means of orthopedic/orthodontic treatment in growing subjects can be achieved in about 70% of the patients (Westwood et al. 2003). The correction of Class III malocclusion by means of orthopedic/orthodontic treatment in growing subjects can be achieved in about 70% of the patients (Petre'n et al. 2003). Orthognathic surgery for Class III malocclusion, however, presents with some limitations due to the possibility of incomplete surgical success or, more importantly, of postsurgical relapse (Mucedero et al. 2003). In a study, Wee and Poon, (2014) on 41 patients reported function, psychosocial and facial aesthetics improved significantly in Class III skeletal patients after surgery and these aspects continued well into two-years post-surgery. The inclusion of quality of life as a routine treatment outcome measure in orthognathic surgery would be beneficial in clinical profiling of patients, decision making and evaluating the efficacy of the procedure. Baek et al. (2010) emphasized the surgery-first approach requires accurate prediction of the postoperative orthodontic treatment for dental alignment, incisor decompensation, arch coordination, and occlusal settling. The long-term outcomes of surgery-first approach provided in transverse, vertical, and sagittal dimensions had shown the same or better skeletal and dental stability.

Unfavorable splits with the bilateral sagittal split osteotomy

Sagittal split osteotomy of the mandible is one of the most common operative techniques used in orthognathic surgery. The presence of a third molar in the mandible increases the chances of an unfavorable split when attempting a sagittal bilateral split osteotomy. However, there are

reports on the no difference in the incidence of unfavorable splits with or without third molars (Bays et al. 2003). Also, it is reported unfavorable splits increased with impacted third molars in younger patients (<20) (Reyneke et al. 2002). One of the operative complications during sagittal split osteotomies is a bad split, which describes an unfavorable or irregular fracture of the mandible in the course of the sagittal split osteotomies (Kim and Park 2007). Bad splits during sagittal split osteotomies can assume several forms and occur in different places, on the superior corner of the proximal segment, inferior border left intact on the distal or proximal segment, nerve trapped in the proximal segment, inadvertent cut through the ramus, distal segment vertical fracture, and buccal plate or proximal segment fracture (Teltzrow et al. 2005). Also, Chrcanovic and Freire-Maia (2012) reported in twenty-one studies the incidence of bad splits from these studies varied between 0.21% and 22.72%. The buccal plate of the proximal segment and the posterior aspect of the distal segment were the most affected areas (Chrcanovic and Freire-Maia, 2012). The surgical patient should be evaluated according to age and the presence of unerupted/impacted third molars (Kriwalsky et al. 2008). The sagittal split osteotomies are an extremely technical and sensitive procedure and careful attention will probably prevent most unfavorable splits (Chrcanovic and Freire-Maia, 2012). The occurrence of bad splits cannot always be avoided. When adequately treated the chances of functional success are good splits (Chrcanovic and Freire-Maia, 2012).

Bone density and bad fracture

An unfavourable fracture, known as a bad split, is a common operative complication in bilateral sagittal split osteotomy. Bad splits can affect the buccal or lingual cortical plate of the mandible or the condylar neck (Van Sickels et al. 1996). Unfavorable fractures usually occur in young, teenage patients when third molars are present

during the sagittal split osteotomies (Kriwalsky et al. 2008). If a fracture occurs, the fractured segments should be incorporated into the fixation scheme if possible. The occurrence of bad splits cannot always be avoided. When adequately treated the chances of functional success are good. Bad split leads to infection, bony fragment sequestration, delayed bone healing, and pseudoarthrosis. Postoperative instability, relapse, or dysfunction of the mandible with consecutive impairment of the temporomandibular joint may develop (Chrcanovic and Freire-Maia, 2012). The cut of mandibular basis should be extended properly to prevent unfavorable fracture at the proximal segment and any bone removal overlying the impacted molar must be avoided until the sagittal splitting procedure has been completed (Precious, 2004). The spreading should be done with spreaders in the superoinferior direction instead of anteroposterior direction because of the resistance of cortical bone under the inferior alveolar channel (Precious, 2004).

Quality and life treatment outcomes

This surgical correction has a large impact on the physical and psychosocial aspects of the patient and consequently leads to an improvement of their quality of life (Murphy et al. 2011). This is especially true in class III skeletal patients who present with a hyperplastic mandible or a combination of hypoplastic maxilla and hyperplastic mandible. This gives rise to a concave facial profile and disproportionate facial appearance leading to functional, aesthetics and psychosocial problems (Khadka et al. 2011). The use of quality of life as a measure of well-being in patients undergoing orthognathic surgeries has been gaining interest in recent years. Quality of life can be used as a discriminatory tool to identify patients with or without dentofacial deformities (Alanko et al. 2010). The other complication that is commonly associated with orthognathic surgery is skeletal and dental relapse. The amount of relapse can be affected by

the choice of surgical technique and the type of fixation employed (Espelandet al. 2008). It is reported isolated mandibular setback had a higher degree of relapse when compared to the combination of maxillary advancement and mandibular setback. It was also noted that the combination of maxillary advancement and mandibular setback was only stable with the use of rigid fixation (Profitt et al. 2007).

Condylar distraction

Condylar distraction implies that the condyle is positioned inferiorly or anteriorly to the glenoid fossa seated position. The condyle is therefore unable to support the mandible in the new advanced position defined by the surgeon. Intraoperative distraction of the condyles from their seated position should result in an immediate skeletal relapse when the condyles return to their preoperative position. This kind of relapse can be masked postoperatively by MMF, Class II elastics, or habituation (Joss et al. 2008). Progressive condylar resorption is related to long-term relapse (Bailey et al. 1998). Scheerlinck et al. (1994) showed that 7% of all BSSO advancement patients appear to undergo the amount of advancement correlates. The importance of correct positioning of the condyles before fixation is well-known. Improper positioning of the condyle in the glenoid fossa at time of surgery, when the soft tissue undergoes considerable stretching, can cause relapse. It is believed that the magnitude of advancement is a factor in the proper seating of condyles (Thüer et al et al. 1994). It is easier to manipulate the proximal segment in patients with small advancement who had their condyles set a bit too far posteriorly, with subsequent anterior relocation after surgery.

Miscellaneous complications

Miscellaneous complications include: infection, facial palsy, transection of the inferior alveolar nerve and foreign bodies left in the surgical field. Airway obstruction has ceased to be a problem since the development of internal rigid fixation

made MMF obsolete. Mechanical problems consist of unfavorable bone splits, mostly of the buccal cortical plate, and mechanical failure of osteosynthesis (Van Sickels et al. 1996).

REFERENCES

1. Alanko OM, Svedstrom-Oristo AL, Tuomisto MT. Patients' perceptions of orthognathic treatment, well-being, and psychological or psychiatric status: a systematic review. *Acta Odontol Scand* 2010;68(5):249–60.
2. Baek SH, Ahn HW, Kwon YH, Choi JY. Surgery-first approach in skeletal class III malocclusion treated with 2-jaw surgery: Evaluation of surgical movement and postoperative orthodontic treatment. *J Craniofac Surg* 2010;21:332–8.
3. Bailey LTJ, Duong LH, Proffit WR: Surgical Class III treatment: Long-term stability and patient perceptions of treatment outcome. *Int J Adult Orthod Orthognath Surg* 13:35, 1998
4. Bays RA., Bouloux GF. Complications of orthognathic surgery. *Oral Maxillofac Surg Clin N Am* 15 (2003) 229–242.
5. Chow LK, Singh B, Chiu WK, Samman N. Prevalence of postoperative complications after orthognathic surgery: a 15-year review. *J Oral Maxillofac Surg* 2007;65(5):984–92.
6. Chrcanovic BR, Freire-Maia B. Risk factors and prevention of bad splits during sagittal split osteotomy. *Oral Maxillofac Surg* (2012) 16:19–27.
7. Egermark I, Blomqvist J, Cromvik U, et al. Temporomandibular dysfunction in patients treated with orthodontics in combination with orthognathic surgery. *Eur J Orthod* 2000;22:537– 44.
8. Espeland L, Høgevold HE, Stenvik A. A 3-year patient-centred follow-up of 516 consecutively treated orthognathic surgery patients. *Eur J Orthod* 2008;30(1):24–30.
9. Espeland L, Høgevold HE, Stenvik A. A 3-year patient-centred follow-up of 516 consecutively treated orthognathic surgery patients. *Eur J Orthod* 2008;30(1):24–30
10. Farronato G, Maspero C, Giannini L, Farronato D. Occlusal splint guides for presurgical orthodontic treatment. *J Clin Orthod.* 2008 Sep;42(9):508-12.
11. Farronato G, Maspero C, Giannini L, Farronato D. Occlusal splint guides for presurgical orthodontic treatment. *J Clin Orthod.* 2008 Sep;42(9):508-12.
12. Francisco LDS, Jaramillo VPM. Complicaciones asociadas con osteotomía Le Fort I. *Rev Fac Odontol Univ Antioq* 2009;20(2):205–21.
13. Huang CS, Hsu SSP, Chen YR. Systematic review of the surgery-first approach in orthognathic surgery. *Biomed J* 2014;37:184-190.
14. Joss CU, Vassalli IM: Stability after bilateral sagittal split osteotomy setback surgery with rigid internal fixation: A systematic review. *J Oral Maxillofac Surg* 66:1634, 2008
15. Khadka A, Liu Y, Li J, Zhu S, Luo E, Feng G, et al. Changes in quality of life after orthognathic surgery: a comparison based on the involvement of the occlusion. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;112(6):719–25.
16. Kim SG, Park SS (2007) Incidence of complications and problems related to orthognathic surgery. *J OralMaxillofac Surg* 65:2438–2444
17. Kriwalsky MS, Maurer P, Veras RB, Eckert AW, Schubert J (2008) Risk factors for a bad split during sagittal split osteotomy. *Br J Oral Maxillofac Surg* 46:177–179
18. Kriwalsky MS, Veras RB, Maurer P, Eckert AW, Schubert J. Risk factors for a bad split during sagittal split osteotomy. *Br J Oral Maxillofac Surg* 2008;46:177-9.
19. Liao YF, Chiu YT, Huang CS, Ko EW, Chen YR. Presurgical orthodontics versus no presurgical orthodontics: Treatment outcome of surgical-orthodontic correction for skeletal

- class III open bite. *Plast Reconstr Surg* 2010;126:2074-83.
20. Mucedero M, Coviello A, Baccetti T, Franchi L, Cozza P. Stability factors after double-jaw surgery in class III malocclusion. *Angle Orthodontist*, 2008; 78 (6): 1141-1152.
 21. Murphy C, Kearns G, Sleeman D, Cronin M, Allen PF. The clinical relevance of orthognathic surgery on quality of life. *Int J Oral Maxillofac Surg* 2011;40(9):926-30
 22. Petre'n S, Bondemark L, So' derfeldt B. A systematic review concerning early orthodontic treatment of unilateral posterior crossbite. *Angle Orthod.* 2003;73:588-596.
 23. Precious DS (2004) Removal of third molars with sagittal split osteotomies: the case for. *J Oral Maxillofac Surg* 62:1144-1146
 24. Proffit WR, Turvey TA, Phillips C. The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension. *Head Face Med* 2007;3:21 doi: 10.1186/1746-160X-3-21.
 25. Reyneke J, Tsakiris P, Becker P. Age as a factor in the complication rate after removal of unerupted/ impacted third molars at the time of mandibular sagittal split osteotomy. *J Oral Maxillofac Surg* 2002;60: 654- 9.
 26. Robinson RC, Holm RL. Orthognathic surgery for patients with maxillofacial deformities. *Aorn J* 2010;92(1):28-49.
 27. Scheerlinck JPO, Stoelinga PJW, Blijdorp PA, et al: Sagittal split advancement osteotomies stabilized with miniplates: A 2-5- year follow-up. *Int J Oral Maxillofac Surg* 23:127, 1994
 28. Sousa CS, Turrini RNT. Complications in orthognathic surgery: A comprehensive review. *Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology* 24 (2012) 67-74.
 29. Souza MTde, Silva MDda, Carvalho Rde. Integrative review: what is it? How to do it? *Einstein* 2010;8(1):102-6.
 30. Stojanovi LS, Mileusni I, Mileusni B, Cutovic T. Orthodontic-surgical treatment of the skeletal class III malocclusion: a case report. *Vojnosanit Pregl* 2013; 70(2): 215-220.
 31. Stroster TG, Pangrazio-Kulbersh V: Assessment of condylar position following bilateral sagittal split ramus osteotomy with wire fixation or rigid fixation. *Int J Adult Orthod Orthognath Surg* 9:55, 1994
 32. Teltzrow T, Kramer FJ, Schulze A, Baethge C, Brachvogel P (2005) Perioperative complications following sagittal split osteotomy of the mandible. *J Craniomaxillofac Surg* 33:307-313
 33. Thüer U, Ingervall B, Vuillemin T: Stability and effect on the soft tissue profile of mandibular advancement with sagittal split osteotomy and rigid internal fixation. *Int J Adult Orthod Orthognath Surg* 9:175, 1994
 34. Van den Braber W, van der Bilt A, van der Glas H, Rosenberg T, Koole R. The influence of mandibular advancement surgery on oral function in retrognathic patients: a 5-year follow-up study. *J Oral Maxillofac Surg.* 2006 Aug;64(8):1237-40.
 35. Van Sickels JE, Richardson DA: Stability of orthognathic surgery: a review of rigid fixation. *Br J Oral Maxillofac Surg* 34: 279-285, 1996
 36. Wee TH, Poon CY. 2014. Quality of Life Treatment Outcomes of Class III Skeletal Patients After Bimaxillary Osteotomies. *Proceedings of Singapore Healthcare* , 23(3): 183-190.
 37. Westwood PV, McNamara JA Jr, Baccetti T, Franchi L, Sarver DM. Long-term effects of Class III treatment with rapid maxillary expansion and facemask therapy followed by fixed appliances. *Am J Orthod Dentofacial Orthop.* 2003; 123:306-320.