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REVIEW ARTICLE

DISTRACTION OSTEOGENESIS IN PATIENTS WITH CLEFT LIP AND PALATE: CURRENT UPDATE

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ABSTRACT

The incidence of cleft lip and palate is very high among developed and developing nations. Craniofacial growth is affected with this deformity resulting in hypoplasia and asymmetry of the facial region, specifically the maxilla. Traditionally, orthognathic surgeries were performed in order to correct the deformity. The unsatisfactory outcome from orthognathic surgeries led to employ new approaches to correct the maxillary deformity. Distraction osteogenesis was introduced as a novel way to achieve acceptable results and patient oriented outcomes. The aim of this review is to discuss the current update and outcome of distraction osteogenesis in correcting facial deformity.

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INTRODUCTION

The primary palate forms during the 4th to 7th week of gestation and secondary palate forms during the 6th to 7th week of gestation. Cleft lip and palate occurs due to non-fusion of epithelial bridges. This affects the development ofthe craniofacial region. The prevalence of cleft lip and palate is 1 in 700 births. There is a more pronounced variation for the isolated cleft palate, at the prevalence of 1.3-25.3/ 10 000 births (Mossey, 2009). A number of techniques have been introduced to correct secondary cleft deformities. The most common surgical procedures are conventional orthognathic surgeries and distraction osteogenesis (Berkowitz, 1977). Orthognathic surgery technique comes with disadvantages and it has been reported in previous studies that this method has poor results in severe maxillary hypoplasia. It is reported that 25% to 40% of cases have relapse rate, instability, limited amount of advancement, and is proved to be a highly invasive surgical technique (Kim *et al*., 2015). Codvilla first described distraction osteogenesis in 1905 and later made popular by Illizarov in 1950.

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The principle behind this technique is the biomechanical mechanism of bone tissue formation. Following corticotomy or osteotomy, a distractor is placed on the maxilla for gradual lengthening (McCarthy *et al*., 2001 and Chin *et al*., 1996). The outcome after distraction osteogenesis is well reported. Recent independent systematic reviews have looked for the effectiveness and outcome of the distraction osteogenesis in correcting the maxillary hypoplasia in cleft lip and palate patients compared to orthognathic surgeries. This review found that distraction osteogenesis provides satisfactory facial aesthetics, helps in maxillary correction during mixed dentition and also facilitates velopharyngeal function compared to that of orthognathic surgery (Scolozzi, Paolo, 2008). Another systematic review of five published single randomized controlled trial suggested that a significant soft tissue improvement of lip and nose can be achieved from distraction osteogenesis and conventional osteotomy but difference in aesthetics is reported. In addition, horizontal stability of the maxilla is relapsed following orthognathic surgery as compared to distraction osteogenesis. In regards to speech status and complications, no significant differences were seen from distraction osteogenesis and orthognathic surgery. Hence, irrespective of the technique planned before the surgery, the outcome of speech and velopharyngeal function should be

carefully discussed with the parents (Austin, 2015).The psychological aspect is found to be low in early post-operative period but in long term the distraction osteogenesis gave better life satisfaction compared to orthognathic surgery. Hence, during process of treatment planning an early intervention to manage initial anxiety associated should be arranged (Austin, 2015). Evidence based information was generated through a meta-analysis to assist surgeons in making informed decisions between distraction osteogenesis and conventional osteotomy. The factors that facilitate surgeons to make decision between these two techniques were based on the facial esthetics, age, bone graft, stability, relapse, amount of advancement, osteotomy design, mandibular procedure concurrently and age Since the two techniques have equal impact of speech and facial aesthetics outcome, the authors recommended that, a well-designed research towards hard and soft tissue ratio changes using three dimensional imaging (CBCT) should be carried out (Cheung, 2006).

Complications

The figures estimated from certain study LK Cheung (2006) found that complications of out of 1418, 4.2% patients had complication when treated with traditional osteotomy compared to 5.4% out of 276 patients who had distraction osteogenesis. These results were retrospective in nature and mainly from patients' record. Hence these results should be carefully evaluated. The most common complication noted after conventional procedures are oronasal communication, avascular necrosis, intra-operative hemorrhage, and intra-operative avulsion of osteotomized maxilla. The complications noted with distraction procedure as a device failure and skin irritation. Similarly a recent systematic review (2015) tried to look at complications of mandibular distraction osteogenesis for developmental deformities. The studies included were from 1966 to 2013. The authors found that, out of 565 patients' 37.4% were reported with complications. The complications namely include Inferior alveolar nerve (IAN) neurosensory disturbances, minor infection, device failure, anterior open bite, permanent dental damage, and skeletal relapse. The author devised a classification into type I to type VI. The complication that managed fast in type I were 11.0%, temporary complications without hospitalization were seen in 10.8% (type II), and permanent complications (type VI) were accounted for 9.6% (Verlinden *et al*., 2015). The complications were reduced based on the type of technique employed to correct the jaw discrepancy. Recent evidence evolved from the previous studies that the distraction osteogenesis significantly reduced the incidence of neurosensory disturbance of the Inferior Alveolar Nerve (IAN) after lengthening of the retro-gnathic mandible compared with the Bilateral Sagittal split Osteotomy (BSSO) (Al-Moraissi *et al*., 2015).

Long Term Stability

A systematic review (2008) was conducted to check long-term skeletal stability after craniofacial distraction osteogenesis. It was found that, distraction osteogenesis showed long term stability but suggested limitations of the study conducted and methodologically well designed studies should be carried out. A short term and long term stability after distraction osteogenesis was reported from a retrospective long term follow up study (Al-Daghreer *et al*., 2008). It was found that, the average maxillary advancement in the growing group was 22.2 ± 5.5 mm (range: 15–32 mm); in the non-growing group, it was 17.7 ± 6.6 mm (range: 6–25 mm). On the other hand, growing children had an average 16% relapse in the first year post distraction osteogenesis and an additional 26% relapse in the long-term follow-up. The post-surgical stability among adults was found to be excellent (Al-Daghreer *et al*., 2008). A cephalometric study by Gürsoy (2010), a five year follow up study found that, there was a significant improvement in dento-facial structure after maxillary distraction osteogenesis and stability in maxillary skeletal advancement in children. The study rules that achieving maximum maxillary advancement or facial correction and having easier approach for finalizing osteotomy were the two important indications for distraction osteogenesis (Gürsoy, 2010).

Airway outcomes following distraction osteogenesis

A recent systematic review (2014) concluded that;distraction osteogenesis achieves significant correction in respiratory distress, night time snoring and apnoeic episodes. These findings are confirmed by investigations like cephalometric analysis, polysomnography and imaging studies. A well-designed prospective multi-center cohort trial with long term patient follow-ups is needed to have a long term outcome of distraction osteogenesis procedures because the interpretations were from smaller sample size (Al-Moraissi *et al*., 2015). A previous systematic review (2012) was not conclusive due to the insufficient prospective randomized controlled clinical trials to confirm consistency of increase in the upper airway size and reduced nasal resistance (Sharshar *et al*., 2012).

Conclusion

Orthognathic surgery has been the primary technique for correcting facial bony discrepancies since its introduction in the 1950's. The technique was developed over time and was the gold standard in achieving aesthetic results. However the unique problems noted in cleft lip and palate patients caused by tissue fibrosis due to multiple surgeries in the early phase of facial growth, brought to the fore, the limitations of orthognathic surgery. This is where distraction osteogenesis was able to bridge the treatment deficit noted in orthognathic surgery. By allowing the gradual bone growth to cause changes in the bony size over a period of weeks, the various soft tissue components were allowed to adapt and grow during the process of distraction osteogenesis as opposed to being stretched beyond physiological limits in orthognathic surgery. This growth of the soft tissue components through physiological means results in a permanent change in size and shape with minimal relapse. Our review presents the various studies that have proven the superiority of distraction osteogenesis over conventional orthognathic surgery in achieving cosmetic results in patients with secondary cleft deformities.

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