CASE REPORT

# DISTRACTION OSTEOGENESIS OF A UNILATERAL HYPOPLASTIC MANDIBLE

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**Summary:** Distraction osteogenesis (DO) is a surgical process in which two bony segments are gradually separated so new soft tissue and bone will form between them by applying tension through a fixation device. There are three phases to this process: latency phase, distraction phase, and consolidation phase. The technique was originally applied to long bones but in recent years the method has been adapted for use in maxillofacial surgery. Distraction osteogenesis is a new variation of more traditional; orthognathic surgical procedures which can be applied for the correction of dento-facial deformities and syndromes of the jaws, treating upper airway obstruction in paediatric patients with mandibualr retrognathia, due to tongue collapse and physical obstruction in the hypopharangeal region. It is an effective and powerful reconstructive surgical technique, which can be performed safely without the need of bone graft or blood transfusion. We present treatment of a child with severe facial asymmetry after unilateral TMJ ankylosis corrected by distraction osteogenesis.

## CASE REPORT

An 8 years old Pakistani boy reported to oral surgery department of AFID with chief complaints of limited mouth opening, difficulty in chewing, speech, sleep apnoea and un-aesthetic appearance. He had history of trauma on his lower left jaw.

On physical examination, he was a young child of normal built, well oriented and cooperative. Extra-orally he had severe convex profile with a receding chin and zero mouth opening, obvious facial deformity with fullness of face and deviation of chin on affected side, and prominent antegonial notch on affected side (Figure-1).

Radiographic examination including orthopentomogram, and lateral cephalogram showed skeletal class II discrepancy confirmed by ANB of 18°. Mandibular corpus length (Go-Gn) was 45 mm revealing deficiency of corpus. The mandibular plane, gonial angle and y-axis emphasise on post rotation of mandible but the vertical height was normal. On the basis of clinico-radiographic assessment provisional diagnosis was severe facial asymmetry due to loss of growth centre by TMJ ankylosis (Figure-2).

Because of limitation of mouth opening, nasotracheal intubation was performed with fiberoptic bronchoscope. Under GA and aseptic conditions, mandibular angle region, where distractors were to be placed, was exposed with submandibular incisions. Exposing the cortex of mandibular corpus and ramus on both sides, TRIMED® turkey submucosal distractors were oriented, bilateral sagittal split osteotomy was performed and distractors were secured on both sides.

The distractors were activated after a latency period of 5 days, 0.5 mm twice daily for 20 days. There followed a consolidation period of 8 weeks. TMJ ankylosis was then released by condylectomy followed by interpositional arthroplasty using temporalis fascia. Removed ankylotic chunk was reshaped and fixed as a condyle with ramus using trans-osseous wiring.

After 4 months of distraction and interpositional arthroplasty, the patient is still undergoing follow-up. He has mouth opening of 19 mm, and marked improvement in chin position and facial asymmetry along with resolution of sleep apnoea (Figure-3).

**Figure-1: Pre-distraction extra-oral frontal and lateral view of the patient**

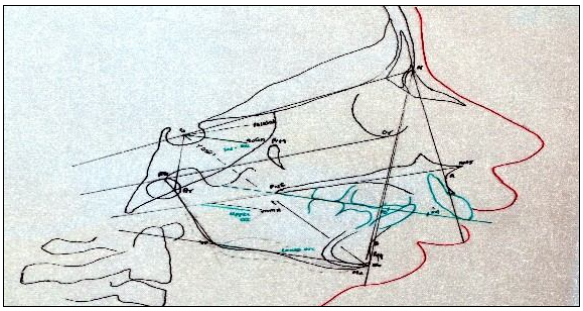

**Figure-2a: Pre-distraction cephalogram analysis**

**Figure-2b: Pre-distraction orthopentomogram**

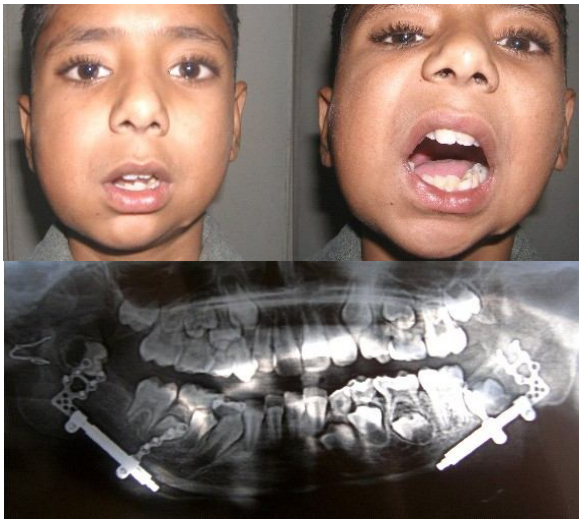

**Figure-3: Post-distraction extraoral frontal view and orthopentomogram**

## DISCUSSION

Distraction osteogenesis is a biological process of new bone formation between the surfaces of iatrogenically fractured bone segments that are gradually separated by incremental traction. A callus forms between the separated bony segments and as long as the traction proceeds, callus tissues are stretched inducing the bone formation.

Distraction osteogenesis was first introduced by Codvilla in 1905 that used the technique to elongate femur. During 1950's the studies of Ilzarov made a contribution in development of the technique by elucidating the biological and mechanical principles in the formation of new bone. DO applied to craniofacial region since McCarthy *et al* in 1992 reported the first clinical application of technique in the treatment of four children with either unilateral or bilateral mandibular hypoplasia.

Early in the history of this procedure, distraction osteogenesis of the mandible involved using bulky external distractors. Although these distractors still have a place in certain applications, a wide variety of intraoral distractors are now available; these are small and compact, with increased patient comfort and acceptance.

In the treatment of our patient, distraction osteogenesis was preferred as orthognathic surgery has relapse risk in severe mandibular deficiencies requiring lengthening of the mandible more than 8–10 mm. Even when the surgical technique is modified, the outer limit of predictable surgical mandibular advancement is 15 mm approximately. In our patient, lengthening of the ramus was also needed but after conventional orthognathic surgical procedures, pterygoid muscle usually does not adapt to the elongation of ramus. However, during distraction osteogenesis, active histogenesis occurs in different tissues including gingiva, blood vessels, ligaments, cartilage, muscles and nerves. These adaptive changes in the soft tissues decrease the relapse risk and allow the treatment of severe facial deformities.

Severe mandibualr hypoplasia can lead to reduction of oropharangeal capacity and glossoptosis because of the post location of the suprahyoid muscles into the mandible and thus airway obstruction, feeding difficulties, speech problem and sleep apnoea. In this patient sleep apnoea resolved after active distraction of about 15 days.

The causes and treatment of TMJ ankylosis have been well documented,[2,3] with trauma and infection identified as the two leading causes[1]. In children, TMJ ankylosis can result in mandibular retrognathism with attendant aesthetic and functional deficits, devastating effects on the future growth and development of the jaws and teeth. Furthermore, in many cases it has a profoundly negative influence on the psychosocial development of the patient, because of the obvious facial deformity.

Mandibular retrognathia is one of the most common craniofacial deformities: approx 10% of the population have significant dental overjet. Mandibular retrognathia may be acquired (due to trauma or a previous surgery) or may be associated with some syndrome like hemifacial micosomai, treacher collins, peirre robin, goldenhar syndrome.

After osteotomy is performed, distraction osteogenesis begins with the formation of a haematoma between the bone segments. The haematoma organises into a clot, and bone necrosis occurs at the end of the fracture segments. An ingrowth of vasoformative elements and capillaries occurs for the restoration of blood supply. Bony trabeculae grow into the fibrous area from the periphery, parallel to the line of tension that occurs during the distraction phase. A bridge of immature bone forms across the distraction gap. A poorly mineralised, radiolucent fibrous inter-zone is located in the middle of the distraction gap. During the consolidation phase, bony remodelling begins and fibrous tissue eventually matures into osseous tissue similar to the native bone.

In the presented case, the patient had a severe mandibular hypoplasia due to short ramus and mandibular body. In this patient reduced vertical height after arthroplasty has been somewhat compensated by reshaped condylar chunk vertically wired with that of ramus by trans-osseous wiring at the end of operation.

Success of the distraction depends on the rate and rhythm of the force applied to site. The optimal rate of distraction is 1 mm per day. A distraction rate of less than 0.5 mm/day may cause premature consolidation of the bone. Distraction of more than 1.5 mm/day may

cause delayed ossification or pseudoarthrosis due to local ischemia in the inter-zone.

The traditional latency period is 5–7 days. The consolidation phase is typically 8 weeks, although some adults may require up to 12 weeks of consolidation. Activation of distractors can often be performed on an outpatient basis, although some patients may require 1–2 days of hospitalisation for postoperative care. During the distraction phase, the patient is examined every 2–3 days to monitor the advancement and to detect potential occlusal discrepancies. Our patient has been treated as an outdoor patient, although admitted before operation day hospitalised only for 2 days post-op. During distraction phase the patient was examined every day. In consolidation phase patient was examined monthly and serial radiogrphs made to see quality of bone formation.

With technologic advancements, distraction devices have become smaller and more sophisticated than early versions. Distraction osteogenesis may even be used with endoscopic techniques to allow the placement of these devices with minimal surgery.

With experience, the overall complication rate is low. Complications include fibrous non-union or premature union of bone, infection that may hinder osteogenesis, noncompliant patient with treatment failure, scarring of the skin with external devices, hardware failure, and malocclusion because of improper vectors. In this patient the only complaint left is slight chin disfigurement which can be treated by genioplasty at a later stage.

## CONCLUSION

Intra-oral distraction of a deformed mandible before releasing TMJ ankylosis is a feasible, and perhaps advantageous, technique in correcting facial asymmetry as well as for upper airway obstruction management in paediatric patients with mandibular retrognathia.

## REFERENCES


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