Original article:

Distraction osteogenesis following gap arthroplasty to correct facial asymmetry - a defined protocol in treatment of patients with temporomandibular joint ankylosis.

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Abstract:

Introduction: Temporomandibular joint ankylosis almost invariably leads to facial asymmetry which can be corrected using either Orthognathic surgeries or Distraction osteogenesis. The aim of this study was to achieve lengthening of mandible in patients with mandibular deformities secondary to Temporomandibular joint Ankylosis using intraoral distraction osteogenesis and also assess the feasibility of use of intraoral distracters.

Method: The Study consisted of ten patients, six males and four females between age group of fourteen to twenty one years, all having unilateral temporomandibular joint ankylosis. Mandibular body osteotomy followed by fixation of intraoral distractor was done in all patients followed by intraoral distraction and consolidation of 6-8 weeks.

Results: Eight(80%) patients had Temporomandibular joint ankylosis secondary to trauma while two(20%) had due to middle ear infection. The amount of distraction done ranged from 9mm to 13mm. The most common postoperative complication was development of open bite (20% cases) which could be corrected with the help of intraoral elastics. Other complication encountered was trauma to adjacent tooth (10% cases) which however was asymptomatic and hence required no active management.

Conclusions: The use of intraoral distracters has very good patient compliance. Only unidirectional movement and second surgery for distractor removal are the shortcomings of intraoral distracters. Distraction Osteogenesis is all in all a comprehensive treatment modality for correction of facial asymmetries as it addresses the hard and soft tissue deficiency both.

Keywords: intraoral distractors, mandibular body osteotomy, latency period, consolidation

Introduction

"Face is the index to mind". Hence an aesthetically well balanced face is actually the essence of beauty. The clinical practice of Maxillofacial surgery has always been faced with the challenge of management of wide variety of facial deformities. The deformities of the mandible involving a combination of soft and osseous tissues are amongst the most common and challenging problems encountered in the face. Hypoplasia involving the mandible may be congenital or acquired. One common acquired cause for the mandibular hypoplasia and subsequent facial asymmetry is Temporomandibular Joint Ankylosis. The Temporomandibular joint has been an Enigma to the Oral and Maxillofacial surgeons over a number of
years now. Temporomandibular Joint Ankylosis is most commonly associated with associated with trauma (13-100%), local or systemic infection (10-49%), or systemic disease (10%). Local infections commonly associated with Temporomandibular Joint Ankylosis are otitis media and mastoiditis. While the systemic infections associated with Temporomandibular Joint Ankylosis are tuberculous, scarlet fever and gonorrhea. Systemic disease known to cause Temporomandibular Joint Ankylosis are ankylosing spondylitis, rheumatoid arthritis, sickle cell anemia, psoriasis and fibrodysplasia ossificans progressiva. Ankylosis can also occur as a result of TMJ surgery. The present study of 10 cases of Facial asymmetry secondary to unilateral ankylosis further emphasizes this fact as 8(80%) of them had trauma as their primary cause & 2(20%) had infection. These findings are also supported by a study by Leonard Kaban conducted in 2009.

Orthognathic surgeries have been the mainstay in the treatment of mandibular hypoplasia. However orthognathic surgeries have their own limitations and complications. One of the major limitations is the inability of the soft tissues to be stretched acutely. In the light of these limitations several new approaches have been developed. One of the alternative approaches is the method of gradual bone distraction known as “Distraction Osteogenesis”. This method was first described by Ilizarov in 1951, who demonstrated that continuous distraction across an artificially created fracture site produced changes similar to those found in an actively growing bone and that gradual distraction acted as a mechanical stimulus to soft tissue growth, even in a mature organ system. Snyder and associates presented first report of experimental distraction of craniofacial skeleton.

Considering the advantages of distraction, a study of ten patients was conducted to assess the management of mandibular deformities secondary to Temporomandibular Joint Ankylosis, using an intraoral distraction osteogenesis device, with following aims & objectives:

1. To achieve lengthening of mandible in patients with mandibular deformities secondary to Temporomandibular joint ankylosis using intraoral distraction osteogenesis technique.
2. To assess the clinical stability and feasibility of distraction osteogenesis in advancement of mandible achieved with Intraoral Distectors.

Methodology
The study consisted of a sample of 10 patients who reported with facial asymmetry secondary to Temporomandibular joint ankylosis. Patients selected for the study were between the age group of 14 year to 21 years. Out of these, 6 were male patients and 4 were female patients. There were 4 cases of left and 6 cases of right sided facial asymmetry owing to ipsilateral Temporomandibular joint Ankylosis. 8 of the cases gave a history of trauma and 2 patients gave the history of middle ear infection. The patients included in study were the ones who had undergone unilateral gap arthroplasty at least 6 months before the distraction planning. Distraction Device used in study was Intraoral stainless steel miniature distraction osteogenesis device (Chaitanya Surgicals, Pune) with monocortical screws of 2mm by 8mm was used.

Pre-operative patient evaluation and preparation included clinical examination along with the evaluation of the facial asymmetry from the frontal as well as lateral aspect. Radiographic evaluation
included PA cephalogram, Lateral Cephalogram (Steiner’s Analysis, Down’s Analysis and Tweed’s Analysis, Grummons analysis) and an OPG. Clinical photographs were taken for the comparison of the correction of the asymmetry.

**Surgical procedure:**

All patients were operated under General Anesthesia in which Nasal intubation was done. The surgical procedure for horizontal elongation of the mandibular body comprised of two stages:-

**Stage I** - Osteotomy and fixation of the distraction device.

**Stage II:** - Removal of distraction device.

Vestibular incision along the external oblique ridge with releasing incision toward the vestibule depth at the anterior end was made. Mucoperiosteal flap reflection was done to expose the osteotomy site. A buccal corticotomy cut was performed at the mandibular body between the second premolar and first molar with the help of straight fissure bur extending from superior to inferior border. Temporary fixation of the device was done parallel to occlusal plane with single monocortical screw on either side of planned osteotomy cut. Lingual corticotomy was done with an osteotome. Osteotomy procedure was carried out preserving the lingual periosteum. The lingual nerve was thus spared. After ensuring the complete mobility of the fragments the appliance was fixed on either side of osteotomy with 2mm diameter monocortical screw of 8mm length (Fig. 1). One complete turn of the device was given once to ensure adequate functioning of appliance. Flap was sutured back using 3-0vicryl suture to cover the entire device. The sleeve was exposed intraorally in buccal vestibule to initiate activation at the 8th day postoperatively (Fig. 2). All patients were given antibiotics and analgesic for 5 days.

**Distraction protocol**:

- Latency period of 7 days before the active distraction.
- Rate and rhythm: 1mm distraction per day, 0.5mm twice daily.
- Consolidation period: 6-8 weeks consolidation period after active distraction.
- Removal of device (After radiological check up).

The amount of distraction was predominantly dictated by the amount of facial midline discrepancy (Fig. 3 & 4). After 6-8 weeks of completion of distraction, the distraction site was evaluated clinically and radiographically to ensure proper healing and callus formation (Fig. 5, 6 & 7). Surgery to remove the device was done through the same intraoral approach that was used for the distractor fixation. OPGs were taken immediate post operatively, at the completion of distraction, at 6 weeks following completion of distraction and 1, 3 and 6 months after distractor removal (Fig. 8).

**Results**

The patients age was ranging between 14 and 21 years, average age being 16.7 years. Out of 10, 6 patients were male 4 were female. 4 patients had left sided while 6 patients had right sided TMJoint Ankylosis.
Table 1: Etiology of mandibular deformities:

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Etiology of Mandibular hypoplasia</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hypoplasia secondary to TMJ ankylosis due to trauma</td>
<td>8(80%)</td>
</tr>
<tr>
<td>2.</td>
<td>Hypoplasia secondary to TMJ ankylosis due to middle ear infection</td>
<td>2(20%)</td>
</tr>
</tbody>
</table>

The amount of the chin deviation (facial midline discrepancy) ranged from 9 to 13mm (Avg. 10.6mm) prior to treatment. Distraction was done till there was no facial midline discrepancy.

Table 2: Complications:

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>Complication</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Infection</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>Paresthesia/Anaesthesia</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>TMJ dysfunction/ Decreased mouth opening</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>Appliance failure</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>Open bite</td>
<td>2(20%)</td>
</tr>
<tr>
<td>6.</td>
<td>Trauma to adjacent tooth</td>
<td>1(10%)</td>
</tr>
</tbody>
</table>

Discussion

Traditionally orthognathic surgeries have been the more common and preferred technique for the correction of the facial asymmetry. However in the recent times Distraction Osteogenesis has emerged to be a more comprehensive treatment modality for this purpose as it addresses the major shortcomings of the Orthognathic surgeries like the amount of asymmetry that can be corrected and the soft tissue deficiency. Besides it can be used in growing patients in whom expansion and new generation of covering soft tissues is necessary. Also the new bone that is formed by distraction osteogenesis is of same morphology as the bone being distracted. Hence there is no need for autogenous bone grafting thereby eliminating the donor site morbidity.

Ever since the technique was propounded by Ilizarov in Orthopedic surgery, it has gained a wide popularity. The success of the procedure in human mandible by McCarthy\textsuperscript{11} and other workers led to its extensive application in Maxillofacial surgery. The distraction devices used may be Intraoral or Extraoral, Monoplanar or Multiplanar.

In 1995 Intraoral Devices were introduced for mandibular distraction by McCarthy \textit{et al.}\textsuperscript{11} Intraoral distracters have proven to be efficient in the mandibular lengthening and this has been supported by the study of van Strijen \textit{et al.}\textsuperscript{12}. Diner \textit{et al.}\textsuperscript{13} claimed that the intraoral unidirectional distracters can treat all cases of mandibular hypoplasia located in the ascending ramus or in body of mandible. Versatility of the intraoral distracters has been shown in a study by Robino Bueno \textit{et al.}\textsuperscript{14} who used intraoral distracters to correct various grades of mandibular hypoplasia using unidirectional intraoral distracters and achieved lengthening ranging from
17 to 30mm. So considering a significant support to the efficacy of the intraoral distracters, in the present study also utilization of intraoral device was done in all the ten cases of mandibular hypoplasia.

The potential benefits of internal device as listed by Diner, Kollar, Martines et al\textsuperscript{13} include:
1. Elimination of skin scarring caused by fixation of transcutaneous pins.
2. Improved patient compliance during the distraction and consolidation phase, because there is no external component.
3. Minimal risk of injury to inferior neurovascular bundle and branches of facial nerve.

Limitations of intraoral devices:
1. Requires second surgery for removal.
2. Do not allow multidirectional lengthening.

All the ten patients underwent unilateral distraction. Horizontal lengthening of mandibular body ranging from 9 to 13 mm was carried out. The lateral aspect of mandibular body between second premolar and first molar was selected as osteotomy site. The advantage of choosing the body region between the second premolar and first molar is that it provides a residual proximal mandible large enough to provide adequate anchorage. This is of particular importance in the patients operated for TMJoint ankylosis and having a relatively smaller residual ramal stump after gap arthroplasty.

The soft tissue associated with distraction zone stretched but did not tear which is consistent with the findings in the study by Molina \textit{et al}\textsuperscript{15}. Gradual distraction of the mandible resulted in an increased mandibular mass and length and simultaneous soft tissue adaptation. Various problems encountered during procedure were:
1. Accessibility was the major issue. Adequate accessibility and retraction to allow the placement of the intraoral distractor was challenging.
2. Orientation of the device is extremely crucial to the overall results. The long axis of the distractor was placed parallel to the mandibular occlusal plane. Moderate difficulty in orientation of device was experienced mainly due to scarce accessibility.
3. The development of anterior open bite occurred in two patients (20.0\%). It was the most common problem during mandibular lengthening. Similar problem was faced by Samchukov \textit{et al}\textsuperscript{16} in his study. However the problem was addressed using intraoral elastics.
4. There was injury to tooth adjacent to the osteotomy cut in one patient (10.0\%). However the patient had no symptoms associated with the involved tooth and so no intervention was needed.

\textbf{Conclusion}
Although distraction achieved the desired results, further study and investigations are required in regard to multiplanar distraction in all three dimensions to correct complex deformities. Long term stability, the effect on growth and temporomandibular joint behavior, await further evaluation.

\textbf{Acknowledgements}
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\textbf{Conflict of interest: Nil}
Fig. 1: Distractor in position intraorally, arrow showing osteotomy line

Fig. 2: Exposure of the sleeve of the distractor in buccal vestibule

Fig. 3: Pretreatment frontal view

Fig. 4: Posttreatment frontal view

Fig. 5: Post distraction OPG showing callous formation

Fig. 6: Preoperative PA Ceph showing midline discrepancy

Fig. 7: Postoperative PA Ceph showing correction of midline discrepancy
Fig. 8: OPG 6 months following distractor removal showing good consolidation.

References

