Evaluation of Functional and Esthetic Outcome After Correction of Mandibular Hypoplasia Secondary to Temporomandibular Ankylosis Treated by Distraction Osteogenesis

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Abstract Patient with TMJ ankylosis are affected with mandibular hypoplasia which in turn causes functional and esthetic problems. Restoration of normal function and esthetics is the prime goal in treatment of such patients with distraction becoming an important treatment option. The present study also was conducted on patients with mandibular hypoplasia secondarily to TMJ ankylosis treated with distraction. Since function and esthetics improvement was the prime aim behind the treatment with distraction, evaluation of functional and esthetics outcome becomes an important aspect. Thus the study was indigenously designed and aimed at qualitative evaluation of the functional and esthetic outcome after correction of mandibular hypoplasia secondary to temporomandibular ankylosis with Distraction osteogenesis. Patients treated with distraction were evaluated on the basis of parameters for function and esthetics. Parameters for function were occlusion, airway, mouth opening and chewing-biting perception of patient pre and post distraction. Parameters for esthetics used were patient and panel perception. All parameters for function and occlusion improved with distraction in all the patients except one in whom occlusion and chewing- biting pattern worsened. It is concluded that distraction is a good option for improving patients functional and esthetic outcome in cases of mandibular

hypoplasia secondary to temporomandibular ankylosis as the results achieved are stable with negligible chances of relapse.

Keywords Distraction osteogenesis · Temporomandibular ankylosis · Mandibular hypoplasia

Introduction

Temporomandibular joint (TMJ) ankylosis is a complex craniofacial disorder which involves fusion of mandibular condyle to glenoid fossa of temporal bone leading to obliteration of TM Joint [1]. Apart from limited to zero mouth opening, it significantly causes mandibular growth retardation in both horizontal and vertical planes [2]. The extent of growth retardation depends on onset, severity and duration of insult to TMJ. Unilateral TMJ ankylosis cases present with jaw asymmetry with or without retrognathia, while bilateral cases present with moderate to severe retrognathia leading to obstructive sleep apnoea. Restoring normal anatomy and facial features is challenging in such cases [3, 4]. A lot of research has been done on it and in recent years the role of distraction in TMJ ankylosis cases has received considerable importance. Distraction osteogenesis has become a mainstay for reconstruction in TMJ ankylosis with mandibular hypoplasia [2].

The standard bone grafts are unpredictable and unsatisfactory results such as re-ankylosis, growth disturbance, facial asymmetry and donor site morbidity are also common. Advancement of the mandible greater than 7 mm becomes increasingly more unstable with traditional osteotomies. Large advancements of the mandible are a relative indication, but when technical difficulties with a thin ramus or relapse after a previous sagittal split are accompanied

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with a large movement, then distraction is a reasonable alternative [5]. This approach of distraction enables the reconstructive team, through a minimally invasive procedure, to manage patients with severe mandibular hypoplasia after ankylosis from childhood to adulthood with excellent and predictable functional and esthetic outcomes [2]. The present study also was conducted on patients with mandibular hypoplasia secondarily to TMJ ankylosis treated with distraction. Since function and esthetics improvement was the prime aim behind the treatment with distraction, evaluation of functional and esthetics outcome becomes an important aspect.

Thus the study was indigenously designed and aimed at qualitative evaluation of the functional and esthetic outcome after correction of mandibular hypoplasia secondary to temporomandibular ankylosis by distraction osteogenesis.

Materials and Methods

The study was a prospective study conducted at Maya Cleft and Craniofacial Center, Agra on 14 patients with severe mandibular hypoplasia who were previously operated for TMJ ankylosis with interpositional arthroplasties.

Inclusion criteria: Patients with severe mandibular hypoplasia post (6 months after) interpositional arthroplasties for TMJ ankylosis (unilateral or bilateral) which cannot be corrected with traditional osteotomies.

Exclusion criteria: Patients unfit to undergo surgery under general anesthesia due to medical problems.

All the patients included in the study were informed in detail about the procedure and informed consents were obtained before starting the procedure.

All cases were subjected to detailed cephalometric analyses to determine the extent and plane of deficiency. Objective analyses gave the amount and vector of distraction to be achieved. Intraoral uniplanar distractors were used which were placed with an extraoral approach (riscons approach) taking care that marginal mandibular nerve was preserved and all incisions came in the shadow of the mandible and neck creases (Figs. 1, 2).

Unilateral distraction was done in cases with just mandibular asymmetry, while bilateral distraction was done in cases with retrognathia with or without asymmetry. All surgeries were performed under general anesthesia with nasotracheal intubation.

In the surgical procedure, osteotomy cut was first marked in Ramus-Body region and distractor adapted according to the predecided vector and screw holes marked. The distractor was then removed and osteotomy completed, preserving the inferior alveolar nerve and vessels. The distractor was then finally applied after checking that there is no soft tissue interposed between the

Fig. 1 Exposure of mandible

Fig. 2 Placement of distractor

osteotomised segments and closure done. The distraction was started after a latency period of 5 days. Distraction rate was 0.5 mm twice per day i.e. 1 mm/day. The distraction was stopped after the desired symmetry and position was achieved. Regular check X-rays were done to monitor the progress of treatment (Fig. 3A–C). In asymmetry cases with severe retrusion, bilateral distractors were placed and differential distraction was done to achieve sufficient advancement and symmetry. After a consolidation phase of 10–12 weeks, distractor removal was done. Advancement sliding genioplasty was performed to achieve good facial profile if required (Fig. 4A–C).

Evaluation Criteria

All patients were evaluated post distraction for functional and esthetic outcome.

Parameters used for evaluating functional outcome were:

- Respiration:** Airway evaluated with the help of pre distraction and post distraction lateral cephalograms and to score as 1 (if improved) and 0 (if same, worsened or not improved).
- Occlusion:** Pre and post distraction occlusal evaluation by an orthodontist and a prosthodontist (jointly) only called for evaluating the occlusion and not

Fig. 3 Check X-rays to monitor progress. **A** Pre-distraction, **B** distractor placed, **C** post-distraction

Fig. 4 Patient with distraction and genioplasty. **A** Pre-distraction, **B** post-distraction, **C** post genioplasty

involved anywhere else in the study and to score them as 1 (if improved) and 0 (if same, worsened or not improved).

- (c) *Biting and chewing efficiency*: Asking patient to compare pre distraction and post distraction biting chewing pattern and scoring them as 1 (if improved) and 0 (if same, worsened or not improved).
- (d) *Mouth opening*: Pre and post distraction was evaluated and scores of 1 (if increased or same) and 0 (if reduced).

Parameters used for evaluating esthetic outcome were:

- (a) *Patients perception*: Showing patient their own pre distraction and post distraction photographs (frontal and profile views) and scoring them as 1 (if facial esthetics according to patients has improved) and 0 (if facial esthetics according to patient is same, worsened or has not improved).
- (b) *Panel perception*: A panel of a plastic surgeon and a cosmetic maxillofacial surgeon were asked to evaluate the pre and post distraction photographs (frontal

and profile views) of the patients. Both were not involved anywhere in the study apart from evaluating the photographs. They were jointly asked to evaluate the photographs and to score them as 1 (if facial esthetic was improved) and 0 (if facial esthetic was same, worsened or not improved).

All parameters for functional and esthetic outcome were evaluated separately for each patient and were put in tabulated form for detailed qualitative analysis. All the patients were followed-up for a period of 2 years. On each follow-up stability and relapse were also noted.

Results

The prospective study was conducted on 14 patients (8 males and 6 females) with severe mandibular hypoplasia, who were previously operated for TMJ ankylosis with interpositional arthroplasties (Graph 1). Fourteen patients included in the study had either unilateral or bilateral

ankylosis. Out of 14 patients, 10 had unilateral ankylosis and 4 had bilateral ankylosis (Graph 2). Age of patients ranged between 14 and 22 years with mean age of 18.64 years.

Mean distraction done was 14.2 mm, minimum being 11 mm and maximum being 18 mm.

Two patients had retrognathia along with asymmetry, who underwent bilateral differential distraction (Table 1).

Functional outcome was evaluated based on individual scores of parameters like change in airway (analysed by checking pre and post distraction lateral cephalograms), occlusion (pre and post distraction occlusion evaluated by an orthodontist and a prosthodontist jointly), chewing–biting (based on patients' perception) and mouth opening (pre and post distraction). On analyzing the qualitative data for functional outcome it was found that airway size had improved for all the patients post distraction (Table 2).

Occlusion had improved for all patients except one and that was the patient where we did a maximum distraction of 18 mm. The patient developed an open bite of 4 mm post distraction.

Biting and chewing perceptions as noted by patients themselves, also improved in all patients except one and that was the same patient with maximum distraction of 18 mm who developed a 4 mm overbite. Mouth opening was maintained for all patients post distraction.

Based on these clinical parameters it can be commented that the functional outcome of patients had improved in all except one patient. In that patient although occlusion and biting perception had not improved and worsened but the airway had improved satisfactorily. Mouth opening for all patients was maintained in pre and post distraction phases.

For esthetic outcome the scores of patient perception and panel perception were used (Table 3).

On analyzing the qualitative data for esthetics based on clinical parameters like patients' own perception (of pre and post distraction photographs, frontal and profile views) and panel perception (of pre and post distraction photographs of frontal and profile views) showed that the esthetics had improved in all the patients. All the patients

Graph 2 Pie chart showing distribution of ankylosis

Table 1 Enumerating type of distraction and amount of distraction

Serial no.	Type of distraction	Amount of distraction (mm)	
		Left	Right
1	B/L	18	18
2	B/L(D)	17	14
3	B/L(D)	15	18
4	B/L	14	14
5	U/L	13	–
6	U/L	–	14
7	U/L	–	12
8	U/L	11	–
9	U/L	13	–
10	U/L	14	–
11	U/L	11	–
12	U/L	15	–
13	U/L	–	13
14	U/L	12	–

B/L bilateral, U/L unilateral, B/L(D) bilateral with differential

were satisfied with the outcome of distraction as perceived by them and according to all of them their esthetics had increased considerably. The panel perception also showed that esthetics had become better post distraction.

Thus the results of the study showed positivity for distraction in patients with mandibular hypoplasia after ankylosis. Both functional and esthetic outcomes increased with the usage of distraction (Figs. 5A, B, 6A, B)—photograph of patients pre and post distraction). Relapse was not seen in any of the cases on follow-up.

Discussion

Patients with TMJ ankylosis mostly suffer from mandibular hypoplasia which in turn effects the patient's normal functions and esthetics. Greater the duration of release of

Graph 1 Pie chart showing sex distribution in the study

Table 2 Scores of patients for functional outcome

Serial number	Airway assessment score	Occlusion score	Chewing and biting score	Mouth opening score
1	1	0	0	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1

ankylosis, more is the severity of hypoplasia and more severely are the functions and esthetics hampered.

Ankylosis release and costochondral graft reconstruction continue to be used as the standard procedures to treat TMJ ankylosis. The complications associated with these procedures are excessive and unpredictable growth or the necrosis and resorption of the costochondral graft. Also costochondral graft does not release the tension caused by the atrophic facial muscles against the graft. Relapse is more accentuated in micrognathic patients presenting with the typical “Bird face” deformity, having deficient soft tissue of the lower third of the face and at the neck, absence of the neck angle and shortened suprahyoid muscles. If a conventional mandibular advancement by osteotomies and

Table 3 Scores of patients for esthetic outcome

Serial number	Patient perception score	Panel perception score
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1
9	1	1
10	1	1
11	1	1
12	1	1
13	1	1
14	1	1

bone grafts is performed in this type of patients, the muscles and the tight skin envelop results in minimal esthetics. With bone distraction all the tissues from skeleton to skin are simultaneously elongated with optimal esthetic results [6].

The other disadvantages of conventional osteotomy procedures are: surgical neurosensory complication, condylar resorption, post-operative relapse, bone graft failure, bone graft donor site morbidity and bone formation by secondary healing. To overcome these problems distraction osteogenesis is the treatment of choice for the reconstruction of temporomandibular joint ankylosis and mandibular hypoplasia [2].

The two major strengths of distraction osteogenesis in the mandibular reconstruction are the ability to provide strong bone with excellent blood supply and the ability to

Fig. 5 **A** Pre distraction photograph of a patient, **B** post distraction photograph of a patient

Fig. 6 **A** Pre distraction photograph of a patient, **B** post distraction photograph of a patient

provide effective expansion of the soft tissue envelope called distraction histogenesis. By this technique elongation of the mandible is done using corticotomies at the angle of the mandible that preserves the integrity of the nerve and vascular supply. The position of the pin placement will determine the distraction vector. The distraction vector is different in each patient according to the grade of mandibular hypoplasia. These enhance the contour and position of the soft tissue. This approach enables the reconstructive team, through a minimally invasive procedure, to manage patients with severe mandibular hypoplasia from childhood to adulthood with excellent and predictable functional and esthetic outcomes [2].

Both intraoral and extraoral distraction techniques have their advantages and disadvantages. Intra oral distraction has limitations such as: placement of distraction device is technically difficult intraorally, difficulty in maintaining oral hygiene, placement of intraoral device at the time of placement may lead to injuries to unerupted tooth, roots of erupted teeth, wound dehiscence and second surgical procedure required to remove the distractor [2, 7]. The advantage of intraoral distraction is that it is less bulkier, hidden in oral cavity, there is greater patient compliance and no extraoral scarring [7].

The advantages of extra oral distraction osteogenesis are: hardware is easy to place, lesser chances of infection, easier to maintain oral hygiene, mandible lengthening more than 20 mm is feasible, multiplanar and bi-directional devices are largely successful in lengthening the mandible. The disadvantage of extra oral distraction osteogenesis are: device looks bulkier to the patient, depressed pin scars along the pin tracts and pin tract infections are a possibility [2].

In the present technique, an intraoral distractor with an extraoral approach was used. This aided in gaining advantages of both intraoral and extraoral distractors, which simultaneously reduced the disadvantages of each

technique. With the use of intraoral distractor, the size of distractor reduced in size which in turn was more acceptable by patient than the bulkier extraoral counterparts. Also due to the hidden nature of distractor, patient acceptance increased. The advantages of easy placement, better control, easy activation and good oral hygiene by patient were achieved. The hidden scars in neck crease and shadow of mandible to place the distractor eliminated the pin tract scars of extraoral distractors which are rarely acceptable to patient. Also, good coverage of oral mucosa was achieved when the distractor was applied through extraoral technique as compared to intraoral placement of distractor. This in turn reduced the chances of mucosal dehiscence. Trauma to the teeth also was not seen as better control was present at the time of surgery and distractor placement due to good accessibility.

Patients with TMJ ankylosis have various functional and esthetic facial deformities. It is characterized by retrognathic mandible; chin deviation towards the affected side, limitation of mandibular movements, sleep apnea syndrome, facial muscle atrophy and occlusal plane cant [2, 5].

Most of the patients in the present study had functional and esthetic problems due to mandibular hypoplasia secondary to TMJ ankylosis. The patients were treated with the help of distraction. Then qualitative evaluation of the functional and esthetic outcome was carried out.

On analyzing the data it was found that the parameters of function like occlusion, airway and biting-chewing had improved in all but one patient. That patient was of bilateral ankylosis and both occlusion and biting-chewing perception of patient had worsen. Mouth opening was maintained by all the patients.

The parameters for esthetics taken were patients' and panel's perception. The patients' opinion (pre and post distraction photographs) as parameters were taken since esthetics is an individual perception and it is of utmost

importance how an individual feels about his or her looks. On the other hand the specialists' opinion as panel perception was also taken into account as they could judge the pre and post distraction esthetics changes professionally and technically. On evaluation it was found that both patient and panel perceptions for esthetics had improved post distraction in all the cases.

Conclusion

It is concluded that distraction is a good option for improving patients functional and esthetic outcomes in cases of mandibular hypoplasia secondary to temporomandibular ankylosis as the results achieved are stable with negligible chances of relapse. The aim behind the qualitative analysis was to find an easier and simpler way in clinical practice to analyze the functional and esthetic outcome for patients with mandibular hypoplasia secondary to TMJ ankylosis. However, it is recommended that future studies should be carried out with more number of

patients along with quantitative estimation of data for cross verification and achieving a more definite conclusion.

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