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LATERAL ARTHROPLASTY AS AN OPTIMAL TREATMENT FOR SURGICAL MANAGEMENT OF UNILATERAL TEMPOROMANDIBULAR JOINT ANKYLOSIS TYPE III IN CHILDREN

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ABSTRACT

Management of temporomandibular joint (TMJ) ankylosis described in the literature showed many surgical techniques.

Purpose: The aim of this study was to evaluate the lateral TMJ arthroplasty as a surgical technique for treatment of type III Sawhney's TMJ ankylosis in children both clinically and radiographically. In that surgical technique the need of a costochondral graft for reconstructive arthroplasty is avoided with its potential complications (as a donor site) and the unpredictable growth pattern.

Materials & Methods: Eight children with unilateral type III Sawheny ankylosis (ankylosis on the lateral aspect of the medially displaced condyle) were included in this research. They all underwent lateral TMJ arthroplasty with the aid of panoramic and coronal C.T views. Evaluation was done both clinically and radiographically regarding interincisal distance, lateral TMJ movement, protrusive movements, postoperative pain, patient's satisfaction and hazards of facial nerve injury. All patients were seen weekly for 4 weeks, at three and six months then at one year.

Results: The used surgical technique of lateral arthroplasty had greatly achieved the desired goals of treating TMJ ankylosis during a follow up period of one year. Those achieved goals include restoration of full mandibular function and free movements of the joint with adequate mouth opening and a mean interincisal distance of 35 mm, maintaining acceptable occlusion and ramus height and obviates the need of any autogenous chondro-osseous graft (commonly costochondral) with potential complications of the donor sites.

Conclusion: The surgical procedure of lateral arthroplasty is an easy and safe technique. It is considered as an effective treatment modality in treatment of type III TMJ ankylosis especially in children.

KEY WORDS: Lateral arthroplasty, Preservation of medially displaced condyle, Temporomandibular joint ankylosis in children, Treatment modalities.

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INTRODUCTION

Temporomandibular ankylosis can be defined as a state in which the mandibular condyle is fused to the glenoid fossa of the temporal bone either by bony or fibrous tissue. [1]

Mandibular fractures are common to occur, mandibular condylar fractures remain the most important cause or predisposing factor to the development of TMJ ankylosis in children.[2-5]

Temporomandibular joint ankylosis in children considered to be challenging in treatment as it has clinical and social problems, and starts during the active growth stage of early childhood. The surgeon must also consider the potential effects of time and growth on the results of the surgical technique. [3]

Establishing temporomandibular joint movement and function, restoring the facial appearance, achieving normal growth and occlusion and of course prevention of relapse in children are the proper goals of managing such patients. [6,7]

Sawhney in 1986 was the first to classify TMJ ankylosis into four types (I–IV) according to the anatomical relationships present in the computed tomography (CT) of the joint. The most common types are type III and type IV ankylosis. Type III ankylosis shows an improperly treated or medially displaced condylar process fracture, in this condition a lateral bridging of bone occurs between the ramus and zygomatic arch.[8] Coronal CT with the panoramic views of the TMJ were considered to give the best radiographic identification of type III ankylosis. [9]

Treatment of TMJ ankylosis in children has a significant challenge to oral and maxillofacial surgeons because of complex and distorted anatomy with loss of anatomical landmarks which lead to technical difficulties with a high incidence of recurrence. Also complicated reconstruction of the joint to provide rehabilitation of mandibular movement, restore posterior facial height (mandibular ramus height) and improve the occlusal plane in children to allow further mandibular growth is needed, this makes this type of surgery particularly difficult.[9]

The location and integrity of the medially displaced condyle and disc can be determined and both should be preserved rather than eliminated to get their important roles in mandibular function and growth, even with their deformed shape and displaced medial position while managing type III cases.[10]

This surgical objective can be obtained by selective excising of the lateral bony bridge (lateral arthroplasty) of the affected TMJ, and allowing the remaining mandibular condyle and disc to function in articulation with the glenoid fossa. [10]

The aim of this study was to evaluate the lateral TMJ arthroplasty as a surgical technique for treatment of type III Sawhney's TMJ ankylosis in children both clinically and radiographically. In that surgical technique the need of a costochondral graft for reconstructive arthroplasty is avoided with its potential complications (as a donor site) and the unpredictable growth pattern.

MATERIALS AND METHODS

This is a prospective non-controlled (one study group) clinical study that was conducted on 8 TMJs of 8 children patients suffering from unilateral TMJ ankylosis. All patients were selected and treated in the oral and maxillofacial surgery department, faculty of dentistry at Tanta University. Ethical approval of the study was obtained from the Research Ethics Committee of Faculty of Dentistry in which the research was conducted.

Exclusion criteria: Children with type I, II, and IV ankylosis (Sawhney's classification), with bilateral ankylosis, cases of recurrent or previously treated ankylosis and patients with medical contraindication for surgery were excluded from our study.

Preoperative evaluation

The preoperative evaluation included the patient history (age, sex, history of previous trauma, medical condition and chief complaint).

Physical examinations involved detection of chin scar, facial asymmetry and measuring of the interincisal distance during maximum opening using calipers, and also the protrusive and lateral movements in relation to the maxillary mid-line were measured. Frontal and lateral profile photographs were obtained for all children (Fig 1).

Radiological examination included panoramic view and coronal, axial and 3-D CT scan (Fig 2). All children underwent routine hematological examinations to check their fitness for surgery.

Surgical technique

The surgical procedures were performed under general anesthesia with endotracheal intubation using either blind nasotracheal or with the aid of fiber-optic laryngoscope.

The surgical technique was performed according to Singh et al. [9] and Xu et al. [11], in which the ankylotic joint was surgically exposed via a standard pre-auricular surgical approach which provides adequate access and sufficient exposure (Fig 3). The resection was performed starting on the lateral aspect of the base of the ankylosed mass, leaving about 1.5–2 cm distance from the base of the skull to the neck of condyle, guided by the coronal CT images, avoiding damage to the condyle and disc that located in a displaced place in the medial aspect of the joint (Fig 4).

The bony resection was only carried out on the lateral side of the joint, which considered to be easier than the conventional method of gap arthroplasty in which a full thickness of bone resection is performed. At this point, the medially displaced condyle and disc were detected and checked for proper function and location by moving the mandible. Now a large

Fig. (1) Clinical photograph showing a child patient with Lt side TMJ ankylosis; marked limitation of mouth opening and deviation to the affected side and facial asymmetry.

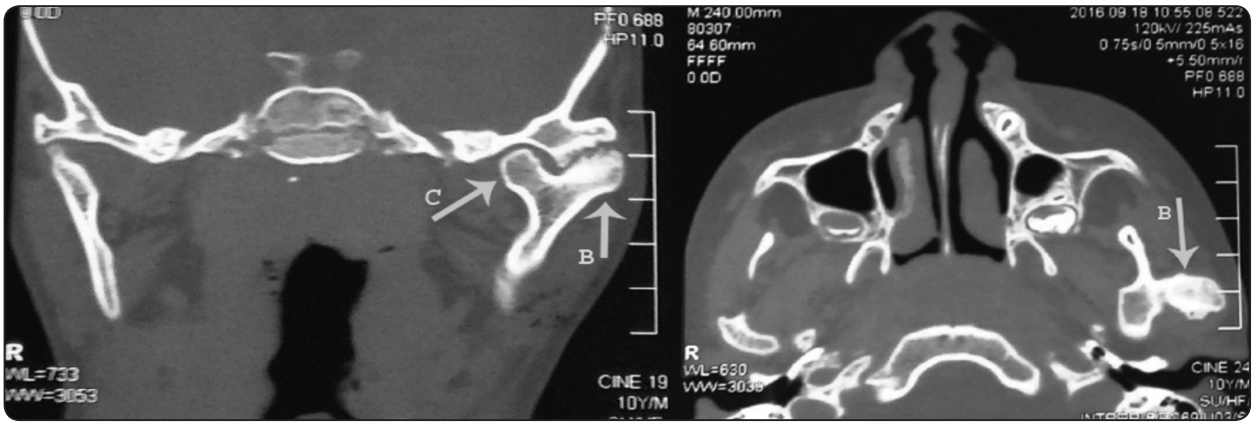

Fig. (2) Coronal and axial CT veiws of the same patient showing the ankylotic bony mass situated laterally (B arrow) while the condyle is displaced medially articulating with the glenoid fossa at the base of the skull and the disc space is preserved (C arrow).

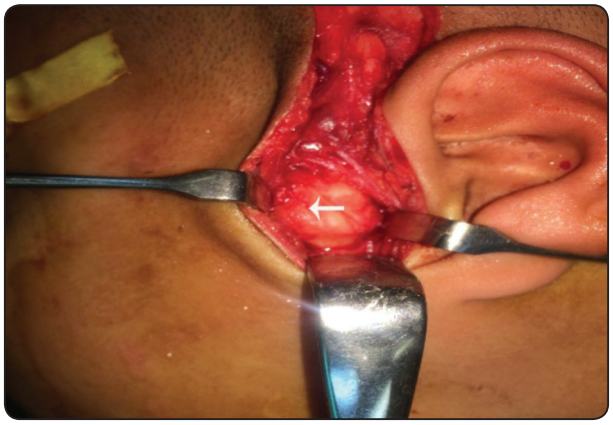

Fig. (3) Intraoperative exposure of the lateral callus (arrow) of a Lt side ankylosis through a preauricular incision.

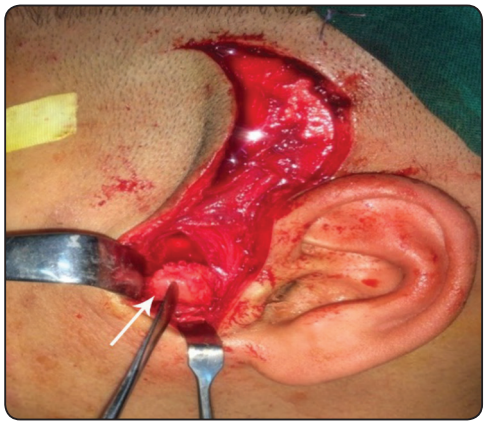

Fig. (4) Intraoperative photograph showing the surgical procedure during removal of the lateral callus (arrow) of a Lt side ankylosis after separation from underlying ramus and arch.

gap between the glenoid fossa and the lateral stump was created while the condyle is completely fused with ramus in a medially angulated position and a considerable relation to the glenoid fossa (Fig 5). The irregular bony margins and spicules at the lateral side of the ramus were then contoured with copious saline irrigation to flush out any residual bony debris. Mouth opening and mandibular movements were checked passively before wound closure. The maximum inter-incisal mouth opening was recorded at the end of the operation.

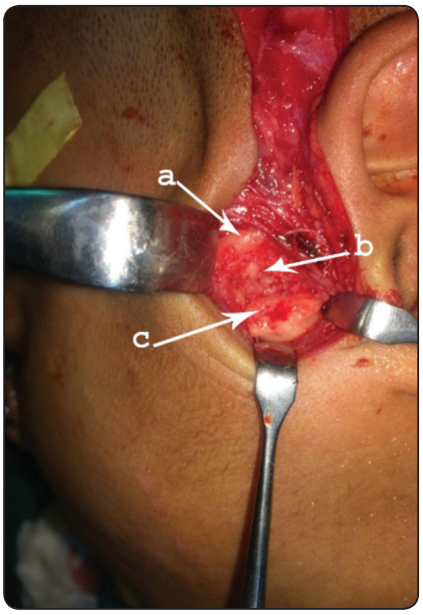

Fig. (5) Introperative photograph after removal of the lateral callus showing the zygomatic arch with underneath glenoid fossa (a arrow), the medially displaced condyle (b arrow) that is in a good relation with the glenoid fossa and the lateral ramus stump fused to the condyle (c arrow).

Post-operative evaluation

All patients underwent physical therapy that was started from the second postoperative day. They were also trained to carry out mouth-opening exercises at home, which included moving of the mandible in all directions by frequent chewing of gum. Also the use of wooden tongue depressors (2 mm thick) was highly recommended and encouraged through bilateral application between the upper and lower premolar–molar region. Patients and/or parents were instructed to practice this exercise three times a day (15-20 min each) with increasing the number of depressors to gain the maximum possible mouth opening.

All patients were seen weekly for 4 weeks and then followed up clinically and radiologically at three and six months then at one year.

Clinical evaluation

1- Pain: Postoperative pain was assessed using a visual analogue scale with a value of 0 indicat-

ing no pain and a value of 10 indicating severe pain.

2- Maximum mouth opening: Postoperative interincisal distance was measured after 1 month, 3 and 6 months and after one year.

3- Protrusive movement: It was also measured during the same follow up recalls.

4- Lateral movements: It was also measured during the same follow up recalls.

Radiographic evaluation: panoramic and CT scans with 3D reformatting were done one month, six months and one year postoperatively.

RESULTS

A total of eight children with ages ranged from 5-12 years and a mean of 10 years were surgically treated from unilateral temporomandibular joint ankylosis. Two patients (25%) were females and six (75%) were males. With regards to the ankylotic joints, 50% (4 children) had right TMJ ankylosis and the rest 50% (4 children) had left TMJ ankylosis. The etiological factor of ankylosis was trauma in all children.

Regarding the soft tissue healing and skin scarring, there was uneventful soft tissue healing at the pre-auricular region. There was no affection of the temporal or zygomatic branches of the facial nerve except in two cases in whom the facial nerve affection was temporary weakness caused by excessive flap retraction and recovered completely after one month. There was also gradual improvement of facial form during the follow up periods due to joint release and proper restoration of muscular function of the affected side with less shift to the previously ankylosed side especially during mouth opening (Fig 6, 7)

Pain score in the immediate postoperative period as measured by the VAS was ranged from 3–7 with a mean of 6 ±1.5 standard deviation (SD). It was decreased at the 2nd week to be (2-5) with a mean of 3± 0.8 and by the end of the 4th week it disappeared completely.

The preoperative maximum interincisal distance was ranged from 18–25 mm with a mean of 20 mm ± 2.78 SD, the protrusive movement was ranged from 1-2 mm with a mean of 1.5 mm ± 0.34 SD and the lateral movement toward the affected side were ranged from 3-5 mm with a mean of 3.3 mm ± 0.56 SD and to the normal side was 0 mm (Table 1, Fig 8).

Fig. (6) Postoperative clinical photograph showing improvement of the facial form and contour 6 months after release of a Lt TMJ ankylosis

Fig. (7) Postoperative clinical photograph showing about 35 mm interincisal distance at one year of follow up with improvement of the facial form and midline shift during maximum opening.

There was a considerable intraoperative improvement of the interincisal distance as compared to the preoperative values with a statistically significant difference. The mean intraoperative value was 38 mm with a range of 35-40 mm.

There was also a marked improvement of the interincisal distance and the TMJ function postoperatively in all children. The one month interincisal distance ranged from 28–35 mm with a mean of 32 mm ± 1.69 SD, the protrusive movement ranged from 2.4-4 mm with a mean of 3 mm ± 0.5 SD, and the lateral movement toward the affected side ranged from 3.5-6 mm with a mean of 4.5 mm ± 0.9 SD and to the normal side ranged from 2-3mm with a mean of 2.5mm ± 0.5 SD.

During the 3rd month of follow up, the interincisal distance ranged from 29–37 mm with a mean of 33 mm ± 0.69 SD, the protrusive movement ranged from 2.6-4.2 mm with a mean of 3.2 mm ± 0.5 SD, and the lateral movement toward the affected side ranged from 3.5-6 mm with a mean of 4.5 mm ± 0.9 SD and to the normal side ranged from 2-3 mm with a mean of 2.5mm ± 0.5 SD.

The six months postoperative maximum interincisal distance increased with a range of 30–38 mm and a mean of 34 mm ± 1.7 SD, the protrusive movement also increased and ranged from 2.8-4.5 mm with a mean of 3.5 mm ± 0.67 SD, the lateral movement toward the affected side slightly increased and ranged from 3.8-6 mm with a mean of 4.5 mm ± 2.84 SD and to the normal side ranged from 2.3- 3.2 mm with a mean of 2.8 mm ± 1.5 SD.

One year postoperatively, the maximum interincisal distance recorded the same range of 30–38 mm with a mean of 35 mm ± 3.7 SD, while the protrusive movement increased and ranged from 3-5 mm with a mean of 3.7 mm ± 0.65 SD, and the lateral movement toward the affected side also increased and ranged from 4-7 mm with a mean of 5 mm ± 0.89 SD and to the normal side were ranged from 2- 3.5mm with a mean of 3 mm ± 0.59 SD (Table 1, Fig 7,8) .

Table (I) Measurements of mandibular movements preoperatively and during different follow up periods.

Period / Measurment	Preoperative	One month postoperative	3 months	6 months	One year
Intericisal Distance					
Mean	20	32	33	34	35
SD	2.78	1.69	0.69	1.7	3.7
P value	-	≤0.05*	≤0.05*	≤0.05*	≤0.05*
Protrusive movements					
Mean	1.5	3	3.2	3.5	3.7
SD	0.34	0.5	0.5	0.67	0.65
P value	-	≤0.05*	≤0.05*	≤0.05*	≤0.05*
Lateral movement to affected side					
Mean	3.3	4.5	4.5	4.5	5
SD	0.56	0.9	0.9	2.84	0.89
P value	-	≤0.05*	≤0.05*	≤0.05*	≤0.05*
Lateral movement to normal side					
Mean	0	2.5	2.5	2.8	3
SD	0	0.5	0.5	1.5	0.59
P value	-	≤0.05*	≤0.05*	≤0.05*	≤0.05*

Significant at level p≤ 0.05*

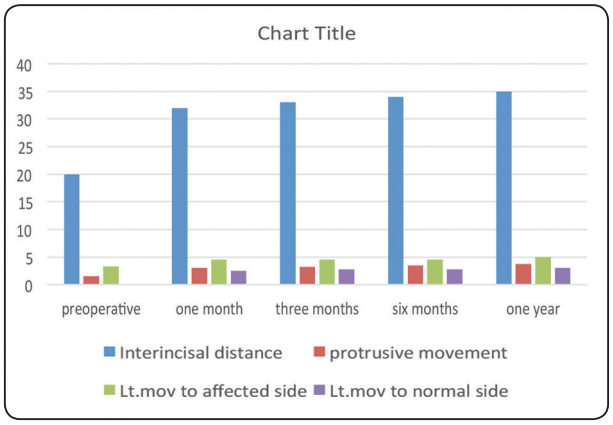

Fig. (8) Measurements of mandibular movements preoperatively and during different follow up periods.

In comparing the values of preoperative mandibular movements to the postoperative values during different follow up periods, there was statistically significant differences as the p value was ≤0.05.

Periodic panoramic radiographs and coronal CT sections during the follow-up recalls showed a well-maintained intra-articular space, the condyle was clearly visible articulating with the glenoid fossa and the preoperative height of the ramus was maintained (Fig 9). The preoperative occlusion was also maintained, stable, and no cases of malocclusion were recorded.

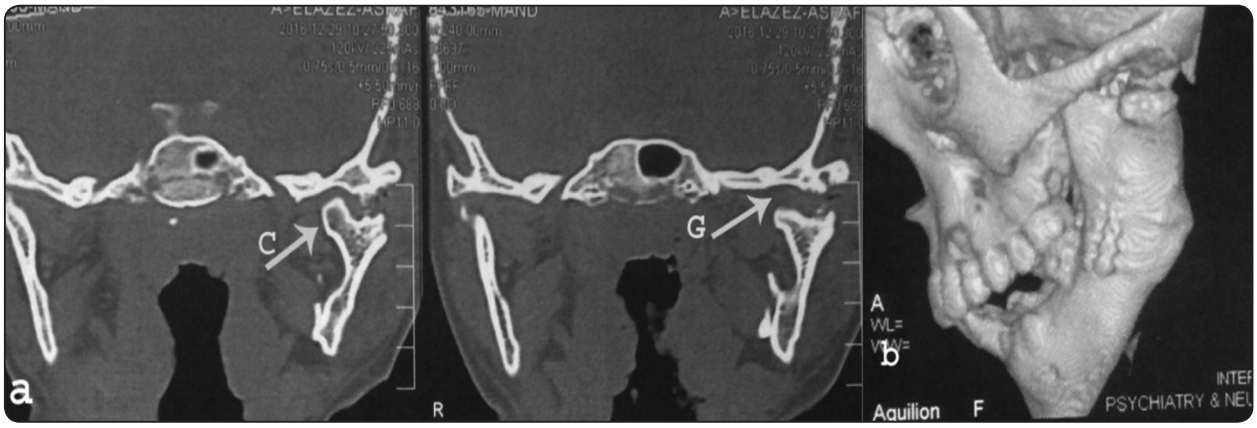

Fig. (9) Postoperative a. coronal CT showing complete release of the Lt joint after excision of the lateral callus and creation of enough bony gap (G arrow); note the condyle in a good relation to the glenoid fossa (C arrow).b. 3-D CT of the same patient.

DISCUSSION

One of the most disabling conditions that can affect children is TMJ ankylosis. This pathological entity if occur during childhood it will affect and complicate the proper growth and development of the face, this will result in varying degrees of facial deformity, lack of function and of course social and psychological harmful effects. In addition TMJ ankylosis will affect the masticatory system function of the child and also lead to improper oral hygiene measures.[11,12]

There are various surgical treatment modalities for the correction of children TMJ ankylosis for restoration of function and esthetics. Restoring the TMJ function in the form of free mandibular movement and increasing mouth opening is being considered the principle surgical objective.[7]

In our research the preoperative mean value of interincisal distance was increased intraoperatively and during the whole follow up periods to reach a mean of 35 mm, which comes in agreement with Kaban et al., [12] who proposed a minimum mouth opening of 30–35 mm for children patients.

Inadequate treatment of an anteromedially and inferiorly displaced condylar process fracture in association with the disc results in ankylosis of the remaining proximal stump to the glenoid fossa, producing type III ankylosis.

The preoperative radiological evaluation of patients in this study revealed that the three-dimensional and coronal CT views can evaluate the severity and nature of the ankylosis in great details.

Several techniques to treat TMJ ankylosis have been described and published, with the most frequently used operations include gap arthroplasty, interpositional arthroplasty, and joint reconstruction with autogenous or alloplastic materials are.[12-14]

Some draw backs had been reported from the use of previous surgical techniques such as an increased risk of re-ankylosis and premature occlusion on the affected side in gap arthroplasty, a risk of a foreign body reaction from alloplastic materials in addition to donor site morbidity in cases of using autogenous materials in interpositional arthroplasty.[15-17]

Jakhar et al., [1] reported that this recent concept of treatment involving preservation of the condyle and excluding the use of any other autogenous or alloplastic graft when the displaced condyle is clearly visible.

Our hypothesis in this research was that by preservation of the intact medially displaced condylar process and the articulating disc, the normal function and growth of the existing condyle will be also maintained and preserved and at the same time obviates the need of a costochondral graft commonly used in growing patients. This concept is consistent with the work of Harvold [18] who reported that in the treatment of hemifacial microsomia, even a deformed condyle show function and growth when released and therefore the condyle and disc should be used rather than removed.

In the same context, Caldwell [19] stated that restoration of joint function rather than removing the condyle at an early age is considered a principle issue and is necessary to activate growth potential.

A good maximum mouth opening was obtained in our research after doing lateral TMJ arthroplasty as we could achieve more than 35 mm at the end of follow up period which is matching the results of Kirk and Farrar [20] who also obtained good results with preservation of the condyle and disc in the treatment of post-infection TMJ ankylosis.

Nitzan et al., [10] proposed this new technique regarding the value of saving the fractured condyle and disc in the displaced position of the ankylosis when he treated four cases of type III ankylosis by leaving the displaced condyle and disc in their medial position, and a large gap was created between the glenoid fossa and stump. The follow-up showed good results.

Also in agreement of this current technique, He et al., [21] in reporting their surgical treatment results of traumatic TMJ ankylosis with a medially displaced residual condyle, they concluded that a lateral arthroplasty can preserve the residual TMJ structure and function.

The results of our study showed that the used surgical technique of lateral arthroplasty had greatly achieved the desired goals of treating TMJ ankylosis during a follow up period of one year. Those achieved goals include restoration of full mandibular function and free movements of the joint with adequate mouth opening and a mean interincisal distance of 35 mm, maintaining acceptable occlusion and ramus height and obviates the need of any autogenous chondro-osseous graft (commonly costochondral) with potential complications of the donor sites.

The only limitation of this study is the limited duration of follow up (one year) in which the monitoring of growth potential could not be assessed. According to the documented theory of functional matrix postulating that the role of normal soft tissue functions including the muscles of mastication will

enhance and accelerate bone growth, we hope that the established free mandibular movements will greatly help in achieving normal mandibular growth of the operated side.

We recommend a long-term follow up study of 5-10 years, according to the patient's age during surgery, to detect the mandibular growth pattern and potential following this type of surgical technique.

CONCLUSION

Lateral arthroplasty of TMJ ankylosis in children is an easy and safe surgical procedure. Preservation of condyle and disc in type III ankylosis has many advantages over the conventional reconstructive arthroplasty. Those include reduced possibility of intraoperative bleeding from injury of the maxillary artery as the medial bony part of the condyle is preserved, the use of the already present articulating disc as an interpositional material (no donor site) to prevent the recurrence of ankylosis, also the existing posterior vertical facial height is maintained thus preventing the shortness of the ramus and avoid future accentuation of facial asymmetry. The mandibular growth and function in growing children are fulfilled by the role of the retained condyle. Finally there is no morbidity of using autogenous grafting as there is no need to reconstruct the TMJ.

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