

## Costochondral Grafts in the treatment of Temporomandibular joint ankylosis – A Clinical Study.

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### Abstract

**Background:** Treatment of temporomandibular joint (TMJ) ankylosis usually requires adequate excision of the involved ankylotic block (arthroplasty) without interposing any material (gap arthroplasty) or interpositional arthroplasty using autogenous or alloplastic materials. The objective of this paper was to note the potential of the costochondral graft (CCGs) as an interpositional material and to see whether they induce normal growth potential in the reconstructed mandible.

**Materials and method:** The ankylosed temporomandibular joint was reached by a preauricular incision with or without angulation and exposed. In the first 4 cases, arthroplasty was done using a bur. The bony mass was detached of its muscle attachments and removed. In the 5th case, condylectomy was performed. In all cases, this was followed by immediate costochondral grafting.

**Results:** The maximal incisal opening in the pre-operative period ranged from 0- 2mm and in the immediate post-operative period from 15- 20mm. at the end of the follow up period it ranged from 20- 35 mm. The increase in SNB angle, SND angle, ramus length and mandibular body length all showed linear growth of mandible on the side where costochondral grafting was done.

**Conclusion:** The articular reconstruction with costochondral grafts for the treatment of TMJ ankylosis is efficient in relation to post- operative maximal incisal opening, recurrence and articular function.

**Key Words:** Temporomandibular joint, Ankylosis, Surgery, Costochondral graft.

## Introduction

Ankylosis may be defined as the fusion of joint surfaces. Temporomandibular joint (TMJ) ankylosis is a rare disorder due to the fusion of mandibular condyle at the cranial base. It is mainly caused by trauma, systemic diseases, or infections. Clinically, the patient presents with severe limitation of mouth opening resulting in compromised oral hygiene procedures. It can also cause disturbances of facial and mandibular growth, and acute compromise of the airway invariably resulting in physical and psychological disability (1).

A number of techniques have been described for the treatment of this condition in the literature. These include adequate excision of the involved ankylotic block (arthroplasty), without interposing any material (gap arthroplasty) or interpositional arthroplasty using autogenous or alloplastic materials (2, 3, 4, 5). Autologous rib grafting in craniofacial surgery dates back to the early twentieth century. Poswillo was the first surgeon to truly establish the physiologic compatibility of costochondral grafting for the TMJ ankylosis.

The bony part of the rib is used to replace the condylar neck or ramus and to affix the graft to the mandible, while the cartilaginous portion rests in the existing or newly constructed glenoid fossa. The bone–cartilage junction provides a center with growth potential.

This paper presents a clinical case series of the immediate correction of the deformity and asymmetry of the face associated with temporomandibular joint ankylosis with costochondral grafts (CCGs) as an interpositional material for arthroplasty.

## Materials and Method

This study was conducted by analyzing 5 cases of unilateral temporomandibular joint ankylosis (4 males, 1 female) in children aged from 3 to 12 years. The duration of ankylosis at the time of the presentation ranged from 2 to 8 years. Four of them gave a history of local infection like otitis media and pre auricular abscess. The 5<sup>th</sup> case had a history of poliomyelitis with residual lower limb paralysis. No history and clinical evidences of systemic arthritis/ trauma was seen in any of the cases.

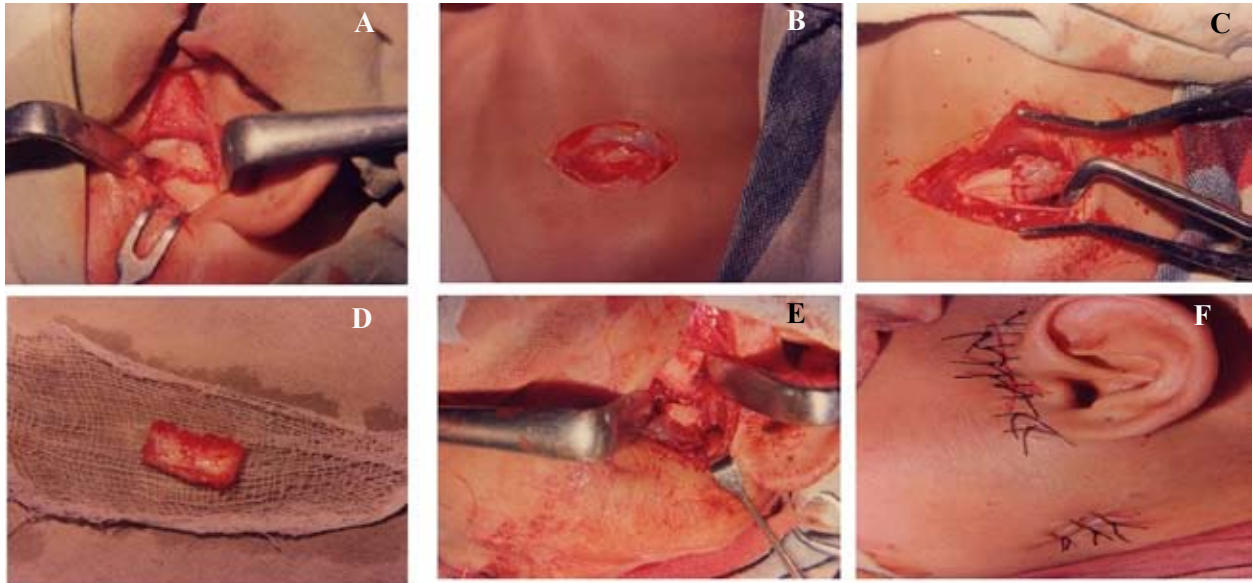
A consistent finding was the asymmetry of the face with fullness of the affected side and flattening of the normal side, deviation of midline of the chin to the side of ankylosis and the prominence of antegonial notch on the affected side. Rampant caries and crossbite on affected side was seen in four out of five cases (Figures 1A-C).

The diagnosis of temporomandibular joint ankylosis was established by clinical and radiological examination. Informed consent of the parents was obtained to click their photographs.

General anesthesia with endotracheal tube passed by



**Fig. 1.** A: Pre-operative lateral view B: Pre-operative front view C: Intraoral view showing severe occlusal disturbance D: Pre-auricular skin incision



**Fig 2:** A: The ankylotic block in the temporomandibular joint. B: Incision for costochondral graft. C: Rib exposed for obtaining costochondral graft. D: The excised costochondral graft. E: The costochondral graft bone plated to the lower border of the mandible by submandibular approach. F: Suturing done of the pre-auricular and the submandibular incisions

blind intubation technique was used in all cases. In 3 cases, the joint was reached by a preauricular incision with angulation and in two cases without angulations (Figure 1D). The ankylosed TMJ was exposed (Figure 2A). In the first 4 cases, osteoarthrectomy was done using a bur. The lower cut was made first, followed by the superior cut. The bony mass was then detached of its muscle attachments and removed. A minimum length of 1.5 cm of length was removed in all the cases. In the 5<sup>th</sup> case, condylectomy was performed.

Surgical treatment at the donor site consisted of harvesting the 6<sup>th</sup> or the 7<sup>th</sup> rib with one cm of its attached costal cartilage. With the help of thoracic surgeon, the 6<sup>th</sup> or 7<sup>th</sup> rib with 1 cm of attached costal cartilage was harvested subperiosteally (Figures 2B-D). Length of the rib varied in the 5 cases depending on the correction of the vertical height of the ramus. The periosteum was reconstituted and the wound was closed in layers. The cartilage was shaped so that the mediolateral dimension was more than the anteroposterior dimension so as to mimic the original condyle of the mandible.

Access to and preparation of the recipient site for the rib graft was made through a submandibular approach. Decortication of the posterior border and lower border of the mandible was then carried out. The rib was tightly fixed to the recipient site using bone plates (Figure 2E). The wound was then irrigated with normal saline and closed in layers (Figure 2F).

## Results

The follow up period varied from 6 months to eighteen months. The maximal incisal opening in the pre-opera-

tive period ranged from 0- 2mm and in the immediate post-operative period from 15- 20mm. At the end of the follow up period the mean maximal incisal opening was 25mm, with a range of 20- 35 mm. The interincisal opening of each case in the pre-operative period, in the immediate post-operative period and at the end of follow up is presented in Table 1. The mouth opening was found to increase gradually with the use of exercisers. Dynamic splints were found to be the most effective tool. Temporary facial nerve injury occurred in 1 out of 5 cases.

Preoperative and postoperative cephalograms were taken in all the cases and analysed. Cephalogram of the case 1 and the relevant measurements are depicted in Table 1. The increase in angle SNB, SND ramus length and mandibular body length all show linear growth of mandible on the side where costochondral grafting was done.

All the 5 cases showed marked improvement with restoration of normal symmetrical faces. The facial deformity had been reduced in all the cases due to increase in the facial height and shift of the midline of the face to normal. They also had significant improvement in their occlusal patterns.

At the end of follow up, there were no signs of any recurrence in any of the cases. Temporary paresis of the temporal branch of the facial nerve occurred in 1 out of the 5 cases. According to the House and Brackmann grading system (6), it was classified as grade III, which means there was a slight to moderate movement of the forehead and slight weakness with maximum effort of the mouth. This patient recovered within 4 months.

Case number	Onset age	Age	Sex	Etiology	Side involved	Pre-op. MIO mm	Immediate post op. MIO mm	Follow up period	MIO at the end of follow up	Facial nerve injury
1	5 y	9 y	M	infection	left	0	20mm	18 m	35mm	No
2	3 y	10 y	M	infection	right	0.5mm	15mm	12 m	25mm	No
3	2 y	6 y	M	infection	right	0	15mm	8 m	20mm	Till 4 months
4	2 y	12 y	M	infection	left	2mm	20mm	6 m	25mm	No
5	1 y	3 y	F	unknown	right	0	15mm	6 m	20mm	No

y- years, MIO – maximum incisal opening, M- male, F- female, m- months

Cephalogram readings of Case 1

Measurements	Pre-operative	Post- operative	Difference between pre- and post-operative readings
ANGLE SNA	79°	79 °	Nil
ANGLE SNB	69 °	73 °	4 °
ANGLE SND	66 °	69 °	3 °
ANGLE FMA	31 °	39 °	8 °
ANGLE Ar Go Gn	127 °	125 °	2 °
Angle of facial convexity	19 °	12 °	7 °
Body length	49.5mm	54mm	4.5mm
Ramus length	36mm	40mm	4mm
Y axis	68 °	67 °	1 °

SNA- angle formed by the intersection of sella- nasion plane and a line joining nasion and point A, SNB- angle between the sella-nasion plane and a line joining nasion to point B, SND- angle obtained by joining the sella –nasion with the center of the symphysis, FMA- angle formed by the intersection of Frankfort horizontal plane with the mandibular plane, Ar Go Gn- angle obtained by joining Articulare, Gonion, Gnathion point, Angle of facial convexity- angle formed by the intersection of a line from nasion to point A and a line from point A to pogonion, Y axis- angle obtained by joining the sella –gnathion line with the Frankfort horizontal plane.

**Table 1.** Patients' data. Ankylosis characteristics according to age of onset of the ankylosis, age at the day of operation, sex, etiology, side involved, pre- and post-operative maximal incisal opening, follow up period and nerve injury after surgery; Cephalogram readings of Case 1

**Discussion**

The main causes of TMJ ankylosis are trauma and infection (3, 4, 7). Estimates of a traumatic origin range from 26% to 75% and of infection from 44% to 68% (7). In the present study the main cause was infection, especially otitis media which is common in young children. This may be because most of our patients were from a less well-informed population without easy access to the specialty. The ensuing ankylosis could therefore be a reflection of misdiagnosis, or non diagnosis of infections, which were not managed appropriately or received no treatment at all. Also, the children were too young at the time the TMJ ankylosis set in, to have experienced trauma, for it to be the main cause.

Use of the autogenous costochondral interpositional graft is an effective procedure for the prevention of re-ankylosis following the surgical release of TMJ ankylosis (8, 9). Replacement of the condyle with a costochondral graft restores the altered biomechanics after condylectomy or gap-arthroplasty procedures (10). In case of growing child the interpositional material should

not only fill the gap but should also reduce the facial deformity and induce normal growth potential of the mandible. Various growth centre transplants have been used but costochondral junction graft has been found to be the material of choice as an interposition in ankylosis in growing children (11). The rib cartilage has capabilities similar to that of the condylar cartilage and when a costochondral graft is used to replace TMJ apparatus and subjected to functional movements; it can function as a replacement for the mandibular condyle both histologically and physiologically. The cartilaginous portions of such grafts adapts well to the function of the reconstructed temporomandibular joint and to the ramus vertical dimension by reproducing condylar morphology. According to MacIntosh (1), the advantages of this graft are its biological compatibility, workability and functional adaptability. The growth potential of the costochondral graft makes it the ideal choice in children (1). This graft has also the advantage of a predicable behavior (1).

With the release of the ankylosis and growth of the costochondral graft, a good functional and esthetic result

can be achieved without further surgery (12), and the masticatory function is restored (13). However, there is a possibility of excessive growth of the graft, resulting in deviation of the chin and mandibular prognathism years later (14). However in the present study no patients developed clinically significant malocclusion.

The 7-step protocol in the treatment of temporomandibular joint ankylosis consists of:

- a) Aggressive excision of the fibrous and/or bony ankylotic mass,
- b) Coronoidectomy on the affected side,
- c) Coronoidectomy on the contralateral side, if steps a and b do not result in a maximal incisal opening greater than 35 mm or to the point of dislocation of the unaffected TMJ

d) Lining of the TMJ with a temporalis myofascial flap or the native disc, if it can be salvaged,

e) Reconstruction of the ramus condyle unit with either distraction osteogenesis or costochondral graft and rigid fixation

f) Early mobilization of the jaw. If distraction osteogenesis is used to reconstruct the ramus condyle unit, mobilization begins the day of the operation. In patients who undergo costochondral graft reconstruction, mobilization begins after 10 days of maxillomandibular fixation.

g) Aggressive physiotherapy.

A mandibular opening of 30mm is sufficient to leave patients with little or no functional deficit following reconstruction (15). This was achieved in 82% of their cases (15). In this study only 20% of the patients achieved this mouth opening. In the remaining 80% of patients despite that the opening was from 20-30 mm, still it was satisfactory especially for those with severe degree of long standing ankylosis. In all the cases the final result was more than that achieved intraoperatively. This can be explained by the presence of reversible pathology in the other joint as minimal fibrosis or contraction of the temporalis muscle. This emphasizes the fact that no forcible opening of the mouth should be done as this will lead to rupture of the fibrosis or temporalis musculature and subsequent scarring with ankylosis of the contralateral side.

In our series, all cases were of unilateral involvement and all showed marked improvement in the functional and aesthetic appearance. Occlusal harmony was also achieved. Neither patient had any signs of recurrence or limitation of mandibular movements. Irrespective of the technique chosen by the surgeon, aggressive resection of the bony or fibrous ankylotic segment is crucial to avoid recurrence.

Regardless of the surgical approach used to gain access to the TMJ, the final dissection places the facial nerve at risk for damage. A loss of function of the frontalis and orbicularis oculi muscles is always a possibility. The incidence of complications such as permanent injury

of the facial nerve is very low, with rate varying from 1.5 to 32%, usually disappearing within 6 months. It is possible that the difficulty of the surgical procedure in relation to the type of ankylosis may increase the risks of damage to the facial nerve, especially because the longer the duration of surgery, the longer tissues are separated, thereby increasing the risk of such damage (16). The incidence of facial injury in this series it was 20% (1 out of 5 cases) and it resolved by itself in 4 months.

Hence, the articular reconstruction with CCGs for the treatment of ankylosis is shown to be efficient in relation to the post-operative maximal incisal opening, recurrence and articular function.

## Conclusion

Autogenous costochondral interpositional graft is an effective procedure for treatment of TMJ ankylosis by articular reconstruction technique; especially if it is associated with mandibular hypoplasia.

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