

# Management of Temporomandibular Joint Ankylosis in Children: Current Perspective

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## ABSTRACT

**Aim:** To overview and analyse the various treatment options used for management of ankylosis in growing children.

**Summary:** Temporomandibular joint ankylosis in children is a challenging problem. A number of techniques have been described for the treatment of this condition in the literature. Mainstay of treatment is excision of ankylosed mass followed by reconstruction of the joint. Earlier protocols advocated use of autografts like costochondral which had growth potential. However, unregulated growth and chances of recurrences reported with them led to the promotion of distraction osteogenesis (DO) for reconstruction in the current era. Transport DO is thus a promising treatment as it has all advantages of autogenous bone grafting without disadvantages of donor site.

**Keywords:** Ankylosis, Distraction osteogenesis, Costochondral graft (CCG), TMJ.

becomes a mental stigma as it not only hinders the integrity of the cranio-facial skeleton, but also affects the normal growth and development of jaws and occlusion. Ankylosis at this age leads to facial deformity, severe malocclusion, poor oral hygiene with multiple decayed teeth difficult chewing and impairment of speech.

Etiology of temporomandibular joint (TMJ) ankylosis is reported to be multifactorial but trauma especially intracapsular and subcondylar fractures in children are the most frequent cause. Excessive mineralization and bone formation in children with comminuted intracapsular fractures due to prolonged immobilization mainly explains the pathogenesis. However, it may happen even in cases where no maxillomandibular fixation is done.<sup>3</sup>

Symptoms of ankylosis in children are progressive trismus and mandibular deformity with retrognathia and lateral displacement of the chin. It is a challenging and complex problem in children as the treatment has to be done in consideration with potential effects of time and growth. Also the cognitive growth and emotional development has both role and impact on the treatment of this disease. Successful treatment requires a comprehensive counselling and psychological rehabilitation with periodic encouragement of both patient and their parents. Postoperative phase of physiotherapy further necessitates child's cooperation, perservance and strong motivation by and of the parents. This paper is intended to overview and analyse the various treatment options used for management of ankylosis in growing children.

## INTRODUCTION

Ankylosis is a Greek word meaning 'Stiff joint'. Temporomandibular joint (TMJ) ankylosis may be defined as the fusion of joint surfaces by bone or fibrous tissue leading to restricted mouth opening.<sup>1</sup> It may be classified according to the site (intra or extra-articular), type of tissue involved (bony, fibrous or fibro-osseous tissue) and the degree of fusion (complete or incomplete).<sup>2</sup> This affliction which restricts the mouth opening if develops in growing age

## TREATMENT OPTIONS

A number of treatments for this condition have been described in the literature including simple arthroplasty,<sup>3</sup> interposition arthroplasty<sup>4,5</sup> using temporal muscle fascia, ear cartilage or alloplastic material and reconstruction of the joint using costochondral graft (CCG), fibula, clavicle, iliac crest, metatarsal head or alloplastic material like acrylic or titanium prosthesis.<sup>6,7</sup> There is, however, no consensus in the literature about the best treatment in these cases, as results have varied and recurrence rates are still high. No single method has produced uniformly successful results. Lack of consistency

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and confusion in published data also adds to the dilemma. Limited range of motion and reankylosis are most commonly reported complications. Lack of cooperation by children for postoperative physiotherapy was thought to be the cause of failure, but the inadequate resection requiring a considerable force for opening mouth intraoperatively, is the main concern. Because postoperatively such inadequate resections will require even more force to open mouth, thus causing pain during physiotherapy, and thus reduced patient co-operation.

Although, there is no literature agreement on a standard protocol to correct ankylosis, three modalities commonly used are: gap arthroplasty, interpositional arthroplasty, and excision and articular reconstruction.

## CHANGING ERAS

### Gap arthroplasty

Gap arthroplasty is based on resection of ankylosed bone without intervening grafts or materials. According to the literature, it is recommended to create at least 15 mm of new joint space peripherally around the mandibular stump to improve mouth opening and prevent recurrence of ankylosis.<sup>4</sup> Advantages of this technique are simplicity and short surgical time. However, there are some drawbacks such as creation of a pseudoarticulation and a short mandibular ramus, with anterior open bite in bilateral cases and posterior open bite in unilateral cases, failure during removal of pathologic bone tissue and the risk of recurrence. Several researchers have highlighted the importance of early immobilization and aggressive physiotherapy for a well-succeeded treatment.<sup>5</sup> The gap arthroplasty aims to reduce the rate of ankylosis by increasing the distance from the severed surface of the ascendant ramus to the cranial base. If this distance is too small, recurrence will probably be seen. However, in cases with excessive gap, the ramus loses height, and there is no support for rotational mandibular movements, with a trend for open bite and contralateral deviation on mouth opening.<sup>8</sup> To avoid it, the gap is not created at the original level of articulation, but at the level of condylar neck below the ankylosed mass. Resection at this level reduces the surface area of resected stumps, thus minimizing the chances of re-ankylosis and also shortens the time for surgery. It is also considered to be a safer procedure with fewer risks to the cranial base. No attempts are made to preserve the disc because it is not attached in the condyle neck.<sup>8</sup> The drawback of gap arthroplasty is the generation of a pseudoarticulation with a short ramus. In addition, the risk of recurrence is increased because of no intervening tissue.

### Interposition arthroplasty

The interposition technique is recommended after gap arthroplasty as a means to limit resection and recurrence.<sup>9</sup> In

interpositional arthroplasty technique, autogenous and alloplastic materials are placed in the osteotomized area to prevent recurrence of ankylosis. Among the autogenous materials used, common ones are the temporal myofascial, the fascia lata (fascia of the thigh muscle), articular cartilage, and dermis.<sup>10,11</sup> Other materials, such as the costochondral grafts (CCGs), sternoclavicular and metatarsal grafts are also used. Among the alloplastic materials gold foil, acrylic, stainless steel, silicone prosthesis, and total articular metallic prosthesis were used in various studies.<sup>12-14</sup>

Numerous protocols for management of TMJ ankylosis throughout the world suggest early surgical intervention, elaborate resection, early mobilization and aggressive physiotherapy for at least 6 months postoperatively.<sup>8,9</sup> Of them, the most accepted is by Kaban *et al.*<sup>2</sup> who had described a protocol based on the treatment of TMJ ankylosis in 14 patients with a one-year follow-up. According to them this protocol was ideal for treating this condition and it consists of aggressive resection, ipsilateral coronoidectomy, contralateral coronoidectomy if maximal incisal opening is not greater than 35 mm or to the point of dislocation of the unaffected TMJ, interposition with temporal fascia or native disc, reconstruction of the ramus with a costochondral graft, its rigid fixation and early mobilization of the jaw. Since then various autogenous grafts like costochondral, iliac crest or coronoid process grafts or alloplastic materials like articular prosthesis have been reported to be used.<sup>5-7</sup> Costochondral grafts (CCGs) are the most widely accepted as they are biologically compatible and functionally adaptable.<sup>2</sup> The growth potential of this type of graft makes it the material of choice in children. However problems with costochondral grafts include resorption or variable graft growth leading to reankylosis, fractures and donor site morbidity. To avoid these complications a number of alloplastic materials have been developed, such as acrylic-resin synthetic fibers and full titanium joints. Alloplastic joints make it possible to reproduce more closely the natural joint anatomy, restoring the vertical height, decreasing surgery time and reducing the rate of recurrences.<sup>6</sup> Acrylic is a simple, inexpensive, and easily manufactured material which does not require another donor site and is well-tolerated in the body. The only disadvantage of this technique is that facial asymmetry may develop when used in children.

Regardless of the graft material chosen it is a consensus that surgeons should undertake aggressive resection of the fibrosed or osseous ankylosed segment to avoid recurrences<sup>15</sup>. Additionally dissection of the mandibular ramus muscles and ipsilateral coronoidectomy should be done to avoid intraoperative mouth opening limitations, as the coronoid process may be elongated in cases of ankylosis of long duration. Post operative physiotherapy also holds an important role for sustaining the obtained results. Some authors prefer to wait 5 to 7 days for pain and edema to subside

and initial healing of soft tissues to take place before implementing physical therapy as early mandible mobilization may cause bleeding and hematomas which would delay healing.<sup>9,16</sup> Drainage tubes are also advocated as they stop blood from accumulating in the newly formed cavity and facilitate postoperative movements.<sup>10</sup>

Reconstruction of the condylar process and mandibular ramus with a costochondral graft and an interpositional temporal muscle-fascia flap is the most popular method for the treatment of TMJ ankylosis in childhood even today.<sup>17</sup> Theoretically autogenous grafts provide the best reconstructive material and are immunologically compatible with capability of continued growth and remodelling. Complete growth of the functioning atrophic mandible is achieved through the growing ability of the costochondral graft. It is suggested that as the chondral structure grows, it reconstructs both the mandibular condyle and the ramus.

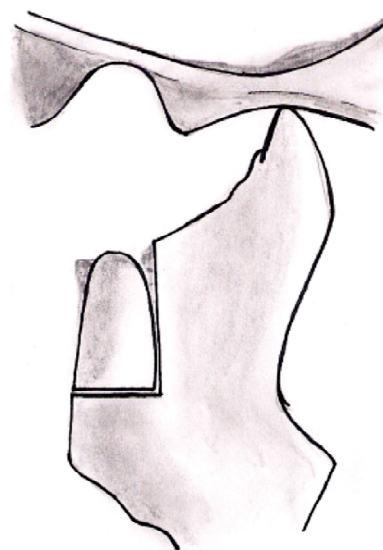
But second operative site and unpredictable results become a hinderance. Occlusion may get unstable because of resorption or overgrowth of graft and heterotropic bone formation can lead to reankylosis. Perrott and Kaban<sup>2</sup> hypothesized that overgrowth of CCG is due to use of an excessively large cartilaginous cap. They described two types of overgrowth; linear overgrowth resulting in asymmetric or bilateral prognathism, and tumour like growth and reankylosis. Prosthetic TMJ reconstruction in an attempt to prevent donor site problems decreases operating time and maintains occlusal stability. However, it has its own set of drawbacks as their design flaws may lead to mechanical failure, or at times wear debris of the prosthesis may lead to the foreign body reaction, infection or degenerative changes. However, long standing temporo-mandibular ankylosis leads to damage of the condyle with de?ciency of the mandibular body and ramus. Trismus in these patients can be managed by condylectomy or gap arthroplasty or by costochondral graft interposition.

## CURRENT CONCEPT

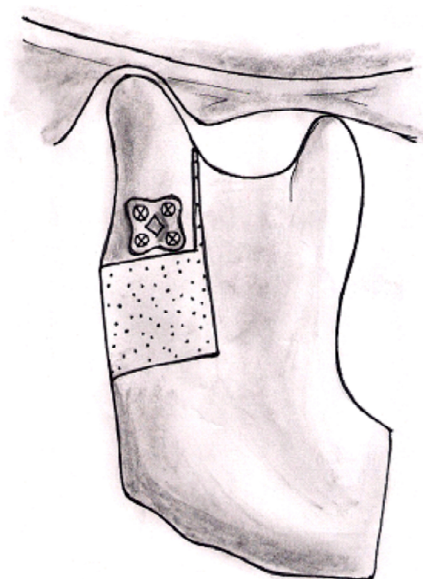
While a satisfactory mouth opening can be achieved with all these methods, the mandibular deformity always needs separate treatment. Hence, current ideology advocates the use of gap arthroplasty in conjunction with distraction osteogenesis (DO) in children.<sup>18-23</sup> This is because in children DO can correct the mandibular hypoplasia also. The other techniques do not address this problem of the mandibular deformity which is the main cause of disfiguration in these children.

DO is well understood as the formation of new bone between living osseous surfaces that are incrementally separated. In transport DO a small segment of bone called transport disc is slowly moved away from the host bone into the defect. At the trailing edge of transport disc new bone continues to form which joins with host bone while the leading edge ends with

a fibrocartilage tissue. In bony reconstructions formation of this fibrocartilage is not welcomed as it does not let complete bony closure of segmental defect but in reconstruction of this TMJ this becomes beneficial as it forms articular disc. A transport disc is fashioned from the ramus or angle of the mandible and is slowly moved into the glenoid fossa. Regenerated bone at the trailing edge of the disc forms new ramus or condylar neck, while fibrocartilage at the leading edge becomes articular surface. A small extraoral incision near angle is taken. A transport disc is created with a partially completed L- shaped osteotomy whose superior surface is rounded to give the shape of articular surface (Fig. 1 and 2). The medial periosteum and muscle attachments are left intact to ensure an intact blood supply to the disc. Distractor selection is based on size of defect, position of transport disc and residual ramus. Initially only a single screw is fixed in the superior attachment plate. Vector is adjusted and then remaining screws are inserted. After the screws are inserted, the osteotomy is completed and the disc is mobilized. To prevent excessive bone formation space between the transport disc and glenoid fossa is filled with either subcutaneous fat or temporalis muscle. Activation rod is brought out through separate incision. When simultaneous release of ankylosis has to be done a separate preauricular incision is carried out and meniscus is left in position whenever possible. After latency period of 7 days distraction of 0.5 mm twice daily is done. Physiotherapy for mouth opening is started almost immediately. Distraction is continued till intercuspation or occlusal plane is reached with some amount of overcorrection. Distractor is removed after consolidation of 3 months. Superior attachment plate can be left in situ as it has moved into the glenoid fossa.<sup>19</sup>



**Figure 1: Transport Disc Created (From Schwartz HC, Relle RJ. Distraction osteogenesis for temporomandibular reconstruction. J Oral Maxillofac Surg 2008; 66: 718-23.)**



**Figure 2: Distraction Done (From Schwartz HC, Relle RJ. Distraction osteogenesis for temporomandibular reconstruction. J Oral Maxillofac Surg 2008; 66: 718-23)**

According to Schwartz and Relle<sup>19</sup> in series of 12 reconstructions with follow up between 7-56 months results obtained were supportive. In all cases solid regenerate bone had formed in the distraction gap. Occlusion was stable with satisfactory interincisal opening. It healed rapidly like a fracture with less of resorption or remodelling seen in free grafts. Stucki – Mc Cormick *et al.*<sup>20</sup> had first published two cases of RCU reconstruction using transport DO in 1997. Dean and Alamillos<sup>21</sup> in 1999 used simultaneous gap arthroplasty and distraction osteogenesis for the treatment of mandibular deformity in three patients of temporo-mandibular joint ankylosis. Douglas *et al.*<sup>22</sup> used a pin and tube device for intraoral distraction in an adult patient with micrognathia due to temporo-mandibular joint ankylosis. The authors achieved a lengthening of 10 mm in their patient, which remained stationary after surgery.

According to Kuntz *et al.*<sup>23</sup> open bite deformity is a well-known complication of mandibular distraction. In this study, distractors were oriented as parallel to the occlusal plane as possible, regardless of the direction of the osteotomy. The osteotomy line was made according to the occlusal plane and not always kept perpendicular to the direction of distraction. This was done so as to distract the chin in a plane parallel to the occlusal plane. Another advantage of such an arrangement was that distraction did not lead to impingement on the gap arthroplasty. For the treatment of open bite deformity after DO, they performed manual remodelling of the distracted callus under general anaesthesia for treatment of open bite deformity after distraction osteogenesis.<sup>23</sup> A custom-made acrylic jaw exerciser was used with an orthodontic splint, as

postoperative exercises are essential for a successful outcome. In patients who are developing an open bite deformity this can be minimized by increasing the thickness of the splint between the molars. Yoon and Kim<sup>24</sup> successfully used gap arthroplasty with intraoral mandibular distraction osteogenesis in two patients with TMJ ankylosis and mandibular deformity, who had undergone failed gap arthroplasty and costochondral graft interposition. They reported a positive result with a total follow-up of 2 years.<sup>24</sup> In 2009, Kaban<sup>17</sup> also modified his previous protocol and advocated gap arthroplasty combined with distraction osteogenesis of the mandibular body with abolishment of CCG reconstruction. After mobilization and lining fossa with temporalis or native disc, mandibular stump is reshaped to make it narrow and rounded at the top. Corticotomy was done distally leaving enough bone as transport disc. Distraction was stopped as transport disc reached the skull base.

DO has many advantages including the lack of donor site, reconstruction with original tissue, optimal replacement of the lost tissue, and the augmentation of the soft tissue simultaneously with the bone.<sup>25</sup> Therefore, DO is becoming the preferred method among the alternative difficult surgical procedures in the maxillo-facial region for esthetic and reconstructive goals. Recently, clinical and experimental studies about the reconstruction of the structure and the function of the TMJ with DO have been reported. Experimental studies also revealed the remodelling of the transported disc to the neocondyle. Histologically also the pseudodisk formed was found to be fibrocartilagenous in nature. However, it is stated that the thickness of this fibrocartilagenous tissue is 1/10<sup>th</sup> of a normal disk. A new condylar process was constructed and the vertical ramus was elongated with distraction of the transport segment. Two year postoperative examinations revealed uneventful healing with postoperatively acquired mouth opening. Continuity of the neocondyle was detected radiographically also. Despite the disadvantages involving skin scars caused by the extra-oral pins, the high cost, and the long treatment period, the method has the advantages of quite easy application, and contouring of atrophic hard and soft tissues by only guiding the primary callus.

## CONCLUSION

Numerous treatment options and their various modifications have been given for management of TMJ ankylosis in growing children. Though mouth opening improved significantly with most of treatment options but problem of recurrence and facial deformity still remained. Distraction osteogenesis not only provides a onetime solution for reconstruction of ramus condylar unit but also omits the need of both interpositional substitute of disc and the donor graft. DO seems to be superior to conventional techniques in TMJ reconstruction when the advantages are taken into account.

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