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Costochondral Graft in Surgical Treatment of TMJ Ankylosis

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Abstract

Temporomandibular joint (TMJ) ankylosis is characterized by difficulty or inability to open the mouth due to fusion of the temporal one and the mandible, resulting in facial asymmetry/deformity, malocclusion and dental problems. It is considered to be one of the most challenging problems managed by oral and maxillofacial surgeons owing to the difficulties encountered technically and the high incidence of recurrence after treatment. The surgical treatment of TMJ ankylosis facilitates the release of the ankylosed mass and the creation of a gap to mobilize the joint. This article focuses on one of the surgical modalities i.e. interpositional gap arthroplasty using a costochondral graft.

Keywords: *Temporomandibular Joint, Ankylosis, Surgical Management, Resection Costochondral graft, Interpositional Arthroplasty.*

Introduction

Ankylosis can be defined as the fusion of joint surfaces. Temporomandibular joint (TMJ) ankylosis is a rare disorder wherein fusion of mandibular condyle with the cranial base is noted. It is mainly caused by trauma, systemic diseases, or infections. Trauma is the most important etiologic factor in causing TMJ. Haematoma formed as a result of trauma eventually organizes and ossifies into a mass. [1] Clinically, the patient presents with severe limitation of mouth opening leading to compromised oral hygiene procedures. Disturbances noted in facial and mandibular growth, and acute compromise of the airway invariably result in physical and psychological disability. [2]

TMJ ankylosis may be classified by the following criteria: 1) location (intra-articular or extra-articular), 2) nature of tissue affected (bone, fibrous, or fibro-osseous), and 3) the extent of fusion (complete or incomplete).

Using Topazian's three-stage classification, complete ankyloses were graded as follows:

- Stage I: an ankylotic mass that is limited to the condylar process of the mandible
- Stage II: ankylotic mass extending to the sigmoid notch of the mandible
- Stage III: ankylotic mass involving the coronoid process of the mandible [3]

The typical pathogenesis of ankylosis is the development of a mass that replaces the TMJ articulation resulting in limited mandibular movements. Treatment of TMJ ankylosis, therefore, warrants removal of an adequate amount of bone/bony mass to achieve full mouth opening and permit free movement of the mandible. [4]

Management of TMJ ankylosis has presented itself as a challenging task for surgeons. There are various surgical treatment options given in literature such as gap arthroplasty, interpositional arthroplasty, and/or joint reconstruction using autogenous grafts or alloplastic material. Choice of treatment modality varies from surgeon to surgeon depending on the extent and type of ankylosis, age of the patient, onset and time of surgery & whether the ankylosis is unilateral or bilateral. [5] The article focuses on joint interposition using costochondral graft (CCG) after arthroplasty in the treatment of TMJ ankylosis with its aim to forestall recurrence of the pathology. Reconstruction of the ramus/condyle unit with autogenous bone, such as CCG, fibula, clavicle, iliac crest, metatarsal head, or alloplastic material have all been reported. [6] No single method has produced uniformly successful results. Limited range of motion and re-ankylosis are the foremost reported complications.[5]

Case Report:

A 4-year-old male reported to The Department Of Oral and Maxillofacial Surgery at Bharati Vidyapeeth (Deemed-to-be) Dental College and Hospital, Pune with a chief complaint of inability to open the mouth completely since 7-8 months (Fig 1). The history of the patient revealed the absence of any recent trauma or trauma at the time of birth or parafunctional habits. There was no relevant medical history or family history. TMJ examination revealed tenderness over both TMJ and deviation of the jaw to the left side (Fig 2). No tenderness on palpation of the masseter muscle. Protrusive movements on the affected side and appearance of flatness and elongation on the unaffected side were noted. Receded chin and a well-defined antegonial notch on the L/R side were some of the other findings. Intraorally no abnormality detected.

Procedure:

The patient was induced and intubated through the right nostril. Following all aseptic conditions and precautions painting and draping were done. Preauricular incision over the left side was marked. Local anesthesia (1:200000) was infiltrated along the incision line.

The standard inframammary incision was used for harvesting rib. The incision of 5 cm in length was made directly over the 5th rib starting approximately 4 cm from the midline. It was carried through skin and subcutaneous fat to the muscles of the anterior chest wall. The muscle encountered first is the lower edge of the pectoralis major. The periosteum was elevated from the anterior and superior aspects of the rib using the Howrath retractor (Fig 4a and 4b). A periosteal elevator was run along the superior surface of the rib from the medial to lateral aspect allowing the periosteum to detach from the rib at its posterosuperior aspect; anteroinferior periosteum was detached similarly until the lower border of the rib is reached (Fig 5). The lateral cut was made first and the rib was elevated with the left hand while the required amount of cartilage was cut with a No. 15 blade.

Continuous palpation was done during harvesting of the underlying rib to avoid pleural injury. Left TMJ arthroplasty was performed starting with the left preauricular incision. Dissection was performed through the fascial layers until exposure of left TMJ was visualized (Fig 7). Direct visual examination revealed bony ankylosis of the left TMJ. Using fissure burs and osteotomes, the ankylosis was osteotomized and a new glenoid fossa and condylar head were created by sculpting the bone in the area of the osteotomy.

The ankylosed mass was removed (Fig 8). The harvested costochondral graft was placed and secured with 2 2x8mm screws (Fig 9). A jaw drain was placed at the operative site. Wound closure was done in layers with 3-0 ethilon, ending with subcutaneous suturing done with 3-0 vicryl (Fig 10).[7]

Discussion:

TMJ ankylosis is a bony or fibrous adhesion of the anatomical joint components by an ankylotic mass with ensuing loss of joint function. It is primarily caused by trauma, infection, or systemic diseases. [5, 1] Salins describes the ankylotic bone as a reparative process similar to that of an exuberant callus, typically seen in pediatric fractures or inadequately immobilized fractures. It has been observed that the process of remodeling which gradually results in the elimination of the callus fails to occur in cases of craniomandibular ankylosis resulting in the establishment of the typical ankylotic mass bridging the articulation. This mass is usually surrounded by very dense scar tissue particularly on its medial aspect, which further limits mandibular movements. [8]

Unilateral ankylosis has been reported to be commoner than bilateral, the ratio being 1.5:1. Ankylosis of the TMJ usually develops before the age of 10 but could be found at any age, the usual range being 20–30 years. [9] If the process of ankylosis begins before the completion of jaw growth or the calcification of cortical bone of the TMJ, extensive ankylosis of the joint area can occur, and inadequate growth in the joint area results in characteristic changes in the morphology of the face. The ankylosis developed after the development of the anterior mandible does not permit the application and distribution of the masticatory force to the mandible. This, in turn, prevents resorption in the areas of muscular attachment. Resorption is then seen to take place in the anterior area of the angle outside the area of attachment, producing the abnormal antegonal notch. [10]

Continuous growth at the angle of the mandible as a result of subperiosteal apposition has been speculated to be the cause of notching at the antegonion and the apparent distortion of the mandibular structure - a pathognomonic sign of the condylar growth arrest. Because of a failure of growth at the condyle, forward and downward movement of the body of the mandible does not occur, and a localized thickening of the bone at the angle accentuates the antegonion. This, coupled with the obtuse angle formed between the cranial base and the lower border of the mandible, is responsible for the characteristic — warping. [11]

El-Hakim et al have proposed a new classification of TMJ ankylosis based on the CT findings encapsulating the tissue involved, extent and relation to the maxillary artery.

Class I: Unilateral and bilateral fibrous ankylosis is noted, with the condyle and glenoid fossa resembling their normal anatomical shape and form, and maxillary artery in normal anatomical relation to the ankylosed mass.

Class II: There is a unilateral or bilateral bony fusion of the condyle with the temporal bone. The maxillary artery can be seen in normal anatomical relation to the ankylosed mass.

Class III: The distance between the maxillary artery and the medial pole of the mandibular condyle is less on the ankylosed side compared to the normal side or the maxillary artery runs within the ankylotic bony mass.

Class IV: The ankylosed mass is evidently fused to the base of the skull. With extensive bone formation, especially from the medial aspect of the condyle, the ankylosed bony mass is seen in close relationship to the vital structures at the base of the skull namely the pterygoid plates, the carotid and jugular foramina and foramen spinosum. Joint anatomy is no longer definable from radiographs.

This new classification gives the surgeon the opportunity for careful surgical planning and achieves better surgical results with minimum operative complications. [12]

Kaban's protocol highlights the steps to be taken in the surgical management of TMJ ankylosis:

1. Aggressive resection of the fibrous and/or bony ankylotic mass.
2. Coronoidectomy on the affected side.
3. Coronoidectomy on the contralateral side (in cases wherein steps 1 and 2 do not result in a maximal incisal opening greater than 35 mm or to the point of dislocation of the unaffected TMJ).
4. The lining of the TMJ with a temporalis myofascial flap
5. Reconstruction of the ramus-condyle unit (RCU) with distraction osteogenesis, or costochondral graft and rigid fixation.
6. Early mobilization of the jaw. In cases of reconstruction by distraction osteogenesis, mobilization begins on the day of the operation and in patients who undergo costochondral graft reconstruction, mobilization begins after 10 days of maxillomandibular fixation.
7. Aggressive physiotherapy. [13]

The use of the autogenous costochondral interposition graft is popular amongst surgeons for the prevention of reankylosis following the surgical release of TMJ ankylosis. 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. [7] CCG is biologically compatible like any autogenous graft, easily workable especially when contouring the cartilaginous part to fit into the glenoid fossa, and takes less time to heal and becomes incorporated into the new environment allowing restoration of the

bone and cartilage components [14] Replacement of the condyle with a costochondral graft restores the altered biomechanics after condylectomy or gap-arthroplasty procedures. [15] In the case of a 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. [7] Recently authors have recommended using thinner sections of cartilage (2–3 mm) due to the potential for overgrowth. [16] Mulliken et al observed that the maximum growth rate occurs around 2 years approximately after the placement of the graft, based on radiograph measurements. In most cases from this study, growth was noted to follow a slow and irregular pattern, not a linear pattern.

He noted some disadvantages of the CCG to be the poor quality of medullar and cortical bone, the possibility of resorption or infection, bone flexibility, elasticity that may cause graft deformity and produce occlusal changes with time, as well as the possible separation of the cartilage from the bone. Donor-site complications such as a pleural tear, pneumothorax, pleural effusion and atelectasis; empyema; pneumonia and occasional fractures was also reported. Cases, where a vascularized graft was harvested, showed more severe complications. Meticulous dissection of the periosteum and perichondrium off the transplanted rib is necessary to maximize performance and minimize complications. This leads to reduced postoperative pain at the donor site and ensures that the parietal layer of the pleura is not perforated. Similarly, retaining an intact piece of periosteum and perichondrium adherent to and bridging the costochondral junction, and sectioning the chondral part before the osseous part, has reduced the incidence of fracture at the costochondral junction. In growing patients, the subcondylar epiphyseal growth plate is a growth site for the mandibule. There is a continuous interaction between epiphyseal proliferation and the surrounding tissues. Disruption in the interaction between the two leads to modification of the delicate mechanisms resulting in severe anomalies of facial growth with resultant facial asymmetry/deformity, malocclusion and dental problems. In spite of the potential problems with the CCG, most authors consider that it should be the preferred graft in the growing child and as an initial reconstruction in many adult deformities. [5]

An intraoperative mandibular opening of 30mm is sufficient to leave patients with little or no functional deficit following reconstruction. [7] 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. [17]

Reankylosis in the range 5–39% has been reported [18]

Regardless of the surgical approach used to gain access to the TMJ, the facial nerve remains at risk for damage. [19] A loss of function of the frontalis and orbicularis oculi muscles is always a possibility. The incidence of facial nerve injury is very low (1.5 to 32%). The right choice of technique for making the approach to the TMJ, such as the preauricular approach modified by Alkayat and Bramley and the

preauricular approach described by Ellis&Zide, when properly performed, may decrease the risk of damaging this nerve. [20]

Conclusion:

Adekeye observed and de-emphasized the role played by aetiology, clinical presentation and treatment technique in determining a successful outcome. [21] Numerous treatment options and their various modifications have been given for management of TMJ ankylosis in growing children. Inspite of various studies acknowledging the disadvantages of autogenous costochondral graft as an interpositional material, some of which have been stated above, it remains a popular and effective procedure for the treatment of TMJ ankylosis.

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