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ANKYLOSIS OF TEMPOROMANDIBULAR JOINT: AN OVERVIEW

Richa Wadhawan[1], Yehoshuva Reddy[1], Dharti N[2], Shiras Verma[1], Gaurav Solanki[3]

[1]Institute of Dental Education & Advance studies, Gwalior, India.
[2]Pacific dental college, Udaipur, India.
[3]Jodhpur Dental College General Hospital, Jodhpur, India.

ABSTRACT

Temporomandibular joint (TMJ) ankylosis involves the fusion of the mandibular condyle with the base of the skull. It is an extremely disabling affliction. In growing patients, deformities of the mandible and maxilla may occur together with malocclusion causing dysphonia, dysphagia, facial deformity, impairment of upper airway and psychological stress. Mandible function rehabilitation, prevention of relapse and promotion of mandible growth are the main goals of the treatment. The arthroplasty in gap technic is indicated in the treatment of TMJ ankylosis. It is a challenging procedure, requiring a massive resection of abnormal bone formation at the base of the skull of the complex anatomy. Different techniques have been developed over period of time but recurrence still remains the major problem when treating TMJ ankylosis. The purpose of this paper is to reveal etiopathogenesis & various treatment modalities in management of TMJ ankylosis.

Key words: Ankylosis, Temporomandibular Disorders, Temporomandibular Joint Ankylosis, Risk Factors, Age Groups etc.

Corresponding Author

Dr.Richa Wadhawan
Email:- richawadhawan@gmail.com

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INTRODUCTION

The word Ankylosis has its origin in the Greek language, meaning 'stiff joint'. TMJ is a bilateral diarthrodial joint. This unique joint can perform both hinge and sliding function and is the only synovial joint in humans where the articulating surfaces are covered by fibro cartilage. True TMJ ankylosis is an intracapsular union of the disc-condyle complex to the temporal articular surface that includes fibrous adhesion or bony fusion between condyle of mandible and glenoid fossa and articular eminence of squamous temporal bone. TMJ ankylosis is an affliction that greatly compromises the quality of life of many patients' particularly young adults. TMJ ankylosis is a very distressing structural condition that denies the victim from the benefit of normal diet and opportunities in careers that require normal speech [1]. When it occurs in a child, it can have devastating effects on the future growth and development of the jaws and teeth. Furthermore, in many cases, it has a profoundly negative influence on the psychosocial development of the patient because of the obvious facial deformity.

TMJ ankylosis associated with trauma, local or systemic infection, degenerative joint diseases, surgical intervention of the joint space and neoplasms. Trauma is the leading cause of the TMJ ankylosis but other rare conditions such as ankylosing spondylitis and septic arthritis can also cause ankylosis. The incidence of TMJ ankylosis is declining in Europe and North America, partly as a result of better, earlier management of condylar fractures and partly because the use of antibiotics which have reduced persistence and recurrence of infection [2].

Etiology: The three main causes of TMJ anklyosis are trauma, inflammation and infection. Damage to the fragile vasculature at the condylar heads during intrauterine fetal movement is a possible etiology for congenital ankylosis. Trauma sustained by the newborn during a difficult forceps delivery and trauma inflicted by an abusive adult have been implicated. Both untreated fractures and badly comminuted condylar head fractures treated by immobilization for extended periods have resulted in ankylosis.

The most common traumas in children are the in adverted use of surgical forceps, vehicle accident, sports, and falls [3]. Some etiologies of TMJ ankylosis are common to both adults and children, such as long-term immobilization for facial fracture; commitment of the articulate disk; fractures of the condyle; fractures of the middle third of the face, especially those involving the zygomatic arch and mandibular coronoid process; intrinsic and extrinsic conditions that can cause contacts between the bone surfaces of the TMJ next to the bruising, which can stimulate the local osteogenesis and facilitate immobility. Any mechanical trauma which is sufficient to produce hemarthrosis, meniscus disruption, or fracture of the condyle or temporal plate can result in ankylosis. The presence of a scar may point toward a traumatic etiology for ankylosis **(Fig1)**, but the probability of ankylosis following TMJ injury is reported to be around 0.2%. Inflammatory causes are rheumatoid arthritis, ankylosing spondylitis, Felty's syndrome, Still's disease, and Marie-Strumpell disease. It may also result from haematogenous spread of infectious conditions such as tuberculosis, gonorrhoea, psoriasis and scarlet fever.

Childhood infections including otitis media, dental infection, mastoiditis, parotid abscess, osteomyelitis, tuberculosis, actinomycosis, scarlet fever, septic arthritis, and mastoiditis of the temporal bone can cause ankylosis after their spread to the TMJ. Paget's disease, metastatic neoplasm and the effects of radiation therapy also must be included in the differential diagnosis of TMJ ankylosis [4].

Classification: TMJ ankylosis may be classified by a combination of location (intra- or extra-articular), type of tissue involved (bony, fibrous, or fibro-osseous) and extent of fusion (complete, incomplete). Literature classifies ankylosis as true and false. Any condition that gives rise to osseous or fibrous adhesion between the surfaces of TMJ is a true ankylosis. False ankylosis results from pathologic conditions not directly related to the joint. TMJ ankylosis is a fibrous or bony fusion of the condylar head of the mandible to the articulating portion of the temporal bone. Mandibular movement is restricted only in fibrous ankylosis, but with bony ankylosis the patient's mandible and temporal bone are united and the TMJ no longer functions normally. Both fibrous and bony ankylosis may allow some movement at the incisors. A vertical or interincisal opening of 5 mm or less indicates full bony union of the mandible to the temporal bone [5].

The severity of ankylosis was classified according to SAWHNEY with type I—condylar head flattened or deformed but closely approximated to the upper articular surface with fibrous adhesions around the joint; type II—condylar head misshaped or flattened but still distinguishable and in close approximation to the articular surface, bony fusion of the head to the outer edge of the articular surface; type III—a bony block bridges across the ramus of the mandible and the zygomatic arch, and the displaced condylar head is atrophic and lying either free or fused to the medial side of the ramus; and type IV—a wide bony block between the ramus and the upper articular surface completely replacing the architecture of the joint. SAWHNEY, 1986; QUDAH; QUDEIMAT; AL-MAAITA, 2005 and VIEIRA; RABELO, 2009) classified into:

Type I – Presence of fibroadhesions at the condyle;
Type II – Bone fusion with condyle remodeling and an intact medial pole;
Type III – Anquilotic mass, mandibular ramus union with the zygomatic arch and medial pole intact; and
Type IV – Complete anquilotic mass, total union of the mandibular ramus with the zygomatic arch [6].

In the year 2002 (HAKIM AND METWALLI) proposed that ankylosed joints can be grouped to the relation of their ankylosed mass to the surrounding vital structures, especially at the base of the skull base, interpreted from C.T. According to them:
Class I: Unilateral & bilateral ankylosis, the condyle and glenoid fossa retain their original shape, and the maxillary artery is in normal anatomic relation to the ankylosed mass.
Class II: There is unilateral or bilateral bony fusion between the condyle and the temporal bone. The maxillary artery is in normal anatomic relation to the ankylosed mass.
Class III: The distance between the maxillary artery and the medial pole of the condyle is less on the ankylosed side than in the normal side or the maxillary artery runs within the ankylotic bony mass (best seen on coronal C.T).
Class IV: The ankylosed mass appeared fused to the base of the skull and there is extensive bony formation, especially from the medial aspect of the condyle to the extent that the ankylosed bony mass is in close relationship to the vital structures at the base of the skull such as the pterygoid plates, the carotid and jugular foramina and foramen spinosum and no joint anatomy can be defined from the radiograph. (This is best visualized on axial C.T).This new classification gives the surgeon opportunity for the careful surgical planning and achieves better surgical results [7].

Characteristic Features: TMJ ankylosis in children results in arrested condylar growth. The loss of growth and function results in muscle and bone atrophy and, in time, micrognathia, microgenia, and retrognathia. Ankylosis is more often unilateral, causing facial asymmetry. The earlier the ankylosis occurs, the more severe the deformity. The tongue position, pattern of swallowing, activity of the muscles of facial expression, and oral habits are functional causes or contributors to the deformity. The child may ingest a poor diet which contributes to a failure to thrive and diminished growth. The restricted airway can cause

problems with respiration and with articulation and speech fluency. The psychological toll varies. Some children cope adequately with the problem, but others are psychologically disabled by their disfigurement and become shy, moody and reclusive. Their oral restrictions cause great frustrations during eating or speech [8].

Ankylosis of the TMJ can occur at any age; however, it has a higher incidence in younger patients. Moreover, the evolution of the pathological process is more severe in children because of the defective cartilage osteogenesis damaged by the ankylotic process and of the loss of muscle guidance over the mandibular growth process In adults, the changes of secondary maxillofacial alterations due to the ankylotic blockage are less complex and can be resolved after restoration of the joint function. TMJ ankylosis is an abnormality which not only causes skeletal alterations but also adversely produces alteration in soft tissue configuration [9].

Secondary effects on the soft tissues surrounding the mandible occur in the form of shortening of the pterygo-masseteric muscle sling and the ligaments attaching the mandible to the skull base (sphenomandibular and stylomandibular ligaments). The masticatory muscles may become hypertrophic as a result of long-standing isometric contractions. Hypertrophy of the temporalis muscle may lead to thickening and elongation of the coronoid process. The suprahyoid muscles also become shorter and hypertrophic as they try to pull the chin inferiorly and simultaneously posteriorly causing shortening of the chin–hyoid distance, and thus contributing to partial obstruction of the airway. The degree of recession and asymmetry of the mandible depends on the growth condition and the time of onset of ankylosis [10].

Anatomic Considerations: The human skeleton is formed by independent but articulated parts. The bones fuse or articulate to provide movements, although some form shielding compartments where no movements are found. In the human body, three types or articulations are seen: fibrous, cartilaginous and synovial .Particularly, synovial joints differ in anatomic and functional aspects by having a cavity filled with liquid. This provides great extent for movements, especially for sliding and angular dislocations [11].

The articular surface is lined by the articular cartilage that diminishes friction between osseous parts. On its inner surface, two tissues can be found: articular cartilage and synovial membrane. The TMJ is a synovial type, lined in its superior aspect by a synovial membrane which produces the synovial fluid. The synovial fluid contains hyaluronic acid and a mucopolysaccharide providing the weeping characteristic along the synovial membrane, the connective tissue that involves the articular surface. It also has metabolic roles to the non-vascularized inner structure. The TMJ involves the temporal bone and the mandibular condyle. Both osseous surfaces are lined by a fibro cartilaginous tissue [12].

The temporal bone region involved in the articular process is located at its inferior aspect and includes the articular tuberculum and the mandibular fossa. The TMJ can be divided in two aspects: first, the superior compartment, limited by the articular fossa and the upper aspect of the disc, and second, by the inferior compartment, limited by the condyle head and the inferior aspect of the disc. The articular bones guide the mandibular movements originated from muscular and ligament actions. Physiological limitation of these actions is provided at the perimeter of border movements.

This means that, when movements reach their limits or go further on, ligaments stretch inhibiting muscle or ligament exacerbation. The TMJ ligaments have an important role as protective structures. They behave in a passive way to restrict mandibular or articular movement. TMJ associated ligaments are composed of collagen and limit movement at the disc/condyle assembly [13]. There are three pairs of ligaments attached to the TMJ: the temporomandibular, the sphenomandibular, and the stylomandibular ligaments. The first one is adjacent to the articulation and behaves as a protection to the articular capsule. This ligament impedes excessive retrusion or mandibular posterior stretching. The sphenomandibular ligament originates from the sphenoid spine and attaches to the lingual surface of mandible.

This ligament is stretched on mandibular protrusion. Finally, the stylomandibular ligament comes from the styloid process of the temporal bone to the mandibular angle, becoming stretched during mandibular protrusion. A fibrous capsule involves the TMJ in a sheet-like configuration. Mandibular movements can occur regardless of its mechanical strength. It attaches superiorly to the temporal bone near the fosse limits and articular eminence, and inferiorly to the condylar poles. Fibers of the articular capsule fuse with fibers of the lateral pterygoid muscle in an anterior direction; laterally, the acquire strength joining the temporomandibular ligament that sustains the articulation. Medially, the spheno and stylomandibular ligaments sustain the articulation [14].

The articular disc is a biconcave, stiff, fibro cartilaginous plate, but flexible. Three regions can be identified: posterior, middle and anterior portions. The middle portion is thinner (1mm) than the posterior (3mm) and anterior (2mm) portions. The disc is positioned like a cap over the condyle head. It lies down more anterior and medially to favor some physiological movements: condyle against the articular eminence (anteroposterior direction) and against the lateral wall of the articular fossa (laterolateral direction). Superiorly, the disc is not attached to the temporal bone, but inferiorly it joins the condyle head at two points, the medial and lateral poles. The TMJ vascular nourishment arises from temporal and maxillary arteries (posteriorly) and masseteric artery

(anteriorly).There is a rich venous network at the posterior articular aspect associated to the retrodiscal tissues, filled in and filled out according to protrusive and retrusive movements, respectively, at the condyle-disc complex, also producing the synovial liquid . Innervations to the TMJ come from branches of the mandibular nerve: the auriculotemporal, masseteric, and deep posterior temporal branches. Those are the same nerves that serve the masticatory muscles [15].

Diagnosis: Certain characteristics help distinguish fibrous from bony anklyosis. Patients with fibrous anklyosis will find forceful opening of the mouth painful while bony ankylosis patients will not. Some fibrous anklyosis patients will be able to protrude the mandible slightly while bony anklyosis patients will not. Photographs, cephalometric and panoramic radiographs **(Fig 2)**, TMJ joint tomograms or CAT scans are valuable in documenting the actual site and extent of ankylosis. In ankylosis the coronoid process usually is enlarged; in long-standing cases, the antegonial notch appears severely depressed and the TMJ area may be obliterated with dense sclerotic bone [16].

Imaging diagnosis is essential in differentiating and in evaluating of the degree of ankylosis. The main clinical aspect is the limited mouth opening due to the asymptomatic nature of the disease. Diagnosis of a fibrous ankylosis is more difficult; since the soft tissue fibrosis is not visible by conventional radiographic examinations. Osseous components of the TMJ in fibrous ankylosis present as normal image, or as small areas of erosion, but the joint space is reduced in association with a limited mandibular opening movement. TMJ osseous components may remodel as an attempt to adapt to the new situation [17]. Since 1930, radiographic images have been used as an important diagnostic tool in TMJ diseases. However the major problems are the overlapping of structures and image distortion. Now again going back to the history of radiography, Conventional tomography was once used most frequently to image the TMJ. Conventional film-based tomography is designed to represent more clearly objects lying within a plane of interest. Since the introduction of computed tomography (CT), which has superior low-contrast resolution, film-based tomography has been used less frequently nowadays [18].

The techniques are successful in detecting the shape of the condyle, joint outline, and osseous changes including flattening, osteophytosis, sclerosis and erosion. Currently, the computed tomography (CT) scan is the gold standard for assessment of TMJ hard tissue. Coronal CT scans are helpful in elucidating the delayed state of the pathological hard tissue and can also change the plan of treatment in accordance with the imaging diagnosis. CT provides adequate information about condyle, mandibular fossa, articular eminence and surrounding tissues. Switching the image slices, it is possible to evaluate the condyle medial pole and lateral pole as well as the central region. Data from sagittal and coronal slices are the most useful for studying TMJ ankylosis [19].

Normally in all complete Type IV ankylosis, 3-dimensional CT reveals the ankylosed mass fused to the base of the skull with is extensive bone formation, especially from the medial aspect of the condyle to the extent that the ankylosed bony mass is in close relationship to the vital structures at the base of the skull such as the pterygoid plates, the carotid and jugular foramina and foramen spinosum and no joint anatomy can be defined from the radiograph with reduced vertical height of the ramus. Three-dimensional reformatted images & Magnetic resonance imaging (MRI) have also been considered for determining the soft tissues and osseous component images. Currently, three-dimensional computed reconstruction allows elaboration of realistic and spatially accurate images for diagnosis and surgical planning [20].

Management: The treatment of choice for ankylosis of the TMJ is always surgical. This treatment permits the removal of all rigid bone mass that involves the articulation, creating enough space to allow the interposition or even full reconstruction of TMJ with customized prosthesis. However, there are no consensuses in the existing literature of the best treatment for TMJ ankylosis.

Several authors studied and developed different techniques, but recurrence still remains as the major problem when treating TMJ ankylosis [21-23]. The critical factor of successful treatment of TMJ ankylosis, at long term, is early detection, implementation of an intensive physiotherapy program and a good post-operative conduct. Long period of physical therapy is essential for obtaining good results in treatment.

The main objective of this treatment is to prevent bone neoformation in articulations, as well as to minimize fibrosis and to prevent scar retraction, trismus, atrophy and muscle spasms. Trauma is the major cause of TMJ ankylosis. The kind of trauma that usually results in ankylosis of the TMJ is predominantly experienced in childhood and if no treatment is undertaken for a fracture of the condyle, the myositic mass grows in the juxta-articular tissue, resulting in a bone mass. Of particular significance is the decision as to the indication and timing of surgical treatment during childhood. The facial remodelling is greater when the release is done in childhood.

Remodelling of the mandible after surgery, especially in unilateral ankylosis, is a phenomenon that has no parallel elsewhere in the body**.** The administration of anaesthesia to patients with TMJ ankylosis is a challenge in as much as securing the airway can be very difficult. It requires considerable expertise and adequate monitoring facilities. The safest technique for securing the airway would be a nasal fiberoptic assisted intubation with the patient awake and under local anaesthesia. TMJ arthroplasty can be done under local anaesthesia, thus

avoiding the need for difficult, often blind, nasal intubation and associated trauma to the pharynx and vocal chords, and possible emergency tracheostomy wherever the facility for fibre optic endoscope is not available [24].

Local anaesthesia is simple, safe, and effective. To prevent surgical recurrence in cases afflicted with ankylosis, radical removal of the bony or fibrous ankylotic segment is essential. However the unfavourable anatomic configuration and the proximity of vital structures make the surgical procedure particularly difficult. Roychoudhury et al. recommended a gap of at least 15 mm between the recountoured glenoid fossa and the mandible and subjected this gap to extensive active jaw opening exercises to prevent re-ankylosis when using gap arthroplasty [25].

According to Kaban et al. the advantages of gap arthroplasty are its simplicity and short operating time and the disadvantages include 1) creation of a pseudo articulation and a short ramus; 2) failure to remove all the bony pathology, and 3) increased risk of reankylosis [26]. Patients with bilateral involvement showed more frequent anterior open bite. This complication was treated with physiotherapy and the use of elastics.

A careful surgical technique and subsequent meticulous attention to long-term physiotherapy are both considered essential to achieve a satisfactory result. Many studies have shown that the choice of interposition material is important in preventing recurrence. Interposition of autogenous or alloplastic material at the ostectomy site is a mechanism to prevent recurrence; however, there are possible disadvantages, such as morbidity at the donor site and unpredictable resorption when autogenous material is used, and the risk of a foreign body reaction when alloplastic material is used. Homograft's such as skin, temporalis muscle, segment of rib or fascia lata are considered as the material of choice for interposition. Bilateral arthroplasty is frequently associated to anterior open bite, because there is a shortening of the ramus and only hinge movement is possible [27-29].

This complication could be minimized, when interpositional arthroplasty or total reconstruction of the TMJ is used. Unstable occlusion after the arthroplasty is corrected once the patient is taught to close in occlusion. The complication of facial nerve weakness occurs when there is excessive retraction intraoperatively of the soft tissues, and it usually responds to steroid therapy. Interpositional Gap Arthroplasty is a highly effective and safe surgical management option for TMJ ankylosis with acceptable immediate and long term outcome, particularly when temporalis fascia and muscle are used for adults and costochondral grafts with fascia interposition used for children [30].

A 7-step protocol has been developed for the treatment of TMJ ankylosis:

1) Aggressive resection of the ankylotic segment, 2) ipsilateral coronoidectomy, 3) contralateral coronoidectomy when necessary, 4) lining of the joint with temporalis fascia or cartilage, 5) reconstruction of the ramus with a costochondral grafts 6) rigid fixation of the graft and 7) early mobilization and aggressive physiotherapy.

Management of TMJ ankylosis is mainly performed through surgical intervention. Various techniques for the management of TMJ ankylosis have been described in the literature. However, no single technique has proved entirely satisfactory. The characteristic pathology of ankylosis is the formation of a bony mass, which replaces the articulation, resulting in restriction of mandibular movements. For this reason, treatment of TMJ ankylosis requires removal of a sufficient amount of bone to allow for free movement of the mandibular stump and interposition of some material between the remaining ramus and skull base [31].

Figure 1. Clinical picture showing indentation at left pre auricular region

Figure 2. Panoramic radiograph depicting left TMJ ankylosis

CONCLUSION

Any delay of corrective surgery will cause an increasing loss of function, diminished mandibular growth and disfigurement**.** Detailed descriptions of clinical, functional and radiographic findings are necessary in order to establish a set of pathognomonic symptoms which can aid in the recognition of TMJ ankylosis. Releasing the condyle can be accomplished by several surgical techniques, immediately improving function. However, the surgical procedure which both improves function and stimulates growth is the surgery of choice for the immature child. Grafting interpositional material between the condyle and temporal bone satisfies both needs.

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