Autogenous Reconstructive Modalities of TMJ Ankylosis-A Retrospective Analysis of 45 Cases

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Abstract The study reports the authors' experience in managing temporomandibular joint (TMJ) ankylosis in Chennai, India (1995–2006) and compares the surgical modalities used. Forty-five patients (67 joints) were reviewed in this retrospective study. Pre- and post-operative assessment included history, radiological, physical examination, and range of mouth opening. Age, gender, aetiology, joint(s) affected, surgical modality, complications and follow-up periods were evaluated. Various types (fibrous, fibroosseous and bony) of TMJ ankylosis were diagnosed. Trauma was the commonest aetiology. The patients' age range was 2–50 years, 51.1 % were males and the follow-up period ranged from 14 to 96 months. Average mouth opening was significantly increased to 32 mm 12 months post-operatively. Mouth opening was compared following different interpositional materials like temporalis interpositioning (33 mm), costochondral graft (30.6 mm) and autograft (30 mm). Minor and major complications were encountered in 37.4 % of cases, including 6.7 %

recurrence rate. Early release of TMJ ankylosis; reconstruction of the ramus height with distraction osteogenesis or bone grafting combined with interpositional arthroplasty, followed by vigorous physiotherapy is a successful strategy for the management of TMJ ankylosis.

Keywords Autogenous reconstruction · TMJ ankylosis · Costochondral graft · Autograft · Ankylosis · Autogenous grafts · Preauricular incision · Gap arthroplasty

Introduction

Ankylosis of the temporomandibular joint (TMJ) involves fusion of the mandibular condyle to the base of skull, which causes distressing conditions including impaired speech, difficulty in chewing, facial disfigurement, compromised airway and psychological stress [1–3]. This is particularly true in young children who are completely unable to open their mouths. It is usually caused by trauma and infection [3–5]. In growing patients, deformities of the mandible and maxilla may occur together with malocclusion [6, 7]. In classifying TMJ ankylosis in children, Sawhney [8] identified four different types: in Type 1 there is minimal bony fusion, but extensive fibrous adhesions around the joint; Type 2 has more bony fusion especially at the outer edge of the articular surface, but no fusion within the more medial area of the joint; in Type 3 there is a bridge of bone between the mandible and the temporal bone; and in Type 4 the joint is replaced by a mass of bone. Treatment for TMJ ankylosis aims at restoring joint function, improving the patient's aesthetic appearance and quality of life and preventing re-ankylosis [9, 10]. Owing to technical difficulties and a high incidence of recurrence, the treatment of TMJ ankylosis and its complications poses a significant challenge to clinicians

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and patients. A variety of techniques for treatment of ankylosis have been described in the literature [11–16]. However no single method has produced uniformly successful results. Limited range of movement and reankylosis are the most frequently reported complications. Restoration of normal motion and functions in patients with TMJ ankylosis has been a difficult goal to achieve. The most frequently reported operations include gap arthroplasty, interpositional arthroplasty, excision and joint reconstruction with autogenous or alloplastic materials. The aim of this study is to report the authors' experience of managing over 45 patients with TMJ ankylosis in Chennai, India, and to determine whether the different surgical modalities they have used from 1993 to 2003 differ in terms of outcomes and complications.

Patients and Methods

This clinical retrospective study included 45 TMJ ankylosis patients (67 joints), managed between 1993 and 2003. For enrolment in this study, patients had to fulfil the following inclusion criteria: diagnosed with true TMJ ankylosis involving the articulating surfaces; the pre- and post-operative data record, including patient consent, clinical and radiological examinations had to be available; a post-operative follow-up period of at least 12 months had to have been completed. Data concerning age, gender, aetiology, joint(s) affected, treatment modalities and post-operative complications were evaluated. The pre-operative assessment included a detailed patient history, radiological, physical examination and mouth-opening measurements. Radiological investigations for all patients included orthopantomography (OPG), posteroanterior skull view (PA), cephalometric views and computed tomography (CT). Mouth opening was assessed using callipers including pre, intra and post-operatively (immediately and at 6 and 12 months).

The TMJ was surgically accessed via a standard preauricular approach with temporal extension. The superficial temporal fascia was identified, and its plane was followed inferiorly and anteriorly to reach the zygomatic arch. The periosteum over the zygomatic arch was incised and reflected, followed by vertical incision of the joint capsule. The ankylotic mass was exposed and excised. Tendons of the masseter and medial pterygoid muscles were carefully dissected and maximum mouth opening was tried intraoperatively. When a bone graft, such as a costochondral graft (CCG), was to be used and fixed with wires, a second incision was also made 2 cm below the angle of the mandible for insertion and fixation of the graft. An intraoral incision was employed in some cases to gain access to the contralateral coronoid processes for coronoidectomy, when it was indicated. Surgical burs and osteotomes were carefully employed to remove a segment of bony and/or fibrous

tissue between the inferior border of the zygomatic arch and the superior edge of the vertical ramus to create a gap of 1.5–2 cm (Fig. 1). Care was taken to protect the maxillary artery behind and deep to the osseous mass, and to remove any bony tissue deep and medial in the surgical field that would interfere with free movement of the mandible and contribute to the recurrence of the ankylosis. Intra-operative arterial or venous bleeding was controlled with cautery or pressure packs. Patients were categorized, according to the surgical technique employed, All patients underwent gap arthroplasty with interpositional arthroplasty using temporalis myofascial flap (TMF), costochondral graft (CCG) or autogenous grafts and adjunctive orthognathic procedures.

A 1.5–2 cm gap was created after resection of the ankylosis mass followed by interpositional arthroplasty. The TMF technique was mainly used in patients who potentially had the risk of re-ankylosis and grafting was performed in patients with marked facial asymmetry. Orthognathic procedures were performed in a few patients for asymmetry correction.

Whenever the TMF was used as an interposition, a 3 cm long myofascial flap was turned outward and downward over the zygomatic arch and placed into the glenoid fossa and then sutured medially and posteriorly to the adjacent tissues with non-absorbable sutures (Fig. 2).

When a CCG was used, in unilateral cases, the graft was taken from the 5th or 6th rib through a submammary incision. In bilateral cases, both the 5th and the 7th ribs were employed. The length of the cartilaginous component of the CCG used ranged from 3 to <6 mm and its ends

Fig. 1 Gap arthroplasty

Fig. 2 Temporalis interpositioning

were dome-shaped to represent the condylar head. This graft was secured to the outer posterior surface of the ascending ramus of the mandible with either two stainless steel wire sutures or with 2 or 3 screws. When the coronoid process was either a part of the ankylosis or mouth opening was still less than had been expected, ipsilateral coronoidectomy was performed through the same preauricular incision used for arthroplasty. Contralateral coronoidectomy was also considered (transoral) in cases where mouth opening was still inadequate. When the resected coronoid process was to be used for reconstruction of the vertical ramus and serve as a condyle, it was modified and fixed to the ramus stump using miniplates. For relapse cases, the Esmark procedure was done creating an osteotomy gap at a lower level near the angle of the mandible, then the masseter and the medial pterygoid muscle were sewn together through the gap. In most patients, a vacuum drain was inserted for 48 h and all wounds were closed in layers and heavily dressed. Post-operative analgesics and prophylactic antibiotics were prescribed for all patients to control pain, enhance the mouth opening and reduce the possibility of infection. Patients were discharged 3–5 days post-operatively. All patients were trained to carry out mouth-opening exercises, which included encouraging them to move their mandibles vertically and horizontally by frequent chewing. The other daily exercise was the use of wooden spatulas (1 mm thick), bilaterally between the upper and lower premolar–molar region. The number of wooden spatulas was increased until the patient gained and retained the maximum mouth opening that had been achieved intra-operatively (Figs. 3, 4). All patients were seen weekly for

6 weeks and then followed-up clinically and radiologically at 3 and 6 months and then annually to the end of the follow-up period.

Results

Forty-five cases (51.1 % males) who fulfilled the inclusion criteria and had had surgical repairs of ankylosed TMJ were included in this study. Their ages ranged from 2 to 50 years with a mean age of 26 years at the time of surgery. Unilateral TMJ ankylosis was diagnosed in 23 (51.1 %) patients, 16 (35.5 %) of which were on the right side and 7 (15.5 %) on the left side, while bilateral ankylosis was diagnosed in 22 (48.8 %) patients. Three different types of ankylosis were identified: bony ankylosis in 25 (55.5 %) patients; fibrous ankylosis in 12 (26.6 %) and fibro-osseous ankylosis in 8 (17.7 %) patients. Thirty-two (71.1 %) patients were successfully intubated blindly under spontaneous respiration with oxygen, nitrous oxide and halothane. The remaining 12 (26.7 %) patients underwent direct nasotracheal and only one (2.2 %) was anaesthetized via tracheotomy. Various surgical treatment modalities were documented in this study-of which 30 (66.6 %) cases were managed only by TMF interpositioning. It was employed with CCG in 6 (13.3 %) cases, and combined with autogenous grafts in 9 (20 %) cases. Adjunctive orthognathic surgery such as; sliding advancement genioplasty for 7 (15.5 %) patients, anterior maxillary osteotomy for 1 (2.2 %) patient, Lefort I osteotomy for 3 (6.66 %) patients and vertical subsigmoid ramus osteotomy was done in 2 (4.44 %) patients simultaneously. Secondary correction was done by Lefort I osteotomy in 4 (8.8 %)

Fig. 3 Pre-op mouth opening

Fig. 4 Post op mouth opening

patients, bilateral sagittal split Osteotomy in 2 (4.4 %) patients and by distraction osteogenesis in 2 (4.4 %) patients. Augmentation of chin using corals was done in 3 (6.6 %) cases (Table 1). Mean mouth opening by year distribution showed a standard deviation of 32.15 ± 1.9 mm for Temporalis muscle interposition only, 30.6 ± 0.0 mm for Costochondral graft and 31.5 ± 1.5 mm for autograft (Table 2).

Discussion

The term temporomandibular joint ankylosis is applied to any disorder resulting in permanent mandibular dysfunction due to fibrous tissue or bony union occurring unilaterally or bilaterally. Management of paediatric cases often poses the dual challenge of restoring mandibular function and correction of deformities. This condition is rarely painful, most patients either consult for masticatory or articulation related problems and are identified at dental treatment.

Several accounts on the epidemiology of Temporomandibular joint ankylosis already exist in the literature [11–15]. In terms of age and gender distribution the results of the present report states that equal distribution (male: 51.1 %—23 cases, female: 48.9 %—22 cases) of this problem posed between both genders when compared with that of Chossegros [16, 17], Nitzan [18] where a higher prevalence of females were seen. It is however pertinent to mention that a significant proportion of our patients presented within the second and third decade of life (42.2 %—19 cases) when compared to those of Obiechina [15] where patients presented within the first decades of life, a fact alluded to by Topazian [19] and Faerber [20], Chidzonga [3].

Ignorance, economic difficulties, poor utilization of dental services and distance to referral centres are some of the reasons that probably account for the late reporting of patients for treatment thereby obscuring the evaluation of etiological factors causing ankylosis. Various authors like Adekeye [11], Rowe [21], Kaban et al. [6], and Lello [22] listed that trauma and infection are the main causes of ankylosis of temporomandibular joint. Trauma can be singled out as the common aetiology in adults which accounts for the greater incidence of patients between the second and third decades of life.

Most patients presented with varying difficulties of mouth opening, speech impairment and mastication. The restricted mouth opening caused occlusal derangement, poor oral hygiene, rampant caries, generalized gingivitis, periodontal disease and gross calculi were almost similar to the list of clinical features reported by Raveh et al. [10]. Those patients who had unilateral ankylosis (12 males and 11 females—51.1 %) presented with mandibular asymmetry. The appearance was that of flatness and elongation on the unaffected side with roundness and fullness of the face on the affected side, with the midpoint of the chin and the mandibular midline deviated to the ankylosed side. The chin had receded considerably with a small mandible. The maxillary and the mandibular incisors were splayed forward because of pressure of the tongue. Those patients with bilateral ankylosis (11 males and 11 females—48.9 %) had classical bird face deformity. These clinical features reported in our study correlate with those of other studies [3, 6, 12–15, 23].

In our present review there were 14 cases of unilateral bony ankylosis (right side: 9, left side: 5 cases), 9 cases of unilateral fibrous ankylosis (right side: 7, left side: 2), 11 cases of bilateral bony ankylosis (6 males and 5 females), 3 cases of bilateral fibrous ankylosis (2 males and 1 female), 2 cases of right side bony and left side fibrous ankylosis (1 male and 1 female), 6 cases of right side fibrous and left bony ankylosis (1 male and 5 females). The incidence of bilateral ankylosis was 46.6 % when compared with 63 % of Chidzonga et al., 31 % of Lello et al. [22], and 71.4 % of Kaban et al. [6].

All patients were managed surgically under general anaesthesia. Temporomandibular joint ankylosis presents a serious problem for airway access. As Adekeye [11] noted in the Nigerian series, achievement of an airway to give anaesthetic was difficult. Our series underwent blind awake nanotracheal intubation (32 cases—71.1 %), direct Nanotracheal intubation (12 cases—26.7 %) and elective tracheostomy (1 case—2.2 %) when compared to Chidzonga [3] where 56 % of cases underwent blind awake nasotracheal intubation, 13 % direct nasotracheal intubation and 13 % (4 cases out of 32) tracheostomy. In our series only one patient underwent tracheostomy before endotracheal

Table 1 Data analysis of 45 cases including diagnosis and treatment modalities

Variables	No of cases
Gender	
Male	23 (51.1 %)
Female	22 (48.8 %)
Age group	
0–10 years	8 (17.7 %)
10–20 years	13 (28.8 %)
20–30 years	19 (42.2 %)
30–40 years	4 (8.88 %)
40–50 years	1 (2.22 %)
Side	
Right	18 (40 %)
Left	13 (28.8 %)
Bilateral	14 (31.1 %)
Type of ankylosis	
Fibrous	12 (26.6 %)
Fibro-osseous	8 (17.7 %)
Bony	25 (55.5 %)
Anaesthetic techniques	
Blind awake intubation	32 (71.1 %)
Nasotracheal intubation	12 (26.6 %)
Tracheostomy	1 (2.22 %)
Approaches	
Pre-auricular with temporal extension	38 (84.4 %)
Pre-auricular with temporal extension and submandibular	4 (8.88 %)
Pre-auricular with temporal extension and intra oral	17 (37.7 %)
Preauricular with intra oral	5 (11.1 %)
Intraoral condylectomy alone	14 (31.1 %)
Treatment modalities	
Temporalis interpositioning	30 (66.6 %)
Costochondral (CCG)	6 (13.3 %)
Other autografts	9 (20 %)
Adjunctive procedures	
Genioplasty	7 (15.5 %)
Anterior maxillary osteotomy	1 (2.22 %)
Lefort I osteotomy	7 (3.15 %)
Vertical subsigmoid osteotomy	2 (4.44 %)
Bilateral sagittal split osteotomy	2 (4.44 %)
Distraction osteogenesis	2 (4.44 %)
Coral augmentation	3 (6.66 %)

intubation could be employed when compared to Adekeye [11] where 30 % of the patients required tracheostomy. Tracheostomy was done only as a last resort because of the possible complications—tracheal stenosis, poor tracheostomy management and infection. The difficulty in intubation was mainly because most of the patients had limited mouth opening.

Table 2 Mean mouth opening—year distribution

Years	Temporalis inter position only (mm)	Costochondral graft (mm)	Autograft (mm)
1993–1995	33	30.6	30
1996–1998	30.2	–	33
1999–2001	31.4	–	–
2002–2004	34	–	–
Standard deviation	32.15 ± 1.9	30.6 ± 0.0	31.5 ± 1.5

The current standard for surgical correction is to operate when the ankylosis is recognized as stated by Chossetros et al. [19] and Faerber [20] regardless of the age of the patient. Most of the cases presented to us were in the second and third decades of life. Worldwide, the treatment of TMJ ankylosis poses a great challenge to the Oral and Maxillofacial surgeon as several techniques and approaches have been described with no uniformly acceptable results. Kaban et al. [6] proposed the protocol of aggressive resection of ankylotic mass not less than 1.5 cm, ipsilateral coronoidectomy, contralateral coronoidectomy if mouth opening not achieved, lining of the glenoid fossa with the temporalis muscle fascia flap, restoration of the ramal height using costochondral graft, rigid fixation and aggressive physiotherapy. We followed the above protocol. In addition, we explored the other joints for identifying and removal of any fibrous adhesions if adequate mouth opening of minimum 35 mm was not achieved. Temporomandibular joint reconstruction was done using costochondral graft at six sites (3 right, 3 left) and using autografts, using the same resected ankylotic mass as recommended by Gunaseelan [9] at 9 sites (4 right and 5 left). The autograft consisted of dense bone and had a smooth cortical surface at its superior aspect facing the temporalis muscle which lined the newly created fossa. We used this method mainly in adult ankylosis/reankylosis patients where the ankylotic mass was often large and, when resected, at least one piece was large enough to be contoured and used to maintain the vertical height of the ramus.

None of the patients reported with complications after costochondral grafting in our review when compared with Manganello et al. [12]. Lindqvist et al. [24] recommended the use of costochondral grafts in TMJ reconstruction. Overgrowth of costochondral grafts have been reported by Lata and Kapila [25], Guyuron and Lasa [26]. Fracture of costochondral graft in temporomandibular joint reconstructive surgery has been reported by Merckx and Freihofer [27]. No alloplastic implants were used in this study though many studies like that of Chidzonga [3], Chossegros et al. [19], Kaban et al. [6], Salins [28], Chossegros et al. [17], recommend their use.

Measurement of inter-incisal opening distance is the most objective criterion for diagnosis and follow-up. Despite the fact that the majority of patients in our series had gap arthroplasty, the overall outcome was quite satisfactory with only a minimal drop in the inter-incisal mouth opening at 6 months into the post-operative period. This may be attributed to the intense instruction and motivation of the patients towards the need of aggressive physiotherapy and also direct supervision of the jaw exercise using wooden spatulas by the clinician in the immediate post-operative period. In addition, the co-operation and perseverance of the patients irrespective of age and pain from the operative site was highly instrumental to the level of mouth opening achieved. Adekeye [11] made similar observations and de-emphasized the role played by aetiology, clinical presentation and treatment technique in determining successful outcome. All patients with bony ankylosis were treated along with temporalis muscle fascia flap interposition. No intermaxillary fixation was used in any patient post-operatively.

The importance of adjunctive orthognathic procedures to produce a symmetrical face with good occlusion has been emphasized by many authors. [21, 22, 29] We have performed sliding advancement genioplasty for 7 patients, anterior maxillary osteotomy for 1 patient, Lefort I osteotomy for 3 patients and vertical subsigmoid ramus osteotomy was done in 2 patients simultaneously. Secondary correction was done by Lefort I osteotomy in 4 patients, bilateral sagittal split osteotomy in 2 patients and by distraction osteogenesis in 2 patients. Augmentation of chin using corals was done in 3 cases.

We had a relapse rate of 6.7 % (3 patients) compared to 19 % by Chidzonga [3], and 14.5 % by Adekeye et al. [11]. Our report supports the 4–31 % incidence range of relapse described by previous investigators like El-Sheikh and Medra [30] and Kaban et al. [6].

Temporary facial nerve paralysis that resolved after a year of follow-up was observed in 17.6 % (8 patients).

Anterior open bite of 17.6 % (8 patients) was the most common complication associated with the release of TMJ ankylosis regardless of the aetiology or extent of the lesion. Intraoperative complication encountered was haemorrhage in 2.2 % (1 patient) which was controlled by packing the site with gauze.

Post-operative infection occurred in 2.2 % (1 patient) that was managed with antibiotics besides premature occlusion that we recorded, are known complications associated with gap arthroplasty.

Relapse from the surgical point of view is generally due to the inadequate removal of bone or incomplete separation of the bone surfaces. It is difficult to locate the deeply situated medial pole which is fused to the base of skull [21]. Aggressive physiotherapy was continued for 1 year to

maintain optimal results [6, 9, 31–33]. Hence to prevent relapse, early surgical intervention, aggressive resection of the ankylotic mass should be performed, regardless of age of the patient [6, 34].

We had 3 cases of relapse of which 2 cases were treated using temporalis interposition gap arthroplasty and 1 using costochondral graft. All cases of relapse were re-operated using Esmark procedure. An osteotomy gap is created at a lower level near the angle of the mandible, then the masseter and the medial pterygoid muscle were sewn together through the gap. The temporalis interposition is difficult to perform in these patients due to fibrosis of the muscle. Moreover identifying the plane of dissection in a redo surgery for relapse is difficult. Therefore, the Esmark procedure is done below the level of re-ankylotic mass and does not interfere with the resection of the ankylotic mass.

Our centre has considerable experience in the treatment of ankylosis. In the 1990s we favoured the resection of ankylotic mass followed by temporalis interposition and reconstruction of ramal height using costochondral graft for children and autograft in adults.

Apart from the disadvantages of these grafts, we found no significant difference in the mouth opening and relapse rate when compared with temporalis interpositioning alone. The facial deformities are corrected with adjunctive orthognathic procedures at the same time or in stages.

We therefore suggest that successful treatment of temporomandibular joint ankylosis can be accomplished with temporalis interposition arthroplasty, adjunctive orthognathic surgery and aggressive physiotherapy.

From the current study, the authors summarize and conclude that early release of TMJs reconstruction of the ramus height with distraction osteogenesis or bone grafting combined with interpositional arthroplasty, followed by vigorous physiotherapy is a successful strategy for the management of TMJs. Despite the potential problems reported with CCG in some previous studies, the authors think that it should be the preferred option in growing patients, provided a shorter chondral length is used. Distraction osteogenesis is gaining popularity in the management of TMJs as the donor site morbidity is eliminated and the complexity of the procedure is minimized. Distraction osteogenesis is best used when other techniques have failed or have produced inadequate results.

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