

Functional Outcomes of Temporomandibular Joint Ankylosis Treatments: A 10-year cohort study

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Introduction : Ankylosis of the temporomandibular joint (TMJ) is a disabling condition due to the fusion of joint to the base of skull and results in mouth opening limitation. Several surgical techniques have been described for treatment of this condition but no consensus has been reached. This study sought to assess the success of treatment with regard to long-term functional improvement and rate of complications in ankylosis patients during a 10-year period. **Materials and Methods**: Patients who underwent unilateral or bilateral condylectomy without joint reconstruction during 2001-2011 in the Maxillofacial Surgery Department of Shariati Hospital were evaluated in this historical cohort study. The patients were recalled to ensure the accuracy of information in their medical records and were clinically examined. Improvement in their joint function and rate of complications were evaluated. Data were analyzed using Wilcoxon Signed rank test, multivariate tests, Mauchly's sphericity test and McNemar's test. **Results**: A total of 27 subjects (13 males and 14 females) with a mean age of 34.8 years and 6.1 years mean duration of follow-up were evaluated. The results of observation showed that trauma was the most common cause of ankylosis (63%). The most common type of ankylosis was fibrous (55.6%) and 55.6% of the patients had bilateral ankylosis. Maximum mouth opening (MMO), the amount of lateral movement and open bite significantly improved after the operation ($P < 0.001$). Frontal, zygomatic and buccal nerves had been injured in 4, 4 and 3 patients, respectively during the operation. **Conclusion**: Condylectomy without reconstruction significantly improves the TMJ function in patients with TMJ ankylosis with regard to MMO, the amount of lateral movement, maintenance of occlusion and the skeletal form.

Keywords: Ankylosis; Condylectomy; Temporomandibular joint

Introduction

Ankylosis of the temporomandibular joint (TMJ) is a disabling condition characterized by the loss of joint movement due to its fusion to the base of skull or calcification of the surrounding ligaments (1). This condition leads to reduction of mouth opening and is associated with problems in mastication, speech, digestion, oral hygiene and even facial appearance (2). The suggested etiologies include prolonged maxillary-mandibular fixation, local or systemic infection, prior gap arthroplasty, rheumatoid arthritis, Paget's disease, Ankylosing spondylitis, pseudo-hypoparathyroidism, psoriasis, burns and trauma. The latter has been suggested as the most common cause of ankylosis (3). Trauma causes hematoma, which later organizes, calcifies and leads to excessive formation of bone in front of the tragus, leading to TMJ ankylosis. TMJ ankylosis can be intra-articular or extra-

articular. Based on the type of involved tissue, it can be classified into bony, fibrous and fibro-osseous types. With regard to the extent of fusion, TMJ ankylosis is categorized into complete and incomplete types (4). TMJ ankylosis also may be unilateral or bilateral. Unilateral TMJ ankylosis results in facial asymmetry and deviation of the chin towards the affected TMJ. Bilateral ankylosis is often characterized by chin recession and absence of the mouth opening. The severity of TMJ ankylosis is estimated by the degree of limitation in interincisal opening (IO). In complete ankylosis, IO decreases to less than 5mm.

No consensus has been reached regarding the best treatment for TMJ ankylosis. Despite the introduction of several surgical techniques for treatment of TMJ ankylosis, recurrence remains a major concern for clinicians (2, 3). Moreover, due to the presence of important anatomical structures adjacent to the TMJ such as the facial nerve, carotid, jugular and maxillary vessels, the

surgeons are usually too careful in adequate removal of ankylotic bone, which results in recurrence. Between several surgical modalities proposed for treatment of TMJ ankylosis, gap arthroplasty, interpositional arthroplasty and joint reconstruction has been commonly administrated (5-7).

Considering the scarcity of studies with long-term follow-ups on ankylosis patients, historical cohort studies would provide valuable data. This study aimed to evaluate long-term joint function improvement and complications in ankylosis patients who underwent unilateral or bilateral condylectomy without reconstruction during a 10-year period.

Materials and Methods

This study was approved by the Ethics Committee of Cranio-Maxillofacial Research Center (CMFRC) of Tehran University of Medical Sciences. This historical cohort study was conducted on patients who presented to the Maxillofacial Surgery Department of Shariati Hospital during 2001-2011 and underwent unilateral or bilateral condylectomy without joint reconstruction. Subjects were selected using census sampling. The inclusion criteria were all patients over 18 years of age who underwent the mentioned procedures during the given time period with complete pre- and post-operative medical records. Written informed consent was obtained from all patients. Age, sex, etiology of ankylosis (trauma, infection, congenital, accident or others), type of ankylosis (unilateral, bilateral, fibrous, osseous, fibro-osseous), technique of surgery and time elapsed from surgery (years) were extracted from patient records. Functional parameters including maximum mouth opening (MMO), amount of lateral movements, pain in the muscles of mastication, occlusal relationship at centric occlusion (CO), the presence of open bite, skeletal relationship, facial asymmetry, mandibular deviation during opening and injury to the facial nerve before and after the operation were all extracted from patient files and recorded. Patients were contacted and recalled to ensure the accuracy of information in their medical records and also for a follow-up examination. Predesigned questionnaires were filled out for each patient based on the pre-operative and post-operative data in patient files as well as the current condition of patients. Patients were thoroughly examined at the recall session with respect to the mentioned parameters.

MMO was defined as the distance from the incisal edge of the maxillary central incisors to that of the mandibular central incisors at maximum opening of the mouth (in mm).

MMO values before the operation and immediately after the operation were extracted from patient records. MMO was also measured at the time of follow-up using a ruler.

The amounts of lateral movements of the mandible before and after the operation were extracted from patient records. At the time of follow-up, it was assessed again by measuring the horizontal distance from the incisal edge of the maxillary central incisors at the midline to the incisal edge of the mandibular central incisors in lateral movements towards the right and left using a ruler.

Pain in the muscles of mastication was assessed by clinical examination of temporalis, masseter, medial pterygoid muscles. Occlusion was classified based on Angle's classification into Class I, Class II, Class III or edentulous. The presence of anterior or posterior open bite in the medical records of patients or at the time of follow-up was recorded. Skeletal relationship of patients before and after the operation and at the time of follow-up was recorded by clinical evaluation. Facial asymmetry was assessed by placing a ruler at the facial midline of patients.

The presence of mandibular deviation during mouth opening was evaluated in patient's post operation records and was clinically examined at the time of follow-up. Facial nerve injury was evaluated based on patient records and also at the time of follow-up by clinical examination.

Statistical analysis

The recorded conditions were compared with normal conditions and statistically analyzed using SPSS version 22 and Wilcoxon Signed rank test, multivariate tests, Mauchly's sphericity test, McNemar's test and repeated measures ANOVA. $P < 0.05$ was considered significantly different.

Results

A total of 27 subjects, including 13 males (48%) and 14 females (52%) with a mean age of 34.8 years (range 21-70 years), who underwent unilateral or bilateral condylectomy during 2001-2011 were evaluated. The mean duration of follow-up was 6.1 years (range 2-11 years).

The most common cause of ankylosis in these patients was trauma (63%) and the most common type of ankylosis was fibrous (55.6%). Etiologies of ankylosis are shown in Figure 1.

Fifteen patients had bilateral (55.6%), 6 had unilateral right side (22.2%) and 6 had unilateral left side (22.2%) ankylosis.



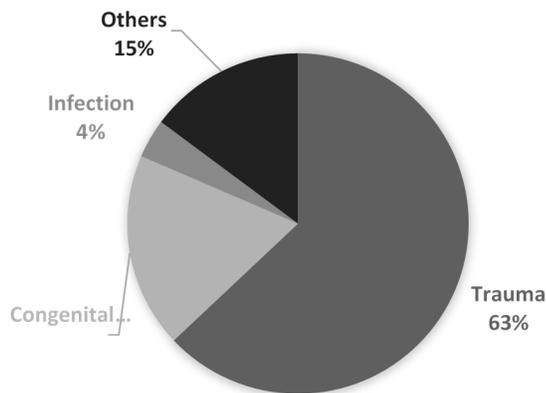


Figure 1. Etiologies of ankylosis

MMO before the operation ranged from 1mm to 22mm. This range after the operation was 24 to 43mm. MMO at the follow-up session ranged from 21 to 40mm. The difference between the pre-operative and post-operative values based on repeated measures ANOVA was significant ($P<0.001$).

At the time of follow-up, MMO had slightly decreased compared to immediately after operation. However, this amount was still significantly higher than the pre-operative value ($P<0.001$) (Figure. 2).

The amount of lateral movement towards the right side was 0mm in 12 patients (44.4%), 1mm in 14 patients (51.9%) and 2mm in 1 patient (3.7%) before the operation. This value at the time of follow-up was 1mm in 7 patients (25.9%), 2mm in 10 patients (37%), 3mm in 6 patients (22.2%) and 4mm in 4 patients (14.8%). ($P<0.001$)

The amount of lateral movement towards the left side was 0mm in 10 patients (37%) and 1mm in 17 patients (63%) pre-operatively. This value was 1mm in 4 patients (14.8%), 2mm in 12 patients (44.4%), 3mm in 6 patients (22.2%), 4mm in 3 patients (11.1%) and 5mm in 2 patients (7.4%) postoperatively. The difference between the preoperative and postoperative values based on McNemar's test was significant ($P<0.001$).

Assessment of pain in muscles of mastication showed that before operation, 3 patients had pain in masseter and 1 patient had pain in medial pterygoid muscles. Post-operatively, 2 patients had pain in temporal muscle, 8 patients had pain in masseter and 5 patients had pain in medial pterygoid muscles. Regarding the type of occlusion, 14 patients had Class I, 6 patients had Class II, 5 patients had Class III, 1 patient was edentulous and 1 patient had anterior and posterior open bite before the operation. After operation, 14 patients had Class I, 5 patients had Class II, 4 patients had Class III (1 patient became class I) and 4 patients had denture ($P=0.9$). No significant change in dental occlusion was observed.

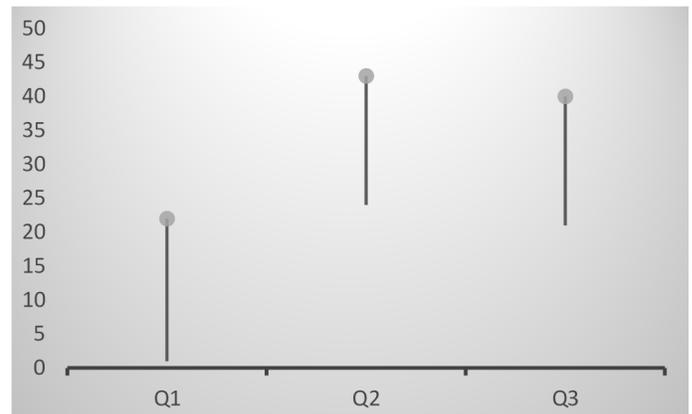


Figure 2. Mouth opening changes

Before operation, 9 patients had anterior open bite and 2 patients had posterior open bite. After operation, 4 of patients still had anterior open bite and 2 still had posterior open bite ($P<0.001$). Overall, the improvement in open bite was significant (Figure. 3).

Before operation, 15 patients had Class I, 10 had Class II and 2 had Class III skeletal relationship. After operation, 16 had Class I, 9 had Class II and 2 had Class III skeletal relationship ($P=0.9$) *i.e.* in one patient class II skeletal relationship converted to Class I. No significant change was observed in skeletal form (Figure.4). Before surgery, 20 patients had facial asymmetry in frontal view. This rate decreased to 13 patients after surgery *i.e.* one patient developed facial asymmetry after surgery ($P=1$).

After the operation, 9 patients had mandibular deviation during opening. Three of them were recovered in the follow-up assessment ($P=1$).

Assessment of facial nerve injury revealed that frontal, zygomatic and buccal nerves had been injured in 4, 4 and 3 patients, respectively during the operation. All patients, except for one case, were recovered by the time of follow-up.

Discussion

In developing countries, TMJ ankylosis has a relatively high prevalence. Trauma has been reported as the most common cause of ankyloses, followed by infection and tumors (8). Our results also showed that trauma was the main cause of TMJ ankylosis among our patients.

Treatment of TMJ ankylosis is intended to restore function and esthetics. All surgical techniques proposed for TMJ ankylosis follow the same principles of dissection and removal of bony and fibrous fusions between the condyle and

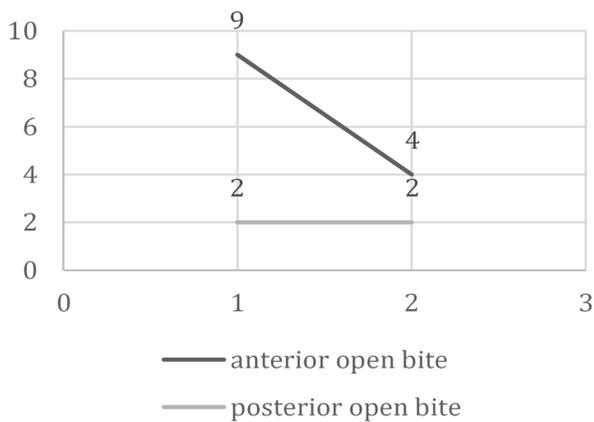


Figure 3. Changes in open bite before and after surgery

the glenoid fossa and the adjacent structures. Different techniques have been suggested based on the reconstruction or no reconstruction of the ramus/condyle unit and the glenoid fossa which includes gap arthroplasty, interpositional gap arthroplasty and total joint reconstruction (9). Functional outcomes of different surgical methods for treatment of ankylosis have been reported and the major goal of treatment was increasing in MMO (2, 9-11).

Vasconcelos *et al.*, (11) assessed functional outcomes such as MMO, recurrence and joint function during 24-60 months of follow-up. They showed no significant difference in functional outcomes among patients who underwent different techniques of surgery. Vasconcelos *et al.*, (11) and Roychoudhury *et al.*, (2) reported successful outcomes for TMJ ankylosis surgery with gap arthroplasty at 2-year and 3-year follow-ups, respectively.

Dimitroulis (12) compared condylectomy, rib grafts and prosthetic joints for treatment of end-stage TMJ ankylosis in 127 patients, and reported that patients who underwent condylectomy showed the most desirable range of mandibular movement. Rate of complications was higher in rib graft group. Similarly in our study, functional improvement was significant in patients after condylectomy and MMO and lateral movement of the mandible significantly improved post-operatively.

Ramus/condyle unit and glenoid fossa reconstruction techniques are based on the use of autogenous costochondral grafts and or alloplastic TMJ prosthesis. Successful results have been reported following TMJ reconstruction using the mentioned techniques.(13) However, risk of requiring re-operation due to the recurrence of ankylosis in use of costochondral grafts and high cost of alloplastic TMJ prosthesis are among the drawbacks of these surgical techniques (9).

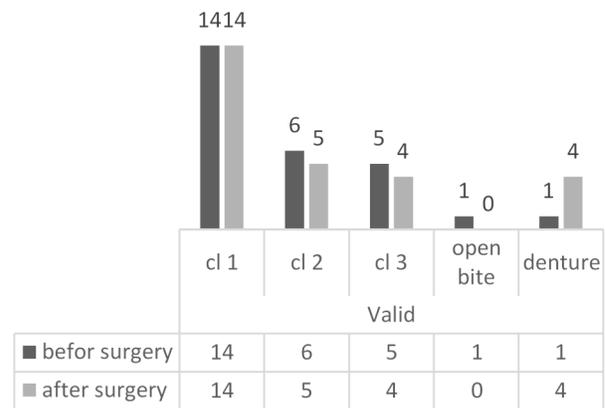


Figure 4. Changes in occlusal relationship in different phases of treatment

In a systematic review by Katsnelson, gap arthroplasty was reported to yield significantly better functional results (MMO) compared to ramus/condyle unit reconstruction by costochondral grafts (9).

Fourteen year follow-up of 61 patients who received CAD/CAM patient-fitted total TMJ reconstruction system showed significant reduction of pain, improved function of the mandible (MMO or IO), increased diet consistency score and improved quality of life.(14) Considering the unavailability of advanced alloplastic total TMJ reconstruction systems in Iran, their high cost and risk of relapse or over-growth of TMJ ankylosis, costochondral grafts and ramus/condyle unit and fossa reconstruction are often not performed for ankylosis patients. In our study, long-term functional status of adult patients who underwent interpositional gap arthroplasty was evaluated. We assessed not only the functional parameters, but also the performance of the mastication system and possible surgical complications during 24 to 132 months of follow-up (mean of 72 months).

Based on the results, the mean MMO was significantly increased after operation. Assessment of lateral movements of the mandible revealed significant improvement in long-term which may be due to the improvement in function of the lateral pterygoid muscle. Assessment of class of occlusion according to Angle's classification showed no significant change in type of dental occlusion after the operation. Evaluation of skeletal form showed the same results. Anterior open bite resolved significantly after the operation. These indicate the significant role of muscles of mastication and less significant role of the joint in dental occlusion.

Conclusion

Gap arthroplasty has desirable functional outcomes in TMJ ankylosis treatment, particularly in adult patients and still could be serve as a desirable treatment modality.

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Conflict of Interest: 'None declared'.

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