

Temporomandibular Joint Ankylosis: Evaluation of surgical outcomes

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Abstract: The study reviews surgical outcomes of 45 temporomandibular joint (TMJ) ankylosis patients that were treated in the maxillofacial and oral surgery unit of the University of the Western Cape, in South Africa. The aim of the study was to evaluate the outcomes of our protocol and to compare the outcomes unilateral and bilateral TMJ ankylosis cases.

In this study the outcomes of TMJ ankylosis were evaluated by using the following three parameters; preoperative maximal interincisal opening (preop MIO), intraoperative maximal interincisal opening (OP MIO) and the outcome Maximal interincisal opening (outcome MIO). The patient progress since surgery is calculated by subtracting Op MIO from the outcome MIO, and parameter is called postoperative change (Pop MIO). While the overall change is measured by subtracting preop MIO from the outcome MIO, and variable is called Overall change in MIO (OC MIO).

The study showed that surgical release of TMJ ankylosis improved mouth opening by a mean OC MIO of 18.5mm. The study also showed that there was no difference in outcomes between unilateral and bilateral cases. Gap arthroplasty showed better outcomes than reconstruction with costochondral graft.

Keywords: Ankylosis, gap arthroplasty, maximum interincisal opening (MIO), temporomandibular joint (TMJ)

I. Literature Review

Temporomandibular joint (TMJ) ankylosis is defined as osseous or fibrous fusion of the condyle of the mandible and the mandibular fossa of temporal bone¹. The challenges faced by patients with TMJ ankylosis have been described in literature^{2,3,4,5,6,7,8,9}. The incidence of TMJ ankylosis differs significantly in different parts of the world. Studies from Egypt^{8,4,10} and India¹¹ present large samples, while studies from other parts of the world report fewer numbers of patients seen over a long period^{12,13,14,15}.

TMJ Ankylosis may be acquired or congenital⁵. Acquired TMJ ankylosis is caused by trauma, infection^{12, 16, 4, 2} systemic inflammatory disorders¹⁹, irradiation, previous surgery^{2, 19} and neoplasm²⁰. Most studies suggest that trauma is the most common cause of TMJ ankylosis^{10, 21,14,7}. It is believed that disc displacement is a prerequisite for posttraumatic ankylosis to occur. This disc displacement allows a direct contact between the distal fragment of the mandible and the mandibular fossa or a clot occupies the region between the two surfaces^{16, 1, 23}. The posttraumatic TMJ ankylosis follows misdiagnosis, delayed treatment, inadequate surgery, prolonged immobilisation or insufficient physiotherapy¹⁹. The incidence of trauma as an etiological cause ranges from 26% to 75%, whereas infection ranges from 44% to 68%¹⁶. In the pre-antibiotic era infection was the most common cause of ankylosis. Kaban et al 2009 maintain that infection is still the most common cause of ankylosis in the third world countries¹⁴.

Clinical presentation of patients with TMJ ankylosis is well documented in maxillofacial literature^{21, 24,14,9}. The goals for the release of TMJ ankylosis are to create a pseudoarthrosis that will improve function or movement of the mandible^{24,21,7,9}, prevent relapse^{24,9}, relieve airway obstruction if present^{10,2,9}, achieve normal growth and correction of deformity in children^{7,13}, restore appearance and occlusion in adults²⁴ and facilitate maintenance of good oral hygiene⁹. Currently, the surgical techniques used to treat TMJ ankylosis are gap arthroplasty, interpositional arthroplasty, joint reconstruction²⁵ and distraction osteogenesis^{19,6}.

Most studies on outcomes of TMJ seem not to have a clear, objective and standardized method of measuring outcomes, and as a result of this discrepancy, outcomes of release of TMJ ankylosis cannot be compared. However Mabongo attempted to address this challenge of the studies of outcomes of TMJ ankylosis by calculating the postoperative change and overall change in MIO⁹. Some studies compared the outcomes of different procedures used to release the TMJ ankylosis^{12,3}, while others studied outcomes of a single procedure like use of costochondral graft^{26, 27}, gap arthroplasty^{28, 29} and interpositional arthroplasty³⁰. All these studies show that reankylosis is common complication irrespective of surgical technique used to treat the TMJ ankylosis. The factors that are regarded as the cause of reankylosis are failure to adequately remove the ankylotic mass^{12,31} and lack of compliance with the exercises^{12,21}. Hence some clinicians believe that aggressive

physiotherapy is equally important as surgery, and is recommended for a year²⁵. Other complications for surgical release of TMJ ankylosis are fracture of the costochondral graft (CCG)³², overgrowth of the graft³³ and suboptimal growth³⁴ which are the complications associated with CCG, and anterior open bite in patients treated with bilateral gap arthroplasty^{28,9}.

The aim of the study was to determine the outcomes of our protocol for management of TMJ ankylosis. The objectives of the study are to determine the extent to which TMJ release improves function; to compare the outcomes of unilateral with bilateral TMJ ankylosis cases.

II. Materials and Methods

Study design

This is a retrospective study of the records of 45 patients treated for TMJ ankylosis in the Maxillofacial and Oral Surgery unit of University of the Western Cape, at Groote Schuur and Red Cross Children's Hospitals. All patients operated for TMJ ankylosis from January 1988 to March 2003 were included in this study. All patients were operated by specialist maxillofacial and oral surgeons. Patients who were 12 years and younger during surgery were grouped as paediatric cases.

Surgical Data

All patients were treated by the protocol described below: - Patients had plain x-rays and computed tomography as standard imaging for confirming diagnosis of TMJ ankylosis. Preauricular incision was made. Excision of ankylotic mass was performed. If adequate mouth opening was not achieved, ipsilateral coronoidectomy was done. Contralateral coronoidectomy via intra-oral approach was performed (where necessary). When reconstruction was planned, costochondral graft was used. Modified submandibular incision was made. Stripping of the masseter from its insertion was done. Harvest of costochondral graft from rib 5, 6 or 7. Costochondral graft was stabilised with screws on the lateral aspect of the ramus of the mandible. Maxillary and mandibular alginate impressions were taken after the release of TMJs. After the operation mouth prop was used to keep the patients in maximum interincisal opening for 24hrs. Exerciser was delivered 24hrs after surgery.

Data Collection

Clinical records were retrieved from both Groote Schuur and Red Cross Children's hospitals. The data that were analysed were categorised into pre-operative, intra-operative and post-operative phases. In the preoperative phase, the data were analysed for age of the patient at the first visit, gender, aetiology, whether the ankylosis was unilateral or bilateral and preoperative maximum incisor opening (pre-op MIO). Operative data included type of ankylosis (fibrous or bony); type of surgery, mouth opening achieved and intubation technique used and achieved intraoperative MIO (Op MIO). Postoperative data were reviewed for method of mobilization used, final recorded interincisal distance, complications and follow up period. In patients that were operated more than once, the MIO before the last operation was used as preop-MIO and Op MIO of the last procedure used. The outcomes were evaluated as described by Mabongo (2013)⁹

Ethical issues

The study was approved by Research Committee of the University of Western Cape. Strict confidentiality was adhered to. Numbers were used to identify patients.

Analysis of results

Tables and graphs were used to demonstrate the outcomes. Statistical Package for Social Science (SPSS) was used to analyse the results.

III. Results

Twenty four (53.3%) of the patients were females and twenty-one (46.7%) were males. The age range was 1-66 years with a mean of 23 years. The cause of ankylosis was trauma in 28 patients (62.2%), degenerative joint disease (DJD) in six patients (13, 3%), infection in five patients (11.1%) and congenital in 5 patients (11, 1). A tumour was the cause of ankylosis in one patient (2, 2%) (Figure 1).

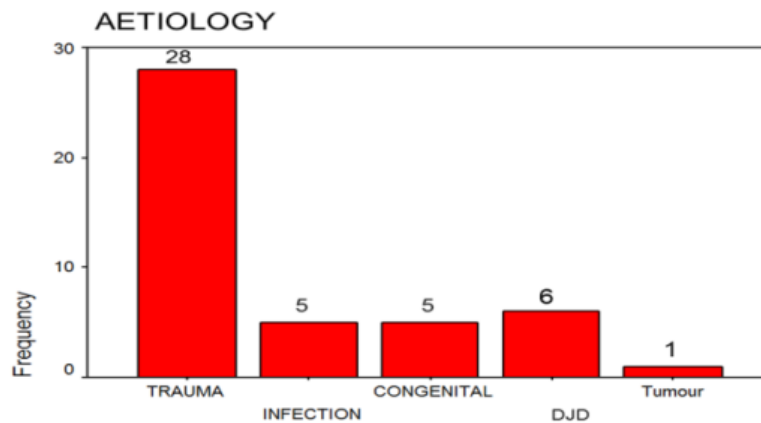


Figure 1 aetiology of TMJ ankylosis

The airway was competent in 41 patients (91.1%), while four patients (8, 9%) were tracheostomy-dependant. These tracheostomy-dependant cases were either born with ankylosis or ankylosis occurred in the first two years of life, and they all had bilateral TMJ ankylosis. TMJ ankylosis was unilateral in twenty-three patients (51.1%) and bilateral in twenty-two patients (48.9%). Duration of ankylosis ranged between 1-32 years with a mean of 7.4 years.

Technique of Intubation	Frequency	Percentage	Cumulative %
Direct Laryngoscopy	2	5.0	5.0
Blind Nasal	11	27.5	32.5
Fibre Optic	20	50.0	82.5
Via Tracheostomy	7	17.5	100

Table 1 shows techniques of intubation used

In seven patients intubation was via tracheostomy. Three of these patients had competent airway, but tracheostomy was done before the release of the TMJ ankylosis. Intubation was by direct laryngoscopy in two patients, blind nasal intubation in eleven patients and fibre optic intubation was done in twenty patients (44%) (Table 1). One patient aspirated blood and gastric contents during intubation and the procedure was abandoned. The resultant pneumonia was successfully treated with antibiotics. In five patients anaesthetic notes were missing, and no data were found regarding method of intubation used.

SURGERY

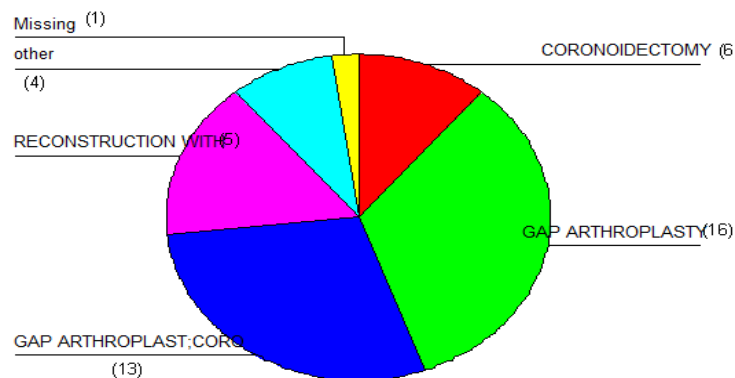


Figure 2: Shows the type of surgery used to release the TMJ ankylosis.

Coronoidectomy, gap arthroplasty and gap arthroplasty with coronoidectomy were done in 6 (13.3%), 16 (35.6%) and 13 (28.8%) patients respectively (Figure 2). Reconstruction with costochondral graft was done in five patients. Four of these patients reankylosed. When gap arthroplasty was done in the patients who were previously treated by costochondral graft, an improvement in mouth opening was achieved, although these developed an anterior open bite.

Each of the following procedures, referred to as other in the graph, were performed in one patient, reconstruction with alloplastic prosthesis (viteck), excision of fibrosis of the temporalis muscle, ostectomy of ossified the medial pterygoid muscle and release intraoral of the fibrous tissue between mandible and maxilla.

Mouth opening outcomes (table 3)

Preoperative MIO (Pre-op MIO) ranged between 0 and 20mm on presentation with mean of 6.31mm. Op MIO ranged between 15 - 45mm with mean of 30.45. The Outcome MIO ranged between 0 - 40mm with a mean of 24.87mm. The mean pop-MIO was - 6.50mm (range -30 to 20mm) (Table 2). Op- MIO was recorded in forty patients. Thirty of these cases had a negative Pop-MIO (Outcome MIO – Op MIO), which means there was a decrease in MIO from what was achieved intra-operatively.

Variable	No of Cases	Minimum	Maximum	Std Dev.
Preop MIO	45	0	20mm	6.31
Op-MIO	40	15mm	45mm	30.45
Final MIO	45	0	40mm	24.87
Pop MIO	45	-30mm	20mm	-6.50
OC MIO	45	0	34	18.51

Table 2 shows descriptive statistics of outcomes

Eight patients had positive Pop MIO, meaning mouth opening improved from what was achieved intra-operatively. Two patients had Pop MIO of zero, meaning, intra-operative MIO was maintained in these patients.

Variable	No of Cases	Minimum	Maximum	Mean
Preop MIO	23	0	20	8
Op MIO	21	15	45	31.43
Final MIO	23	5	40	25.57
Pop MIO	21	-30	20	-5.76
OC MIO	23	0	34	17.78

Table 3 shows outcomes of unilateral cases

All patients that had positive Pop MIO had trauma as the cause of ankylosis. Five patients had outcome MIO between 0-9mm, three had outcome MIO between 10 – 19mm, twenty-two patients had outcome MIO between 20 – 29mm and 15 patients had outcome MIO of 30mm and above.

Variable	No of Cases	Minimum	Maximum	Mean
Preop MIO	22	0	20	4.55
Op MIO	19	15	40	29.37
Final MIO	22	0	40	24.14
Pop MIO	19	-20	10	-7.32
OC MIO	22	0	33	19.27

Table 4 shows outcomes of bilateral cases

Reankylosis occurred in 5 patients (11, 1%). Profuse bleeding was encountered in three patients (6.7%), these 3 patients developed sepsis. The follow-up period ranged between 1-132 months (mean 28 months).

IV. Discussion

Fourteen patients are classified as paediatric cases and the ratio of adult to paediatric case is 2.2:1. This age distribution of patients with TMJ ankylosis differed from other studies where paediatric cases made up a large proportion of the samples^{8, 18, 7}. This difference might have been caused by the upper age limit for paediatric cases. An age of 12 years was used as the upper limit in this study, while in other studies 15 years was used as the upper limit for paediatric cases.

Trauma was the main cause of TMJ ankylosis, this concurs with the findings from other studies where trauma was the most common cause of TMJ ankylosis^{9, 21, 3, 2}. The shift from infection to trauma as the major cause of TMJ ankylosis is caused by use of antibiotics¹². All congenital cases had bilateral TMJ ankylosis, and this concurs with findings of Posnick and Goldstein (1993)³⁵. However, it was interesting to note that two patients who reported the cause of their TMJ ankylosis as congenital, medially tilted condyles were found during the operation, and that was suggestive of trauma as the possible cause. This finding supports the view of some authors who believe that the term “congenital ankylosis” tends to be applied to patients who had limitation of mouth opening at infancy which might have been caused by trauma during delivery^{15, 25}. However, El-Sheik (1999) applies the term congenital ankylosis to a condition where there is complete bony fusion between mandibular condyle and temporal bone, with absence of any trace of intra-articular disc and lateral pterygoid muscle¹⁰.

Review of the literature shows that outcomes are mainly assessed by using the outcome MIO, whereby outcomes are grouped into ranges of MIO of 10-20mm; 20-30mm and 30 and above¹⁶. Chessegros et al (1997) regard an MIO of least 30mm as a good result³⁶, while Kaban et al (1990, 2009) believe an MIO of 35mm is a good outcome^{14, 31}. However, Topazian (1966) regards an MIO of 20mm as adequate for function¹³. This study does not show any difference between outcomes of fibrous and bony ankylosis but bony ankylosis had higher reankylosis rate. The assumption is that muscle activity is significantly reduced in bony ankylosis and this might have caused atrophy of muscles of mastication. When the outcomes of unilateral cases (table 3) were compared with those of bilateral cases (table 4), clinically unilateral cases tended to show better outcomes than bilateral cases. When these outcomes were tested with independent T-test and one way analysis of variance (ANOVA). There is no statistically significant difference between the outcomes of these groups ($P < 0.005$). These outcomes between bilateral and unilateral cases differed with the findings of other studies in which unilateral cases had better outcomes than bilateral cases³⁷.

Postoperative change in MIO (Pop-MIO)

This variable gives us an objective way of assessing the progress after surgical release of TMJ ankylosis. The mean for post-operative change in MIO was -6,5mm. This means the sample had varying loss of mouth opening from what was achieved intra-operatively (table 2). This concurs with Adekeye (1983) and Salins (2000) who also reported reduction of postoperative MIO in some patients of the former and all patients of the latter^{26, 37}. The negative Pop MIO could be caused by impact of muscle relaxants when Op MIO is measured, and lack of compliance to exercises. If a possible decrease in mouth opening is accommodated, an Op MIO of 30-35mm should be a goal for every surgeon as suggested by Kaban et al (1990)^{14,31}.

This parameter, pop-MIO, could be of help in the following ways⁹:-

- Assessing post-surgical progress in TMJ ankylosis patients.
- Motivating and encouraging the patient to continue with physiotherapy.
- Can also be used as a research tool to compare outcomes of different studies.

However what would be regarded as an acceptable range for Pop MIO still needs to be determined in studies with bigger samples sizes. The main disadvantage of this variable is that it cannot be worked out if Op MIO was not recorded.

Overall change in MIO (OC MIO)

Literature review shows that the outcome MIO is used to measure the outcomes of release of TMJ ankylosis. The mean outcome MIO of 24.87mm in this study compares favourably with that of some studies^{4, 29} (Roychoudry 1999; Elmofty 1974). When this mean outcome MIO of 24.87mm, achieved in this study, is compared with 37,5mm in a study Kaban et al (1990), the outcomes in this study are relatively poor. This difference in outcomes lies in the pre-op MIO, which was 16,5mm in Kaban et al (1990), while in this study was 6.31mm. When the OC MIO is calculated in these two studies, the difference in mean OC MIO is about 3,5mm. This shows that outcomes of TMJ ankylosis can be objectively compared by using the OC MIO and Pop MIO rather than the outcome MIO only.

Although there is an agreement on the importance of aggressive physiotherapy after the release of TMJ ankylosis, but there is still controversy on when to start with the mobilisation of the jaws. Some authors believe in early mobilisation^{18, 26, 29}, while others immobilise the patient for a period of 1-10 days^{35, 38}. In our Unit the patients are kept in maximum mouth opening with a mouth prop for about 24 hours while the exerciser is being made. Exercises are started 24 hours after surgery. Nitzan et al (1998) also reported using mouth prop 24 hours after surgery¹. Results in this study show that all patients whose post-operative exercises are monitored by a physiotherapist maintained an MIO of 30mm and above. This supports Chessegros et al (1997) who maintain that post-operative exercises should be done under supervision of physiotherapist³⁶.

Reankylosis rate is 9.6% in patients treated by gap arthroplasty and 11.1% in this series. This rate compares favourably with outcomes reported by other authors^{4, 39, 29} (table 3). Reankylosis is the most commonly reported complication of TMJ surgery for ankylosis^{34, 27, 21,35,39,14}. Factors that have been postulated as cause of this high reankylosis rate can be classified into patient factors, surgical factors and postoperative factors. **Patient factors** are high osteogenic and periosteal reaction in children³⁵. Andrade et al 2012 noted that some patients develop respiratory distress during exercises which leads to non-compliance to exercises resulting in reankylosis⁴⁰. **Surgical factors** include failure to adequately remove medial extent of the ankylotic mass^{31,35,14}, failure to explore and remove the coronoid processes when indicated¹⁰ and failure to strip off contracted muscles of mastication that pull the ramus towards the base of the skull^{9,10}. **Post-operative causes** would include lack of compliance to the exercises^{31,21,10}.

In this study reankylosis was encountered in different surgical procedures used to release TMJ ankylosis. This confirms that reankylosis does not depend on the type of procedure used to release the ankylosis but on adequacy of intraoperative mouth opening³¹ and compliance to postoperative physiotherapy^{9,21}. The mean follow up period was 28.51 months in this series. This follow up period compares favourably with mean of 22 months in a study by Ruzzeneet. al (1990)⁴⁰, 24.4 months by Elmofty (1972)⁸ and 20 months for Danda et al (2009)³.

V. Conclusion

This study has shown that mouth opening in TMJ ankylotic patients can be improved by a mean of 18.51mm. There is no statistically significant difference between the outcomes of unilateral and bilateral TMJ ankylotic cases. This study used a more detailed and objective approach in the measurement of outcomes of TMJ surgery. The challenge encountered was that Op MIO was not recorded in some of the patients.

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