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Temporomandibular joint chronic closed lock: Spontaneous resolution following surgical arthroscopy

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Abstract
Purpose: This study evaluated the efficacy of surgical arthroscopy in the management of patients with temporomandibular joint chronic closed lock.

Patients and Methods: Fifteen TMJs (Twelve patients) suffering anterior disc displacement without reduction and chronic closed lock were enrolled in the study. Arthroscopic lysis and lavage of the superior joint compartment was done under general anesthesia for all patients.

Results: The results showed significant resolution of clinical signs and symptoms of TMJ chronic closed lock (pain and tenderness) and full restoration of normal range of motion (maximum interincisal opening, lateral excursions and protrusive movements) and regain of chewing ability.

Conclusion: Temporomandibular joint surgical arthroscopy is an effective and minimally invasive modality in treatment of TMJ closed lock.

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1. Introduction
Internal derangement (ID) of the temporomandibular joint (TMJ) is one of the most common forms of temporomandibular disorders (TMD) [1]. The term ID comprises anterior disc displacement with or without reduction, perforation of the articular disc or of the retrodiscal tissue, and various degenerative changes of the disc and/or the articulating surfaces [2]. The most commonly used classification to describe the severity of ID was proposed by Wilkes in 1989. The Wilkes classification consists of 5 stages based on clinical, radiologic, and intraoperative findings, varying from a slight forward displacement with symptom-free normal joints to essentially degenerative arthritic changes with severe clinical symptoms [3].

Anterior disc displacement of the TMJ represents an intra-capsular different conditions are recognized: anterior disc displacement with reduction (DDWR), where the proper relationship between the disc and condyle is restored during maximum mouth opening; and anterior disc displacement without reduction (DDWOR), as described by Dolwick [4] where the disc stays anterior to the condyle and prevents maximum mouth opening. DDWOR is clinically apparent by reduced mandibular movement and pain [5]. [6] [7].

The patients with displaced discs are usually treated conservatively. Open arthrotomy of the TMJ has been widely advocated for treatment of ID with closed lock when conservative treatment has failed. More recently, arthroscopic surgery of the TMJ has increased in popularity due to its conservative approach compared to open surgery, fewer complications, and being a one day surgery. It allows surgeons to diagnose and treat intra-articular conditions directly with a minimally invasive technique that reliably reduces pain and increases the mandibular range of movement [8], [9] [10].

The aim of the present study was to evaluate the outcome of a standard arthroscopic lysis and lavage of the TMJ in patients with ID and chronic closed lock.

2. Patients and Methods
Fifteen TMJ (twelve adult patients) suffering from DDWOR and...
closed lock (Wilkes class II, III) were enrolled in the study. All patients were females with age range from 19 to 48 years (average 33.5 years).

Inclusion criteria were: a verified clinical diagnosis of DWMOR that was confirmed using magnetic resonance imaging (MRI) of the TMJ; 3-month of conservative treatment (including occlusal splint and physiotherapy) with unsatisfactory results; unilateral or bilateral disorder; and a patient without comorbidities (especially endocrine, rheumatological or skeletal diseases). On the other hand, patients were excluded from this study if they did not adhere to our inclusion criteria; or were unable to attend throughout entire follow-up period (1 year); and superimposition of other TMD (as follows, but not limited to: dislocation, discal perforations).

2.1. Preoperative assessment

The patients were examined clinically as well as radiologically using MRI.

Clinical examination consisted of palpation of the TMJ region and masticatory muscles. Mandibular movements: 1) maximal interincisal opening (MIO), 2) lateral movements, and 3) protrusion were measured and tabulated. The patients filled out a self assessment visual analog scale (VAS) for 1) Pain (where 0 equals no pain and 10 is the most severe pain); 2) Tenderness (where 0 equals no tenderness and 10 is the most severe tenderness); 3) Chewing (where 0 equals fluid diet only and 10 is the normal chewing).

2.2. Arthroscopic surgical procedures

The surgical procedure was carried out under general anesthesia. A sterile cotton pellet was placed in the external auditory canal followed by routine surgical field scrubbing with povidone iodine solution and the patient was draped in the usual manner with sterile adhesive sheets. To reach the TMJ arthroscopically the inferolateral approach described by Murakami and Ono was used [11].

The first puncture was placed at the maximum concavity of the glenoid fossa. A sharp trocar protected by an outer cannula was advanced through the puncture point till contacting the bone of the lateral crest of the fossa. Puncture of the capsule was accomplished by rotating the trocar till a pop was felt, denoting gaining access to the upper joint compartment. Once the capsule had been pierced, the sharp trocar was removed to avoid scuffing of the articular surfaces and a blunt obturator was introduced in the cannula for further insertion into the joint cavity (Fig. 1).

Examination of the upper compartment of the TMJ was performed using a 70° telescope (Karl Storz, Tuttlingen, Germany). The arthroscopic live image was received on the connected medical monitor and was used to verify for proper placement in superior compartment. After receiving arthroscopic image of the superior joint space, further capsular distension and intermittent lavage with isotonic saline were maintained through the irrigation system. The upper joint compartment was examined postero-anteriorly from the posterior pouch, along the intermediate zone to the anterior pouch and was swept clear under constant irrigation, suction and capsular distention (Fig. 2).

Intraarticular adhesions that failed to dislodge through hydraulic manipulations, were further addressed using hand instruments (namely: the grasping forceps and hooks); resistant adhesions and organized blood clots where further trimmed using motorized shavers. Surgical arthroscopic instruments (hand or motor driven) were introduced through a second working cannula (Fig. 3). Following release of the TMJ disc as visualized intra-capsularly by its movements in co-ordination with the condylar head during cycles of mouth opening and closure, the upper compartment was thoroughly irrigated with isotonic solution and 2 ml of betamethasone were injected into the joint compartment.

Immediately following recovery the patients started self-administered physiotherapy training exercises and splint therapy. Patients were followed up on weekly basis for the first post-operative month; fortnightly till the third postoperative month; then on a monthly basis till the end of the follow up period (1 year).

2.3. Postoperative assessment

Maximum interincisal opening, lateral excursions, protrusion. VAS for pain, tenderness and chewing were recorded immediate, 1 week, 1, 3, 6, 9, 12 months postoperatively for all patients. Four patients (5 TMJs) have been followed up for over 2 years.

2.4. Success criteria

The treatment was considered successful if mouth opening capacity was ≥40 mm at the end of the study and TMJ pain according to VAS as assessed by patients as ≤1.

2.5. Statistical analysis

Numerical data for VAS, MIO, lateral and protrusive movements were tabulated for statistical analysis. Quantitative data was in the form of mean and standard deviation (SD). The mean pre-operative and postoperative values were compared using paired t-test. Results were expressed in the form p-values that were differentiated into:
* Non-significant when p-value > 0.05.
* Significant when p-value ≤ 0.05.

3. Results

3.1. Clinical outcome

No major or persistent complications were encountered in all patients and the procedure was generally perceived as a tolerable measure not necessitating overnight stay at the hospital. Two patients complained of blocked ear sensation which resolved 2 and 6 days postoperatively, respectively. One patient reported preauricular numbness that resolved 2 weeks postoperatively. Intra operative bleeding during skin and capsular puncture was encountered in one joint which was controlled by combined direct compression over the puncture point and increasing intra articular pressure. The healing of puncture sites was uneventful with no scars in all cases. Patients showed clinical improvement in the form of:
i. Reduction of pain level:

**VAS for Pain:** The greatest mean value was recorded preoperatively 7.45 (±0.68). This value showed a gradual decrease in the following post observation dates with a significant decrease starting from 1 week post-operatively 3.54 (±1.12) and diminished to 0.27 (±0.64) by the 12th postoperative month. All postoperative scores differed significantly from the preoperative score (P < 0.0001), (Fig. 4).

ii. Reduction of Tenderness:

**VAS for tenderness:** The greatest mean value was recorded preoperatively 7.36 (±0.67). This value showed a gradual decrease in the following post observation dates with a significant decrease starting from 1 week post-operatively 3.9 (±1.3) and diminished to 0.54 (±0.52) by the 12th postoperative month. All postoperative scores differed significantly from the preoperative score (P < 0.0001), (Fig. 4).

iii. Improvement of chewing ability:

**VAS for chewing:** The lowest mean value was recorded preoperatively 3.36 (±0.81). This value showed a gradual increase in the following post observation dates with a significant increase starting from 1 week post-operatively 5.18 (±1.6) and increased to 9.09 (±0.7) by the 12th postoperative month. All postoperative scores differed significantly from the preoperative score (P < 0.0001), (Fig. 5).

iv. Increase in MIO:

The lowest mean value was recorded preoperatively 24 mm (±4). This value increased significantly 1 week post-operatively 34.6 mm (±3.6) and showed a gradual increase in the following post observation dates to reach 43 mm (±3.2) by the 12th postoperative month. Mean values in all post observation dates were significantly different from the preoperative value (P < 0.0001), (Figs. 6 and 7).
v. Increase in lateral excursions:

The lowest mean value was recorded preoperatively. This value showed a gradual increase in the following post observation dates with a significant increase starting from 3 months post-operatively. Mean values in all post observation dates starting from 3 months post-operatively were significantly different from the preoperative value ($P < 0.0001$). (Fig. 8).

vi. Increase in protrusion:

The lowest mean value was recorded preoperatively. This value showed a gradual increase in the following post observation dates with a significant increase starting from 3 months post-operatively. Mean values in all post observation dates starting from 3 months post-operatively were significantly different from the preoperative value ($P < 0.0001$). (Fig. 8).

3.2. Success rate

Eleven out of the twelve patients (92%) exhibited successful outcome according to the preset success criteria, while the remaining patient despite demonstrating postoperative improvement was inferior to the preset success criteria parameters.
4. Discussion

Internal Derangement (ID) is one of the frequently diagnosed TMD. Anterior disc displacement without reduction (closed lock) DDWOR/Wilkes class II, III is among the most commonly diagnosed phases of ID. It is accompanied by many intra articular changes, including inflammation (joint effusions), the development of fibrous adhesions, and degeneration. It can progress to anterior band atrophy, flattening and thinning of the disc, decreased innervation and vascularization of the retrodiscal tissue, and degenerative changes in the articular surfaces [12].

TMJ clinical sample selection is a critical factor influencing a study’s results and drawn conclusions. Many studies attributed the high percentage of females with TMD and ID to a correlation between female sex hormones and dysfunction of the TMJ [13], [14] [15] In agreement with those studies and despite not targeting the selection of female patients (twelve females included), all those fulfilling the inclusion criteria of the current study and presenting to the faculties’ clinics were females.

Numerous modalities of treatment were suggested with varying degrees of success rates. While no single modality of treatment is agreed upon by surgeons to be the treatment of choice; yet, there seems to be a general agreement that the progression of treatment is initiated only after failure of more conservative modalities. The least invasive and most reversible treatment should be tried first [16]. Moreover, the current study included only patients with DDWOR/Wilkes class II, III; contrary to other arthroscopic studies [17][9] [18] that involved a heterogeneous variety of patients with TMJ diseases and employed a wide range of operative arthroscopic techniques. In the current study design, focusing on specific category of patients and implementing a standardized surgical arthroscopic protocol, as well as, overall management plan was attempted to provide weighable results.

Stiesch-Scholz et al [19]and Murakami et al [20] advocated the use of splint therapy as a primary treatment modality and indicated that an early start of splint therapy had a positive influence on treatment outcome for DDWOR. In agreement and praise of their studies, splint therapy for a minimum of 3 months was advocated for all our patients, that 12 patients were ruled out of this study based on their significant improvement and were in no need for further invasive interventions. Needless to indicate that NSAIDs and muscle relaxants have been prescribed as an adjunct for all patients during the screening, conservative and for 1 week postsurgical phases, as advocated by previous studies [21]. [22] [23].

Within the context of TMJ diseases, one logical parameter of success was “changing the impaired mandibular function in sufficient measure” resulting in restored movement and reduction of TMJ pain. In the current study, clinical assessment of patients’ signs and symptoms postoperatively and statistical analysis of such data showed a statistically significant: decrease in mean VAS scores, increase in mean MIO and excursion movements throughout the study periods. This could be attributed to the ability of arthroscopic lysis and lavage to eliminate restrictions imposed on the disc and lateral capsule; wash out microscopic debris resulting from the breakdown of the articular surfaces; irrigate the joint from enzymes and prostaglandins and stimulate the normal lubricating properties of the synovial membrane.

Several studies [24] [25] [26] [27] based their success rates on two main criteria: improvement of mandibular movement (in terms of MIO) and reduction of pain levels (VAS). While those studies regarded postsurgical success criteria of: a) MIO 35–38 mm; and b) VAS for pain of 2–3 or less; in current study we set higher standards as success criteria for MIO and VAS for pain: at 40 and 1 or less, respectively. Eleven out of the twelve patients (92%) in this study met the success criteria, with a mean MIO of 43 ± 3.2 mm and a mean VAS for pain of 0.2 ± 0.6 at the end of the follow-up period. These findings compare favorably to those of Smolka & Izuka [24][78%; Murakami et al [25] 91%, Fridrich et al [26] 82%, and Ohnuki et al [27] 74%. Despite obtaining statistically significant results, further study of a larger sample size with the current standardized protocol is necessary.

Moreover, TMJ arthroscopy has provided insight that not all feeding needles with adequate outflow are intracapsular “Arthrocentesis”. To be noted that the single patient in the current study that did not meet the designated success criteria was the oldest (48 years) in our studied sample. However, despite not meeting our success criteria this patient had a MIO of 37 mm and VAS for pain 2 at the end of the follow up period; that is considered a successful outcome by others [24]. [28] This denotes that age and the longevity of the standing condition could be contributing factors to arthroscopic prognosis.

In one of the most comprehensive reviews of literature Israel [29] reviewed 11 studies of TMJ arthroscopic outcomes that were published between 1987 and 1996. In a cumulative total of 6071 joints in 3955 patients, Israel calculated a mean success rate of 84% across the 11 studies. He also reported a mean improvement in interincisal opening of 10.4 mm, which compares closely with the 18.9 mm reported in this study, in terms of pain scores on the visual analog scale of 0–10. Israel calculated a mean reduction of 4.6 units, which is lower than that recorded in this study 7.1 units. Moreover, in this study 92% of patients reported an improvement in their pain levels after arthroscopy, which is higher than the average of 82% reported by Israel for the 11 studies combined. However, despite the superior outcome of the current study compared to Israel’s review of 11 studies, this does not imply better results were obtained in the current study. This is attributed to a) the difference in the study designs and arthroscopic protocols used; b) the other studies included patients with different entities of TMD compared to the current study specifically targeting DDWOR not complying to conservative treatment for a minimum of 3 months; c) the larger sample size in the other studies and over a larger time interval providing them with much more leverage over the current study. A more reasonably comparable study to the current would be Kurita et al [28] whom included 16 joints with internal derangement (DDWOR) and reported an 86% success rate using TMJ arthroscopic lysis and lavage. On the other hand, Holmlund et al [30] reported only 50% success rates using also lysis and lavage; yet they attributed such lower success rates to concomitant osteoarthrosis that involved 30 of their studied 42 TMJ. It is pertinent to conclude that proper diagnosis and classification of ID with the aid of MRI is crucial and influential on the treatment planning and consequently the clinical outcome.

Arthroscopic surgery in the current study was directed at the restoration of normal function and alleviation of pain associated with TMJ closed lock by lysis and lavage of the superior compartment adhesions. Once the joint was arthroscopically released, a maintenance phase of physiotherapy (jaw exercises) was an integral part of the rehabilitation program to help maintain the results achieved with TMJ arthroscopy and to prevent recurrent episodes of locking. Although TMJ arthroscopy is a highly effective treatment for closed lock of the TMJ, it is best used as part of a wider treatment regimen that includes physiotherapy and occlusal splints to prevent recurrences. The distinctly unique advantage of TMJ arthroscopic lavage and lysis is that it provides early and dramatic improvement in mandibular function and immediate relief of painful symptoms associated with closed lock and therefore should be pivotal, but not exclusive, in the management of this disorder. On the other hand open surgical management of ID of the TMJ should be reserved for patients who fail to respond to conservative and minimally invasive treatment [16].
References


