

Efficacy of arthrocentesis with intra-articular injection of hyaluronic acid and corticosteroid in the treatment of internal derangement of temporomandibular joint

ABSTRACT

Introduction: Various techniques have been used to treat internal temporomandibular joint derangements (TMJ ID), with arthrocentesis one of the most successful in reducing symptoms and promoting function. In cases of TMJ ID, this research study compares and evaluates the efficacy of arthrocentesis with injections of corticosteroids (CS) or hyaluronic acid (HA).

Methods: This prospective randomized, non-blinded study involving 91 patients with symptoms of TMJ ID treated by arthrocentesis followed by intra articular injection of 1 ml of either corticosteroid (group A) or HA (group B). Maximum mouth opening, lateral excursive movements, TMJ pain at rest and during function, masticatory efficiency, pre-treatment functional TMJ limitation and subjective judgment of efficacy of treatment were assessed with millimeter scale. All the parameters measured before the procedure and further followed at 1st week, 1st month, 3rd month and 6th month post-procedure.

Results: Maximum mouth opening post procedure improved significantly in Group B at follow up visits ($P < 0.05$). Subjects in group B showed significant reduction in pain at rest ($P = 0.001$) at 1 week and 1 month follow up & increased masticatory efficiency at 6 months ($P = 0.042$) as compared to that of group A subjects.

Conclusion: Injection of HA post-TMJ arthrocentesis is found be comparatively more effective method of treating TMD IDs with resultant decrease in pain & improved functionality of the jaw. TMJ arthrocentesis along with injection of HA could serve as a possible alternative to treat chronic TMJ pain sufferers who are unresponsive to conservative medical therapies.

Keywords: Arthrocentesis, corticosteroids, hyaluronic acid, internal derangement, TMJ

INTRODUCTION

Millions of individuals suffer from temporomandibular joint disorders (TMDs) worldwide. Internal derangement of the temporomandibular joint (TMJ ID) is one of the most frequent causes of TMD. TMJ ID is defined as a progressive disorder which usually starts as clicking associated with normal opening (anterior disc displacement with reduction), to a stage where clicking gradually ceases but restricted mouth opening ensues (closed lock).^[1] The common causes for TMJ ID are due to trauma and parafunctional habits which lead to degenerative changes in the articular structures, increased friction, and gradual disc displacement.^[2] TMJ ID is usually characterized by pain, clicking, deviated jaw, and limitation of jaw movement.^[3]

Many conservative approaches have been proposed throughout the years among which are occlusal splint

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therapies, jaw physiotherapy, complimentary medication, and occlusal treatment.^[4] In the past treatment of TMJ ID that did not respond to conservative measures was surgical re-contouring and repositioning of the disc.^[5]

Nitzan *et al.*^[11] first described the procedure of TMJ arthrocentesis as the simplest and effective minimal invasive modalities for treatment of TMJ closed lock. The TMJ arthrocentesis procedure bridged the gap between surgical and nonsurgical treatment. It involved irrigation of the upper joint compartment with a therapeutic substance, releasing adhesions, and flushing out inflammatory substrates, thereby relieving pain and improving function. TMJ arthrocentesis signifies the lavage of the upper joint compartment with physiological saline or Hartmann's solution (Ringer's lactate) using a needle for in- and out-flow.^[6]

Hyaluronic acid (HA) is largely responsible for the viscosity of normal synovial joint. Its capacity to function as a molecular sieve is thought to be important both in regulating the nutrition of articular cartilage and in physical interactions with the macromolecules of the articular surfaces. HA is a linear polysaccharides consisting of poly-disaccharide units of glucuronic acid and N-acetyl glucosamine linked by B1-3 and B1-4, glycosidic bonds.^[7] Viscosupplementation (VS) is newly coined term to describe a minimally invasive technique that involves replacement of synovial fluid by intra-articular injection of HA which restores its concentration and molecular weight in joint cavity.^[8]

Systemically administered corticosteroids (CSs) result in a myriad of effects on cellular and humoral immune systems with profound anti-inflammatory and immunosuppressive responses. When injected locally, it shows a potent anti-inflammatory effect on synovial tissue and helps to reduce effusion, decrease pain with subsequent increase in range of motion of joint. Intra-articular CS injection alone or after arthrocentesis provides long-term palliative effects on subjective symptoms and clinical signs of TMJ pain.^[9] However, the exact mechanism of action of CSs on joint synovium is not clearly delineated in existing literature.

The objective of the study is to evaluate and compare the effectiveness of post-arthrocentesis intra articular injection of HA to that of CS injection in treatment of internal derangement of TMJ.

METHODS

The present study comprised 91 patients with internal derangement of TMJ visiting the outpatient Department of Oral and Maxillofacial Surgery at our institute. It included

patients from February 2012 to March 2020. The study was randomized, non-blinded with a period of 6 months follow-up comparing the efficacy of arthrocentesis with HA injection to that of CS injection. The thorough history and clinical examination was done. All patients provided written informed consent before inclusion in the study. The study was approved by institutional ethical committee.

Preoperatively, the baseline data in the form of maximal mouth opening (MMO), lateral excursions, TMJ pain at rest and on movement, masticatory efficiency (ME) and functional TMJ limitation were measured. Post operatively the aforementioned parameters were assessed along with subjective judgment of efficacy till 6 months follow-up period. The data were collected after 1st week after the first intervention and on subsequent follow-up visits (1 month, 3 month, and 6 month) in order to gauge the effectiveness of the treatment modality. Data obtained were compiled on a MS Office Excel Sheet (v 2019, Microsoft Redmond Campus, Redmond, Washington, United States).

MMO was measured as distance between mesio-incisal angle of upper central incisor and lower central incisor on maximal active pain free mouth opening as tolerated by the patient. Lateral excursion movements on right and left were measured distance between mesio-incisal angle of upper and lower central incisors during maximal pain free lateral excursive movements of mandible towards right and left as tolerated by the patient.

Pain at rest and during functional movement is measured via Visual-Analog Scale (VAS) with grades 0 to 10, where 0 denotes no pain and 10 attributed to worst pain imaginable to patient. ME was defined on Likert scale of 0 to 3, where 0 = Inability to chew, 1 = Ability to chew soft food, 2 = Ability to chew medium hard food, and 3 = Ability to chew hard food. The patients were allowed to select from the scale on the basis of understanding in local language and regional food habits.

Pre-operative assessment of the functional TMJ limitation level done using the Scale by two experienced clinicians, following Wilkes criteria^[10] given in 1989.

- 1 = Painless clicking, no locking
No restricted motion
- 2 = Occasional painful clicking, intermittent locking
Headaches, occasional tenderness
- 3 = Frequent pain and joint tenderness, headaches
Locking episodes, restricted motion
- 4 = Chronic pain, headaches
Restricted motion with crepitus
- 5 = Variable pain and difficulty with function
Audible joint crepitus.

Post operatively at each visit, patient is asked to provide a feedback subjective judgment of efficacy of the treatment procedure on a Likert scale 0 to 4 defined as 0 = Poor, 1 = Below average, 2 = Average, 3 = Good, 4 = Very good.

Patient selection

Patients were included in the study on the basis of the following criteria.

Inclusion criteria:

- Age more than 15 years
- Wilkes stage ≥ 2 disease for at least 2 months
- TMJ pain > 3 on VAS
- Patients not responding to conservative treatment for at least 2 months.

Exclusion criteria

- Infection of the affected joint and pre-auricular area.
- Previous surgery of the affected joint.
- History of injection of any substance into the target TMJ during previous 6 months.
- History drug allergy.
- Pregnant and lactating female.

These patients were diagnosed as having internal derangement of TMJ and were randomly divided into two groups irrespective of age, sex, and religion. Each patient was treated with a standard arthrocentesis procedure in the affected TMJ by the two experienced surgeons, following which intra articular injection 1 ml of either hyaluronic acid (1500 IU) or CS (Dexamethasone sodium phosphate 4 mg) was done.

Group A: arthrocentesis with Ringer's lactate solution plus intra-articular injection of CS immediately after arthrocentesis.

Group B: arthrocentesis with Ringer's lactate solution plus intra-articular injection of HA immediately after arthrocentesis.

Arthrocentesis technique

This procedure was done under local anesthesia with auriculotemporal nerve block. The patient is seated inclined at a 45° angle with the head turned contralateral side to provide an easy approach to the joint to be treated. After proper sterile preparation of pre-auricular area with povidone iodine, the external auditory meatus is covered with moist cotton.

With palpating index finger on the affected side, the TMJ movements are palpated. A line was drawn from the lateral canthus to the most posterior and central point on the tragus (Holmlund–Hellsing Line)^[11] [Figure 1]. Two points

are marked over the skin indicating the articular fossa and eminence. The posterior point of entry was located along the cantho-tragal line, 10 mm from the middle of the tragus and 2 mm below the canthotragal line (point A). The anterior point of entry was 10 mm farther along the canthotragal line and 10 mm below it (point B).

Following the traditional technique of Double puncture arthrocentesis proposed by Nitzan *et al.*^[11] an 18 Gauge, 1.5 inch long needle is inserted about 1 inch in depth into the superior joint compartment corresponding to the posterior mark (point A). Then second similar needle is inserted at the second mark corresponding to the articular eminence (point B). A 10 ml syringe is filled up with ringers lactate solution and connected to the first needle. The solution is pushed to distend the joint space. The joint space is lavaged with approximately 100 ml of ringers lactate solution to wash out the entire joint and eliminate the catabolytes present in the synovial fluid^[5] [Figure 2]. During the lavage, mandible is moved through opening, excursive, and protrusive movements to facilitate lysis of adhesions. At the completion of arthrocentesis procedure, the second needle (at point B) is then removed and 1 ml of hyaluronic acid IP (1 ml = 1500 IU) or CS (Dexamethasone sodium phosphate IP, 1 ml = 4 mg) is slowly injected into the superior joint compartment through the first needle. The involved site is then packed with sterile head dressing and patient is advised suitable analgesic and anti-inflammatory drugs for 1 week.

The patients were followed at regular interval of 1 week, 1 month, 3rd month, and 6th month and assessed in terms of maximum mouth opening, right and left excursive mandibular movements, relief of symptoms (Pain at rest and on movement), ME, judgment of efficacy and presence of adverse events if any. Pre-treatment and 1 month post-treatment clinical photographs of patients showing maximum mouth opening and excursive movements of mandible in each group is shown in Figures 3 and 4, respectively.

Statistical analysis

Data were subjected to statistical analysis using Statistical Package for Social Sciences (SPSS v 26.0, IBM). Descriptive statistics like frequencies and percentage for categorical data, mean, and SD for numerical data has been depicted.

Parametric tests have been used for comparisons of data for Mouth opening, Lateral excursion movements – Right and Left, Pain at rest and on movement. Inter-group comparison (2 groups) was done using t-test.

Considering data of ME, subjective assessment of the functional TMJ limitation level (Pre-op) and subjective judgment of efficacy to be ordinal and nominal, non-parametric tests



Figure 1: Marking of cantho-tragal line over the face of patient with points of insertion of arthrocentesis needle marked by asterisks



Figure 2: Clinical picture of arthrocentesis performed via two needle insertion technique

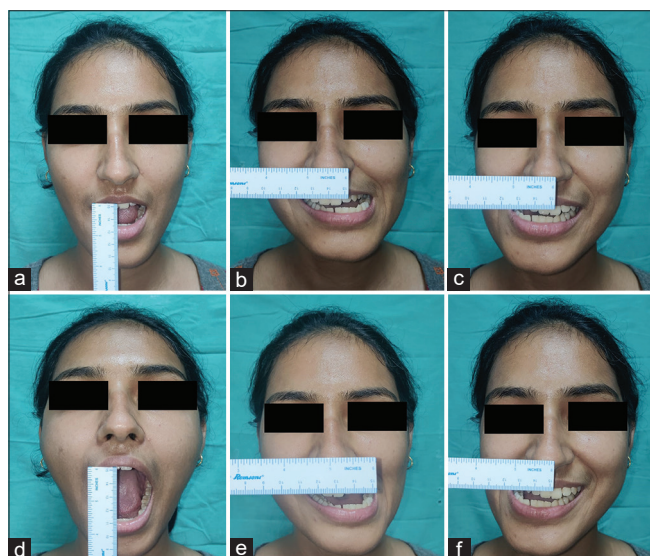


Figure 3: Clinical photos of patient in group A treated by arthrocentesis and corticosteroid injection pre treatment (a-c) and at 1 month follow up (d-f) showing maximum mouth opening, left and right lateral excursion movements respectively



Figure 4: Clinical photos of patient in group B treated by arthrocentesis and hyaluronic acid injection pre treatment (a-c) and at 1 month follow up (d-f) showing maximum mouth opening, left and right lateral excursion movements respectively

have been used for comparison. Inter-group comparison (2 groups) was done using Mann–Whitney U test. Comparison of frequencies of categories of variables with groups was done using Chi-square test.

For all the statistical tests, $P < 0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

RESULTS

Total 91 patients with internal derangement of at least one TMJ were included in the proposed study. The age range of subjects was between 17 and 56 years with average age 32.23 ± 9.6 years. Out of these patients, 56 (61.53%)

were females and 35 (38.46%) were males. Relevant dental history included carious teeth (6.6%), impacted tooth (5.5%), unilateral chewing (3.3%), bruxism (2.2%), and history of facial trauma in childhood (1.1%). Remaining patients (81.3%) were unable to provide a relevant dental history as a cause of their TMJ pain disorder.

Out of 91 patients group A (arthrocentesis + CS) included 48 patients (average age 32.52 ± 9.29 years) and group B (arthrocentesis + HA) included 43 patients (average age 31.91 ± 10.05 years). There was no significant difference for the age parameter between the groups ($p = 0.763$, $P > 0.05$). Total numbers of females in each group were 28 while group A had 20 males and Group B had 15 males. There

was no statistically significant difference for sex frequencies between the groups ($p = 0.654, P > 0.05$).

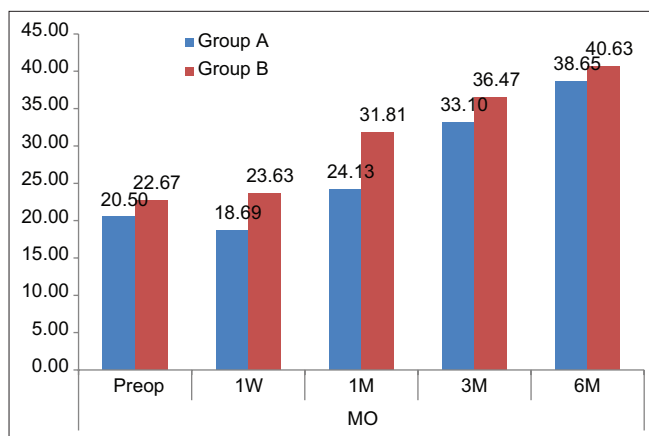
In group A patients, mean pre-op mouth opening was 20.5 ± 6.604 mm, which initially decreased at first week after intervention (18.69 ± 4.934 mm), and then it improved at subsequent visits at 3 months and 6 months. Similarly, in group B mean pre-op mouth opening was 22.67 ± 6.086 mm which improved at monthly visits after initial decline at first week. When inter-incisal opening between two groups were compared pre operatively, it found to be statistically non-significant ($p = 0.107$). However, mouth opening post procedure improved significantly at follow-up visits ($p < 0.05$) [Graphs 1 and 2].

Patients in group A had mean pre-op right and left lateral excursive movements as 2.44 ± 0.89 and 2.63 ± 1.25 mm, respectively, whereas pre-operatively right and left excursive movements in group B were 2.51 ± 0.66 and 2.74 ± 0.82 mm, respectively. Improvements in right and left excursive movements have been depicted with line Graphs 3 and 4. There was a no significant difference

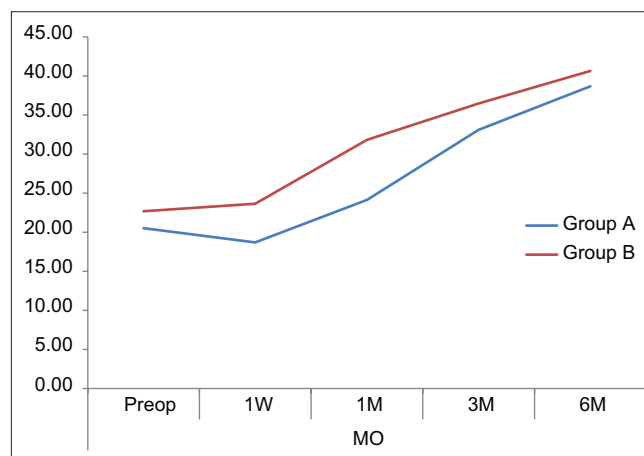
between both groups while comparing excursive mandibular movements pre-treatment as well as post procedure follow-up visits ($p > 0.05$) [Graphs 3 and 4].

Pain intensity at rest of both groups pre operatively were non-significant statistically ($p = 0.365$). It decreased significantly at 1 week and 1 month visits ($p 0.001$). However, there was significant reduction in group B as compared to group A. At subsequent visits (3 and 6 month follow-up) the intensity pain at rest was non-significant in both groups. ($p > 0.05$) [Graph 5]. Pain on excursive mandibular movements improved post procedural but the differences between both groups were statistically non-significant [Graph 6].

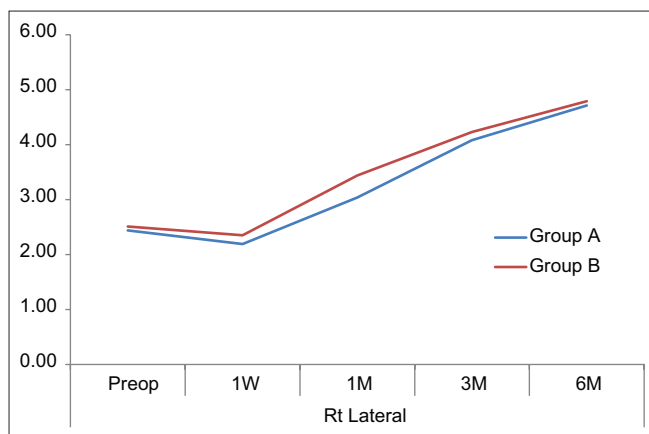
Limitation of TMJ activity, ME and efficacy of judgment to therapy in both groups were compared via Mann–Whitney U test. There was no difference statistically in TMJ limitation pre op in both groups [Graph 7]. Improvements in ME was gradual



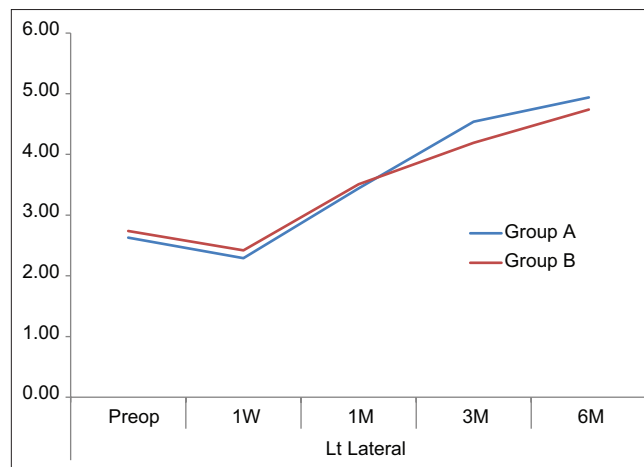
Graph 1: Comparison of maximum mouth opening (in mm) in both groups



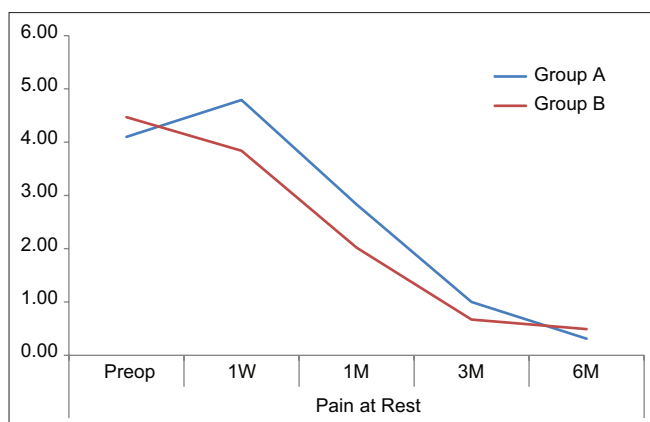
Graph 2: Comparative frequency polygon chart showing changes in mouth opening during follow-up



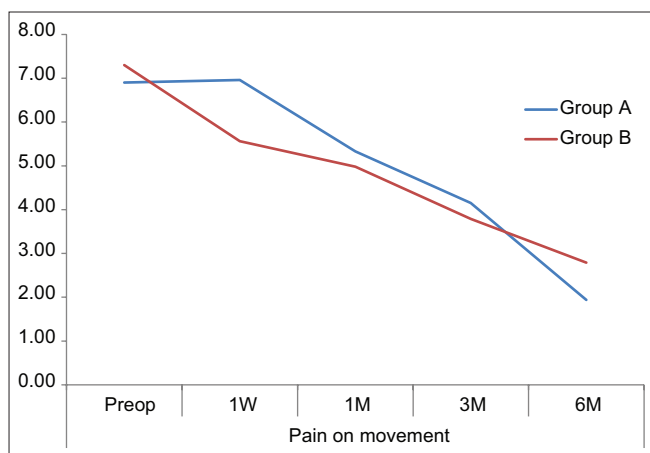
Graph 3: Frequency polygon comparing right lateral excursive movements (in mm) in both groups



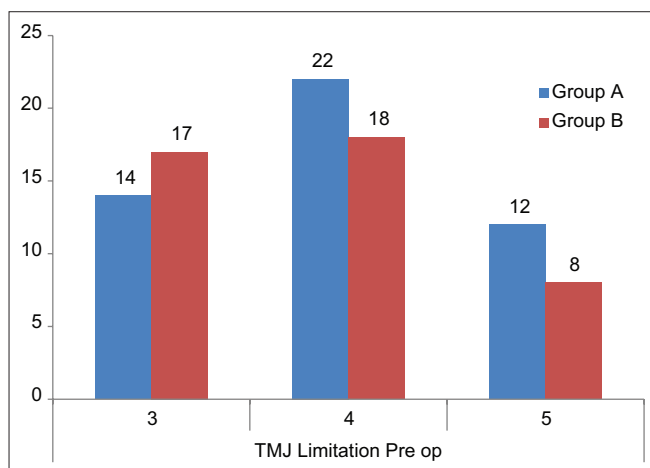
Graph 4: Frequency polygon comparing left lateral excursive movements (in mm) in both groups



Graph 5: Comparison of pain at rest scores (on Visual Analog Scale)



Graph 6: Comparison of pain on mandibular movement scores (on Visual Analog Scale)



Graph 7: Bar chart showing number of patients with functional TMJ limitation pre-treatment following Wilkes criteria

initially till 1 month, however, it improved significantly after 3 months. Group B had increased ME at 6 months ($p = 0.042$).

DISCUSSION

The effectiveness of the arthrocentesis with injection of HA

and CS in the management of TMJ ID in the present study was based on the following clinical parameters: increase in MMO and excursion- right and left, reduction in pain at rest and during function as well as ME.

Many researchers have reported variety of results of their series of patients treated with arthrocentesis and they are affirmative.

In a study by Nitzan *et al.*,^[11] 17 cases were treated by arthrocentesis only with a success rate of 91%. Hosaka *et al.*^[12] did a 3 months follow-up study and found 74% success rate. A similar study by Murakami *et al.*^[13] with 6 month follow-up reported 70% success rate. Arthrocentesis is therapeutic in most of the reported cases, but its efficacy in TMJ IDs can be improved by selective injection of medicated substances like HA, CS, growth factors, etc.

Al-Belasy and Dolwick^[14] reported in their review article that no medication was used for intra articular injection in 4 studies, steroid was used in 14 studies and HA was used in 2 studies.

Study by Alpaslan and Alpaslan^[15] compared efficacy of arthrocentesis with and without injection of Sodium hyaluronate and found that patient with internal derangement benefited in terms of relief of pain, mouth opening, and function. In conclusion, they found that arthrocentesis with HA injection seems to be superior to arthrocentesis alone.

A similar cross sectional study by Shakya P *et al.*^[16] evaluated effectiveness of injection of sodium hyaluronate post arthrocentesis and found 84% reduction in TMJ pain, 92% improvement in MMO and disappearance of clicking in 80% of patients during a follow-up of 6 months. Hyaluronic acid group subjects had increase in MMO and relief of pain explained by lubricating effect of HA which is highly effective in first 3 months. HA maintains lubrication, minimizes wear and tear or plays role in nutrition of avascular parts of disc and condylar cartilage (Hishashi *et al.*^[17]).

Study by Bjørnland *et al.*^[18] involving 40 cases compared between HA and CS injection post-arthrocentesis and confirmed that both injections in the TMJ may reduce pain and improve function in patients with osteoarthritis. These injections effectively reduced TMJ pain only compared to both TMJ and myofascial pain. HA injection more effectively decreased pain intensity than CS, although they observed temporary pain after injections.

Intra-articular injection of CSs was widely used as a simple method to treat the intra-articular problems of the TMJ.^[19,20]

Experimental studies provided evidence that CS might cause necrosis of the articular cartilage^[21,22] and there are reported cases that showed evidence that multiple injections of such a drug might cause damage to the TMJ.^[19,23]

Kopp *et al.*^[24] used the intra-articular injection of HA or CS in patients with TMJ IDs refractory to conservative management. The symptoms were evaluated and assessed TMJ pain and pain in different zones of the face, difficulty opening the mouth, joint sounds, the duration of symptoms, and pain in other joints. The authors recorded improvement in both groups, with symptoms remission in 13 of the 18 patients treated with HA and in 9 of the 15 patients treated with CS after four weeks of follow-up. In another similar study by the same authors^[9] and involving two years of follow-up, similar improvement was recorded for both types of treatment (HA and CS) according to the clinical dysfunction index.

In our study, those patients who had been given injection HA post-arthrocentesis had decreased pain at rest and during functional mandibular activities for a period of 3 months, after which intensity of pain at rest increased. Also, group B had significant improvements in MMO and excursive movements [Graphs 1 and 2]. Group B (HA) patients had relatively increased ME when compared with Group A at the follow-up of 6 months. However, group A patients judged the efficacy of their treatment more beneficial by feedback questionnaire.

A study by Manfredini *et al.*^[25] compared six treatment protocols in a series of 72 patients for treatment of TMDs by arthrocentesis with or without additional drugs. They compared single session, 5 weekly session, low and high molecular weight HA and CSs in their protocols. Although they observed improvements over baseline values in all groups over 3 month follow-up period, there was no significant difference between groups in any outcome variables.

Intra-articular injection of either CS or HA has a significant long-term effect on chronic arthritis of the TMJ and HA might be the best alternative due to the lower risk of side-effects.^[9]

Regardless of whether HA or CS is injected, we at least can be sure that there will be no bone structural changes, as evidenced by Møystad *et al.*,^[26] in their study of 36 patients with osteoarthritis in both TMJs.

CONCLUSION

Internal derangements of TMJ are a complex group of diseases that can cause progressive joint degeneration leading to chronic pain and altered quality of life. Both effective pain

reduction and restoration of normal TMJ function remain unmet challenges. Arthrocentesis with intra-articular injections of CSs and HA are currently used to treat chronic pain over conservative methods.

The results of our study demonstrated that arthrocentesis with the infiltration of sodium hyaluronate is a valid and comparatively more effective method of treating TMJ degenerative disease. In particular, a decrease in pain and an improvement in functionality of the jaw were observed in patients with TMJ ID, who were refractory to the conservative methods. Although infiltration is a slightly invasive method of administration, it proved to be absolutely reliable if correctly performed.

This is a minimally invasive procedure with fewest complications. Thus, it may be the preferred treatment for the patients suffering with TMJ ID who were refractory to conservative methods. This technique will gain ground in maxillo-facial surgery as a possible alternative to treat chronic TMJ pain sufferers who are unresponsive to conservative medical therapies.

Ethical approval

All procedures performed in the study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Provided by Institutional Ethical Committee vide letter no Dean/2012-13/507 dated 23/03/2012.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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