ORIGINAL ARTICLE

ANNALS OF PUNJAB MEDICAL COLLEGE

Enhanced Management of TMJ Internal Derangement: A Focus on Sodium Hyaluronate in Arthrocentesis

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Submitted for Publication: 22-08-2024
Accepted for Publication 04-02-2025

How to Cite: Amjad A, Sohail A, Zahid N, Siddiqui MS, Ayyaz A. Enhanced Management of TMJ Internal Derangement: A Focus on Sodium Hyaluronate in Arthrocentesis. APMC 2025;19(1):30-35. **DOI: 10.29054/APMC/2025.1672**

ABSTRACT

Background: Internal derangement (ID) of the temporomandibular joint (TMJ), often leading to pain and impaired jaw function. Traditional non-surgical treatments include diet modification, splint therapy, physiotherapy, and medications, while invasive surgical options are considered when this fails. Arthrocentesis is a minimally invasive procedure, and adding sodium hyaluronate (SH) has shown the potential to enhance outcomes. **Objective:** This study explores the impact of adding sodium hyaluronate to arthrocentesis to enhance pain relief and joint function in TMJ internal derangement. **Study Design:** Randomized controlled experiment. **Settings:** This research was performed at the Departments of Oral Medicine and Oral & Maxillofacial Surgery at Lahore Medical & Dental College, Lahore Pakistan. **Duration:** The study lasted for one year and eight months. **Methods:** Fifty patients with Wilkes stage III, TMJ ID, unresponsive to conservative treatment, were enrolled and randomized into two groups. Group A received arthrocentesis with regular saline, while Group B received arthrocentesis followed by an intra-articular injection of SH. Pain and maximum mouth opening (MMO) were evaluated preoperatively and during the six months postoperatively. **Results:** Group B exhibited significantly greater pain reduction (VAS score: 1.95 vs. 6.85) and improved MMO (16.75 mm vs. 10.65 mm) compared to Group A. SH showed superior outcomes in both pain relief and MMO. **Conclusion:** Arthrocentesis combined with sodium hyaluronate significantly enhances pain reduction and joint function in TMJ internal derangement compared to arthrocentesis alone.

Keywords: *Temporomandibular joint ailments, Internal derangement, Arthrocentesis, Sodium hyaluronate, Pain management, Mouth opening, randomized controlled trial.*

INTRODUCTION

Internal derangement (ID) of the temporomandibular joint (TMJ) is an abnormal articulation of disc to the condylar head and the articular eminence.[1] This ailment commonly accompanies symptoms of aching, joint noises, and deviation of the mandible. Traditionally, TMJ, ID has been considered a progressive condition, typically involving the antero-medial displacement of the fibrocartilage disc.[2] Initial treatment approaches usually include non-surgical methods like diet amendment, occlusal splints, physical therapy, medication, transcutaneous electrical nerve stimulation, and stress management practices.[3] When these methods fail, surgical interventions, including arthroscopy, disc-repositioning discectomy, and reparation of disc perforation, are considered; though, these surgical procedures are invasive and carry the risk of severe symptoms.[4]

Arthrocentesis is often the primary invasive intervention for patients unresponsive to non-invasive techniques. This procedure aims to disrupt the adhesions inside the joint and eliminate inflammatory mediators, which are responsible for ongoing aching. Alleviating TMJ discomfort through arthrocentesis can improve mouth opening and jaw function.[5]

Arthrocentesis of the TMJ is a negligibly invasive procedure, a transitional choice before surgical approaches. It involves flushing the superior joint space, applying hydraulic pressure, and manipulating the joint

to break up adhesions or address the "anchored disc phenomenon," which improves joint movement.[6] This technique is simple, effective, and can be performed under local anesthesia with minimal risk of complications. It has shown high success rates in treating TMJ closed lock, with no reported relapses during long-term follow-up.[7] Lavage of superior joint space helps alleviate pain by removing inflammatory mediators, improves mandibular movement by breaking intra-articular adhesions, relieves negative pressure, restores space between the disc and fossa, and enhances disc mobility, reducing impediment caused by its anterior displacement.[8]

Medicaments used for TMJ arthrocentesis include corticosteroids, sodium hyaluronate, platelet-rich plasma, local anesthetics, and nonsteroidal anti-inflammatory drugs.[9] Corticosteroids and sodium hyaluronate are commonly reported to have high success rates, effectively reducing inflammation and pain and improving joint function in temporomandibular joint disorders.[10] Intra-articular injection corticosteroid following arthrocentesis provides prolonged relief of TMJ pain and improvement in clinical symptoms. However, their prognosis is unpredictable and may cause local side effects on joint tissues.[11]

Among the various adjunctive used in arthrocentesis for treating Wilkes's stage III internal derangement of the temporomandibular joint (TMJ), sodium hyaluronate (SH) it remained frequently highlighted in research and literature as particularly effective.[12,13] Hyaluronic acid is a linear polysaccharide comprising poly-disaccharide units of glucuronic acid and N-acetyl glucosamine linked by β1-3 and β1-4 glycosidic bonds.[14] Sodium hyaluronate is a naturally occurring constituent of synovial fluid that maintains viscosity. Its function as a molecular sieve is key in controlling the nutrient supply to articular cartilage and facilitating interactions with macromolecules on joint surfaces. SH has anti-inflammatory properties, which can significantly enhance the therapeutic outcomes of arthrocentesis.[15]

TMJ arthrocentesis, being the simplest and least aggressive surgical method, has proven highly effective in restoring normal jaw opening in patients with TMJ internal derangements. Nevertheless, combining arthrocentesis with sodium hyaluronate (SH) yields better results than arthrocentesis unaided. This combination significantly reduces TMJ aching and improves mouth opening (MMO) and mandibular deviation. Consequently, it is the favored option for patients with TMJ ID unresponsive to conventional management.[16]

The rationale of this study is to assess whether incorporating sodium hyaluronate into arthrocentesis can provide greater pain relief and recover joint movement in patients with TMJ internal derangement. This approach aims to offer a more effective, minimally invasive treatment for patients unresponsive to conventional therapies.

METHODS

This randomized controlled trial was executed at the Departments of Oral Medicine and Oral & Maxillofacial Surgery at Lahore Medical & Dental College, Lahore, following ethical approval from the institution's Ethical Review Board on May 26, 2022; reference no: FD/1941/22. This experiment was accomplished in one year and eight months following the approval of the synopsis, and we applied a probability-randomized consecutive sampling system.

The sample size was grounded on an anticipated effect size of 1.2 points on the Visual Analog Scale (VAS), with a pooled standard deviation of 1.25. To attain a 5% significance level and 80% power, we used a standard sample size calculation formula for comparing two means. The calculation showed that at least 17 participants for each group would be required to distinguish the expected outcome difference. To ensure robustness and account for potential dropouts, 25 patients per group were selected.

Participants of both genders over the age of 20-50 were included. Eligibility required restricted mouth opening (less than normal: males 40-70mm, females 35-65mm), TMJ pain at rest or when palpated for at least two months, and resistance to conservative treatments, including physiotherapy, muscle relaxants, NSAIDs and diet.

Participants were excluded if they had an infected joint, previous surgical procedure on the joint, prior sodium hyaluronate or corticosteroid injections in the TMJ within the last six months, any known drug allergies, bony or fibrous ankylosis, extracapsular pain or dysfunction, osteoarthritis or rheumatoid arthritis, or if they were unwilling to participate in this research.

After endorsement by the LMDC Ethical Board and patient-informed agreement, fifty individuals with TMJ internal derangement were enrolled in this research. They were randomly allocated to group A, irrespective of age and gender, using the lottery method by an independent statistician. They were assigned to a clinical investigator just before the procedure. All arthrocentesis procedures were performed by the same clinical investigator, who was well-trained in performing the technique. Possible complications were explained, and informed consent was obtained. Each joint was analyzed both clinically and radiographically using a Panoramic radiograph. Wilkes's stage III is characterized by joint soreness, restricted jaw opening, recurring pain, disc displacement without

reduction, and the absence of bony changes[12]. For optimization, only patients diagnosed with Wilkes stage III dysfunction were involved in our research; pain and maximum mouth opening (MMO) were obtained before surgery.

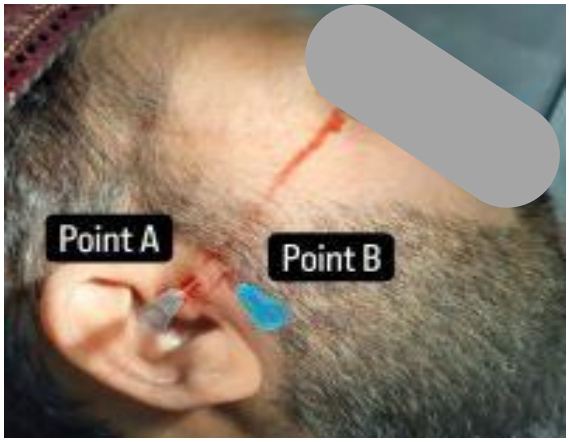
In Group A, arthrocentesis was performed using normal saline. In contrast, in Group B, normal saline was used for the arthrocentesis, followed by an intra-articular injection of 2 ml sodium hyaluronate immediately after the procedure. Patients were regularly monitored after the initial intervention, with the second intervention taking place one week later. Follow-up assessments were conducted weakly during the first month, later at three and six-month intervals to evaluate pain relief, mouth opening capacity, and outcomes. Maximum mouth opening (MMO) was determined by measurement of distance between the upper and lower central incisors. Pain levels were evaluated using the Visual Analog Scale (VAS), where 0 represented no pain, and 10 signified severe pain.[17] A single investigator performed all clinical evaluations for pain and jaw movement issues.

Group A, arthrocentesis, was performed under local anesthesia to block the auriculotemporal nerve. The patient was seated at a 45° angle with their head turned to the opposite side. After preparing the target area, a damp cotton plug was used to block the external auditory meatus. Needle insertion points were marked on the skin following McCain's method. A line was drawn from the tragus's center to the eye's outer canthus. The posterior insertion point was located on this canthus-tragal line, 10 mm in front of the middle of the tragus and 2 mm below it (Point A). The anterior insertion point was 10 mm further along the line and 10 mm below it (Point B).[18] A two-milliliter sample of regular saline was infused into the superior joint space through Point A (Fig 1). To aid in the lysis of adhesions, the jaw was manipulated in opening, excursive, and protrusive ways during the lavage, while the residual fluid was evacuated through Point B. After a week, the same procedure was repeated as the second intervention.

In Group B, after performing arthrocentesis as described for Group A, one milliliter of 2% sodium hyaluronate (20 mg per ml) was injected into the joint. The first intervention included an injection of one milliliter into the superior joint cavity, followed by a second injection of another milliliter one week later.

Data was analyzed using SPSS version 26. Quantitative data was assessed by calculating the mean and standard deviation. Group means were compared using an independent sample t-test, while a paired sample t-test was used to assess parameters before and after treatment. A p-value of less than 0.05 was considered statistically significant. The same instruments and operators were used throughout the study to minimize bias.

Fig 1: Markings for needle insertion



RESULTS

Among the 50 patients aged 20-50 years, Group A comprised 60% females and 40% males, whereas Group B had an equal distribution of 50% males and 50% females. Regarding mouth opening, 30% of participants from Group A possessed a maximum mouth opening (MMO) of 30 mm±2.71 compared to 26% in Group B. The age distribution was balanced across both groups, ensuring a comparable baseline for evaluating the effectiveness of treatments.

At the end of one month, Group B demonstrated a significantly greater reduction in pain, with a mean VAS score of 1.95, compared to Group A, with a mean VAS score of 6.85. The standard deviations indicate that the variability in pain reduction was relatively similar in both groups, reflecting consistent treatment responses among the patients (Table 1). These results support the effectiveness of sodium hyaluronate in providing more substantial pain alleviation in participants with TMJ ailments than normal saline.

Table 1: Calculating Mean and Standard Deviation for Pain on VAS

Follow-Up	Group A Mean Pain on VAS & SD	Group B Mean Pain on VAS & SD
Preoperative pain	8.10 ±0.28	8.20 ± 0.25
1 Week	8.00 ± 0.20	6.35± 0.31
2 Week	7.00± 0.20	4.30± 0.30
3 Week	6.90 ± 0.32	3.00 ± 0.35
4 Weeks	6.85 ±0.41	1.95 ± 0.42

Data shows that both groups experienced increased maximum mouth opening (MMO) over time. Still, Group B (Sodium Hyaluronate) consistently had higher mean MMO and greater improvements at each follow-up point

than Group A (Normal Saline). At the end of six months, Group A had a mean improvement MMO of 10.65 mm with a standard deviation (SD) of 0.67, while Group B had a mean MMO of 16.75 mm with an SD of 0.90. The standard deviations indicate that the variability in MMO was relatively stable in Group A, while Group B showed a slight increase in variability over time, particularly at the three- and six-month follow-ups, reflecting a more pronounced response to the treatment in different patients (Table 2). Group B's consistently superior performance underscores sodium hyaluronate's efficacy in enhancing joint mobility and function in patients with TMJ disorders.

Table 2: Calculating Mean and Standard Deviation for MMO

Follow-Up		Group A Mean &(SD)	Group B Mean &(SD)
Improvement in Maximum Mouth Opening (MMO)	1 Week	5.05 ±0.52	8.05 ± 0.53
	2 Weeks	7.05 ±0.53	10.05 ± 0.53
	3 Weeks	7.55 ± 0.59	11.05 ± 0.63
	1 Month	8.05 ±0.52	12.05 ± 0.53
	3 Months	9.05 ±0.52	14.75 ±0.79
	6 Months	10.65 ±0.67	16.75 ± 0.90

Regarding TMJ pain reduction, Group B had a mean VAS score of 1.95 compared to 6.85 in Group A. This substantial reduction in pain suggests the efficacy of sodium hyaluronate in alleviating TMJ pain compared to normal saline. Similarly, Group B exhibited a greater increase in MMO with a mean of 16.75 mm compared to 10.65 mm in Group A (Table 3). This indicates that sodium hyaluronate improves joint mobility and function, leading to a more significant enhancement in MMO.

Table 3: Comparison of Reduction in TMJ Pain (VAS Score) and Increase in Maximum Mouth Opening (MMO) between Groups

Group	TMJ Pain (VAS Score)	MMO Increase (mm)
Group A	Mean: 6.85, SD: ±0.41	Mean: 10.65, SD: ±0.67
Group B	Mean: 1.95, SD: ±0.42	Mean: 16.75, SD: ±0.90

DISCUSSION

The outcomes of this intervention provide a strong indication supporting the effectiveness of combining arthrocentesis with sodium hyaluronate (SH) for treating internal derangement of the temporomandibular joint (TMJ). Group B showed a significant reduction in TMJ pain with a mean VAS score of 1.95, compared to 6.85 in Group A, highlighting the effectiveness of sodium hyaluronate over normal saline. Additionally, Group B had a greater increase in MMO of 16.75 mm versus 10.65 mm in Group A, indicating better joint mobility and function with sodium hyaluronate. By comparing our results with existing literature, we can further elucidate the significance of our findings and contextualize them within the broader landscape of TMJ treatment modalities.

Arthrocentesis, a minimally invasive procedure, has gained considerable attention as a therapeutic option for TMJ internal derangement. The rationale behind arthrocentesis lies in its ability to lavage the upper joint space, release adhesions, and improve joint mobility, thereby alleviating pain and dysfunction associated with TMJ disorders.[19-21] Our study corroborates previous research, signifying the effectiveness of arthrocentesis in improving TMJ symptoms, as evidenced by a substantial drop in TMJ pain and an improvement in jaw opening postoperatively.

Alpaslan *et al*. assessed the outcomes of arthrocentesis with SH in patients with Wilkes stage III and IV internal derangement, reporting remarkable enhancement in pain scores and MMO, consistent with our findings.[22]

Moldez *et al*., in a meta-analysis, synthesized data from multiple studies, revealing that SH injection significantly reduced pain and improved joint function in TMJ disorders. Our results align with these findings, further supporting the therapeutic benefits of SH in TMJ management.[23]

Manfredini *et al.* (2012) compared arthrocentesis with and without corticosteroid injections, finding that the group receiving corticosteroids had a pain reduction from 6.8 ± 1.9 to 3.2 ± 1.4 and an increase in MMO from 30.1 ± 7.2 mm to 38.3 ± 5.9 mm after six months.[19] While effective, our results suggest that SH provides superior outcomes regarding diminished pain and improved jaw opening.

The study of Guarda-Nardini *et al*. showed that arthrocentesis with hyaluronic acid reduced pain from 6.1 ± 2.4 to 2.5 ± 1.6 and improved MMO from 32.0 ± 5.1 mm to 41.2 ± 3.9 mm. The outcomes of our study, focusing specifically on SH, are comparable, indicating similar efficacy in TMJ symptom improvement.[24]

Ramakrishnan *et al*. (2022) investigated the efficiency of arthrocentesis with PRP, reporting a significant reduction in pain scores from 7.2 ± 1.5 to 2.9 ± 1.3 and an improvement in MMO from 28.3 ± 5.4 mm to 38.1 ± 4.8 mm postoperatively. While PRP shows promise, our study indicates that SH is a potent alternative, providing comparable improvements in TMJ function and pain relief.[25]

The study concluded that arthrocentesis with sodium hyaluronate is more competent in pain alleviation and enhanced joint function than arthrocentesis with saline solution. Specifically, the sodium hyaluronate group had a 20% higher rate of significant pain reduction and a 20%

greater improvement in MMO compared to the control group, highlighting the added benefits of SH in TMJ arthrocentesis.

CONCLUSION

This experimentation explores the probable benefits of sodium hyaluronate as an additional therapy in TMJ interventions, emphasizing the need for personalized approaches in managing TMJ disorders. By comparing our findings with existing literature, we have shown that combining arthrocentesis with sodium hyaluronate leads to better results in pain reduction and improvement in joint function compared to arthrocentesis alone. Further research, with extended follow-up is needed to confirm these results and potentially establish arthrocentesis with sodium hyaluronate as a standard treatment for TMJ internal derangement.

LIMITATIONS

Although our study presents strong evidence for the efficacy of arthrocentesis with sodium hyaluronate, several confines must be accepted. The small sample size may limit the broader applicability of the conclusions. Moreover, the brief follow-up period restricts insight into the long-term effects, necessitating further research to assess the durability of the treatment outcomes.

SUGGESTIONS / RECOMMENDATIONS

Additional revisions with a greater model and prolonged follow-up are required to authenticate these conclusions and potentially establish arthrocentesis with sodium hyaluronate as a standard treatment for TMJ internal derangement.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

FUNDING

No economic provision was received for this article's research, authorship, or publication.

ACKNOWLEDGEMENTS

We acknowledge the statistician for randomization and the staff who were involved in the study for their unconditional support in data collection and patient care.

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