

COMPARITIVE STUDY OF CONVENTIONAL ARTHROCENTESIS WITH DOUBLE NEEDLE CANNULA ARTHROCENTESIS FOR TMJ LYSIS AND LAVAGE - A PROSPECTIVE STUDY

Dr.Tharani.P¹,Dr.Vijay Ebenezer²,Dr.Balakrishnan³

*(Post Graduate,Department Of Oral And Maxillofacial Surgery,Sree Balaji Dental College
And Hospital ,Chennai,Tamilnadu)¹*

*(Head Of The Department,Department Of Oral And Maxillofacial Surgery,Sree Balaji Dental
College And Hospital ,Chennai,Tamilnadu)²*

*(Professor,Department Of Oral And Maxillofacial Surgery,Sree Balaji Dental College And
Hospital ,Chennai,Tamilnadu)³*

Abstract:

Background: Temporomandibular joint arthrocentesis represents a form of minimally invasive surgical treatment in patients suffering from internal derangement of temporomandibular joint which is a simple, inexpensive and highly efficient procedure.

Arthrocentesis changes the synovial fluid viscosity contributing to the translation of the disc and mandibular head complex. Drug is instilled under pressure directly on to the TMJ to breakdown early adhesion generating shear free jaw movements. thus mouth opening is improved, pain is decreased as proinflammatory mediators are washed out.

Material and methods: The present study was carried out in the department of oral and maxillofacial surgery at sree balaji dental college and hospital ethical committee clearance was obtained prior to study .the patients were informed about the surgical procedure the risk associated and informed consent was obtained from all the patients.

Conclusion: The lysis of adhesion of adhesion is achieved by intermittent distension of the joint space by momentary blocking of the outflow needle and injection under pressure during lavage using both SPA and DPA.

1. INTRODUCTION:

Arthrocentesis has been considered as a first line of surgical treatment for a patient with temporomandibular disorder who do not respond to conservative therapy such as interocclusal device ,physical therapy drugs , behavioural and life style changes .

For patients with acute closed lock jaw ,anterior or anteromedial disc displacement, the disc deforms and become impossible to reduce and poses an obstacle in normal movement of the condyle. The condition may further progress as internal derangement of temporomandibular joint. Initially, clicking is present with normal mouth opening in this condition. Later, the

patient develops restriction in mouth opening and the clicking gradually stops. (closed lock jaw).The temporomandibular joint at this stage is non reducible,with the disc acting as an obstacle for the translation of the condyle.

The inflammatory stimuli,induces the action of proinflammatory cytokines such as Interleukin-1-beta(IL-1- β)and tumor necrosis factor –alpha (TNF- α) which are responsible for destruction of cartilage through degradation of proteoglycans.

IL-6 may act to protect cartilage through promotion of the production of tissue inhibitors. It has been suggested that IL- β and IL-6 in synovial fluid may be associated with the development of osteoarthritis and the presence of IL-6 may be an index of synovitis.

Increased permeability of the synovial membrane to plasma protein results in elevated protein levels in synovial fluid which parallels the degree of inflammation. Thus, the Joint overloading in turn results in increased intraarticular pressure and hypoxia that may cause collapse of the lubrication system.

This joint overloading is terminated by a procedure called Arthrocentesis which re-oxygenates the hypoxic intraarticular site. The re-perfusion cycle can lead to the release and production of reactive oxygen species ,resulting in degeneration of hyaluronic acid and marked reduction in synovial fluid viscosity.

The objective of arthrocentesis is to improve the disk mobility, eliminate joint inflammation,remove the resistance to condyle translation, to restore normal function and eliminate pain.

There are eight different methods and modifications for the lysis and lavage of the temporomandibular joint like arthroscopic lysis and lavage, two-needle arthrocentesis using irrigation pump, modified two-needle arthrocentesis, the double-needle cannula method, single-needle arthrocentesis, use of a single shepherd cannula with two ports and two lumens, two-needle arthrocentesis, single puncture arthrocentesis, two-needle arthrocentesis with new anatomical landmarks.

And the anatomical consideration of the lysis and lavage is initially done using the canthotragal line which was given by **Holmlund and Helsing in the 1980s** and it is also known as Holmlund and hellising line. Later it is modified by **Alkan and etoz in 2010**.

Lysis and lavage did use saline or ringer lactate initially which later is followed by intraarticular injections like steroids, analgesic and sedative agents.

The purpose of this study is to compare and evaluate the efficiency of conventional arthrocentesis and double-needle cannula method using ringer lactate solution with anatomical guidance of Holmlund and hellising's line without any intraarticular fluids.

2. AIM AND OBJECTIVE OF THE STUDY:

1. The aim of the study is to compare and evaluate the efficiency of conventional arthrocentesis and double-needle cannula method using ringer lactate.
2. To identify the minimally invasive surgical technique between double needle cannula and conventional arthrocentesis using ringer lactate without any intra articular injection.

BETWEEN THE TWO METHODS:

- a) post operative mouth opening is evaluated with the help of ruler
- b) post operative pain is evaluated using visual analog scale.

3. MATERIALS AND METHODS:

The present study was carried out in the department of oral and maxillofacial surgery at Sree Balaji Dental College and Hospital. Ethical committee clearance was obtained prior to study. The patients were informed about the surgical procedure, the risk associated, and informed consent was obtained from all the patients.

In this study two groups were taken into account.

a) GROUP-1: consist of 5 patients who are provided with conventional arthrocentesis using Ringer lactate solution without any intra articular injection.

b) GROUP-2: consist of 5 patients who are provided with double needle cannula arthrocentesis using Ringer lactate solution without any intra articular injection.

Inclusion criteria:

- Pain located in the affected TMJ, especially during opening.
- Joint noises.
- Limited mouth opening (less than 35 mm).
- Difficulty in lateral movement toward the unaffected side.
- Deviation towards the affected side in opening and protrusion movements.
- Patient who did not respond to conservative management including splint therapy.

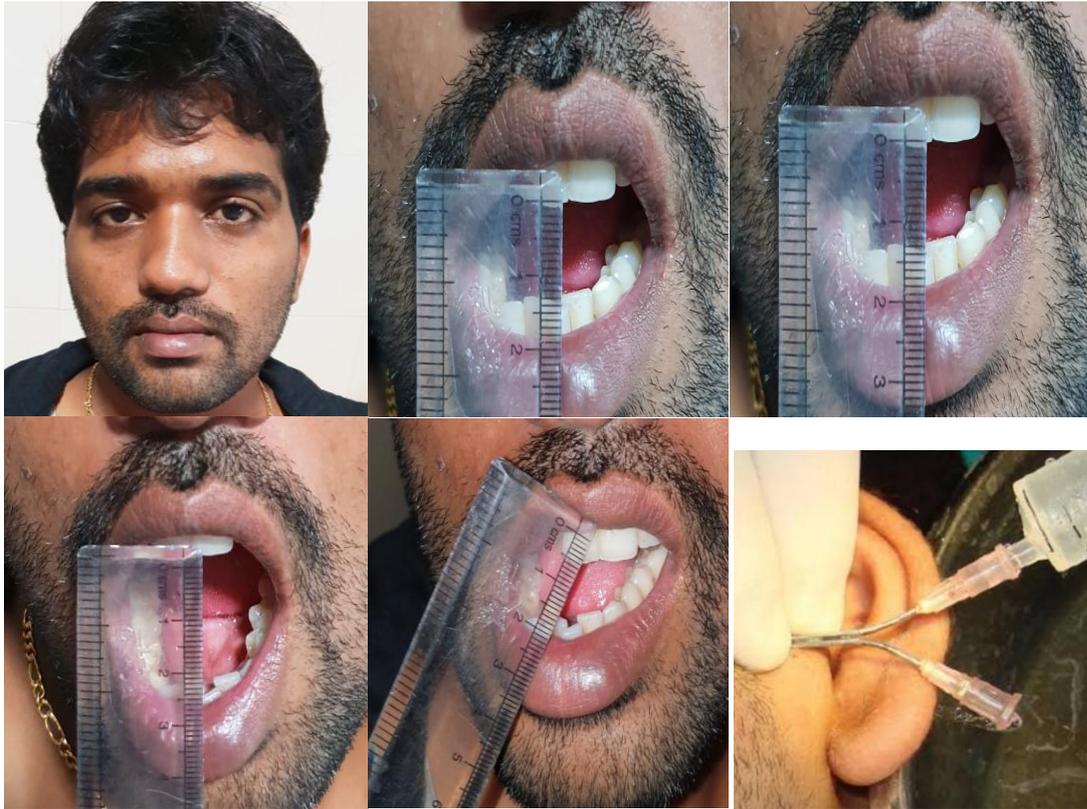
Exclusion criteria:

- Patients suffering from any systemic diseases, platelets function disorders, fibrinogen deficiency.
- Patients with previous TMJ surgery.
- Patients with previous joint fractures, infection.
- Patients receiving anticoagulation treatment or non-steroidal anti-inflammatory drugs within 48 hours preoperatively
- Corticosteroid injection at treatment site within 1 month or systemic use of corticosteroids within 2 weeks.

Surgical protocol:

A proforma was used for all the patients containing name, age, sex, address, chief complaint, past medical history, medical history, intra oral examinations, previous endodontic, periodontic, orthodontic treatment history, pre and post operative tomograph assessment were carried out for all the patients.





Surgical technique:

Conventional arthrocentesis:

- In both groups, the same technique of anesthesia was done after disinfection by povidone-iodine.
- Canthotragal line was drawn.
- Few drops of local anesthesia were injected subcutaneously to block auriculotemporal nerve.
- 20- gauge needle was inserted into the superior joint space at the glenoid fossa
- Approximately 2 ml of ringier's lactate solution was then injected to distend the superior joint space.
- A second 20-gauge needle was inserted into the area of articular eminence to establish a free flow of the solution through the superior joint space.
- This needle provides an outflow for the solution which was collected in a kidney dish.
- A total of 100 ml of solution was used to lavage the superior joint space, during which time the outlet needle was blocked with finger pressure 2 or 3 times to help distend and break up the joint adhesions.
- Once the needles were removed, the patient's jaw was gently manipulated in the vertical, protrusive and lateral excursions.

Double needle cannula :

- In both groups, the same technique of anesthesia was done after disinfection by povidone-iodine.

- Canthotragal line was drawn.
- Few drops of local anesthesia were injected subcutaneously to block auriculotemporal nerve.
- Double needle cannula was inserted into the superior joint space at the glenoid fossa
- Approximately 2 ml of ringer's lactate solution was then injected to distend the superior joint space.
- This needle provides an outflow for the solution which was collected in a kidney dish.
- A total of 100 ml of solution was used to lavage the superior joint space, during which time the outlet needle was blocked with finger pressure 2 or 3 times to help distend and break up the joint adhesions.
- Once the needles were removed, the patient's jaw was gently manipulated in the vertical, protrusive and lateral excursions

4. Discussion:

Lysis and lavage of the TMJ were first done using arthroscopy by Ohnishi in 1975, but because it was found that visualisation of the joint is not necessary arthrocentesis is a modification of TMJ arthroscopy. In our study, the difference in intraoperative time of single-needle technique and double-needle technique was found to be statistically significant. A similar result was in accordance with Talaat W, Ghoneim MM, Elsholkamy M. 2016,²² in which they suggested the advantages of single-needle technique as compared to traditional two-needle arthrocentesis would be faster execution time.⁵³

Similar to the studies of several authors, single-puncture reduces patient pain in the postoperative period, reducing the need for extracare postoperatively.¹³

Many authors suggested the use of a single and more stable needle should limit the traumatism of the intervention, so reducing pain and disability in the postoperative phase.¹⁹

Nitzan et al., then described a technique whereby two needles instead of one were introduced into the upper joint space.

There was a significant decrease in pain scores at 1 week, 1 and 3 months with double-needle technique as reported by several authors.^{26,19,44} Similar results were evaluated in the studies of many with double-needle technique at intervals of 1, 3 weeks, 3 and 6 months after the procedure with the improvement with emphasis on pain.¹⁸

Similar results were suggested by many authors shown significant improvement with respect to baseline levels were achieved in both treatment groups. The rate of improvement was not significantly different between the two treatment protocols in any of the outcome variables.²⁶

Similar findings were seen in studies of several authors. They found the success rate was 70% at 6 months follow-up; it increased to 78.9% over the 3 years of follow-up.⁵¹

Similar findings were observed by many other authors. They observed good results in all

patients with immediate improvement in mouth opening with double-needle technique.¹⁸

Laskin²⁸ mentioned that it is usually difficult to insert the second needle anterior to the first one, and therefore, he had inserted the anterior needle in the posterior recess of the upper joint compartment by placing it 3–4 mm anterior to the first one and suggested this technique to be much easier than the previous method. However, if the second needle is entered anterior to the first one, it is inserted into a narrower region of the upper joint compartment, and this may cause damage to the articular disc leading to failure of the outflow of irrigating solution. As author said in this study this technique where avoided to prevent the damage of articular disc .

The arthrocentesis is effective ,simple, low pressure lysis and lavage of adhesion in temporomandibular for both spa and dpa with prolonged follow up of the technique.

In our study, comparison of the incidence of TMJ clicking at different time interval was done. Incidence of TMJ clicking at baseline (before surgery) was similar in Group A (46.67%) and Group B (46.67%).

At rest of the follow-up periods i.e., at IMMEDIATE,3DAY,1WEEK postoperatively incidence of TMJ clicking was higher in Group A (46.67%) as compared to Group B (20.00%) but difference was not found to be statistically significant.

In our study out of 10 joints, 6 initially complained of Clicking. At the end of 1WEEK patients stated MILD evidence of clicking were observed in the studies of many authors.^[15]

Similar findings were demonstrated in the studies of many authors that clicking decreased in (63%) patients remaining (37%) patients it was absent in 1 week. Postoperatively after 1-month clicking decreased in 54%, absent in 27%, increased in 8.3%, and still present in 8.3% patients respectively. At 3 months clicking decreased in (36%) patients, absent in (27%), increased in 2 (18%), and present in 2 (18%).

In our study, postoperative facial nerve damage was found in none of the patients of either groups.

Results of our study shows that both the techniques have similar outcome in terms of pain, mouth opening, clicking, and facial nerve injury.

This may be explained as after needle inserted in the upper compartment and pressure exerted by forced fluid not only detaches adhered disc but also washes inflammatory exudates in inflamed joint which can be achieved through single-needle technique also.

Results of our study shows that both the techniques have similar outcome in terms of pain, mouth opening, clicking, and facial nerve injury.

In particular, the present study underlined that baseline physical findings and the type of intervention (two-needle vs. Single-needle approach) were not predictors for treatment effectiveness in patients with TMJ inflammatory-degenerative disease. Furthermore,

studies related to the presence of IL, prostaglandin and several disc-related disorders (disc rupture) may be a variable to evaluate the outcome of procedure. A more multicentric study with large sample size and long follow-up duration with biochemical evaluation of collected lavage fluid can make future study more informative.

Systematic review on this could help in better understanding about both the techniques and can be considered as the first-treatment option for patients with painful hypomobilized TMJ.

5. Result:

The present study was conducted in the department of oral and maxillofacial surgery, sree balaji dental college and hospital in post graduate department ,pallikarani ,chennai to compare arthrocentesis of tmj by single- and double-needle technique [table 1]. 10 joints were included in the study and were randomly selected in two groups as under:

Group	Description	No.of joint
Group a	Single needle	5
Group b	Double needle	5
		total:10

Proportion of females and males in both the groups was found to be similar. In both, the groups majority of participants were female (50%), and the rest were male (50%) [table 2]

Gender	Group a	Group b
Female	3	1
Male	2	4

Between-group comparison of mouth opening at different time intervals. Table 5b: intragroup change in mouth opening from baseline (before surgery) at different time intervals

Maximum mouth opening: group -a

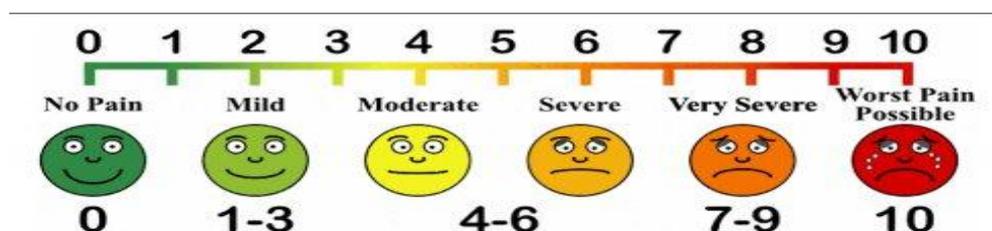
Group-a	Pre -op	Immediate post op	3days	1week
Patient 1	2	3.5	4	4
Patient 2	1.5	2.5	4	4.5
Patient 3	2	4	4	4.5
Patient 4	2	2.5	2.5	2.5
Patient 5	2	3.5	4	4.5

Maximum mouth opening: group -b

Group-b	Pre -op	Immediate post op	3days	1week
---------	---------	-------------------	-------	-------

Patient 1	1.5	2.5	4	4.5
Patient 2	2	3.5	4	4.5
Patient 3	2	3.5	4	4.5
Patient 4	2	3.5	4	4.5
Patient 5	1.5	3.5	4	4

At immediate p.o. mouth opening of group a was found to be higher than that of group b though this difference was not found to be statistically significant at 3rd p.o. mouth opening of group a was found to be higher than that of group b though this difference was not found to be statistically significant .at 1week p.o. mouth opening of groupb was found to be higher than that of group a though this difference was not found to be statistically significant



Vas:

Group -a

Group-a	Pre -op	Immediate post op	3days	1week
Patient 1	4	3	3	3
Patient 2	4	3	3	3
Patient 3	4	3	3	3
Patient 4	4	3	3	3
Patient 5	4	3	3	3

Group -b

Group-b	Pre -op	Immediate post op	3days	1week
Patient 1	4	3	3	3
Patient 2	4	3	3	3
Patient 3	4	3	3	3
Patient 4	4	3	3	3
Patient 5	4	3	3	3

At immediate p.o. pain score of group a was found to be higher than that of group b though this difference was not found to be statistically significant at 3rd p.o. pain score of group a was found to be higher than that of group b though this

difference was not found to be statistically significant .at 1week p.o. pain score of group b was found to be higher than that of group a though this difference was not found to be statistically significant.

Effectiveness of both techniques were equal in mouth opening and pain reduction. The both the technique were easier to perform and long term observation.

6. Conclusion: the results indicate that both arthrocentesis techniques were equally effective in mouth opening,pain reduction and reducing the clicking sound. The both the technique were easier to perform and long term observation required.

7. REFERENCE:

- 1.Alpaslan GH, Alpaslan C. Efficacy of temporomandibular joint arthrocentesis with and without injection of sodium hyaluronate in treatment of internal derangements. *J Oral Maxillofac Surg.* 2001;59:613-8.
2. Alpaslan C, Bilgihan A, Alpaslan GH, Güner B, Ozgür Yis M, Erbaş D. Effect of arthrocentesis and sodium hyaluronate injection on nitrite, nitrate, and thiobarbituric acid-reactive substance levels in the synovial fluid. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2000;89:686-90.
3. Alpaslan C, Bilgihan A, Alpaslan GH, Güner B, Ozgür Yis M, Erbaş D. Effect of arthrocentesis and sodium hyaluronate injection on nitrite, nitrate, and thiobarbituric acid-reactive substance levels in the synovial fluid. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2000;89:686-90.
4. Alkan A, Etöz OA. A new anatomical landmark to simplify temporomandibular joint arthrocentesis. *Br J Oral Maxillofac Surg* 2010;48:310-1. †
- 5 . Bertolami CN, Gay T, Clark GT, Rendell J, Shetty V, Liu C, Swann DA. Use of sodium hyaluronate in treating temporomandibular joint disorders: a randomized, double-blind, placebo-controlled clinical trial. *J Oral Maxillofac Surg.* 1993;51:232-42.
6. Carvajal WA, Laskin DM. Long-term evaluation of arthrocentesis for the temporomandibular joint. *J Oral Maxillofac Surg* 2000;58:852-855.
7. Dolwick MF. The role of temporomandibular joint surgery in the treatment of patients with internal derangement. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1997;83:150-5.
- 8 . Dimitroulis G, Dolwick MF, Martinez A. Temporomandibular joint arthrocentesis and lavage for the treatment of closed lock: a follow-up study. *Br J Oral Maxillofac Surg.* 1995;33:23-6.
9. Emshoff R, Rudisch A. Determining predictor variables for treatment outcomes of arthrocentesis and hydraulic distension of the temporo-mandibular joint. *J Oral Maxillofac Surg* 2004; 62:816-823.
10. Emshoff R, Rudisch A, Bösch R, Gassner R. Effect of arthrocentesis and hydraulic distension on the temporomandibular joint disk position. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2000;89:271-7.
- 11 . Emshoff R, Gerhard S, Ennemoser T, Rudidch A. Magnetic resonance imaging findings of internal derangement, osteoarthritis, effusion, and bone marrow edema before and after performance of arthrocentesis and hydraulic distension of the temporomandibular joint. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:784-790.

12. Emshoff R, Rudisch A, Bösch R, Strobl H. Prognostic indicators of the outcome of arthrocentesis: a short-term follow-up study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2003;96:12-8.
13. Emshoff R, Puffer P, Rudisch A, Gassner R. Temporomandibular joint pain: relationship to internal derangement type, osteoarthritis, and synovial fluid mediator level or tumor necrosis factor- α . *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000;90:442-449.
14. Fridrich KL, Wise JM, Zeitler DL. Prospective comparison of arthroscopy and arthrocentesis for temporomandibular joint disorders. *J Oral Maxillofac Surg.* 1996;54:816-20.
15. Frost DE, Kendall BD. Part II: The use of arthrocentesis for treatment of temporomandibular joint disorders. *J Oral Maxillofac Surg.* 1999;57:583-7.
16. Goudot P, Jaquinet AR, Hugonnet S, Haefliger W, Richter M. Improvement of pain and function after arthroscopy and arthrocentesis of the temporomandibular joint: a comparative study. *J Craniomaxillofac Surg* 2000;28:39-43.
17. Guarda-Nardini L, Stifano M, Brombin C, Salmaso L, Manfredini D. A one-year case series of arthrocentesis with hyaluronic acid injections for temporomandibular joint osteoarthritis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;103:14-22.
18. Grossmann E, Guilherme Vargas Pasqual P, Poluha RL, Iwaki LCV, Iwaki Filho L, Setogutti ET, *et al.* Single-needle arthrocentesis with upper compartment distension versus conventional two-needle arthrocentesis: Randomized clinical trial. *Pain Res Manag* 2017;2017:2435263. †
19. Guarda-Nardini L, Olivo M, Ferronato G, Salmaso L, Bonnini S, Manfredini D, *et al.* Treatment effectiveness of arthrocentesis plus hyaluronic acid injections in different age groups of patients with temporomandibular joint osteoarthritis. *J Oral Maxillofac Surg* 2012;70:2048-56. †
20. Guarda-Nardini L, Stifano M, Brombin C, Salmaso L, Manfredini D. A one-year case series of arthrocentesis with hyaluronic acid injections for temporomandibular joint osteoarthritis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;103:e14-22. †
[PUBMED]
21. Grossmann E. Arthrocentesis techniques applied to arthrogenic temporomandibular joint disorders. *Rev Dor Sao Paulo* 2012;13:374-81.
22. Hosaka H, Murakami K, Goto K, Iizuka T. Outcome of arthrocentesis for temporomandibular joint with closed lock at 3 years follow-up. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996;82:501-4. †
[PUBMED]
23. Hosaka H, Murakami K, Goto K, Iizuka T. Outcome of arthrocentesis for temporomandibular joint with closed lock at 3 years follow-up. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1996;82:501-4.
24. Kropmans TJ, Dijkstra PU, Stegenga B, De Bont LGM. Therapeutic outcome assessment in permanent temporomandibular joint disc displacement. *J Oral Rehabil* 1999;26:357-363.
25. Kaneyama K, Segami N, Shin-Ichi T, Fujimura K, Sato J, Nagao T. Anchored disc phenomenon with a normally positioned disc in the temporomandibular joint: characteristics and behaviour. *Br J Oral Maxillofac Surg* 2007;45:279-283.
26. Kuruvilla VE, Prasad K. Arthrocentesis in TMJ internal derangement: A Prospective study. *J Maxillofac Oral Surg* 2012;11:53-6. †
[PUBMED]

27. Kaneyama K, Segami N, Sato J, Fujimura K, Nagao T, Yoshimura H, *et al.* Prognostic factors in arthrocentesis of the temporomandibular joint: Comparison of bradykinin, leukotriene B₄, prostaglandin E₂, and substance P level in synovial fluid between successful and unsuccessful cases. *J Oral Maxillofac Surg* 2007;65:242-7. †
28. Laskin DM, Best AM. Meta-analysis of surgical treatments for temporomandibular articular disorders: discussion. *J Oral Maxillo-fac Surg* 2003;61:10-12.
29. Murakami Ki, Iizuka T, Matsuki M, Ono T. Recapturing the persistent anteriorly displaced disk by mandibular manipulation after pumping and hydraulic pressure to the upper joint cavity of the temporomandibular joint. *Cranio* 1987;5:17-24.
30. Manfredini D. Hyaluronic acid in the treatment of TMJ Disorders: A systematic review of the literature. *Cranio* 2010;28:166-176.
31. Manfredini D, Bonini S, Arboretti R, Guarda Nardini L. Temporomandibular joint osteoarthritis: an open label trial of 76 patients treated with arthrocentesis plus hyaluronic acid injections. *Int J Oral Maxillofac Surg* 2009;38:827-834.
32. Murakami K, Hosaka H, Moriya Y, Segami N, Iizuka T. Short-term treatment outcome study for the management of temporomandibular joint closed lock. A comparison of arthrocentesis to nonsurgical therapy and arthroscopic lysis and lavage. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 1995;80:253-7.
33. McCarty WL, Farrar WB. Surgery for internal derangements of the temporomandibular joint. *J Prosthet Dent.* 1979;42:191-6.
34. Neeli AS, Umarani M, Kotrashetti SM, Baliga S. Arthrocentesis for the treatment of internal derangement of the temporomandibular joint. *J Maxillofac Oral Surg* 2010;9:350-4. †
- [[PUBMED](#)]
35. Nitzan DW, Dolwick MF, Heft MW. Arthroscopic lavage and lysis of the temporomandibular joint: a change in perspective. *J Oral Maxillofac Surg.* 1990;48:798-801
36. Nitzan DW, Dolwick MF. An alternative explanation for the genesis of closed-lock symptoms in the internal derangement process. *J Oral Maxillofac Surg.* 1991;49:810-5.
37. Nitzan DW, Etsion Y. Adhesive force- the underlying cause of the “anchored disc phenomenon”. *Int J Oral maxillofac Surg* 2002;31:94-99
38. Nitzan DW, Samson B, Better H. Long-term outcome of arthrocentesis for sudden-onset, persistent, severe closed lock of the temporomandibular joint. *J Oral Maxillofac Surg.* 1997;55:151-7.
39. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. *J Oral Maxillofac Surg.* 1991;49:1163-7.
40. Ness GM, Crawford KC. Temporomandibular joint arthrocentesis for acute or chronic closed lock. *J. Oral Maxillofac Surg* 1996;54:112.
41. Nitzan DW, Samson B, Better H. Long-term outcome of arthrocentesis for sudden-onset, persistent, severe closed lock of the temporomandibular joint. *J Oral Maxillofac Surg.* 1997;55:151-7.
42. Nishimura M, Segami N, Kaneyama K, Suzuki T. Prognostic factors in arthrocentesis of the temporomandibular joint: evaluation of 100 patients with internal derangement. *J Oral Maxillofac Surg* 2001;59:874-877.
43. Öreroğlu AR, Özkaya Ö, Öztürk MB, Bingöl D, Akan M. Concentric-needle cannula method for single-puncture arthrocentesis in temporomandibular joint disease: An inexpensive and feasible technique. *J Oral Maxillofac Surg* 2011;69:2334-8. †

44. Reddy R, Reddy VS, Reddy S, Reddy S. Arthrocentesis – A minimally invasive treatment of temporomandibular joint dysfunction: Our experience. *J Dr NTR Univ Health Sci* 2013;2:196-200. †
45. Ross JB. The intracapsular therapeutic modalities in conjunction with arthrography: case reports. *J. Craniomandib Disord* 1989; 3:35-43.
46. Sanders B. Arthroscopic surgery of the temporomandibular joint: treatment of internal derangement with persistent closed lock. *Oral Surg Oral Med Oral Pathol.* 1986;62:361-72.
47. Segami N, Murakami K, Iizuka T. Arthrographic evaluation of disk position following mandibular manipulation technique for in-ternal derangement with closed lock of the temporomandibular joint. *J Craniomandib Disord* 1990; 4:99-108.
48. Sanroman JF. Closed lock (MRI fixed disc): a comparison of arthrocentesis and arthroscopy. *Int J Oral Maxillofac Surg* 2004;33:344-348.
49. Tvrdy P, Heinz P, Pink R. Arthrocentesis of the temporomandibular joint: A review. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2015;159:31-4. †
50. Thomas H, Neelakantan RS, Thomas TK. Role of arthrocentesis in the management of acute closed lock of TM joint: A Pilot study. *J Maxillofac Oral Surg* 2012;11:390-3. † [\[PUBMED\]](#)
51. Talaat W, Ghoneim MM, Elsholkamy M. Single-needle arthrocentesis (Shepard cannula) vs. Double-needle arthrocentesis for treating disc displacement without reduction. *Cranio* 2016;34:296-302. †
52. Yura S, Totsuka Y, Yoshikawa T, Inoue N. Can arthrocentesis release intracapsular adhesions? Arthroscopic findings before and after irrigation under sufficient hydraulic pressure. *J Oral Maxillofac Surg.* 2003;61:1253-6.
53. Yura S, Totsuka Y. Relationship between effectiveness of arthrocentesis under sufficient pressure and conditions of the temporoman-dibular joint. *J Oral Maxillofac Surg* 2005; 63:225-228.
54. Zardeneta G, Milam SB, Schmitz JP. Elution of proteins by continuous temporomandibular joint arthrocentesis. *J Oral Maxillofac Surg* 1997;55:709-16. †