Research Article

AHB Advances in Human Biology

Adv Hum Biol. 2015;5(1):25-33.

Single Puncture Arthrocentesis for the Inflammatory Temporomandibular Joint Disorders

Naveen Rao[1] Prithish Patnayak[2*] Shreyas Sorake[3] Ashish Shetty[4] Chethan M Koteswara[5] Vikram Bhat[6]

[1]Professor, Department of Oral and Maxillofacial Surgery, AJ Shetty Institute of Dental Science, Mangalore, Karnataka, India.
[2]Senior Resident, Department of Dental Surgery, MKCG Medical College and Hospital, Brahmapur, Ganjam, Odisha, India.
[3]Reader, Department of Oral and Maxillofacial Surgery, AJ Shetty Institute of Dental Science, Mangalore, Karnataka, India.
[4]Reader, Department of Oral and Maxillofacial Surgery, AJ Shetty Institute of Dental Science, Mangalore, Karnataka, India.
[5]Reader, Department of Anaesthesiology, A.J. Institute of Medical Sciences, Mangalore, Karnataka, India.
[6]Senior Lecturer, Department of Oral and Maxillofacial Surgery, AJ Shetty Institute of Dental Science, Mangalore, Karnataka, India.

ABSTRACT

Aim: Arthrocentesis of the temporomandibular joint traditionally involves irrigation of the upper joint space and manipulation of the joint, using 2 needles inserted through two separate puncture sites. The blind insertion of the second needle is often challenging. The surgeon may lose the right place during the procedure. So it may need manipulation and sometimes even multiple punctures. This often leads to extra-articular leak of the lavage solution which decreases the intra-articular pressure required for lysis. To overcome this unwanted clinical situation, a simple technique of introducing both the needles through a single puncture to accomplish the procedure of arthrocentesis more effectively has been followed in this study.

Materials and Method: This study was conducted on 20 patients diagnosed with inflammatory conditions of the temporomandibular joint. Patient underwent arthrocentesis using a modified dual needle device with Ringer's lactate as a lavage solution. Pre-op and post-op data were recorded over three months and analyzed statistically.

Results: Mouth opening and visual analogue score for pain which were analyzed by student paired t test revealed that mouth opening increased and pain decreased significantly ($p<0.05$). Joint sounds reduced only in two patients.

Conclusions: Arthrocentesis is a simple conservative surgical procedure with minimal inVASion performed to flush the inflamed TMJ. Single puncture arthrocentesis technique with a dual needle device further simplifies the procedure which is evident with significant results. Future studies with larger sample size and longer duration of follow up will test the true efficacy of this technique.

Keywords: Needle, Temporomandibular joint, Inflammation.

INTRODUCTION

Temporomandibular disorders (TMD) is a collective term used for a number of clinical problems that involve the masticatory muscles, temporomandibular joint (TMJ), and/or associated structures[1]. The cardinal signs and symptoms for TMD are pain in the TMJ and muscles associated with it and limited mouth-opening along with joint sounds[2]. TMD symptoms generally fluctuate over time and correlate significantly with masticatory

Received: Aug. 19, 2014**: Accepted**: Dec. 3, 2014
***Correspondence Dr. Pritish Patnaik.**
Department of Dental Surgery, MKCG Medical College and Hospital, Brahmapur, Ganjam, Odisha, India.
Email: pritishpatnaik02@gmail.com

pISSN 2321-8568
eISSN 2348-4691

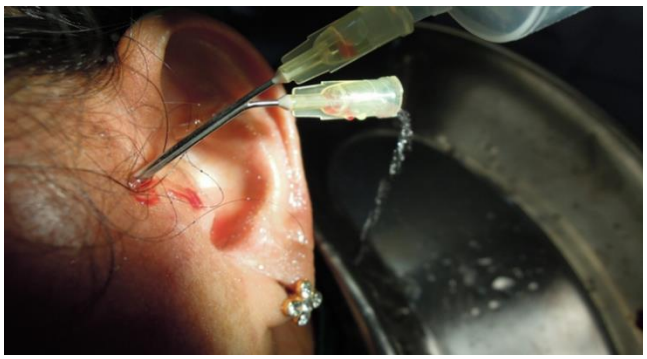
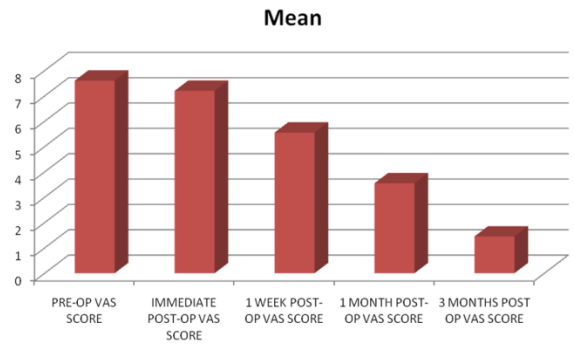


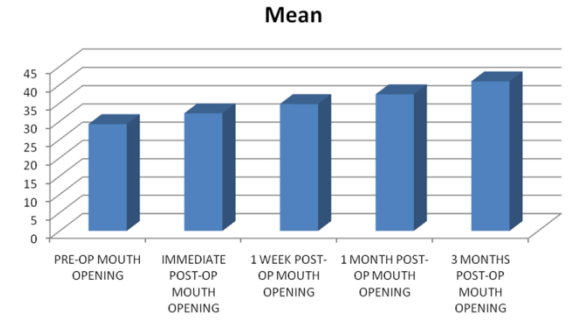
Fig 1: Single puncture arthrocentesis technique.

Fig 2: Pre-Op Mouth Opening (25 mm in this patient).

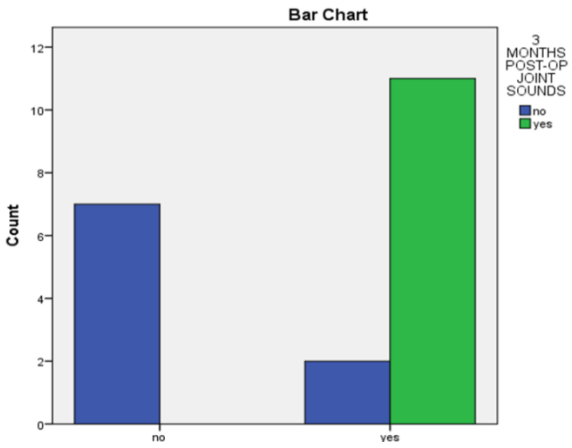
Fig 3: Post-Op Mouth Opening (38 mm in the same patient in Fig 2).



Graph 1: Mean VAS score over 3 months period.



Graph 2: Mean mouth opening over 3 months period.



Graph 3: Bar chart for joint sounds.

muscle tension, tooth clenching, grinding, and other oral parafunctional habits. TMD symptoms are also significantly correlated with an increase in psychosocial factors, e.g.,worry, stress, irritation, frustration, and depression[3]. Nitzan in her study evaluated the chain of events leading to an inflammed TMJ. She explained that the translation of the disc in the TMJ is enabled due to the presence of phospholipids and hyaluronic acid, which constitute an efficient lubrication system. This system may break down in the presence of uncontrolled free radicals[4].

Table 1: Statistical analysis of pre-op and immediate post-op VAS scores.

Paired Samples Statistics					Paired Differences		t	df	fig.(2-tailed)
		Mean	N	Std. Deviation	Mean	Std. Deviation			
Pair 1	Pre-op VAS score	7.6	20	0.995	0.4	0.598	2.99	19	0.008
	Immediate post-op VAS score	7.2	20	0.834					

Table 2: Statistical analysis of pre-op and 1 week post-op VAS scores.

Paired samples statistics					Paired differences		t	df	Sig. (2-tailed)
		Mean	N	Std. Deviation	Mean	Std. Deviation			
Pair 2	Pre-op VAS score	7.6	20	0.995	2.05	0.999	9.18	19	<0.001
	1 week post-op VAS score	5.55	20	1.099					

Table 3: Statistical analysis of pre-op and 1 month post-op VAS scores.

Paired Samples Statistics					Paired Differences		t	df	Sig. (2-tailed)
		Mean	N	Std. Deviation	Mean	Std. Deviation			
Pair 3	Pre-op VAS score	7.6	20	0.995	4.05	1.504	12.047	19	<0.001
	1 month post-op VAS score	3.55	20	1.504					

Table 4: Statistical analysis of pre-op and 3 months post-op VAS scores.

Paired Samples Statistics					Paired Differences		t	df	Sig. (2-tailed)
		Mean	N	Std. Deviation	Mean	Std. Deviation			
Pair 4	Pre-op VAS score	7.6	20	0.995	6.15	1.631	16.862	19	<0.001
	3 months post op VAS score	1.45	20	1.791					

Table 5: Statistical analysis of pre-op and immediate post-op mouth opening.

Paired Samples Statistics					Paired Differences		t	df	Sig. (2-tailed)
		Mean	N	Std. Deviation	Mean	Std. Deviation			
Pair 5	Pre-op mouth opening	29.2	20	5.755	-2.95	2.164	-6.097	19	**<0.001**
	Immediate post-op mouth opening	32.15	20	4.221					

Table 6: Statistical analysis of pre-op and 1 week post-op mouth opening.

Paired Samples Statistics					Paired Differences		t	df	Sig. (2-tailed)
		Mean	N	Std. deviation	Mean	Std. Deviation			
Pair 6	Pre-op mouth opening	29.2	20	5.755	-5.5	3.649	-6.741	19	**<0.001**
	1 week post-op mouth opening	34.7	20	3.42					

Table 7: Statistical analysis of pre-op and 1 month post-op mouth opening.

Paired Samples Statistics					Paired Differences		t	df	Sig. (2-tailed)
		Mean	N	Std. deviation	Mean	Std. Deviation			
Pair 7	Pre-op mouth opening	29.2	20	5.755	-8.15	4.671	-7.803	19	**<0.001**
	1 week post-op mouth opening	37.35	20	2.084					

Table 8: Statistical analysis of pre-op and 3 months post-op mouth opening.

Paired Samples Statistics					Paired Differences		t	df	Sig. (2-tailed)
		Mean	N	Std. Deviation	Mean	Std. Deviation			
Pair 8	Pre-op mouth opening	29.2	20	5.755	-11.7	5.957	-8.784	19	<0.001
	3 months post-op mouth opening	40.9	20	1.917					

Table 9: McNemars test for comparison of the joint sounds.

Pre-Op Joint Sounds and 3 Months Post-Op Joint Sounds Cross tabulation					
			3 months post-op joint sounds		Total
			no	Yes	
Pre-op joint sounds	no	Count	7	0	7
		% within pre-op joint sounds	100.0%	0.0%	100.0%
		% within 3 months post-op joint sounds	77.8%	0.0%	35.0%
	yes	Count	2	11	13
		% within pre-op joint sounds	**15.4%**	84.6%	100.0%
		% within 3 months post-op joint sounds	22.2%	100.0%	65.0%
Total		Count	9	11	20
		% within pre-op joint sounds	45.0%	55.0%	100.0%
		% within 3 months post-op joint sounds	100.0%	100.0%	100.0%

Table 10: Chi square test for comparison of the joint sounds.

	Value	Exact Sig. (2-sided)
McNemar Test		.500
N of Valid Cases	20	

These radicals are usually reactive oxygen species which are generated due to joint overloading. This plays a prime role in initiating the complex vicious pain cycle in the joint.

Since TMD is a multifactorial disorder, many therapies have a positive impact on patient's symptoms. The range of treatment includes initially correction of the occlusion, analgesics, muscle relaxants, soft diet intake proceeding to splint therapy, minimally invasive surgical procedures like arthroscopy and arthrocentesis and finally disc repositioning, discectomy, condyloplasty and debridement of glenoid fossa. Arthrocentesis of the temporomandibular joint was introduced in 1991 by Nitzan et al[5]. Since then it has gained widespread popularity among practitioners who treat TMDs.

It is considered by many as the first-line surgical treatment for patients who do not respond to conservative treatment. The procedure involves irrigation of the upper joint space and manipulation of the joint, which releases adhesions and so function is improved. The traditional procedure uses 2 needles inserted through 2 separate puncture sites. These 2 needles must triangulate in the upper joint space to be efficient. One of the needles serves for the inflow of the lavage solution and the other as the outflow. During the procedure, the surgeon can face some clinical difficulties. The blind insertion of the second needle is often challenging. The surgeon may lose the right place during the procedure. So it may need manipulation and sometimes even multiple punctures. This often leads to extra-articular leak of the lavage solution which decreases the intra-articular pressure required for lysis of the adhesions[6]. It also leads to post-operative pain and discomfort.

To overcome this unwanted clinical situation, we have followed a simple technique of introducing both the needles (i.e. dual needle device) through a single puncture as described by Rahal et al to accomplish the procedure of arthrocentesis more effectively[7]. The dual needle device was fabricated in a local medical instrument company, packaged and sterilized appropriately.

MATERIALS AND METHODS

Twenty patients by method of convenience sampling diagnosed with inflammatory conditions of the TMJ were included in the study presenting with one or more symptoms such as limited mouth opening, pain in the joint on jaw movements and joint sounds. Patients presenting with non-inflammatory conditions of the joint were excluded from the study.

After thorough clinical examination and obtaining a surgical consent, the patient was placed in a semi-seated position with head turned to the unaffected side. Pre-auricular region was prepared with appropriate antiseptic solution. Holmlund-Hellsing canthotragal line (a straight line from the midpoint of the tragus to the lateral canthus) was marked using methylene blue. The point of puncture of the dual needle device is located 10mm on this line (from the middle of the tragus) and 2mm below the canthotragal line. Local anaesthesia was achieved using 2% lignocaine with 1:200000 adrenaline. Auriculotemporal nerve was blocked with 2mL of the anaesthetic agent. After about five minutes, the anaesthetic solution was injected subcutaneously at the area of puncture and then slowly the needle was directed anteriorly and superiorly down to the zygomatic arch. This region along with the peri-capsular region were infiltrated following which the upper compartment of the joint is penetrated and slowly distended with the anaesthetic agent.

Next, through the marked puncture site, the dual needle device is directed anteriorly and superiorly until contact is made with the zygomatic arch. Keeping close contact with the bone in this area, both needles in the upper compartment (which is distended by the anaesthetic solution) were slid. The patient was then asked to open the mouth and to shift the mandible to the opposite side

to facilitate entry into the joint space. Once inside the joint space, 100mL of Ringer's lactate was used to flush the joint under optimum pressure. During the lavage, the patient was asked to mobilize the mandible as much as possible and also the surgeon passively manipulated the joint to aid in the release of adhesions. At the end of the procedure, 1 mL of triamcinolone acetonide (10 mg/mL) was injected in the joint space through one of the needles while occluding the other with a finger after which the device was completely withdrawn. A small sterile dressing was applied at the puncture site and the patient was then discharged when stable.

RESULTS

Of the twenty patients treated, eleven (55%) were females and nine (45%) were males. Their age ranged from 23 years to 54 years (mean age: 38.8 years). All patients had unilateral inflammatory conditions of the joint. Prior to joint lavage, the average visual analogue score (VAS) for pain was 7.6 (range 6 to 9). Paired t- test analysis comparing the VAS scores in 5 levels showed that at each successive interval as compared with the baseline, there was statistically significant drop in the pain scores. The mean difference was 0.4 in the pre-op and immediate post-op. This further reduced by 2.05, 4.05 and 6.15 in the first week, 1 month and 3 month post-operative phase. All the values were significant (Table I-IV, Graph I).

The pre-operative mouth opening ranged from 20 to 37 mm with a mean of 29.2 mm. This average mouth opening increased to 25 to 39 mm in the immediate post-op phase with an average of 32.15 mm. One week post-operatively, mouth opening increased to a mean of 34.7 mm (range: 29-39 mm). After a period of 1 month and 3 months, the mouth opening progressively increased to an average of 37.35 mm and 40.9 mm respectively. Paired t test analysis revealed that at all stages values were significant (Table V-VIII, Graph II).

Thirteen (65%) out of twenty patients had joint clicks pre-operatively. Joint sounds disappeared only in two patients after three months. McNemar's Chi square test comparing the joint sounds showed that only 15% had resolution. This result though not statistically significant indicated that the resolution took place to a lesser degree (Table IX and X, Graph III).

DISCUSSION

Articular disc displacement in the TMJ was described and identified as a potential clinical problem more than 100 years ago[7]. Joint function remains normal if its adaptive capacity is not compromised. Parafunctions, such as clenching, are good examples of repetitive jaw motion associated with possible high TMJ impact loading that convert shearing stresses to compressive stresses. Intra- and extra-articular overloading which exerts many effects on synovial joints (eg, interruption of the blood supply) is, in addition to other complications, a major reason for collapse of the lubrication system[8]. When overloaded, the generated hypoxia–reperfusion cycle in the joint evokes non-enzymatic release of radical oxygen species (ROS), such as superoxide and hydroxyl anions. The highly reactive ROS undergo rapid chemical reactions in various tissues and can destroy important molecules. In addition to the direct oxidative damage to lipids within the inflamed human, the ROS degrade hyaluronic acid, causing a marked decrease in synovial fluid viscosity in vitro[4]. The degraded form of hyaluronic acid indirectly affects joint lubrication because it fails to inhibit phospholipase A2. Phospholipase A2 that is secreted into the synovial fluid is free to lyse surface-active phospholipids and therefore thins, jeopardizing the continuity of the surface-active phospholipid layer[9].

In the absence of lubricant, the articular surfaces are smooth planes, implying large contact areas that, with the surface's elasticity (such as at the disc) and the high surface energy lead to increased adhesiveness, friction, shear, and rupture of articular surfaces[10]. The above pathogenesis leads to severe inflammatory changes in the joint, the cardinal signs and symptoms of which are pain in the TMJ and muscles associated with it, limitated mouth-opening along with joint sounds[2]. The range of treatment includes initially correction of the occlusion, analgesics, muscle relaxants, soft diet intake proceeding to splint therapy, minimally inVASive surgical procedures like arthroscopy and arthrocentesis and finally disc repositioning, discectomy, condyloplasty and debridement of glenoid fossa. When conservative management fails, arthroscopy with lavage and lysis of the adhesions is carried out. In the search of a conservative approach to treat the diseased TMJ, the idea of arthrocentesis and lavage was first borne.

Arthrocentesis, which was already in use to treat other joints, is traditionally defined as a procedure in which the fluid in a joint cavity is aspirated with a needle and a therapeutic substance is injected[11]. Murakami and colleagues offered the first systematic description of TMJ arthrocentesis, which they termed manipulation technique after pumping and hydraulic pressure[12]. This technique was modified and the term was introduced as arthrocentesis of the TMJ. The traditional procedure used 2 needles inserted through 2 separate puncture sites. These 2 needles were triangulated in the upper joint space to be efficient. One of the needles serves for the inflow of the lavage solution and the other as the outflow. Controversy existed regarding the use of appropriate lavage solution. Shinjo et al suggested that lactated Ringer's solution is better tolerated than isotonic saline solution for cells derived from human meniscus tissue[13]. Zardeneta et al recommended a free flow of Ringer's solution 100 ml because denatured haemoglobin and various proteinases were recovered in this fraction[14] whereas Kaneyama et al suggested that 300–400 ml should be used to wash out bradykinin, interleukin-6, and proteins[15]. It is recognized that the conventional procedure can be sometimes be very challenging. The blind insertion of the second (outflow) needle can sometimes be difficult. Multiple punctures through the temporomandibular joint capsule are often necessary, which often leads to extra-articular leak of the lavage solution and decreases the intra-articular pressure required for lysis of the adhesions[6]. Hence, many surgeons introduced techniques of gaining access to the superior joint space via a single puncture site. The concept of single puncture makes the procedure easier for the surgeons and comfortable for the patient. Alkan and Bas reported a case with anterior disc displacement without reduction where they successfully used a double-needle cannula to perform arthrocentesis[16].

Nardini et al in their study first outlined the technique of conventional two needle arthrocentesis and then proposed their new technique of single needle arthrocentesis. The use of a single and more stable needle should limit the traumatism of the intervention, so reducing patients' pain and disability in the postoperative phase[17]. Rehman and Hall suggested using a single Shepard cannula, which has two ports and two lumens that allows both irrigation and washout through the same device[18]. Oreroglu et al proposed a concentric-needle cannula method for single puncture arthrocentesis in using 2 different gauge needles placed in a concentric manner[19]. Rahal et al developed a simple device where two 18- gauge needles 1.5 inches long are each bent 30 degrees toward their respective opening and welded together in a Y fashion with the openings facing outward. This device has been used this in over 200 cases with no complications[6]. The present study used the same concept as that of Rahal et al though the dual needle device was designed with two minor modifications. Two 20 gauge needles (instead of 18 gauge) were used and only one of the two needles was bent at 45^0 (instead of Y design) and welded to the other needle which was maintained straight. The first modification made the combined diameter of the portal of entry smaller than that of the dual needle device used by Rahal et al. The second modification helped the surgeon to hold the straight needle alone at the hub while entering the joint. These two simple modifications made the procedure further easy. No major complication was encountered in the study except transient facial nerve palsy in only one patient which was due to the local anesthetic agent. This complication lasted only as long as the effect of the anaesthesia acted.

CONCLUSION

Arthrocentesis is definitely a simple conservative surgical procedure with minimal inVASion performed to flush the inflamed TMJ. This treatment modality has been well in practice since over two decades now. We achieved impressive results and believe that the concept of single puncture has revolutionized the traditional technique of arthrocentesis.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. McNeill C. History and evolution of TMD concepts. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1997;83(1):51-60.

2. Okeson JP. Management of temporomandibular disorders and occlusion. 5th edition, St Louis: CV Mosbey, 203:153.

3. Egermark I, Carlsson GE, Magnusson T. A 20-year longitudinal study of subjective symptoms of temporomandibular disorders from childhood to adulthood. Acta Odontol Scand. 2001;59(1):40-8.

4. Nitzan DW. The process of lubrication impairment and its involvement in temporo-mandibular joint disc displacement: A theoretical concept. J Oral Maxillofac Surg. 2001;59(1):36-45.

5. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. J Oral Maxillofac Surg 1991;49(11):1168-70.

6. Rahal A, Poirier J, Ahmarani C. Single-puncture arthrocentesis-introducing a new technique and a novel device. J Oral Maxillofac Surg. 2009;67(8):1171-3.

7. Greene CS. The etiology of temporomandibular disorders: implications for treatment. J Orofac Pain. 2001;15(2):93–105.

8. Blake DR, Merry P, Unsworth J, Kidd BL, Outhwaite JM, Ballard R, Morris CJ, Gray L, Lunec J. Hypoxic-reperfusion injury in the inflamed human joint. Lancet. 1989;1(8633):289–93.

9. Nitzan DW, Nitzan U, Dan P, Yedgar S. The role of hyaluronic acid in protecting surface-active phospholipids from lysis by exogenous phospholipase A(2). Rheumatology. 2001;40(3):336–40.

10. Rahamim E, Better H, Dagan A, Nitzan DW. Electron microscope and biochemical observations of the surface active phospholipids on the articular surfaces and in the synovial fluid of the temporomandibular joint: a preliminary investigation. J Oral Maxillofac Surg. 2001;59(11):1326-32.

11. Brown PW. Arthrocentesis for diagnosis and therapy. Surg Clin North Am. 1969;49(6):1269–78.

12. 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(1):17–24.

13. Shinjo H, Nakata K, Shino K, Hamada M, Nakamura N, Mae T, Miyama T, Horibe S, Yoshikawa H, Ochi T. Effect of irrigation solutions for arthroscopic surgery on intraarticular tissue: comparison in human meniscus-derived primary cell culture between lactate Ringer's solution and saline solution. J Orthop Res. 2002;20(6):1305–10.

14. Zardeneta G, Milam SB, Schmitz JP. Elution of proteins by continuous temporomandibular joint arthrocentesis. J Oral Maxillofac Surg. 1997;55(7):709–16.

15. Kaneyama K, Segami N, Nishimura M, Sato J, Fujimura K, Yoshimura H. The ideal lavage volume for removing bradykinin, interleukin-6, and protein from the temporomandibular joint by arthrocentesis. J Oral Maxillofac Surg. 2004;62(6):657–61.

16. Alkan A, Bas B. The use of double-needle method for temporomandibular joint arthrocentesis: clinical report. Eur J Dent. 2007;1(3):179-82.

17. Guarda-Nardini L, Manfredini D, Ferronato G. Arthrocentesis of the temporomandibular joint: a proposal for a single-needle technique. Oral Surg Oral med Oral pathol Oral Radiol Endod 2008;106(4):483-6.

18. Rehman KU, Hall T. Single needle arthrocentesis. Br J Oral maxillofac Surg. 2009;47(5):403-4.

19. 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(9):2334-8.

How to cite this article:

Rao N, Patnayak P, Sorake S, Shetty A, Koteswara CM, Bhat V. Single Puncture Arthrocentesis for the Inflammatory Temporomandibular Joint Disorders. Adv Hum Biol. 2015;5(1):25-33.