Internal Derangement of Temporomandibular Joint: An Evaluation of Effect of Corticosteroid Injection Compared with Injection of Sodium Hyaluronate after Arthrocentesis

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Abstract

Aims and Objectives Internal derangements are the commonest disorders of temporomandibular joint (TMJ). Different treatment modalities including conservative and surgical methods have been proposed to treat the same. Arthrocentesis is gaining popularity in the treatment of internal derangement of TMJ. Being minimally invasive it does not have the demerits of surgical approaches and at the same time is producing better results than conservative approaches. This study evaluates and compares corticosteroid and sodium hyaluronate after arthrocentesis in the treatment of internal derangement of TMJ.

Materials and Methods Sixteen patients with internal derangement were randomly selected and divided into 2 groups (8 in each group). Arthrocentesis of the upper joint space was then performed using Ringer lactate under local anaesthesia followed by injection of either betamethasone or sodium hyaluronate into the joint. Clinical data was collected in the form of pain (visual analog scale), maximum mouth opening, joint sound and deviation before and after treatment up to 6 months.

Results Both groups of patients were benefited from the treatment at the 6 month follow up and there was slightly less intensity of pain in sodium hyaluronate group compared with corticosteroid group. Maximum mouth opening was also increased in both groups. A decrease in clicking and deviation were seen in both groups. There was no

statistically significant difference between betamethasone and sodium hyaluronate.

Conclusion Intra articular injection of corticosteroid or sodium hyaluronate after arthrocentesis had considerable effect on the TMJ. Both betamethasone and sodium hyaluronate can be used after arthrocentesis with similar results.

Keywords Temporomandibular joint · Arthrocentesis · Betamethasone · Sodium hyaluronate

Introduction

Temporomandibular joint (TMJ) disorders are the main cause of chronic facial pain and disability. The prevalence of clinically significant TMJ related jaw pain is 5% of the general population. Approximately 2% of the general population seeks treatment for TMJ-related symptoms [1]. TMJ with internal derangement is one of the common intra-articular disorder. It has always presented a therapeutic challenge to the oral and maxillofacial surgeons. The disorder has been associated with characteristic clinical findings such as pain, joint sounds and irregular or deviating jaw function [2].

It is estimated that up to 25% of the entire population has an internal derangement[3], which is usually treated with non-surgical methods initially such as, diet modification, occlusal splint therapy, physiotherapy, pharmacotherapy, transcutaneous electrical nerve stimulation (TENS) and stress reduction techniques followed by surgical methods such as arthroscopy, reconstruction arthroplasty (disk repositioning), meniscectomy (discectomy), eminectomy, and repair of perforation of disk [1, 2]. Development of TMJ arthroscopic surgery, a minimally

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invasive procedure has filled the clinical void between failed non-surgical treatment and open arthrotomy [4].

In 1975, Ohnishi described the use of arthroscopy in the TMJ. Numerous studies have since proved the value of arthroscopy for management of symptomatic TMJs with internal derangement. The physical action of lysis and lavage in the superior joint space, rather than disc repositioning, is now believed to be responsible for success of arthroscopic surgery. This has led to the use of TMJ arthrocentesis as a relatively less invasive alternative [4].

Nitzan first described arthrocentesis as the simplest form of surgery in the TMJ, aiming to release the articular disc and to remove adhesion between the disc surface and the mandibular fossa by means of hydraulic pressure from irrigation of the upper chamber of the TMJ [5]. Arthrocentesis is considered as an intervening treatment modality between nonsurgical treatment and arthroscopic surgery [6]. Besides being the least invasive and simplest form of surgical interventions into the TMJ, arthrocentesis carries a very low risk and is relatively easy to accomplish as an in-office procedure under local anaesthesia alone or in combination with conscious sedation [7].

Intra-articular corticosteroid injection alone or after arthrocentesis provides long-term palliative effects on subjective symptoms and clinical signs of TMJ pain. Recently, sodium hyaluronate (SH) has been proposed as an alternative therapeutic agent with similar therapeutic effects. This highly viscous, high-molecular substance plays an important role in joint lubrication and protection of the cartilage [8]. However, till date no study has compared corticosteroid and sodium hyaluronate after arthrocentesis in the treatment of internal derangement of TMJ.

This study was undertaken to compare betamethasone and sodium hyaluronate after arthrocentesis in the treatment of internal derangement of TMJ.

Materials and Methods

This is a randomized clinical study conducted on patients visiting Department of Oral and Maxillofacial Surgery, Government Dental College and Research Institute, Bangalore. 16 patients were evaluated in this study. 6 males and 10 females, aged 19–40, with chief complaints of TMJ pain, joint sound in the TMJ and limited mouth opening. All patients were examined clinically and radiographically. Based on the history and examination of patient a diagnosis of internal derangement was made. Patients were informed about the procedure, its possible complication and about the material used and after the consent, patients were randomly divided into two groups (8 in each group) and arthrocentesis was performed in each group following which 1 ml of betamethasone was given in first group and

1 ml of sodium hyaluronate in second group. Pain was assessed using visual analogue scale (VAS) 0–10, 0 reading of VAS was taken as absence of pain and 10 as the maximum pain. The initial maximum mouth opening was measured as the distance in millimetres between the incisal edges of the central incisors, following which arthrocentesis was performed using aseptic procedure.

The patient was seated at 45° angle on the dental chair with the head turned towards the unaffected side. The target site was prepared, scrubbed and isolated with the sterile drapes. The points of needle insertion were marked on the skin according to the method suggested by McCain [9]. A line was drawn from the middle of the tragus to the outer canthus and entry points marked along this canthotragal line. 1st point (posterior entrance point) which corresponds to the glenoid fossa was marked 10 mm from the midtragus and 2 mm below the line and 2nd point (anterior entrance point) which corresponds to the articular eminence was marked 10 mm from the first point and 10 mm below the line. 2% Lignocaine was injected at the planned entrance point. Patient were asked to open the mouth wide and mandible held in protruded position. Then a 19 gauge needle was introduced at 1st point and 2–3 ml of ringer lactate injected through this needle to distend the joint space. Another 19 gauge needle was then inserted at the 2nd point to establish a free flow of the solution through the joint space. A 20 ml syringe filled with ringer lactate was injected into the superior joint space through the 1st needle and 2nd needle provides an outflow for the ringer lactate. A total of 100–200 ml solution was used to lavage the superior joint space. Then one needle is removed and 1 ml of betamethasone or SH was injected into the superior joint space before the removal of final needle. Once the needles are removed, patient's lower jaw was gently manipulated in the vertical, protrusive and lateral excursions to facilitate lysis of adhesions and help further free up the disc. Patients were kept on soft diet, NSAIDs and muscle relaxants for 7–10 days and continuous physiotherapy for 2–3 months.

Post operatively pain (using VAS), maximum mouth opening, deviation and clicking of TMJ of mandible were measured and recorded on 2nd day, 1st week, 2nd week, 1st month, 2nd month and 6th month after the arthrocentesis.

Statistical Analysis

Baseline and post treatment data were compared by means of paired *t* test for pain and maximum mouth opening and χ^2 test for deviation of mouth and clicking. *P* value for statistical significance was set at 0.05. All statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS 15.0, SPSS Inc., Chicago, IL, USA).

Results

All results were calculated using the mean value and standard deviation for each of the parameters considered and checked for statistical significance using either paired *t* test or χ^2 test.

Among the study population, SH group patients were with age ranges from 20 to 30 year with mean age (25.63) in which 6 were male and 2 were female and betamethasone group patients were with age ranges from 19 to 40 with mean age (27.13) in which all were females (Table 1).

In the study of pain in SH group (Table 2), the reduction in pain from pre-op to 2nd day, 2nd day to 1 week, 1 week to 2 weeks and 2 weeks to 1 month was found to be statistically significant. The mean pain level was found to have remained the same from 1 month time interval to 2 months. The decrease in mean pain from 2 months to 6 months time interval was not statistically significant. In the study of pain in corticosteroid group (Table 2), the reduction in pain from pre-op to 2nd day, 2nd day to 1 week, 2 weeks to 1 months and 2 months to 6 months was found to be statistically significant. The reduction in pain from 1 week to 2 weeks and 1 month to 2 months was not statistically significant. In the study of comparison between the two groups it was found that (Table 3) at pre-op time interval, slightly higher mean pain was recorded in SH group compared to betamethasone group, but the difference in mean pain level between the two groups was not statistically significant ($P > 0.05$). At a time interval of 1 day, 1 week, 2 weeks and 6 months the mean pain was found to be higher in SH group compared to betamethasone group, but the difference in mean pain level between the two groups was not statistically significant ($P > 0.05$). At 1 month, 2 months' time interval, the mean pain was found to be higher in betamethasone group compared to SH, but the difference in mean pain level between the two groups was not statistically significant.

In the study of mouth opening in SH group (Table 2), it was found that the increase in mouth opening from 2nd day to 1 week and 2 months to 6 months was found to be statistically significant. In the study of mouth opening in corticosteroid group, it was found that the increase in mouth opening from pre-op to 2nd day, 2 weeks to 1 month and 2 months to 6 months was found to be

Table 1 Demographic data of the study samples in both the groups

Group	Age	Gender	
		Male	Female
Sodium hyaluronate	25.63 ± 3.25	6	2
Betamethasone	27.13 ± 6.83	0	8

Table 2 Comparison of pain and mouth opening in Sodium hyaluronate and betamethasone groups at different time intervals

Visit	Sodium hyaluronate				Betamethasone			
	Pain		Mouth opening		Pain		Mouth opening	
	Mean ± SD	T	P value		Mean ± SD	T	Mean ± SD	P value
Pre-op	6.75 ± 1.83	4.020	0.005*		6.13 ± 1.73	4.965	35.25 ± 2.31	0.006*
2nd day	4.13 ± 2.10				3.88 ± 0.64		39.13 ± 3.09	
2nd day	4.13 ± 2.10	3.416	0.011*		3.88 ± 0.64	3.416	39.13 ± 3.09	0.104
1 Week	3.50 ± 2.14				3.25 ± 0.89		39.63 ± 3.07	
1 Week	3.50 ± 2.14	2.646	0.033*		3.25 ± 0.89	2.049	39.63 ± 3.07	0.351
2 Weeks	3.00 ± 2.00				2. ± 0.99		39.75 ± 2.87	
2 Weeks	3.00 ± 2.00	5.000	0.002*		2.88 ± 0.99	2.393	39.75 ± 2.87	0.007*
1 Month	1.75 ± 1.49				2.13 ± 0.64		40.75 ± 2.31	
1 Month	1.75 ± 1.49	–	–		2.13 ± 0.64	1.000	40.75 ± 2.31	0.351
2 Months	1.75 ± 1.49				2.00 ± 0.53		40.88 ± 2.30	
2 Months	1.75 ± 1.49	–1.871	0.104		2.00 ± 0.53	–3.862	40.88 ± 2.30	0.049*
Post-Op	1.25 ± 1.39				1.13 ± 0.99		41.50 ± 2.45	

Asterisk signifies the statistically significant results highlighted which is discussed in the article under section results

Table 3 Comparison of Pain and mouth opening between the two groups at different time intervals

Time interval	Group	Pain			Mouth opening		
		Mean difference	<i>T</i>	<i>P</i> value	Mean difference	<i>T</i>	<i>P</i> value
Pre-op	Sodium Hyaluronate	0.625	0.702	0.494	2.000	0.560	0.585
	Betamethasone						
2nd day	Sodium Hyaluronate	0.250	0.322	0.755	1.375	0.741	0.471
	Betamethasone						
1 Week	Sodium hyaluronate	0.250	0.306	0.764	2.250	1.149	0.270
	Betamethasone						
2 Weeks	Sodium hyaluronate	0.125	0.158	0.876	2.750	1.519	0.151
	Betamethasone						
1 Month	Sodium hyaluronate	−0.375	−0.655	0.523	2.125	1.256	0.230
	Betamethasone						
2 Months	Sodium hyaluronate	−0.250	−0.447	0.666	2.125	1.278	0.222
	Betamethasone						
6 Months	Sodium hyaluronate	0.127	0.207	0.839	2.250	1.325	0.206
	Betamethasone						

statistically significant. In the study comparison between two groups (Table 3), it was found that at pre-op time interval, higher mean mouth opening was recorded in SH group compared to betamethasone group, but the difference in mean mouth opening between the two groups was not statistically significant ($P > 0.05$). The mean mouth opening was found to be slightly higher in SH group compared to betamethasone group at all time intervals, but the difference in mean mouth opening between the two groups was not statistically significant ($P > 0.05$).

The effect of the treatment for clicking and deviation was decided on the basis of the proportion of improvement at the end of the treatment by noting their presence or absence. No significant association was observed between the groups and the presence of clicking at any time intervals ($P > 0.05$) (Table 4). The presence of deviation was found to be higher in sodium hyaluronate group compared to betamethasone group at pre-op and post-op, but no statistically significant association was observed between the groups and the presence of deviation ($P > 0.05$) (Table 4).

Table 4 Presence of clicking and deviation in the groups at different time intervals

Time interval	Group	Clicking				Deviation			
		Present		χ^2	<i>P</i> value	Present		χ^2	<i>P</i> value
		n	%			n	%		
Pre-op	Sodium hyaluronate	7	88	–	–	6	75	2.286	0.131
	Betamethasone	7	88			3	38		
2nd Day	Sodium hyaluronate	1	13	1.067	0.302	3	38	3.692	0.055
	Betamethasone	0	0			0	0		
1 Week	Sodium hyaluronate	1	13	1.067	0.302	3	38	3.692	0.055
	Betamethasone	0	0			0	0		
2 Weeks	Sodium hyaluronate	1	13	0.410	0.522	4	50	2.618	0.106
	Betamethasone	2	25			1	13		
1 Month	Sodium hyaluronate	1	13	0.410	0.522	3	38	1.333	0.248
	Betamethasone	2	25			1	13		
2 Months	Sodium hyaluronate	1	13	–	–	3	38	1.333	0.248
	Betamethasone	1	13			1	13		
6 Months	Sodium hyaluronate	1	13	–	–	3	38	1.333	0.248
	Betamethasone	1	13%			1	13%		

Discussion

There is clinical evidence supporting the existence of disc displacement in TMJ internal derangement. However the recent concept suggests that a change in the position of the disc is not the primary factor in dysfunction and pain of the TMJ. Alterations in joint pressure, various biochemical substances and the constituents of the synovial fluid (and thereby failure of lubrication) may lead to clicking and derangement of the TMJ [10].

Although arthrocentesis is not a panacea, it has been used for various TMJ disorders. It is generally suggested in patients irresponsive to conservative therapies [11]. It is a minimally invasive procedure that may be performed under local anaesthesia, with or without sedation, [6] and its main purpose is to clear the joint of tissue debris, blood, and pain mediators that are believed to be by products of intra-articular inflammation. It was proposed that lavage and lysis of the upper joint space would eliminate the vacuum effect and alter the viscosity of the synovial fluid [12], thereby aiding translation of the disc and the condyle. The pressure of fluid injected into the joint during arthrocentesis may facilitate joint movements by releasing intra-capsular adhesions [13].

Various studies have demonstrated the use of Morphine, Fentanyl, Bupivacaine, Corticosteroids and SH for the management of TMJ disorders. Corticosteroids have a potent anti inflammatory effect on synovial tissue and are known to reduce effusion, decrease pain and bring about an increase in range of motion of synovial joints. Intra-articular corticosteroid injection alone [14, 15] or after arthrocentesis provides long-term palliative effects on subjective symptoms and clinical signs of TMJ pain. 1 ml of betamethasone is routinely used at the end of lysis and lavage of superior compartment of TMJ [5, 16]. Recently, SH has been proposed as an alternative therapeutic agent with similar therapeutic effects. This highly viscous, high-molecular substance plays an important role in joint lubrication and protection of the cartilage [8]. Hyaluronic acid (HA) is a normal product of joint tissues that is continuously released into the synovial fluid, where it serves as a lubricant, anti-inflammatory, and pain-reliever. In TMJ disorders, intra-articular HA is administered either alone [14, 15] or as an adjunct to arthrocentesis [8, 17]. The most common viscosupplementation strategy is a series of either two intra-articular HA injections spaced 7–14 days apart [10] or five injections each 7 days apart [17].

Several randomized comparisons of intra-articular hyaluronic acid (sodium hyaluronate) and corticosteroid (betamethasone) TMJ injections have shown no significant difference between the two treatments. Both treatments resulted in sustained, significantly reduced TMJ symptoms and improved joint mobility for 1–2 years [14, 15].

However no comparative studies are repeated between hyaluronic acid and corticosteroid after arthrocentesis.

In our prospective study on 16 patients with TMJ internal derangement arthrocentesis was performed under high pressure using ringer lactate as irrigation solution followed by betamethasone or SH injection into the joint. A study by Zardeneta et al. [18] recommended a free flow of 100 ml of ringers solution because denatured haemoglobin and various proteinases were recovered in this fraction. Keneyama et al. [19] recommended that ideal lavage volume of perfusate for arthrocentesis was 300–400 ml.

The decrease in the intensity of pain was observed in both the groups with no statistically significant difference. The pain reduction in our study is attributed to the high pressure irrigation which washes away inflammatory mediators. Also it may stimulate increased natural hyaluronic acid production by the synovial cells. This hyaluronic acid may help in scavenging of free radicals [20]. The improvement in mouth opening could be because of reduction of pain and high pressure irrigation which helps to release the adhered disc by release of negative pressure, reduction of surface friction and viscosity of synovial fluid [13]. In the immediate postoperative period not much improvement in mouth opening was seen but with reduction in pain and continuing physiotherapy, mouth opening increased significantly during 3–4 month follow up period and it was found to be maintained till 6 months. No significant association was observed between the groups and the presence of clicking at any time intervals as well as deviation on opening mouth at the end of 6 months.

Transient facial paralysis due to the local anaesthetic leading to altered motor function on the side of arthrocentesis or swelling of the neighbouring tissues caused by perfusion of solution may occur during the procedure. Both the complications were transient and resolved in few hours.

Arthrocentesis is a simple and minimally invasive procedure, with little risk of complications and significant benefits. Lavage of superior joint space exerts its effects via its ability to eliminate joint effusion. Various proteins and biochemical mediators causing pain are washed away; healthy synovial fluid production is promoted and hydraulic pressure release adhesions allowing some component of repair and adaptation.

Our results are encouraging and have been promising, showing a significant improvement in symptoms after arthrocentesis followed by betamethasone or sodium hyaluronate injection into the joint. Our study failed to show a statistically significant difference in post treatment outcome between betamethasone group and sodium hyaluronate group. Further longitudinal interventional studies with a larger sample size and a longer follow up period are essential to determine the efficacy of and sodium

hyaluronate after arthrocentesis in the treatment of internal derangement of TMJ.

Conclusion

This study concluded that arthrocentesis is a simple and minimally invasive procedure, with little risk of complications and has shown significant possible benefits in terms of improvements in pain and mouth opening and reduction in clicking and jaw deviation. Many patients who did not respond to the conservative management alone, arthrocentesis became the next line of treatment option before attempting any surgical or aggressive treatment. Intra-articular injection of sodium hyaluronate or corticosteroid (betamethasone) following arthrocentesis has a considerable effect. Very few studies have been done till date to see the effect of the intra-articular injection of betamethasone or sodium hyaluronate after arthrocentesis. There was no statistically significant difference between the two drugs and both were equally good. With the result of this study we conclude that arthrocentesis followed by intra-articular injection of either betamethasone or sodium hyaluronate provides excellent relief of TMJ symptoms and sodium hyaluronate can be used as alternative to corticosteroid as some surgeons are reluctant to use corticosteroids in the joint for possible resorption of the condylar surfaces over a long period [21].

References

- Goulet JP, Lavigne GJ, Lund JP (1995) Jaw pain prevalence among French speaking Canadians in Quebec and related symptoms of temporomandibular disorders. *J Dent Res* 74: 1738–1744
- Mccarthy WL (1992) Internal derangement of the temporomandibular joint. In: Keith David A (ed) *Surgery of temporomandibular joint*, 2nd edn. Blackwell Scientific Pub, Boston, pp 180–224
- Barkin S, Weinberg S (2000) Internal derangements of the TMJ: The role of arthroscopic surgery and arthrocentesis. *J Can Dent Assoc* 69:199–203
- Carvajal WA, Laskin DM (2000) Long term evaluation of arthrocentesis for the treatment of internal derangement of temporomandibular joint. *J Oral Maxillofac Surg* 58:852–855
- Nitzan DW, Dolwick MF, Martinez GA (1991) Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. *J Oral Maxillofac Surg* 49:1163–1167
- Frost DE, Kendell B (1999) The use of arthrocentesis for treatment of temporomandibular joint disorders. *J Oral Maxillofac Surg* 57:583–587
- Alpaslan C, Dolwick MF, Heft MW (2003) Five year retrospective evaluation of temporomandibular joint arthrocentesis. *Int J Oral Maxillofac Surg* 32:263–267
- Alpaslan GH, Alpaslan C (2001) Efficacy of temporomandibular joint arthrocentesis with and without injection of sodium hyaluronate in the treatment of internal derangements. *J Oral Maxillofac Surg* 59:613–618
- McCain JP, de la Rua H, LeBlanc WG (1991) Puncture technique and portals of entry for diagnostic and operative arthroscopy of the temporomandibular joint. *Arthroscopy* 7:221–232
- Alpaslan C, Bilgihan A, Alpaslan GH, Güner B, Özgür Yis M, Erbaş D (2000) Effect of arthrocentesis and sodium hyaluronate injection on nitrite, nitrate, and thiobarbiturate acid-reactive substance levels in the synovial fluid. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 89:686–690
- Alpaslan C, Kahraman S, Güner B, Cula S (2008) Does the use of soft or hard splints affect the short-term outcome of temporomandibular joint arthrocentesis? *Int J Oral Maxillofac Surg* 37:424–427
- Nitzan D, Dolwick MF (1991) An alternate explanation for the genesis of closed-lock symptoms in the internal derangement process. *J Oral Maxillofac Surg* 49:810–815
- Yura S, Totsuka Y, Yoshikawa T, Inoue N (2003) Can arthrocentesis release intracapsular adhesions? Arthroscopic findings before and after irrigation under sufficient hydraulic pressure. *J Oral Maxillofac Surg* 61:1253–1256
- Koop S, Carlsson GE, Haraldson T, Wenneberg B (1985) The short term effect of intra-articular injection of sodium hyaluronate and corticosteroid on temporomandibular joint pain and dysfunction. *J Oral Maxillofac Surg* 43:429–435
- Koop S, Carlsson GE, Haraldson T, Wenneberg B (1987) The long term effect of intra-articular injection of sodium hyaluronate and corticosteroid on temporomandibular joint arthritis. *J Oral Maxillofac Surg* 43:929–935
- Nitzan DW, Dolwick MF, Heft MW (1990) Arthroscopic lavage and lysis of the TMJ: a change in perspective. *J Oral Maxillofac Surg* 48:798–801
- Guarda-Nardini L, Manfredini D, Ferronato G (2010) Short-term effects of arthrocentesis plus viscosupplementation in the management of signs and symptoms of painful TMJ disc displacement with reduction. A pilot study. *Oral Maxillofac Surg* 14:29–34
- Zardeneta G, Milam SB, Schmitz JP (1997) Elution of proteins by continuous TMJ Joint arthrocentesis. *J Oral Maxillofac Surg* 55:709–716
- Kaneyama K, Segami N, Nishimura M, Sato J, Fujimura K, Yoshimura H (2004) The ideal volume for removing bradykinins, interleukin-6 and protein from the temporomandibular joint by arthrocentesis. *J Oral and Maxillofac Surg* 62:657–661
- Hirota W (1998) Intra-articular injection of hyaluronic acid reduces total amounts of leukotriene C₄, 6-keto-prostaglandin F₁α, prostaglandin F₂ α and interleukin-1 β in synovial fluid of patients with internal derangement in disorders of TMJ. *Br J Oral and Maxillofac Surg* 36:35–38
- Wenneberg B, Kopp S, Gröndahl HG (1991) Long-term effect of intra-articular injections of a glucocorticosteroid into the TMJ: a clinical and radiographic 8-year follow-up. *J Craniomandib Disord* 5(1):11–18