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Efficacy of Temporomandibular Joint Arthrocentesis With and Without Injection of Sodium Hyaluronate in Treatment of Internal Derangements

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Purpose: This study was designed to investigate the efficacy of arthrocentesis with and without injection of sodium hyaluronate (SH) into the upper joint space in the treatment of temporomandibular joint (TMJ) internal derangements.

Patients and Methods: Forty-one TMJs in 5 males and 26 females aged 14 to 53 years comprised the study material. The patients' complaints were limited mouth opening, TMJ pain and tenderness, and joint noises during function. Patients were randomly divided into 2 groups in which only arthrocentesis was performed in 1 group and arthrocentesis plus intra-articular injection of sodium hyaluronate was performed in the other group. Both groups contained patients with disc displacement with reduction and with closed lock. Clinical evaluation of the patients was done before the procedure, immediately after the procedure, on postoperative day 1, and at 1, 2, 3, 4, 5, 6, 9, 12, 18, and 24 months postoperatively. Intensity of TMJ pain, jaw function, and clicking sounds in the TMJ were assessed using visual analog scales. Maximal mouth opening and lateral jaw movements also were recorded at each follow-up visit.

Results: Both techniques increased maximal mouth opening, lateral movements, and function, while reducing TMJ pain and noise.

Conclusions: Although patients benefitted from both techniques, arthrocentesis with injection of SH seemed to be superior to arthrocentesis alone.
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The term temporomandibular joint (TMJ) internal derangement has long been used synonymously with displacement of the disc. Both conservative and surgical techniques have been put forward for the treatment of TMJ internal derangement, but only a few of them have gained wide acceptance. The basic attempt has been to replace the disc in its normal position and thereby to provide relief of the symptoms.[1]

The turning point in the treatment of TMJ internal derangement was the introduction of TMJ arthroscopy and later of TMJ arthrocentesis.[2,3] The simple lavage of the upper joint compartment under local anesthesia enables the disc to slide and reestablishes a normal range of mouth opening in patients with closed lock.[4] Today TMJ arthrocentesis is not only used in the treatment of acute closed lock but in various other temporomandibular disorders as well.

Intra-articular corticosteroid injection alone or after arthrocentesis provides long-term palliative effects on subjective symptoms and clinical signs of TMJ pain. Unfortunately, intra-articular corticosteroid injection has an unpredictable prognosis and also can cause local side effects on joint tissues.[5] Recently, sodium hyaluronate (SH) has been proposed as an alternative therapeutic agent with similar therapeutic effects.[6,7] This highly viscous, high-molecular substance plays an important role in joint lubrication and protection of the cartilage.[8]

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Table 1. PATIENT CHARACTERISTICS AND TREATMENT PROTOCOLS

	Internal Derangements	ADDR	Closed Lock
Patients (n)	31	16	15
Female/Male (n)	26/5	12/4	14/1
TMJs (n)	41	19	22
Left/Right (n)	22/19	9/10	13/9
Age (yr)	14-53 (mean, 27.05)	14-50 (mean, 22.20)	15-53 (mean, 31.90)
Period of suffering (mo)	1-96 (mean, 23.15)	1-96 (mean, 27.80)	2-72 (mean, 18.50)
Follow-up (mo)	3-28 (mean, 13.90)	3-28 (mean, 14.50)	3-28 (mean, 13.30)
Arthrocentesis + SH (no. joints/patients)	26/23	13/12	13/11
Arthrocentesis alone (no. joints/patients)	15/8	6/4	9/4

This study was undertaken to evaluate the efficacy of arthrocentesis with or without SH injection in a group of patients suffering from TMJ internal derangement. Subgroups of closed lock and anterior disc displacement with reduction (ADDR) were constituted according to the diagnosis and the efficacy of these procedures based on the diagnosis was also evaluated.

Patients and Methods

Forty-one temporomandibular joints in 31 patients were evaluated in this study. Five males and 26 females aged 14 to 53 years (mean, 27 years) with chief complaints of limited mouth opening, TMJ pain, and clicking sounds in the TMJ were examined clinically and radiologically. Based on these examinations and the patient's history, a diagnosis of TMJ internal derangements was made. Among these internal derangements, a diagnosis of ADDR was made in 19 joints in 16 patients, and a diagnosis of closed lock was made in 22 joints in 15 patients. (Table 1). Patients were randomly divided into 2 groups with only arthrocentesis performed in 1 group (arthrocentesis only group), and arthrocentesis plus an intra-articular injection of sodium hyaluronate performed in the other group (SH group). Both groups contained patients with disc displacement with reduction and with closed lock. To evaluate the efficacy of both procedures based on the diagnosis of closed lock and ADDR, 2 subgroups (closed lock group, ADDR group) were also constituted.

Patients were informed about the procedure, its possible complications, and about the materials used. Patient consent was obtained before the procedure. The operative site was prepared aseptically and the area was isolated with sterile drapes. The skin was then penetrated with a 20-gauge needle at a point 10 mm in front of the tragus and 2 mm below the canthal-tragus line. For the auriculotemporal nerve block, 0.3 to 0.5 mL of an anesthetic solution was injected and the needle was introduced into the upper joint compartment and approximately 3.5 mL of anesthetic solution was injected. After this, a second needle attached to a syringe and filled with sterile saline solution was introduced 2 mm anterior to the former one and the upper joint compartment was irrigated with 200 to 300 mL of sterile saline solution, allowing a free flow through the first needle.

On termination of the procedure, 1 mL of commercially available SH (Orthovisc; Anika Research Inc, Woburn, MA) was injected into the upper joint space in 26 joints in 23 patients; 15 joints were not injected. The number of joints with ADDR and closed lock in each group is shown in Table 1.

Evaluation of the patients was done before the procedure, immediately after the procedure, on postoperative day 1, then at 1, 2, 3, 4, 5, 6, 9, 12, 18, and 24 months after the procedure. This evaluation was not blinded. Maximal mouth opening and range of lateral jaw movement were measured and recorded at each appointment. Also, the intensity of pain, mandibular function, and presence of TMJ sounds were recorded on 100-mm visual analog scales (VAS). Dropout patients were excluded from the study groups. Between group and within group statistical analyses were done using 1-way analysis of variance and Tukey HSD test.

Results

Maximal mouth opening increased in both the arthrocentesis only and arthrocentesis + SH groups, but the increase was significant ($P < .05$) only in the arthrocentesis + SH group (Table 2). These increases occurred in both the ADDR and the closed lock groups, but were significant ($P < .05$) only for the closed lock group. Among patients receiving arthrocentesis + SH, closed lock patients showed a signifi-

Table 2. MEAN ± STANDARD DEVIATION (mm) OF MAXIMAL MOUTH OPENING IN PATIENTS DIAGNOSED WITH INTERNAL DERANGEMENTS

	Arthrocentesis + SH		Arthrocentesis Only	
	Mean	SD	Mean	SD
Preoperatively	34.31	9.18	31.10	12.30
Immediately postoperative	41.58*	6.66	36.90	10.90
1 day	36.81	6.79	32.30	10.50
1 month	39.85*	7.01	34.60	9.89
2 months	40.54*	7.16	35.13	9.77
3 months	40.73*	7.39	35.20	9.99
4 months	41.00*†	6.96	35.33†	9.57
5 months	41.58*†	7.16	35.80†	9.97
6 months	42.23*†	7.56	35.80†	9.81
9 months	42.46*†	7.03	35.87†	9.52
12 months	42.48*†	6.53	35.73†	9.59
18 months	42.50*†	6.17	36.50†	10.30
24 months	42.35*†	6.05	36.60†	10.30

* $P < .05$ within group analysis.
† $P < .05$ between group analysis.

Table 4. MEAN ± STANDARD DEVIATION (mm) OF MAXIMAL MOUTH OPENING IN PATIENTS DIAGNOSED WITH CLOSED LOCK

	Arthrocentesis + SH		Arthrocentesis Only	
	Mean	SD	Mean	SD
Preoperatively	28.38	7.77	24.00	8.38
Immediately postoperative	38.00*†	6.10	31.00†	8.97
1 day	34.85*†	5.65	28.44†	9.38
1 month	35.54*†	6.21	28.67†	7.62
2 months	36.77*†	7.12	30.33†	9.01
3 months	37.15*†	7.20	30.33†	9.31
4 months	37.77*†	6.97	30.76†	8.91
5 months	37.85*†	6.87	31.22†	9.56
6 months	37.92*†	6.91	31.22†	9.36
9 months	38.54*†	6.48	31.33†	8.93
12 months	38.85*†	5.97	31.11†	8.87
18 months	39.08*†	5.71	31.11†	8.94
24 months	39.08*†	5.71	31.11†	8.94

* $P < .05$ within group analysis.
† $P < .05$ between group analysis.

cant ($P < .05$) increase in opening whereas the ADDR patients did not (Tables 3, 4).

Lateral movements increased in both groups. However, this increase was only statistically significant ($P < .05$) in the arthrocentesis + SH group at all time intervals. When the arthrocentesis + SH group was compared with the arthrocentesis only group, lateral movements increased significantly ($P < .05$) from 9 through 24 months (Table 5). The subgroups also showed an increase in lateral jaw movements. In the between group analysis of the subgroups, the increase was statistically significant ($P < .05$) in the closed lock group from 9 through 24 months (Tables 6 and 7).

Intensity of pain decreased significantly ($P < .05$) in the arthrocentesis + SH group at all time intervals (Fig 1A). The VAS scores for pain decreased from day 1 through the first postoperative month, and remained almost constant at that level until 24 months in the arthrocentesis only group (Fig 1B). In the between group analysis, there was a steady decrease in pain in the arthrocentesis + SH group between the second

Table 3. MEAN ± STANDARD DEVIATION (mm) OF MAXIMAL MOUTH OPENING IN PATIENTS DIAGNOSED WITH DISC DISPLACEMENT WITH REDUCTION

	Arthrocentesis + SH		Arthrocentesis Only	
	Mean	SD	Mean	SD
Preoperatively	40.23	6.25	41.83	8.89
Immediately postoperative	45.15	5.24	45.67	7.09
1 day	38.77	7.47	38.00	10.10
1 month	44.15	4.85	43.50	4.76
2 months	44.31	5.09	42.33	5.79
3 months	44.31	5.85	42.50	5.82
4 months	44.23	5.45	42.17	6.01
5 months	45.31	5.44	42.67	6.12
6 months	46.54	5.58	42.67	5.89
9 months	46.38	5.27	42.67	5.79
12 months	46.31	4.80	42.67	5.96
18 months	45.92	4.63	44.50	6.16
24 months	45.23	4.80	44.83	5.71

Table 5. MEAN ± STANDARD DEVIATION (mm) OF LEFT + RIGHT LATERAL JAW MOVEMENT IN PATIENTS WITH INTERNAL DERANGEMENTS

	Arthrocentesis + SH		Arthrocentesis Only	
	Mean	SD	Mean	SD
Preoperatively	16.19	4.20	15.53	4.44
Immediately postoperative	17.42*	4.40	18.40	3.68
1 day	17.35*	4.52	16.47	3.68
1 month	17.58*	3.79	17.80	3.61
2 months	17.65*	3.53	17.93	3.67
3 months	18.38*	3.41	18.33	4.53
4 months	18.58*	3.32	18.00	3.84
5 months	19.04*	2.44	17.93	3.26
6 months	18.77*	2.21	18.13	3.00
9 months	19.00*†	2.30	17.53†	3.20
12 months	18.92*†	2.50	17.60†	2.97
18 months	18.85*†	2.33	17.13†	2.90
24 months	18.81*†	2.32	16.93†	2.74

* $P < .05$ within group analysis.
† $P < .05$ between group analysis.

Table 6. MEAN LEFT + RIGHT LATERAL JAW MOVEMENT (mm) IN PATIENTS WITH DISC DISPLACEMENT WITH REDUCTION

	Arthrocentesis + SH		Arthrocentesis Only	
	Mean	SD	Mean	SD
Preoperatively	17.46	3.10	20.00	2.45
Immediately postoperative	18.31	3.82	20.33	2.58
1 day	17.31	4.25	19.67	1.37
1 month	18.54	2.47	20.67	1.75
2 months	18.69	2.63	20.83	1.33
3 months	19.54	2.11	20.33	1.37
4 months	19.54	2.40	20.17	1.17
5 months	19.69	1.89	19.66	0.81
6 months	19.31	1.44	20.00	1.10
9 months	19.62	1.50	20.00	0.89
12 months	19.77	1.36	20.17	1.17
18 months	19.23	2.17	19.00	2.53
24 months	19.15	2.15	18.50	2.43

and 24th months that was statistically significant ($P < .05$). When the subgroups were evaluated, the patients who received SH, whether for closed lock or ADDR, showed significant ($P < .05$) pain relief at all time intervals (Figs 1C, E). Among patients who received arthrocentesis only, those with closed lock showed significant ($P < .05$) pain relief starting from the first postoperative day (Fig 1 F). However, this decrease was not significant for patients with ADDR (Fig 1D). When between group statistics for the ADDR and closed lock groups were evaluated, the decrease in pain was significant in the closed lock group ($P < .05$) on the first day and from 9 through 18 months (Figs 1 C through F).

Clicking disappeared significantly ($P < .05$) in patients receiving SH. However, this was not seen in the arthrocentesis only group (Figs 1A, B). When the subgroups were evaluated, TMJ sounds disappeared significantly ($P < .05$) in patients receiving SH irrespective of the diagnosis (Figs 1C, E). On the other hand, patients with closed lock or ADDR receiving arthrocentesis only did not show a significant decrease in joint sounds (Figs 1D, F). Injection of SH provided significant ($P < .05$) reduction in joint noises from 2 through 9 months in the closed lock patients when compared with those receiving arthrocentesis alone. (Figs 1E, F).

Jaw function improved significantly ($P < .05$) in both groups. Between group statistics were significant ($P < .05$) from 6 to 24 months postoperatively (Figs 1A, B). The improvement was significant ($P < .05$) in patients receiving SH irrespective of the diagnosis (Figs 1C, E). On the other hand, among patients receiving arthrocentesis alone, only patients with ADDR showed significant ($P < .05$) improvement in jaw function (Fig 1F).

Discussion

In the present study, maximal mouth opening and lateral jaw movements increased, and jaw function improved, while pain and joint noises disappeared or lessened, both in patients having arthrocentesis only and in those having intra-articular injection of SH following arthrocentesis. Although pain decreased in both groups after treatment, a greater decrease in pain was seen in the arthrocentesis + SH group throughout the postoperative period. The results of the subgroup analysis for pain showed that pain decreased markedly both in the ADDR patients and the closed lock patients in the SH group, whereas in the arthrocentesis-only group only the closed lock patients experienced a marked decrease in pain. This may be explained by the long-term lubricating effect of SH, which prevents the onset of inflammatory mediators that are responsible for pain. Both ADDR and closed lock patients benefitted from arthrocentesis with or without injection of SH in terms of relief of pain. It can be speculated that SH has a faster and longer effect on pain relief, particularly in patients with closed lock. However, due to the limited number of patients in the study, no judgment can be made regarding the relief of pain according to the subgroups. Studies with larger patient populations are required for further speculation.

Jaw function improved and maximal mouth opening increased earlier and continued longer in patients who received SH. The improvement in jaw function

Table 7. MEAN LEFT + RIGHT LATERAL JAW MOVEMENT (mm) IN PATIENTS WITH CLOSED LOCK

	Arthrocentesis + SH		Arthrocentesis Only	
	Mean	SD	Mean	SD
Preoperatively	14.92	4.87	12.56	2.40
Immediately postoperative	16.54	4.91	17.11	3.86
1 day	17.38	4.94	14.33	3.12
1 month	16.62	4.66	15.89	3.26
2 months	16.62	4.09	16.00	3.46
3 months	17.23	4.11	17.00	5.45
4 months	17.62	3.91	16.56	4.36
5 months	18.38	2.81	16.78	3.80
6 months	18.23	2.74	16.89	3.26
9 months	18.38*	2.81	15.89*	3.14
12 months	18.08*	3.09	15.89*	2.52
18 months	18.46*	2.50	15.89*	2.52
24 months	18.46*	2.50	15.81*	2.52

* $P < .05$ between group analysis.

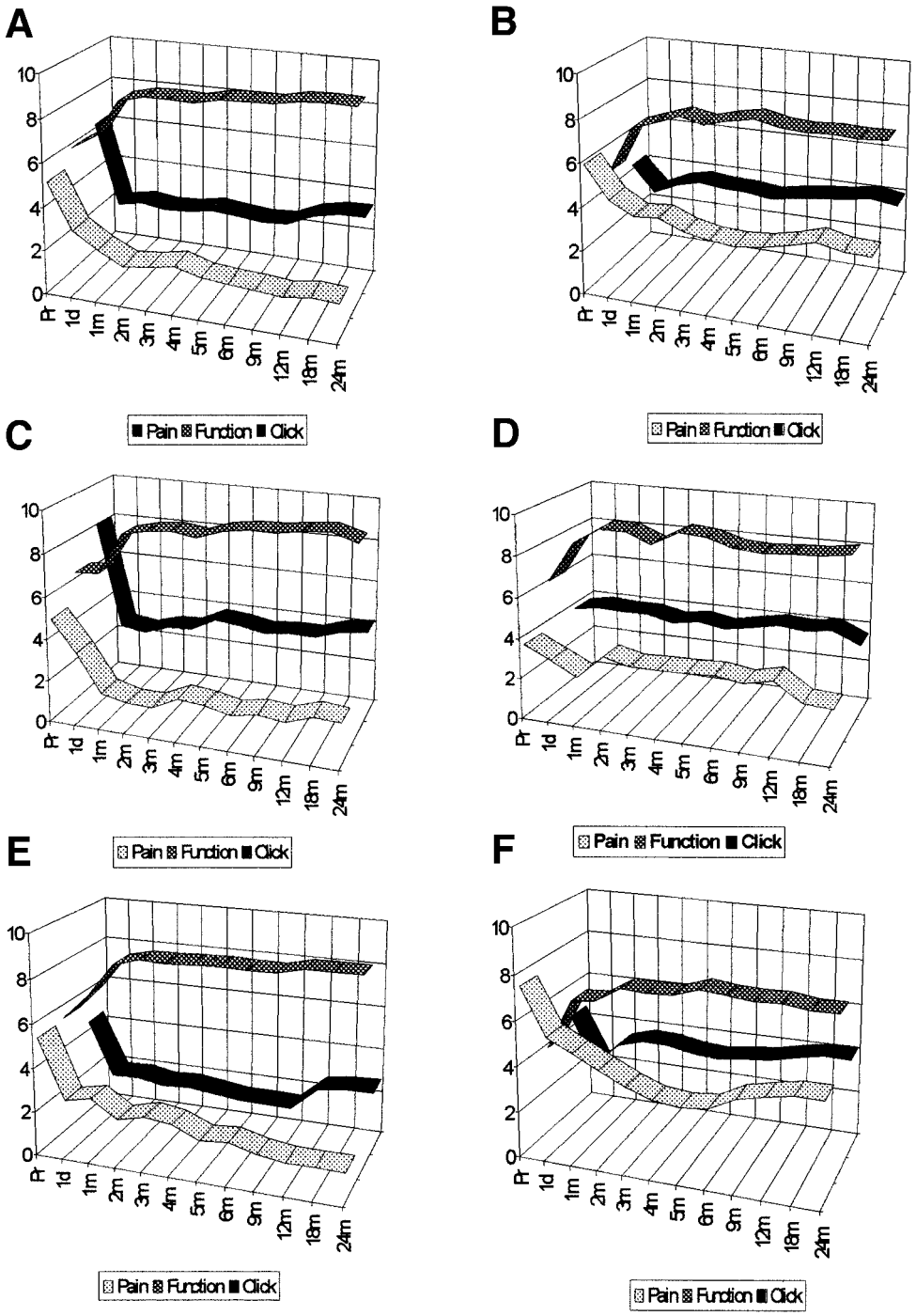


FIGURE 1. VAS scores in patients. *A*, Internal derangements, SH group. *B*, Internal derangements, arthrocentesis group. *C*, Anterior disc displacement with reduction, SH group. *D*, Anterior disc displacement with reduction, arthrocentesis group. *E*, Closed lock, SH group. *F*, Closed lock, arthrocentesis group.

and the increase in maximal mouth opening in the SH group may also be explained by the lubricant effect of SH and the relief of pain. The lubricating effect of SH was highly effective in the first 3 months. SH either maintains lubrication and minimizes wear and tear mechanically, or plays a role in nutrition of the avascular parts of the disc and condylar cartilage.[9] Intra-articular injection of either corticosteroid or SH has a significant long-term effect on chronic arthritis of the TMJ, and SH might be the best alternative due to the lower risk of side-effects.[10] Bertolami et al[11] showed that a single intra-articular injection of SH offered clear and consistent benefit for at least 6 months, primarily in patients with disc displacement with reduction, and this was attributed to the mechanical effect of SH.

TMJ arthrocentesis, the least invasive and the simplest of all surgical techniques, has proven to be highly successful in re-establishing a normal range of mouth opening in patients with closed lock.[12] Simi-

larly, patients with either disc displacement with reduction and closed lock benefitted from arthrocentesis in this study. However, arthrocentesis with SH injection seemed to be superior to arthrocentesis alone, especially in patients with closed lock.

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