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Efficacy of steroids in temporomandibular joint disc displacement after arthrocentesis

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Abstract:
Temporomandibular joint disc displacement causes pain and restricted mandibular function, requiring effective minimally invasive treatment. A comparative clinical study evaluated 22 patients receiving arthrocentesis alone or with intra-articular steroid injection. Steroid administration significantly reduced pain up to 21 days, improved early mouth opening and enhanced lateral excursion ($p<0.05$). Arthrocentesis with steroids provided superior early pain relief and selected functional improvements compared with arthrocentesis alone. These findings advance clinical knowledge by identifying intra-articular steroids as a potentially beneficial adjunct for early recovery following TMJ arthrocentesis.

Keywords: Arthrocentesis, intra-articular, reduction, temporomandibular joint, steroid injection

Background:
Temporomandibular joint disorders comprise a wide range of intra-articular and extra-articular conditions that typically develop with pain, joint noises, reduced mouth opening and restricted mandibular movements. Within the framework of those conditions, the importance of internal derangement with disc displacement can be highlighted in regard to mechanical obstruction, inflammatory changes and functional limitations associated with disturbed condyle-disc relationship **[1]**. Conservative therapy with splint, physiotherapy, analgesia and behavioral management being ineffective, minimally invasive intra-articular treatments are usually applied in order to avoid surgery **[2]**. Arthrocentesis can be defined as a conservative surgical technique based on the superior joint space lavage. Mechanisms underlying therapeutic effect include the clearance of inflammatory mediators from the joint, adhesion reduction, joint space hydraulic expansion and restoration of condyle translation **[3]**. This way, arthrocentesis can help relieve pain and restore mandibular functions in case of disc displacement with closed lock, clicking, or reduced mouth opening **[4]**. Nonetheless, effectiveness and duration of improvements achieved after this procedure are likely to vary because of various mechanical, inflammatory, neuromuscular and psychological determinants of temporomandibular joint dysfunction **[5]**. The use of intra-articular steroids as an additional treatment after arthrocentesis can be explained by strong anti-inflammatory effects of the latter in the synovial fluid environment **[6]**. This treatment helps to control pro-inflammatory cytokines' release, reduce synovitis and pain-induced functional limitations and facilitate early recovery after surgery **[7]**. At the same time, the long-term efficacy of this procedure is questionable as results may depend on the disease stage, initial inflammatory activity, disc structure and the duration of symptoms **[8]**. Besides, repeated steroid administration can be problematic because of its influence on cartilage metabolism, tissue healing and joint degeneration **[9].** Thus, for the assessment of effectiveness of temporomandibular joint disc displacement treatment, it is important to consider multiple factors like pain, mouth opening, mandibular movement, joint function and some patient-related factors such as anxiety **[10]**. The knowledge of temporomandibular joint anatomy and internal derangement achieved with imaging also emphasizes the importance of taking into account joint complexity while evaluating clinical improvement **[11]**. Therefore, it is of interest to evaluate the efficacy of steroids in temporomandibular joint disc displacement after arthrocentesis.

Materials and Methods:
Minimally invasive arthrocentesis lavage for treatment of patients with temporomandibular joint anterior disc displacement without reduction was carried out at the Department of Oral and Maxillofacial Surgery upon informed

consent. All patients were screened clinically and radiologically prior to enrolment to evaluate their inclusion/exclusion status and eligibility for the procedure.

Inclusion criteria:
Healthy individuals, age 16–65 years, suffering from closed TMJ lock, mouth opening ≤25 mm without any apparent cause, recurrent pain in the TMJ accompanied by clicking, or remaining symptomatic after previous treatment of MPDS were included.

Exclusion criteria:
Patients with uncontrolled systemic diseases (hypertension, diabetes mellitus, epilepsy) were not included. Additionally, pregnant or lactating women, individuals suffering from symptomatic acute soft and hard tissue infection locally or systemically or receiving disease-modifying anti-rheumatoid drugs were also not included in the study.

Clinical examination:
The presence/absence of pain in TMJ region was recorded with Visual Analogue Scale, mouth opening measurement was done preoperatively and TMJ clicking was documented. Movements of the jaws were examined with custom made recording device fabricated with maxillo-mandibular casts. The appliance enabled the graphical registration of protrusive and lateral excursive movements through the fixation of the pencil attached to the lower jaw and placing of the graph paper in the upper jaw. Anxiety of each patient was assessed through Beck's Anxiety Inventory – 21 question test with score range 0–63 (minimal, mild, moderate, or severe anxiety).

Radiographic examination:
Radiographic examination involved taking open- and closed-mouth TMJ radiographs. Magnetic resonance imaging was done for the evaluation of the articular disc and retrodiscal tissues.

Study design:
Twenty-two patients with 22 TMJs were equally divided into two groups. Group I was given arthrocentesis with injection of 100 ml Ringer's solution while Group II was given the same procedure plus 1 ml intra-articular steroid injection with concentration of 20 mg/ml. The symptoms were evaluated before treatment and then during follow-up, done on weekly basis in the first month and monthly up to 3 months.

Procedure:
All procedures were done under local anesthesia with 2% lignocaine and 1:80,000 adrenaline through auriculotemporal nerve block. Patients were placed in 45° position with their head turned to the opposite side. The procedure started with aseptic preparation and draping, then two points for needle insertion were marked on the canthotragal line using McCain's method. Entry into the superior joint space was made with 18-gauge needle; Ringer's solution was injected in order to ensure that joint was accessed. Another needle was introduced to perform anterior lavage drainage. Lavage was done only for Group I, while for Group II the procedure included steroid injection after the end of lavage with removal of the latter needle. Follow-up was done with correction of occlusion with removable partial denture, splint, or selective grinding of teeth, if needed.

Statistical analysis:
Descriptive and comparative statistics were done. Categorical variables were presented as number and percent, while numerical ones were described with mean ± SD. Chi-square test, Student's t-test and Mann–Whitney U-test were used depending on type of data, with intergroup comparisons performed between the two treatment groups.

Results:
There was no statistically significant inter-group difference in the age parameter, as Group I demonstrated a mean age of 30.45 ± 10.20 years while Group II – 36.45 ± 15.08 years. Mean total age of 33.45 ± 12.88 years and non-statistically significant inter-group difference ($t = 1.093$, $p = 0.287$) confirmed age-matching of the groups **(Table 1).** There was no statistically significant inter-group difference in preoperative VAS pain score, as Group I demonstrated 5.91 ± 1.300 while Group II – 5.82 ± 1.328 ($U = 58.000$, $p = 0.898$). For the period from immediate postoperative period up to 21st day there was a statistically significant lower pain score in Group II compared to Group I, as the corresponding p-values varied mainly from $p = 0.023$ to $p < 0.001$. As for 22nd day and beyond, including 1 month mark, there was no statistically significant difference between the groups (p-value from 0.076 to 0.478), which means that statistically significant analgesic effect existed only during the early postoperative period **(Table 2).** There was no statistically significant inter-group difference in mouth opening preoperatively, as Group I had 24.45 ± 0.93 mm while Group II – 22.64 ± 3.38 mm ($t = 1.718$, $p = 0.101$). There was no statistically significant difference even in immediate postoperative period (33.18 ± 1.94 mm vs 34.36 ± 3.14 mm; $t = -1.062$, $p = 0.301$). Statistically significant difference was found only on the 1st day (33.27 ± 2.33 mm vs 35.64 ± 1.91 mm; $t = -2.603$, $p = 0.017$) and at 1st week (34.18 ± 2.04 mm vs 37.36 ± 4.57 mm; $t = -2.110$, $p = 0.048$). At 1 month and 3 months there was no statistically significant difference ($p = 0.068$ and $p = 0.086$), thus indicating that statistically significant increase in mouth opening was short-term **(Table 3).** There was no statistically significant difference between the groups in relation to protrusive jaw movement. The preoperative value for this parameter was 4.55 ± 0.82 in Group I and 5.09 ± 0.70 in Group II ($U = 38.5$, $p = 0.151$); immediately postoperative values were 6.27 ± 0.65 and 6.36 ± 0.50 ($U = 57.000$, $p = 0.847$) and at 3 months – 6.09 ± 0.54 and 6.18 ± 0.60 ($U = 55.500$, $p = 0.748$). All p-values were greater than 0.05, which means there was no statistically significant superiority in protrusive movement **(Table 4).** The lateral excursion parameter was statistically similar preoperatively as Group I had 5.36 ± 0.92 while Group II had 5.64 ± 0.92 ($U = 51.00$, $p = 0.562$). However, postoperatively Group II had a statistically significant larger value for lateral excursion than Group I (9.09 ± 0.54 vs 7.55 ± 0.69; $U = 7.00$, $p < 0.001$). This significant difference was

maintained up to 3 months as well (8.36 ± 0.81 vs 6.73 ± 0.65; U = 7.00, p < 0.001) **(Table 5).** There was no statistically significant inter-group difference in relation to BAIS score. Preoperatively, 90.9% of patients in both groups had minimal anxiety level and 9.1% – mild anxiety (χ^2 = 0.000, p = 1.000). Immediate postoperative distribution of levels was identical (χ^2 = 0.000, p = 1.000). On the 1st day and 1st week there was no statistically significant difference (χ^2 = 2.000, p = 0.368; χ^2 = 1.048, p = 0.306). At 1 month and 3 months both groups had identical distribution of BAIS scores, hence χ^2 and p-values were not applicable **(Table 6).** There was no statistical difference between the groups in relation to occlusal corrections as 100.0% of patients in both Group I and Group II did not need such corrections at each follow-up evaluation point. Since both groups had identical distribution of scores across follow-up, chi-square and p-values were not applicable, indicating no measurable intergroup variation for this parameter **(Table 7).**

Table 1: Age distributions of subjects

Group	Mean Age (yr)	SD	t-value	p-value
Group I	30.45	10.20	1.093	0.287
Group II	36.45	15.08	1.093	0.287
Overall	33.45	12.88		

Table 2: Comparison of pain rating between the groups

Follow-up	Group I Mean	Group I SD	Group II Mean	Group II SD	Mann-Whitney U	p-value
Pre Op.	5.91	1.300	5.82	1.328	58.000	.898
Immediate Post Op.	1.36	0.505	.64	0.674	26.500	.023
1st day	2.30	0.218	1.57	0.389	6.500	<.001
2nd day	2.41	0.503	1.64	0.424	12.500	.001
3rd day	2.23	0.395	1.68	0.582	28.500	.034
4th day	3.50	0.536	2.00	0.512	0.500	<.001
5th day	3.09	0.437	1.41	0.392	0.000	<.001
6th day	2.57	0.807	1.34	0.465	8.000	<.001
7th day	2.61	0.393	1.36	0.585	5.000	<.001
8th day	2.43	0.298	1.32	0.582	3.500	<.001
9th day	1.77	0.440	0.70	0.445	5.500	<.001
10th day	1.82	0.420	0.52	0.208	0.000	<.001
11th day	1.70	0.445	0.25	0.224	0.500	<.001
12th day	1.48	0.541	0.27	0.467	7.500	<.001
13th day	1.27	0.586	0.11	0.259	4.000	<.001
14th day	1.11	0.728	0.02	0.075	1.000	<.001
15th day	.98	0.770	0.00	0.000	0.000	<.001
16th day	0.89	0.736	0.00	0.000	5.500	<.001
17th day	0.66	0.625	0.00	0.000	0.000	<.001
18th day	0.61	0.540	0.02	0.075	7.500	<.001
19th day	0.45	0.557	0.00	0.000	16.500	.002
20th day	0.32	0.420	0.00	0.000	27.500	.028
21st day	0.43	0.513	0.00	0.000	16.500	.002
22nd day	0.23	0.344	0.00	0.000	33.000	.076
23rd day	0.18	0.276	0.00	0.000	38.500	.151
24th day	0.27	0.410	0.00	0.000	38.500	.151
25th day	0.14	0.377	0.00	0.000	49.500	.478
26th day	0.20	0.332	0.00	0.000	38.500	.151
27th day	0.14	0.323	0.00	0.000	49.500	.478
28th day	0.11	0.234	0.00	0.000	44.000	.300
29th day	0.11	0.303	0.00	0.000	49.500	.478
1 month	0.20	0.313	0.00	0.000	33.000	.076

Table 3: Comparison of mouth opening between groups

Mouth Opening	Group I Mean	Group I SD	Group II Mean	Group II SD	t-value	p-value
Pre Op.	24.45	0.93	22.64	3.38	1.718	0.101
Immediate Post Op.	33.18	1.94	34.36	3.14	-1.062	0.301
1st day	33.27	2.33	35.64	1.91	-2.603	0.017
1st week	34.18	2.04	37.36	4.57	-2.110	0.048
1 month	34.45	2.50	37.45	4.50	-1.931	0.068
3 months	34.36	2.29	37.18	4.64	-1.805	0.086

Table 4: Comparison of protrusive jaw movement between the groups

Protrusive	Group I Mean	Group I SD	Group II Mean	Group II SD	Mann-Whitney U	p-value
Pre Op.	4.55	0.82	5.09	0.70	38.5	0.151
Immediate Post Op.	6.27	0.65	6.36	0.50	57.000	.847
3 Month	6.09	0.54	6.18	0.60	55.500	.748

Table 5: Comparison of lateral excursion jaw movement between the groups

Lateral Excursion	Group I Mean	Group I SD	Group II Mean	Group II SD	Mann-Whitney U	p-value
Pre Op.	5.36	0.92	5.64	0.92	51.00	0.562
Post Op.	7.55	0.69	9.09	0.54	7.00	<0.001
3 Month	6.73	0.65	8.36	0.81	7.00	<0.001

Table 6: Comparison of BAIS (Beck's Anxiety Inventory Scale) score between the groups

BAIS	Category	Group I No. (%)	Group II No. (%)	Chi-square	p-value
Pre Op.	Minimal	10 (90.9%)	10 (90.9%)	0.000	1.000
Pre Op.	Mild	1 (9.1%)	1 (9.1%)		
Immediate Post Op.	Minimal	10 (90.9%)	10 (90.9%)	0.000	1.000
Immediate Post Op.	Mild	1 (9.1%)	1 (9.1%)		
1st day	Not Required	10 (90.9%)	10 (90.9%)	2.000	0.368
1st day	Minimal	0 (.0%)	1 (9.1%)		
1st day	Mild	1 (9.1%)	0 (.0%)		
1st week	Not Required	10 (90.9%)	11 (100.0%)	1.048	0.306
1st week	Minimal	1 (9.1%)	0 (.0%)		
1 month	Not Required	11 (100.0%)	11 (100.0%)	NA	NA
3 months	Not Required	11 (100.0%)	11 (100.0%)	NA	NA

Table 7: Comparison of occlusal corrections between the groups

Occlusal Corrections	Status	Group I No. (%)	Group II No. (%)	Chi-square	p-value
Immediate Post Op.	Not required	11 (100.0%)	11 (100.0%)	NA	NA
1st day	Not required	11 (100.0%)	11 (100.0%)	NA	NA
1st week	Not required	11 (100.0%)	11 (100.0%)	NA	NA
1 month	Not required	11 (100.0%)	11 (100.0%)	NA	NA
3 months	Not required	11 (100.0%)	11 (100.0%)	NA	NA

Discussion:

In accordance with the results obtained in the current study, the administration of steroids intra-articularly after arthrocentesis provided for short-term clinical advantage. Adequate baseline comparability can be evidenced through insignificantly different age (p = 0.287) and preoperative VAS score (p = 0.898) values in the groups. Early reduction in pain in Group II was associated

with the intra-articular inflammatory nature of the disease and also correlated with the relevance of the procedure of superior joint-space lavage established in imaging and structural analysis of the TMJ **[11]**. It is reasonable to understand the statistically significant reduction in the pain score from the immediate postoperative period to the 21st day as early analgesia rather than complete disease elimination **[12]**. It is also compatible with the psychophysiological concept of TMD although no significant differences in BAIS scores were found between groups indicating that there was no anxiety-related pain confounding **[13]**. Functional superiority was found only on the 1st day ($p = 0.017$) and the 1st week ($p = 0.048$) but not on the 1 month and 3 month marks in Group II, which indicated the application of corticosteroids as an additional anti-inflammatory procedure in case of TMJ arthrocentesis **[14, 15]**. However, the results of the study were similar to those presented in other literature sources dealing with the benefits of arthrocentesis in reduction of pain and improvement of mandibular function although the current study emphasized the early rather than late advantages **[16]**. The protrusive mouth movement remained insignificant at all studied periods of time, however, the lateral excursion movement demonstrated the postoperative and 3-month superiority ($p < 0.001$) in Group II patients, indicating its greater sensitivity to changes in the articular function **[17, 18]**. The lack of persistence of functional superiority can be explained by the presence of different structural stages of internal derangement when the procedures of lavage and injection of corticosteroids reduced the inflammatory symptoms but not corrected the disc displacement and degenerative processes in joints **[19]**. Moreover, some caution should be shown because corticosteroids can reduce inflammation but not reverse the degenerative processes in cartilages and matrices **[20]**. In addition, the lack of significant differences in BAIS and occlusal corrections indicated that there were no psychological or occlusal factors in the observed functional superiority **[21–23]**.

Conclusion:

Intra-articular steroid administration following arthrocentesis significantly improved early pain relief and mandibular function in patients with temporomandibular joint disc displacement. The benefits were most pronounced during early recovery, with sustained improvement in lateral excursion. These findings highlight intra-articular steroids as a promising adjunct to arthrocentesis for optimizing short-term clinical outcomes.

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