The Use of Arthrocentesis for the Treatment of Osteoarthritic Temporomandibular Joints

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Purpose: The purpose of this retrospective study was to determine the efficacy of arthrocentesis in restoring the functional capacity of osteoarthritic temperomandibular joints (TMJ).

Patients and Methods: This study involved 36 patients (29 females, 7 males; age range, 16 to 54 years, mean, 37.36 ± 14.60 years) presenting with 38 dysfunctional joints that had not responded to conservative treatment. The postarthrocentesis status (follow-up period 6 to 62 months, mean 20.7 ± 20.5 months) of the TMJs was determined by patient self-evaluation using visual analog scales and clinical examination.

Results: Of the 38 TMJs treated with arthrocentesis, 26 joints reacted favorably to the treatment; pain and dysfunction scores were reduced from 9.86 ± 0.73 to 3.39 ± 0.76 and from 11.34 ± 0.66 to 3.4 ± 0.69, respectively (P < .001). Self-assessed general improvement/deterioration was +4.90 ± 2.10 (on a scale of −7 to +7). Maximal mouth opening increased from 24.40 ± 2.70 mm to 43.20 ± 3.10 mm (P < .001). Lateral and protrusive jaw movements also increased in magnitude. In 14 patients in whom no improvement was noted, arthrocentesis acted as a diagnostic tool before surgical treatment.

Conclusion: Arthrocentesis is a safe and rapid procedure that in many instances results in the osteoarthritic TMJs returning to a healthy functional state. Failure of arthrocentesis suggests that the painful limitation is most probably caused by changes such as fibrous adhesions or osteophytes that require surgical intervention for their removal.

Osteoarthritis of the temporomandibular joint (TMJ), a local inflammatory disease, is believed to be the outcome of a reaction to joint loading that exceeds its adaptive capacity.1,3 This sequence of events is set in motion when the mechanism that holds the degenerative processes in check is lost or severely curtailed and when the subsequent rate of synthesis is insufficient to form normal tissue.6,7 The progress of the process may be subclinical or may be associated with painful and dysfunctional TMJs. The degree of severity of the clinical signs and symptoms varies considerably from patient to patient and runs from short to prolonged periods.8 Periods of intense pain and discomfort may alternate with asymptomatic intervals.

In the acute phase, the patient complains of stiffness in the TMJ on arising in the morning, severe joint pain both with the jaw at rest and during movement in all directions, limited mouth opening, and difficulty in yawning, biting, and chewing. Sometimes, the symptoms are accompanied by a sensation of swelling in the TMJ region.8,9 Attempts to open the mouth or to move the jaw in a lateral and protrusive direction beyond the limitation imposed by the disorder elicit considerable pain in the affected joint. Crepitation in the arthritic joint, with or without clicking, may be present on jaw movement.8,9

Imaging of an osteoarthritic joint in the advanced stages typically shows, among other things, erosion of the cortical outline, osteophytes, subcortical cysts, reduced joint space, and a perforated disc.8,10,11 Studies of osteoarthritic TMJs from human cadavers have revealed disc perforation, atypical cellular architecture, osteophyte formation, subchondral bone resorption, disruption of the articular surfaces, drastic changes in the extracellular collagenous matrix, and loss of proteoglycans.7,12,14

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A characteristic feature of osteoarthritis is the inconsistency between the clinical picture and the imaging appearance, where the former may display signs and symptoms of severe disease with no radiologic evidence of joint disorder or vice versa. This paradoxic state of affairs has shown the need for biomarkers, and investigations have been initiated to establish arthroscopic and biochemical standards so as to enlarge the diagnostic armamentarium and to afford better treatment protocols. However, Milam has correctly pointed out that the value of any marker is questionable and that the boundary between remodeling or adaptation and a disease state is at present ill-defined. He further noted that the markers that have been revealed by the current research efforts may indicate a process of adaptation rather than a state of disease. This statement has been verified by Zardeneta et al. who, in their attempt to establish whether proteinase can be used as a marker to indicate an unsound joint, found no correlation between pain in the TMJ and the total local proteinase activity. Studies need to be implemented to establish criteria that will reliably distinguish between disease and remodeling and thus help develop agents that will support the anabolic processes.

The treatment procedures applied in patients with osteoarthritis have focused on encouraging the joint to adapt to its demands. The palliative methods have included joint unloading (eg, interocclusal appliances, soft diet), reduction of inflammation, pain relief, physiotherapy, and correction of behavioral factors. The problematic stage is reached when nonsurgical treatment fails to alleviate the symptoms, and surgical intervention is contemplated. The hope of eliminating the disorder and restoring the anatomy of the osteoarthritic joint has brought forth several surgical procedures; some of which do carry good outcomes. Discectomy, for example, is a commonly used approach that has yielded satisfactory long-term results. Nevertheless, both clinicians and researchers have been looking increasingly for some optimal substance that might serve as a substitute for the removed disc. In this context, autologous grafts have been used with satisfactory results. On the other hand, although convenient for both the surgeon and the patient, artificial materials that have been introduced into the TMJ have caused serious complications.

Thus, the use of Teflon-Proplast (Vitek Inc, Houston, TX) and silicone rubber has given rise to severe foreign body reactions that have critically damaged a large number of joints. The resulting massive condylar destruction, which makes multiple surgical interventions imperative, has led to search for a satisfactory artificial TMJ to rehabilitate these sometimes gravely damaged joints.

An important change in the therapeutic approach occurred with the introduction of arthroscopic lavage and lysis for the treatment of arthritic TMJs. This procedure also has been shown to achieve acceptable results with minimal complications in treating internal derangements of the TMJ. It is possible to lavage the upper joint space, view the entire space, take samples from specifically chosen locations, and inject therapeutic agents directly into any pathologic foci. The procedure often results in a very good outcome, thus circumventing the need for surgical intervention and avoiding the previously mentioned unwarranted complications. The success of arthroscopy has led to the use of arthrocentesis (lavage only) as a simple therapeutic modality with a satisfactory outcome, especially in patients with sudden and severe closed lock.

The purpose of this retrospective study was to examine the value of arthrocentesis in facilitating control of inflammation in patients with symptomatic osteoarthritis of the TMJ who did not respond to nonsurgical treatment.

**Patients and Methods**

The study involved 38 osteoarthritic joints in 36 patients (29 females, 7 males; age range, 15 to 64 years, mean, 37.36 ± 14.6 years) with increasingly severe pain that remained localized to the affected joint. The pain was exacerbated on mouth opening, biting, and chewing. The symptoms had reportedly started 3 to 62 months (mean, 15.2 ± 19 months) before the patients’ presentation at the clinic. None of the patients had responded to nonsurgical treatment of at least a month’s duration before their referral. In most cases, the chief complaint was pain in the affected joint associated with limited mouth opening. Most patients could not recall any event that might have caused the symptoms. All patients were diagnosed, treated, and followed in the Department of Oral and Maxillofacial Surgery, Hadassah Faculty of Dental Medicine of the Hebrew University in Jerusalem.

In addition to no response to nonsurgical treatment, the criteria for entering into the study were as follows: 1) limited maximal mouth opening (MMO) (<35 mm) with deviation toward the affected side, impeded lateral movement to both sides and limited protrusive movement with deviation toward the affected side; 2) all jaw movements associated with localized pain in the affected joint; 3) increased pain on joint loading and decreased pain on unloading; 4) joint crepitation, with or without clicking; and 5) presence of radiographic signs of osteoarthritis, such as sclerosis, osteolytic cysts, flattening of the condyle, osteophytic lipping, disc perforation, and diminished joint space.

Evaluation of the patient involved obtaining demographic data and a comprehensive history that in-
arthrocentesis for treatment of osteoarthritic TMJs

was essentially the same as described previously, "none," "early," or "late" clicking/crepitus. Of joint noises on palpation, which were rated as pain, and timing of the symptoms), and determination of the characteristics of the limitation in jaw movement (measured by the distance between the upper and lower incisors, determination of the range of lateral and protrusive mandibular movement as measured by the distance between the upper and lower midline on lateral and forward movements; evaluation of the characteristics of the limitation in jaw movement (mechanical origin, persistent or intermittent pain, and timing of the symptoms), and determination of joint noises on palpation, which were rated as "none," "early," or "late" clicking/crepitus.

The method of arthrocentesis used in this study was essentially the same as described previously, except that the solution used for lavage (100 mL saline) was introduced manually using a 10-mL syringe with an 18-gauge needle. No medication was injected into the joint at the end of the procedure. Postoperatively, anti-inflammatory medication for 10 days, or as required, soft diet, and physiotherapy (passive and active mouth opening without deviation; lateral excursions and protrusive movements without deviation, and same movements performed against resistance) were used. Each movement was performed 10 times, 6 times a day. A joint-unloading occlusal appliance was prescribed to be worn nightly for 4 to 6 weeks; thereafter, the patients were advised to use the appliance selectively.

At least 6 months postoperatively, the level and location of the pain, as well as the degree of joint dysfunction, were evaluated by patient self-assessment (facial diagram; VAS I, II, and III) and clinical examination. The latter included measurement of MMO, degree of contralateral movement (CLM) and protrusion, and determination of presence of joint noises.

The paired t-test was used to compare the pre- and post-treatment differences in MMO, CLM, pain, and dysfunction. Improvement or deterioration were tested applying a 2-tailed t-test.

**Results**

None of the patients experienced local or systemic complications related to the arthrocentesis. The follow-up period ranged from 6 to 62 months (mean, 20.7 ± 20.5). Immediate improvement after arthrocentesis was noted in 26/38 (68.4%) of the osteoarthritic TMJs; in 12/38 (31.6%) joints, arthrocentesis had no effect on either pain or dysfunction. In these 12 joints, the procedure had acted as a diagnostic tool, and these patients were referred for surgical intervention (surgical arthroscopy or joint arthroplasty), which revealed altered conditions in the TMJ, such as fibroadhesions or bone spicules, that could not be removed by arthrocentesis.

The following describes the outcome in the 26 TMJs (26 patients) in whom the symptoms were alleviated by the arthrocentesis.

**Subjective Findings Post Treatment**

The 26 patients in whom the signs and symptoms were ameliorated by the treatment had reported considerable pain in the rest position and on forced mouth opening, chewing, and biting before arthrocentesis, which was reflected in the high self-assessed scores on VAS I (9.86 ± 0.73). At follow-up (Table 1), the pain score was significantly reduced (3.39 ± 0.76, P < .001, range, 5 to 15 on VAS I). The mean gain in pain relief was 6.46 ± 1.05 (P < .02). The pain level was directly related to the length of the follow-up period (ie, the greater the time between arthrocentesis and the follow-up examination, the lower the pain level; P < .02).

Functional disturbance was rated high on the VAS II before arthrocentesis (11.34 ± 0.66), but was significantly lower at the follow-up examination (3.4 ± 0.69, P < .001, range, 3.5 to 12.5 VAS II) (Table 1). The mean gain in restored function at follow-up was 7.94 ± 0.94 (P < .02). The rate of improvement in function was directly related to the elapse of time between arthrocentesis and the follow-up examination (P < .02).

Global self-assessment of improvement or deterioration of pain and dysfunction (VAS III, scale −7 to +7) at follow-up relative to the condition before arthrocentesis showed an improvement in both of these parameters to a degree that made further intervention unnecessary. The overall mean improvement rating for pain relief and improved function was 4.9 (70% overall improvement), with the breakdown as follows: 18 patients (69%) reported a mean improvement of 5.6 (80%), 4 patients (15%) claimed an improvement of 4.34 (62%), and 3 patients (12%) noted an improvement of 3.2 (40%). Deterioration was reported by 1 patient (3.4%), who was referred for re-evaluation.
Table 1. THE EFFECT OF ARTHROCENTESIS ON THE SIGNS AND SYMPTOMS IN 26 SUCCESSFULLY TREATED PATIENTS WITH OSTEOARTHRITIS OF THE TMJ

<table>
<thead>
<tr>
<th>Subjective Findings</th>
<th>Before Treatment</th>
<th>After Treatment*</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain (VAS I; 0–15)</td>
<td>9.86 ± 0.73</td>
<td>3.39 ± 0.76</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dysfunction (VAS II; 0–15)</td>
<td>11.54 ± 0.66</td>
<td>3.40 ± 0.69</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Pain and dysfunction: improvement/deterioration (VAS III; 0–15)</td>
<td>4.90 ± 2.10</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objective Data</th>
<th>Before Treatment</th>
<th>After Treatment*</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMO (mm)</td>
<td>24.40 ± 2.70</td>
<td>43.20 ± 3.10</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>CLM (mm)</td>
<td>6.88 ± 0.59</td>
<td>8.85 ± 0.60</td>
<td>&lt;.03</td>
</tr>
<tr>
<td>ILM (mm)</td>
<td>6.30 ± 0.61</td>
<td>9.40 ± 0.61</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PM</td>
<td>5.0 ± 0.60</td>
<td>6.70 ± 0.62</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Follow-up period ranged from 6 to 62 months.
Abbreviations: MMO, maximal mouth opening; CLM, contralateral movement; ILM, ipsilateral movement; PM, protrusive movement; VAS, visual analog scale; NS, not significant; TMJ, temporomandibular joint.

**Discussion**

The TMJ is a highly adaptive organ that constantly adjusts to the functional demands made on it by means of remodeling. However, when the rate of degradation exceeds that of synthesis, the joint’s modeling capacity will be insufficient to keep up with the demands, with resultant changes in the joint structure. These changes are not necessarily expressed in clinical signs and symptoms, and even a severely deformed joint may remain quiescent without apparent indications as to its condition. Thus, Coleman and Weisengreen observed degenerative changes in 22% of TMJs on postmortem examination; none of which were known to have had a history of pain or dysfunction before death. As a matter of fact, the adaptable loading factor is capable of altering the synthesizing function of cell populations (eg, as is the case of chondrocytes, which increase synthesis of cartilage matrix components within the framework of remodeling). In cases of disc displacement, the retrodistal tissue synthesizes chondroitin sulfate and keratan sulfate in response to compressive loads. Another instance is heat-shock-like protein production; a process that has been observed in cells subjected to a 20-minute continuous compressive force. These proteins preserve the vital cellular function during stress in an attempt to conserve energy. The high adaptive capacity of the joint enabling it to respond to alterations, such as in the occlusal pattern, has been further shown on forced protrusion or retrusion of the mandible.

In osteoarthritis, changes in shape without any further signs or symptoms are, by definition, associated with an adaptation process, whereas disturbance in function and generation of pain are designated as disease. However, efforts have been made to establish more objective and conclusive criteria that would, besides the clinical factors, specify the disease state of the TMJ. In this context, histologic findings and radiologic measures have been documented; however, these still do not fulfill the stringent principles required of accurate diagnostic tools and, at this moment, the clinical signs and symptoms constitute the preferred parameters for judging joint status and for deciding on the desired treatment approach. In fact, it should not be forgotten that the treatment protocol for osteoarthritic joints is targeted at the pain generated by the joint and/or its dysfunction and not at affecting its shape.

In contemplating the appropriate course of treatment, one should be aware of the numerous elements involved in the degenerative processes, their latent and active manifestations, and their interrelationship. Joint overloading is believed by many to constitute an important factor in disruption of a stable relationship. One facet of excessive mechanical force is the resultant tissue degeneration that, in turn, is associated with the production of free radicals. The latter are generated instantaneously on loading, but also through other mechanisms, including hypoxic-reperfusion cycles. These cycles are a result of intermittent overloading, and this again is closely linked with increased intra-articular pressure and elevated contact stress; both entities that interfere with normal blood supply. These episodes are followed by an intermission that allows reperfusion, thus presenting an alter-
nating cycle of hypoxia and oxygenation.\textsuperscript{17,57,41} When uncontrolled, the consequently generated free radicals will contribute to the process of joint degeneration, starting with disruption of the joint’s lubrication system,\textsuperscript{32} bringing in its wake increased friction and stronger adhesive force between the articular surfaces.\textsuperscript{5,42,44} This course of events will culminate in fatigue and wear of the joint’s components,\textsuperscript{55,46} bringing about disruption of the underlying collagenous matrix and a loss of glucosaminoglycans, particularly in the more elastic part, the articular disc.\textsuperscript{45} The matrix-degrading agents most likely to be active in the degenerative process are proteinases, notably metalloproteinases, which are present in the joint in both latent and active forms.\textsuperscript{1,21,47}

Often, the destructive effect of the enzymes (ie, their various inflammatory and tissue-degrading products), cannot be controlled by noninvasive conservative means to the point that the supposedly protective reaction becomes an almost independent virulent inflammatory core. Because the TMJ has a limited blood supply, the natural elimination of inflammatory elements greatly depends on the joint’s functional performance,\textsuperscript{37} which is often painful and in many instances not effective, especially when there is effusion in the joint. Active removal of these noxious products by lavage is therefore essential at this stage of the disease. Lavage of the osteoarthritic TMJ with about 100 mL saline often corrects the dysfunctional state. In the laboratory, products, such as denatured hemoglobin or different types of proteinases, have been recovered in various fractions of outflow during arthrocentesis with less than 100 mL of fluid.\textsuperscript{18,48}

Arthrocentesis is a safe tool to remove inflammatory products and tissue degradants. The method is used in conjunction with joint unloading, medication, and physiotherapy. After active elimination of the altered synovial fluid, joint function is improved, together with a diminished pain sensation. Better functional performance of the joint, which enables its nutrition, waste removal, lubrication, and absorption of medications (anti-inflammatory and analgesic drugs), serves as the next step in the rehabilitation process. As ancillary treatment to the lavage, joint unloading (soft diet and an interocclusal appliance) and physiotherapy are advocated to further support the process.\textsuperscript{57} Indeed, the results documented in the present series support our claim of continuous improvement in the status of the arthritic joint treated with arthrocentesis.

The expectations regarding the outcome of arthrocentesis must be directed to well-defined objectives that take into account both the nature of the disease and the remedial modality. Because none of the patients in the present series had responded to nonsurgical treatment, they were candidates for surgical intervention before they were referred for arthrocentesis. Although this study did not include a control group receiving only medical management nor were standard periods of evaluation assigned to the participants, the high percentage of patients that did well on a long-term basis clearly indicates that arthrocentesis is effective for osteoarthritic TMJs. On an immediate basis, the treatment obviated the necessity of corrective surgery in 68.4\% of patients. Yet, not all patients enjoyed full recovery of normal joint function, as witnessed by the values on the visual analog scales (VAS I and II). Pain and dysfunction (3.4 on a scale of 0 to 15) remained part of the clinical picture, and general improvement (4.9 on a scale of 0 to +7) still left something to be desired.

Despite the extensive use of arthrocentesis for various TMJ disorders, only scarce data and imprecise information are available regarding its effect on osteoarthritis. Using arthroscopic lavage and lysis, Murakami et al\textsuperscript{32,35} reported similar satisfactory results to ours in advanced stages of internal derangement of the TMJ. Gynther and Holmlund\textsuperscript{31} have shown that arthroscopic lavage and lysis achieves better results in patients with rheumatoid arthritis than in patients with osteoarthritis. It should be pointed out that a symptomatic TMJ in a rheumatoid arthritis patients may be caused by osteoarthritis rather than constituting a manifestation of the former disorder.

Arthrocentesis is not a panacea for all joint disorders. It does not change the shape or location of the disc nor does it affect the structure of the condyle and fossa. Pathology, such as bone spicules, fibroankylosis, or perforation of the disc, are not amenable to lavage. Indeed, in the 12 TMJs in the present series where arthrocentesis was not successful, severe adhesions and/or bone spicules were found intraoperatively; their removal yielded satisfactory outcome. In these instances, arthrocentesis functioned solely as a diagnostic tool that provided the basis for referring the patient for justified corrective surgical intervention.

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