

Temporomandibular Joint Arthrocentesis in Patients with Degenerative Joint Disease: A 10- to 22-year Follow-up

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Aims: To report the effectiveness of temporomandibular joint (TMJ) arthrocentesis with viscosupplementation for degenerative joint disease (DJD) over a long-term (ie, 10–22 years) follow-up. **Methods:** A total of 103 patients aged between 30 and 91 years (13 men and 90 women; mean age 63.7 years) who received a cycle of five arthrocentesis sessions with HA viscosupplementation to manage their symptoms related to TMJ DJD during the time period from 1998 to 2010 were recalled for clinical evaluation. After the treatment cycle, clinical outcomes were assessed based on the following parameters: maximum mouth opening (MO), pain with function (PF), pain at rest (PR), and self-reported chewing efficiency (CE). Data were collected at baseline (T_0) and at successive follow-up assessments, after at least 3 months (T_1) and 1 year (T_2), as per previous publications. Patients who had received treatment at least 10 years prior were then recalled for this study (T_3 : 10 to 22 years follow-up). Analysis of variance for repeated measures was performed to assess changes over time. **Results:** Significant improvement in all clinical parameters was achieved at T_1 and was maintained for up to 10 years (T_3), with $P < .01$ for each parameter. At T_3 , treatment effectiveness was perceived as excellent by 56% and as good by 26.5% of subjects, while 10.7% perceived a moderate improvement, and 6.8% referred a slight improvement or did not have any improvement. Only seven individuals required additional treatments after T_2 . **Conclusion:** These findings suggest that the symptomatic management of TMJ DJD achieved in the short or medium term with a cycle of arthrocentesis and viscosupplementation was effectively maintained in the long term. *J Oral Facial Pain Headache 2021;35:113–118. doi: 10.11607/ofph.2871*

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Temporomandibular joint degenerative joint disease (TMJ DJD) causes changes in the articular surfaces of the condyle and the mandibular fossa. TMJ DJD develops due to multiple mechanical and biologic events.¹ Patients with TMJ DJD may complain of joint pain at rest and during function, limitation of mouth movements, and joint noises (eg, crepitus sounds).¹ Imaging shows abnormalities of the condylar head, such as erosions, sclerosis, flattening, and osteophytes.² At the tissue level, the concentration of sodium hyaluronate (eg, hyaluronic acid [HA]) in the synovial fluid is diminished as a consequence of the dilution, fragmentation, and production of acid molecules with a lower weight than normal, thus compromising the conditions of intra-articular homeostasis.³

In order to restore the HA concentration, wash out the inflammatory fluid, decrease the friction of articular surfaces, and improve function, a minimally invasive approach combining arthrocentesis and HA viscosupplementation was introduced a couple of decades ago.⁴ The term “arthrocentesis” defines the lavage of the upper joint compartment with the use of saline solution, using either two needles for the inflow and outflow of the physiologic saline or a single needle for both fluid inflow and outflow. The procedure may be followed by the positioning of HA or other medications or compounds.

Arthrocentesis of the TMJ has been the subject of several investigations over the past 20 years. After its introduction as a strategy to solve sudden-onset mouth-opening limitations,⁵ the technique has progres-

sively been adopted to manage symptomatic osteoarthritis. Early studies suggested that a cycle of five weekly arthrocentesis sessions with HA viscosupplementation is effective to manage symptoms of TMJ inflammatory-degenerative disease in the short term.⁶ Several other works were performed to investigate the various aspects that may be related to clinical outcomes.^{7–9} However, a recent review highlighted a lack of studies reporting on the long-term results.¹⁰

Within these premises, the aim of this retrospective study is to report the effectiveness of a cycle of TMJ arthrocentesis sessions with HA viscosupplementation in a case series of patients with DJD after 10 to 22 years from the interventions.

Materials and Methods

Study Design

This study included patients who were treated at the Department of Maxillofacial Surgery, University of Padova, Italy, during the time span from 1998 to 2010. Patients complained of symptoms related to the presence of TMJ-DJD and received a diagnosis of TMJ osteoarthritis based on the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD Axis I, group IIIb diagnosis of osteoarthritis) in the absence of both RDC/TMD muscle disorders (group I diagnoses) and rheumatic diseases.¹¹

All patients underwent a cycle of five weekly arthrocentesis sessions with HA viscosupplementation to manage their symptoms, based on protocols suggested for larger joints.¹² Two injection techniques were employed using the same landmarks used for arthroscopy. The two-needle technique provides that two 19-gauge needles are placed to make entry and exit points for the physiologic saline used to wash the joint.⁴ The single-needle technique provides the use of a single needle for both fluid inflow and outflow. The procedure is based on the under-pressure fluid inflation, with the patient keeping an open mouth position. Then, the patient is asked to close the mouth to remove the fluid via the same needle, for several repetitions.¹³ Once arthrocentesis is completed, 1 mL of low-molecular weight HA (500–730 kDa, Hyalgan) is gently positioned into the joint through one needle (providing that the other needle is removed in the two-needle technique). HA has a potential lubricating, anti-inflammatory, and pain-relieving action and may allow activation of the tissue repair process in the articular cartilage.^{14,15} The two techniques were shown to be equivalent in terms of effectiveness and safety in a previous study.¹⁶

All procedures were performed by the same maxillofacial surgeon. Details on the study design and effectiveness over a 1-year follow up can be found in

previous publications.^{7,17} As part of the clinical evaluation protocol, the same operator (D.M.), different from the surgeon and blinded to the patients' features, assessed the following parameters before the treatment cycle, just after every session of the cycle, and during the follow-up assessments at 3 months and 1 year:

- Maximum mouth opening (MO), measured in millimeters
- Pain during function (PF) and pain at rest (PR), evaluated by a visual analog scale (VAS) from 0 to 10, going from “no pain” to “pain as bad as the patient ever experienced,” respectively
- Chewing efficiency (CE), assessed by a VAS from 0 to 10, the extremes of which were “eating only semi-liquids” and “eating solid hard food,” respectively.
- Subjective effectiveness (SE) of the treatment perceived by the patients (0 = none; 1 = slight; 2 = moderate; 3 = good; 4 = excellent).

In January 2020, the same leading investigator (L.G.N.), now at the Operative Unit of Oral and Maxillofacial Surgery of the Hospital of Treviso, Italy, organized a follow-up recall of the patients who had reached 10 years from the last intervention. Half ($n = 130$) of the potentially eligible patients were randomly chosen based on alphabetical order (letter “A” to “L”) and recalled for a clinical assessment. A total of 103 were available (13 men, 90 women; age at time of follow-up, between 30 and 91 years, mean 63.7 years). Patients' age at the time of the first interventions ranged between 20 and 81 years, and the mean follow-up time from the treatment cycle was 13.6 years (range 10 to 22 years).

In this investigation, data that were recorded at baseline (T_0) and at successive follow-up assessments ($T_1 = 3$ months; $T_2 = 1$ year) were compared to those collected during the recall ($T_3 = 10$ to 22 years) that was organized for this study. Analysis of variance (ANOVA) for repeated measures was used to test for significant differences in treatment effectiveness over time. The null hypothesis was that there were no differences in any of the outcome variables among the four observation points. Bonferroni post hoc test was used for pairwise comparisons of follow-up assessments when significant differences emerged with ANOVA. The level for statistical significance was set at $P < .05$. All procedures were performed with the software SPSS 25.0 (IBM).

Results

Significant improvement in mean values of all clinical parameters at the study population level ($N = 103$)

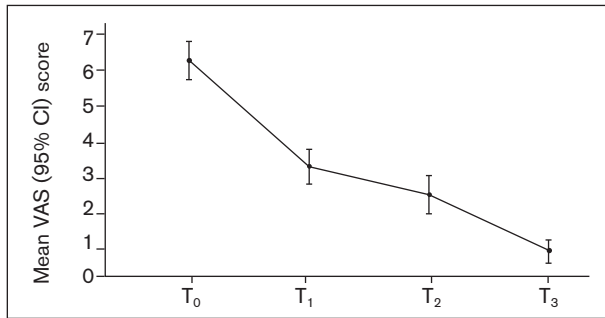


Fig 1 Changes in levels of maximum pain during function over the four observation points (T₀ = baseline; T₁ = 3 months; T₂ = 1 year; T₃ = 10+ years follow-up).

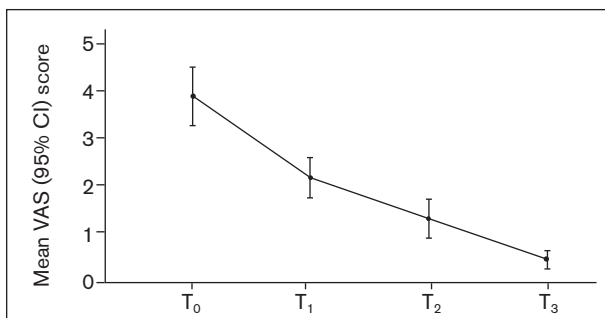


Fig 2 Changes in levels of maximum pain at rest over the four observation points (T₀ = baseline; T₁ = 3 months; T₂ = 1 year; T₃ = 10+ years follow-up).

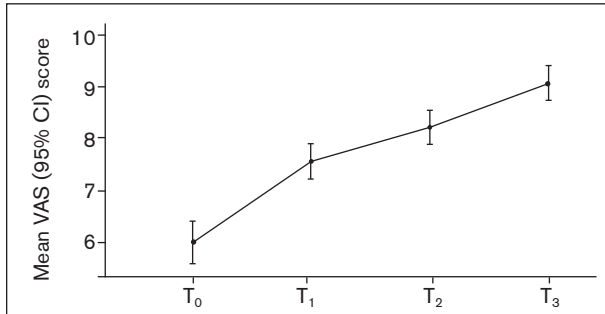


Fig 3 Changes in self-reported chewing efficiency over the four observation points (T₀ = baseline; T₁ = 3 months; T₂ = 1 year; T₃ = 10+ years follow-up).

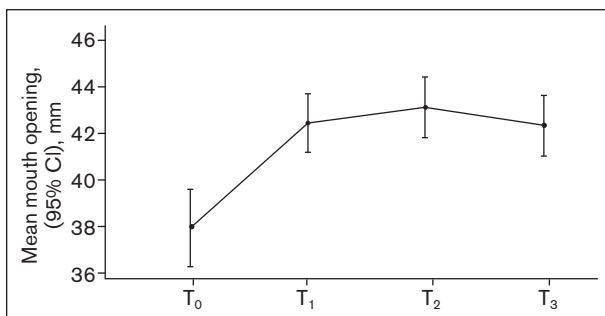


Fig 4 Changes in maximum unassisted mouth opening levels (average mm values and 95% confidence intervals) over the four observation points (T₀ = baseline; T₁ = 3 months; T₂ = 1 year; T₃ = 10+ years follow-up).

was achieved at T₁ and maintained up to 10 years (T₃), with $P < .01$ for each parameter.

Detailed findings in the single-outcome variables are as follows:

- Maximum pain with function (Fig 1): The downward curve from T₀ to T₃ indicates that pain was reduced throughout the control period, especially in the T₀ to T₁ range. The average decrease was 5.3 VAS points from T₀ to T₃.
- Maximum pain at rest (Fig 2): The results from T₀ to T₃ are almost superimposable to the trend of the curve for pain with function—VAS values decreased constantly over the four observation points. The average decrease was 3.5 VAS points from T₀ to T₃.
- Chewing efficacy (Fig 3): The chewing efficacy constantly increased, especially during the time span from T₀ to T₁. The improvement was maintained over time. The average improvement was 3.1 VAS points from T₀ to T₃.
- Mouth opening (Fig 4): Mouth opening values (in mm) during the observation period increased markedly from T₀ to T₂ and stabilized at T₃, after at least 10 years from the first arthrocentesis. On average, subjects improved mouth opening by 4.4 mm from T₀ to T₃.

At T₃, the effectiveness of the treatment was perceived as excellent by 56% and good by 26.5% of subjects, while 10.7% perceived a moderate improvement. Only 6.8% reported a slight improvement or any improvement. Only seven individuals were referred for additional treatments after T₂. Three of them were provided with one or multiple oral appliances by other caregivers, without any relevant changes in their symptoms. All three were prescribed pharmacologic treatment for chronic orofacial pain management at the time of T₃, while three other patients were already under pharmacologic treatment and not fully satisfied with the level of pain control currently achieved. Major TMJ surgery was planned for another patient.

Discussion

TMJ arthrocentesis is derived directly from the arthroscopy technique, which originated with the development of mini-arthroscopes and dedicated surgical instruments of miniature size. Arthrocentesis was introduced in the early 90s as a treatment strategy for the anchored disc phenomenon associated with sudden-onset closed lock, with the progressive decline of TMJ disc repositioning strategies in favor of less invasive and conservative techniques.^{4,18} The capsular distention achieved with joint lavage, as well

as the lysis of intra-articular adhesions that may be responsible for limited mouth opening with sudden occurrence, provided excellent clinical results for pain relief and functional improvement. Thus, positioning two needles inside the joint instead of an arthroscope was enough to achieve the same results.¹⁹

In the last 20 years, based on emerging knowledge from other joints, studies on the possible usefulness of arthrocentesis have also been performed in patients with TMJ DJD. Currently, the literature also offers a general expert agreement that arthrocentesis is a minimally invasive and safe procedure with the potential to help reduce symptoms in patients with TMJ DJD.¹⁰ Refinement studies have then suggested that the classic two-needle technique could be replaced by an intervention performed with a single needle, used both for the inflow and outflow of saline solution. The potential advantages concern the execution time and the better tolerability, in parallel with an equivalent clinical effectiveness with respect to the two-needle technique.^{16,20,21} Over the years, efforts have also been made to identify outcome predictors at the individual level.^{22,23}

In particular, orthopedic literature on HA positioning has been taken as an example to assess the additional advantages of viscosupplementation. This shows that the main indication to implement lubrication through the positioning of hyaluronic acid is the presence of DJD.^{12,24} The first TMJ DJD studies on HA were then performed, also in combination with arthrocentesis, with the idea of providing a better environment for the HA compound within the joint.⁶ HA is found in many extracellular tissues, including synovial fluid and cartilage, as the product of chondrocytes and synoviocytes.²⁵ In joints with DJD, HA becomes depolymerized, resulting in decreased molecular weight and viscoelasticity.²⁶ Thus, positioning exogenous HA can partly restore the natural environment and stimulate the synthesis of endogenous HA. Arthrocentesis is a procedure that has never been associated with complications or side effects, and its combination with HA positioning, which is equally considered a procedure without negative effects, provided good results in all the investigations. This laid the foundation for a modern concept of TMJ arthrocentesis in line with the clinical literature showing a greater decrease in friction coefficient after HA positioning with respect to joint washing alone.^{27,28} Moreover, it has been suggested that multiple arthrocentesis sessions are more effective than a single procedure.^{8,29} Investigations of TMJ symptoms provide homogenous results in support of the finding that pain levels in the TMJ decrease in a large majority of patients, also giving interesting improvement in the nearby areas (eg, neck).³⁰

To the best of the authors' knowledge, this study is the first attempt to extend the assessment of TMJ arthrocentesis outcomes to a very long follow-up span. Results suggest that improvements that were shown after 1 year were maintained for up to over 10 years, with the longest observation period of 22 years. Thus, in general terms, it seems that the procedure can offer long-term positive effectiveness.

These data add to the amount of literature suggesting that conservative treatment may be enough to provide successful outcomes over time and to reduce the need for re-treatment in the majority of patients with TMJ limited function and DJD.³¹ Nonetheless, it is also important to remark that the main outcome predictors are not necessarily directly related to the TMJ, but also involve individual host responses concerning factors such as age, psychosocial features, and concurrent comorbid conditions. The absence of longitudinal data on these issues is a limitation of this study, which should be investigated further. For instance, it can be hypothesized that patients with lower levels of psychosocial impairment (eg, absence of moderate to severe depression and somatization symptoms; low pain threshold) who were responsive to treatment at 6 months might emerge as the best responders to a cycle of five arthrocentesis sessions with viscosupplementation of HA in the long term as well.²³ In addition to that, an improvement in the differential diagnosis process to discriminate TMD-related pain from other orofacial pain causes might further diminish the percentage of patients who did not benefit from treatment.

Further studies that retrospectively analyze clinical databases to identify a possible phenotype of patients who do not respond to the procedure could be designed. In the present investigation, criteria for inclusion in the study were conditioned by the original choice to include patients with a diagnosis of osteoarthritis (RDC/TMD Axis I, group IIIb) in the absence of both RDC/TMD muscle disorders (group I diagnoses) and rheumatic diseases. Along with the clinical diagnosis, imaging was performed in all patients, even if not strictly needed for RDC/TMD classification purposes concerning TMJ-DJD. With the emerging knowledge on the frequent presence of multiple TMD diagnoses (ie, combined TMJ and muscle symptoms/disorders),³² the choice to exclude patients with muscle symptoms could have been questionable. Future studies adopting the new DC/TMD may be performed to assess the possible influence of updated patient categorization on treatment outcome. In addition, imaging studies on the evolution of MRI signs over time could be fundamental to further link imaging to clinical symptoms and to identify predictors of clinical outcomes.^{33,34} Indeed, a clear-cut correlation between arthritic TMJ lesions

and clinical symptoms in the long term has not yet been confirmed because of the cross-sectional design of most imaging studies.^{35,36}

As in many other medical fields, a possible future perspective is the further investigation of those few patients of this group who have not improved. Their psychologic characteristics (related to Axis II) should be clarified in order to evaluate any unfavorable outcomes, along with the presence of other possible comorbid factors and conditions that negatively influenced the treatment outcome. Other factors to consider in future designs for long-term controlled trials concern symptom fluctuation and the positive natural course of disease, which sometimes may become asymptomatic with time regardless of intervention, as well as the skill of the surgeon performing the procedure. Based on that, multiple-variable studies performed at multiple tertiary centers could offer better insights into the predictive factors for long-term positive outcomes.

Conclusions

Within the limitations of this study, it can be suggested that the management of symptomatic TMJ-DJD can be effectively and safely achieved with a cycle of arthrocentesis with intra-articular positioning of HA. Long-term results (ie, 10 to 22 years) support the maintenance of improvement achieved in the short or medium term in almost all patients, with a very good satisfaction perceived in the majority of the patients.

Key Findings

- In patients with TMJ DJD, a cycle of five weekly arthrocentesis sessions plus HA viscosupplementation can be effective to provide long-term pain relief. Treatment effectiveness that was reported in the short and medium term was maintained after 10 to 22 years in 85% of the study patients.
- Future research identifying predictors of symptom relapse and comparing different protocols in the long term are needed.

Acknowledgments

L.G.N.: performed interventions and revised the manuscript; M.M., S.Z.: collected the data and drafted the manuscript D.M.: conceptualized the study, supervised all phases, and revised the manuscript.

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