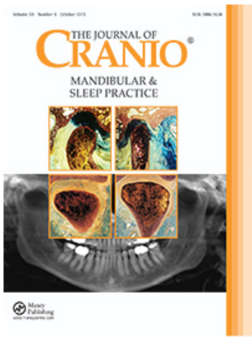

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TMJ

Interrelationship between temporomandibular joint osteoarthritis (OA) and cervical spine pain: Effects of intra-articular injection with hyaluronic acid

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ABSTRACT

Objective: The aim of this study was to evaluate cervical spine pain and function after five sessions of viscosupplementation with hyaluronic acid (HA) in patients with temporomandibular joint (TMJ) osteoarthritis.

Methods: Forty-nine patients, (79% females, aged between 43–81 years), affected by TMJ osteoarthritis and concurrent cervical spine pain and limited function were recruited. All patients underwent a cycle of five weekly arthrocenteses and viscosupplementation with 1 ml of medium molecular weight HA according to the single-needle arthrocentesis technique. Outcome variables were TMJ pain (VAS), cervical active ranges of motion, cervical disability (NPDS), and presence of painful palpation sites. Assessments were carried out at baseline and at one, three and six months after the end of treatment protocol.

Results: A significant reduction over time was shown both in TMJ pain levels and in NPDS values with respect to baseline ($p < 0.001$). Most parameters of active cervical range of motion showed an improvement with time. Benefits remained stable throughout six months after the viscosupplementation protocol.

Conclusions: A protocol of TMJ intra articular arthrocentesis and viscosupplementation improved cervical function and reduced disability in patients with concurrent cervical spine pain. These findings add to the complex amount of literature on the relationship between temporomandibular disorders and cervical spine disorders.

KEYWORDS
Temporomandibular disorders; neck pain; temporomandibular joint; osteoarthritis; hyaluronic acid injections

Introduction

Temporomandibular Disorders (TMD) are a heterogeneous group of disorders involving the temporomandibular joint (TMJ) and the related musculoskeletal structures. Common signs and symptoms are TMJ sounds, mouth opening limitation, joint and/or myofascial pain and muscle stiffness. They are the main cause of chronic facial pain and affect 450 millions of individuals around the world (6% of males and 10% of females).[1] Prevalence increases from the second through the fourth decade of life, with different age peaks for the different diagnoses.[2] Recent reviews and multicenter studies also focused on TMD as a potential disability cause in adults.[3,4]

Cervical spine disorders (CSD) are also very common musculoskeletal conditions that could lead to socially relevant disability in the general population. The most frequent symptom is cervical pain, often associated with cervical stiffness and limited cervical range of motion (ROM).[5] According to literature data, about 30% of men and 43% of women experience some kind of neck pain during their lifetime, with an increasing prevalence with age.[6] The prevalence of chronic neck pain is up to 11.5% in the general population.[5]

Several epidemiological studies have reported that patients with TMD often have neck pain, and vice versa: patients with neck pain may also present symptoms in the orofacial area.[7–11] The complexity of the interaction between the two conditions usually forces clinicians to manage symptoms with short-term palliative treatments. The management of chronic neck pain is mainly conservative and includes physical therapy in addition to strength and endurance training exercises.[12] Notwithstanding that, the standard of care for CSD has yet to be established.[13] Similarly, TMD management options include several

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strategies, mainly based on approaches to symptoms management.[14]

Among the different treatment modalities for TMJ disorders, viscosupplementation with hyaluronic acid (HA) has been gaining acceptance into the clinical practice, thanks to several studies showing its usefulness to manage symptoms of osteoarthritis (OA).[15–18] Despite the amount of literature on HA viscosupplementation in other joints,[19,20] its effectiveness in patients with TMJ OA who also have concurrent CSD has never been assessed. The close anatomical relationship between cranial and cervical districts may explain the co-occurrence of neck and TMD symptoms, but it seems that further investigations are needed to get deeper into the issue of such comorbidity.

Considering the above premises, the twofold aim of this study was to: (1) assess cervical function in patients with TMJ OA; and (2) evaluate the effectiveness of a treatment protocol consisting of five weekly arthrocenteses plus intra-articular viscosupplementation on the reduction of neck pain or improvement of ROM in patients with CSD.

Methods

Study design

The investigation was approved by the University of Padova's IRB.

Participants to the study were consecutive patients with a diagnosis of bilateral TMJ OA seeking treatment at the TMD Clinic, Department of Neuroscience, University of Padova, Italy. TMJ OA was diagnosed when the following signs and symptoms were present [21]:

- arthralgia (TMJ pain with lateral and/or posterior palpation plus anamnestic reporting of TMJ pain during maximum voluntary mouth opening and or maximum assisted mouth opening and/or lateral excursions);
- crepitus sounds;
- radiological signs of TMJ bone structures abnormalities, such as erosions, sclerosis, flattening, osteophytes.

Eligibility criteria

Patients were eligible for the study if they also met the following criteria: (i) a primary diagnosis of myofascial cervical pain [22]; (ii) cervical pain with stiffness and limitation of movements during the six months previous to the study; (iii) presence of at least one painful palpation point in any cervical muscles (superior trapezius, scalenus, sternocleidomastoideus, splenii colli and suboccipitalis). Subjects were excluded if they exhibited any of the following: (1) primary TMD complaint due to muscle pain; (2) history of TMJ surgery or steroid injections; (3) comorbid fibromyalgia; (4) diagnosis of any systemic disease (rheumatoid arthritis, systemic lupus erythematous, psoriatic arthritis); (5) previous cervical or head trauma; (6) history of cervical surgery; (7) diagnosis of primary headache (tension-type headache or migraine); or (8) cognitive impairment.

Outcome measures

Pain intensity

A visual-analogue scale (VAS) was used to record the patient's level of TMJ pain. The VAS is a 10 cm line anchored with a "0" at one end representing "no pain" and "10" at the other end representing "the worst pain imaginable." Patients placed a mark along the line to rate the intensity of their symptoms, which was scored to the nearest millimeter. The VAS has been shown to be a reliable and valid instrument for measuring pain intensity.[23]

Cervical spine ROM

Neck function was assessed by the same examiner, by an evaluation of active ROM with degrees of movement and muscle strength. Assessment of neck ROM, measured with a specific and validated goniometer (Inclimed®, CST, Padova, Italy),[24,25] included an evaluation of flexion, extension, lateral right and left flexion, and right and left rotation.

Painful palpation points – trigger points

Trigger points diagnosis was done following the criteria described by Simons et al. [26]: (1) presence of a palpable taut band in a skeletal muscle; (2) presence of a sensitive spot within the taut band; (3) local twitch response elicited by the snapping palpation of the taut band; and (4) presence of referred pain in response to TrP compression (approximately 20 N force for 5 s). Such criteria have been shown to have good inter-examiner reliability (kappa), ranging from 0.84 to 0.88.[27,28] Trigger point diagnosis within the suboccipitalis muscles was made when there was local tenderness in the suboccipitalis region, referred pain with maintained pressure for 10 s and increased referred pain with active extension of the upper cervical spine. Trigger points were considered active when both the local and the referred pain evoked by the compression reproduced the usual pain symptoms, and the elicited pain was familiar for the participant.[29] Trigger points were bilaterally explored within the upper trapezius, sternocleidomastoid and sub-occipital muscles by the same examiner.

Table 1. Descriptive baseline values.

	Minimum	Maximum	Average	S.D.
Age (yrs)	43	81	57.7	13.8
VAS (0–10)	3	9	5.0	2.2
Cervical flexion (°)	25	78	58.6	13.1
Cervical extension (°)	22	85	50.2	14.6
Cervical rotation right (°)	22	85	62.8	13.2
Cervical rotation left (°)	35	85	61.6	12.9
Cervical inclination right (°)	18	74	42.3	12.3
Cervical inclination left (°)	18	76	47.3	13.1
NPDS pre	10	78	38.7	15.2

Notes: YRS = years, VAS = visual analog scale, NPDS = neck pain and disability scale, S.D. = standard deviation.

Table 2. Distribution of active muscle TrPs in the sample.

	Positive	Negative
TrP upper trapezius	23 (46.9%)	26 (53.1%)
TrP scaleni	3 (6.1%)	46 (93.3%)
TrP sterno-cleido-mastoideus	8 (16.3%)	41 (83.7%)
TrP splenio	7 (14.3%)	42 (85.7%)
TrP suboccipital	3 (6.1%)	46 (93.3%)

Note: TrP = Trigger points.

Cervical disorders and disability

All subjects underwent the numerical pain rate scale Neck Pain and Disability Scale (NPDS). The NPDS was developed in the USA and then validated in the Italian language as a comprehensive measure of neck pain and related disability.[30] The 20-item scale measures problems with neck movements, neck pain intensity, effect of neck pain on emotion and cognition, and the level of interference with functional, vocational, recreational, social and emotional aspects of living. It has been shown to be easy for patients to complete and simple to score, and as a specifically developed scale, it provides a validated measure to evaluate outcomes in patients with neck pain.[30,31] Patients responded to each item by marking a 10 cm visual analogue scale. Item scores range from 0 to 5, and the total score is the sum of the item scores (possible range 0 = no pain to 100 = maximum pain).

Treatment protocol

All patients underwent a cycle of five bilateral TMJ arthrocenteses with viscosupplementation (one per week) of 1 ml HA (Sinovial® MW 800–1200 KDa; IBSA Pharmaceutics, Lodi, Italy) according to the single-needle technique described by Guarda-Nardini et al.[32] Clinical evaluation was performed at baseline and one, three and six months after the end of the treatment protocol. To maximize internal validity of findings, all interventions, as well as the clinical assessments, were performed by a single investigator (L.G.-N. and C.C., respectively). During the study protocol, patients were instructed to avoid performing any other treatment approaches (e.g. oral appliances, physical therapy), with the exception of paracetamol (acetaminophen) 500 mg tablets, as needed.

Statistical analysis

Statistical analysis included demographic data with median values and standard deviation values. Correlation analysis with Pearson's test or with Tau coefficient was performed to evaluate the existence of significant correlations between the level of TMJ pain and the different continuous or dichotomous parameters adopted to evaluate cervical function. After testing for normal distribution of all outcome variables, the significance of changes from baseline levels in the cervical variables and TMJ pain to the different observation points was assessed with ANOVA. Significance level was set at $p < 0.05$. All statistical procedures were performed with the software SPSS 19.0 (IBM, Milan, Italy).

Results

Seventy-one ($n = 71$) consecutive patients with a diagnosis of TMJ OA were screened for eligibility criteria. Nine ($n = 9$; 12.6%) patients with previous whiplash, eight patients ($n = 8$; 11.2%) with primary headache, three patients with a history of TMJ steroid injections ($n = 3$; 4.2%), one patient with previous cervical surgery ($n = 1$; 1.4%); and one patient with rheumatoid arthritis ($n = 1$; 1.4%), were excluded from the study. Finally, a total of 49 ($n = 49$) subjects (21.7% males, 78.3% females) with a diagnosis of TMJ OA (mean age 57.7 years ± 13.8) satisfied all the inclusion criteria and took part in the study.

TMJ pain intensity measured with VAS was, on average, 5.06 ± 2.2 (range 3–9). NPDS values at baseline varied from 10 to 78 (mean value 38.7 ± 15.2), indicating a moderate-to-high level of functional disability. The descriptive data concerning cervical active ROM in patients with TMJ OA are shown in Table 1. The majority of active muscle trigger points (TrPs) concerned the upper trapezius and sternocleidomastoid muscles (46.9 and 16.3% of patients, respectively). The distribution of active muscle TrPs is reported in Table 2.

At baseline, no correlations between sex, active TrPs, and cervical active ROM with TMJ VAS values were shown. A significant positive correlation was detected between TMJ pain VAS levels and the NPDS scores ($r = 0.440$; $p < 0.01$).

As for treatment effects, ANOVA test showed the presence of significant differences for VAS and NPDS values at the various observation points (VAS: $F = 18.030$, $p < 0.001$; NPDS: $F = 12.058$, $p < 0.001$). Post-hoc comparisons

Table 3. Trend of active muscle TrPs in the follow-up period.

Number of patients with positive TrPs	Baseline	1 month	3 months	6 months
Trapezius	23	13	13	9
Scaleni	3	0	0	0
Sterno-cleido-mastoideus	7	6	5	4
Splenio capitis	7	4	9	3
Suboccipital	3	3	4	2

Note: TrP = Trigger points.

Table 4. Changes in outcome variables over time.

Outcome variable	Base-line	1 Month	3 Months	6 Months	ANOVA (F)	Sig.
VAS (0–10)	5.0 (2.2)	3.0 (2.3)	2.2 (2.3)	1.9 (2.2)	18.030	<0.0001
Cervical flexion (°)	58.6 (13.1)	58.0 (13.6)	60.4 (13.5)	60.0 (13.6)	0.351	0.788
Cervical extension (°)	50.2 (14.6)	52.1 (14.2)	52.5 (14.7)	53.8 (13.2)	0.546	0.651
Cervical rotation right (°)	62.8 (13.2)	66.5 (12.7)	67.5 (12.8)	68.6 (13.8)	1.799	0.149
Cervical rotation left (°)	61.6 (12.9)	63.6 (13.6)	63.6 (14.2)	65.2 (14.7)	0.542	0.654
Cervical inclination right (°)	42.3 (12.3)	44.1 (13.0)	45.4 (12.1)	46.1 (11.8)	0.851	0.468
Cervical inclination left (°)	47.3 (13.1)	47.5 (15.5)	47.5 (14.0)	49.1 (12.8)	0.179	0.911
NPDS	38.7 (15.2)	31.8 (14.4)	26.3 (13.4)	22.5 (13.4)	12.058	<0.0001

Notes: YRS = years, VAS = visual analog scale, NPDS = neck pain and disability scale, S.D. = standard deviation.
Comparison of the mean values (s.d.) at different follow-up appointments with respect to baseline values.

showed a significant clinical improvement in VAS and NPDS values immediately after the five sessions of viscosupplementation, which was maintained throughout six months after the procedure. Regarding the clinical parameters of cervical ROM, in spite of a slight improvement with time, differences between the various observation points were not significant, with F-values ranging from 0.179 to 1.799 (p-values = 0.149–0.911). All data analyses are shown in Tables 3 and 4.

Discussion

In the literature, the possible relationship between cervical musculoskeletal impairments and TMD has been largely investigated.[33–35] However, most of the current evidence supporting the relationship between neck and craniofacial disorders came from studies with low levels of evidence.[1] Thus, the topic is still controversial and unclear, also due to the absence of studies on the possible correlation between cervical spine function and TMJ intra-articular disorders. Considering these premises, the twofold aim of the current study was to assess cervical function in patients with TMJ OA and to assess its possible changes after the management of TMJ OA symptoms.

OA is a progressive multifactorial condition leading to pain and disability.[36] New treatment modalities are being developed for articular cartilage defects [37] and, among the possible therapeutic options, intra-articular positioning of HA has proven to be effective and tolerable for patients with OA.[20,38] In the present investigation, a five session protocol of arthrocenteses plus viscosupplementation, which was shown to be effective for reducing symptoms of TMJ OA,[39] was adopted to assess whether the improvement on TMJ symptoms also affects cervical function or not.

The results show a significant correlation ($p < 0.01$) between the baseline levels of TMJ pain and cervical disability (NPDS). To the authors' knowledge, there is no literature dealing with this aspect in TMJ disorders. The cervical spine and craniofacial area have been studied in many ways and from different perspectives, but this multidisciplinary study has a potentially new clinical implication, based on the assessment of post-osteoarthritis treatment effects on cervical parameters. Indeed, findings also suggest that an effective treatment protocol for TMJ osteoarthritis,[15] providing a cycle of five combined arthrocenteses and TMJ viscosupplementation with HA, was also effective in patients with concurrent CSD. The improvement in cervical spine disability and the reduction in TMJ were maintained over the six-month follow-up. A concurrent improvement in neck and TMJ pain was thus shown, even if any speculations cannot be made on the possible cause and effect relationship between the two conditions.

This investigation also focused on myofascial cervical TrPs, which have attracted increasing attention in recent years,[26,40] but have never been assessed in subjects with TMJ disorders. In this patient population, TrPs in the sternocleidomastoid and suboccipital muscles were more prevalent than TrPs in the masticatory muscles, while the literature on muscular TMD suggests a lower prevalence of cervical TrPs.[41]

As far as the possible interpretation of the results, the findings may suggest that TMJ viscosupplementation effects positively modulate pain facilitation pathways as well as the malfunctioning of descending pain inhibitory pathways. This may allow a restoration of the endogenous analgesic control, thus playing a role in the adjustment of muscular behavior. Some authors reported the maximal cervical muscles strength, cervical flexor and extensor muscles endurance as well as cervical flexor muscle performance, while others have found an increased activity in the superficial muscles [22,42,43]; this could be seen as a strategy to compensate for the dysfunction of the deep flexor muscles. On this point, Sterling et al. [44] suggested that the presence of pain may lead to an inhibition or delayed activation of specific muscles or group of muscles in the spine. This inhibition generally occurs in deep muscles such as the longus colli and longus capitis, which control joint stability. However, according to Falla and Farina,[45] finer changes in cervical muscular activity of the cervical spine are present.

Results of this investigation are in agreement with the hypothesis that cervical muscle activity is conditioned, at least in part, by the TMJ status. So, it can be suggested that intracapsular inflammatory-degenerative disorders may require muscle adaptations to reduce the potentially derived motor instability, with subsequent pain perpetuation and reduced ranges of motion. In this way, TMJ viscosupplementation could provide a positive stimulus from the jaw district, thus improving the function of deep cervical spine muscles and reducing hyperactivation of cervical rotator muscles.

This investigation has some weaknesses. Some of them are related to the pathophysiology of TMJ disorders and/or with the techniques adopted in the investigation; others are due to the study design, and are worthy of exploration in future research. Among the former, there is the lack of information on the skeletal morphology of the patients, based on recent suggestions that individuals with a Class II skeletal type and hyperdivergent profile may be at risk for developing TMJ degenerative disorders earlier than other subjects.[46] In addition, the combined arthrocenteses plus viscosupplementation interventions did not allow gathering information on the relative effectiveness of the two components (e.g. joint lavage and the additional HA positioning). On the other hand, such aims were beyond the scope of this investigation and, based on literature suggestions, the assumption of the five-session arthrocenteses plus viscosupplementation protocol as the reference standard allowed maximizing the treatment effect,[47] thus not having any potential influence on the study outcomes. On the other hand, among the latter issues (e.g. study design features), gathering information on the MRI or CT signs of joint degeneration and their evolution over time in the patient population might have been useful to link them with the presence and course of clinical symptoms. Thus, more investigations on those aspects are needed to get deeper into the potential clinical implications of these findings, with special concerns to the definition of tailored treatment protocols for patients with temporomandibular disorders.

Conclusions

The results indicate that there is a considerable overlap in the signs and symptoms of patients with TMD and concurrent CSD, and that managing symptoms of TMJ OA may also be useful to increase parameters of cervical function. Future studies on larger sample sizes and with longer follow-up spans are needed to further confirm the results. These findings may have important clinical implications, since clinicians need to be aware that not only signs and symptoms of their region of interest (i.e. the neck or the TMJ) should be considered.

Notes on contributors

Luca Guarda-Nardini performed the TMJ arthrocentesis and viscosupplementation.
Cristina Cadorin performed the clinical assessment and drafted the early manuscript version.
Antonio Frizziero contributed to manuscript writing and coordinated the recruitment phases.
Stefano Masiero revised the paper and coordinated the clinical activities.
Daniele Manfredini revised the paper, approved its final submission, and coordinated the research project.

Disclosure statement

No potential conflict of interest was reported by the authors.

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