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Ultrasound-Guided Intra-Articular Infiltration of Hyaluronic Acid, Lidocaine, and Cortisone in Patients with Temporomandibular Disorders (TMD): Our Experience

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Abstract

(Background/Objectives): This study aims to evaluate the efficacy of an ultrasound-guided infiltration method with hyaluronic acid and corticosteroids in the treatment of Temporomandibular Disorders (TMD). **(Methods):** Twenty-eight patients (16 females and 12 males), aged between 25 and 55 years, with TMD and evidence of retrodiscal tissue hyperemia on Magnetic Resonance Imaging (MRI) of the Temporomandibular Joint (TMJ) were enrolled. Before treatment, the intensity of preauricular pain was assessed using the Visual Analogue Scale (VAS), and the presence of associated symptoms such as tinnitus, vertigo, headache, and joint clicking was recorded. After the creation of individualized interocclusal devices, a bilateral ultrasound-guided infiltration of low molecular weight hyaluronic acid and corticosteroid was performed. **(Results):** Immediately after treatment, joint clicking disappeared in 80% of patients. Follow-up assessments at 30, 60, and 90 days, supported by control ultrasound, showed a substantial and statistically significant ($p < 0.001$) improvement in pain symptoms. **(Conclusions):** The ultrasound-guided infiltration technique proved to be a valid short-term therapeutic option for patients with TMD and inflammation of the retrodiscal tissue. A larger sample size and long-term follow-up are necessary to confirm these preliminary results.

Keywords: temporomandibular joint (TMJ); Temporomandibular Disorders (TMD); hyaluronic acid; ultrasound-guided infiltration; preauricular pain

1. Introduction

Temporomandibular Disorders (TMD) represent a complex of signs and symptoms affecting the temporomandibular joint (TMJ) and the masticatory musculature [1,2]. The scientific literature has extensively shown that patients with TMD present a heterogeneous symptomatology, which can include pain, functional limitations, joint noises, and otoneurological symptoms [3,5]. Recently, the therapeutic approach has been enriched with minimally invasive techniques, including intra-articular infiltrations, which have shown promising results in pain control and functional recovery [6,10].

The diagnosis of TMD is based on a careful clinical evaluation, which includes medical history, physical examination of the masticatory muscles, and analysis of mandibular dynamics, sometimes assisted by instrumental examinations such as mandibular kinesiography. The diagnostic imaging of choice for studying the joint components is dynamic Magnetic Resonance Imaging (MRI), which allows a detailed analysis of the morphology and position of the articular disc during mouth opening

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and closing movements, as well as the evaluation of the state of the soft tissues, such as the retrodiscal tissue, and the possible presence of joint effusion [4].

This study focused on patients who experienced pain in the preauricular region, both at rest and exacerbated during mastication, associated with an alteration of the condyle-disc complex dynamics, as an expression of an inflammatory process (phlogosis) of the retrodiscal tissue. The purpose of this work was to evaluate the efficacy and safety of the ultrasound-guided infiltration technique with hyaluronic acid and corticosteroids in this specific patient population. This approach, already established in the treatment of other joint diseases [9,12,17], was applied here to the TMJ, intervening directly on the area of inflammation highlighted by MRI.

2. Materials and Methods

2.1. Study Design and Patient Selection

A prospective study was conducted between January 2014 and December 2015 at the Center for Integrated Functional Orthodontics in Palermo. The study received approval from the local ethics committee (No. 1/2014-14.01.2014, Ethics Committee of the University of Palermo) and was conducted in accordance with the principles of the Declaration of Helsinki. All participants provided written informed consent before enrollment.

Twenty-eight patients (16 females and 12 males), with a mean age of 39.1 (± 8.9) years (range: 25-55), were selected, referring to the center for pain and dysfunctional symptoms of the TMJ.

Inclusion criteria were:

1. Clinical diagnosis of TMD.
2. Presence of preauricular pain, assessed by VAS scale.
3. MRI evidence of altered signal in the retrodiscal tissue, indicative of inflammation.

Exclusion criteria were:

1. History of maxillofacial trauma in the previous 6 months.
2. Presence of fixed orthodontic treatments.
3. Presence of complete removable dentures.

2.2. Preliminary Clinical and Instrumental Evaluation

The initial evaluation included the administration of a Visual Analogue Scale (VAS) to quantify the intensity of the pain perceived by the patient. The scale consisted of a 10 cm line, where 0 represented “no pain” and 10 “the worst imaginable pain”. Patients were also given a questionnaire to record the presence and characteristics of associated symptoms, as summarized in Table 1.

Table 1. Questionnaire for the evaluation of symptoms associated with TMD.

Symptom	Characteristic	Options
Headache	Frequency	1) Upon waking, 2) Afternoon, 3) Evening
	Localization	Frontal, Occipital, Parietal, Temporal
Vertigo	Type	1) Subjective, 2) Objective
Tinnitus	Laterality	1) Unilateral, 2) Bilateral
Cervical ROM	Evaluation	1) Regular, 2) Limited
Dysphagia	Presence	1) Present, 2) Absent
Neck Tension	Presence/Laterality	1) Present (Unilateral/Bilateral), 2) Absent
Joint Clicking	Presence	1) Present, 2) Absent

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2.3. Realization of Interocclusal Devices and MRI Acquisition

For each patient, impressions of the dental arches were taken in alginate, and the habitual occlusion and a position of mandibular protrusion were recorded using wax bites. Subsequently, in the dental laboratory, four interocclusal devices were made of silicone with a hardness of 63 shore A, with vertical thicknesses of 10, 20, 30, and 40 mm.

The patients were then sent to a radiology center for a dynamic MRI of the TMJ. A Philips Achieva 1.5T D-stream machine was used. The acquisition protocol included sequences with the mouth closed and with the different interocclusal devices to evaluate the condyle-disc dynamics at various degrees of opening.

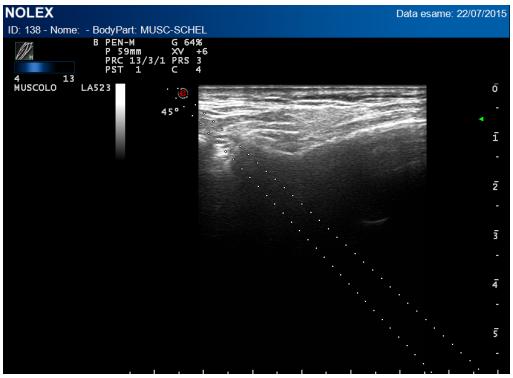
2.4. Ultrasound-Guided Infiltration Procedure

All patients underwent a single intra-articular ultrasound-guided (US-guided) infiltration in both TMJs. The procedure was performed using a MyLab 70 XVG ultrasound machine (Esaote) with a multi-frequency linear probe (3-15 MHz), equipped with a needle guide.

The procedure was carried out as follows, and is illustrated in Figure 1:

1. **Patient positioning:** The patient was positioned in lateral decubitus, contralateral to the side to be treated.
2. **Target identification:** Through longitudinal ultrasound scans with the mouth open and closed, the antero-superior portion of the joint capsule was identified as the target for the infiltration, in order to optimize the distribution of the drug in the bilaminar area.
3. **Preparation:** After disinfecting the skin with a povidone-iodine solution, an interocclusal device (30 or 40 mm) was positioned to maintain the maximum possible opening and facilitate access to the glenoid fossa.
4. **Anesthesia and Infiltration:** After cutaneous anesthesia with ethyl chloride spray, a 20G spinal needle was inserted with an oblique approach of 45° under continuous ultrasound guidance. Once the needle was positioned inside the capsule, 1 ml of low molecular weight hyaluronic acid (Sinoviale HL 32, IBSA) and 0.5 ml of a combined corticosteroid and anesthetic preparation (Depo-Medrol + Lidocaine, 40 mg/ml of methylprednisolone acetate and 10 mg/ml of lidocaine, Pfizer) were injected. During the retraction of the needle, an additional 0.5 ml of corticosteroid was infiltrated in the periarticular area.

(a)



(b)

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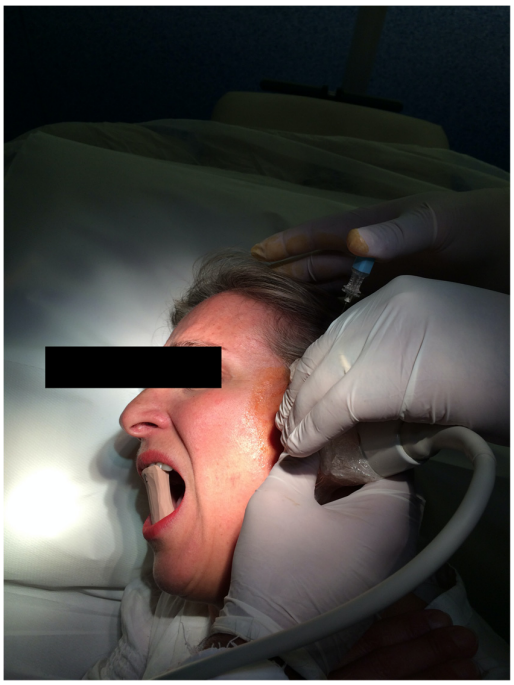
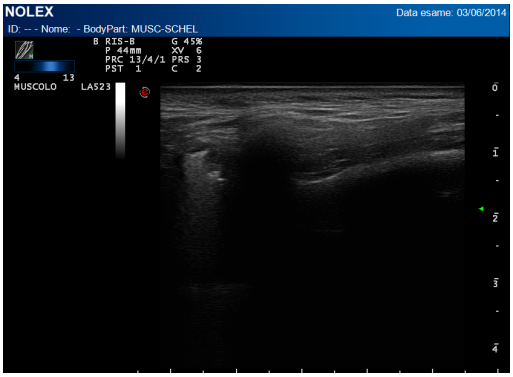


(c)



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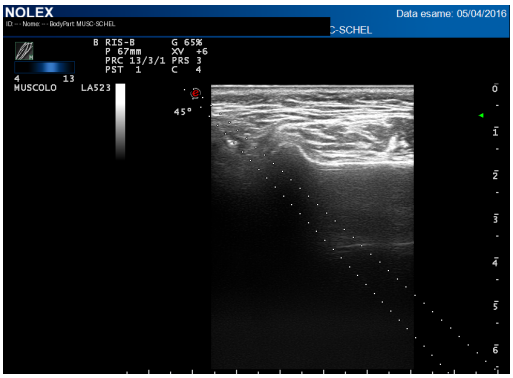

(f)

Figure 1. Ultrasound-guided intra-articular infiltration technique. (a) Positioning of the ultrasound probe in the preauricular region. (b) Pre-infiltration ultrasound image showing the needle guide at a 45° angle. (c) Needle insertion with an interocclusal device in place to ensure correct mandibular position. (d) Ultrasound image of the temporomandibular joint. (e) Infiltration in progress. (f) Ultrasound image during the infiltration procedure, showing the needle path.

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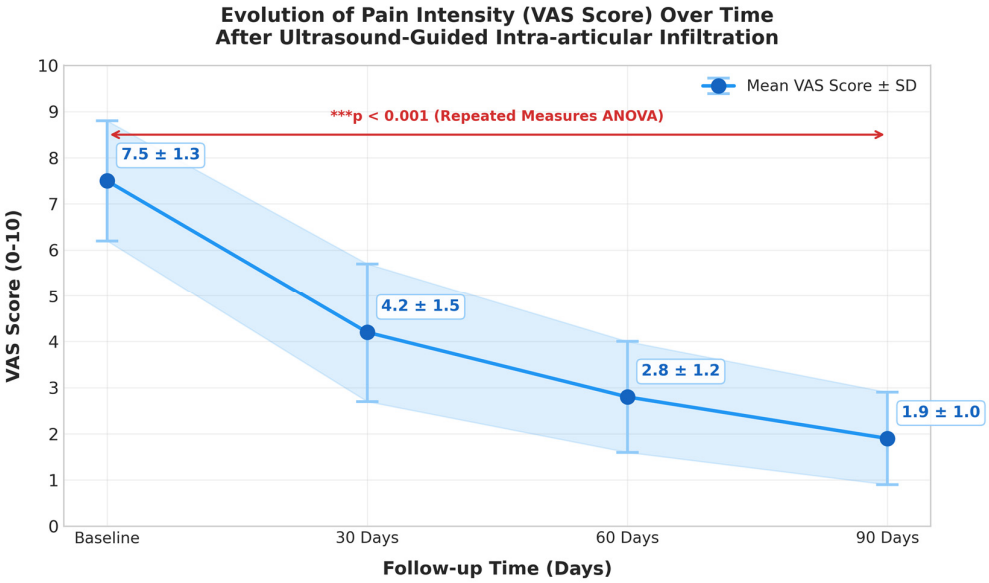

Figure 2. Evolution of pain intensity measured by Visual Analogue Scale (VAS) over the 90-day follow-up period. Data are presented as mean ± standard deviation. Repeated measures ANOVA confirmed a statistically significant reduction in pain across all time points ($F(3, 81) = 95.61$, $p < 0.001$).

2.5. Post-Infiltration Evaluation and Follow-Up

After the infiltration, the patients were monitored for 15 minutes. A dynamic ultrasound was performed to check the condylar sliding. The patients were re-evaluated clinically and with a control ultrasound at 24 hours, 30 days, 60 days, and 90 days after the treatment to monitor the evolution of the symptomatology.

3. Results

The study population consisted of 28 patients (16 females, 57.1%; 12 males, 42.9%) with a mean age of 39.1 ± 8.9 years. All patients completed the treatment protocol and the 90-day follow-up period.

3.1. Pain Assessment (VAS Scale)

The mean pain score on the VAS scale at baseline (T0) was 70.54 ± 11.43. After treatment, a statistically significant reduction in pain was observed at all follow-up times, as confirmed by repeated measures analysis of variance (ANOVA) ($F(3, 81) = 95.61$, $p < 0.001$). The mean scores are reported in Table 2.

Table 2. Evolution of the VAS score over time.

Time Point	Mean VAS Score (± SD)	% Reduction vs. T0	p-value
Baseline (T0)	70.54 (± 11.43)	-	-
30 days (T1)	48.29 (± 10.02)	31.54%	< 0.001
60 days (T2)	44.46 (± 9.41)	36.96%	< 0.001
90 days (T3)	43.04 (± 11.15)	38.99%	< 0.001

3.2. Associated Symptoms

All 28 patients presented with joint clicking at baseline. Immediately after treatment, the disappearance of the joint click was observed in 80% of cases (22/28 patients). Furthermore, patients

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subjectively reported a reduction in the frequency and intensity of other investigated symptoms, such as headache, vertigo, and tinnitus.

3.3. Adverse Events

The procedure was well tolerated by all patients. There was only one case (3.6%) of temporary and self-resolving paralysis of the mimic muscles ipsilateral to the injection site. No other complications were recorded.

4. Discussion

The results of this preliminary study suggest that ultrasound-guided intra-articular infiltration with hyaluronic acid and corticosteroids is a safe and effective procedure in reducing pain symptoms and improving joint function in patients with TMD characterized by inflammation of the retrodiscal tissue. The significant reduction in pain ($p < 0.001$), observed as early as 30 days after treatment and maintained for up to 90 days, is a clinically relevant finding.

The hypothesized mechanism of action is threefold: the anesthetic (lidocaine) provides immediate pain relief; the corticosteroid acts rapidly on the inflammatory component, reducing hyperemia and edema of the retrodiscal tissue, while hyaluronic acid contributes to viscosupplementation, improving joint lubrication and protecting the cartilage. The disappearance of the joint click in a high percentage of patients supports the hypothesis of improved sliding of the condyle-disc complex.

These results are in line with the existing literature on the use of hyaluronic acid and corticosteroids in other joints [9,12,17], but our study adds specific evidence on the effectiveness of the ultrasound-guided approach in the TMJ, which ensures precise needle placement and increases the safety of the procedure. The single case of temporary paralysis of the mimic muscles can be related to the diffusion of the anesthetic component and a possible anomaly in the course of a branch of the trigeminal nerve.

Limitations of the study: This study has some limitations, including the small sample size, the absence of a control group (e.g., placebo or other therapy), and a relatively short follow-up period.

5. Conclusions

In conclusion, the ultrasound-guided infiltration technique with hyaluronic acid and corticosteroids has proven to be a valid and safe therapeutic option for the short-term treatment of pain and associated symptoms of TMD with an inflammatory component. The integration of this technique into clinical practice could represent a significant advancement in the management of TMD, especially in cases where inflammation of the retrodiscal tissue is a key pathogenic factor. The biomechanical harmony of the tongue-mandible-hyoid system is crucial for proper stomatognathic function, and alterations, such as those observed in TMD, can have repercussions on the entire system [21]. The presence of an elongated styloid process, as in Eagle syndrome, can further complicate the clinical picture, creating an anatomical substrate that predisposes to or exacerbates TMD symptoms [22]. It is plausible that the proposed infiltration technique could also be beneficial in managing the inflammatory and pain symptoms associated with Eagle syndrome, although specific studies are needed to validate this hypothesis. Therefore, a comprehensive diagnostic approach that considers these anatomical and functional relationships is essential for targeted and effective treatment. Although the results of our study are encouraging, randomized controlled trials with a larger sample and a long-term follow-up are necessary to confirm the effectiveness of this method and to define its role within a multimodal therapeutic pathway that also considers the complex biomechanics of the craniocervical-mandibular region.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the University of Palermo (No. 1/2014-14.01.2014).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Conflicts of Interest: The authors declare no conflict of interest.

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