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Non-Pharmacological Pain Treatment of Patients with Myofascial Pain Syndrome of the Masticatory Muscles—Case Series

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Abstract: Myofascial pain is the most common cause of chronic pain in the masticatory region and can be assessed through clinical analysis and muscle palpation. Generally, it appears with headache and orofacial pain associated with sensitive points (trigger points) due to the excessive contraction of the masticatory muscle fibres. The study aims to evaluate how a correct treatment of myofascial pain can improve the life quality of the affected patients. In this case series, 300 patients with myofascial pain were divided into two groups: 150 with intra- and extra-articular disorder and 150 with the only extra-articular disorder. Each group included 75 males and 75 females. All the patients were treated with gnathological therapy through passive aligners and biofeedback exercises for 4 months. They underwent pain assessment (through a visual analogue scale and muscular palpation test) before, during and after the treatment, and nuclear magnetic resonance of the temporomandibular joint before and after the gnathological treatment. The treatment considerably reduced the pain in all patients, without drugs, in 4 months, according to the visual analogue scales and the palpation test. The temporomandibular magnetic resonance in each patient was similar before and after the gnathological treatment. The improvement in pain did not depend on a change in the relationship between the articular condyle and the disc.

Keywords: myofascial pain; temporomandibular joint; temporomandibular disorder; TMD; TMJ MRI

1. Introduction

Temporomandibular disorders (TMD) are a group of musculoskeletal and neuromuscular conditions involving the temporomandibular joint complex and the surrounding musculature and osseous components. TMD affects up to 15% of adults, with a peak incidence from 20 to 40 years. TMD is classified as intra-articular and extra-articular diseases. The intra-articular TMD are congenital, developmental or degenerative disorders in which the relationship among the articular disc, the mandibular condyle and the glenoid fossa are impaired. The extra-articular TMD includes disorders involving the masticatory muscles: local myalgia, myofascial pain disorder, myofibrotic contracture, myositis and myospasm [1]. The aetiology of TMD is multifactorial. Temporomandibular disorders have a wide range of causes, among which the most common are severe malocclusions, stress, anxiety, mandibular instability, postural imbalance, pathological conditions and parafunctional habits [2–4]. Parafunctional habits, bruxism and clenching, cause constant micro trauma of the temporomandibular joint (TMJ). This condition stimulates the fibres of the masticatory muscles for a long time, causing pain in the affected areas [5]. The most frequent TMD associated with unconscious clenching is myofascial pain syndrome. [6]

The myofascial pain syndrome also represents one of the maxillofacial region's most common chronic problems. It is classified as a dysfunction of the stomatognathic system that belongs to the Axis I Pain-Related TMD. In the new DC/TMD, the term "myofascial pain" implies two new DC/TMD diagnoses: 1) myofascial pain, that is, pain spreading beyond the site of palpation but within the palpated muscle, and 2) myofascial pain with referral, that is, the pain of an area beyond the boundary of the palpated muscle [7].

Myofascial pain syndrome is a painful condition characterised by trigger points, which create local and referred pain, tenderness, autonomic phenomena, anxiety and depression [8]. A myofascial trigger point (MTrP) is a hyperirritable spot, usually within a taut band of skeletal muscle, which provokes pain when compressed and can lead to a characteristic referred to as orofacial pain, headache, and motor dysfunction. The painful symptoms result from hyperalgesia of trigger points which radiates pain to distant sites [9]. There are two main types of myofascial trigger points (MTrP): active MTrP and latent MTrP. An active TrP produces constant pain, while a latent TrP causes pain only during palpation [10]. The scientific evidence of the remarkable sensory capacity of muscle fasciae can be explained through this review. It investigates histological and immunohistochemical aspects of fascial innervation, proposing that the fasciae may be considered our largest sensory organ given its complete surface area and participating actively in proprioception and nociception. In the head, in particular, for the masseter fascia, the innervation density between the muscle and its fascia has been compared, demonstrating that the latter is more innerved (404.5 fibres/area mm2 inside the connective tissue) concerning the masseter muscle (227.6 fibres/area mm2). Besides, most of the nerves were nociceptors [11]. Pathological fascia is characterised by increased tissue stiffness and alterations in myofibroblast activity and the extra-cellular matrix regarding collagen and Matrix Metalloproteases (MMP) levels. Pain originating from the deep fascia likely results from increased nerve density, sensitisation and chronic nociceptive stimulation, whether physical or chemical [12].

Studies also reported tension-type headaches (TTH) and migraine is associated with referred pain from TrPs in several muscular areas such as the suboccipital, upper trapezius, sternocleidomastoid, temporalis, or superior oblique ones. Referred pain caused by active TrPs simulates the pain areas detected during head pain episodes in these primary headaches [13–15]. One interesting theory that underlines the importance of the MTrP and its relationship to headaches is that the progression from episodic to chronic forms of TTH is related to prolonged nociceptive input from peripheral myofascial tissues. [16].

Myofascial pain in masticatory muscles is associated with parafunctional habits such as teeth clenching and grinding and emotional factors such as distress. Parafunctional patterns during the day and sleep bruxism induce the intensification of muscle tension connected to myofascial pain [17]. The muscle symptoms include fatigue and increased tension, especially about elevator muscles (m. Masseter and m. Temporalis) [18,19]. The patients refer pain in specific areas, especially around the jaw, temples and ears.

The presence of myofascial trigger points and associated orofacial and referred pain diagnose myofascial pain syndrome. The trigger points can be detected by palpation of the muscles, which consists of palpating the muscle perpendicular to the direction of the muscle fibres [20]. The palpation pressure is 1 kg for 2 seconds. To differentiate the types of myalgia, the duration of this pressure is increased up to 5 seconds to elicit spreading or referred pain, if present. [21].

Furthermore, ultrasound imaging makes assessing the muscles and fasciae of the head and neck region activity and the trigger point areas possible. This device permits the evaluation of the ability of the muscles to contract and identifies functional asymmetry that could become symptomatic [22]. The ultrasound image can help diagnose temporomandibular dysfunction, but cases, for example, that are scheduled for surgery should be evaluated with MRI [23].

This study aimed to evaluate the reduction of head and orofacial pain caused by MTrP associated with unconscious teeth clenching. Patients were treated with passive aligners and biofeedback exercises to teach them not to clench their teeth [24]. The treatment lasted 4 months.

An adequate, non-pharmacological, gnathological therapy leads to the remission of orofacial pain and active trigger points [25,26].

2. Materials and Methods

This case series was conducted in the Oral Sciences Department of the University of Chieti G. D'Annunzio. The study protocol was designed per the European Union Good Practice Rules and the

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Helsinki Declaration. Each patient provided written informed consent to participate in this study. Ethics approval (number 23) was obtained by the hospital's Independent Ethics Committee of Chieti.

The study considered diagnosing myofascial pain with referral headaches according to DC/TDM and ICHD-3 beta criteria.

All 300 selected patients underwent a quantitative pain assessment through a visual analogue scale (VAS) and palpation test before, during, and magnetic resonance imaging of the temporomandibular joint (TMJ MRI) before and after the gnathological treatment. The initial TMJ MRI was required to collocate patients in the right groups; the final TMJ MRI was needed to assess the unaltered relationship between disc and condyle.

The study lasted for 3 years: 18 months to recruit the patients, 12 months for the follow-up and 6 months for the data processing. The patients were treated for 4 months.

Sample size

358 patients were eligible for the study [27]. 42 declined to participate, and 16 were lost during follow-up.

The sample included 300 patients with unconscious teeth clenching and myofascial pain syndrome.

150 pts with extra-articular TMD were included in the first group, whereas 150 pts with extra and intraarticular TMD were included in the second group.

Each group comprised 75 men and 75 women.

Inclusion Criteria

(1) Patients between 18 – 55 years.
(2) Diagnosis of myofascial pain in the masticatory muscles.
(3) Pain, including headache, in the last 30 days since the stated sensitivity (new DC/TMD)
(4) Average pain severity of 4 on a 10-point scale for at least 1 hour daily.

Exclusion Criteria

(1) Pregnancy.
(2) Psychiatric disorder or current use of psychiatric medications.
(3) Presence of whatever cause of chronic pain disorder.
(4) Family history of arthritis or gout.
(5) Current use of non–steroidal anti-inflammatory drugs, paracetamol, or opioids.

Measurements

VAS: visual analogue scale (VAS). It was a graphic representation of the patient's face, where he had to highlight painful areas specifying the intensity (from 0=No Pain to 10=Maximum Pain) and occurrence of the disturbance. [28].

Each patient completed the VAS before and after treatment and at each month of the follow-up appointment. Every month the same operator visited each patient.

PALPATION: The aim was to find trigger points in masticatory muscles (temporal, masseter, sternocleidomastoid, digastric, and pterygoid muscles), which, once stimulated, produce or increase orofacial pain and referred headache.

The same operator made the palpation on all patients every month. The operator manually exerted the pressure of 1 kg bilaterally for 5 seconds on the masseter, temporal, pterygoid, sternocleidomastoid and digastric masticatory muscles.

The pain was classified by the patient on a scale from 0 to 3:

- 0: absence of pain.
- 1: mild pain or apparent discomfort.
- 2: moderate pain or discomfort.
- 3: severe pain [29].

Each patient underwent a palpation test before and after treatment and each month of the follow-up appointment. Every month the same operator did the test patient, and the same operator performed the palpation test.

MRI TMJ: MRI evaluated the integrity of the temporomandibular joint.

It has been used to diagnose intra-articular or extra-articular disorders before the treatment, to localise patients in the correct group, and to assess changes in the condyle-disc relationship after treatment.

Each patient underwent TMJ MRI with open-mouth and closed-mouth postures before and after the treatment.

Treatment protocol

The treatment protocol used two passive splints (lower and upper). To obtain the greatest possible comfort for the patient, the splints were made of polycarbonate and customised in the mouth to avoid irritation or damage to the soft tissues. Furthermore, the thickness of the splints was <0,7mm.

The patients wore the lower passive aligner splint (LPAS) during the daytime and the upper passive aligner splint (UPAS) at night. The splint was removed only at mealtimes and during oral hygiene, and the two splints were never in the mouth simultaneously.

While wearing the LPAS, the patients performed a biofeedback exercise for two minutes daily (before breakfast, lunch, and dinner) over the study duration.

To avoid bias during the biofeedback exercise, the patients must maintain the upright or lying position without crossing their legs or arms. Traditionally biofeedback is presented to the patient and the clinician via visual displays and acoustic or vibrotactile feedback [30]. In our case, the patient was asked to imagine a tennis ball during the exercise phases, so the neuronal activation during the biofeedback visualisation corresponded to the action phase.

The exercise consisted of 4 steps [31].

The first step was characterised by the full contraction on the masseters and the teeth clenching. The patients had to visualise the maximum contraction of the muscles as a fully inflated tennis ball, with the help of a light touch of the cheeks with the forefinger.

In the second step, the patients had to clench their teeth, partially contracting the masseter (on each side) and associating a light touch with the forefinger. A semi-deflated tennis ball was visualised this time [31].

During the third step, the patients fully relaxed their jaw (opened about 1 mm). They applied a light touch with the forefinger on the fully relaxed masseter, visualising the muscle's volume as a deflated tennis ball.

In the last step, the patients touched the top of the palatine vault with the tip of the tongue for five seconds[31].

The duration of the treatment (and consequently of the performance of the biofeedback exercise) was 4 months. Then, a new assessment was made using the VAS and palpation of the pertinent muscles, and TMJ MRI was repeated to evaluate the treatment effect and outcome.

The patients recorded pain diaries during the study period to supervise compliance and examine and monitor symptoms' development [31].

Patients were followed up after one year, and only 6 of them showed relapses with mild symptoms[31].

Study Protocol

The subjects' selection required the diagnosis of myofascial pain syndrome based on a standardised and complete clinical examination which fulfilled the Research Diagnostic Criteria (RDC TMDs) [32].

After recruitment, they underwent TMJ MRI to assess the intra-articular TMJ condition.

The study included 300 patients with myofascial pain matched for sex, 150 with intra-articular and extra-articular TMD and 150 with extra-articular TMD, classified by the TMJ MRI.

In the study's first phase, the patients underwent the palpation test and visual analogue scale to assess, measure and locate the pain.

In the study's second phase, the patients were treated with the gnathological therapy previously described for 4 months. All patients underwent follow-up appointments once a month, in which he underwent the VAS and palpation test again by the same operator for all months.

After 4 months, TMJ MRI with open-mouth and closed-mouth postures were performed again.

Statistical methods

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All statistical analysis was performed using SPSS 26.0 (IBM, Armonk, NY) and evaluated at a two-tailed alpha level 0.05. The sample population was assessed to determine the deviation ratio for women to men from the expected 1:1 (Fisher's exact test) and differences in the distribution of VAS scores (Pearson´s chi-squared). The effect of the treatment protocol on modifying the parameters was assessed using a Wilcoxon Signed Ranks Test. Correlations between the modification of VAS with baseline and change of palpation measurements were evaluated using Spearman's rho.

3. Results

All patients were affected by orofacial pain and headache but no migraine.

After treatment, the primary outcome was pain reduction, assessed by VAS and palpation test after 4 months. Patients were re-examined after one year; only 6 showed relapses with mild orofacial pain. Anyway, these patients did not require any medications.

We observed that pain symptomatology decreased in all patients by comparing the baseline values (T1) to post-treatment values (T2). The improvements were unrelated to age (data not shown) and gender but related to symptom intensity and chronicity at T1.

The characteristics of the study group are reported in Table 1.

All patients completed the treatment protocol using gnathological therapy consisting of passive aligners[33] and biofeedback exercises, and nine patients were lost to follow-up.

Table 1. Study population characteristics.

	Women	**Men**	**Total**
N	141 (48%)	150 (52%)	291
Age	36.2+10.4	36.7+10.5	36.5+10.5
VAS T0	7.9+1.3	8+1.1	8+1.2
VAS T1	1.4+1.2	1.2+1.2	1.4+1.3
Delta VAS	6.5+1.4	6.7+1.2	6.7+1.4
Masseter T0	2.5+0.5	2.6+0.4	2.6+0.5
Masseter T1	0.5+0.6	0.5+0.5	0.6+0.6
Temporal T0	2+0.6	2.1+0.6	2.1+0.7
Temporal T1	0.3+0.4	0.3+0.4	0.4+0.5
Pterygoid T0	2.8+0.3	2.8+0.3	2.9+0.4
Pterygoid T1	0.8+0.6	0.8+0.6	0.9+0.7
Sternocleidomastoid T0	1.8+0.8	1.8+0.8	1.9+0.8
Sternocleidomastoid T1	0.2+0.4	0.2+0.4	0.3+0.5
Digastric T0	0.8+0.7	0.9+0.7	0.9+0.8
Digastric T1	0+0.1	0+0.1	0+0.2
Delta Masseter	2+0.6	2.1+0.6	2.1+0.6
Delta Temporal	1.7+0.6	1.7+0.6	1.7+0.6
Delta Pterygoid	1.9+0.6	1.9+0.6	2+0.7
Delta Sternocleidomastoid	1.5+0.7	1.6+0.7	1.6+0.8
Delta Digastric	0.8+0.7	0.8+0.7	0.9+0.7

[1] T0: time zero. T1: time one. VAS: visual analogue scale.

The statistical results are reported in Table 2.

Table 2. Statistical results.

VAS with		**Masseter**	**Temporal**	**Pterygoid**	**Sternocleidomastoid**	**Digastric**
T0						
Women	CC	.124	-.087	.061	-.027	.160
	p	.143	.304	.473	.752	.059
Men	CC	.047	-.168	.032	-.008	-.116
	p	.565	.040 *	.696	.918	.157

delta						
Women	CC	.124	-.087	.061	-.027	.160
	p	.143	.304	.473	.752	.059
Men	CC	.114	-.143	.069	.071	-.096
	p	.166	.082	.401	.386	.241

* T0: time zero.

The sample population did not differ from the expected 1:1 ratio of women to men, and the distribution of VAS scores with age did not differ between the sexes. Treatment significantly modified the VAS and palpation scores ($p<0.001$, Wilcoxon Signed Ranks Test).

The modification of VAS scores was highly correlated (positively) with the change of the Masseter palpation score ($p=0.001$) and correlated with the improvement in the Sternocleidomastoid palpation score ($p=0.016$). There was a trend toward statistical significance with the Pterygoid palpation score ($p=0.092$). The modifications in palpation scores were all highly correlated, with a range of $p<0.001$ (to $p=0.021$), except for Temporal - Pterygoid, Masseter - Pterygoid, and Pterygoid - Digastric.

Initial palpitation scores did not correlate with modifying the VAS score, except for the Pterygoid palpation score ($p=0.030$, positive correlation).

When dividing the sample population into women and men separately, only the initial Temporal palpation score negatively correlated with the modification of the VAS score ($p=0.040$).

The impact of the gnathological treatment on trigger points (palpation) respectively in the 150 patients with the extra-articular disorder and the 150 patients with the intra-ed extra-articular disorder, compared to baseline (T1), post-treatment (T2) pain extent and intensity during palpation test decreased uniformly. Again, the improvements were not related to age and gender but to symptom intensity and chronicity at T1.

4. Discussion

This study reports the impact of gnathological therapies with passive aligners [33] and biofeedback exercises in patients with myofascial pain syndrome associated with unconscious teeth clenching[33]. All patients had orofacial pain and headache as referred pain of MTrP.

Myofascial pain can be treated through invasive or non-invasive procedures. Non-invasive measures are spray and stretch, transcutaneous electrical stimulation, physical therapy and massage. Among them, Fascial Manipulation was shown to reduce pain and the gold standard in orofacial pain [34]. Invasive treatments for myofascial trigger points include injections with local anaesthetics, corticosteroids, botulinum toxin or dry needling [35]. Most patients improve with a combination of non-invasive therapies such as patient education, self-care, cognitive behaviour therapy, pharmacotherapy, physical therapy, and occlusal devices. Some patients are also treated with nonsteroidal anti-inflammatory drugs and muscle relaxants; benzodiazepines or antidepressants may be added for chronic cases. Oral and maxillofacial surgery is indicated for refractory cases [36].

The biofeedback technique is a method to teach patients to recognise, correct and prevent the physiological alterations underlying various pathological conditions, with their consequent reduction or elimination. Biofeedback approaches to headache therapy fall into two broad categories: general biofeedback techniques and techniques more directly related to the pathophysiology underlying the onset of the headache. Several meta-analyses have evaluated the use of available biofeedback-assisted relaxation techniques for headaches. These reviews indicate that various biofeedback techniques are effective for migraine and tension-type headaches [37]. Biofeedback exercises of the tongue aim at enhancing patients' awareness about the position of palatal arches associated with jaw clenching so that they can learn to stop or decrease this habit.

This study included 300 pts (150 men and 150 women), aged between 18 and 55 years, that showed orofacial pain (VAS values between 5 and 10), trigger point of masticatory muscles and mandible movement restriction. All 300 patients had no migraine, and none had a family history of arthritis or gout.

After the treatment, we noticed a significant (TABLE 1, TABLE 2) decrease in the symptomatology, both about referred pain (VAS) and trigger points (previously detected by muscle palpation). The TMJ resonance did not change the disc-condyle relationship in patients with extra- and intra- articular disorders and those with only extra-articular disorders. However, the treatment effectively reduced pain regardless of the intra-articular relation between the condyle and disc. All patients showed a significant decrease in the symptoms after 4 months of therapy and did not report any relapse after one year.

The treatment protocol does not change the intra-articular interaction between the disc and condyle, as revealed by the MR analysis of the TMJ, thus limiting its action to ameliorating the symptoms [38]. However, joint noises do not necessarily correlate with pain severity or functional limitation. The most appropriate markers of treatment success are the absence of pain, improved function and standard quality of life [38]. The lack of clicking is not a reliable indicator of whether the patient has responded to treatment [39].

Finally, our findings demonstrate that this therapeutical setup efficiently reduces[40] the pain of myofascial syndrome in both intra- and extra-articular TMD patients, regardless of age and gender [40]. It is of great interest that the pain is reduced without pharmacological treatment and dental orthodontic or prosthetic treatments. The muscle biofeedback exercise [41] is sufficient to teach the patient not to clench the teeth and the splints to release the arches. [41]The muscle relaxation obtained implies the reduction of pain and improved function.

No improvements have been observed in patients with intra-articular disorder regarding disc dislocation. Pain relief does not depend on a change in intra-articular condition.

5. Conclusions

From our perspective, the importance of this research lies in the fact that orofacial pain is treated with a conservative non-medical treatment, which requires only 4 months. The patients were re-examined after one year, and only six showed a mild relapse, which did not require any drugs.

The limit of this study is the wide range of ages. Still, we think it can be helpful to those clinicians who want to treat orofacial pain and referred headaches by myofascial pain syndrome of the masticatory muscles without medications and with a low relapse rate after one year.

Author Contributions: MM: submitted the study protocol to the ethics committee. FF, and MM selected the sample. MM analysed data. FF, MM, CR and FP wrote the manuscript. All authors read and approved the final manuscript.

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

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