Short-Term Effects of Dry Needling of Active Myofascial Trigger Points in the Masseter Muscle in Patients With Temporomandibular Disorders

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Aims: *To investigate the effects of dry needling over active trigger points (TrPs) in the masseter muscle in patients with temporomandibular disorders (TMD).* ***Methods:*** *Twelve females, aged 20 to 41 years old (mean = 25, standard deviation ± 6 years) diagnosed with myofascial TMD were recruited. Each patient attended two treatment sessions on two separate days and received one intervention assigned in a random fashion, at each visit: deep dry needling (experimental) or sham dry needling (placebo) at the most painful point on the masseter muscle TrP. Pressure pain threshold (PPT) over the masseter muscle TrP and the mandibular condyle and pain-free active jaw opening were assessed pre- and 5 minutes postintervention by an examiner blinded to the treatment allocation of the subject. A two-way repeated-measures analysis of variance (ANOVA) with intervention as the between-subjects variable and time as the within-subjects variable was used to examine the effects of the intervention.* ***Results:*** *The ANOVA detected a significant interaction between intervention and time for PPT levels in the masseter muscle ($F = 62.5$; $P < .001$) and condyle ($F = 50.4$; $P < .001$), and pain-free active mouth opening ($F = 34.9$; $P < .001$). Subjects showed greater improvements in all the outcomes when receiving the deep dry needling compared to the sham dry needling ($P < .001$).* ***Conclusion:*** *The application of dry needling into active TrPs in the masseter muscle induced significant increases in PPT levels and maximal jaw opening when compared to the sham dry needling in patients with myofascial TMD.* J OROFAC PAIN 2010;24:106–112

Key words: dry needling, masseter, temporomandibular disorder, trigger points

Temporomandibular disorders (TMD) manifest pain that can affect the temporomandibular joints as well as the jaw muscles.[1] Myofascial pain is one of the major causes of non-dental pain in the orofacial region, accounting for approximately 30% of patients who seek treatment for TMD.[2] A descriptive epidemiological study found that 3 to 15% of the Western population suffers from TMD pain.[3] One longitudinal study has shown substantial variations in the time course of myofascial TMD, with 31% persistenting over a 5-year period, 33% remittenting, and 36% recurring.[4]

Jaw muscles are a frequent source of orofacial pain, and Svensson et al described the referred pain patterns from the masseter, the anterior temporalis, lateral pterygoid, medial pterygoid, and anterior digastric muscles.[5] Furthermore, Kupers et al have reported that the cerebral processing of jaw-muscle pain differs from the processing of cutaneous pain and that mechanical hyperesthesia may be encountered in patients with TMD.[6]

Muscle trigger points (TrPs), defined as hyperirritable points located within the taut bands of skeletal muscles, are considered a major source of musculoskeletal pain.[7] Chaiamnuay et al reported the disease rate prevalence for TrPs to be 11.3% over a sample of 2,456 subjects.[8] Local pain and tenderness, referred pain, and a local twitch response have been reported upon digital compression or dry needling of the muscle TrP.[9] Furthermore, there may be intramuscular spontaneous electrical activity at TrPs when the muscle is at rest.[10] Without intervention, the pain (local and referred) may become chronic and restricted range of motion and muscle weakness might occur. From a clinical viewpoint, active TrPs cause pain and their local and referred pain is responsible for pain symptoms of the subject and the referred pain is recognized as a familiar or usual pain by the subject.[7] Latent TrPs are those for which local and referred pain is not responsible for the symptoms. Higher levels of chemical mediators (ie, bradykinin, substance P, or serotonin) have been found in active TrPs as compared with latent TrPs or control points.[11] Active TrPs have been found in several pain conditions, eg, mechanical neck pain,[12] lateral epicondylalgia,[13] migraine,[14] shoulder pain,[15] and chronic tension-type headache.[16] Additionally, TrPs have also been suggested to be involved in TMD.[7,17]

Therapies targeted at TrPs include muscle TrP injection,[18] dry needling, or acupuncture.[19,20] Muscle TrP dry needling is a procedure commonly applied for the management of TrPs which has been used in many scientific studies.[21,22] Although the mechanisms of muscle TrP dry needling are unknown, the practice of inserting acupuncture needles into TrPs appears to reduce pain symptoms. In a recent systematic review about TrP dry needling, limited evidence has been found.[22] To the authors' knowledge, no previous studies have investigated the effects of dry needling of TrPs in the masseter muscle on pressure pain sensitivity and range of jaw motion. The aim of the present study was to investigate the effectiveness of dry needling over active TrPs in the masseter muscle in patients with TMD.

Materials and Methods

Subjects

Consecutive patients presenting with pain in the orofacial region at the Dental and Orofacial Pain Department, Universidad Rey Juan Carlos, Madrid, were screened for eligibility criteria. The inclusion criteria were: *(1)* a primary diagnosis of myofascial pain according to the Research Diagnostic Criteria for TMD (RDC/TMD),[23] *(2)* pain involving the masseter muscle, *(3)* duration of symptoms of at least 6 months, *(4)* pain on palpation of the jaw muscles, *(5)* limitation of mandibular movement, and *(6)* a mean intensity of pain corresponding to a weekly average of at least 3 cm on a 10 cm visual analog scale (VAS). Participants were excluded if they presented any of the following criteria: *(1)* cervical trauma (whiplash injury), *(2)* any systematic joint or muscle disease (eg, fibromyalgia, rheumatoid arthritis), *(3)* needle phobia, *(4)* bleeding disorders, *(5)* metabolic disease (diabetes), *(6)* any neurological disorder (eg, trigeminal neuralgia), *(7)* any vascular disease, or *(8)* have previously received acupuncture, dry needling, or physical therapy in the 6 months prior to the study.

The study was supervised by the Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine (Universidad Rey Juan Carlos). The project was approved by the human research committee (FHA-URJC). All subjects signed an informed consent prior to their inclusion.

Self-Reported Measures

A 10-cm Numerical Pain Rating Scale (NPRS; 0 = no pain, 10 = maximum pain) was used to assess each patient's current level of facial pain, and worst level and lowest level of pain experienced in the preceding 24 hours.[24]

Pressure Pain Threshold

Pressure pain threshold (PPT) is defined as the minimal amount of pressure where a sense of pressure first changes to pain.[25] An electronic algometer (Somedic AB) was used to assess PPT. The algometer consists of a 1 cm^2 rubber tipped plunger mounted on a force transducer. The pressure was applied at a rate of 30 kPa/sec. The participants were instructed to press a switch when the sensation changed from pressure to pain. The mean of three trials was calculated and used for analysis and the value of each trial was used to assess intraexaminer reliability. A 30-second resting period was

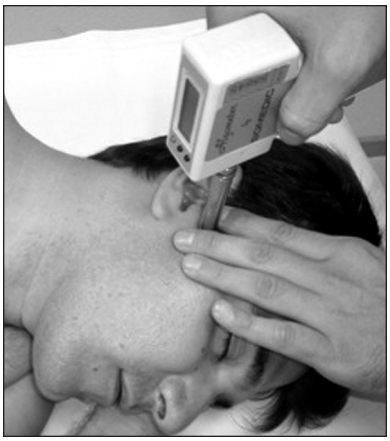

Fig 1 PPT assessment over the condyle.

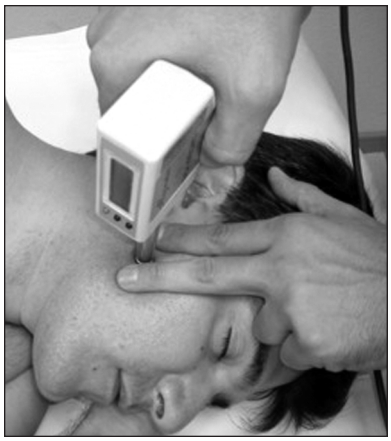

Fig 2 PPT assessment over the masseter muscle.

allowed between each measure. The reliability of pressure algometry has been found to be high (interclass correlation coefficient [ICC] = 0.91 [95% confidence interval ((CI)) 0.82–0.97]),[26] including for the masticatory muscles.[27] PPT levels were assessed over the mandibular condyle (Fig 1) and the most painful point of the masseter muscle (Fig 2) which elicited referred pain (active TrP).

Pain-Free Maximal Jaw Opening

Maximal mouth opening was assessed with the participant seated. Subjects were asked to "open the mouth as wide as possible without causing an increase in your pain or discomfort." At the end position of maximum mouth opening, the distance between the upper and lower central dental incisors was measured in millimeters (mm). Intratester reliability has shown to be high (ICC = 0.90–0.98).[28] It has been found that jaw opening is the only reliable range of motion measurement of the temporomandibular joint that is able to discriminate between TMD patients and healthy controls.[29]

Myofascial TrP Examination in the Masseter Muscle

The presence of active TrPs was explored using the diagnostic criteria described by Simons et al[7]: *(1)* presence of a palpable taut band in a skeletal muscle; *(2)* presence of a hypersensitive tender spot within the taut band; *(3)* local twitch response provoked by the snapping palpation of the taut band; and *(4)* replication of the patient's pain symptoms with the referred pain elicited by the TrP. These criteria had good interexaminer reliability (κ) ranging from 0.84 to 0.88.[30]

Intervention Conditions

Each participant attended two treatment sessions at least 7 days apart and received one intervention assigned in a random fashion at each visit: deep dry needling (experimental) or sham dry needling (placebo) at the most painful point on the masseter muscle. Both interventions were administered by a therapist with more than 5 years of clinical experience in dry needling. For both interventions, needles used for this experiment were stainless steel, manufactured by Novasan (Maraca "Ener-Qi" CE0197). The needle size used for the study was different for each intervention: in the experimental (deep dry needling) condition, an acupuncture needle (0.26 × 25 mm) was used, whereas in the sham intervention a shorter needle was employed (0.26 × 13 mm).

In all participants, the area was first disinfected with alcohol. The needles were inserted perpendicular to the skin, trough a telescope device. On removal of the needle, pressure was immediately applied to the skin, using a cotton bud, for 10 seconds to avoid any post-needling soreness. The needling site was reexamined for soreness and the subject was requested to report any painful reaction. For the experimental procedure, the deep dry needling intervention consisted of a true penetration of the needle into the masseter muscle. The needle was inserted into the skin at a point above the taut band over the TrP. After penetration of the needle into the skin tissue, it was directed to the muscle TrP until a first local twitch response was provoked. The local twitch response was perceived by the therapist as a transient and involuntary contraction of the taut band. Then, the needle was inserted and withdrawn from the TrP rapidly. With rapid movement of the needle, a local twitch

response can be elicited if the needle tip encounters a sensitive locus. The needle insertions were repeated to elicit at least five local twitch responses.[31] The sham dry needling looked exactly like a real dry needling except it penetrated only a few millimeters of the skin without inducing any local twitch response.

Study Protocol

All participants were subjected to a systematic examination to diagnose myofascial TMD. A clinical examination according to the RCD/TMD[23] was first conducted by an experienced specialist dentist with 15-years experience in orofacial pain practice. Possible risks of acupuncture treatment were explained and participants were informed that they could stop participating in the study at any time.

Each subject attended two experimental sessions scheduled on separate days at least 7 days apart and at the same time of the day. At each session participants received either sham dry needling or deep dry needling. The order of interventions was randomized by an external clinical assistant who used a computerized randomization program to generate intervention allocation (experimental or sham) of the study population. Participants were not allowed to take any analgesic or anti-inflammatory drug for 48 hours prior to each session.

The preintervention outcome measures were taken by an external assessor, with randomization in the order. Following preintervention measurements, the therapist, blinded to the preintervention data, applied one of the intervention conditions (ie, deep dry needling or sham dry needling). Postintervention testing was taken 5 minutes after either intervention by the same external assessor who was blinded to the treatment allocation of the subject. Neither the assessor nor the patient was aware of the real objective of the TrP dry needling (double blind). Finally, participants were asked by the assessor through standardized questioning whether they recognized if they received the real or sham intervention.

Statistical Analysis

Data were analyzed with the SPSS package (version 14.0). Mean values and standard deviations (SDs) or 95% CIs of the values were calculated for each variable. The Kolmogorov-Smirnov test showed a normal distribution of the quantitative data ($P > .05$). ICC and standard error of the mean of measurements (SEM) were calculated to assess intra-examiner reliability of the data. Preintervention values prior to each intervention were compared using the independent *t*-tests for continuous data. A two-way repeated-measures analysis of variance (ANOVA) test with intervention (sham or experimental) as the between-subjects variable and time (pre-post test) as the within-subjects variable was used to examine the effects of the intervention. Separate ANOVAs were performed with PPT and active mouth opening as the dependent variables. The hypothesis of interest was Group * Time interaction. A P value less than .025 was considered statistically significant (Bonferroni correction) for multiple comparisons of pre-post intervention data for each condition (sham or experimental).

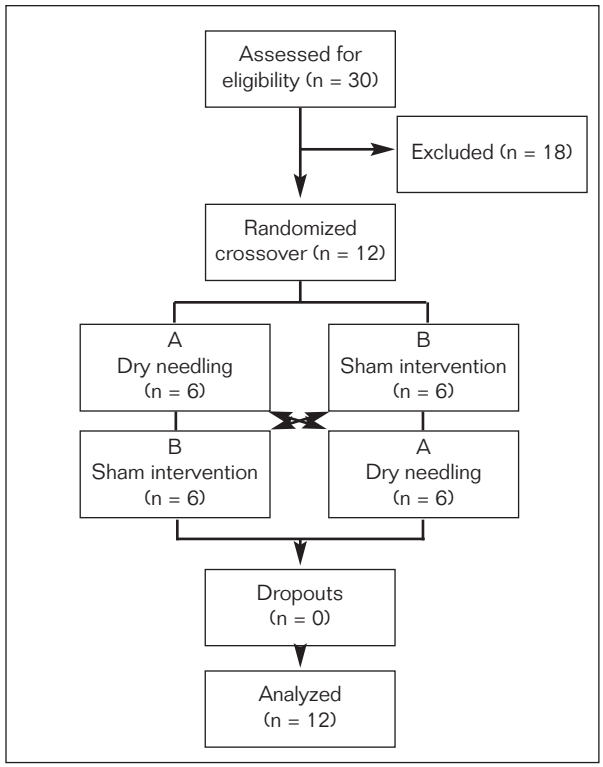

Fig 3 Flow diagram of subjects throughout the course of the study.

Results

Thirty consecutive patients with orofacial pain between January and July 2008 were screened for possible eligibility criteria. Finally, a total of 12 women, aged 20 to 41 years old (mean = 25, SD ± 6 years) satisfied all the criteria and agreed to participate. Figure 3 shows the diagram of recruitment of the participants.

Table 1 Pre-Post and Within-Intervention Differences for Either Sham Needling or Deep Dry Needling

	Preintervention (95% CI)	Postintervention (95% CI)	Mean difference (95% CI)
PPT masseter muscle (kPa)			
Dry needling	98.5 (81.1 – 115.7)	176.5 (157.2 – 195.9)	79.1 (57.4 – 98.8)
Sham dry needling	108.7 (91.4 – 126.1)	100.0 (80.6 – 119.4)	– 8.0 (–21.8 – 4.4)
PPT mandibular condyle (kPa)			
Dry needling	91.5 (70.6 – 112.3)	182.0 (159.9 – 204.1)	98.9 (78.6 – 125.6)
Sham dry needling	113.3 (95.5 – 131.1)	104.9 (86.1 – 123.7)	–7.4 (–20.7 – 4.0)
Active mouth opening (degrees)			
Dry needling	30.9 (26.2 – 35.5)	41.5 (35.2 – 47.7)	34.3 (7.7 – 13.5)
Sham dry needling	36.2 (29.8 – 42.2)	36.1 (29.8 – 42.3)	–0.2 (3.0 – 2.8)

Data are expressed as mean (95% CI).

The mean duration of facial pain was 49.2 months (95% CI 26.0 – 72.4), the mean current level of pain was 3.4 (95% CI 1.9 – 5.0), the mean worst level of pain experienced in the preceding 24 hours was 6.2 (95% CI 4.8 – 7.5), and the lowest level of pain in the preceding 24 hours was 2.2 (95% CI 1 – 3.5). PPT levels over the masseter muscle (P = .4) and over the mandibular condyle (P = .3), and active mouth opening (P = .3) prior to each intervention were not significantly different between experimental and sham conditions (Table 1).

The intraexaminer reliability (ICC) of PPT readings, which was determined from the three repeated trials collected prior to each intervention, was 0.94 (95% CI 0.88 – 0.97) over the masseter muscle and 0.916 (95% CI 0.83 – 0.96) over the mandibular condyle, suggesting high repeatability of PPT testing. The SEMs were 4.3 kPa and 4.9 kPa, respectively. The ICC (1,3) for active mouth opening was 0.95 (95% CI 0.9 – 0.97) whereas the SEM was 1.22 mm.

The ANOVA detected a significant interaction between intervention and time for PPT levels in the masseter muscle (F = 62.5; P < .001) and condyle (F = 50.4; P < .001), and active mouth opening (F = 34.9; P < .001) was found. Subjects showed greater improvements in all the outcomes when receiving the deep dry needling compared to the sham dry needling (P < .001). Table 1 summarizes pre-post scores and between differences for both interventions. Note that PPT levels increased 79.1% ± 44% in the masseter muscle and 98.9% ± 53% in the condyle after the deep dry needling which was significantly greater (P < .001) than the change of –8% ± 14% and –7.4% ± 13% produced by the sham dry needling, respectively. Furthermore, an increase of 34.3% ± 17% in active mouth opening after the experimental condition was also found compared to an increase of –0.2% ± 8% with the sham condition (P < .001).

Discussion

This study has demonstrated that dry needling of active TrPs in the masseter muscle induced more significant increases in PPT and in the degree of the pain-free maximal jaw opening when compared to sham needling. The results support the hypothesis that there may be a beneficial effect of TrP dry needling on the signs and symptoms in patients with TMD. Nevertheless, the effects were documented in the short term, so long-term clinical application should be further explored in future studies, including the incorporation of dry needling of active TrPs in the masseter muscle into a multimodal treatment for TMD patients in randomized controlled trials.

In a recent meta-analysis, it was concluded that the effectiveness of acupuncture and dry needling in the management of TrPs is limited, partly due to lack of large scale, good quality placebo-controlled trials.[22] The significant increases in PPT and in the degree of the pain-free maximal jaw opening in the current controlled study suggest that TrP dry needling is effective in relieving pain and motor dysfunction in TMD. Indeed, one of the first studies investigating TrP dry needling concluded that dry needling was effective at alleviating chronic myofascial pain.[32] The results in the current study are consistent with some randomized controlled trials showing that TrP dry needling is effective for chronic leg pain,[33] low back pain,[34] neck pain,[35] knee pain,[36] and jaw pain.[37] The increased level of PPT following TrPs dry needling in the study may suggest that one of the mechanisms of dry needling targeted at TrPs may be the reduction of muscle TrP activity. A previous study has shown that the pain intensity and PPT are highly correlated with the prevalence of electrical activity in the TrP region[38] while dry needling can significantly inhibit the spontaneous electrical activity at TrPs in rabbits.[39] A decrease in the algesic substances at

active TrPs following induction of multiple local twitch responses during dry needling may also be involved in the pain reduction mechanism.[11] Apart from peripheral mechanisms, electrical stimulation (inactivation) of active TrPs has been shown to involve supraspinal pain control mechanisms related to both antinociception and relief of TrP pain.[40] Thus, it is possible that both peripheral and central mechanisms are involved in the therapeutic effects of TrP dry needling in the treatment of pain in TMD.

Increased pain-free maximal jaw opening may indicate that TrP dry needling can relieve muscle tension of taut bands in the masseter muscle. This result is consistent with the increased range of motion of the shoulder joint following TrP dry needling of the shoulder muscles.[41] Furthermore, muscle TrPs have been associated with abnormal movement pattern[42] and increased motor neuron excitability.[43] Consequently, dry needling may result in decreased motor unit activity at TrPs[39] and lead to improved motor function. Therefore, the increased jaw opening could be related to peripheral effects of TrP dry needling. Nevertheless, it is also possible that changes in active jaw opening may be also related to central mechanisms involved in the effects of TrP treatment.

The current study has several limitations. First, it only addressed the immediate effects of dry needling on TrPs in the masseter muscle in TMD patients. A study with a large sample size and a longer follow-up period is needed to determine the long-term benefits of dry needling. Second, an inherent limitation of a crossover study is the possibility of contamination of the outcomes with carry-over effects from the first intervention to the second intervention. Nevertheless, this possibility was minimized with the randomization of the interventions and with a difference of at least 7 days between experimental sessions. In addition, the fact that measures before each intervention were not significantly different would support the view that any contamination was minimal.

In conclusion, the application of dry needling of active TrPs in the masseter muscle induced significant increases in PPT levels and pain-free maximal jaw opening when compared to sham dry needling in TMD patients.

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