Effects of myofascial trigger point dry needling in patients with sleep bruxism and temporomandibular disorders: a prospective case series

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ABSTRACT

Objectives To investigate the effects of deep dry needling (DN) of myofascial trigger points (MTrPs) of the masseter and temporalis on pain, pressure pain threshold (PPT), pain-free maximal jaw opening and temporomandibular disorder (TMD)-related disability in patients with sleep bruxism (SB) and myofascial TMD.

Methods Seventeen subjects (11 women, 6 men) aged 39±13 years (range 23–66) diagnosed with SB and myofascial TMD were invited to participate in this prospective case series study. Each subject received a deep DN intervention in the masseter and temporalis MTrPs. Pain intensity, PPT, pain-free maximal jaw opening and TMD-related disability were assessed before treatment, immediately after treatment and at 1-week follow-up. Jaw disability was assessed using the jaw disability checklist (JDC) at baseline and 1 week post-treatment only.

Results One-way analyses of variance showed significant improvements in pain intensity, PPT and jaw opening ($p<0.001$). Post-hoc analysis revealed significant differences between baseline and post-intervention follow-up time points in pain (immediate: Cohen's $d=1.72$, $p<0.001$; 1 week: $d=3.24$, $p<0.001$), jaw opening (immediate: $d=0.77$, $p<0.001$; 1 week: $d=1.02$, $p<0.001$) and PPT in the masseter (immediate: $d=1.02$, $p<0.001$; 1 week: $d=1.64$, $p<0.001$) and temporalis (immediate: $d=0.91$, $p=0.006$; 1 week: $d=1.8$, $p<0.001$). A dependent t-test showed a significant improvement in jaw functioning, reflected by a large reduction in 1-week JDC scores relative to baseline ($d=3.15$, $p<0.001$).

Conclusions Deep DN of active MTrPs in the masseter and temporalis in patients with myofascial TMD and SB was associated with immediate and 1-week improvements in pain, sensitivity, jaw opening and TMD-related disability.

Trial registration number NCT02587182; Results.

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INTRODUCTION

Sleep bruxism (SB) is defined as a stereotyped movement disorder characterised by grinding or clenching of the teeth during sleep.[1] Its prevalence in the adult population has been found to range between 5.5% and 8%.[2 3]

Temporomandibular disorders (TMD) include different structural and functional conditions affecting the temporomandibular joint and the masticatory muscles.[4] The prevalence of TMD has been estimated to range between 5% and 12%.[5]

It is traditionally believed by dentists and patients that bruxism may cause or maintain TMD.[6 7] Furthermore, it has been hypothesised that bruxism may play an aetiological role in the pathogenesis of TMD via a complex relationship that may involve prolonged mechanical stimulation of the masticatory system, as well as neurological mechanisms.[8] However, the relationship between bruxism and TMD is not fully understood and there is insufficient evidence to establish a direct cause-effect relationship between them.[9 10] Controversy even exists over whether SB is positively associated with TMD,[11] since a relationship has been demonstrated in cases of self-reported diagnosis of bruxism[12–14] but not in cases formally diagnosed by laboratory polysomnography.[15] Based on self-reported diagnoses of SB, the subtype of TMD showing the strongest relationship with the presence of SB is that associated with myofascial disorders rather than disc displacements or joint pathology.[13 14]

Myofascial TMD includes referred pain from masticatory muscles.[4] Myofascial trigger points (MTrPs) in the neck and masticatory muscles have been found in patients with myofascial TMD and they have been implicated in the pathophysiology and manifestations of myofascial TMD.[16] MTrPs are defined as hypersensitive spots within taut bands of skeletal muscle which are painful upon compression and trigger characteristic referred pain. MTrPs are classified as active when they cause spontaneous pain and latent when they only provoke pain when stimulated.[17] The masseter and temporalis have been found to be the most prevalent muscles presenting active MTrPs in patients with myofascial TMD.[16] However, to the authors' knowledge, no studies have assessed the presence of MTrPs in patients with SB. However, Simons *et al* consider SB to be an activating and perpetuating factor of MTrPs in the temporalis and masseter muscles.[17]

Different conservative treatments for MTrPs have been investigated in relation to myofascial TMD, including deep dry needling (DN) in which a solid filament needle is inserted into the MTrP.[18] DN has recently been recommended for the treatment of MTrPs in the neck and shoulder areas,[19 20] but only a few studies have investigated its effectiveness for the treatment of MTrPs in patients with TMD, although they have shown positive effects on pain, sensitivity and jaw range of motion.[21] Nevertheless, to our knowledge, there are few studies investigating the effectiveness of MTrP DN for the treatment of SB associated with TMD.

The objective of the present study was to report the results of deep DN of masseter and temporalis MTrPs on pain intensity, pressure pain threshold (PPT), pain-free maximal jaw opening and TMD-related disability in patients with SB and myofascial TMD.

METHODS

Participants

Patients were recruited from a private physical therapy clinic in Spain between January and May 2015. Patients were included in this prospective case series if they satisfied the minimum diagnostic criteria for SB: (1) complaint of tooth-grinding or tooth-clenching during sleep; and (2) one or more of the following—abnormal wear of the teeth, sounds associated with bruxism or jaw muscle discomfort.[1]

Moreover, patients were only included if a dentist confirmed the primary diagnosis of myofascial TMD according to the Research Diagnostic Criteria for TMD (RDC/TMD):[4] (1) pain in the jaw, temple, ear or front of the ear and pain modified by jaw movement, function or parafunction; and (2) confirmation of pain location in the temporalis or masseter muscles, report of familiar pain upon palpation of the temporalis and masseter muscles and report of pain spreading beyond the site of palpation within or beyond the muscle being palpated.

Additionally, the specific diagnosis of active MTrPs, as described by Simons *et al*,[17] had to be met in both the masseter and temporalis muscles: (1) presence of a palpable taut band of skeletal muscle; (2) presence of a hypersensitive tender spot within the taut band; (3) local twitch response (LTR) provoked by snapping palpation of the taut band; and (4) replication of the patient's pain symptoms with referred pain elicited from the MTrP. If both sides presented active MTrPs, the most painful side was selected.

All patients needed to have had chronic SB and TMD for at least 3 months and a pain intensity score at the initial assessment of >30 on a 100 mm visual analogue scale (VAS).

Participants were excluded if they presented with any of the following criteria: (1) insurmountable fear of needles; (2) any systematic joint or muscle disease; (3) bleeding disorders; or (4) prior physical therapy treatment for SB or TMD in the previous month, except for occlusal splints. All subjects were asked not to take any pain medication during their participation in the study.

The study protocol was approved by the ethics committee of the CEU San Pablo University (reference number 01.2016). All patients signed an informed consent before their inclusion and agreed to have their medical information published on an anonymised basis

Intervention

One session of deep DN was performed in both the masseter and temporalis muscles. First, each patient was asked to lie in a supine position and rotate their neck in the direction contralateral to the affected side. MTrP DN was performed with a solid stainless steel filament needle (0.16×25 mm; Suzhou Huanqiu Acupuncture Medical Appliance, Xiangcheng District, Suzhou, China). The DN procedure was based on the needling method described by Hong[22] in which the muscle was repeatedly perforated by rapidly inserting, then partially withdrawing, the needle in and out of the MTrP, eliciting LTRs with some insertions. This procedure continued until no more LTRs were elicited. All subjects had LTRs elicited during needling. The depth of penetration of the needle varied between subjects but was approximately 15–25 mm. Following removal of the needle, the area was compressed firmly with a cotton swab for 1 min.

Outcome measures

All outcomes were assessed before treatment, immediately after treatment and at 1 week, except for jaw disability which was not assessed immediately after treatment. All outcomes were evaluated by an assessor who was unaware of the study's objectives and design.

Pain intensity was measured using a 100 mm VAS ranging from 0 mm (no pain) to 100 mm (worst imaginable pain). The VAS has been shown to be a

valid and reliable instrument for assessing chronic pain, especially in studies with relatively small sample sizes.[23] The minimal clinically important difference (MCID) in VAS score for chronic TMD pain has been estimated to be 19.5 mm (37.9% change).[24]

PPT of the MTrPs was assessed with a mechanical pressure algometer. PPT is defined as the minimal amount of pressure at which the sense of pressure first changes to pain. Pressure was applied at a rate of 1 kg/s and three consecutive trials of PPT on the MTrPs were conducted at 30 s intervals. PPT assessment demonstrates good to excellent agreement between examiners in the masseter and temporalis muscles.[25]

Pain-free maximal jaw opening was assessed with the participant seated and maintaining a neutral neck and head posture. Participants were asked to open the mouth as wide as possible without causing pain and the distance between the upper and lower central dental incisors was measured with a millimetre ruler. This method has been shown to have good to excellent inter-rater reliability.[25]

The Spanish version[26] of the jaw disability checklist (JDC) from the RDC/TMD questionnaire[27] was used to assess the limitations related to jaw functioning experienced in the preceding week. It is a self-reported questionnaire consisting of 12 items that assess limitations of daily activities of patients with TMD. Each item includes a 'yes/no' response and the total score of the questionnaire, from 0 (no disability) to 12 (maximum disability), is obtained from summing up the 'yes' answers. The Spanish version of the JDC has been shown to be a valid and reliable instrument for assessing TMD-related disability.[26]

Statistical analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) V.20.0 (SPSS, Chicago, IL, USA). The mean and SD for each quantitative variable was calculated after confirming normal distribution of the data using the Shapiro-Wilk test. Within-patient scores of VAS, PPT and maximal mouth opening scores were compared using one-way analysis of variance for repeated measures, with a post-hoc Bonferroni correction. A dependent (paired) t-test was used to compare baseline and 1-week JDC scores. For all analyses, the level of statistical significance was set at $p<0.05$. Effect sizes were calculated using Cohen's d (0.2='small', 0.5='medium' and 0.8='large' effects) or partial eta squared (η_p^2; 0.01='small', 0.06='medium' and 0.14='large' effects).

RESULTS

Twenty-three patients with SB and myofascial TMD were screened for eligibility. Six patients were excluded because they did not meet the eligibility criteria due to insurmountable fear of needles (n=3) and a previous medical diagnosis of joint or muscle disease (n=3). Seventeen patients (11 women, 6 men) aged 39±13 years (range 23–66) were recruited and completed the study protocol. Baseline characteristics for each patient are shown in table 1. Baseline scores, follow-up scores and differences between baseline and

Table 1 Baseline characteristics of 17 patients with sleep bruxism and temporomandibular joint disorder

Patient	Age	Sex	TMJ click sound	Occlusal splint	Tooth wear	VAS	PPT masseter (Kg/cm^2)	PPT temporalis (Kg/cm^2)	JDC	Maximal jaw opening (cm)
1	43	F	Yes	No	Yes	7.1	1.3	1.8	6	3.5
2	33	F	Yes	Yes	Yes	7.4	1.6	2.4	6	4.8
3	39	F	Yes	Yes	Yes	7.1	1.5	2	5	3.4
4	38	M	Yes	Yes	Yes	7.2	1.6	1.8	7	5
5	66	M	Yes	No	Yes	7.6	1.9	2.3	4	3.5
6	25	F	Yes	Yes	Yes	8.5	1.3	1.7	6	2.5
7	35	F	Yes	No	Yes	5.7	1.3	1.7	7	3.6
8	33	F	Yes	Yes	No	6.4	1.3	2.2	10	3
9	30	M	Yes	Yes	Yes	4.4	1.4	2.6	4	4
10	54	F	No	No	Yes	7.5	1.7	2.4	5	4
11	24	F	No	No	Yes	7.6	2.1	2.1	8	3.3
12	53	F	Yes	Yes	No	8	1.3	2.3	5	4.5
13	53	F	Yes	No	No	6.5	1.2	2.5	7	3.4
14	27	M	Yes	No	No	6.9	1.7	1.7	8	3.2
15	25	F	Yes	Yes	Yes	7.6	1.4	1.8	6	5
16	55	M	No	Yes	Yes	6.2	2	2.1	6	4.3
17	23	M	Yes	No	No	5.2	1.5	1.5	4	2.5
Total	38.6±13.2	M/F 6/11	Y/N 14/3	Y/N 9/8	Y/N 12/5	6.9±1	1.5±0.3	2.1±0.3	6.1±1.6	3.7±0.8

Data are mean±SD or n.
F, female; JDC, jaw disability checklist; m, male; PPT, pressure pain threshold; TMJ, temporomandibular joint; VAS, visual analogue scale.

Table 2 Baseline and follow-up scores and differences between baseline and post-treatment values

	Pre-intervention	Post-intervention (immediately)	Post-intervention (1 week)	Post-intervention (immediately) vs pre-intervention	Post-intervention (1 week) vs pre-intervention
Pain intensity (VAS)	6.88±1.04	4.18±1.95	1.92±1.89	−2.69 (−1.38 to −4.01)***	−4.96 (−3.66 to −6.25)***
Maximal jaw opening	3.73±0.78	4.29±0.64	4.43±0.56	0.56 (0.86 to 0.26)***	0.69 (1.11 to 0.27)***
Jaw disability checklist	6.12±1.62	–	1.18±1.51	–	−4.94 (−4 to −5.88)***
PPT (kg/cm^2)					
Masseter	1.54±0.27	1.85±0.36	2.10±0.4	0.32 (0.45 to 0.18)***	0.56 (0.85 to −0.28)***
Temporalis	2.06±0.32	2.46±0.53	3.04±0.7	0.40 (0.69 to 0.11)**	0.98 (1.41 to 0.55)***

Data are mean±SD or mean (95% CIs).
**p<0.01, ***p<0.001, post-intervention versus pre-intervention values.
PPT, pressure pain threshold; VAS, visual analogue scale.

post-treatment values are shown in table 2. All variables were normally distributed.

No significant complications related to DN were observed. Some subjects reported post-needling soreness that resolved spontaneously within 48 hours.

The VAS pain scores showed a significant effect for time ($p<0.001$; $\eta_p^2=0.74$). Post-hoc testing showed a statistically significant decrease in pain between baseline and immediate ($p<0.001$; $d=1.72$) and 1-week ($p<0.001$; $d=3.24$) pain levels.

Pain-free maximal jaw opening showed a significant effect for time ($p<0.001$; $\eta_p^2=0.53$). Post-hoc testing demonstrated a statistically significant increase between both immediate ($p<0.001$; $d=0.77$) and 1-week ($p<0.001$; $d=1.02$) values of mouth opening relative to baseline.

The PPT showed a significant effect for time in the masseter ($p<0.001$; $\eta_p^2=0.51$) and temporalis muscles ($p<0.001$; $\eta_p^2=0.65$). Post-hoc testing showed a statistically significant improvement between baseline and immediate PPT values in the masseter ($p<0.001$; $d=1.02$) and temporalis muscles ($p=0.006$; $d=0.91$). Moreover, significant improvements were found between baseline and 1-week PPT values in both muscles ($p<0.001$ each; $d=1.64$ and $d=1.8$ for masseter and temporalis, respectively).

A large observed decrease in JDC scores also suggested a significant improvement in jaw functioning between baseline and 1 week ($p<0.001$; $d=3.15$).

DISCUSSION

The present case series study found that a single intervention of deep DN in the masseter and temporalis MTrPs of patients with SB and myofascial TMD was associated with improvements in pain, tenderness, maximal jaw opening and jaw functioning immediately after treatment and 1 week later. The effectiveness of DN cannot be definitely determined due to the lack of a control group and the small sample size, hence our results must be interpreted with caution. Further randomised controlled trials (RCTs) are needed to confirm the effectiveness of DN for the treatment of patients with myofascial TMD and SB.

Regarding the relevance of the improvements observed, the orofacial pain changes can be considered clinically relevant since they reached the MCID reported by Emshoff *et al*[24] in chronic TMD pain, which was estimated to be 19.5 mm (or 37.9% change). In the present study, an immediate pain reduction of 26.9 mm (39.1%) and a 1-week pain reduction of 49.6 mm (72.1%) from baseline were observed. Conversely, the pain-free maximal jaw opening changes observed immediately after needling and at 1 week were arguably not clinically significant since the differences (albeit statistically significant) were below the MCID of 9 mm reported by Kropmans *et al*.[28]

To our knowledge, no previous study has investigated the effectiveness of DN of the masseter and temporalis MTrPs in patients with SB, and few studies have been conducted in patients with myofascial TMD.[29–32]

Diraçoğlu *et al*[29] applied DN with intramuscular stimulation of temporalis and masseter MTrPs in patients with myofascial TMD pain and observed immediate improvements in pain and tenderness, but not pain-free maximal jaw opening. However, the pain reduction obtained in the DN group was not found to be superior to a placebo superficial sham DN group. The DN procedure differed from that used in the present study in that the needle was only inserted to the depth allowed by the guide tube and was only stimulated 3–5 times, with no mention of any elicitation of a LTR.

McMillan *et al*[30] observed reductions in pain after DN of masseter MTrPs in patients with myofascial pain in the jaw muscles but did not find improvements in the PPT of the masseter and temporalis muscles after needling. The pain improvements were not superior to those observed in a control group that received superficial needling into the skin and application of a percutaneous drop of isotonic saline in the

same area. The needling procedure also differed from the present study; it involved inserting the needle into the MTrP and retention for 1–2 min, with no reference to LTR elicitation.

Fernández-Carnero *et al*[31] applied a deep DN protocol in masseter MTrPs in patients with myofascial TMD, similar to the present study, including repeated needle insertions in order to elicit LTRs. The results showed immediate improvements in PPT and pain-free maximal jaw opening compared with superficial sham DN.

Deep DN of MTrPs present in other jaw muscles in patients with myofascial pain and TMD, such as the lateral pterygoid, has been also investigated. González-Perez *et al*[32] obtained higher reductions in pain with DN compared with a control group receiving oral methocarbamol–paracetamol combination therapy, but did not observe any differences between the groups in the range of jaw opening.

Although DN has not been investigated for the treatment of SB, other needle procedures such as injection of botulinum toxin have been evaluated for the management of patients with both myofascial TMD and SB. Guarda-Nardini *et al*[33] injected type A botulinum toxin into the masseter and temporalis muscles and found improvements in pain at rest, pain on chewing and the range of mandibular movements during a 6-month follow-up period compared with a placebo group. Future RCTs should investigate whether a similar effect could be obtained from MTrP DN in patients with SB and myofascial TMD.

In addition, other studies have investigated the effect of botulinum toxin injection of the masticatory muscles and their electromyographic activity during bruxism in patients with SB. Shim *et al*[34] found a reduction in the intensity of masticatory muscle contraction during SB events whereas Lee *et al*[35] observed fewer SB events. Further research is needed to determine the effect of MTrP DN on the electromyographic activity of masticatory muscles in patients with SB. Additional studies focused only on patients presenting with myofascial TMD in the masticatory muscles have investigated the effectiveness of lidocaine injection[36 37] or botulinum toxin[38] and have shown positive results regarding masticatory myofascial pain.

The current study has several limitations, at least in part due to its case series design. First, a definitive diagnosis of SB including polysomnographic recordings was not obtained and the presence of possible MTrPs in masticatory muscles other than the masseter and temporalis was not considered. Second, the influence of the placebo effect and/or the natural evolution of TMD on our results cannot be determined. Third, the small sample size and the short-term immediate and 1-week evaluation of the effect of DN limit the clinical relevance of the results. Finally, the effect of DN on the electromyographic activity of the masticatory muscles during SB events was not assessed. Future RCTs including larger sample sizes, longer follow-up periods and a specific evaluation of the electromyographic activity of the masticatory muscles should be carried out to evaluate the effectiveness of DN for myofascial TMD and SB.

In conclusion, deep DN of active MTrPs in the masseter and temporalis muscles in patients with myofascial TMD and SB was associated with statistically significant and clinically important immediate and 1-week improvements in pain, sensitivity and TMD-related disability. However, the current results must be interpreted with caution because of the absence of a control group. Further studies including RCTs are needed to determine the effectiveness of DN in this particular population.

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