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The Immediate Effects of Atlanto-occipital Joint Manipulation and Suboccipital Muscle Inhibition Technique on Active Mouth Opening and Pressure Pain Sensitivity Over Latent Myofascial Trigger Points in the Masticatory Muscles

DESIGN: A randomized controlled trial.

OBJECTIVE: To investigate the immediate effects on pressure pain thresholds over latent trigger points (TrPs) in the masseter and temporalis muscles and active mouth opening following atlanto-occipital joint thrust manipulation or a soft tissue manual intervention targeted to the suboccipital muscles.

BACKGROUND: Previous studies have described hypoalgesic effects of neck manipulative interventions over TrPs in the cervical musculature. There is a lack of studies analyzing these mechanisms over TrPs of muscles innervated by the trigeminal nerve.

METHODS: One hundred twenty-two volunteers, 31 men and 91 women, between the ages of 18 and 30 years, with latent TrPs in the masseter muscle, were randomly divided into 3 groups: a manipulative group who received an atlanto-occipital joint thrust, a soft tissue group who received an inhibition technique over the suboccipital muscles, and a control group who did not receive an intervention. Pressure pain thresholds over latent TrPs in the masseter and temporalis muscles, and active mouth opening were assessed pretreatment and 2 minutes posttreatment by a blinded assessor. Mixed-model analyses of variance (ANOVA) were used to examine the effects of interventions on each outcome, with group as the between-subjects variable and time as the within-subjects variable. The primary analysis was the group-by-time interaction.

RESULTS: The 2-by-3 mixed-model ANOVA revealed a significant group-by-time interaction for changes in pressure pain thresholds over masseter ($P<.01$) and temporalis ($P = .003$) muscle latent TrPs and also for active mouth opening ($P<.001$) in favor of the manipulative and soft tissue groups. Between-group effect sizes were small.

CONCLUSIONS: The application of an atlanto-occipital thrust manipulation or soft tissue technique targeted to the suboccipital muscles led to an immediate increase in pressure pain thresholds over latent TrPs in the masseter and temporalis muscles and an increase in maximum active mouth opening. Nevertheless, the effects of both interventions were small and future studies are required to elucidate the clinical relevance of these changes.

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Myofascial/muscle trigger points (TrPs) are claimed to be a common source of musculoskeletal pain in people presenting to physical therapists for treatment. TrPs are defined as hyperirritable regions associated within a taut band of a skeletal muscle that are painful on stimulation (compression, contraction, or stretching of the affected muscle) and elicit a referred pain distant to the TrP.[43] Active TrPs are those which local and referred pains reproduce the symptoms reported by a patient, and the pain is recognized by the patient as a usual pain.[43] Latent TrPs are those which local and referred pains did not reproduce symptoms familiar or usual to the patient.[43] Latent TrPs have the same clinical features (taut band, hyperirritable region, local twitch response)

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than active TrPs, but they are not responsible for pain symptoms. This clinical distinction has been substantiated by histochemical findings, with higher levels of algogenic substances and chemical mediators (ie, bradykinin, substance P, or serotonin) found in active TrPs as compared to latent TrPs or non-TrP locations.[41]

A number of studies have demonstrated that active TrPs are clinically relevant for patients with mechanical neck pain,[12] lateral epicondylalgia,[9] unilateral migraine,[4,15] shoulder pain,[20] and chronic tension type headache.[14,16] More recent studies have also demonstrated the clinical relevance of latent TrPs, particularly for muscle function[34,35] (latent TrPs disturb normal pattern of motor recruitment and movement efficiency) and sensitization pain mechanisms.[8] In fact, several studies have used individuals with latent TrPs in the masseter muscle for investigating the effects of local interventions targeted to the TrP, such as ischemic compression,[11,18] neuromuscular approach,[27] or postisometric relaxation technique.[2]

Further, there are several studies showing the potential relevance of latent TrPs. Some studies have found pressure pain hypersensitivity at latent TrPs, as compared to non-TrP areas, suggesting increased nociceptive sensitivity at latent TrPs.[19,28] The existence of nociception in latent TrPs has been recently confirmed in a study demonstrating the existence of nociceptive (hyperalgesia) and nonnociceptive (allodynia) hypersensitivity at latent TrPs.[33] Other researchers have reported that nociceptive stimulation of latent TrPs induced an attenuated skin blood flow response,[52] not increased by maneuvers that activate sympathetic outflow,[30] suggesting sympathetic vasoconstrictor activity elicited by nociceptive stimulation of latent TrPs. Finally, there is also evidence that latent TrPs induced motor disturbances.[34,35] For instance, the presence of latent TrPs in pain-free subjects has been shown to modulate muscle activation pattern during motor tasks when compared to subjects without latent TrPs.[34] The results of a preliminary study indicate an increase in H-reflex response and decrease in H-reflex threshold at latent TrPs as compared to non-TrPs.[21] Finally, a recent study has demonstrated that latent TrPs can be involved in the genesis of muscle cramps.[22] Therefore, because latent TrPs may become active by several factors, including muscle overload or strain,[42] clinicians should be aware of their presence.

There is increasing evidence about hypoalgesic effects induced by cervical spine thrust manipulative interventions.[10,17] A few studies have also investigated the effects of cervical spine interventions on the orofacial region. La-Touché et al[32] have recently demonstrated that the application of treatment directed to the neck, particularly to the upper cervical spine, was beneficial in decreasing pain symptoms, decreasing pressure pain sensitivity over the masticatory muscles, and increasing pain-free mouth opening in patients with temporomandibular disorders related to myofascial dysfunction. Mansilla-Ferragut et al[38] also found that the application of an atlantoaxial joint manipulation resulted in a hypoalgesic effect over areas innervated by the trigeminal nerve and an increase in active mouth opening in women with mechanical idiopathic neck pain. But these studies investigated changes in pressure pain sensitivity over standardized locations, as opposed to sensitized areas.

Previous work provides preliminary evidence suggesting that thrust manipulation can provoke a hypoalgesic effect in myofascial TrPs located in those muscles innervated by the same segment (eg, a manipulation directed at the C3-4 joint segment increased pressure pain thresholds [PPT] in latent TrPs in the upper trapezius muscle).[31,40] The results of these studies support that hypoalgesic effects of spinal manipulative interventions are also present over sensitized locations (latent muscle TrPs). But to the best of the authors' knowledge, this mechanism has not been investigated over trigeminal muscle TrPs. Therefore, the aim of the current study was to investigate the immediate effects on pressure pain sensitivity over latent TrPs in the masseter and temporalis muscles and active mouth opening, following an atlanto-occipital joint thrust manipulation or a soft tissue manual intervention targeted to the suboccipital muscles.

METHODS

Participants

One hundred and twenty-two volunteers (31 men and 91 women) between 18 and 30 years of age (mean ± SD age, 20 ± 3 years; body mass, 62 ± 12 kg; height, 168 ± 9 cm), recruited from the Escola Superior de Tecnologia da Saúde do Porto, participated in this study. The sample size and power calculations were performed with the ENE 2.0 (GlaxoSmithKline, London, UK) software. The calculations were based on detecting an effect size of 0.3 kg/cm^2, with a standard deviation of 0.5 kg/cm^2 at postintervention data,[27] an α level of .05, and a desired power of 80%. These assumptions generated a desired sample size of at least 30 subjects per group.

Participants were included if there was a diagnosis of a latent TrPs in the masseter muscle on either the left or right side. TrP diagnosis was conducted according to previous guidelines[23,43]: (1) the presence of a palpable taut band within a skeletal muscle, (2) the presence of a hypersensitive area in the taut band, (3) a local twitch response provoked by the snapping palpation of the taut band, and (4) a reproduction of referred pain distant from the TrP in response to compression. Using these criteria has shown good interexaminer reliability (κ), ranging from 0.84 to 0.88.[23] However, information about TrP reliability is related to the presence or absence of TrPs, without distinction between active and latent TrPs.[36] Participants underwent a screening process to establish the presence of latent TrPs in both masseter and temporalis muscles by the same clinician (J.R.), who had more than 4 years' experience in TrP diagnosis.

Subjects were excluded if they had any

of the following: (1) any contraindication to cervical manipulation, (2) a diagnosis of fibromyalgia,[48] (3) a history of neck trauma, (4) a history of any surgery in the orofacial or cervical region, (5) a history of chronic neck pain, (6) a history of temporomandibular joint disorder, (7) myofascial pain therapy in the cervical region in the month prior to the study, or (8) a positive extension-rotation test.[29,37] The study was approved by the Ethical Research Commission of the Escuela de Osteopatía de Madrid (Spain), and the subjects signed an informed consent form before their participation.

Interventions

Subjects were randomly assigned to 3 groups using a table of random numbers created by online software (www.randomization.com): a manipulative group, who received an atlanto-occipital joint thrust; a soft tissue group, who received an inhibition technique over the suboccipital muscles; and a control group, who received no intervention. Both interventions were done by a clinician (N.M.O.) with a 6-year postgraduate training in spinal manipulative therapy and more than 7 years of clinical experience in the management of spinal disorders.

We performed the same atlantoaxial thrust manipulation technique used by Mansilla-Ferragut et al[38] to reduce pressure pain sensitivity over areas innervated by the trigeminal nerve and to increase active mouth opening in their patients with neck pain. The same technique was performed in the current study to determine if similar effects can be obtained over latent TrP. The manipulation was performed as follows: the subject was supine and the head was rotated to one side. With the middle and ring fingers of the cephalic hand, the therapist contacted the mastoid process. With the palm of the cranial hand, the therapist contacted the subjects' jaw line and cheek. Both forearms of the therapist were placed in a plane parallel with the subject, that is, aligned with the vertical axis of the subject's body. A slight traction in the cranial direction was introduced with both hands. When joint tension was perceived by the therapist, a high-velocity low-amplitude thrust was performed in the direction of traction with a gentle rotary force (**FIGURE 1**).[24] If no popping sound was heard on the first manipulative attempt, the therapist repositioned again and performed a second manipulation. A maximum of 2 thrust attempts were performed on each subject.

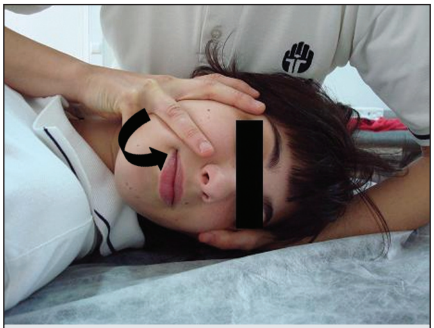

FIGURE 1. Atlanto-occipital joint thrust manipulation to the left. The subject is supine with the head rotated to the left. The right hand contacts the mastoid process and the left hand contacts the jaw and cheek. Both forearms of the therapist are aligned with the vertical axis of the patient. A slight traction is cranially introduced and a high-velocity low-amplitude thrust is performed in the direction of traction with a gentle left rotation force.

For the suboccipital inhibition technique, the subject was supine, whereas the therapist was seated at his head with the elbows resting on the surface of the table. The therapist placed both hands behind the head of the subject, with the palms facing upwards, the fingers flexed, and the finger pads positioned on the posterior arch of the atlas, to allow the occiput to rest in the palm of the hands (**FIGURE 2**). A force was applied with the finger pads over the atlas in the direction of the ceiling with slight traction in a cranial direction for 2 minutes.[1]

The control group did not receive any treatment or manual sham procedure. Preintervention data were collected with subjects lying supine. After the intervention, they remained supine with the cervical spine in a neutral position for 2 minutes until postintervention data were again assessed.

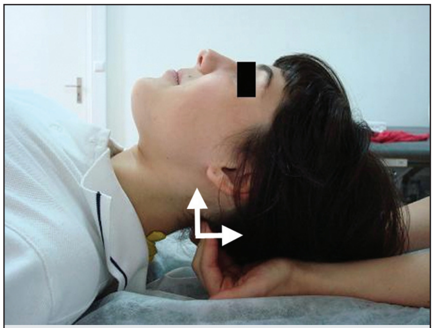

FIGURE 2. Suboccipital muscle inhibition technique. The hands of the therapist are behind the head of the subject with the palms facing upwards and the finger flexed with the finger pads positioned on the posterior arch of the atlas. A force is applied on the atlas in the direction of the ceiling, with a slight traction in a cranial direction.

Outcome Measures

Previous studies reported that manual interventions targeted to the upper cervical spine increased PPTs and active mouth opening in patients with neck[38] or orofacial pain.[32] Therefore, we used the same outcome measures in our study. All outcomes measures were collected with the subject in a supine position.

PPT is defined as the amount of pressure corresponding to when the sensation of pressure changes to a perception of pain.[45] A mechanical pressure algometer (FPK 20; Wagner Instruments, Greenwich, CT) was used. The device consists of a round rubber disk (1 cm^2) attached to a pressure gauge. The gauge displays values in kg/cm^2 ranging from 0 to 10 kg. Pressure was applied at a rate of 0.1 kg/cm^2 per second. The mean of 3 trials (intraexaminer reliability) was calculated and used for the main analysis. A 30-second resting period was allowed between each trial. The reliability of algometry has been found to be high in both asymptomatic subjects[5] (ICC = 0.91; 95% confidence interval [CI]: 0.82-0.97) and patients with neck pain[50] (ICC = 0.78-0.93). To make PPT assessment over the same location prior and postintervention, latent TrPs were marked with a pencil at the moment of the diagnosis.

Active mouth opening was assessed as the distance in millimeters between the upper and lower-central dental inci-

TABLE 1	Descriptive Data for the Outcome Measures*		
Measures/Group	Preintervention	Postintervention	Change Score
Pressure pain thresholds over the masseter (kg/cm²)			
Manipulative (n = 41)	2.6 ± 0.7 (2.4, 2.8)	2.8 ± 0.7 (2.6, 3.1)	0.2 ± 0.4 (0.1, 0.4)
Soft tissue (n = 41)	2.7 ± 0.6 (2.5, 2.9)	2.7 ± 0.8 (2.5, 3.0)	0.0 ± 0.4 (–0.2, 0.1)
Control (n = 40)	2.8 ± 0.7 (2.6, 3.0)	2.7 ± 0.7 (2.5, 2.9)	–0.1 ± 0.2 (–0.2, 0.0)
Pressure pain thresholds over the temporalis (kg/cm²)			
Manipulative (n = 31)	2.6 ± 0.7 (2.3, 2.8)	2.8 ± 0.7 (2.5, 3.1)	0.2 ± 0.3 (0.1, 0.4)
Soft tissue (n = 35)	2.7 ± 0.7 (2.5, 3.0)	2.9 ± 0.9 (2.6, 3.1)	0.2 ± 0.4 (0.0, 0.4)
Control (n = 31)	2.8 ± 0.9 (2.6, 3.1)	2.7 ± 0.8 (2.5, 3.0)	–0.1 ± 0.3 (–0.2, 0.0)
Active mouth opening (mm)			
Manipulative (n = 41)	46.4 ± 6.8 (44.4, 48.4)	47.9 ± 6.8 (45.9, 49.9)	1.5 ± 1.5 (1.0, 1.9)
Soft tissue (n = 41)	47.2 ± 6.2 (45.2, 49.3)	47.7 ± 6.1 (45.6, 49.7)	0.5 ± 1.7 (0.0, 1.0)
Control (n = 40)	46.8 ± 6.8 (44.8, 48.9)	46.8 ± 6.7 (44.8, 48.9)	0.0 ± 1.1 (–0.4, 0.3)

** Data are mean ± SD (95% confidence intervals).*

sors using a universal caliper. Individuals were asked to "open your mouth as wide as possible without being painful, and hold it in this position while the measurement is made." Three consecutive trials were made at 30-second intervals and the mean of the 3 trials was used for data analysis. The intra-assessor reliability has been shown to be high (ICC = 0.90-0.98) for the measurement of mouth opening using this method.[25]

PPT levels over latent TrPs within the masseter or temporalis muscles and active mouth opening were assessed prior to the intervention and 2 minutes postintervention by an assessor (J.R.), who was blinded to group assignment. The assessor was the same clinician who performed the assessment for the presence of TrP. Individuals were unaware of the true objective of the study in that they were aware of the ethical implications without revealing which intervention was being evaluated. All subjects were informed of the true nature of the study at the end of the session.

Statistical Analyses

Statistical analysis was conducted with the SPSS 16.0 package (SPSS, Chicago, IL). Mean, standard deviation, and 95% CIs for each of the outcome measures are presented. The Kolmogorov-Smirnov test showed a normal distribution of quantitative data ($P>.05$). Baseline features of the groups were compared using an analysis of variance (ANOVA) for continuous data and chi-square tests for categorical data. A separate 2-by-3 mixed-model ANOVA, with time (preintervention or postintervention) as within-subjects variable and group (manipulative, soft tissue, and control) as between-subject variable, was used to examine the effects of interventions on PPTs and maximum active mouth opening. The hypothesis of interest was the group-by-time interaction at α level equal to .05. The Bonferroni test was used for post hoc analysis. Within-group and between-group effect sizes were calculated using Cohen *d* coefficient (*d*).[6] An effect size greater than 0.8 was considered large, 0.5 moderate, and less than 0.2 small. The statistical analysis was conducted at a 95% confidence level. A *P* value less than .05 was considered as statistically significant for all analyses.

RESULTS

Forty subjects, 10 men and 30 women (mean ± SD age, 20 ± 2 years; body mass, 61 ± 10 kg; height, 168 ± 8 cm) were assigned to the control group; 41 participants, 12 men and 29 women (age, 21 ± 2 years; body mass, 64 ± 11 kg; height, 167 ± 10 cm), were in the manipulative group; and the remaining 41 subjects, 9 men and 32 women (age, 21 ± 3 years; body mass, 61 ± 10 kg; height, 168 ± 8 cm), formed the soft tissue group. No significant differences for gender distribution (X^2 = 0.584, P = .747), age (F = 1.074, P = .773), body mass (F = 0.758, P = .471), or height (F = 0.090, P = .914) were found between groups.

All participants had latent TrPs in 1 masseter muscle, of which 51 (42%) were located on the left side and 71 (58%) on the right. Additionally, 97 subjects also had latent TrPs within 1 temporalis muscle (n = 35, 36% in the left side; n = 62, 64% in the right side). No significant differences for the distribution of latent TrPs in both masseter (X^2 = 2.922, P = .341) and temporalis muscles (X^2 = 1.825, P = .402) between groups were found.

The ANOVA revealed no significant differences between active mouth opening (F = 0.171, P = .843) and PPTs over the masseter (F = 1.467; P = .235) or temporalis (F = 0.944, P = .393) latent TrPs between groups, establishing baseline similarity between groups preintervention (**TABLE 1**).

No adverse effects were reported by any participant after the manipulative

procedure. Further, a successful popping sound was obtained with all manipulative procedures.

Pressure-Pain Threshold

The 2-by-3 mixed-model ANOVA revealed a significant group-by-time interaction (F = 9.646, $P<.01$) for changes in PPT over the masseter latent TrPs. Post hoc analysis indicated significant differences between the manipulative group as compared to the soft tissue and control groups ($P<.001$) but not between the soft tissue and control group ($P = .472$). Between-group effect sizes were small between manipulative group and both soft tissue and control groups. Preintervention-postintervention effect size was small for the manipulative group and nonexistent for the soft tissue and control groups. **TABLE 1** shows preintervention and postintervention data, along with change scores, whereas **TABLE 2** summarizes within- and between-group effect sizes for PPTs over the masseter latent TrPs in the 3 groups.

The mixed-model ANOVA also indicated a significant group-by-time interaction (F = 6.110, $P = .003$) for changes in PPTs over the temporalis muscle latent TrPs. Post hoc analyses indicated differences between the control group and both manipulative and soft tissue groups ($P = .003$), but not between the manipulative and soft tissue groups ($P = .9$). Between-group effect sizes were small between the manipulative and soft tissue groups as compared to the control group, but inexistent between both treatment groups. Preintervention-postintervention effect sizes were small for manipulative and soft tissue groups and inexistent for the control group. **TABLE 1** details preintervention and postintervention data, along with change scores, and **TABLE 2** summarizes within- and between-group effect sizes.

TABLE 2 Within- and Between-Group Effect Sizes

Measures	Effect Size (Calculated Values)*
Pressure pain thresholds over the masseter	
Within-group	
Manipulative group (n = 41)	0.29 (0.20/0.70)
Soft tissue group (n = 41)	0.00 (0.00/0.70)
Control group (n = 40)	0.019 (–0.10/0.70)
Between-groups	
Manipulative-soft tissue group comparison	0.28 ([0.20 – 0.00]/0.7)
Manipulative-control group comparison	0.28 ([0.20 – –0.10]/0.70)
Soft tissue-control group comparison	0.00 ([0.00 – –0.10]/0.70)
Pressure pain thresholds over the temporalis	
Within-group	
Manipulative group (n = 31)	0.29 (0.20/0.70)
Soft tissue group (n = 35)	0.25 (0.20/0.80)
Control group (n = 31)	0.02 (–0.10/0.80)
Between-groups	
Manipulative-soft tissue group comparison	0.00 ([0.20 – 0.20]/0.70)
Manipulative-control group comparison	0.25 ([0.20 – –0.10]/0.80)
Soft tissue-control group comparison	0.25 ([0.20 – –0.10]/0.80)
Active mouth opening	
Within-group	
Manipulative group (n = 41)	0.23 (1.50/6.80)
Soft tissue group (n = 41)	0.10 (0.50/6.10)
Control group (n = 40)	0.00 (0.00/6.7)
Between-groups	
Manipulative-soft tissue group comparison	0.15 ([1.50 – 0.50]/6.80)
Manipulative-control group comparison	0.22 ([1.50 – 0.00]/6.90)
Soft tissue-control group comparison	0.07 ([0.50 – 0.00]/6.70)

** Within-group effect sizes were calculated as follows: (preintervention – postintervention score) ÷ pooled SD. Between-group effect sizes were calculated as follows: (change score of the first group – change score of the second group) ÷ pooled SD. Data are the effect size and the values to calculate the effect size in parentheses.*

Active Mouth Opening

The 2-by-3 mixed-model ANOVA indicated a significant group-by-time interaction (F = 10.669, $P<.001$) for active mouth opening. The post hoc analysis showed significant differences between the manipulative group as compared to the soft tissue and control groups ($P<.001$) but not between the soft tissue and control group ($P = .575$). Between-group effect sizes were small between the manipulative group and both soft tissue and control groups. Preintervention-postintervention effect sizes were small for manipulative and soft tissue groups, and nonexistent for the control group. **TABLE 1** shows preintervention and postintervention data along with change scores, while **TABLE 2** summarizes within and between-group effect sizes.

DISCUSSION

The results of the current study suggest that the application of an atlanto-occipital joint thrust manipulation immediately increases PPT over latent myofascial TrPs within the masseter and temporalis muscles. We also found that a soft tissue technique targeted to the suboccipital musculature also increased PPT over temporalis, but not masseter, latent TrPs. Finally, an increase in maximum active mouth opening was also found after the atlanto-occipital thrust manipu-

lation, but not after the suboccipital muscle inhibition intervention. Nevertheless, effect sizes were small, indicating limited clinical relevance. Therefore, our results should be considered within that context.

Our study provides preliminary evidence that cervical manipulative therapy may exert a mechanical hypoalgesic effect over latent muscle TrPs located in the trigeminal region (masseter and temporalis muscles). However, we found small within-group and between-group effect sizes. Therefore, increases in PPTs (0.2 kg/cm^2) found in this study may not be clinically relevant at this stage. Nevertheless, the reported that improvements in the current study (10%) are similar to those previously found in studies investigating hypoalgesic effects elicited by joint mobilization/manipulation interventions over nonsensitized points.[39,46] The lower increase in PPTs found in the current study may be related to the fact that pressure pain sensitivity was assessed over muscle TrPs, which have been found to be sensitized points.[41] However, if manual therapies are effective for pain relief, we should expect that sensitized points would be more responsive to treatment. Future studies are needed to elucidate the effects of those manual interventions used in the current study.

Previous studies have demonstrated that cervical manipulation induces changes on PPT in latent TrPs located in muscles innervated by the manipulated segment.[31,40] The current study demonstrates that these hypoalgesic effects are also evident within the trigeminocervical area. Furthermore, our results are consistent with those previously reported by Mansilla-Ferragut et al,[38] who also found an increase in PPTs over the sphenoid bone after the application of the same manipulative intervention in women suffering from neck pain. Therefore, it is possible that upper-cervical manipulation may activate segmental inhibitory pathways[47] via the trigeminal nucleus caudalis. Accordingly, the results from our study support activation of segmental mechanisms after the application of upper-cervical manipulation or suboccipital muscle inhibition intervention.

There is recent evidence suggesting that soft tissue interventions exert similar hypoalgesic effects. It has been reported that hamstring muscle stretching produced an immediate increase in PPTs over both trigeminal and nontrigeminal regions in healthy subjects.[3] A postisometric stretching of the hamstring musculature also increased PPTs at TrPs within the masseter muscle.[13] Aparicio et al[1] found that manual inhibition of the suboccipital muscles increased PPT over the semimembranous muscle TrP. The current study showed that manual inhibition of the suboccipital muscles increased PPT over the temporalis but not over the masseter muscle. The reason for this difference is unclear, although may be due to a distinct functional role between the 2 muscles. It is possible that spinal manipulative and soft tissue interventions have similar neurophysiological effects, but future studies are needed.

The fact that segmental mechanisms explain the current results does not exclude a potential effect of central mechanisms. It is also plausible that activation of cortical or subcortical structures elicited by the thrust manipulation[26] may be involved in this hypoalgesic effect. This assumption is consistent with previous hypotheses suggesting that manipulative procedures stimulate descending inhibitory systems.[44,49] Nevertheless, we collected no data on treatment effects outside the trigeminal innervated area, so evidence of descending inhibition is lacking from the current data.

We found an increase of 1.5 mm in active mouth opening after the application of the atlanto-occipital manipulation, which is less than the 3.5-mm increase previously reported by Mansilla-Ferragut et al.[38] Other studies investigating changes in mouth opening after local treatment of TrPs within the masseter muscle[2,27] also found greater improvements ranging from 2.5 to 4 mm. Because there is a biomechanical relationship between the upper-cervical spine and the temporomandibular joint during active mouth opening,[7,51] it has been suggested that biomechanical adaptation of the jaw and the neck may be one possible reason why mouth opening increased after a cervical spine thrust manipulation. Nevertheless, the increase obtained in mouth opening following the atlanto-occipital manipulation cannot be considered as clinically relevant. It is possible that the presence of latent TrPs within the masticatory muscles in our sample of participants limits the ability to improve active mouth opening.

Finally, the current study has several limitations. First, it should be recognized that we only assessed immediate hypoalgesic effects on PPTs over latent muscle TrPs and active mouth opening. Therefore, we do not know if the hypoalgesic effects are more widespread, possibly having an effect on latent TrPs in more distant anatomical areas. Further, we did not assess for hypoalgesic effects in nonlatent TrP areas. The fact that immediate changes occurred after spinal manipulative procedure provides impetus for future studies in this area. Secondly, in the current study we selected a subthreshold pain stimulation protocol (PPT assessment). We do not know if the application of suprathreshold stimuli (pressure pain tolerance) would have greater clinical relevance. This topic may be related to the fact that our results may be affected by the standard error of measurement of PPT assessment. Therefore, future studies including both PPT and tolerance thresholds are needed to determine the effects of the interventions used in the current study. Another limitation is the fact that we included subjects with latent TrPs who may not be typical population presenting to therapists for treatment. We do not know if the clinical effects of these interventions would be similar or possibly greater in subjects

with active TrPs. Lastly, as the control group did not receive an intervention, we cannot exclude the possibility that the changes noted for the 2 interventions might have been due to a placebo effect related to the joint-popping sound for the manipulation technique or hand contact for the soft tissue technique. Future studies resolving these clinical limitations are needed to further elucidate the effects of cervical interventions into muscle TrPs within the masticatory musculature.

CONCLUSIONS

The application of an atlanto-occipital thrust manipulation produces an immediate increase in PPTs over latent TrPs in the masseter and temporalis muscles. A soft tissue technique targeted to the suboccipital muscles also increased PPT over the temporalis but not masseter latent TrPs. Finally, an increase in maximum mouth opening was also found after the atlanto-occipital joint thrust manipulation but not after the suboccipital muscle inhibition intervention. However, the effects of the interventions were small and further studies are required to elucidate the clinical relevance of these changes. ◉

KEY POINTS

FINDINGS: Atlanto-occipital joint manipulation increased PPTs over latent TrPs within the masseter and temporalis muscles and a suboccipital inhibition technique increased PPTs over temporalis TrPs but not those of the masseter. The effects of these interventions were small.

IMPLICATIONS: This finding suggests that cervical interventions can exert a hypoalgesic effect over the trigeminal area.

CAUTION: As only individuals with latent TrPs were included in the study, we do not know if similar effects would occur in patients with acute or chronic pain.

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