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CASE REPORT

Dry needling in the management of chronic tension-type headache associated with levator scapulae syndrome: A case report

Peter Gagnon[1,2] | James Dunning[1,3] | Paul Bliton[1,4] | Casey Charlebois[1,5] | Nathan Henry[1,6] | Patrick Gorby[1,7] | Firas Mourad[8,9]

[1]American Academy of Manipulative Therapy Fellowship in Orthopaedic Manual Physical Therapy, Montgomery, Alabama, USA

[2]Physical Therapy of Boulder, Boulder, Colorado, USA

[3]Montgomery Osteopractic Physical Therapy & Acupuncture, Montgomery, Alabama, USA

[4]William S. Middleton VA Hospital, Madison, Wisconsin, USA

[5]Arcadia University, Glenside, Pennsylvania, USA

[6]Physio Room, Colorado Springs, Colorado, USA

[7]Gorby Osteopractic Physiotherapy, Colorado Springs, CO, Colorado Springs, Colorado, USA

[8]Department of Physiotherapy, LUNEX International University of Health, Exercise and Sports, Differdange, Luxembourg

[9]Luxembourg Health & Sport Sciences Research Institute ASBL, Differdange, Luxembourg

Correspondence

James Dunning, American Academy of Manipulative Therapy Fellowship in Orthopaedic Manual Physical Therapy, Montgomery, AL, USA.

Email: drjamesdunning@gmail.com

Key Clinical Message

The use of DN to the muscular trigger points and distal periosteal enthesis of the levator scapulae may be a useful adjunct intervention within a multi-modal plan of care for the management of work-related chronic tension-type headaches associated with LSS.

Abstract

Chronic tension-type headaches (CTTH) have a lifetime prevalence of 42% and account for more lost workdays than migraine headaches. Dry needling (DN) is being increasingly used by physical therapists in the management of CTTH; however, to date, the supporting evidence is limited. The purpose of this case report was to describe how three sessions of DN targeting myofascial trigger points in the levator scapulae (LS) muscle and its distal enthesis was used to treat a 63-year-old male patient who presented with work-related CTTH associated with levator scapulae syndrome (LSS). The patient was treated for five visits over the course of 2 months. At discharge and 6-month follow-up, the patient reported full resolution of symptoms. Self-report outcomes included the numeric pain rating scale and the Neck Disability Index. The use of DN to the LS muscle and its distal enthesis may be a valuable addition to a multi-modal plan of care in the treatment of work-related CTTH associated with LSS.

KEYWORDS

dry needling, myofascial, tendon, tension type headache, trigger point

1 | BACKGROUND

Headache ranks among the top 10 most disabling conditions worldwide.[1] Tension type headache (TTH) is the most frequent primary headache and is characterized by bilateral, non-throbbing, mild to moderate pain of the head and neck that is not exacerbated by routine physical activity.[2] According to the International Headache Society (IHS), there are two distinct types of TTH. Episodic TTHs (sub-classified as infrequent or frequent) occur between 1 and 14 days per month. Less common, chronic tension-type headaches (CTTH) are present on ≥15 days per month.[2] Population-based studies suggest a lifetime prevalence of 42%[1] with three times more workdays lost when compared to migraine headaches.[3] The IHS criteria for diagnosis of CTTH includes: (1) headache occurring ≥15 days per month on average for >3 months, (2) headache lasting hours to days, and (3) headache demonstrating at least two of the following four characteristics: bilateral location, pressing or tightening (non-pulsating) quality, mild or moderate intensity, not aggravated by routine physical activity.[2]

The onset of episodic headaches can occur due to peripheral tissue irritation with central pain mechanisms underlying the evolution to CTTH.[4–6] Patients with CTTH demonstrate greater headache intensity and frequency compared to those with episodic TTH, indicating temporal summation of noxious afferent input.[7] Recurrent, low-frequency nociceptor stimulation progressively sensitizes peripheral nerve terminals and spinal dorsal horn neurons related to the neck and shoulder region, contributing to the formation and maintenance of MTrPs in patients with CTTH.[8,9] Previous studies have demonstrated neck and shoulder MTrPs, along with surrounding soft tissues including tendons, ligaments, and fascia may reproduce the symptoms associated with CTTH.[10–14]

Simons and Travell defined a MTrP as a hyperirritable spot within a taut band of a skeletal muscle that is painful on compression, stretch, overload, or contraction, with referred pain perceived as distant from the hyperirritable spot.[15] Although a systematic review and meta-analysis concluded the inter-rater reliability of manual palpation for identification of myofascial trigger points is "unreliable",[16] good reliability has been reported for diagnostic signs including local tenderness ($k=0.22$–1.0) and pain recognition ($k=0.57$–1.0).[17] In addition, sonoelastography and magnetic resonance elastography appear to contribute to the objective identification of MTrPs.[18,19]

The integrated hypothesis of MTrP formation theory proposed by Simons, speculates excessive acetylcholine release at the neuromuscular junction, leading to a sustained contraction of sarcomeres, local ischemia and an ATP driven "energy crisis." The resultant hypoxic state of the muscle induces secretion of inflammatory chemical mediators followed by the antidromic release of neuropeptides from local nerve endings, lowering pH levels and sensitizing neural pathways that contribute to the formation of MTrPs.[20] Active MTrPs are clinically associated with spontaneous pain (without palpation or manual compression) in the immediate surrounding tissue and/or distant, referred sites. In contrast, latent MTrPs elicit local or referred pain only upon palpation and are not recognized as familiar pain to the patient.[21] Both active and latent MTrPs can provoke tissue dysfunction characterized by reduced range of motion, muscle fatigue, and altered activation patterns.[22,23]

Approximately 70% of patients with CTTH appear to experience muscle spasms in the cervical region.[24,25] More specifically, pathophysiological changes in the muscular activity of the sub-occipitals, sternocleidomastoid, upper trapezius, and levator scapulae (LS) have been recognized in the development of CTTH.[13,26]

Levator scapulae syndrome (LSS) is a musculoskeletal disorder, characterized by pain and stiffness in the upper thoracic and cervical regions, with limited cervical range of motion and tenderness to palpation at the medial aspect of the superior angle of the scapula.[27–29] Distal LS muscle belly and teno-osseous attachment tenderness has been reported in patients with LSS and may play a role in the development of "enthesopathy resulting from sustained MTrP tension."[15] Increased heat emission has been measured from the medial aspect of the superior angle of the scapula in more than 60% of patients diagnosed with LSS, suggestive of an active metabolic process.[29] Notably, this specific region is the anatomical correlate for the enthesis attachment in LSS. Following mechanical damage, tissue repair responses and vessel ingrowth have been observed.[30] Similar to tendons in disrepair, pain, and tenderness at the enthesis is associated with increased vascularity on color imaging.[31]

Physical therapy is one of the most commonly used non-pharmacological approaches in the management of CTTH and can include manipulation and mobilization, postural control, exercise, soft tissue release, and dry needling (DN).[32,33] DN is a skilled treatment technique that uses solid filiform needles inserted into MTrPs, tendons, teno-osseous structures and other soft tissues.[34–36] DN has been found to significantly improve headache frequency, MTrP tenderness, cervical range of motion and health-related quality of life in patients with CTTH by providing a more comprehensive treatment approach than exercise and manual therapy alone.[37–39] Although DN was found to be superior to ischemic compression, follow up data was only taken immediately post intervention, 48h and 1 week after treatment with notable improvement in pressure pain thresholds, pain intensity, and tissue stiffness in the DN group.[40]

This case report describes the history, physical examination findings, specific treatments, and outcomes of a patient with CTTH associated with LSS and highlights the importance of a thorough palpatory examination, including both myofascial and teno-osseous structures. Considering the documented effects of postural stress on musculoskeletal dysfunction in the workplace, increased sedentary behavior associated with the use of technological devices may lead to a higher prevalence of TTH in the future.[41–47]

2 | CASE DESCRIPTION

2.1 | Patient history

A 63-year-old male presented to the physical therapist with a primary complaint of insidious onset headaches over the past 5 months while typing at the computer with a secondary complaint of chronic neck and shoulder tightness. Notably, outside of work-related computer typing activities, the patient was otherwise active and did not live a sedentary lifestyle. The headache pain was described as a diffuse, dull ache originating near the medial aspect of the superior angle of the scapula bilaterally and progressively radiating upward toward the occiput. The patient reported a steady increase in symptoms while typing that peaked in the afternoon and decreased in the evening after self-administered treatment. Past medical history included concussion and an acute bout of neck pain after a traumatic biking accident 5 years prior. Imaging ruled out red flags and aside from some intermittent lingering stiffness, a full recovery was achieved.

Relief from headache symptoms occurred while taking a hot shower, using a heating pad, or applying self-massage to muscles in the neck and scapulothoracic region. At worst, headache pain was 6/10 on the Numeric Pain Rating Scale (NPRS) and negatively affected the patient's ability to concentrate while working. The NPRS is a reliable and valid instrument to assess pain intensity.[48–50] The minimal clinically important difference (MCID) for the NPRS has been shown to be 1.74 in patients with chronic pain conditions;[49] however, the MCID for TTH pain has not yet been established. Nevertheless, a change of two points or a 30% decrease in pain from baseline can be considered as a MCID in patients with chronic musculoskeletal pain.[49,51]

The Neck Disability Index (NDI) score at the initial examination (i.e., baseline) was 19/50 (38%). The NDI is the most widely used instrument for assessing self-rated disability in patients with neck pain.[52–54] The NDI is a self-report questionnaire with 10 items rated from 0 (no disability) to 5 (complete disability).[55] The numeric responses for each item are summed for a total score ranging between 0 and 50. Higher scores represent increased levels of disability.[52,56] The NDI has been found to possess excellent test–retest reliability, strong construct validity, strong internal consistency, and good responsiveness in assessing disability in patients with cervicogenic headache (CH).[50] Although the MCID for CTTH has not been determined, the MCID for the NDI has been reported to be 7.5 in patients with CH.[50]

2.2 | Physical examination

The initial physical examination and all treatments were performed by a physical therapist with 8 years of clinical experience. In addition, this clinician was certified in DN and a fellow-in-training within an APTA-accredited orthopedic manual physical therapy fellowship program. The patient provided consent for treatment and for publication of the case details in a scholarly journal. Objective examination findings can be found in Table 1. Notably, the patient reported severe tenderness and specific reproduction of posterior neck and suboccipital pain with pincer grasp palpation to the distal LS muscle bilaterally (i.e., approximately one thumb width superior and medial to the superior angle of the scapula). Tenderness with referred pain was also reported during palpation over the muscle's distal enthesis (i.e., the medial aspect of the superior angle of the scapula), bilaterally.

The patient demonstrated pronounced thoracic kyphosis and forward head posture while using a laptop computer. Correlations have been reported between forward head posture and increased incidence of neck and headache pain in patients with CTTH when compared to controls.[57–60] A 3-D kinematics study of desk workers found increased head–neck flexion angles to be associated with increased upper trapezius muscle activity, a synergist of the LS.[61] Additionally, significant weakness of the rhomboid and middle trapezius muscles have been reported in patients with neck pain when compared to controls, potentially increasing mechanical load to the scapular elevators.[62,63] Prior studies related to work-related myofascial disorders reported changes in muscle activity, stiffness and microcirculation during prolonged computer tasks, likely contributing to the onset and continuation of TTH.[42,43,45,61,64]

TABLE 1 Summary of relevant examination & discharge findings.

Visit	1 (initial visit)	2	3	4 (at 4 weeks)	5 (discharge at 8 weeks)	Follow up (6 months)
NPRS	6/10	5/10	1/10	0/10	0/10	0/10
NDI	19/50 (38%)			0/50 (0%)	0/50 (0%)	0/50 (0%)
Cervical rotation	55° (b)				65° (b)	
Cervical side bend	10° (b)				15° (b)	
Cervical flexion/extension	50°/60°				60°/65°	
Strength						
Mid trap	3+/5				4/5	
Rhomboid	3+/5				4/5	
ER's	3+/5				4+/5	
Deep neck flexor endurance	45 s					
Cervical Flexion Rotation Test	Negative					
Joint mobility testing	C1-7 Lateral glide testing: hypomobile (b)				C1-7 Lateral glide testing: hypomobile (b)	
	Thoracic T1-5 CPA: hypomobile				Thoracic T1-5 CPA: hypomobile	
Screen	(−) cranial nerve, upper motor neuron, myotomes, dermatomes, deep tendon reflex tests					

Abbreviations: (b), bilateral; CPA, central posterior to anterior; ER's, external rotators; NDI, Neck Disability Index; NPRS, numeric pain rating scale.

2.3 | Differential diagnosis

Potential diagnoses included CTTH, CH, cervical facet arthropathy and cervical spondylosis. Notably, the patient presentation did not match the revised diagnostic criteria for CH[65] developed by the Cervicogenic Headache International Study Group (CHISG)[65–67] consisting of (1) the unilaterality of head pain without side shift, starting in the upper posterior neck or occipital region, eventually spreading to the oculofrontotemporal area on the symptomatic side, (2) pain triggered by neck movement and/or sustained awkward positions, (3)the reduced range of motion in the cervical spine[68] (i.e., ≤32° of right or left passive rotation on the Flexion-Rotation Test),[69–71] (4) pain elicited by external pressure over at least one of the upper cervical joints (C0-3), and (5) moderate to severe, non-throbbing and non-lancinating pain. Nevertheless, the diagnosis was guided by the patient's subjective presentation of bilateral headache pain, the IHS criteria for CTTH including (1) headache occurring ≥15 days per month on average for >3 months (2) headache lasting hours to days and (3) headache demonstrating at least two of the following four characteristics: bilateral location, pressing or tightening (non-pulsating) quality, mild or moderate intensity, not aggravated by routine physical activity,[2] and specific reproduction of the patient's headache symptoms with palpation of the LS muscle and it's enthesis.

2.4 | Interventions

Cervical and thoracic mobilization was performed at the initial visit and the patient was also provided a home exercise program.[72] At the second visit, 1-week following initial evaluation, DN was performed and directed to the LS muscle belly one thumb width medial and cephalad to the superior angle of the scapula and to the distal teno-osseous attachment, bilaterally. The patient was placed in a prone position with his arm internally rotated behind the back and a rolled towel was placed under the anterior shoulder to further expose the superior angle of the scapula. A pincer grip was used to bracket the superior angle of the scapula as well as draw the tissue superiorly, thus avoiding proximity to the ribcage and underlying lungs. Seiren needles (0.30 mm diameter × 50 mm length) were inserted obliquely from lateral-to-medial, superior-to-inferior and posterior-to-anterior through the upper trapezius and into the LS muscle belly, one thumb width medial and cephalad to the superior angle of the scapula (Figure 1). At the muscle belly, the needle was partially withdrawn and re-angled using a fanning technique to target 3–4 unique points within a narrow cone-shaped area. The observation or lack thereof of local twitch responses during DN did not appear to correlate with a subjective change of symptoms, consistent with a recent literature review that concluded that local twitch responses during DN are not necessary for analgesia.[73]

Periosteal pecking at the distal enthesis of the left and right LS was also performed at the junction between of the root of the spine of scapula and the superior angle of the scapula, bilaterally (Figure 1). The superior angle was marked superiorly by the left index finger and medially by the third (long) finger to ensure the needle did not migrate superiorly or medially and miss the scapula. The patient reported reproduction of headache symptoms during unidirectional winding of the needle targeting the distal MTrPs enthesis of the LS muscle, bilaterally. The technique of winding or twisting needles enhances the physiological effects of DN, by increasing local tissue stimulation, activating mechanoreceptors and subsequently amplifying the transmission of sensory signals to the central nervous system.[74] This heightened sensory input has been linked to the release of neurotransmitters, including endorphins and serotonin, which are crucial for pain modulation and regulation.[75] Interstitial adenosine, one of the body's natural anti-inflammatory mechanisms, has been shown to remain elevated for 30 min post needle insertion, if the needle is inserted and unidirectionally rotated.[76]

All interventions performed during each session along with prescribed home exercise program can be found in Table 2.

2.5 | Outcomes

Immediately following DN treatment, patient reported decreased neck stiffness and pain intensity reduction (NPRS, 0–10) to 3/10 (from 6/10) for headache pain. At the third appointment, near complete relief of work-related headaches (1/10 on the NPRS) was described with onset occurring only during prolonged periods of work without attention to ergonomics.

Eight weeks from the initial evaluation, a complete cessation of work-related headaches with a significant reduction in muscle stiffness was reported. In addition, the patient demonstrated increased active range of motion in cervical rotation, side bend, flexion and extension, along with increased strength of middle trapezius, rhomboids, and shoulder external rotators. Emphasis was placed on a modified at-home workspace to optimize computer ergonomics and progressive strength training focusing on retraction-based exercises.

The patient was seen for a total of five visits over the course of 2 months. The timeline of interventions can be found in Figure 2. At discharge (8 weeks after initial evaluation) and at 6-month follow-up, the patient reported no headaches during the workday, no disability (i.e., a 0/50 score on the NDI), and no pain (i.e., 0/10 score on the NPRS). (Table 1).

FIGURE 1 Dry needling to the levator scapulae muscle belly (left) and its distal enthesis (right) in the management of chronic tension-type headache associated with levator scapulae syndrome.

TABLE 2 Interventions and exercise.

Visit	1 (initial visit)	2	3	4	5 (discharge)
Interventions	Cervical rotational and lateral glide mobilization C1-7	Cervical rotational and lateral glide mobilization C1-7	Cervical rotational and lateral glide mobilization C1-7	Cervical rotational and lateral glide mobilization C1-7	None
	Thoracic CPA/UPA T1-5	Thoracic CPA/UPA T1-5	Thoracic CPA/UPA T1-5	Thoracic CPA/UPA T1-5	
		Dry needling targeting (b) levator scapulae muscle and enthesis	Dry needling targeting (b) levator scapulae muscle and enthesis	Dry needling targeting (b) levator scapulae muscle and enthesis	
Home exercise program	Sidelying thoracic rotation stretch (b) (5×, 30 s hold)	Sidelying thoracic rotation stretch (b) (5×, 30 s hold)	Sidelying thoracic rotation stretch (b) (5×, 30 s hold)	Sidelying thoracic rotation stretch (b) (5×, 30 s hold)	Sidelying thoracic rotation stretch (b) (5×, 30 s hold)
	Theraband resisted row (3 × 10)	Theraband resisted row (3 × 10)	Theraband resisted row (3 × 10)	Theraband resisted row (3 × 10)	Theraband resisted row (3 × 10)
	Extensive ergonomic education	Bilateral ER with scapular retraction and band resistance (2 × 10 with 5″ hold)	Bilateral ER with scapular retraction and band resistance (2 × 10 with 5″ hold)	Bilateral ER with scapular retraction and band resistance (3 × 10 with 5″ hold)	Bilateral ER with scapular retraction and band resistance (3 × 10 with 5″ hold)
			Horizontal abduction at 90° elevation (3 × 10)	Horizontal abduction at 90° elevation (3 × 10)	Horizontal abduction at 90° elevation (3 × 10)

Abbreviations: (b), bilateral; CPA, central posterior to anterior; ER, external rotation; UPA, unilateral posterior to anterior.

FIGURE 2 Timeline of interventions in a patient with chronic tension-type headache associated with levator scapulae syndrome.

3 | DISCUSSION

The results of this case report suggest the addition of DN targeting MTrPs of the distal LS muscle and distal enthesis over the medial aspect of the superior angle of the scapula, along with joint mobilization (C1-C4 in supine and T1-T6 in prone grade III/IV), strength training and ergonomic education may be useful when treating individuals with CTTH associated with LSS.

Manual therapy, therapeutic exercise and ergonomics are common types of physical therapy interventions for CTTH and were addressed with this patient; however, these non-invasive interventions did not appear to be associated in time with the patient reported changes in pain and disability.[72,77–79] Manipulation and mobilization appear no more effective than conservative care at short-term follow up for individuals with TTH.[80] Strength training has demonstrated a moderate clinical effect, but that is with a very low quality of evidence in patients with TTH.[79] Notably, a workplace intervention study that delivered an 8-week resistance training program for neck and shoulder pain found no between-group difference and reported a reduction in mean worst pain of 25% and 43%, respectively, when the two groups were merged.[81] Nevertheless, resistance training has been found to stimulate collagen turnover and increase levels of growth factor that further insulate tissue from pathology and be beneficial for CTTH patients.[78,79]

Although multiple interventions were utilized and no cause-and-effect relationship can be established in a single case report, the addition of DN targeting MTrPs in the distal belly and enthesis of the LS reproduced and appeared to improve the patient's headache symptoms, reflecting a change in pain intensity scores (NPRS, 0–10) from 5/10 on the second visit to 1/10 on the third visit after the first inclusion of the DN intervention. Notably, the amount of reported change in pain intensity was considerably smaller (i.e., from 6/10 at the initial visit to 5/10 on the second visit) when cervical and thoracic mobilization along with a home exercise program was only administered. In addition, the observed changes in pain intensity following the addition of the DN treatment to MTrPs suggests the etiology for this specific patient was likely not from underlying facet joint dysfunction.[82]

The underlying mechanisms of spinal mobilization, exercise, and DN remain to be elucidated. However, it has been suggested displacement of vertebrae may alter afferent discharge rates[83] by stimulating mechanoreceptors and proprioceptors, thereby changing alpha motorneuron excitability levels and subsequent muscle activity.[83–85] Spinal manipulation may stimulate receptors in the deep paraspinal musculature, whereas spinal mobilization may be more likely to stimulate receptors in the superficial muscles.[86] Notably, biomechanical,[87,88] spinal or segmental[89,90] and central descending inhibitory pain pathway[91–94] models are all possible explanations for the hypoalgesic effects reported by the patient in this case study. Additionally, the biomechanical effects of spinal mobilization and/or manipulation have recently been under scientific scrutiny,[95] and it is plausible that the hypoalgesic effects observed in this patient are associated with a neurophysiological response involving temporal sensory summation at the dorsal horn of the spinal cord;[89] however, this proposed pain model is currently supported only on findings from transient, experimentally induced pain in healthy subjects,[96,97] not patients with CTTH.

Notably, this is a case report of a single patient; therefore, it is possible that the observed improvements in pain and disability reported by this individual are associated with a placebo effect from the insertion of monofilament needles without injectate. Nevertheless, a secondary analysis of an individual patient data meta-analysis of 29 trials ($n = 19{,}827$) of acupuncture for chronic pain concluded that real acupuncture was superior to sham needling irrespective of the subtype of control or sham procedure (penetrating or non-penetrating).[98]

Inactivation of MTrPs can improve local circulation, increase range of motion, decrease muscle tightness and improve the overall functional status of a muscle.[82] Two meta-analyses concluded that trigger point DN may be effective in decreasing pain in the short and medium term compared to control or sham needling.[99,100] Reductions in headache intensity, frequency and duration have been demonstrated following three sessions of DN to active MTrPs in muscles of the head and neck.[32] Additionally, a recent meta-analysis reported that DN produces similar effects to other interventions for short term headache relief.[99] Results demonstrate that potential benefits of DN included an increase in cervical ROM and a decrease in MTrP tenderness and headache frequency. Notably, DN has previously been found to provide significant improvement in short-term disability in patients with TTH.[99]

Notably, this case utilized DN to target the teno-osseous junction or enthesis of the LS, that is, the interface between the periosteum and the tendon. Poor tendon vascularization and vessel anastomosis justify DN to this region; in addition, previous clinical trials have reported successful outcomes in pain and disability when DN to the enthesis at the periosteal region was included.[35,101]

4 | CONCLUSION

Myofascial trigger points and sensitive entheses associated with the LS muscle may reproduce headache symptoms in individuals with CTTH. Particular areas of interest for both diagnosis and treatment are the region medial and cephalad to the superior angle of the scapula and also the distal teno-osseus attachment site over the medial aspect of the superior angle of the scapula. These two pathoanatomic lesions appeared to respond favorably to a multimodal treatment approach that included DN targeting MTrPs, periosteal DN targeting the enthesis, education, and strength training. A future randomized clinical trial with an active comparison group would be a useful next step to ascertain whether the changes seen in this single case study are apparent in a two-arm clinical trial.

AUTHOR CONTRIBUTIONS

Peter Gagnon: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; writing – original draft; writing – review and editing. **James Dunning:** Conceptualization; formal analysis; methodology; project administration; supervision; writing – original draft; writing – review and editing. **Paul Bliton:** Methodology; resources; supervision; writing – review and editing. **Casey Charlebois:** Project administration; software; supervision; visualization; writing – review and editing. **Nathan Henry:** Methodology; project administration; supervision; writing – original draft. **Patrick Gorby:** Methodology; project administration; software; writing – review and editing. **Firas Mourad:** Data curation; methodology; project administration; supervision; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

J.D. is the director and owner of the American Academy of Manipulative Therapy (AAMT) Fellowship in Orthopedic Manual Physical Therapy. AAMT provides postgraduate training programs in diagnostic musculoskeletal sonography, vestibular rehabilitation, spinal manipulation/mobilization, dry needling, extremity manipulation/mobilization, therapeutic exercise, and differential diagnosis to licensed physical therapists, dentists, chiropractors, and medical physicians. The other authors declare that they have no competing interests. None of the authors received any funding for this study.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ETHICS STATEMENT

The patient involved in this case study provided informed consent for treatment and for the publication of the case details in a scholarly journal.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

ORCID

James Dunning https://orcid.org/0000-0002-1194-0108
Firas Mourad https://orcid.org/0000-0002-8981-2085

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