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Effects of Strain/Counter strain on Cervical Pain & Disability: A Case Report

Abstract

The purpose of this case report is to describe the effectiveness of strain-counterstrain (S-CS) on outcomes for a patient with cervical spine pain, weakness and disability. The patient was a 36-year-old male Marine referred for a cervical sprain with neck stiffness, weakness, and pain. Treatment of the cervical spine consisted of S-CS for the upper trapezius and superior oblique tender points, performed twice weekly for four weeks. He exhibited a significant reduction in pain scores measured by the Numeric Pain Rating Scale (NRPS), increased cervical flexion strength measured by MMT, and improved disability scores measured by the Neck Disability Index (NDI). Although a causative effect may not be inferred by this case report, results suggest a potential benefit from the use of this gentle intervention for reducing pain, improving strength and function. Future studies are recommended to investigate the effectiveness of S-CS in the treatment of neck pain and disability.

Keywords: Strain-counterstrain (S-CS); Cervical (Neck) Pain; Neck Disability Index (NDI); Tender Point (TP); Muscle Strength (MMT)

Case Report

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Abbreviations: SCS: Strain-counterstrain; NDI: Neck Disability Index; HHD: Hand-Held Dynamometer; MMT: Manual Muscle Tester; NRPS: Numeric Pain Rating Scores

Introduction

The use of strain-counterstrain (S-CS) as a primary and effective intervention technique has been controversial due to a lack of empirical evidence. The issue is further complicated when one adds in a generalized pathological condition, such as musculoskeletal related cervical (neck) pain. Determining the efficacy of S-CS as an effective primary intervention or adjunct to modalities, mobilization, or therapeutic exercise has been problem-some for practitioners due to the lack of intervention-specific S-CS research. Prior research has demonstrated that S-CS decreases pain [1-5], improves strength [2], increases mobility, improves function, and decreases disability [3,6]; however, none of the studies have described the application of S-CS for musculoskeletal-related cervical pain [1-6].

Prior research on the efficacy of S-CS in affecting positive changes in pain and strength in the foot [4,5], hip [2], low back [6], and for neurological conditions such as complex regional pain syndrome [3] have been reported. See Table 1 for a summary of the research. To date, there are no studies which support the use of S-CS for neck pain and disability. Although Wong & Schauer-Alvarez [2] found significant strength gains as a result of S-CS, no studies have documented such gains for patients with cervical muscle weakness. This case report describes not only the result of S-CS for neck pain and weakness; it includes outcome measures of neck disability and strength changes in a patient referred with cervical pain and weakness. The purpose of this case report is to describe the effectiveness of S-CS in treatment of cervical spine pain, muscle weakness, and neck disability scores in a patient who sustained whiplash injury to his neck.

Case Description

The patient was a 36 y/o male soldier serving in Iraq. He was riding in a truck, traveling at high speed, when it hit an explosive device six months prior to referral to PT, resulting in injury to his head, cervical spine, and left knee. He stated he was checked briefly by a medic, but was given no treatment. He returned to duty immediately despite his injuries and returned home six months later for medical follow-up. Once home, the patient reported that he was examined by a physician, who simply referred him to PT for his neck pain. He had no radiographic exams or treatment of his head or cervical spine. The patient reported taking only ibuprofen 400mg. for pain since the accident. Prior medical history was noncontributory.

During the initial examination, the patient stated that he had tried to participate in his daily physical training after the accident, including 12 hours of daily patrols and martial arts, but was limited in doing so by persistent pain, stiffness, and weakness in his cervical spine and right shoulder (upper trapezius). The patient reported that prior to the accident, he had maintained the fitness level of an elite athlete by running 3 miles daily, weight training, and practicing martial arts. His goal was to resume his prior level of athletic function.

His chief complaint was weakness, pain, stiffness, and clicking in his cervical spine and right upper trapezius, exacerbated by attempting pull-ups, pushups, sit-ups, or martial arts. The patient reported that his cervical pain radiated into the right posterior occiput and upper trapezius belly.

Examination

The examination processes are described in the context of The Guide to Physical Therapist Practice (Guide) [7] and The

International Classification of Function (ICF) [8,9]. The patient's identified problems (PIP) included: intense pain in cervical spine, occiput and trapezius associated with loss of cervical motion and difficulty turning his head, looking up or down, performing job-related activities such as martial arts, combat practice, pull-ups, pushups, and sit-ups. The patient's main goals were to regain sufficient strength and mobility in his cervical spine to be able to perform all job-related activities without restrictions or pain and to resume his prior level of athletic function.

Table 1: Summary of Existing Strain – Counterstrain (S-CS) Literature.

Study	Population	Design	Purpose	Sample Size	Instruments	Outcomes
Wong KW, Schauer-Alvarez C	Hip	Randomized controlled trial	Analyze the effect of S-CS on hip strength and TPs of abductors and adductors	49	Pain: Visual Analog Scale Muscle Strength: Nicholas Manual Muscle Tester	1) Significant reduction in pain intensity scores 2) Significant increase in hip strength in both the S-CS group and S-CS with exercise group. 3) Changes were maintained 2-4 weeks post intervention.
Collins CK	Single patient CRPS and ankle sprain in an adolescent girl	Case Report	Describe outcomes of S-CS for 45-50 mins. combined with gait training for 3 months, followed by strength, endurance and gait for 3 months on chronic pain and disability post-ankle sprain	1	1)Gait analysis 2) Single limb stance 3) Left ankle range of motion and strength (MMT) 4) Pain intensity (NRPS)	Improvement in all outcomes for pain each visit and reduction of pain score to 0-2 by last visit. Improved gait, strength and AROM.
Howell JN, Cabell KS, Chila AG, Eland DC	Achilles Tendonitis	Controlled clinical trial experimental design	Examined the efficacy of S-CS on Achilles tendonitis	31	1)Pain Ratings 2)EMG Stretch Reflex and H Reflex Amplitudes and torque response 3)Symptom rating for pain, stiffness and swelling	Significant reduction in: 1) pain from 5.69 to 3.69 2) 23.1% decrease in soleus stretch reflex amplitude on EMG 3)pain and swelling reduced
Wynne MM, Burns JM, Eland DC, Conaster RR, and Howell JN	Plantar fasciitis	Single-blind RCT crossover design	Examined effect of S-CS on clinical outcomes and stretch reflexes of patients with Achilles tendinitis	20	Clinical outcome question-naires. Stretch reflex and H reflex with peak force EMG of triceps surae	1)Decreased intensity of symptoms, 2) Increased peak torque of both reflexes in triceps surae

Structural Examination

The patient was 36 years old, 6'0", 200 lbs. Range of motion (ROM) and strength (MMT) assessments were unremarkable, except for painful limited cervical rotation and painful, weak forward flexion. Passive cervical flexion was 0-30 degrees. Right rotation was 0-25 degrees, left rotation was 0-30 degrees. Neurological assessment revealed normal deep tendon reflexes and sensation, except for slightly reduced sensation to light touch in his right hand, digits 1-3. Postural assessment revealed forward head posture, with protracted and elevated right scapula. Palpation revealed tender points (TPs) with palpable taut bands at the upper trapezius muscle belly (TRA), and superior oblique, which is referred to as PC1-E (superior oblique/posterior cervical one-extension) by D'Ambrogio [10].

Strength Testing

Muscle strength for cervical flexion was measured using a hand-held dynamometer (HHD) in the testing position described by Daniels & Worthingham [11]. The Nicholas Manual Muscle Tester (MMT) a HHD, was placed over the forehead of the patient in the supine position (Lafayette Instrument Instruction Manual, Nicholas Manual Muscle Tester 3700 Sagamore Parkway North, Lafayette IN, 47903). The patient was instructed and manually cued to elevate his head from the table, and to maximally hold against the examiner's opposing resistance at end-range cervical flexion. Upon measurement of the force value, the HHD was removed and the patient instructed to rest. To minimize error, three measurements were taken at the initial examination, with a ten second rest between tests, as recommended by Phillips & Bohannon [12,13]. The mean of the three tests was used as the strength value for cervical flexion on the initial visit. The HHD has been shown to be a reliable tool for strength testing in experienced physical therapists [13]. A single test is adequate in clinical practice, since there is a high intra-session and inter-session correlation for single examiners, according to Bohannon [13], who reported correlation coefficients of .84 to .99 for multiple muscle tests using the HHD. Reliability and validity of HHDs was described by Roy et al. [14], who reported test-retest intra-class correlation coefficients from 0.90-0.91 in fractured and non-fractured legs. See Table 2 for MMT outcome measures.

Functional Activities/Work Activities

The patient was unable to participate in his required activities as a soldier due to neck pain, stiffness and weakness. To perform patrols, martial arts, pull-ups, pushups, and sit-ups, he had to be able to fully lift and turn his head without pain.

Self Reported Outcome Measures

Several outcome measures were used in this study including: Numeric Pain Rating Scores (NRPS) and MMT measurements (Table 2). To support objective findings and amount of disability, the NDI [15], a self-reported instrument, was used as an additional outcome measure [15-18]. Data were collected before and after the four week intervention period.

The NDI [15] was selected to assess the patient's perceived neck disability and symptoms with respect to performing tasks. The NDI consists of a ten item disability/symptom questionnaire, rated on a five point ordinal scale, from zero (no disability) to five (highest functional disability level) [15]. Vernon & Mior [15] reported a high level of reliability for the NDI. Several studies confirmed the validity and reliability of the NDI outcome instrument as a disability indicator for neck pain [15-18]. Outcome measurements are noted in Table 2.

Table 2: Outcome Measurements of Cervical Pain, Disability and Strength.

Visit Number	Time	NRPS Pain Scale TRA	NRPS Pain Scale PC1-E	NDI Neck Disability Index*	MMT cervical flexion (kg.)
1	Pretest	10	9	23 points (46%)	10.7
1	Posttest	3	4		14.6
2	Pretest	7	8		10.0
2	Posttest	3	3		14.3
3	Pretest	7	8		12.1
3	Posttest	2	0		15.5
4	Pretest	6	7		16.5
4	Posttest	2	2		24.2
5	Pretest	7	7		15.8
5	Posttest	2	0	20 points (40%)	19.1
6	Pretest	5	6		16.2
6	Posttest	1	0		19.9
7	Pretest	4	4		18.3
7	Posttest	1	1		23.7
8	Pretest	3	4		19.8
8	Posttest	1	0	10 points (20%)	26.5

Pain Scale Measurement

The verbal NRPS was selected to assess and monitor changes in reported pain [19-27]. The NRPS provides a quantitative measurement of pain intensity from 0 to 10, with 0 representing "no pain" and 10 representing the "worst pain imaginable". In 1978, the first numeric rating scale for pain was described by Downie et al. [19], modeled after the graphic scales described by Freyd & Huskinsson [20,21]. The NPRS was used to measure pain before and after the S-CS intervention for each TP each visit. Studies on the NRPS reported a reliability of 0.67-0.96 [24-27]. The NRPS was reported as a valid and reliable indicator for pain, with correlations of r = 0.79 - 0.95 to the Visual Analog Scale for Pain [21] by Berthier & DeLoach et al. [22,24,28]. Stratford reported a minimally important clinical difference of three points for the NRPS [22]. See Table 2 for outcomes.

Diagnosis and Prognosis

Clinical impression

Patient presented with painful limited movement and weakness of his cervical spine, postural asymmetry, and cervical muscle TPs. Key findings which lead to a differential diagnosis of cervical sprain included: (1) the painful hypomobility of cervical spine flexion and rotation, (2) weakness of cervical spine flexion and (3) painful TPs in the trapezius and superior oblique muscles. According to the *Guide* [7], cervical sprain is ICD-9 code 847.0 [29]. The patient was classified into Preferred Physical Therapist Practice Pattern 4C (Impaired Musculoskeletal Performance) and Practice Pattern 4D, (impaired joint mobility, motor function, muscle performance, and range of motion associated with connective tissue dysfunction) [7].

Manual therapy was a recommended intervention for Patterns 4C and 4D. S-CS was chosen as the primary intervention for this case with the intent of targeting the TPs of the trapezius (TRA) and superior oblique (PC1-E) to decrease the aberrant proprioceptor sensitivity to stretch [10,30-33]. The use of S-CS was supported by the neurophysiological rationales provided by Jones & Korr [4,5,31-33], which state that abnormal tension and painful TPs indicate an abnormally high sensitivity to stretch of the monosynaptic reflex arc, due to abrupt strain [4,5,30-33]. By passively placing a hypertonic sensitive muscle into a shortened position, the neurological system restores the normal spindle bias (sensitivity to stretch) and range of motion, thereby reducing the pain in the tender point associated with that short muscle [4,5]. Wong & Schauer [2] found that S-CS also improves the strength of the involved muscle [2].

Intervention

The intervention (S-CS) used in this case was within the scope of neuromuscular re-education and manual therapy interventions listed in the *Guide* [7] for Practice Patterns 4C and 4D. At the beginning of each session, cervical flexion strength was measured using the Nicholas MMT and recorded. Next, palpation was used to identify TPs TRA (trapezius muscle belly) and PC1-E (superior oblique), respectively, as described by D'Ambrogio & Roth [10]. The patient was rated his pain using the NRPS for each point. Scores were recorded. Each tender point was treated separately, in consecutive order, for each visit. Each TP was marked with a pen for accuracy and palpated for tenderness throughout the intervention.

The TRA TP was treated first. The muscle belly of the upper trapezius was palpated, as defined by D'Ambrogio & Roth [10] to locate the TRA TP. With the patient supine, direct pressure was applied to the TRA and the patient's cervical spine was placed in the position of comfort (POC), to the point where the TP pain was reduced by at least 70%, as described by Jones [30]. The patient's cervical spine was passively flexed toward the side with the TP; the ipsilateral shoulder was placed in about 90 degrees of abduction and slight flexion until the TP pain completely subsided. This POC position was held for 90 seconds, as described by Jones [30]. During the hold, the TP was monitored by palpation to detect a relaxation of the muscle, and to ensure pain reduction was maintained for the entire 90 seconds [10]. After 90 seconds, the point was released; the cervical spine and shoulder were passively slowly returned to the neutral position. The TP was reassessed for tenderness, and rated by the patient using the NRPS. The same procedure was repeated for the next TP, PC1-E.

PC1-E was treated with the patient supine and the therapist sitting at the head of the patient. The therapist placed her hands under the patient's cervical spine and head to palpate the PC1-E TP, which is located on the occiput, about 1.5cm. Medial to the mastoid process, as described by D'Ambrogio & Roth [10]. The therapist passively extended the occiput, and slightly laterally flexed toward and rotated his cervical spine away from the TP side, until the PC1-E TP pain subsided. The position was held for 90 seconds, and returned to neutral slowly. The TP for PC1-E was re-tested and recorded for pain intensity using the NRPS. Post-intervention, neck flexion strength was tested and recorded using the Nicholas MMT, as previously described. See Figure 1 & 2 for illustration of the techniques.

Outcome measurements for the NDI were tested at the initial session, the fifth session, and at the end of the four week period. All outcome measures are listed in Table 2. At the final discharge visit, after all measurements were completed, the patient demonstrated normal neck range of motion. He was given a home program of conditioning exercises to perform daily.

Figure 1: Illustration of S-CS Intervention for TRA.

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Figure 2: Illustration of S-CS Intervention for PC1-E.

Data Analysis

All data collected was entered into Excel spreadsheets following data collection. Raw spreadsheet data was translated and then uploaded into the Statistical Package for Social Sciences (SPSS), Version 16.0. Analysis included paired t-tests and regression.

Results

Analysis included two tailed paired samples t-tests on the pre and post NRPS pain scores and MMT cervical flexion measurements to determine if there was a significant change in scores before and after the treatment during each visit. Analysis revealed that the results for TRA, PC1-E and MMT were each significant (t values of 7.000, 9.514, and -8.271 respectively, degrees of freedom equaled 7 for each test, and p-values < .001 for all). During each visit, the patient sustained a reduction in pain (NRPS) and tenderness of the two TPs, and a significant increase in strength. Assuming that each test is independent of each other, the low p- values suggest that the probability that not each test is significant is less than .003. Scores for all variables were improved over time.

TP TRA pain (NRPS) scores were compared across eight visits for pre-and post-intervention scores. Pain scores for both TPs decreased from 10 and 9 to 1 and 0, respectively. Initial NRPS score for TRA was 10, final score was 1. Changes in pain associated with TP TRA using the NRPS shows the patient's drop in TRA score over time (Figure 3). A simple regression plotting visit number against pre-test TRA score shows that as the visits increase, the pre-test TRA decreases significantly (β = -.821, t = -6.123, p<.001). A regression plotting time versus post-test TRA score also shows a significant, yet smaller, decrease as visits progress at the 5% level of significance (β = -.238, t = -3.573, p <.05). Another regression of the difference in scores (pre-test TRA - post-test TRA) against time demonstrated that the effect of the treatment decreased as the visits continued (β = -.583, t = -3.363, p-value<.05).

TP PC1-E pain (NRPS) scores were compared across eight visits for pre-and post-intervention scores (Figure 4). Initial score for PC1-E was 9, final score was 0. A simple regression plotting visit number against pretest PC1-E score revealed a significant decrease in pretest PC1-E score as the number of visits increased (β = -.726, t = -.963, p-value <.001). A regression of visit number versus post-test PC1-E score also revealed a smaller decrease over time at the 5% level of significance (β = -.476, t = -2.677, p-value < .05). Additional regression plotting visits against the difference between pretest and posttest scores did not show a decrease over time in the effect of the treatment during a single visit (β = -.250, t = -1.019, p-value >.05).

Neck flexion strength (MMT) was compared across eight visits for pre-and post-intervention scores. Neck flexion strength increased from 10.7kg on the initial visit to 26.5kg on the final visit, as documented in Figure 5. A simple regression plotting visit number against pretest MMT score shows a significant increase in the pre-test MMT score throughout the patient's therapy (β = 1.390, t = 7.394, p-value < .001). Additional regression including visit number versus post-test MMT score also demonstrated significant increase in the patient's post-test MMT score over time (β = 1.648, t = 4.051, p-value <.01). Further regression measuring the difference in pre-test and post-test MMT score throughout therapy did not show a significant change in the effect of the treatment within a single visit (β = .257, t = 1.018, p-value >.05).

Neck Disability Index (NDI) scores were compared as a percentage difference over the eight sessions. Initial and final NDI scores were compared. The initial NDI score was 23 points (46% disability), and the final score was 10 points, (20% disability). A zero level indicates no disability. NDI scores improved from 46% to 40% by the fifth visit and 20% on the final visit. Overall, NDI scores improved from 23 to 10 points (46% to 20% level of disability) with an overall improvement of 13 points (26%) over eight visits.

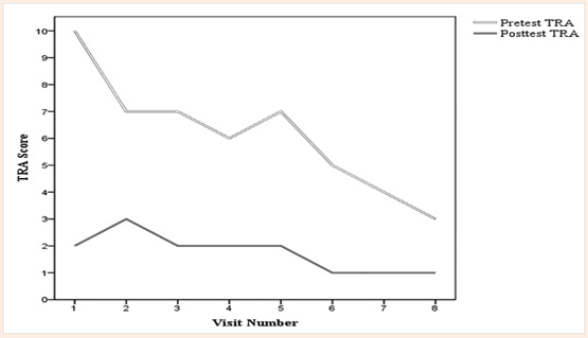

Figure 3: Outcomes for Pre-test and Post-test NRPS for Upper Trapezius TP: TRA.

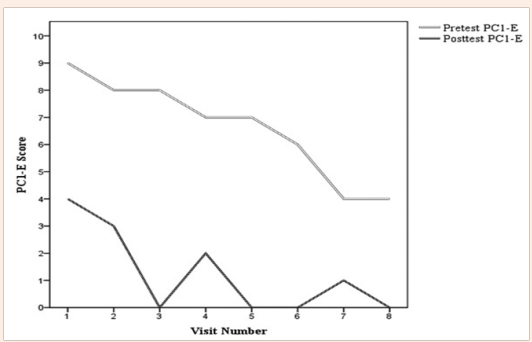

Figure 4: Outcomes for Pre-test and Post-test NRPS for Superior Oblique TP: PC1-E.

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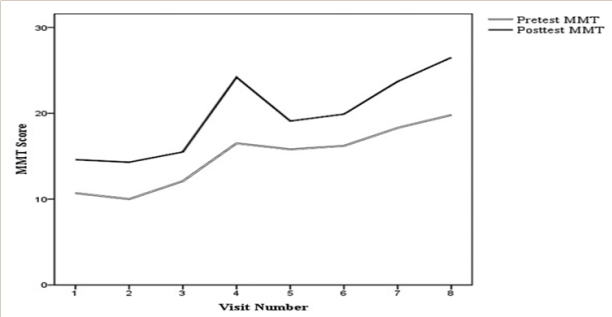

Figure 5: Outcomes for Pre-test and Post-test Measurements of Strength (MMT).

Discussion

This report shows the result of using S-CS to manage neck pain, weakness and disability in a soldier with cervical sprain. The results clearly show a trend toward substantial improvement in all outcome measures over four weeks of intervention. Whether the results are due to healing over time or due to the intervention cannot be inferred from this study, since there were no controls used and only a single subject was monitored. According to the patient, he had little to no improvement over the six months prior to his referral to PT, and he had a statistically significant improvement in all scores since the inception of PT.

Throughout therapy, the patient's TP TRA and PC1-E pain (NRPS) scores decreased significantly, neck flexion strength (MMT) improved, and NDI scores decreased by 26%. The authors were unable to determine whether these results were a result of the specific S-CS treatment or simply due to time. The patient was discharged from PT earlier than expected because he was suddenly ordered to return to duty. However, considering the improvement over four weeks, there may have been additional improvement had the patient been able to complete therapy prior to return to duty.

The relatively isolated effect of S-CS was examined in this case report of a patient who had no additional interventions for his neck pain since starting PT. His initial complaint was weakness from a torn medial meniscus of his left knee, with secondary complaint of cervical spine pain, stiffness and weakness. The S-CS was the only intervention provided for his cervical spine pain, since it generated immediate results, allowing more time to attend to treating his knee. In accordance with the published research, this case report data shows pain reduction and strength gains from a single application of S-CS, as well as across multiple interventions. Although the mechanism of action of S-CS is not yet understood, the theories of Jones & Korr [30-32] and the findings of Howell & Wynne, et al. [4,5] suggest a relationship between S-CS, pain relief, and reflex changes.

Pain reduction is considered a primary factor in the effectiveness of S-CS [1,2,30-33]. Howell [4] reported significant alterations in stretch reflex amplitude in response to S-CS, in addition to improvements in pain, stiffness, and edema [4]. This finding matches the theory of Jones & Korr [31,32] that S-CS reduces the aberrant reflex sensitivity to stretch by positioning. Wong & Schauer [4] were the first to document significant improvements in strength and pain scores as a result of S-CS in their randomized controlled trial (RCT) for S-CS of the hip [2]. Wynne et al. [5] reported in a RCT of S-CS compared to placebo, a significant alteration in the peak torque of the stretch reflex and H-reflex as well as symptom relief after S-CS intervention [5]. To date, no studies have reported changes in NDI, strength or pain scores after S-CS intervention for neck pain.

Factors which may contribute to the outcomes found in this case were discussed in the literature. Wynne et al. [5] noted that the reflex changes could not be due to stretch of the involved muscles, since the POC is based on reduction of strain by positioning into a shortened state [5]. Wynne et al. [5] reported no placebo effect in their control group compared to the treatment group for symptom severity. Similar to my case report, Wynne et al. [5] reported the immediate effect was more substantial than the lasting effect, which was significant [5]. Additional studies are suggested to assess the temporal aspect of symptom relief from S-CS [3,5,6]. In a case report on S-CS for a 14-year old with Complex Regional Pain Syndrome, Collins [3] reported pain reduction for up to three days post-intervention and an overall improvement over the six months of treatment for the patient in their case [3]. Future studies may investigate the duration of symptom reduction after S-CS to determine an optimal plan of care for patients with pain.

Future studies should include: 1) repeating this study using a larger population; 2) using a quasi-experimental clinically based study involving repeated-measures ANOVA to establish the difference in between-subject effects and within-subject effects; and 3) conducting a prospective RCT design with a large population may reveal a relationship between the intervention and the outcomes.

Conclusion

In this case report, the effect of S-CS on outcome measures of pain, strength, and disability scores were described for a soldier diagnosed with cervical sprain. Since starting therapy, he reported immediate improvement in his symptoms. There were significant improvements in pain, strength, and NDI scores after four weeks of S-CS. Within a single visit, pain scores for this case report showed a significant decrease immediately following S-CS. Because there was only a 90 second interval between pre- and post-intervention scores, it is unlikely that other factors were responsible for the changes. While this patient saw a significant decrease in pain and increase in strength both during visits and over time, further study is required to determine if the effect is merely a result of placebo. While this study demonstrates the clinical efficacy of S-CS, one cannot infer that S-CS was the operative factor in causing the clinical improvements in this case report. However, the difference in outcome measures is clearly illustrated, both in its immediate outcome and over four weeks. S-CS is a simple positioning technique that may be used to reduce painful trigger points, increase strength and decrease disability. Future studies may use prospective randomized controlled trials to investigate the effects of S-CS in a larger population of patients with neck pain.

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