A pilot study to determine the effects of a supine sacroiliac orthopedic blocking procedure on cervical spine extensor isometric strength[☆]

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Abstract

Objective: The purpose of this study was to determine if an orthopedic pelvic blocking procedure affects cervical spine extensor isometric strength.

Methods: Twenty-two participants were sequentially assigned into treatment and control groups. Treatment consisted of a 2-minute procedure using orthopedic blocks (padded wedges with a 45° incline) that were placed bilaterally under the ilia as determined by leg length assessment. Isometric strength measurements took place in 2 sessions with a day of rest between. The treatment group received therapy at the second session immediate to postisometric measures.

Results: Outcome measures were the pre- and posttreatment measurements of cervical isometric extension strength in pounds. The *t* tests showed no statistically significant difference between groups in isometric extension strength before treatment. One-way analysis of variance demonstrated a significant difference between groups after treatment ($F_{1,21} = 7.174$, $P = .014$). The treatment group demonstrated an average increase of 6.35 (8.18) lb in extensor strength.

Conclusions: The current study showed a statistically significant change in cervical isometric extensor strength after sacroiliac joint blocking.

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Introduction

Recent systematic reviews of the effects of chiropractic manipulation on common head and neck conditions are equivocal.^{1,2} Head and neck conditions, like headache, neck pain, and whiplash, present frequently in chiropractic clinical settings and

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are typically treated with cervical manipulation and/or mobilization. Treatments reported in the literature include manual therapies, such as high-velocity, low-amplitude manipulation (HVLA), or instrument-assisted techniques such as Activator (Activator Methods International, Phoenix, AZ). Pelvic orthopedic blocking (Fig 1), a chiropractic procedure originating from the sacrooccipital technique (SOT), is a low-force method for treating sacroiliac joint (SIJ) dysfunction.³ Sacroiliac function is considered to be important in many manual therapy systems because of the complexity and location of the SIJ in the kinetic chain. Use of an orthopedic blocking procedure may serve as a useful adjunctive treatment for the cervical spine. The purpose of the current feasibility study was to determine if supine orthopedic blocking, a method for imparting gravitational forces into the SIJ complex for the treatment of SIJ dysfunction/leg length inequality (LLI),^{4,5} can produce changes in cervical muscle function as determined by isometric strength measurements.

Spinal manipulative therapy (SMT) can produce both excitatory and inhibitory effects upon muscle function. There is growing evidence that stimulation of joint mechanoreceptors such as that which occurs during SMT alters paraspinal muscle reflexes and motoneuron excitability.⁶ The orthopedic blocks, or wedges, serve as fulcrums that apply a slow gravitational load to the SIJ.^{4,5} The SIJs and ligaments contain mechanoreceptors that signal for muscular reactions.⁷ The associated afferent pathways are intersegmental and in theory would allow a single mechanoreceptive stimulus to create a muscular response in kinetic areas distant from the site of stimulation. Nansel et al⁸ have shown that cervical manipulation can significantly alter

lumbar paraspinal tone, presumably through intersegmental pathways.

Chiropractic physicians have long known that there is a functional relationship between spinal regions. Blum and Globe⁹ sought to test the postulate that there is a functional relationship between cervical and lumbar vertebrae. Following a technique protocol for locating lumbar fixations, these researchers sought to elicit pain at specific cervical reflex points. According to their protocol, each specific tender reflex point is predictive of a specific lumbar vertebral fixation. Lumbar segments indicated by tender contact points were manipulated. A *t* test indicated significant pre- to postmanipulation changes to pain thresholds at cervical reflex points.

A recent study sought to test the magnitude and extent of reflexive responses to HVLA manipulative thrusts.¹⁰ Ten asymptomatic subjects had 16 pairs of electrodes placed in each spinal region and also on the back of proximal extremities. The participants received HVLA thrusts to cervical, thoracic, lumbar, and sacroiliac regions. These researchers showed repeatable, systematic electromyogram (EMG) patterns at a given SMT level. The EMG responses endured for 100 to 400 milliseconds. The lower thoracic and lumbar areas showed a proximal leg muscle response, and the upper and midthoracic areas affected the proximal arm. Generally, treatments at each region showed an effect throughout the entire kinetic chain.

A clinic-based orthopedic blocking study demonstrates change to cervical spine function after treatment with orthopedic blocks.¹¹ This pilot investigation measured pre- and posttreatment cervical and lumbar ranges of motion in sagittal, transverse, and coronal planes using an ultrasound motion capture system. Five symptomatic (low back pain) patients received supine orthopedic blocking treatment to the SIJ to correct LLI. These patients received a varied number of treatments (ranging from 1-6) to the SIJ. The investigator found mean cervical range of motion (ROM) increases of 2° to 6° posttreatment. These increases were accompanied by a slight loss of left lateral flexion. Changes to lumbar ROM were more pronounced. Although this study did not examine isometric strength, a functional change to the cervical spine after orthopedic blocking was demonstrated, suggesting further study. Unger¹² found that a supine blocking procedure can alter strength in muscles surrounding the SIJ and in muscles distant to the SIJ. To further investigate these phenomena, the purpose of this study was to determine if an orthopedic pelvic blocking procedure affects cervical spine extensor isometric strength.

Fig 1. Pelvic orthopedic blocking procedure.

Methods

Subjects

After institutional review board approval of this study and clinical trial registration (registration NCT00523822), participants were recruited at Logan University, College of Chiropractic. A total of 22 subjects (15 men and 7 women) participated. Written informed consent was obtained after an explanation of study procedures. Participants were aged 26.3 years (± 3.1 years), with an LLI of 5 mm or more. Participants with any recent SMT, trauma, medication, or condition that would interfere with cervical spine isometric muscle testing were excluded.

Study protocol

Sequential assignment was used to assign participants into treatment and control groups. The treatment group received a 2-minute orthopedic blocking procedure. Control participants received the pre and post assessments only and no intervention or sham procedure. Sacroiliac joint dysfunction and cervical extensor strength were assessed at the first appointment. For purposes of this study, *SIJ dysfunction* is defined as a functional LLI of 5 mm or more and was determined using direct tape measurement from the umbilicus to the medial malleolus. Data collection took place in 2 sessions with a day of rest between. At the second appointment, the treatment group received therapy. Both treatment and control groups had isometric extensor strength reassessed on the second appointment.

Isometric strength testing

The Multi-Cervical Unit (MCU) (BTE Technologies, Hanover, MD) was used to perform the isometric testing of cervical extensors (Fig 2). This machine is specifically designed to measure isometric strength of the cervical spine in each plane of movement. A single published study demonstrates the reliability of this device for measuring isometric strength as excellent (intraclass correlation coefficients, 0.92-0.99).¹³

Participants were briefed on the procedure, were comfortably seated in the MCU, and were belted about the waist and shoulders. A halo assembly was used to position a padded dynamometer sensor just above the occiput and was angled at 15° cephalad for the extension motion. A research assistant demonstrated

Fig 2. Subject positioned for cervical isometric testing.

and explained the extension motion. Participants were instructed to “push as hard as you can.” The MCU uses a computer prompt to indicate when to begin and end the isometric contraction. Each isometric measurement consisted of 3 repetitions that were averaged for a single test value.

Intervention

Participants lay supine on a therapy table wearing a loosely fitting trochanter belt. Sacroiliac joint dysfunction was treated with SOT orthopedic blocks by a licensed doctor of chiropractic. The blocks are padded wedges with a 45° incline. Block placement is determined by leg length assessment; on the side of the short leg, a block is placed under the crest of the ilium with the incline pointed toward the spine; on the long leg side, a block is placed under the greater trochanter with the bevel angled upward at 45°. ¹⁴ The blocks were removed after 2 minutes, and the trochanter belt was tightened to keep the SIJ compressed as the participant walked from the therapy table to the MCU. The participant was immediately resealed for extensor strength testing.

Results

The *t* tests showed no statistically significant difference between groups in isometric extension strength before treatment. Outcome measures were the pre- and posttreatment measurements of cervical isometric extension strength in pounds. The maximum voluntary force readings before the intervention period

were 22.21 (14.11) lb for the control group and 21.07 (7.18) lb for the treatment group. Pre- and posttreatment isometric strength scores were subtracted to arrive at normally distributed difference scores. A 1-way analysis of variance using difference scores was performed to determine if there were significant differences between groups after therapy. A significant difference was found between groups ($F_{1,21} = 7.174$, $P = .014$). The experimental group experienced a significant increase in isometric strength. The average isometric strength value for the treatment group was 27.43 (13.09) lb; and the average isometric strength value for the control group at post measurement was 21.49 (13.53) lb, demonstrating an average increase of 6.35 (8.18) lb for the treatment group.

Discussion

Orthopedic blocking, also called *pelvic blocking*, in SOT generally refers to the use of any pelvic blocking procedure. Clinicians vary the block positions and patient placement to change forces applied to the SIJ. Cooperstein and Lisi³ suggest that prone orthopedic blocking mobilizes the SIJ and supine orthopedic blocking stabilizes the SIJ. Use of a supine blocking method is thought to approximate or compress the SIJ.⁴ The current study sought to determine if supine orthopedic blocking can influence cervical spine function. A statistically significant increase in cervical extensor isometric strength was found postmanipulation.

Correction of SIJ dysfunction through orthopedic blocking may produce beneficial effects to cervical spine function through stimulation of afferent pathways. The stimulation of muscle and joint mechanoreceptors is known to produce reflexive muscle changes.⁶ Histologic analysis of SIJ ligaments demonstrates the presence of paciniform-type mechanoreceptors.¹⁵ Generally, all 4 types of joint receptors are found in all diarthrodial joints and associated ligaments.¹⁶ Mechanoreceptor afferents have reflexive connections to motoneurons.¹⁷ These afferents are not specific to a given spinal level but are distributed intersegmentally throughout the length of the neuraxis. The intersegmental distribution of mechanoreceptor afferents enables reflexive muscle effects specific to the site of manipulation as well as areas distal to the manipulation site.¹⁷

Several studies have documented functional changes remote to the site of manipulation. One group of researchers was able to show a lumbar

paraspinal muscular response to upper and lower cervical spine manipulations.⁸ Tissue compliance measures were taken from asymptomatic participants at each lumbar level. This study used a sham manipulation that was similar to the HVLA manipulation in the manner that the head and neck were positioned and tension was taken. Cervical spine manipulation produced a significant change to lumbo-pelvic musculature. The sham manipulation also affected the lumbopelvic musculature; however, the magnitude of the effect for the lower cervical spine compared with the sham was significantly greater.

Herzog et al¹⁰ demonstrated global muscle responses to HVLA manipulative thrusts. Thrusts to cervical, thoracic, lumbar, and sacroiliac regions showed systematic surface EMG (sEMG) patterns at the level of manipulation and at kinetic areas distant from the site of manipulation. The effects of spinal manipulation on paraspinal sEMG activity may be associated with increases in muscle strength. An instrument-applied manipulation to the lumbar spine was shown to increase lumbar erector spinae isometric extensor output by 21%.¹⁸ This outpatient study using low back pain patients did not directly measure force levels; isometric extensor output was assessed with sEMG only. Effects distal to the manipulation site were not investigated.

Some studies concerning arthrogenic inhibition of the quadriceps femoris muscle have demonstrated isometric strength changes remote to the site of manipulation. Twenty participants were assigned to receive HVLA manipulation of either the tibiofemoral joint or SIJ.¹⁹ A Cybex isokinetic machine (Cybex International, Medway, MA) was used for pre- and postmanipulation isometric strength measurements. The SIJ manipulation group demonstrated a significant change in mean isometric strength of the quadriceps femoris muscle, whereas the tibiofemoral group showed a small but nonsignificant increase. Random allocation of participants was not used. The premanipulation scores between the groups were not equal, signaling a possible sampling error. A similar study sought to assess whether SIJ manipulation alters muscle inhibition and strength of the knee extensor muscles in patients with anterior knee pain.²⁰ The manipulation consisted of an HVLA thrust in the side-lying position aimed to correct SIJ dysfunction. A significant decrease in quadriceps muscle inhibition (greater isometric extensor strength) was found postmanipulation.

A recent orthopedic blocking study demonstrates change to cervical spine function. Hochman,¹¹ using an

ultrasound motion capture system, found mean cervical ROM increases of 2° to 6° posttreatment. An earlier orthopedic blocking study concluded that a blocking procedure can increase muscle tone. Unger¹² performed the blocking procedure with the patient supine as the current study did. The purpose of this study was to determine if orthopedic blocking could change pre- to postprocedure dynamometric strength measurements taken from 8 major muscle groups. These muscle groups included psoas, gluteus medius, pectorals, anterior deltoids, latissimus dorsi, tensor fascia lata, and the adductors. In a population of 16 patients, there were statistically significant increases in the strength of all tested muscle groups after the blocking procedure. As in the current study, Unger found a change in strength distant from the site of manipulation.

In theory, SMT alters the inflow of sensory signals from paraspinal tissues in a manner that improves physiologic function.⁶ Paciniform receptors of the SIJ are believed to be activated by compression.²¹ The presence of paciniform receptors suggests that mechanoreceptive signals are transmitted to the central nervous system. This afferent information is necessary for motor control of the torso. Afferent signaling is crucial to effective motor performance such that even a small change could have system-wide effects. It may be that stabilization of the SIJ using the supine orthopedic blocking method compresses the paciniform mechanoreceptors, improving motor unit recruitment throughout the kinetic chain including the cervical spine. Documented neuromuscular responses to manipulation are similar. Orthopedic blocking differs from HVLA and instrumented techniques in the way that force is delivered through the joint and associated ligaments. Inherent differences in duration and amplitude of forces between types of manipulation and differences in mechanoreceptor types may produce varied neurophysiologic effects. The results of this study are not directly generalizable to other methods of manipulation.

One limitation of the current study is the use of a nonequivalent control group. Randomization was not used to assign participants to groups. The current study is only a pilot; results are promising and suggest that a randomized controlled trial incorporating a sham manipulation be performed. Another limitation is the inclusion of the trochanter belt for walking participants from the treatment table to the MCU. The belt was included to minimize the effects of spinal and hip movement induced when moving the participant from the therapy table to the MCU. The trochanter belt is commonly used in conjunction with orthopedic blocks in clinical practice, especially in cases where SIJ

dysfunction does not resolve quickly. Testing the blocking procedure this way approximates a common field application but does make it difficult to isolate the blocks as being responsible for the increase in isometric strength. The belt may activate mechanoreceptors similarly to the blocks; there could even be a synergistic effect. Future studies should treat the belt as an additional variable and also include a combination blocking/belt group to determine the existence of a synergistic effect.

Conclusion

The current study showed a statistically significant change in cervical isometric extensor strength after SIJ manipulation using a supine orthopedic blocking procedure. It is not known at this time if other blocking configurations will produce similar effects. It is thought that the isometric strength changes were mediated through mechanoreceptor stimulation and resulting α -motor neuron recruitment.

References

1. Bronfort G, Haas M, Evans RL, Bouter LM. Efficacy of spinal manipulation and mobilization for low back pain and neck pain: a systematic review and best evidence synthesis. *Spine J* 2004;4(3):335-56.
2. Gross AR, Hoving JL, Haines TA, Goldsmith CH, Kay T, Aker P, et al. A Cochrane review of manipulation and mobilization for mechanical neck disorders. *Spine* 2004;29(14):1541-8.
3. Cooperstein R, Lisi AJ. Blocking procedures: an expanded approach. *J Am Chiropr Assoc* 2004;41(1):44-6.
4. Cooperstein R. Padded wedges for lumbopelvic mechanical analysis. *J Am Chiropr Assoc* 2000;37(10):24-6.
5. Knutson G. The sacroiliac sprain; neuromuscular reactions, diagnosis and treatment with pelvic blocking. *J Am Chiropr Assoc* 2004;41(8):32-9.
6. Pickar JG. Neurophysiological effects of spinal manipulation. *Spine J* 2002;2(5):357-71.
7. Slosberg M. Effects of altered afferent articular input on sensation, proprioception, muscle tone and sympathetic reflex responses. *J Manipulative Physiol Ther* 1988;11(5):400-8.
8. Nansel DD, Waldorf T, Cooperstein R. Effect of cervical spinal adjustments on lumbar paraspinal muscle tone: evidence for facilitation of intersegmental tonic neck reflexes. *J Manipulative Physiol Ther* 1993;16(2):91-5.
9. Blum C, Globe G. R + C factors and sacro-occipital technique orthopedic blocking: a pilot study. *J Chiropr Educ* 2005;19:45.
10. Herzog W, Scheele D, Conway PJ. Electromyographic responses of back and limb muscles associated with spinal manipulative therapy. *Spine* 1999;24(2):146-52 [discussion 153].

11. Hochman JJ. The effect of sacro occipital technique category II blocking on spinal ranges of motion: a case series. *J Manipulative Physiol Ther* 2005;28(9):719-23.
12. Unger J. The effects of a pelvic blocking procedure upon muscle strength: a pilot study. *J Chiropr Tech* 1998;10(4):150-5.
13. Chiu TT, Sing KL. Evaluation of cervical range of motion and isometric neck muscle strength: reliability and validity. *Clin Rehabil* 2002;16(8):851-8.
14. DeJarnette M. In: Bathie R, editor. SORSI SOT manual. Omaha (Neb): Sacro Occipital Research Society International; 1996.
15. Vilensky JA, O'Connor BL, Fortin JD, Merkel GJ, Jimenez AM, Scofield BA, et al. Histologic analysis of neural elements in the human sacroiliac joint. *Spine* 2002;27(11):1202-7.
16. Newton RA. Joint receptor contributions to reflexive and kinesthetic responses. *Phys Ther* 1982;62(1):22-9.
17. Wyke B. Articular neurology and manipulative therapy. New York: Churchill Livingstone; 1985. p. 5.
18. Keller TS, Colloca CJ. Mechanical force spinal manipulation increases trunk muscle strength assessed by electromyography: a comparative clinical trial. *J Manipulative Physiol Ther* 2000;23(9):585-95.
19. Hillermann B, Gomes AN, Korpelaar C, Jackson D. A pilot study comparing the effects of spinal manipulative therapy with those of extra-spinal manipulative therapy on quadriceps muscle strength. *J Manipulative Physiol Ther* 2006;29(2):145-9.
20. Suter E, McMorland G, Herzog W, Bray R. Decrease in quadriceps inhibition after sacroiliac joint manipulation in patients with anterior knee pain. *J Manipulative Physiol Ther* 1999;22(3):149-53.
21. Hogervorst T, Brand RA. Mechanoreceptors in joint function. *J Bone Joint Surg Am* 1998;80(9):1365-78.