COMPARISON OF TIBIAL NERVE H-REFLEX EXCITABILITY AFTER CERVICAL AND LUMBAR SPINE MANIPULATION

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ABSTRACT

Background: Previous investigations indicate that spinal manipulation leads to short-term attenuation of α-motoneuron excitability, when assessed by means of the Hoffmann reflex. Past studies, however, are limited to regional effects, such as lumbar manipulation effects on lumbar α-motoneuron activity.

Objective: This study compared and contrasted the effects of cervical and lumbar spine manipulation on the excitability of the lumbar α-motoneuronal pool in human subjects without low back pain, and compared the effects of cervical (nonregional) and lumbar (regional) spinal manipulation on lumbar α-motoneuron pool excitability in healthy subjects. The specific aim of this study was to determine if the inhibitory effects on the lumbar α-motoneuron pool associated with spinal manipulation are limited to the specific region in which the manipulative procedure is applied, or if rostral (cervical) manipulation can also influence caudal (lumbar) motoneuron excitability.

Method: Thirty-six nonpatient human subjects were used to study the effect of cervical and lumbar spinal manipulation on the amplitude of the tibial nerve Hoffmann reflex, recorded from the gastrocnemius muscle. The Hoffmann reflex (H-reflex) technique allows for an indirect index of motoneuron pool excitability by means of peripheral nerve Ia-afferent fiber stimulation. Reflexes were recorded before and after spinal manipulative procedures.

Results: Lumbar spinal manipulation, as measured by amplitude changes of the tibial nerve H-reflex, attenuated lumbar α-motoneuronal activity. Suppression of motoneuronal excitability was significant ($P <$ .05) but transient, with a return to baseline within 60 seconds after manipulation. Cervical spinal manipulation had no significant effect on lumbar motoneuron activity.

Conclusion: These data indicate that the inhibitory effects of spinal manipulation on motoneuronal excitability are regional, rather than global. (J Manipulative Physiol Ther 2002;25:318-25)

Key Indexing Terms: *Chiropractic Manipulation; H-reflex; Back Pain; Electromyography*

INTRODUCTION

Despite the widespread use of spinal manipulative therapy (SMT) in the management of patients with neck and low back pain, the physiologic effects exerted on the human motor system are largely unknown. Previous research from our laboratory indicates that there is an attenuation of motoneuron activity immediately after high-velocity, low-amplitude (HVLA) spinal manipulation with thrust, as well as mobilization without thrust, to the lumbosacral spine in asymptomatic subjects.[1,2] Similarly, SMT of the sacroiliac joint produced an attenuation of motoneuron activity for up to 15 minutes after manipulation in asymptomatic subjects.[3] These data in asymptomatic subjects provide evidence that a basic physiologic response to SMT is a transient decrease in motoneuron activity. Although the mechanisms and the extent to which SMT attenuates motoneuron activity remain to be elucidated, it is of significance to chiropractors to substantiate the integrative nature of SMT effects on the motor system.

Many practitioners of SMT have promulgated the concept that the modality may evoke both integrative central control responses[4] and local segmental responses.[5] If the influence of SMT on the motor system involves integrative central control responses, then concomitant changes in motoneuron activity should occur along the entire neuraxis. According to some reports,[6,7] the cervical spine may pos-

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sess a greater responsiveness to SMT than the lumbar spine, in part because the cervical spine compared with the lumbar spine is more richly populated by zygapophyseal joint mechanoreceptors and muscles spindles. These spinal and paraspinal receptors have been implicated as the primary afferent generators that are potentiated as a consequence of SMT.[1-3] In addition, the extensive convergence of neck afferents on vestibular nuclei and propriospinal neurons allows for complex patterns of facilitation and inhibition of motoneurons at all levels of the spinal cord.[8-15]

Conversely, if the influence of SMT on the motor system involves local segment responses, then changes in motoneuron activity should be specific to the level of the SMT procedure. At the segmental level, SMT has been postulated to relieve mechanical nerve compression at dorsal and ventral rami.[16] SMT may also produce an inhibitory reflex response that is segmental in origin.[17] In support of an inhibitory segmental reflex response, mechanical perturbations, such as SMT, may initiate afferent discharges from mechanoreceptors and free nerve endings in the annulus fibrosus, zygapophyseal joint capsule, and ligaments of the spine that synapse on inhibitory interneurons, which in turn inhibit motoneurons.[17]

The available research to date supports the supposition that treatment effects of SMT are localized to segmentally related muscle groups.[1-3,5,18,19] However, the qualitative analysis of surface electromyographic responses was a major limitation of the research by Herzog and colleagues.[5,19] Another experimental protocol to quantify motoneuron activity uses the Hoffmann reflex (H-reflex) technique. The H-reflex technique involves peripheral stimulation of the Ia-afferent feedback pathway to assess the excitability of the α-motoneuron pool. The advantage of the H-reflex technique compared with measuring surface electromyographic responses is that the peripheral stimulation of Ia afferents evokes a clearly defined compound muscle action potential. The amplitude of the H-reflex is easily quantified by measuring the peak-to-peak electromyographic (EMG) response. Although the research of Dishman and Bulbulian[1,2] used the H-reflex technique, their data were limited to SMT-targeted motoneurons that were segmentally related, such as lumbar spinal manipulation effects on tibial nerve H-reflex responses.

A distinction between integrative central control responses and local segmental responses is significant with respect to understanding the potential mechanisms of SMT. Clinical conditions involving spasticity and hypertonicity have been attributed to pathophysiologic abnormalities in the modulation of motoneuron activity by presynaptic and postsynaptic interneurons.[20] Central nervous system regulation of these modulatory interneurons may involve influences from local spinal circuits, propriospinal pathways, or supraspinal reflex loops. Knowledge of neural pathways affected by SMT will provide the anatomic foundation for identifying the inhibitory mechanisms by which SMT may attenuate motoneuron activity. Similar to pharmacologic interventions, an understanding of the influence of SMT on presynaptic and postsynaptic processes is important to identify pathophysiologic abnormalities that may be corrected by SMT.

Table 1. *Subject characteristics (Mean ± SD)*

Group	Age (years)	Height (cm)	Weight (kg)
Lumbar	27.3 ± 2.86	170.4 ± 9.60	71.0 ± 10.93
Cervical	27.3 ± 4.08	172.5 ± 9.27	75.1 ± 16.85
Lumbar + cervical	27.2 ± 3.67	169.8 ± 8.28	71.1 ± 11.95

The purpose of this research was to differentiate between integrative central control responses and local segmental responses evoked by SMT. This information was ascertained by comparing and contrasting the effects of lumbar and cervical SMT procedures on the tibial nerve H-reflex response.

METHODS

Subjects and Experimental Design

Thirty-six volunteers were recruited from a college student population. The subjects were randomly assigned to 1 of 3 experimental groups: (1) lumbar spinal manipulation (n = 12); (2) cervical spine manipulation (n = 12), or (3) cervical and lumbar spine manipulation (n = 12). There were 7 males and 5 females in each group. The subjects in each group were of similar age, height, and weight (Table 1). All subjects received a neurologic screening by one clinician before the initiation of the experiments to exclude subjects with radiculopathy or peripheral neuropathy. The local ethics committee reviewed and approved all experimental procedures.

One clinician with 15 years of experience performed the spinal manipulation procedures, which were delivered unilaterally to the right side of the spine. The segmental levels targeted by the spinal manipulation procedures were C5-6 and L5-S1. The subjects in Group 3 received both spinal manipulation procedures on a single test day, in a random order. The interval of time between spinal manipulation procedures was 20 minutes.

The tibial nerve H-reflex technique as described by Hugon[21] was used to quantify motoneuron activity, before and after spinal manipulation procedures. M-wave and H-reflex responses were recorded from the right gastrocnemius muscle by use of standard EMG techniques. Peak-to-peak EMG amplitude values of the M-wave and H-reflex responses were measured. At the beginning of the test session, the H/M recruitment curve was generated by increasing stimulus intensity from 0 to 150 V, in 5-V increments. The maximal M-wave was defined as the plateau in EMG amplitude that occurred in response to 3 successive 5-V increments of stimulus intensity. To determine the stimulus intensity for evoking maximal H-reflexes, stimulus intensity was increased in 2-V increments within the range of ±5 V from the apex of the H-reflex recruitment curve. This optimal stimulus intensity for evoking maximal H-reflex responses was not adjusted for the remainder of the experimental session.

Before delivering the spinal manipulation procedure, the mean EMG amplitude of 10 maximal H-reflex responses was recorded as the baseline value. The stimulation rate for evoking baseline H-reflex responses was 0.1 Hz. Immediately after the spinal manipulation procedure, maximal H-reflex responses were measured at 10-second intervals within the first 90 seconds to determine the acute time course of postmanipulation effects on motoneuron activity. Ten maximal H-reflexes were also evoked 5 and 10 minutes after manipulation at a stimulation rate of 0.1 Hz. At the completion of the postmanipulation H-reflex testing, the maximal M-wave response was recorded.

H-reflex Methodology

A prone testing position was used when the spinal manipulation procedure was delivered to L5-S1 segments, whereas a semireclined testing position was used when the spinal manipulation procedure was delivered to the C5-6 segments. For both testing positions, the subject's right foot was lightly secured to a plate to maintain a 90° angle of the foot to the tibia.

The right tibial nerve was stimulated in the popliteal fossa by use of a 1.0-ms square-wave pulse delivered by a constant voltage stimulator (Grass S88, Grass Instruments, W Warwick, RI). The cathode-stimulating electrode was positioned within the popliteal fossa at the optimal location for evoking an H-reflex in the gastrocnemius muscle. The optimal location for the cathode was defined as the site within the popliteal fossa at which a slightly suprathreshold stimulus for evoking an H-reflex did not simultaneously evoke an M-wave response. The anode stimulating electrode was placed 10 cm proximal to the cathode on the posterior thigh. The stimulating electrodes were 10-mm self-adhesive, pregelled, disposable AgCl electrodes.

Bipolar EMG recordings of M-wave and H-reflex responses in the right gastrocnemius muscle (GM) were measured by use of self-adhesive, pregelled, disposable surface Ag-AgCl electrodes. The bipolar electrode configuration was in accordance with the methodology outlined by Braddom and Johnson[22] to ensure consistent placement of the recording electrodes over the GM across subjects (Fig 1). The recording areas for the active and reference electrodes were 15 mm × 20 mm. The ground electrode was 10 mm in diameter. The EMG signal was bandpass filtered (10 Hz to 1 kHz) and amplified by use of an Grass P511 EMG system (Grass Instruments, W Warwick, RI). Peak-to-peak EMG values (EMG amplitudes) of the M-wave and H-reflex responses evoked in the GM were recorded with a digital oscilloscope (Tektronix TDS 420, Tektronix Inc, Beaverton, Ore).

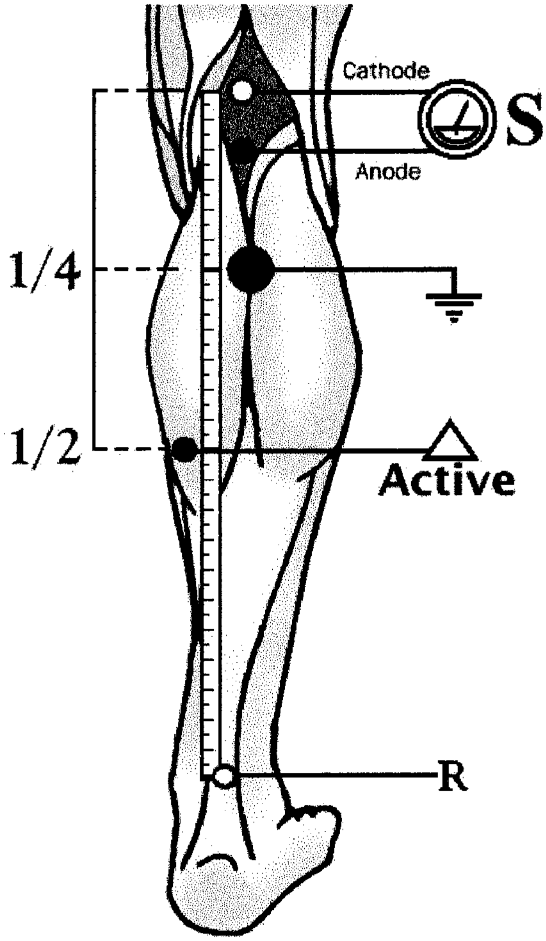

Fig 1. *Location of electrodes for obtaining tibial nerve H-reflex. The active (recording) electrode is placed half the distance between midpopliteal fossa and apex of the medial malleous.* R, *Reference electrode is applied over the triceps surae tendon. The ground is placed between the active and stimulating electrodes.* S, *Stimulating electrodes are applied directly over the nerve on the popliteal fossa.*

Spinal Manipulation Procedures

The cervical and lumbar spinal manipulative procedures consisted of HVLA manipulation, as commonly performed by practitioners of manual medicine.[5,9,23] These procedures consisted of a supine rotational manipulation for the cervical region, and a "side-posture" rotational manipulation for the lumbosacral region. The spinal manipulation procedures were delivered unilaterally to the right side of the spine (homolateral to the H-reflex recording site). The force applied to the spine in these types of procedures has been previously reported to be delivered in approximately 200 ms,[18] with linear vertebral displacements of less than 10 mm.[23] The manual force, or thrusts, to the zygapophyseal joint are applied at the end of physiologic range of joint motion and extend into the so-called "paraphysiologic zone" of joint motion.[24] The paraphysiologic zone is defined as the endpoint range of motion in which a joint can be passively forced without any deleterious effects.[24]

For the lumbosacral spinal manipulative procedure, the subject was in a lateral decubitus posture, with the right side up. The clinician provided a manual contact on the tissues overlying the right L5-S1 zygapophyseal joint. Using the right-handed Cartesian orthogonal coordinate system of movement as a reference,[25] manual tension was slightly increased by providing $+Y$-axis translation (axial distraction) to the spine, coupled with a $+\theta Y$-axis rotation force, thereby increasing the mechanical load on the soft tissues. Once tissue tension was maximized, an HVLA impulsive force was applied. The primary force vector applied to the zygapophyseal joint was $+Z$-axis translation, (posterior-anterior) with a secondary vector consisting of $+\theta Y$-axis rotation (left axial rotation). This L5-S1 spinal manipulative procedure has been previously described by the authors.[1] On completion of the lumbosacral spinal manipulative procedure, the subject was returned within 10 seconds to the prone H-reflex testing position.

For the cervical spine manipulation procedure, the subject was in a supine, semirecumbent position. The clinician applied a right hand contact to the paraspinal tissues overlying the right C5-6 vertebral level. The lateral aspect of digit two was applied to the tissues overlying the right lamina-pedicle junction. The subject's head was then placed in the $+\theta Y$ plane (left head rotation), with increasing pressure applied to the soft tissues. An HVLA manual thrust was applied with a primary force vector of $+\theta Y$ (rotation), with a secondary vector of $+\theta Z$ rotation (lateral flexion). On completion of the manipulative procedure, the subject's head was returned to the neutral position. Within 10 seconds, after manipulation H-reflex testing began with the subject in a supine, semireclined position.

Statistical Analysis

The H/Mmax ratio was the dependent variable. The H/Mmax ratio reflects the proportion of the α-motoneuron pool recruited by Ia afferents and is used as a functional index of motoneuron activity.[21] Data from Groups 1 and 2 were analyzed by use of a Group × Time mixed analysis of variance (ANOVA) model to reveal the segmental effects of spinal manipulative procedures. The Dunnett test for a priori contrasts was used to detect any differences between baseline values and postmanipulation time points. A trend analysis was used to describe the nature of the H/Mmax ratio recovery profile after a spinal manipulative procedure. Analysis of the simple effects of Group within Time, incorporating the baseline value as the covariant, was used to compare postmanipulation time points between the cervical and lumbosacral spinal manipulative procedures. This analysis of covariance provided statistical control for slight variations in baseline values that may occur in a between-subjects experimental design.

The within-subjects design is an experimental approach to increase statistical precision. For subjects in Group 3, a Site × Time repeated measures ANOVA model was used to reveal the possible segmental effects of spinal manipulative procedures. The Dunnett test, trend analysis, and analysis of simple main effects of Site within Time were used to detect differences in the recovery profiles of the H/Mmax ratio after cervical and lumbosacral spinal manipulative procedures.

A 2-factor mixed ANOVA model was used for Groups 1 and 2 and a 2-factor repeated measures ANOVA model was used for Group 3 to reveal differences in the maximum M-wave amplitudes from pretesting to posttesting as a function of cervical and lumbosacral spinal manipulative procedures. The Erlebacher's ANOVA procedure[26] was used to reveal any statistical effect of experimental design on the recovery profiles of the H/Mmax ratio after cervical and lumbosacral spinal manipulative procedures.

RESULTS

The H/Mmax ratio was significantly depressed with respect to baseline values for 60 seconds after the L5-S1 spinal manipulative procedure, without a concomitant change after the C5-6 spinal manipulative procedure (Fig 2; $P < .05$). The H/Mmax ratio recovery after the L5-S1 SMT procedure occurred in 2 phases ($P < .05$). There was a rapid recovery of the H/Mmax ratio between 10 to 20 seconds, with a more gradual recovery from 20 seconds to 60 seconds. These data profiles were similar for the 2 experimental designs as determined by the Erlebacher's ANOVA procedure (Fig 2, *A* and *B*). This significant interaction between the spinal level of the SMT procedure and the H/Mmax ratio recovery profile indicated that inhibition of motoneuron activity after SMT involved a local segmental response.

The H/Mmax ratio at each postmanipulation time point was also compared between L5-S1 and C5-6 SMT procedures. The H/Mmax ratio after the L5-S1 SMT procedure was significantly depressed with respect to the H/Mmax ratio after the C5-6 SMT procedure for 40 seconds in the subjects assigned to the repeated measures experimental design (Fig 2, *A*; $P < .05$, Group 3). Comparison of postmanipulation time points between Groups 1 and 2, by use of the baseline value as the covariate, detected that the H/Mmax ratio at 10 seconds was significantly depressed for the L5-S1 SMT procedure compared with the C5-6 SMT procedure (Fig 2, *B*; $P < .05$).

Post hoc power analysis revealed that a sample size of 20 subjects was needed to detect significant differences for 40 seconds postmanipulation at an adopted power of .80, when comparing L5-S1 and C5-6 spinal manipulative procedures on lumbosacral motoneuron activity by use of a between-

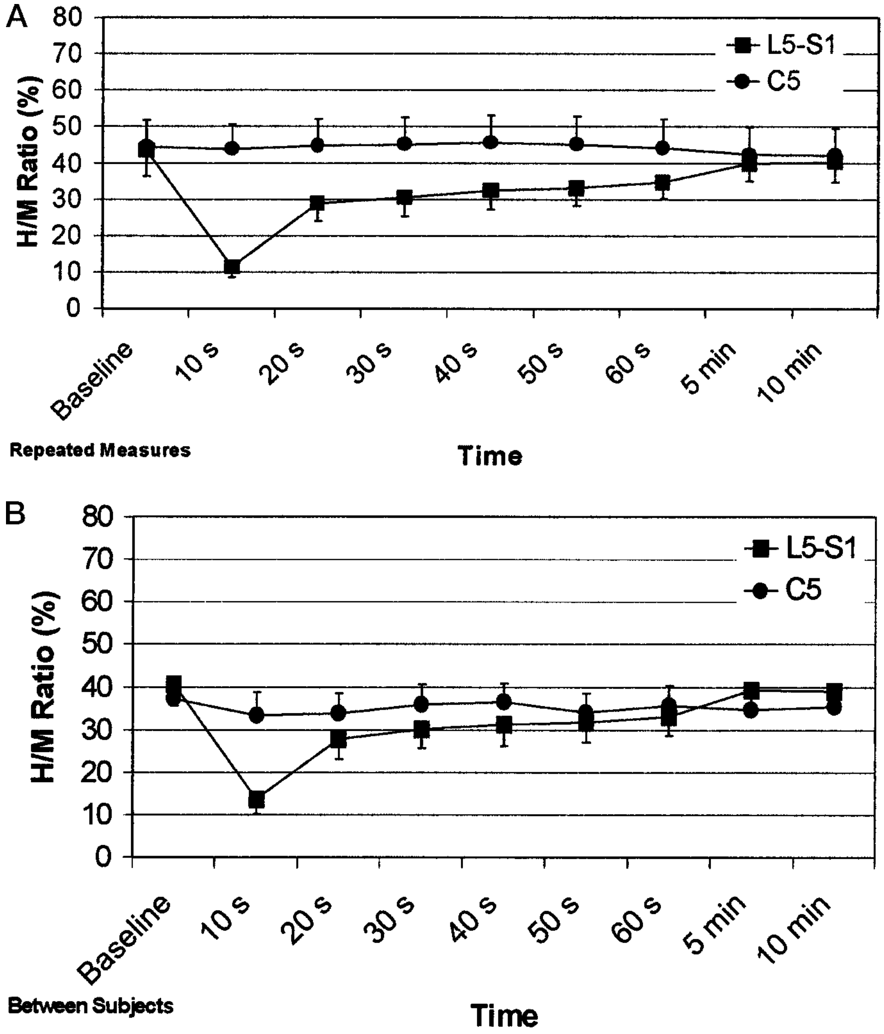

Fig 2. *Comparison of effects of lumbar versus cervical spine manipulation on lumbar motoneuron excitability measured by means of gastrocnemius H-reflex amplitude. Baseline values were recorded before manipulation, with postmanipulation recordings occurring at 10 to 60 seconds, and at 5 and 10 minutes. Significant ($P < .05$) attenuation of motoneuron excitability is noted to occur for 60 seconds after lumbar spine manipulation; however, no effect is demonstrable after cervical spine manipulation.* ***A****, Results for repeated measures subjects;* ***B****, results obtained from the between-subjects group.*

subjects experimental design. Experimental design type did not influence this comparison of L5-S1 and C5-6 SMT procedures and H/Mmax ratio at each postmanipulation time point, as determined by the Erlebacher's ANOVA procedure. Our use of the Erlebacher's ANOVA procedure, however, demonstrated that the within-subjects experimental design increased the statistical precision of detecting the segmental nature of SMT procedures on motoneuron activity without confounding the data analyses. In a between-subjects experimental design, there is loss of statistical precision and a need for a greater number of subjects because of the intrusion of individual differences on observed conditions.

The amplitudes of the M-wave responses were consistent from pretesting to posttesting in all subject groups (Table 2). These data indicated that recording and stimulating environments were the same throughout the experimental session, before and after spinal manipulative procedures. Thus, the changes in the H/Mmax ratio reflected the physiologic effects of spinal manipulative procedures on motoneuron activity.

Table 2. *Amplitudes of the M-wave responses (mV, Mean ± SD)*

Groups	Pre manipulative procedure	Post manipulative procedure
Group 1: lumbar	36.8 ± 5.82	36.2 ± 5.05
Group 2: cervical	32.6 ± 5.56	31.5 ± 5.49
Group 3: lumbar	30.3 ± 9.54	29.9 ± 9.70
Group 3: cervical	32.4 ± 9.19	32.5 ± 10.04

DISCUSSION

The results of this investigation indicate that lumbar SMT exerts a transient but significant attenuation of the lumbar region α-motoneuronal pool, as measured by tibial nerve H-reflex amplitude changes. The effects of cervical SMT on the excitability of lumbar spinal cord motoneuronal pools were determined to be insignificant. These data support the supposition that the effect SMT exerts on the excitability of the α-motoneuronal pool is one that is profoundly segmental, rather than global.

Regardless of the exact mechanism, this finding of localized motoneuronal attenuation after SMT corroborates previous reports.[1-3,5,19] The transient nature of SMT inhibition of motoneurons may involve after-effects (changes in sensory discharge rates, predominantly in Ia afferents) that occur in response to an alteration in a muscle's history of activation and length changes.[27] SMT may induce after-effects by altering the mechanical state of the muscle spindle receptor region.[27]

SMT is equivalent to rapidly applying a mechanical strain to the trunk. Mechanical strain of the ligament-muscular system of the spine evokes reflex activation of paraspinal muscles.[28-30] Reflex activation of the paraspinal muscles may depress the Ia motoneuron synapse, in accordance with the well-documented neurophysiologic phenomenon of postactivation depression.[31] Although postactivation depression appears to be limited to the fibers activated by the conditioning procedure,[31] there is sufficient evidence to suggest heteronymous inhibition of motoneurons by altering Ia-afferent discharge rates from postural, synergistic, and antagonistic muscles.[32-35] Moreover, the transient effects of SMT on motoneuron activity occur with a similar time course as other after-effects phenomena reported in the literature.[36,37]

A presynaptic mechanism underlies the neurophysiologic phenomenon of postactivation depression.[31] In support of postsynaptic mechanisms, mechanical perturbations, such as SMT, may initiate afferent discharges from mechanoreceptors and free nerve endings in the annulus fibrosus, zygapophyseal joint capsule, and ligaments of the spine that synapse on inhibitory interneurons, which in turn inhibit motoneurons.[17] There are numerous conditioned reflex protocols that one may now use to provide insights on presynaptic and postsynaptic spinal mechanisms underlying the segmental inhibition of motoneuron activity after SMT.[38] These same techniques may be used to more clearly delineate the contributions of the high-velocity thrust and mobilization to the attenuation of motoneuron activity after spinal manipulation.

The current data suggest that descending propriospinal influences from the cervical spine region may not be significantly activated by HVLA cervical spinal manipulative procedures. This finding is in frank contrast to previous reports of tibial H-reflex amplitude changes after rapid volitional head movements. The reports on the effects of vestibular and neck receptors on tibial H-reflex amplitude generally indicate that static and dynamic head positions do exert an influence, depending on the direction of movement.[39-44] Although there are several reports describing the role of neck mechanoreceptors in tonic reflexes,[40,42,45-47] the findings tend to reveal paradoxical results with respect to the effects that cervical spine motion has on caudal motoneuron pools. Some investigators have suggested that ipsilateral rotation leads to a reduction in amplitude, although others report the opposite effect.[48] Clearly, the role of mechanoreceptor afferents in the cervical spine on the excitability of caudal motoneuronal pools is not fully understood.

The results of this study also do not support the supposition that the cervical spine may possess a greater responsiveness to SMT than does the lumbar spine. Although the cervical spine and paraspinal tissue reportedly contain a higher density of mechanoreceptors than the lumbar spine,[6,7,11,49] the summated primary afferent discharge produced by SMT does not appear to be of sufficient magnitude to evoke reflex inhibition in caudal regions. Likewise, the differences in muscle spindle population between the cervical and lumbar paraspinal muscles do not appear to influence the proposed mechanisms underlying SMT of muscle spindle after-effects and postactivation depression. Although variations in the density and characteristics of cutaneous mechanoreceptors between the two paraspinal regions may also play a role in stimulus-response patterns to SMT, there are no known reports elucidating this possibility. In addition, inherent differences in the circuitry of the cervical and lumbar spinal cords have been reported, including differences in neurotransmitter turnover rate, motor unit size, and low-frequency depression susceptibility.[50]

Integrative central responses do not appear to contribute to the attenuation of motoneuron activity after SMT. This finding may be of significance to practitioners of manual medicine as some have previously reported that the therapeutic modality produces an overall inhibitory effect on motoneuron excitability.[1,3] Clinicians providing manipulative therapy may use the results of this investigation in an effort to devise a more appropriate treatment regimen that targets the appropriate spinal segmental levels; however, it must be unequivocally stated that the clinical implications of these data are unknown. Our data do not exclude the possibility that cervical SMT induces a greater attenuation of segmental motoneuron activity than lumbar SMT. Cervical SMT effects on local motoneuronal pools (flexor carpi radialis H-reflex) have yet to be reported, but we are investigating these.

Postural differences between the cervical and lumbar SMT groups (supine semireclined vs prone, respectively) most likely cannot account for the results obtained in this study. Previous investigators have reported that H-reflex recordings are not significantly different when recorded in either the supine reclining or prone position; however, standing postures do affect H-reflex amplitude recordings.[51,52] Additionally, these data offer a perspective with respect to issues of appropriate control procedures when evaluating motoneuron excitability changes as a consequence of SMT. Clearly, the current data indicate that cervical perturbation (ie, SMT) does not cause changes in the excitability of the lumbar motoneuron pool; thus, claims that SMT may produce the same result as a nonspecific perturbation, such as a "startle" maneuver, are not supported by the current data. The current data do, however, tend to support the supposition that SMT imparts a specific effect on regional motoneuron pool excitability.

The clinical efficacy of SMT-induced inhibition of motoneuron activity for mechanical neck and low back pain may involve an alleviation of the "pain-spasm-pain" cycle.[1,17,53] Although an alteration of the afferent discharge reaching the spinal cord may be proposed to assist in disrupting the pain-spasm-pain cycle, the clinical consequence of attenuation of α-motoneuronal activity has not yet been established. In addition, the concept of the pain-spasm-pain cycle remains controversial,[54,55] and we acknowledge numerous other plausible competitive theories that attempt to explain this cycle of pain and muscular spasm. However, there is some preliminary evidence in the literature to suggest that reflex activation of the paraspinal muscles targeted by SMT leads to an attenuation of motoneuron activity and the alleviation of hypertonicity.[5,19] Reflex activation of SMT-targeted thoracic musculature led to a subsequent alleviation of hypertonicity in one symptomatic patient with thoracic muscle spasms.[5] Thus, SMT may indeed play some role in the reduction of pain and muscle spasm in low back pain populations.

CONCLUSION

Our data support the supposition that SMT inhibition of motoneuron activity involves a local segmental response rather than an integrative central response.

Although the mechanism of the attenuation is unknown, as we previously reported, the characteristics of the inhibition appear to be consistent with that of muscle spindle after-effects and postactivation depression. Future research needs to focus on the local segmental mechanisms underlying this transient inhibition of motoneuron activity after SMT. The results of the current investigation, however, should be interpreted with caution because the data were collected from asymptomatic, healthy subjects. Clearly, the findings cannot be extended to the patient population with neck or back pain at this time. Future investigations also need to identify SMT responses obtained in the patient population with mechanical neck and back pain.

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