Can Neck Exercises Enhance the Activation of the Semispinalis Cervicis Relative to the Splenius Capitus at Specific Spinal Levels?

A Comparison of Two Non-Thrust Mobilization Techniques Applied to the C7 Segment in Patients with Restricted and Painful Cervical Rotation

COLLEAGUE Q & A
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Pressure Pain and Isometric Strength of Neck Flexors are Related in Chronic Tension-Type Headache
LETTER FROM THE EDITOR:

Greetings and a warm welcome to “The Connection” readership!

I could not be more excited to introduce a special issue on the cervical spine. It has been my mission for the past few years to improve the quality of our commentaries in order to allow readers to use the information in clinical practice. This e-publication is a collection of inspired and instructive commentaries written by the IAOM-US Fellows and Fellow candidates based on current literature in the world of manual therapy. Please take some time to read Dr. Sizer’s clinical update on the cervical spine as it is a new feature this issue. We are honored to share the work of so many committed and thoughtful clinicians.

In addition, we invite you to tell us how you have utilized this information in the clinic. Feel free to leave comments on the articles, to share your thoughts, or ask the author a question in a quick note or letter to the editor: tsmith@iaom-us.com.

We appreciate your continued support and are so happy that you take part in the IAOM-US through “The Connection”.

With warmest thanks,
Tanya Smith
Managing Editor
Dear Colleagues:

We hope your 2016 is going well so far. It’s hard to believe we’re half-way through the year. We had a great Annual Faculty meeting in Tucson in January, and are well on our way to implementing some projects and priorities that were set during that meeting. We were extremely excited to create and roll out the IAOM-US Surface Anatomy App, (if you haven’t seen it, check it out for apple and android) and are currently exploring the possibility of an app for Dry Needling, as well as some other app options.

We’re also continually working with our colleagues in Chile on the IAOM-LA model to bring IAOM content to Latin America. Vicente Mauri Stecca and Pedro Castex are spreading the word and enjoying great success with their IAOM-LA courses.

We’re also currently collaborating with IAOM-EU and colleagues in Paris to bring IAOM concepts and teaching to France. It’s an exciting time for the IAOM! Please enjoy this latest issue of the Connection, which focuses on the cervical spine. We hope you have a great summer, and are looking forward to starting work on the second half of 2016.

Joel, John, Sharon and Valerie
Exercise has been shown to be an effective treatment for people with chronic neck pain but the neuromuscular changes in response to training are typically specific to the mode of exercise performed. Patients with neck pain often display increased sternocleidomastoid activity and decreased deep cervical flexor activation. Therefore, exercises to increase deep cervical flexors activity are often employed. It has also been shown that the deep cervical extensor, semispinalis cervicis, is relatively inactive in individuals with chronic neck pain while showing increased activation of the superficial extensor muscles including the splenius capitis. This study attempted to demonstrate a method to activate the deep cervical extensor muscle, semispinalis cervicis, while relatively inhibiting the superficial cervical extensor, splenius capitis, as is done with deep cervical flexor exercises.

Using intramuscular electromyography (EMG), this study investigated the activity of the deep semispinalis cervicis and the superficial splenius capitis muscle at two spinal levels (C2 and C5) in ten healthy volunteers during a series of neck exercises:

1. Traction and compression
2. Resistance applied in either flexion or extension at the occiput, at the level of the vertebral arch of C1 and of C4.
3. Maintaining the neck in neutral while inclined prone on the elbows, with and without resistance at C4.

The ratio between semispinalis cervicis and the splenius capitis EMG amplitude was quantified as an indication of whether the exercise could emphasize the activation of the semispinalis cervicis muscle relative to the splenius capitis. Manual resistance applied in extension over the vertebral arch emphasized the activation of the semispinalis cervicis relative to the splenius capitis at the spinal level directly caudal to the site of resistance (ratio: 2.0 ± 1.1 measured at C5 with resistance at C4 and 2.1 ± 1.2 measured at C2 with resistance at C1).

Methods:
Ten healthy volunteers (3 men and 7 women; age 30.7+/−7.4 years; height 170+/−8.8 cm; weight 67.6+/−24.8 kg) without neck pain participated. Intramuscular EMG, guided by ultrasound, was acquired from the semispinalis cervicis and splenius capitis muscles at the level of the 2nd and 5th spinous processes on the right side. The subjects were placed in a prone position with the head slightly flexed. The deep cervical artery, which lies in the fascia separating the semispinalis cervicis from the splenius capitis muscle, was visualized with Doppler sonography prior to the insertion of the needle. The needle was inserted at the spinal levels of C2 and C5 vertically into the semispinalis cervicis and at a 45° angle into the splenius capitis and at a 45° angle into the splenius capitis. Once the target muscles were identified by ultrasound, the needle was removed leaving the wire in the muscle belly for the duration of the experiment. A reference surface electrode for each wire was placed adjacently (mastoid process, spinous process C7, and for the levels of C2 and C5) and a further common reference electrode was placed around the wrist.

The participants were then seated in a device to measure neck muscle force (Cervical-Multi unit, BTE technologies, USA). Three maximum voluntary neck extension contractions were measured and the highest value of force
was selected as the maximal force. The subjects then performed isometric exercises against manual resistance in sitting resisting extension and flexion (Figures 1 to 4), standing in front of a table propped up on both forearms in extension (Figures 5 and 6), axial traction and compression (Figures 7 and 8). Each exercise was repeated twice for approximately 10 seconds during which EMG activity was recorded. The intensity of the resistance was applied with the maximal force that each subject could counteract without discomfort from the investigator’s hands/fingers over the neck. Manual resistance could not be standardized so the ratio between normalized root mean square (RMS – estimated amplitude of the EMG signal) of the semispinalis cervicis and splenius capitis was calculated and compared across conditions.

Figure 1: Subject retracts head and neck against the extension resistance at the occiput.

Figure 2: Subject retracts head and neck against the extension resistance at C1.

Figure 3: Subject protracts head against the flexion resistance at the occiput.

Figure 4: Subject protracts head against the flexion resistance at C4.

Figure 5: Propping on elbows with head aligned.

Figure 6: Propping on elbows with resistance in extension at the level of C4.
A three-way Analysis of Variance (ANOVA) was conducted on the normalized RMS values for semispinalis cervicis and splenius capitis, both at C2 and C5, with direction (flexion and extension), location of resistance (occiput, C1 and C4) and muscle (semispinalis cervicis and splenius capitis) as factors.

Results/Discussion:

This study evaluated and confirmed, for the first time, the ability to enhance the activation of the semispinalis cervicis muscle relative to the splenius capitis at different spinal levels with targeted exercise interventions.

Resistance in cervical flexion and extension:

- The activation of both muscles at both spinal levels was greatest when resistance was applied to the head, for flexion and extension, compared to resistance over the vertebral arches.
- Resistance at C1 produced higher muscle activity at C2 compared to resistance at C4, which has no direct lever at the level of C2.
- Resistance at C1 had the same level of muscle activity at C2 as it did at C5 indicating the other factors influence muscle activation.
- The ratio between the semispinalis cervicis and splenius capitis recorded at C2 was highest when resistance was applied in extension at the level of C1 compared to resistance applied at the occiput or the level of C4.
- The ratio of muscle activity at C5 was highest with resistance in extension at C4 compared to the occiput or C1.
- Manual resistance applied over the vertebral arch can emphasize the activation of the semispinalis cervicis relative to the splenius capitis directly caudal to the location of the resistance compared to resistance applied at other locations.
- These concepts might be clinically relevant when movement dysfunction or structural changes are identified at specific segments.

Prone extension on elbows:

- The aim of this exercise was to emphasize the lower cervical extensor muscles, so resistance was only applied at C4. This may be helpful for patients presenting with a forward head posture.
- As previously confirmed, resistance over the vertebral arch of C4 further increased the activity of both muscles at both levels but more so at C5 compared to C2.
- The ratio between the deep and superficial muscles did not differ with this exercise, however the muscle activity recorded at C5 was higher compared to the exercises when the resistance was applied in flexion, which suggests that extension on elbows is still an effective way to activate the semispinalis cervicis in the lower cervical spine.

Seated cervical traction and compression:

- Higher muscle activity was recorded for both muscles at both levels during traction versus compression.
- Cervical lordosis flattened during traction and increased during compression. Flattening of the cervical lordosis occurs during traction which may prompt activation of all extensor muscles. Compression tends to increase cervical lordosis which cannot be limited by extensor muscle contraction. The activation of both the semispinalis cervicis and splenius capitis during compression may reflect co-activation with the cervical flexor muscles which are likely more activated.

Methodological considerations and limitations of the study:

- The invasive nature of the experiment limited the sample size of the study, however, it is consistent with other EMG studies.
• The size of the electrode wires may have caused movement during the exercise. This was addressed with a hook at the end of the wire to limit movement.
• Pressure on the tissue near the wires may have caused EMG artifact.
• The validity and reliability of the exercises selected have not been previously evaluated.
• Both muscles were activated in all of the exercises. Exclusive activation of the semispinalis cervicis was not found, however resistance applied over the vertebral arch did activate the semispinalis cervicis relative to the splenius capitis directly caudal to the site of resistance.
• The study was performed on pain-free subjects and the results may differ when performed on subjects with neck pain. However, previous studies have concluded a difference in semispinalis cervicis relative to splenius capitis in people with chronic neck pain when resistance was applied locally to the neck.

Conclusion:
Resistance applied over the vertebral arch was found to activate the semispinalis cervicis relative to the splenius capitis directly caudal to the site where the resistance was applied. This concept may prove useful when applied to people with neck pain who have shown impairment to this muscle during clinical testing.

IAOM-US COMMENTARY:
The fibers of semispinalis cervicis originate from the transverse processes of T1 to T5/T6 and insert on the spinous processes of C2 to C5 13 respectively down to C7.4, 21 The deep semispinalis cervicis muscle is active predominantly in extension with a small ipsilateral side bending component. 21 The activity of the semispinalis cervicis increases with increasing contraction intensity, 21 confirming observations for other neck musculature, such as the sternocleidomastoid, semispinalis capitis, splenius capitus and upper trapezius.1, 8, 15 This finding suggests that multiple muscles can be recruited at lower loads to generate a required force in a desired direction, while at higher loads the primary muscles are predominantly recruited.1

Schomacher and Falla, in 2013, found structural changes in the deep cervical extensors of patients with neck pain compared to healthy controls, with a higher concentration of fat within the muscle, variable cross-sectional area and higher proportions of type II fibers.20 They postulated that these findings suggest that the behavior of the deep extensors may be altered in patients with neck pain. On the contrary, fatty infiltration of muscle tissue has not been observed consistently in patients with insidious-onset neck pain.3 The superficial cervical extensors typically show increased activation in patients with neck pain 10, 13, 15, 24 as well as delayed offset (relaxation) after activity.10 In contrast, recent studies show that patients with neck pain display reduced activation of the deep extensor muscles, semispinalis cervicis and multifidus when assessed with muscle functional magnetic resonance imaging (mfMRI).18

Good questions to ask are: how do you know in clinical practice when the semispinalis cervicis is weak? and, is it weaker in patients with chronic neck pain? The answers to these questions were alluded to in this abstracted study but no testing was performed to measure weakness because the test subjects in this study had no neck pain. Can we make the assumption that weakness is occurring in muscles showing a higher concentration of fat, variable cross sectional area and higher proportions of type II fibers?

Quote from the previous IAOM-US CTL-Safe course: “The musculoskeletal system of the cervical spine is among the most complex of the human body. Cervical muscles demonstrate marked morphological diversity to permit and control the wide variety of head movements that are possible. Untrained individuals are unable to maximally activate cervical muscles.”3

With this in mind, it is important that we include appropriate stabilization training that encompasses the complete cervical spine. This is the attempt of the SensoriMotor Control and Rehabilitation of the CT Spine (SenMoCORT™) course taught Phil Sizer Jr., PT, PhD, OCS, FAAOMPT with the IAOM-US. The information contained in this article is an effective precursor to the SenMoCORT™ program. Emphasis in this article is placed on the semispinalis cervicis, a deep cervical postural stabilizing muscle, similar to the multifidus. When used as a neuromuscular re-education (NMR) tool post cervical mobilization, it can be an effective means to keep the newly gained range of motion in addition to activating the appropriate deep cervical extensors that are important in the stability of the cervical spine. This study specifically looked at muscular activity at C2 and C5 levels for ease of research; however, activation of the semispinalis cervicis could be emphasized at all cervical levels. Activation of the semispinalis cervicis after mobilization is performed by the patient gently retracting (2-3 lbs. of force) while the therapist provides resistance at
the vertebral arch. A light force of resistance is recommended so that multiple muscles can be recruited at lower loads to generate a required force in a desired direction, while at higher loads the primary muscles are predominantly recruited.  

Resistance applied over the vertebral arch was found to activate the semispinalis cervicis relative to the splenius capitis directly caudal to the site where the resistance was applied; it is important that surface anatomy for the cervical spine be emphasized. The IAOM recommends beginning with the Frankfurt position, which is performed when the dorsal most part of the occiput is in line with the dorsal most aspect of the thoracic spine and the lower part of the orbit is in line with the external auditory meatus. C1 is then found between the mastoid and the posterior angle of the mandible, anterior and deep to the sternocleidomastoid muscle. C2 is the first spinous process caudal to the external occipital protuberance; C3 is found at the level of the hyoid bone; C4 is found at the level of the v-notch of the thyroid cartilage; C5 is found at the 3 plates of the thyroid cartilage; and C6 is located at the level of the 1st ring of the cricoid cartilage.

A home exercise program utilizing these principles for strengthening the semispinalis cervicis can be prescribed, using a strap used as pictured below (Figures 9 and 10). It is recommended to use an isometric resistance of 2-3 lbs. into extension against the strap for a 3-second hold for a total of 3 sets of 25 repetitions or as symptoms will allow. Seventy-two repetitions over a 15-minute period for 7 consecutive days was shown to improve long term motor learning.  All cervical levels can be treated in this manner. Proprioceptive training can also be implemented using guided imagery with “thinking” looking up and “thinking” looking right or left while maintaining the resistance to add an additional component to the exercises.

Figure 9: Subject retracting head and neck against extension resistance at the Level of C1.

Figure 10: Subject retracting head and neck against extension resistance at the level of C4.
References:


References Con’t:


Thrust manipulation and non-thrust mobilization to the cervical spine are two different types of treatment interventions intended for patients suffering from neck pain and/or motion limitations of the cervical spine. Both interventions have resulted in positive effects for reducing pain and addressing motion impairments. However, according to studies when manipulation was compared to mobilization, neither technique appeared to be more beneficial. In addition, studies have reported that rotatory cervical manipulation may worsen pre-existing disc herniations, cause disc herniation resulting in both radiculopathy and myelopathy, and may be an independent risk factor for vertebral artery dissection, potential cause of stroke, or internal jugular vein thrombosis. Because of the controversy surrounding cervical manipulation and the work of both Norlander et al. and Ozer et al. in which they found that reduced mobility at the cervical-thoracic junction was a risk factor for neck pain and that disc herniations are very rare at the C7-T1 segment, the objective for this clinical trial was formulated.

The purpose of this study was to describe two translatory non-thrust mobilization techniques and evaluate their effect on cervical pain, motion restriction, and whether any adverse reactions (AR) were reported when applied to the C7-T1 segment.

Thirty participants (17 females and 13 males, with a mean age of 58.37 years) with restricted and painful cervical rotation and a diagnosis of cervicalgia, cervical osteoarthritis, cervical radiculitis, or cervical spondylitis were referred to an outpatient clinic and recruited into the trial. Participants were included in this trial if their neck pain was reported as two or greater (on a 0-to-10 scale) on the numeric pain rating scale (NPRS), pain was reported at the end range of both left and right active cervical rotation, and active cervical rotation was restricted in both directions when examined using the cervical range of motion device (CROM). Individuals were screened for and excluded if they presented with any absolute contraindication to mobilization such as acute fractures, dislocations, ligamentous ruptures, instability, infection, tumors, acute myelopathy, acute soft tissue injury, osteoporosis, ankylosing spondylitis, rheumatoid arthritis, vascular disease, vertebral artery abnormalities, connective tissue disease, and anticoagulant therapy. Using a coin toss, the first patient was assigned to the facet joint gliding mobilization group (Figure 11). The second patient was then assigned to the facet joint distraction mobilization (Figure 12). The group assignment was then alternated. Four variables were measured: active right rotation, active left rotation, cervical pain intensity level at end range right and left cervical rotation, and number of AR produced during or immediately post mobilization. Active range of motion (AROM) was measured using a CROM. Active
right cervical rotation was measured immediately before and immediately after a single intervention with either the C7 facet joint gliding or the C7 facet joint distraction technique. Self-report of cervical pain intensity using the 0-10 NPRS was recorded at the end of available active right rotation both immediately before and after application of one of the two mobilization techniques. The same measurement process was then followed for left cervical rotation. During and at the conclusion of technique application, each participant was asked to report if he/she experienced any feeling of stiffness, discomfort, or other abnormal or unpleasant sensation. This ended the patient’s involvement in the study and additional therapeutic interventions could be applied as indicated. In this study, a single intervention consisted of three consecutive, 7-second, grade III, non-thrust facet glide or facet distraction mobilizations. The same clinician performed the mobilization techniques, and recorded both pain intensity level and CROM measurements before and after technique application.

Results and Conclusion
Following application of the aforementioned mobilization techniques (regardless of technique) there was an increase in active cervical rotation in both directions. The active motion increase was, in total, approximately 10° for each participant. In addition, there was a statistically significant reduction of pain intensity reported at the end range of active cervical rotation. Furthermore, no participant in this study reported discomfort or any other form of minor reaction or injury (AR), related to the application of the two mobilization techniques examined. No significant difference was found between these two manual interventions for rotation and NPRS intensity level after treatment application.
Limitations
A limitation of this study is that the researcher was not blinded and performed all interventions and subsequent measurements. Therefore, there is a potential for examiner bias regarding the use of these techniques. Another limitation is that the C7-T1 segment was not evaluated for joint mobility prior to mobilization. In fact, the study does not mention or discuss any joint mobility testing of the cranial or caudal segments surrounding the C7 vertebra prior to or following mobilization. A joint that is not hypomobile is not going to benefit from mobilization or manipulation and in this case could potentially affect recovery as the C7-T1 segments serve as a transition zone and could potentially be unstable or hypermobile.

Future studies including a sham treatment for comparison may prove beneficial and provide pertinent information as it may serve to rule out the risk of a placebo effect associated with hands-on treatment.

IAOM-US COMMENTARY:
This study explores the idea that non-thrust mobilization applied to the C7-T1 segment in patients with restricted and painful cervical rotation can provide the same therapeutic benefits without the added risks and potential adverse reactions associated with cervical manipulation. The authors comment that non-thrust mobilization may and can in fact, serve as an alternative and much safer technique than rotatory cervical manipulation. Studies have shown that when manipulation is compared to mobilization, neither technique appeared to be more beneficial. Patients suffering from restricted and painful cervical rotation typically present with motion limitations associated with C7-T1 segmental hypomobility. This can lead to compensatory increases in segmental mobility of the cranial vertebrae leading to pathology. Restricted and painful cervical rotation may be due to a hypomobility of the cervicothoracic junction; specifically, the C7-T1 vertebral segment. This article explores and evaluates two mobilization techniques applied to the C7-T1 segment and their effect on cervical pain, motion restriction, and whether any adverse reactions (AR) were reported.

In the IAOM-US course, Clinical Examination and Manual Therapy of the Thoracic Outlet Syndrome & Cervicothoracic Junction, the cervicothoracic junction is said to be made up anatomically of the C7-T1 segment, but biomechanically of the C7-T4 segments (termed ‘cervicothoracic region’ for this discussion). The C7-T1 segment is the caudal end of the cervical chain and therefore contributes mobility. However, it also requires rigidity as it serves as the cranial end of the thoracic chain. The cervicothoracic region, which includes the C7-T1 segment demonstrates the same coupling behavior as the lower cervical spine. In fact, with cervical rotation a flexion occurs in the cervicothoracic region. The C7-T1 segment has more mobility in flexion and extension with less rotation and side-bending when compared to its more caudal segments. In addition, C7 is the last vertebra to show a large
rotation coupling during side-bending of the cervical spine. Several authors have concluded how reduced mobility at C7-T1 and T1-T2 significantly predicted neck-shoulder pain and weakness in the hands. Norlander showed a positive predictive value of 84% of C7-T1 hypomobility and the incidence of neck-shoulder pain, where others demonstrated greater improvements in pressure pain thresholds at C5-C6 zygapophyseal joints following C7-T1 manipulations. Despite its key role in the kinematic chain, C7-T1 is similar to the thoracolumbar junction as it too serves as a spinal transition zone, and therefore, a potential site for instability. Because of its potential predisposition to a spinal cord injury and instability, one must still exercise caution when mobilizing this segment due to its smaller canal size.

The mobilization to the C7-T1 segment described in this article is different than that practiced by the IAOM. In the instance that the C7-T1 segment presents as hypomobile, mobilization techniques can be utilized and implemented as shown in (Figures 13 and 14). The IAOM also emphasizes the importance of testing the joint mobility prior to mobilization/manipulation.

**Figure 13:** (left picture): C7 on T1 right rotation mobilization. The IAOM technique is performed with the individual seated and the left arm abducted over the thigh of the therapist (relax muscles attaching to the spinous process). With the right hand, the therapist takes the cervical spine into right rotation and left side-bending until movement is palpated with the left thumb along the left side of the T1 spinous process (thereby locking the cervical spine). The therapist then applies pressure to the left side of the T1 spinous process to the patient’s right side inducing a left rotation of the T1 vertebra thus creating a right rotation of the C7 vertebra above. The head does not move.

**Figure 14:** (right picture): C7-T1 Extension Jenkner (dorsoventral translation) mobilization. The patient is seated with fingers interlocked between the head and neck. The therapist uses his/her left shoulder to apply and maintain upper cervical flexion (chin tuck). The therapist then uses a pincer grip with the right hand to apply a ventral mobilization force to the laminae of the T1 vertebra.
References:


QUESTION #1:
What is the biomechanical explanation for a cluster of segmental cervical limitations in the cervical spine observed during the 3-D side bending (SB) test being associated with rotational motion limits? And why is a single isolated segmental cervical limit in the 3-D SB test associated with side bending limits of motion and not a rotation limit?

ANSWER #1:
1. Jirout helps us understand that the side-bending test examines the synkinetic response of a rotation limit, which behaves in a chain-reaction, where segments below cannot synkinetically move until segments above can synkinetically move. The examiner will find two or more adjacent limitations: a cluster of limited segments. When rotation at the cranial segment improves, the synkinetic side-bending at that level allows the synkinetic side-bending to occur caudally (in other words, freeing up that chain reaction). Thus, the side bending test improves caudal to the level of treatment.

2. Direct observation in the clinic reveals a phenomenon that repetitively exists as a clustered (rotation) limit. Treatment of the cranial hypomobile segment with a rotation glide (either in flexion or extension, depending on the level), that segment and the lower segments in the cluster have a tendency to improve in their mobility. It seems to be a chain reaction. Additionally, the cranial segment appears to respond better at first to the rotation glide versus using the sidebend (lateral scooping) technique.

3. If the segment just under the cranial segment continues to be limited after performing the rotation mobilization at the cranial segment, the following concept of treatment can be helpful:
   - If that limit is one level only, the sidebend (also called lateral scooping) technique generally restores mobility at that level.
   - If again, there is a cluster of limits (2 or more adjacent levels), performing a rotation mobilization at the most cranial level in that ‘new’ cluster is repeated.

Summary:
- The observed limits in the side bending test are either single-level (indicating side bend limit) or clustered (indicating a rotation limit).
- It is observed that rotation glides work better for a cluster of limits whereas sidebend (lateral scooping) techniques are often most beneficial for single level limits.
QUESTION #2:
When or how do you select to use techniques to improve flexion or extension in the presence of segmental hypomobilities? We understand that techniques to improve rotation are performed in presence of a cluster limit in the upper segment, but when do you select flexion and/or extension mobilizations in this case?

ANSWER #2:
1. Choose to use a flexion or extension directed rotation glide depending on the level of limitation. Based on what occurs in rotation of the neck, the more caudal segments flex and turn downward in response to coupled motion of ipsilateral sidebend. So, essentially the segments flex in space and this would turn the eyes downward if they worked in isolation. In response, however, the cranial segments tend to extend, thus keeping the eyes level.

2. For upper disc segments, choose to first use extension rotation glides on the ipsilateral side to the direction of rotation limit because that side’s zygapophyseal joint is segmentally gliding in the direction of extension during the rotation, which corresponds with the extension that is occurring in the segment during rotation. Upon hitting a plateau in segmental mobility response to the extension rotation glide, a single level sidebend (lateral scooping) technique at the adjacent caudal segment can be performed, or a flexion glide on the contralateral side at the same level. These techniques will further enhance the rotation in the most cranial segment. In clinical practice all these accompanying techniques are performed.

3. For lower disc segments choose to first use flexion rotation glides on the side contralateral to the direction of rotation limit, because that side’s zygapophyseal joint is segmentally gliding in the direction of flexion during the rotation, which corresponds with the flexion that is occurring in the segment during rotation. After hitting a plateau in segmental mobility response to the flexion rotation glide, a single level sidebend (lateral scooping) technique at the adjacent caudal segment can be performed, or an extension glide on the ipsilateral side at the same level. These techniques further enhance the rotation in the most cranial segment. In clinical practice all these accompanying techniques are performed.

References


Pressure Pain and Isometric Strength Of Neck Flexors Are Related In Chronic Tension-Type Headache


Abstracted by: Denise Schneider, PT, FAAOMPT, ATC—Lisle, IL

Tension-type headache is the most common type of headache and is further divided into episodic and chronic. Individuals who suffer from chronic tension type headache (CTTH) may experience substantial disability and decreased quality of life. The International Classification of Headache Disorders-3 (beta version) classifies CTTH based on the following diagnostic criteria: occurs > 15 days a month on average for > 3 months; lasts hours to days or is constant; has at least two of the following characteristics of bilateral location: pressing or tightening sensation, mild or moderate intensity, and not aggravated by normal daily activity; no more than one episode of photophobia, phonophobia, or mild nausea are present; and neither moderate or severe nausea or vomiting are present. The cause of tension type headache is not precisely known; however, peripheral and central sensitization plays a role. Peripheral sensitization occurs as a consequence of local injury or tissue damage in which pain producing substances are released. Subsequently, peripheral muscle nociceptors are sensitized which results in local pain. Prolonged peripheral sensitization can lead to central sensitization as in CTTH. In this case, pain is widespread and radiates beyond the original injury or tissue damage. Key indicators of central sensitization are allodynia, pain that is caused by non-painful stimuli, and hyperalgesia, an exaggerated response to pain. The main clinical findings of tension type headache are myofascial trigger points, typically located in the upper trapezius, suboccipital, sternocleidomastoid, and temporalis muscle groups. Other findings include decreased deep neck flexor strength and endurance, and postural abnormalities.

The authors of this study present that in patients with CTTH, changes in pressure pain in the cervical region are associated with peripheral or central sensitization. They hypothesize that an increase in isometric strength of neck flexors will result in a decrease in pressure pain (indicating a decrease in sensitization). This study utilized data from 145 patients between the ages of 18 and 65 meeting the diagnostic criteria for CTTH. Exclusion criteria for the study consisted of: diagnosis of rheumatoid arthritis, malignancy or brain tumor; pregnancy; inability to read or write Dutch; and having had received manual therapy treatment two months prior to the study.

Patients included in this study received manual therapy treatment for 8 weeks, with a maximum of nine 30-minute sessions. The sessions consisted of a combination of mobilization of the cervical spine and of the thoracic spine; postural correction; and isometric strengthening of the deep neck flexors. Patients were given a booklet on self-management exercises with instructions to perform...
the exercises during the 8-week period of treatment and to continue beyond that. Measurements were taken at baseline, 8 weeks post treatment, and 26 weeks post treatment. Measurements included: isometric strength of the deep neck flexors, pressure pain scores, and Headache Impact Test (baseline only). First, isometric strength of the deep neck flexors was tested (Figure 15). This is a timed test in which the patient is instructed to lift their head from the treatment table while lying supine.

The second test assessed pressure pain scores (PPS) of the upper trapezius and suboccipital muscles. A pressure algometer was used with 3.0kg/cm pressure at 4 different points; 2 points on the upper trapezius muscle and 2 points on the suboccipital muscles. Patients were instructed to rate their pain on a scale of 0 to 10, whereby 0 equals no pain and 10 equals severe pain. Lastly, the Headache Impact Test (HIT-6) was administered at baseline only. This 6-item questionnaire quantifies an individual’s degree of pain intensity, and measures the negative effect headache has on social functioning, role functioning, vitality, cognitive functioning and psycho-social distress.

Results and Conclusions
The results of this study are as follows: At 8 weeks, 142 out of 145 patients demonstrated a significant increase in isometric strength of the neck flexors and a significant decrease in PPS. After the 8-week mark, manual therapy treatment was discontinued; however, patients were instructed to continue the self-management exercises. At 26 weeks, 125 patients demonstrated an increase in isometric strength of the deep neck flexors and a decrease in PPS.

The authors confirmed that an increase in strength of the deep neck flexors significantly correlated with a decrease in PPS in the upper trapezius and suboccipital muscles. PPS measure the degree of peripheral and central sensitization, therefore, the authors conclude that a decrease in PPS correlates with a decrease in frequency and duration of CTTH.

**IAOM-US COMMENTARY:**
For certain types of headache, physical therapy is part of the comprehensive treatment plan. Specific to tension type headache, physical therapy has been shown to decrease headache frequency, decrease headache intensity, decrease headache duration, and decrease use of medications. This allows the headache sufferer to improve his/her functional mobility and quality of life. The physical therapist performs a comprehensive musculoskeletal examination and includes items as the abstracted article indicates such as: assessment of postural abnormalities; assessment of soft tissue and myofascial trigger points in head and neck musculature; assessment of joint mobility; and assessment of strength and endurance of the deep neck flexor muscles. The IAOM-US course, Clinical Examination and Manual Therapy of the Upper Cervical Spine and Headache, teaches a systematic clinical approach that can be applied to this patient population.

The physical therapist then uses the examination findings to formulate an individualized treatment plan. The patient receives education on the findings, the plan of care and prognosis, and additional items specific to the patient that will allow for optimal care. As suggested in the abstracted article, physical therapy interventions may include postural correction, manual therapy, and isometric strengthening of the deep neck flexors. The IAOM-US coursework also provides treatment techniques that are beneficial for these patients. Postural correction is important to reduce muscle tightness, improve joint mobility, and improve range of motion. The patient is instructed on how to achieve an upright neutral spine position (Figure 16). In this position, the most dorsal aspect of the occiput should be in line with the most dorsal part of the thoracic spine. In addition, the lower part of the orbit should be in line with the external auditory meatus.10

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**Figure 15:** Deep neck flexor test: The patient lies in a supine hooklying position on the treatment table. The patient is instructed to perform a chin retraction, lift the head up about 1 inch and maintain this position. The test ends when the patient can no longer hold their head up, or the patient is unable to maintain the correct position.
Manual therapy interventions, such as joint mobilization techniques and soft tissue techniques, have been demonstrated to benefit individuals with CTTH. For example, the physical therapist may elect to use a transverse stretch to address trigger points in the upper trapezius muscle (Figure 17). The goals of this technique are to increase blood flow, decrease muscle tension, and decrease pain. Other muscles commonly treated for CTTH are the splenius capitus, levator scapula, suboccipitals, temporalis, masseter, lateral pterygoid, superior oblique (extra-occular) and sternocleidomastoid.11-14

If in the clinical exam, the physical therapist locates hypomobile segments, various local segmental techniques may be used. The goals of these techniques are to decrease joint stiffness, improve movement, decrease muscular tension, and decrease pain. Figure 18 depicts one of the various techniques that can be implemented.

Lastly, the abstracted article references deep neck flexor training. The function of the deep neck flexors are to offer support and segmental stability to the cervical spine. Training is designed to improve motor control and to decrease activity of the superficial flexors. This will improve movement patterns and ultimately decrease muscle tension and stress in head/neck. Initially, training begins in the supine position (Figure 19). The patient is instructed to gently nod his/her head while the physical therapist monitors for compensatory movement patterns. The physical therapist provides cues to the patient as needed. Dosage is determined based on the performance of the exercise. Training can be progressed to other positions such as sitting and standing.
The physical therapy interventions described above are commonly implemented with individuals who suffer from CTTH. This is not an exhaustive list, however. The physical therapist will utilize additional interventions that are patient-specific to ensure an individualized treatment plan is executed for optimal outcomes. There are other factors to consider and address when treating patients with CTTH. CTTH can be made worse with the following: consumption of alcohol and caffeine; fatigue or inadequate sleep; emotional stress; poor eating habits; and eyestrain. It is essential that the physical therapist inquire about these factors as well. Since physical therapy has proven to be effective for individuals who suffer from CTTH it should be considered as a part of the comprehensive treatment plan.

Figure 19: Deep neck flexor training. A towel is placed under the neck. The patient is instructed to gently nod their head. This position may be held for 10 seconds. The physical therapist determines the number of repetitions to be performed.
References:


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