

SCIENTIFIC

PHYSICAL THERAPY

Implementing Evidence-Based Medicine for Cervicogenic Headache

By

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Headache takes many forms and its presentation varies. Some examples of headache include migraine, tension-type, cluster, hemiplegic migraine, cervicogenic, and ophthalmoplegic migraine. The pathogenesis of headache or head and face pain is complicated and its cause remains unclear. It has been reported that classical migraine only comprises only about 10% of patients with migraine symptoms, yet migraine headache seems to dominate the discussion of headaches, demonstrating the state of affairs with headache terminology. Since so much attention is given to migraine headache other forms of headache have taken a back seat. In today's headache dialogue it seems that the tail is wagging the dog.

In the United States it is estimated 50 million people who suffer from headaches lose approximately 150 million workdays per year, which results in about \$57 billion dollars per year in productivity loss and in medical expenses. Headache patients account for 50 million visits annually to health care providers. This constitutes 2.4% of all patients who seek help from their primary care physicians. Furthermore, 5% to 8% of all patients with migraine headache seek consultation with non-traditional health care providers including

physiotherapists, chiropractors, and herbalists.¹ Cervicogenic headache, as defined by the International Headache Society (IHS), comprises 15-20% of all recurrent headaches.² However, as a distinct medical disorder or diagnosis, cervicogenic headache lacks expert consensus. The presence of cervicogenic headache may be generally accepted in today's medical society, yet the pathophysiology and headache source or pain generator is still debated.³ The impact of headaches on quality of life far exceeds other chronic conditions including osteoarthritis, hypertension, and diabetes.⁴ Physical therapy management of cervicogenic headache has had few studies that have been directly performed to evaluate the efficiency of treatment methods for this condition.⁵

Clinically, headache appears to be intimately linked with dysfunctional movement patterns of the upper cervical joints and is occasionally due to degenerative changes of the lower cervical and upper thoracic joint regions. Because is not easy to identify the structure responsible for headache signs and symptoms, especially considering that two or more structures may be causing symptoms at the same time, there are many theories of the causes of headaches.

Abstracts:

- **Implementing Evidence-Based Medicine for Cervicogenic Headache.**

By Brent Harper, PT, DMT, DPT, OCS, FAAOMPT

- **Function of the Upper and Lower Subscapularis Muscle and its Possible Indication for Rehabilitation.**

By Ben Grotenhuis, PT, MOMT, FAAOMPT

Pathophysiology

Gregory Grieve⁶ reported twelve possible theories of causation for headache:

- 1) Interfering with afferent impulses from the mechanoreceptors of the upper cervical joints;
- 2) Vertebrobasilar ischemia due to atheroma of vertebral artery, or encroachment by osteophytes and/or thickenings of adjoining soft tissues;
- 3) Vertebrobasilar ischemia due to arterial spasm due to encroachment by osteophytes and/or thickenings of adjoining soft tissues;
- 4) Autonomic nervous system concussion;
- 5) Direct mechanical compromise on sympathetic and parasympathetic neurons that may result in symptoms involving visual acuity disturbance, nausea, vomiting, voice disturbances, and difficulty swallowing;
- 6) Maigne postulated a vasculosympathetic mechanism for unilateral supraorbital headache based on the anatomical basis of (a) sympathetic plexus around the internal carotid artery is continued into the cranial cavity and accompanies the arterial branches, thus emerging via the supraorbital foramen with the supraorbital artery, and (b) the superior cervical ganglion communicates with spinal nerve roots C1, C2, and C3. This demonstrates a somatic-autonomic-vascular link between the somatic cervical structures and the region of the eyebrow;
- 7) The trigeminal nerve which is accompanied by sympathetic and parasympathetic neurons. The ophthalmic and maxillary branches are primarily involved in sympathetic fiber activity accompanying somatosensory neurons, blood vessels, and free nerve endings. The third mandibular branch is primarily involved in parasympathetic fiber activity;
- 8) Spinal tract of V cranial nerve at C1-C2 can result in vertebrobasilar ischaemia due to degenerative joint disease at this area;
- 9) Spinal tract of V cranial nerve involved in spread of excitation with summation effects and facilitation from increased volume of impulses from nociceptor endings in upper cervical connective and other tissues;
- 10) Trauma and degenerative changes may produce adhesions of the spinal meninges that can bind down or tether the dura mater, which may result in movement of the neck causing increased traction and distortion. This can produce localized ischaemia in certain segments and associated tissues;
- 11) Ridges from disc-and-vertebral body margins

from degenerative change in the neck may occlude arterial anastomoses of the surface of the spinal cord;

- 2) The transverse ligament of atlas is attenuated and loosened by a retropharyngeal spread of throat infection. However, other tissues besides ligaments may be involved by the physical trespass of oedema.

Cailliet⁷ in his book, describes the nerve pathways that can conduct painful stimulus in coordination with chemical and hormonal agents. Historically the somatic sensory system has been indicated as the cause of head and face pain, but recently the sympathetic system has been implicated as a major pathway. The trigeminal nerve (the Vth cranial nerve) innervates the skin fascia, teeth, masticatory muscles, oral and nasal mucosa, cornea, tongue, and meningeal lining. It is the largest of the cranial nerves and has mixed somatic sensory and motor nerve innervation. This nerve is very short and emanates from the ventrolateral pons in an anterolateral direction to the apex to the temporal bone where it expands to form the gasserian ganglion, where the sensory roots are contained. The trigeminal nerve then divides into three branches: the mandibular, the ophthalmic, and maxillary. The dermatomal region includes the face and anterior two-thirds of the head. The ophthalmic division of the trigeminal nerve is the smallest branch and uppermost. It is exclusively sensory to the eye except vision and includes the lacrimal gland, the conjunctiva, the skin of the forehead, eyelids, and nose, as well as the mucous membrane of the nose and paranasal sinuses. The maxillary division is purely sensory and innervates the skin of the middle portion of the face which includes the lower eyelid, the side of the nose, the mucous membranes of the nasopharynx, the upper lip, soft palate, tonsil, maxillary sinus, roof of the mouth, teeth, and upper gums. It is implicated when there is pain in the region of the lower orbit of the eye, the midface, and the nose and mouth. The mandibular division is the only mixed region having both sensory and motor roots. Sensory region innervates the skin of temple area, the lower part of the face, auricula, the external meatus of ear, cheek, and lower lip. It also has innervations to the gums, lower teeth, temporomandibular joint, the mucous membrane of the cheek, and to a part of the dura mater and skull. The motor region supplies the muscle of mastication which include the temporalis, pterygoids, masseter, digastric, and mylohyoid. Lesions of the trigeminal nerve are termed "tic douloureux". The symptoms may occur in one or more of the

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divisions causing pain. The sympathetic nervous system, a division of the autonomic nervous system, arises from the preganglionic cell fibers that are located in the intermediolateral cell column from the 12 thoracic and upper 3 or 4 lumbar vertebrae of spinal cord. The cord level is where the sympathetic sensory system, the somatic motor system, and the somatic sensory system merge together. The sympathetic nervous system innervates the eye, cranial nerves, and arteries through the ganglia. It also innervates the dura and ligaments of the cervical spine through the recurrent meningeal nerve. The term cervicogenic headache has been given medical consideration, however the specific neurophysiological mechanism remains unclear. Cailliet⁷ indicates that the articular joints, specifically the facet (zygapophyseal) joints, the facet capsule, and surrounding ligaments may be causes of pain. Head pain is also attributed to cervical musculature, even muscles involved in poor posture, posttrauma from hyperextension-hyperflexion injuries, faulty movement of the head, or emotional tension. Cailliet states that “only by being associated with cervical movements or positions can the headache be considered cervicogenic” (p83). He also states that there may be a consistent history associated with the diagnosis of cervicogenic headache, in that some activity must occur to the upper cervical spinal segment(s). Trauma, either minor from abnormal posture (like forward head positioning) or from major trauma (like motor vehicle accident, sports injury, or physical impact), implicates nociceptors in tissues that have been irritated because of the trauma in the upper cervical segments. He finally states that the diagnosis of cervicogenic headache can be made by the response to various therapeutic procedures, which include manipulation, traction, exercises, local nerve blocks of the rami at occipital-atlanto and atlanto-axial joint spaces, local injections of cervical muscles, immobilization, local modalities (including ultrasound, electrical stimulation, TENS), and improvement of postures during activities of daily living.

A more recent study by Friedman and Nelson⁸ performed a literature review to identify the variability of conditions that can give rise to head and neck pain. Their purpose was “to describe the characteristics of several musculoskeletal, neurological, and systemic conditions frequently cited as possible causes of head and neck pain and to suggest a new technique for treating head and neck pain.” Head and neck pain can be caused by various musculoskeletal factors including muscle spasm (muscle hyperactivity), trigger points (small ischemic tender points in muscle that can refer pain and cause other symptoms), tendinitis, and inflammation of joints (temporomandibular or cervical apophyseal joints). Head

and neck pain can be considered to be headache pain. Headaches can be classified into different categories based on symptom presentation. The types listed here are migraine, cluster headache, tension headache, occipital headache, chronic daily headache, posttraumatic headache, and post lumbar puncture headache. Head and neck pain may also arise from various neurologic conditions, which include atypical facial pain (neuralgia, facial pain), glossopharyngeal neuralgia, reflex sympathetic dystrophy, and trigeminal neuralgia (tic douloureux). Systemic disease processes may also influence pain. These include osteoarthritis, inflammatory arthritis (includes rheumatoid arthritis), dermatomyositis (inflammatory condition of skeletal muscle, unknown origin), temporal arteritis (giant-cell arteritis), lyme’s disease, and fibromyalgia. A new perspective on treatment for head and neck pain was performed by a pilot study with the purpose of measuring the effectiveness of intraoral circulating ice water due to neurogenic inflammation. A device called a Cryotron, developed by Friedman, specifically chilled the maxillary alveolar tender area (Trigeminal V2 intraoral tenderness) for patients with neck pain and cervical muscle spasm, who may or may not have an accompanying headache. The specific noninvasive goal to be achieved was edema resolution by the reduction of local vasodilatation. It is postulated that the chilling of areas of edema innervated by the maxillary nerve will decrease inter-capillary pressure providing the opportunity for excessive edema (interstitial fluid) via the capillary wall to return to microcirculation. Apparent intraoral tenderness is directly related to the pressure of edema on sensory nerve endings. The authors conclude that this pilot study demonstrated significant relief from pain symptoms and these results suggest a neurogenic inflammation as the cause to trigemino-cervical pathology in association with cervical muscle spasm.

The specific pathophysiology for cervicogenic headache is still being debated. An article by Alix and Bates⁴ examined the neurophysiological basis and anatomic relationship for the etiology of cervicogenic headache between the dura mater and rectus capitis posterior minor muscle. According to the IHS cervicogenic headache accounts for approximately 15-20% of all recurrent benign headaches. There were connective bridges noted in the region of the atlanto-occipital junction between the dorsal spinal dura and the rectus capitis posterior minor muscle. These fibers were arranged in a perpendicular manor apparently restricting dural movement toward the spinal cord. Since the spinal dura has a tendency to fold inward in the direction of the spinal cord these connective tissue bridges may assist in

this dural enfolding, resulting in tension which causes thickening of posterior spinal dura. This mechanism may be compromised if trauma to the upper cervical spine resulted in rectus capitis posterior minor muscle atrophy. This dura-muscular connection transmits forces to the pain sensitive dura from the cervical spine joint complex. The proposed mechanism of cervicogenic headache is from the adverse tension in the spinal dura. Thus, any pathophysiologic condition affecting the biomechanics of the cervical spine will disrupt the balance between the stability and mobility of the cervical joint complex, creating a potential for cervicogenic headache pain. Due to the convergence of the trigeminal and cervical C1-C3 afferents there is the possibility of cervicogenic headache resulting from the pathologic condition affecting any structures innervated by these spinal nerves. Therefore, any joint complex dysfunction affecting the C1-C3 spinal nerves may cause cervicogenic headache pain. Including, but not limited to, the upper three cervical segments, the dura mater, and spinal cord. Spinal manipulation for benign sources of headache suggest efficacy for its use when cervical pathology is present. The authors conclude that the literature does suggest that there is a neurophysiological mechanism for headaches when there is a cervical spine joint complex dysfunction. The connections of the dura-muscular and dura-ligamentum nuchae in the upper cervical spine could have the potential to produce cranial pain in the presence of functional pathosis. This may aid in the understanding the mechanism of cervicogenic headache and in the use of conservative spinal manipulation for those with chronic benign headaches.

According to Biondi³, as a diagnosis, cervicogenic headache “lacks expert consensus with respect to its acceptance as a distinct medical disorder. Although its existence is generally accepted, the condition’s pathophysiology and source of pain are debated.” (pS7). The purpose Biondi’s article was to review cervicogenic headache as to its mechanism, its evaluation, and the treatment strategies available. It has been reported that head pain, referred from the neck, is considered cervicogenic headache, however, this is not always the case. In medical literature today many structures have been defined as able to refer to the head including vascular, osseous, muscular, articular, and neurogenic. Clinically, referred head pain appears to have more than one anatomical source as its driving factor. What makes headache diagnosis difficult is the similarities in the clinical symptoms of primary headache disorders like cluster, benign paroxysmal hemicrania, tension-type, migraine, hemicrania continua, and cervicogenic headaches. The author focuses his idea of pathophysiologic cervicogenic headache on the trigeminal nucleus caudalis (trigemincervical nucleus). This descends to the C3 or C4 spinal cord segments.

This nucleus is contiguous with the gray matter of the spinal dorsal horn at these levels. This column of gray matter has been called the *trigemincervical nucleus*. Interneurons within the trigemincervical nucleus allow for an exchange of sensory information that nociceptive signals from the anatomic structures and soft tissues of the upper region of the neck can be referred to the sensory receptive fields of the trigeminal nerve in the head and face. The topographic arrangement of the trigeminal nucleus caudalis allows the greatest interchange of nociceptive information with the ophthalmic division of the trigeminal nerve (CN V); therefore, it is most common for pain from a cervical source to be referred to the forehead, temple, or orbit. There is also some interchange of sensory signals with the maxillary division of CN V that allows referral of neck pain to the face. ... Afferent sensory signals ascend or descend up to three spinal cord segments in the dorsolateral tract and substantia gelatinosa before entering the spinal dorsal horn. This can allow nociceptive signals from spinal segments as low as C6 or C7 the potential to interact with interneurons in the trigemincervical nucleus, and thereby, the referral of pain from anatomy structures of soft tissues in the middle and lower portions of the head and face. (pS11)

Thus, the pathophysiology of cervicogenic headache continues to be debated. Unfortunately, in the literature, there is no objective consensus that is depicted as the primary cause for cervicogenic headache presentation. However, there are anatomical regions that can be identified as causative factors. The most likely causative regions are: the synovial and articular components of the facets and uncovertebral joints, the corresponding discs to these regions, myofascial trigger points, cervical and upper thoracic musculature, and the surrounding ligaments in the cervical and upper thoracic regions¹⁰⁷.

Cervicogenic Headache Diagnosis

What has been identified conclusively, as far as possible in present day standards, is the presentation or the symptomatology of cervicogenic headache. There are many common clinical characteristics of cervicogenic headache (refer to Appendix).

The term “cervicogenic headache” is attributed to Sjaastad et al^{11,12,13}. From 1983 to 1987, he and his colleagues^{11,12,13} conducted a series of studies dealing with cervicogenic headache, something described as a variant of the chronic paroxysmal headache. Cervicogenic headache diagnosis tended to be unilateral, was accompanied by autonomic symptoms, and provoked by head and neck movements, especially forward flexion. The head pain was described as nonclustering and episodic, originating from the neck and spreading to the head. Furthermore, the neck pain should respond to a root or nerve blockade. Sjaastad proposed that cervicogenic headache may be due to an entrapment of the occipital nerve or to a C2-C3 rhizopathy. Sjaastad did acknowledge that there is significant potential to have overlap between cervicogenic, tension, and common migraine headaches.

It was Vernon’s opinion that this description by Sjaastad et al. of cervicogenic headache was too narrow, restricting the diagnosis and treatment of the complaint. In order to support this, Vernon⁵⁸ conducted a complete literature review of clinical studies that investigated the effect of spinal manipulation and the investigative methods used by the practitioners of spinal manipulation in the treatment of headaches. As a result of this review, Vernon asserted that headache of cervicogenic origin may have broad manifestations including bilaterality, and with or without occipital, suboccipital, or cervical component. According to Vernon, this means that the cervicogenic headache can manifest itself as a frontotemporal, orbital, or vertex headache that may or may not be accompanied by autonomic symptoms. Vernon concluded, then, that the narrow definition Sjaastad gave for cervicogenic headache opened the door for misdiagnosis of the headache as a tension headache, or common migraine, resulting in suboptimal treatment and medication dependency.

Partly due to criticism such as that and by request of The Cervicogenic Headache International Study Group, Sjaastad, Fredriksen, and Pfaffenrath⁵⁹ provided diagnostic criteria on cervicogenic headache on the behalf of The Cervicogenic Headache International Study

Group. They described cervicogenic headache as “a unilateral headache, but it may also be bilateral (‘unilaterality on two sides’). The duration of the solitary attack-or an exacerbation- varies, from a few hours to a few weeks. In the initial phase, the headache is not infrequently episodic; later, it frequently becomes chronic-fluctuating. Symptoms and signs referable to the neck are essential, such as reduced range of motion in the neck, mechanical precipitation of attacks or exacerbation, etc. ‘Migrainous’ symptoms, like nausea and photophobia are, when present, generally not marked. A positive response to appropriate anesthetic blockades is essential. No specific radiological abnormalities have been identified.” (p442) They further defined what constituted as the minimal requirements for the diagnosis of cervicogenic headache. These were:

- (I) Symptoms and signs of neck involvement:
 - (a) precipitation of head pain, similar to the usually occurring one:
 - (1) by neck movement and/or sustained awkward head positioning, and/or:
 - (2) by external pressure over the upper cervical or occipital region on the symptomatic side
 - (b) restriction of the range of motion (ROM) in the neck
 - (c) ipsilateral neck, shoulder, or arm pain of a rather vague nonradicular nature or, occasionally, arm pain of a radicular nature.
- (II) Confirmatory evidence by diagnostic anesthetic blockades. Point (II) is an obligatory point in scientific works.
- (III) Unilaterality of the head pain, without sideshift. For scientific work, point (III) should preferably be adhered to. (p442)

“It is considered that the combination of (I)(a)...and (II) secures (proves?) the diagnosis. Presence of the other points under (I), (1b), and (1c) utterly fortifies the diagnosis.” (p443) The authors stated that cervicogenic headache can clinically be differentiated with reasonable certainty from other headaches. They report that “it is not a ‘disease’ or ‘entity’... but a reaction pattern.” (p444) The authors did not give a specific tissue as the pain generating mechanism, however, they felt this type of headache may come from structures located in the upper, middle, or even lower cervical segments. They concluded, “Cervicogenic headache may be viewed as a sort of final common pathway for several pain-generating disorders in the neck.” (p444)

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Treatment

Treatment options required for cervicogenic headache provided by Biondi³ is a multifaceted approach. It may include the use of pharmacology, nonpharmacology, anesthetic, manipulation, and at times surgical intervention. However, the author states that medications alone will not provide substantial relief of pain in most cases. Yet, these medications may allow the patient to be more active in the rehabilitation process. Osteopathic manipulative procedures should be performed in a gradual progression starting with muscle stretching and manual cervical traction. Various osteopathic manipulation techniques include muscle energy, craniosacral, and strain/counter-strain and should be followed by a home exercise program. The author states that cervicogenic headache caused chronic headache, which is often misdiagnosed or unrecognized. Early diagnosis and therapeutic management is essential in decreasing the possible costs and social disability often associated with cervicogenic headache. He concludes that those trained in manual diagnostic skills and with the proficiency in manipulative procedures “are well equipped to identify and manage this challenging pain disorder.” (pS13)

Cervical manipulation has been demonstrated to be effective in helping headache pain. According to the American Physical Therapy Association’s (APTA) Orthopaedic Section¹⁰⁵ “manipulative techniques by licensed physical therapists in evaluation and treatment of individuals with musculoskeletal dysfunctions has always been an integral component of physical therapy practice.” Reinforcing the fact that manipulation, in all its various forms except under anesthesia, is within the scope of physical therapy practice. Manipulation implies a variety of techniques including “peripheral joint and spine mobilization, thrust, oscillations, articulations, soft tissue mobilization, myofascial release, and craniosacral techniques.” Nilsson et al.² specified that during spinal manipulation, a “high-velocity, low-amplitude thrust in a specific line of drive is given at the end point of the normal passive range of motion; this is often accompanied by an audible crack” (p. 327).

A Modified Extensive Literature Review: Cervicogenic Headache

Harper¹⁰⁷ performed a dissertation on manipulation as ascribed to manipulation. It determined the efficacy of spinal manipulation on patients with cervicogenic headache in relation to quality of life, intensity and frequency of cervicogenic headache, and articular mobility (ROM). Definition of Terms: **Manipulation:** High-velocity, low-amplitude thrust in a specific line of drive

[that] is given at the end point of the normal passive range of motion. **Cervicogenic headache:** According to the classification system devised by Sjaastad, Fredriksen, and Pfaffenrath⁵⁹. **Quality of Life:** A measure of the degree of impairment by cervicogenic headache on one’s level of participation in personal and social roles. **Articular Mobility:** Degree of passive range of motion that a joint can be moved without being symptomatic. With a specific focus placed on cervical articular mobility as demonstrated by changes in goniometric measurements of the cervical spine. **Frequency:** Rate of recurrence of the headache during the study time interval. **Intensity:** Visual analogue scale.

In order to accomplish the purpose of this study¹⁰⁷, answers to the following questions were sought through a review of current literature:

1. What manual therapy treatment options are physiotherapists using for headaches? Can manual therapy skills be utilized to identify segments in dysfunction?

Physical therapists are presently utilizing both mobilization and manipulation as manual therapy treatments options for the cervical spine.^{1,35,36,39,46,70} However, due to various reasons, most apparently due to the risk factors associated with manipulation to the upper cervical spine and an unclear understanding of a good candidate for the manipulative procedure, the manual therapy treatment of choice is mobilization instead of manipulation.^{35,36,46}

Intraexaminer passive segmental mobility testing was supported by the literature.^{25,38} However, the reliability of interexaminer testing remains an area of debate.^{38,61,63} Current research^{61,64,65} supported the reliability of interexaminer categorization of those suffering from cervical headache. Interexaminer⁶⁵ reliability was found to be reliable for those suffering from cervicogenic headache as described by Sjaastad, et al⁵⁹.

From the literature, it is clear that the reliability of interexaminer and intraexaminer mobility testing, for both physiological and accessory segmental testing, is still under debate.^{25,38,61,63,64,65} This is unfortunate, since the ability to identify limited mobility is essential to the diagnosis of cervicogenic headache and has been shown to be a reliable indicator for differential diagnosis.^{21,26,64,65} It is reasonable to say at this time, that as long as one therapist was identifying the limited spinal segment, it was a reliable method to make a differential diagnosis of cervicogenic headache.

2. What is the efficacy of spinal manipulation on patients with cervicogenic headache?

What are the short-term effects of spinal manipulation on cervicogenic headache?

What are the long-term effects of spinal manipulation on cervicogenic headache?

Presently, there is a lack of quality studies on the efficacy of cervical spine manipulation^{1,47,67,69}. Several studies^{37,40,45,49} supported manipulation as efficacious for neck pain. Manipulation^{2,5} was beneficial for those suffering from cervicogenic headache as defined by the IHS. Manipulation was more beneficial when compared to mobilization in a couple studies.^{1,70} Manipulation in conjunction with exercise was beneficial.⁶⁸ The use of manipulation combined with exercise,^{5,43,44,70} rather than each alone, had the most significant short-term and long-term benefits. Manipulation was beneficial⁷⁰ for those who met the criteria of Sjaasted, et al.⁵⁹ Thus, to ensure the most optimal outcomes over both short and long-term for those suffering from cervicogenic headache, the research supports the use of cervical manipulation, which includes mobilization and manipulation, in combination with exercise.

3. How does spinal manipulation influence the quality of life in patients suffering from cervicogenic headaches?

What is the definition for quality of life?

What is the impact of headache in society?

Quality of life is a subjective degree of well-being and stress in one's life and has been measured using a SF-36 questionnaire on those suffering from cervicogenic headache.^{31,73}

There was a negative impact on both the societal as well as the individual quality of life of those suffering from cervicogenic headache.^{31,73} Society has been impacted negatively both economically and socially from chronic headache.^{31,32}

4. How does spinal manipulation influence the intensity and frequency of cervicogenic headache?

What is the underlying pathology that leads to cervicogenic headache?

What are the advantages of spinal manipulation?

What are the risk factors associated with spinal manipulation?

There are many theories^{3,4,6,7,8,10,15} of the pathology of cervicogenic headaches. Unfortunately, there has been no objective consensus on the primary cause. Therefore,

it continues to be debated. Presently, the main idea seems to be a common pathway for afferent information culminating at the trigeminocervical nucleus as a sort of relay station.

The advantages of spinal manipulation have been shown earlier under the discussion of the efficacy of spinal manipulation. Spinal manipulation, especially in conjunction with exercise,^{5,43,44,70} has demonstrated statistical efficacy in treating headache. Manipulation has demonstrated the effect of decreasing medication usage and headache intensity and frequency.^{1,2,37,71} Working on the upper thoracic segments⁴⁰ as well as cervical segments^{1,5,2,37,43,44,70} has also been shown as beneficial for Cervicogenic headache. Spinal manipulation, especially in conjunction with exercise,^{5,43,44,70} has demonstrated statistical efficacy in treating headache. One article⁵¹ advised the use of mobilization techniques instead of manipulation techniques because of the potential risk factors associated with such procedures. Spinal manipulations may not need to be specifically performed to get the desired effect; the desired effect may get the same benefit from non-specific manipulations. However, The use of non-specific manipulation may be applicable to the thoracic spine;^{41,79} yet, the application of non-specific manipulation performed to the upper cervical spine could be quite disastrous to the patient, even deadly. A more specific manipulation approach which includes segmental specificity based on individual biomechanical coupling patterns may be a more efficacious method of manual therapy

According to the literature the presence of complications from spinal manipulation varies. Critics say part of this variability is due to a lack of reporting injury incidence from manipulation. The percentage of risk for those who have spinal manipulation performed to their upper cervical spine is very low.^{51,68} [Atchison⁶⁸ Mild: 1 in 40,000; Severe (Fx, VBI) 5-10 per 10 million; Death <3 per 10 million][DiFabio⁵¹ Severe NV compromise was 1 per 50,000 to 1 per 5 million] However, risk factors associated with spinal manipulation continue to occur.^{51,52,83,84}

Vertebral artery compromise is the most common concern during the application of spinal manipulation. Multiple studies^{53,54,85,86,87,88,89,90,91,92} have evaluated various anatomical head positions as possible screening tools to be used prior to the application of spinal manipulation to aid in the identification of individuals at high risk for arterial compromise. The literature has not identified one clinical screening test as best for ruling-in or ruling-out the possibility of vertebral artery

problems to help identify those at risk from a manipulative procedure.^{51,53,54,67,,85,86,87,88,89,90,91,92, 107} The literature¹⁰⁷ indicates that there are several co-morbidities that may influence risk factors after cervical manipulation procedures. These co-morbidities may be ones that cause **abnormal blood flow** (atherosclerosis, HTN, homocysteine), or may be **predisposing factors** (*Genetic/Lifestyle* [female, advancing age, obesity, sedentary, smoker, oral contraceptives], *Pathological* [DM, lupus, sickle cell disease, previous strokes, Hx TIA's, HTN, atherosclerosis]), or may be due to **physical damage** (from a manipulative procedure itself)^{90,91,107,108,110,111}.

5. How does spinal manipulation influence articular mobility in patients with cervicogenic headache?
What is the biomechanical effect of spinal manipulation on cervicogenic headache patients?
What is the neurophysiological effect of spinal manipulation on cervicogenic headache patients?

Spinal manipulation has been shown to affect the biomechanics of articular mobility by increasing the range of motion of the cervical spine.^{93,94,95,96,97} Unfortunately, no studies were found identifying the biomechanics of spinal manipulation performed on those suffering specifically from cervicogenic headache.

Spinal manipulation has been shown to have a neurophysiological affect when applied to the spine.^{55,98,100} It appears to affect multiple systems, including joint mechanoreceptors, muscle spindles, and the dorsal horn of the spinal cord. Unfortunately, no studies were found identifying the neurophysiological effect of spinal manipulation on those suffering specifically from cervicogenic headache.

This comprehensive literature review¹⁰⁷ has provided legitimacy and a clear definition for the diagnosis of cervicogenic headache. This study¹⁰⁷ along with clarifying articles^{108,109} on specific topics have helped understanding on cervicogenic headache, vertebral artery, and manipulation when considering various treatment options for this condition. This study¹⁰⁷ has compiled the current evidence-based physical therapy knowledge base on the implementation and efficacy of spinal manipulation to the cervical spine, specifically for those suffering from cervicogenic headache. It also has exposed the importance of rigorous training of spinal manipulation, especially to the upper cervical spine, in physical therapy education.

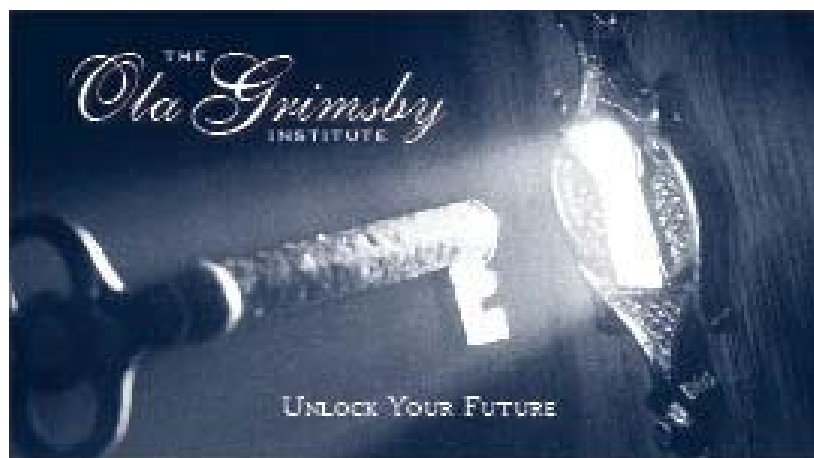
Evidence-Based Treatment for Cervicogenic Headache:

The most optimal outcomes for long term benefit from those suffering from cervicogenic headache, from the present literature¹⁰⁷, is the use of mobilization and/or manipulation in combination with exercise. This included manual therapy primarily to the upper cervical spine (OA-C3 segments) and secondarily to the upper thoracic spine (T1 to T4 segments). Exercise should accompany the manual therapy (manipulation/mobilization) with the exercises addressing the deep neck flexors, the scapular musculature (suggestive of with/without neck motion), and mobilizing exercises for the cervical and thoracic spine regions. However, here continues to be a need for quality, randomized clinical trials to support evidence-based treatment.

Parting Thoughts: Importance of Quality Training in Manual Therapy

Recently, the role of spinal manipulation has reached a more prominent level of interest in the realm of physical therapy. The Guide to Physical Therapy has clearly defined manipulation as within the scope of practice of physical therapy. The Manipulation Education Manual (MEM)¹⁰⁶ was developed by the Manipulation Education Committee American Physical Therapy Association (APTA) Manipulation task force in conjunction with the Education and Orthopaedic sections of the APTA, the APTA proper, and the American Academy of Orthopaedic Manual Physical Therapy (AAOMPT), with the express purpose of supporting evidence-based information concerning thrust manipulation. MEM would like to see manual therapy, both non-thrust and thrust mobilization/manipulation, taught in professional degree physical therapy education programs in the United States, with respect to the restrictions of existing state law(s) on what can be academically and/or clinically taught. MEM recognizes the lack of information regarding spinal manipulation, especially related to the cervical spine or any specific cervical diagnosis.

The most obvious implication of this risk factors review is the necessity of increasing the competency of therapists employing such manipulative procedures. This includes the manual dexterity of the therapist as well as his or her knowledge of any contraindications, information upon which the decision to manipulate or not to manipulate rests. It is apparent the essential components in the successful implementation of spinal manipulation are the knowledge and understanding of its indications and



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contraindications. Knowledge of when manipulation is indicated and when contraindicated is the key. True competency encompasses this understanding, in addition to the knowledge of manipulative techniques.^{51,83,84} If MEM¹⁰⁶ is promoting consumer safety and professional competency, it seems only reasonable to introduce manipulation at the entry-level education model and let various APTA/AAOMPT credentialed residencies and fellowship programs teach physical therapists spinal manipulation.

It is essential that entry-level physical therapy programs instruct students in both the indications and contraindications of manipulative therapy, in addition to any limited introduction of the techniques. Because of the extensive training and potential risk factors associated with spinal manipulation, especially upper cervical spine manipulation, individuals practicing the techniques should be certified through post-graduate residency or fellowship programs.

References

- Hurwitz EL, Aker PD, Adams AH, Meeker WC, Shekelle PG. Manipulation and mobilization of the cervical spine: a systematic review of the literature. *Spine*. 1996;15:1746-1760.
- Nilsson N, Christensen HW, Hartvigsen J. The effect of spinal manipulation in the treatment of cervicogenic headache. *J Manipulative Physiol Ther*. 1997;20:326-330.
- Biondi DM. Cervicogenic headache: mechanisms, evaluation, and treatment strategies. *JAOA*. 2000;100(suppl):S7-S14.
- Alix ME, Bates DK. A proposed etiology of cervicogenic headache: The neurophysiologic basis and anatomic relationship between the dura mater and the rectus posterior capitis minor muscle. *J Manipulative Physiol Ther*. 1999;22:534-539.
- Beeton K, Jull G. Effectiveness of manipulative physiotherapy in the management of cervicogenic headache: A single case study. *Physiotherapy*. 1997;80:417-423.
- Grieve GP. *Common Vertebral Joint Problems*. New York: Churchill Livingstone Inc; 1981.
- Cailliet R. *Head and Face Pain Syndromes*. 1st ed. Philadelphia: F. A. Davis Company; 1992.
- Friedmann MH, Nelson AJ. Head and neck pain review: Traditional and new perspectives. *J Orthop Sports Phys Ther*. 1996;24:286-278.
- Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Headache Classification Committee of the International Headache Society. *Cephalalgia*. 1988;8(suppl 7):1-96. Cited by: Biondi DM. Cervicogenic headache: mechanisms, evaluation, and treatment strategies. *JAOA*. 2000;100(suppl):S7-S14.
- Jaeger B. Are "cervicogenic" headaches due to myofascial pain and cervical spine dysfunction? *Cephalalgia*. 1989;9:157-164.
- Sjaastad O, Saunte C, Hovdal H, Breivik H, Grønbaek E. "Cervicogenic" headache. An hypothesis. *Cephalalgia*. 1983;3:249-256. Cited by: Jaeger B. Are "cervicogenic" headaches due to myofascial pain and cervical spine dysfunction? *Cephalalgia*. 1989;9:157-164.
- Fredriksen TA, Hovdal H, Sjaastad O. "Cervicogenic headache": clinical manifestations. *Cephalalgia*. 1987;7:147-160. Cited by: Jaeger B. Are "cervicogenic" headaches due to myofascial pain and cervical spine dysfunction? *Cephalalgia*. 1989;9:157-164.
- Sjaastad O, Fredriksen TA, Stolt-Nielsen A. Cervicogenic headache, C₂ rhizopathy, and occipital neuralgia: a connection? *Cephalalgia*. 1986;6:189-195. Cited by: Jaeger B. Are "cervicogenic" headaches due to myofascial pain and cervical spine dysfunction? *Cephalalgia*. 1989;9:157-164.
- Sjaastad O, Fredriksen TA, Pfaffenrath V. Cervicogenic headache: Diagnostic criteria. *Headache*. 1998;38:442-445. Cited by: Biondi DM. Cervicogenic headache: mechanisms, evaluation, and treatment strategies. *JAOA*. 2000;100(suppl):S7-S14.
- Sizer PS, Jr, Phelps V, Brismee J. Diagnosis and management of cervicogenic headache and local cervical syndrome with multiple pain generators. *The Journal of Manual & Manipulative Therapy*, 2002;10:136-152.
- Nicholson GG, Gaston J. Cervical headache. *J Orthop Sports Phys Ther*. 2001;31:184-193.
- Bogduk N. Cervical causes of headache and dizziness. In: Boyling JD, Palastanga N, eds. *Grieve's Modern Manual Therapy*. 2nd ed. New York, NY: Churchill Livingstone Inc; 1994;587-606. Cited by: Nicholson GG, Gaston J. Cervical headache. *J Orthop Sports Phys Ther*. 2001;31:184-193.
- Slater H, Bulter DS, Shaclock MO. The dynamic central nervous system: examination and assessment using tension tests. In: Boyling JD, Palastanga N, eds. *Grieve's Modern Manual Therapy*. 2nd ed. New York, NY: Churchill Livingstone Inc; 1994;587-606. Cited by: Nicholson GG, Gaston J. Cervical headache. *J Orthop Sports Phys Ther*. 2001;31:184-193.
- Edeling J. *Manual Therapy for Chronic Headache*. London, England: Butterworth-Heinemann; 1988. Cited by: Nicholson GG, Gaston J. Cervical headache. *J Orthop Sports Phys Ther*. 2001;31:184-193.
- Turk Z, Ratkolb O. Mobilization of the cervical spine and chronic headaches. *Manual Med*. 1987;3:15-17. Cited by: Nicholson GG, Gaston J. Cervical headache. *J Orthop Sports Phys Ther*. 2001;31:184-193.
- Zwart JA. Neck mobility in different headache disorders. *Headache*. 1997;37:6-11.
- Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Headache Classification Committee of the International Headache Society. *Cephalalgia*. 1988;8(suppl 7):1-96. Cited by: Zwart JA. Neck mobility in different headache disorders. *Headache*. 1997;37:6-11.
- Sjaastad, O., Fredriksen, T. A., Pfaffenrath, V. (1998). Cervicogenic headache: Diagnostic criteria. *Headache*, 38, 442-445. Cited by: Zwart JA. Neck mobility in different headache disorders. *Headache*. 1997;37:6-11.
- Merskey H, Bogduk N, eds. *Classification of Chronic Pain*. Seattle, Wash: IASP Press; 1994. Cited by: Zwart JA. Neck mobility in different headache disorders. *Headache*. 1997;37:6-11.
- Jull G, Bogduk, N, Marsland A. The accuracy of manual diagnosis for cervical zygapophysial joint pain syndromes. *The Medical Journal of Australia*. 1988;147:233-236.
- Jull G. Management of cervical headache. *Manual Therapy*. 1997;2:182-190.
- Vernon H, Moir SA. The Neck Disability Index: a study of reliability and validity. *J Manipulative Physiol Ther*. 1991;14:409-415. Cited by: Jull G. Management of cervical headache. *Manual Therapy*. 1997;2:182-190.
- Leak AM, Cooper J, Dyer S, Williams KA, Turner-Stokes L, Frank AO. The Northwick Park neck pain questionnaire, devised to measure neck pain and disability. *British Journal of Rheumatology*. 1994;33:469-474. Cited by: Jull G. Management of cervical headache. *Manual Therapy*. 1997;2:182-190.
- Scher AI, Stewart WF, Liberman J, Lipton RB. Prevalence of frequent headache in a population sample. *Headache*. 1998;38:497-506. he in a population sample. *Headache*. 1998;38:497-506.

30. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Headache Classification Committee of the International Headache Society. *Cephalalgia*. 1988;8(suppl 7):1-96. Cited by: Scher AI, Stewart WF, Liberman J, Lipton RB. Prevalence of frequent headache in a population sample. *Headache*. 1998;38:497-506.
31. Cavallini A, Miceli G, Bussone G, Rossi F, Nappi G. Headache and quality of life. *Headache*. 1995;35:29-35.
32. Passchier J, de Boo M, Quak HZA, Brienen JA. Health-related quality of life of chronic headache patients is predicted by the emotional component of their pain. *Headache*. 1996;36:556-560.
33. Nilsson N. The prevalence of cervicogenic headache in a random population sample of 20-59 year olds. *Spine*. 1995;20:1884-1888.
34. Jay G, Brunson J, Branson SJ. The effectiveness of physical therapy in the treatment of chronic daily headaches. *Headache*. 1989;29:156-162.
35. Grant T, Niere, K. Techniques used by manipulative physiotherapists in the management of headaches. *Australian Journal of Physiotherapy*. 2000;46:215-222.
36. Hurley L, Yardley K, Gross, AR, Gendry L, McLaughlin L. A survey to examine attitudes and patterns of practice of physiotherapists who perform cervical spine manipulation. *Manual Therapy*. 2002;7:10-18.
37. Niere K, Robinson P. Determination of manipulative physiotherapy treatment outcome in headache patients. *Manual Therapy*. 1997;2:199-205.
38. Smedmark V, Wallin M, Arvidsson I. Inter-examiner reliability in assessing passive intervertebral motion of the cervical spine. *Manual Therapy*. 2000;5:97-101.
39. Michaelis J. A comparison of mobilization and manipulation on muscle inhibition – an electromyographic study. *Scientific Physical Therapy*. 1992;3(1):1,8-15.
40. Vitti JA, Paris SV. The use of upper thoracic manipulation in a patient with headache. *The Journal of Manual & Manipulative Therapy*. 2000;8:25-28.
41. Schoensee SK, Jensen G, Nicholson G, Gossman M, Katholi C. The effect of mobilization on cervical headaches. *J Orthop Sports Phys Ther*. 1995;21:184-196.
42. Bove G, Nilsson N. Spinal manipulation in the treatment of episodic tension-type headache. *JAMA*. 1998;280:1576-1579.
43. Bronfort G, Evans R, Nelson B, Aker PD, Goldsmith CH, and Vernon H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain. *Spine*. 2001;26:788-799.
44. Evans R, Bronfort G, Nelson B, Goldsmith CH. Two-year follow-up of a randomized clinical trial of spinal manipulation: types of exercise for patients with chronic neck pain. *Spine*. 2002;27:2383-2389.
45. Giles LGF, Müller R. Chronic spinal pain syndromes: a clinical pilot trial comparing acupuncture, a nonsteroidal anti-inflammatory drug, and spinal manipulation. *J Manipulative Physiol Ther*. 1999;22:376-381.
46. Jull G. Use of high and low velocity cervical manipulative therapy procedures by Australian manipulative physiotherapists. *Australian Journal of Physiotherapy*. 2002;48:189-193.
47. Bronfort G, Assendelft WJJ, Evans R, Haas M, Bouter L. Efficacy of spinal manipulation for chronic headache: a systematic review. *J Manipulative Physiol Ther*. 2001;24:457-466.
48. Whittingham W, Ellis WB, Molyneux TP. The effect of manipulation (Toggle Recoil Technique) for headaches with upper cervical joint dysfunction: a pilot study. *J Manipulative Physiol Ther*. 1994;17:369-375.
49. Sjaastad O, Saunte C, Hovdal H, Breivik H, Grønbaek E. "Cervicogenic" headache. An hypothesis. *Cephalalgia*. 1983;3:249-256. Cited by: Whittingham W, Ellis WB, Molyneux TP. The effect of manipulation (Toggle Recoil Technique) for headaches with upper cervical joint dysfunction: a pilot study. *J Manipulative Physiol Ther*. 1994;17:369-375.
50. Nilsson N. A randomized controlled trial of the effect of spinal manipulation in the treatment of cervicogenic headache. *J Manipulative Physiol Ther*, 1995;18:435-440.
51. Di Fabio RP. Manipulation of the cervical spine: risk and benefits. *Physical Therapy*. 1999;79:50-65.
52. Senstad O, Leboeuf-Yde C, Borchgrevink C. Frequency and characteristics of side effects of spinal manipulative therapy. *Spine*. 1997;22:435-441.
53. Licht PB, Christensen HW, and Heilund-Carlsen PF. Is there a role for premanipulative testing before cervical manipulation? *J Manipulative Physiol Ther*. 2000;23:175-179.
54. Zaina C, Grant R, Johnson C, Dansie B, Taylor J, Spyropolous P. The effect of cervical rotation of blood flow in the contralateral vertebral artery. *Manual Therapy*. 2003;8:103-109.
55. Evans DW. Mechanisms and effects of spinal high-velocity low-amplitude thrust manipulation: previous theories. *J Manipulative Physiol Ther*. 2002;25:251-262.
56. Shekelle PG. Spinal manipulation. *Spine*. 1994;19:858-861. Cited by: Evans DW. Mechanisms and effects of spinal high-velocity low-amplitude thrust manipulation: previous theories. *J Manipulative Physiol Ther*. 2002;25:251-262.
57. *Compendium of Manual Therapy Practice and Legislative Issues*. La Crosse, WI:Orthopaedic Section, APTA; 1998.
58. Vernon HT. Spinal manipulation and headaches of cervical origin. *J Manipulative Physiol Ther*. 1989;12:455-468.
59. Sjaastad O, Fredriksen TA, Pfaffenrath V. Cervicogenic headache: Diagnostic criteria. *Headache*. 1998;38:442-445.
60. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Headache Classification Committee of the International Headache Society. *Cephalalgia*. 1988;8(suppl 7):1-96. Cited by: Alix ME, Bates DK. A proposed etiology of cervicogenic headache: The neurophysiologic basis and anatomic relationship between the dura mater and the rectus posterior capitis minor muscle. *J Manipulative Physiol Ther*. 1999;22:534-539.
61. Fjellner A, Bexander C, Faleij R, Stender LE. Interexaminer reliability in physical examination of the cervical spine. *J Manipulative Physiol Ther*. 1999;22:511-516.
62. Kaltenborn FM *Manuell mobilisering av ryggraden*. Oslo:Olaf Norlis Bokhandel; 1989. Cited by: Fjellner A, Bexander C, Faleij R, Stender LE. Interexaminer reliability in physical examination of the cervical spine. *J Manipulative Physiol Ther*. 1999;22:511-516.
63. Pool JJ, Hoving JL, de Vat HC, van Mameren H, Bouter LB. The interexaminer reproducibility of physical examination of the cervical spine. *J Manipulative Physiol Ther*. 2004;27:84-90.
64. Hanten WP, Olson SL, Ludwig GM. Reliability of manual mobility testing of the upper cervical spine in subjects with cervicogenic headache. *The Journal of Manual & Manipulative Therapy*. 2002;10:76-82.
65. van Suijlekom JA, van den Berg SGM, Weber WEJ. Interobserver reliability of diagnostic criteria for cervicogenic headache. *Cephalalgia*. 1999;19:817-823.

66. Korthals-de Bos IBC, Hoving JL, van Tulder MW, Rutten-van Mólken MPMH, Adèr HJ, de Vet HCW, Koes BW, Vondeling H, Bouter LM, Müllner M. Cost effectiveness of physiotherapy, manual therapy, and general practitioner care for neck pain: economic evaluation alongside a randomised controlled trial. *BMJ*. 2003;326:911-914.
67. Ernst E. Chiropractic spinal manipulation for neck pain: A systematic review. *The J of Pain*. 2003;4:417-421.
68. Atchison JW. Manipulation efficacy: Upper body. *J of Back and Musculoskeletal Rehab*. 2000;15:3-15.
69. Astin JA, Ernst E. The effectiveness of spinal manipulation for the treatment of headache disorders: A systematic review of randomized clinical trials. *Cephalalgia*. 2002;22:617-623.
70. Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, Emberson J, Marschner I, Richardson C. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. *Spine*. 2002;27:1835-1843.
71. Sjaastad O, Fredriksen TA, Pfaffenrath V. Cervicogenic headache: Diagnostic criteria. *Headache*. 1998;38:442-445. Cited by: Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, Emberson J, Marschner I, Richardson C. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. *Spine*. 2002;27:1835-1843.
72. International Headache Committee on clinical Trials. Guidelines for trials of drug treatment in tension-type headache. *Cephalalgia*. 1995;15:165-179. Cited by: Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, Emberson J, Marschner I, Richardson C. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache. *Spine*. 2002;27:1835-1843.
73. van Suijlekom HA, Lame I, Stomp-van den Berg SGM, Kessels AGH, Weber WEJ. Quality of life of patients with cervicogenic headache: A comparison with control subjects and patients with migraine or tension-type headache. *Headache*. 2003;43:1034-1041.
74. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. Headache Classification Committee of the International Headache Society. *Cephalalgia*. 1988;8(suppl 7):1-96. Cited by: van Suijlekom HA, Lame I, Stomp-van den Berg SGM, Kessels AGH, Weber WEJ. Quality of life of patients with cervicogenic headache: A comparison with control subjects and patients with migraine or tension-type headache. *Headache*. 2003;43:1034-1041.
75. Sjaastad, O., Fredriksen, T. A., & Pfaffenrath, V. (1998). Cervicogenic headache: Diagnostic criteria. *Headache*, 38, 442-445. Cited by: van Suijlekom HA, Lame I, Stomp-van den Berg SGM, Kessels AGH, Weber WEJ. Quality of life of patients with cervicogenic headache: A comparison with control subjects and patients with migraine or tension-type headache. *Headache*. 2003;43:1034-1041.
76. Nilsson N, Bove G. Evidence that tension-type headache and cervicogenic headache are distinct disorders. *J Manipulative Physiol Ther*. 2000;23:288-289.
77. Pfaffenrath V, Kaube H. Diagnostics of cervicogenic headache. *Functional Neurology*. 1990;5:159-164.
78. Niere KR. Pain descriptors used by headache patients presenting for physiotherapy. *Physiotherapy*. 2002;88:409-416.
79. Herzog W, Kats M, Symons B. The effective forces transmitted by high-speed, low-amplitude thoracic manipulation. *Spine*. 2001;26:2105-2111.
80. Laban MM, Taylor RS. Manipulation: An objective analysis of the literature. *Orthopedic Clinics of North Amer*. 1992;23:451-459.
81. Ottenbacher K, Difabro RP. Efficacy of spinal manipulation/mobilization therapy. A meta-analysis. *Spine*. 1985;10:833. Cited by: Laban MM, Taylor RS. Manipulation: An objective analysis of the literature. *Orthopedic Clinics of North Amer*. 1992;23:451-459.
82. Vernon H, Steiman I, Crnec M, et al: Letter to the editor. *Spine*. 1986;11:973. Cited by: Laban MM, Taylor RS. Manipulation: An objective analysis of the literature. *Orthopedic Clinics of North Amer*. 1992;23:451-459.
83. Ernst E. Manipulation of the cervical spine: A systematic review of case reports of serious adverse events, 1995-2001. *The Medical J of Australia*. 2002;176:376-380.
84. Cagnie B, Vinck E, Beernaert A, and Cambier D. How common are side effects of spinal manipulation and can these side effects be predicted? *Man Ther*. 2004;9:151-156.
85. Kerry R. Pre-manipulative procedures for the cervical spine: New guidelines and a time for dialectics: Knowledge, risks, evidence and consent. *Physiotherapy*. 2002;88:417-420.
86. Arnold C, Bourassa R, Langer T, Stoneham G. Doppler studies evaluating the effect of a physical therapy screening protocol on vertebral artery blood flow. *Manual Ther*. 2004;9:13-21.
87. Symons BP, Leonard T, Herzog W. Internal forces sustained by the vertebral artery during spinal manipulative therapy. *J of Manipulative and Physiol Ther*. 2002;25:504-510.
88. Licht PB, Christensen HW, Høilund-Carlson PF. Carotid artery blood flow during premanipulative testing. *J of Manipulative and Physiol Ther*. 2002;25:568-572.
89. Licht PB, Christensen HW, Høilund-Carlson PF. Is cervical spinal manipulation dangerous? *J of Manipulative and Physiol Ther*. 2003;26:48-52.
90. Rosner R. Spontaneous cervical artery dissections and implications for homocysteine. *J of Manipulative and Physiol Ther*. 2004;27:124-132.
91. Symons BP, Westaway M. Virchow's triad and spinal manipulative therapy of the cervical spine. *J Can Chiropr Assoc*. 2001;45:225-231.
92. Haynes MJ. Vertebral arteries and cervical movement: Doppler ultrasound velocimetry for screening before manipulation. *J of Manipulative and Physiol Ther*. 2002;25:556-567.
93. Nansel DD, Cremata E, Carlson J, Szlazak M. Effect of unilateral spinal adjustment on goniometrically-assessed cervical lateral-flexion end-range asymmetries in otherwise asymptomatic subjects. *J of Manipulative and Physiol Ther*. 1989;12419-427.
94. Cassidy JD, Lopes AA, Yong-Hing K. The immediate effect of manipulation versus mobilization on pain and range of motion in the cervical spine: A randomized controlled trial. *J of Manipulative and Physiol Ther*. 1992;15:570-575.
95. Whittingham W, Nilsson N. Active range of motion in the cervical spine increases after spinal manipulation (toggle recoil). *J of Manipulative and Physiol Ther*. 2001;24:552-555.
96. Pikula JR. The effect of spinal manipulative therapy (SMT) on pain reduction and range of motion in patients with acute unilateral neck pain: A pilot study. *J Can Chiropr Assoc*. 1999;43:111-119.
97. Nilsson N, Christensen HW, Hartvigsen J. Lasting changes in passive range of motion after spinal manipulation: A randomized, blind, controlled trial. *J of Manipulative and Physiol Ther*. 1996;19:165-168.
98. Sterling M, Jull, G. Wright A. Cervical mobilization: Concurrent effects on pain, sympathetic nervous system activity and motor activity. *Manual Ther*. 2001;6:72-81.
99. Rowlan M, Tozer T. clinical pharmacokinetics: Concepts and applications. *J of Manipulative and Physiol Ther*. 1997;20:80-85. Cited in: Sterling M, Jull, G. Wright A. Cervical mobilization: Concurrent effects on pain, sympathetic nervous system activity and motor activity. *Manual Ther*. 2001;6:72-81.
100. Pickar JG. Neurophysiological effects of spinal manipulation. *The Spine J*. 2002;2:357-371.

101. Jordan A, Bendix T, Nielsen H, Hansen FR, Host D, Winkel A. Intensive training, physiotherapy, or manipulation for patients with chronic neck pain. A prospective, single-blinded, randomized clinical trial. *Spine*. 1998;23:311-318. Cited by: Atchison JW. Manipulation efficacy: Upper body. *J of Back and Musculoskeletal Rehab*. 2000;15:3-15.
102. Maitland G. *Vertebral Manipulation*. 5th ed. Butterworth, London; 1986. Cited by: Beeton K, Jull G. Effectiveness of manipulative physiotherapy in the management of cervicogenic headache: A single case study. *Physiotherapy*. 1997;80:417-423.
103. Richardson C, Jull G, Comerford M. *Stabilizer, new dimensions in muscle control and stabilization*. Tutorial video. Australia: Chattanooga Pty Ltd; 1992. Cited by: Beeton K, Jull G. Effectiveness of manipulative physiotherapy in the management of cervicogenic headache: A single case study. *Physiotherapy*. 1997;80:417-423.
104. Sjaastad O, Fredriksen TA, Pfaffenrath V. Cervicogenic headache: Diagnostic criteria. *Headache*. 1990;30:725-726. Cited by: Niere KR. Pain descriptors used by headache patients presenting for physiotherapy. *Physiotherapy*. 2002;88:409-416.
105. *Guide to Physical Therapist Practice*. Revised 2nd ed. Alexandria, VA: American Physical Therapy Association; 2003.
106. Manipulation Education Committee: APTA Manipulation Task Force. *Manipulation Education Manual For Physical Therapist Professional Degree Programs*. Alexandria, VA: American Physical Therapy Association; 2004.
107. Harper, BA. *Cervical Spine Manipulation for the Treatment of Cervicogenic Headache: A Modified Extensive Literature Review* [doctoral dissertation]. San Diego, CA: Ola Grimsby Institute; 2005.
108. Harper, BA. Evidence-Based Medicine for Manipulation and Vertebral Artery Concerns. *Scientific Physical Therapy*. 2006;15(1):3-7.
109. Harper, BA. Evidence-Based Medicine for the Treatment of Cervicogenic Headache and Whiplash Associated Disorders. *Scientific Physical Therapy*. 2006;15(2):4-10.
110. Childs JD, Flynn TW, Fritz JM, et al. Screening for vertebral artery insufficiency in patients with neck pain: manual therapy decision-making in the presence of uncertainty. *J Orthop Sports Phys Ther*. 2005;35:300-306.
111. Asavasopon S, Jankosk J, and Godges J. Clinical diagnosis of vertebral artery insufficiency: Resident's case problem. *JOSPT*. 2005;35:645-650.

Function of the Upper and Lower Subscapularis Muscle and its Possible Indication for Rehabilitation

By

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Summary

The subscapularis muscle is one of the four rotator cuff muscles that because of its size and position, plays an important role in providing dynamic stability to the glenohumeral joint. Shoulder internal rotation is frequently used to exercise the subscapularis muscle during rehabilitation for rotator cuff pathology and/or shoulder instability. Controversy exists however, about the role of the two separate parts that make up the subscapularis muscle during active resisted shoulder internal rotation.

The following article review discusses the importance of the subscapularis muscle and its two different parts in normal and abnormal shoulders during various activities. Differences in subscapularis recruitment when selecting various options for rehabilitation exercises for shoulder internal rotation, are being discussed. A hypothesis for the controversy in research data is given and a new exercise for shoulder internal rotation is briefly described. Recommendations for further research are identified.

Function of the Subscapularis Muscle in Normal and Abnormal Shoulders

The subscapularis muscle has traditionally been considered

to perform internal rotation of the shoulder. However, the main function of the subscapularis muscle is to assist in depression of the humeral head of the humerus in the glenohumeral joint during abduction of the shoulder and to counteract the superiorly directed shearing forces of the deltoid and supraspinatus muscle. This concept is not new and was first described by Inman et al. in 1944 [1]. A second force couple exists between the subscapularis and the posterior rotator cuff muscles (the infraspinatus and the teres minor muscles) in the transverse plane, providing anterior-posterior stability to the glenohumeral joint as well (Lo et al., 2003[2], David et al., 2000[3]).

A recent review of the muscle architecture of the four rotator cuff muscles of the shoulder in cadavers revealed that the subscapularis has the greatest force-producing capacity. It also contributed passive tension at maximum abduction and external rotation, indicating that it plays a critical role in glenohumeral stability in the position of apprehension (Ward et al., 2006)[4].

EMG investigations of several sports-specific activities in normal shoulders have shown marked recruitment of the subscapularis muscle throughout the activity. In the

subscapularis muscle throughout the activity. In normal healthy shoulders, the rotator cuff muscles and the biceps muscle were found to be active prior to initiation of the deltoid and pectoralis muscle during isokinetic internal and external rotation, indicating a non-specific pre-setting phase enhancing stability of the shoulder (David et al., 2000)[3]. Even scapulothoracic shoulder movements with the arm immobilized in a shoulder immobilizer against the trunk with the hand placed against the stomach, showed fairly high activity (40-63% MVC) of the upper subscapularis muscle as measured by fine-wire electromyography in normal shoulders (Smith et al., 2006)[5]. These findings made the authors conclude that scapulothoracic movements after a subscapularis tendon repair should be considered unsafe in the acute phase of rehabilitation following surgery.

EMG studies on patients with known shoulder instability show a suppressed co-activation of the rotator cuff muscles during perturbation in the apprehension position (Myers et al., 2004)[6]. In addition, Glousman et al. (1988)[7] reported decreased subscapularis, pectoralis major, latissimus dorsi, and serratus anterior activity during the late cocking and acceleration phases of pitching in throwers with instability.

Different patterns of muscle activation in the subscapularis muscle between symptomatic and asymptomatic patients with rotator cuff tears in the supraspinatus and infraspinatus tendons have been demonstrated by Kelly et al. (2005)[8]. All subjects had an intact subscapularis tendon and all subjects had a trend toward increased general muscle activation during functional tasks compared to normal subjects. However, they found increased firing of the subscapularis in asymptomatic subjects compared to symptomatic shoulders during functional activities such as elevating an 8 pound weight. In their study, symptomatic subjects continued to depend on torn rotator cuff tendons and periscapular muscle substitution, resulting in impaired function. Hess et al. (2005)[9] also showed a slower onset of subscapularis EMG activity during a rapid shoulder external rotation movement in throwers with painful shoulders compared to throwers without symptoms of pain.

Activity of the Upper and Lower Subscapularis Muscle

The subscapularis muscle is innervated by two or more distinct nerves. A difference in EMG activity has been shown between the upper and lower portions of the muscle in various positions of the shoulder and with various activities during rehabilitation.

When comparing the upper and lower portion of the subscapularis muscle by using fine-wire EMG during sagittal flexion, abduction in the coronal plane, and abduction in the scapular plane (scaption), O'Donnell et al. (2006)[10] recorded earlier and higher levels of activation in the upper portion of the subscapularis muscle compared to the lower portion. They explained the early onset of upper subscapularis muscle activity as a pre-setting role for this muscle to enhance glenohumeral congruity prior to elevation. They also suggested that the higher levels of activation of the upper subscapularis may be important in providing abduction torque, while the lower subscapularis muscle may be performing more a tonic stabilizing role.

Decker et al.(2003)[11] found similar findings when testing for subscapularis (fine-wire) EMG activity during seven different rehabilitation exercises, using elastic resistance during 6 of the 7 exercises. The upper subscapularis was found to have higher average amplitudes of EMG activity and higher peak amplitude EMG activity for six of the seven exercises (forward punch, internal rotation high (90° abduction), internal rotation mid (45° abduction), dynamic hug, diagonal, and the push-up plus) when compared to the lower subscapularis muscle. Internal rotation against elastic resistance at 0° of humeral abduction with the arm unsupported showed similar EMG values for the lower subscapularis muscle compared to the upper subscapularis muscle.

These results are in contradiction with earlier research performed by Kadaba et al. (1992)[12]. They showed that during internal rotation against isometric resistance, EMG activity in the upper subscapularis either remained the same or decreased in going from 0 to 90° abduction. EMG activity of the lower subscapularis muscle increased when going from 0 to 90° abduction. In a description of their testing protocol, Kadada et al. ignored to mention if the shoulder was in a supported or unsupported position, although they do mention that two of the six healthy subjects were tested on a Cybex II. We could therefore assume that this was done in a supported position.

Hypothesis

When tested in a supported position, the stabilizing force couple on the glenohumeral joint from the subscapularis that counteracts the abduction force of the deltoid and

supraspinatus muscles, may not be as predominant as when the shoulder is tested in an unsupported position. Therefore, a difference in muscle recruitment of the two different parts of the subscapularis muscles may exist, depending on the amount of support placed on the upper extremity during rehabilitation when exercising the subscapularis muscle for internal rotation in various positions of the shoulder. If this is true, this can have consequences for shoulder rehabilitation when treating rotator cuff pathology and/or glenohumeral instability by exercising the shoulder for internal rotation. By selecting different levels of upper extremity support in various positions of the shoulder, the clinician can have a choice of either placing emphasis on tonic stabilization or enhancing activity of the subscapularis to counteract the abduction force from the deltoid muscle.

The following clinical examples give a more detailed explanation on how to apply and compare the research performed by Decker et al.[11] and Kadaba et al.[12].



Figure 1A

Shoulder internal rotation in neutral (low) position with the arm in 0° abduction: elbow unsupported (fig 1A) and elbow supported (fig1B).



Figure 1B

Decker's study [11] suggests that internal rotation at 0° abduction with the elbow unsupported (fig. 1A) elicits moderate-to-marked upper and lower subscapularis muscle activity. According to Kadaba et al.[12], internal rotation with the elbow supported at 0° abduction (fig. 1B) stimulates predominantly the upper subscapularis muscle.

Internal rotation with the shoulder supported at 90° abduction (fig. 2) shows increased EMG activity of the lower subscapularis muscle in this position, according to Kadaba et al.[12].



Figure 2: Shoulder internal rotation high position at 90° abduction with the elbow supported.

Shoulder internal rotation with the arm unsupported in 90° abduction (figure 3A and 3B) facilitates the upper subscapularis muscle (Decker et al., 2003)[11].



Fig. 3A



Fig. 3B

Figure 3. Shoulder internal rotation high position with the elbow unsupported: 3A. Beginning position. 3B. End position.

A modified version of shoulder internal rotation high position is shown in figure 4A and 4B, where the distal humerus is supported by a sling strap attached to a pulley resistance. The sling strap with pulley resistance in this way assists the shoulder in supporting the weight of the upper extremity. This modification could make it easier for the patient to progress from a supported to an unsupported position. EMG activity of the upper and lower subscapularis muscles for this particular exercise has not been tested.



Fig. 4A



Fig. 4B

Figure 4. Shoulder internal rotation at 90° with the elbow semi-supported using a sling strap with pulley weight: 4A. Beginning position. 4B. End position.

Conclusion

The subscapularis muscle functions as an internal rotator of the shoulder. However, its main function is during its activity as a shoulder abductor, anterior stabilizer, and humeral head depressor. The subscapularis muscle is innervated by two or more distinct nerves and two independent muscle units can therefore be identified. The two parts of the subscapularis muscle have been shown to function differently during normal shoulder flexion, abduction, scaption, as well as during various positions of the shoulder when performing active internal rotation.

When targeting the subscapularis muscle by performing exercises for shoulder internal rotation during rehabilitation for shoulder pathology, the clinician should take into consideration that various positions of the shoulder and variations in upper extremity support can have consequences for the differences in activity level of the upper and lower portions of the subscapularis muscle.

Further research to determine the importance of upper arm support in different positions of the shoulder when targeting different parts of the subscapularis muscle during exercises for shoulder internal rotation, is recommended.

References:

1. Inman VT, Saunders JB, Abbott LC. Observations on the function of the shoulder joint. *J Bone Joint Surgery* 1944; 26: 1-30.
2. Lo, IKY, Burkhart SS: Current concepts in arthroscopic rotator cuff repair. *Am J Sports Med* 2003 (31) 2: 308-323.
3. David G, Magarey ME, Jones MA, Dvir Z, Türker KS, Sharpe M. EMG and strength correlations of selected shoulder muscles during rotation of the glenohumeral joint. *Clinical Biomechanics* 2000; 15: 95-102.
4. Ward SR, Hentzen ER, Smallwood LH, Eastlack RK, Burns KA, Fithian DC, Friden J, Lieber RL. Rotator cuff musculature. *Clinical Orthop and Related Res* 2006; 448: 157-163.
5. Smith J, Dahm DL, Kaufman KR, Boon AJ, Laskowski ER, Kotajarvi BR, Jacofsky DL: Electromyography in the immobilized shoulder girdle during scapulothoracic exercises. *Arch Phys Med Rehabil.* 2006 Jul; 87 (7): 923-927.
6. Myers JB, Ju Y, Hwang J, McMahon PJ, Rodosky MW, Lephart SM. Reflexive muscle activation alterations in shoulders with anterior instability. *Am J Sports Med* 2004; 32 (4): 1013-1020.
7. Glousman RE, Jobe FW, Tibone J, et al. Dynamic electromyographic analysis of the throwing shoulder with glenohumeral instability. *J Bone Joint Surg* 1988; 70A: 220-226.

8. Kelly BT, Williams RJ, Cordasco FA, Backus SI, Otis JC, Weiland DE, Altchek DW, Craig EV, Wickiewicz TL, Warren RF: Differential patterns of muscle activation in patients with symptomatic and asymptomatic rotator cuff tears. J Shoulder Elbow Surg 2005; 14 (2): 165-171.
9. Hess SA, Richardson C, Darnell R, Friis P, Lisle D, Myers P: Timing of rotator cuff activation during shoulder external rotation in throwers with and without pain. J. Orthop Sports Phys Ther 2005; 35 (12): 812-820.
10. O'Donnell NE, Cowan J, Christopher T: An investigation in the upper and lower portions of the subscapularis muscle during normal shoulder motion. Physiother Res Int. 2006 Sep; 11(3): 148-151.
11. Decker MJ, Tokish JM, Ellis HB, Torry MR, Hawkins RJ. Subscapularis muscle activity during selected rehabilitation exercises. Am J Sports Med. 2003; 31 (1): 126-134.
12. Kadaba MP, Cole A, Wootten ME, McCann P, Reid M, Mulford G, April E, Bigliani L. Intramuscular wire electromyography of the subscapularis. Journal Orthop Res 1992 (10): 394-397.

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