

# Subluxation, Headaches, and Cervicogenic Vertigo

## INTRODUCTION

It has been estimated that each year, 50 million headache sufferers make 50 million office visits to U. S. health care physicians. Headaches result in approximately 150 million workdays being lost each year, with a cost to business of \$57 billion annually in lost productivity and medical expenses.<sup>1,2</sup> The point prevalence of headaches as a whole ranges from about 15–20%<sup>3,4</sup> or more in the general population. Prevalence indicates the number of instances of a given condition in a given population at a designated time. The prevalence rates depend on whether they refer to the measure of a condition in a population at a given time (point prevalence), at any time during a specified period (period prevalence), or at any time in a lifetime (lifetime prevalence). Incidence is the number of new occurrences of a condition in a population over a specified period.

Based on medical criteria, cervicogenic headaches represent about 15–20% or more<sup>4-7</sup> of all types of cephalgia. The 1-year prevalence of tension-type (TT) headaches (>1/month) is 20–30%, with about 3% of the population suffering from chronic ( $\geq$  180 days/year) TT headaches. One population-based study has shown that regular activities were limited during 38% of TT headache attacks, and 4% of subjects' attendance at work was affected. Relationships with family and friends were affected in 89% of respondents.<sup>8</sup> The medical management of these headaches consists of various medications and trigger point injections in certain cases. These treatments are conducted after other serious etiologies, such as brain tumors, are ruled out. The medical approach is usually directed toward treatment of the symptoms as opposed to a possible cervicogenic cause.

It has only been since the 1980s that the medical profession has begun to recognize the existence of cervicogenic headaches. Chiropractors, however, have been helping patients with headaches for more than 100 years. This chapter will reveal the role of the doctor of chiropractic in the management of cephalgia. The anatomy and physiology pertaining to the likely etiology of cervicogenic headaches and correlations between cervical biomechanical dysfunctions and headaches are also covered. Controlled and uncontrolled trials involving chiropractic care and its efficacy for headaches are reviewed. This chapter challenges the notion that most headaches stem from a lack of drugs in the blood stream.

## REFERENCES

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## Headache Neurology

### ► Bogduk N. The Cervical-Cranial Connection. *J Manipulative Physiol Ther*, 1992; 15(1):67–70.

**ABSTRACT** The neuroanatomical basis for cervicogenic headache is a convergence in the trigeminocervical nucleus between nociceptive afferents from the field of the trigeminal nerve and the receptive field of the first three cervical nerves. Only structures innervated by C1–C3 have been shown to be capable of causing headache. These are the muscles, joints, and ligaments of the upper three cervical segments, but also include the dura mater of the spinal cord and posterior cranial fossa and the vertebral artery. ■

The trigeminocervical nucleus can be defined as those cells in the upper three cervical segments that receive both a trigeminal and a cervical peripheral input (Figure 1). As such, the trigeminocervical nucleus is the essential nociceptive nucleus of the upper neck, head and throat. Whatever the actual innervation of structures in this region, noxious stimuli from them will be mediated by the trigeminocervical nucleus.

In the absence of any other sensory information, second-order nociceptive neurons in the trigeminocervical nucleus that receive both a trigeminal and a cervical input have no means of determining whether they are activated by trigeminal or by cervical afferents. Consequently, if a neuron that is accustomed to a trigeminal input happens to receive a noxious input from an unaccustomed cervical source, the nociceptive information is relayed to the thalamus; however, the actual source of the information is am-

biguous, whereupon the brain, relying on familiarity with the more accustomed input, interprets the pain as arising from the trigeminal field and not from the neck.

The C1–C3 ventral rami supply the atlanto-occipital and lateral atlantoaxial joints, the prevertebral muscles and the trapezius and sternocleidomastoid (1).

The C1–C3 sinuvertebral nerves enter the vertebral canal and supply the median atlantoaxial joint and its ligaments and the dura mater of the spinal cord. They continue through the foramen magnum to innervate the dura mater over the clivus (2).

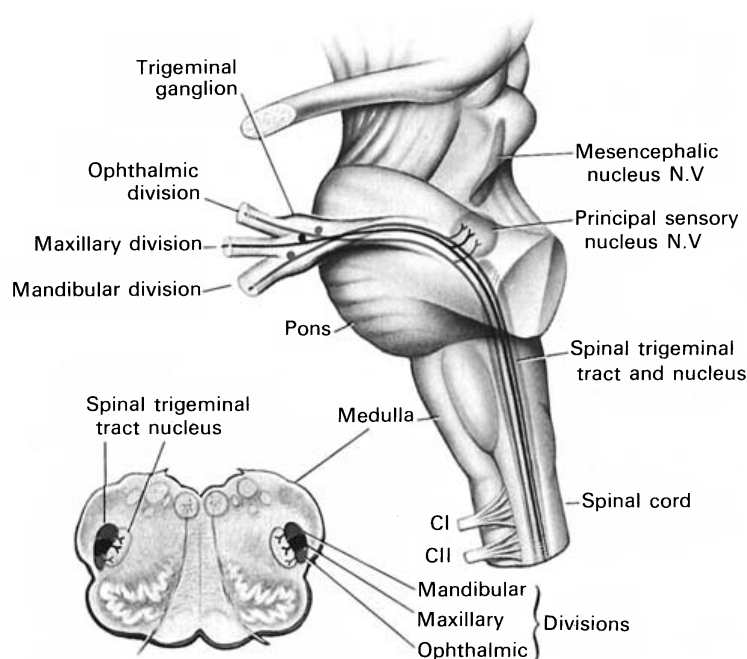
The lateral atlantoaxial joints have not been stimulated experimentally in normal volunteers, but headaches have been relieved by anesthetizing the lateral atlantoaxial joints (6).

The pain of cervicogenic headache can be similar to the pain of migraine, tension headache or that of intercranial lesions.

Recent interest has focused on the detection of functional disturbances of the upper cervical joints, manifest by displacement of the instantaneous axis of rotation for that segment (9). Radiographic biomechanics promises to be a means of objectively verifying abnormal motion, but its sensitivity and specificity have yet to be determined.

There is the prospect, however, that a large proportion of patients otherwise diagnosed as suffering from tension headache may, in fact, be suffering from cervicogenic headache.

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► **FIGURE 8–1** Topographical arrangement of the fibers in the spinal trigeminal tract. The laminar arrangement of fibers from the different divisions of the trigeminal nerve persists throughout its length, although fibers leave the tract at all levels to terminate upon adjacent cells of the spinal trigeminal nucleus.

► **Pfaffenrath V, Dandekar R, Pollmann W. Cervicogenic Headache—The Clinical Picture, Radiological Findings and Hypotheses on its Pathophysiology. *Headache*, 1987; 27(9):495–499.**

*In contrast to the migrainous visual disturbances, the ipsilateral monocular visual disturbances with associated blurring might indicate an accommodation disorder: the pathological input of impulses from the cervical posterior roots via the ascending spinotegmental and spino-mesencephalic tracts possibly affects the parasympathetic connections between the Edinger-Westphal nuclei and the ciliary muscles.<sup>16</sup>*

*The accompanying dizziness reported by 6 of the 15 patients might be due to the fact that the dorsal cervical muscles are part of the proprioceptive system. The cervical muscles are interconnected with the vestibular nuclei by the spino-vestibular tract and with the nuclei of the extraocular muscles by the medial longitudinal fasciculi. Therefore, an excessive unilateral input of impulses from the cervical muscles might provoke an unsteady gate with concomitant dizziness.<sup>17</sup>*

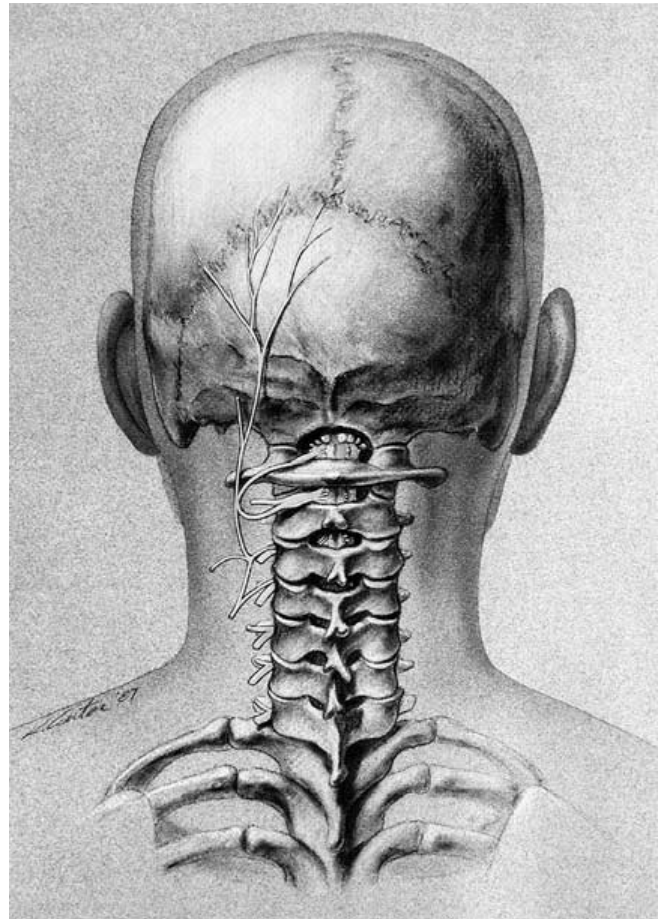
*During severe CEH attacks some patients have also difficulties in swallowing and a feeling of a “lump in the throat,”<sup>18</sup> resembling the “neck-tongue-syndrome” described by Lance and Anthony.<sup>18</sup> These symptoms can be attributed to anatomical connections between C2, the hypoglossal nerve and the vagus nerve as well as between the pharyngeal plexus and the cervical roots.<sup>19</sup>*

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► **Bovim G, Sand T. Cervicogenic Headache, Migraine Without Aura and Tension-Type Headache. Diagnostic Blockade of Greater Occipital and Supra-Orbital Nerves. *Pain*, 1992; 51(1):43–48.**

**ABSTRACT** *The diagnostic value of greater occipital and supra-orbital nerve blockades in patients with cervicogenic headache, migraine without aura, and tension-type headache was investigated. The pain reduction after greater occipital nerve blockade was significantly more marked in the cervicogenic headache group than in the other categories. Moreover, pain reduction in the forehead was generally only found in the cervicogenic headache patients (77%). Pain reduction (in %) was significantly more marked following the greater occipital than the supra-orbital nerve blockade. The volume effect per se was evaluated by saline injection. This procedure did not result in distinct pain reduction. The effect obtained in cervicogenic headache is, accordingly, probably due to the local anaesthesia. The present results support the postulate that different pathogenetic factors probably are responsible for cervicogenic headache, tension-type headache, and migraine without aura. ■*

*According to the present pathogenetic model for cervicogenic headache, pain in the forehead may be*



► **FIGURE 8–2** Relationship between greater occipital nerve and upper cervical spine.

*caused by painful stimuli being transferred from the neck/posterior part of the head (mainly by the C1–C3 nerves).*

*In the brainstem, nerve fibres have a very intimate relationship to the caudal part of the spinal trigeminal nucleus. Cortical interpretation of the impulses stemming from the posterior parts may, therefore, be a pain in the area of the ophthalmic division of the trigeminal nerve (in the following referred to as the “Kerr principle”) (Kerr 1961).*

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► **Barnsley L, Lord S, Bogduk N. Whiplash Injury. *Pain*, 1994; 58(3):283–307.**

*Pain from the lateral atlanto-axial joint is also perceived in the occipital or sub-occipital region (McCormick 1987) and would appear to be clinically indistinguishable from C2–3 zygapophysial joint pain.*

*A recent study (Lord et al. 1994) employing double-blind, controlled, diagnostic blocks of the C2–3 zygapophysial joints found that referred pain from this joint occurred in 27% of 100 consecutive patients with chronic pain after whiplash; and amongst those patients in whom headache was the dominant pain complaint, referred*

pain from the C2–3 joint was the basis of their headache in 53% of cases.

More subtle disturbances of balance and equilibrium may result from interference with postural reflexes that have cervical afferents (De Jong and Bles 1986). Anaesthetising the neck muscles of animals and humans results in ataxia and/or nystagmus (Biernand and De Jong 1969; Igarashi et al, 1969, 1972; De Jong et al, 1977; Bogduk 1981), indicating that important proprioceptive information arises from these structures. It is conceivable that disturbance of this output may result from pain or spasm following damage to these muscles, or related structures. Such a proposition is further supported by experimental work on 44 patients with whiplash injury (Hinoki and Niki 1975). In this study, deep cervical muscle tone, as measured by EMG, was increased by the administration of isoproterenol, a  $\beta$ -sympathetic agonist. Vestibular function deteriorated and symptoms worsened in 8 of 13 patients. Conversely, when propranolol, a  $\beta$ -sympathetic blocker, was administered, cervical muscle tone decreased, vestibular function and symptoms of vertigo improved.

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► **Lord SM, Bogduk N. The Cervical Synovial Joints as Sources of Post-Traumatic Headache. *J Musculoskeletal Pain*, 1996; 4(4):81–94.**

The cervical zygapophysial joints are innervated by articular branches which arise from the medial branches of the cervical dorsal rami [Figure 1, 2] (11,12). The C2–3 zygapophysial joint is innervated by the superficial medial branch of the C3 dorsal ramus which is large and is known as the third occipital nerve (13). Beyond the C2–C3 zygapophysial joint, the third occipital nerve furnishes muscle branches to the semispinalis capitis and becomes cutaneous over the suboccipital region. In this respect the C3 dorsal ramus is the only cervical dorsal ramus below C2 that regularly has a cutaneous distribution. The C3–4 to C7–T1 zygapophysial joints have a dual innervation derived from the deep medial branches of the cervical dorsal rami immediately above and below the joint. Beyond the zygapophysial joints the medial branches of the cervical dorsal rami supply the semispinalis and multifidus muscles. Those from C4 to C8 typically lack any cutaneous branches (13).

Experimental studies in normal volunteers have clearly shown that the cervical synovial joints can be a source of local pain and referred pain to the head. Distension of these joints with injections of contrast medium produces patterns of pain that are reasonably characteristic of the segment being stimulated (17–19) [Figure 4]. In particular, stimulation of the atlanto-occipital joints, the lateral atlanto-axial joints and the C2–C3 zygapophysial joints produced pain that was referred to various regions of the head.

Clinical studies have shown that certain patients with headache can be relieved of their pain by blocking cervical synovial joints with local anesthetic (19–36). Patients with painful atlanto-occipital and atlanto-axial joints have had their pain relieved by intra-articular (29,32,37,38) or periarticular (32) injections of local anesthetic. Patients with pain stemming from the cervical zygapophysial joints have had their headache relieved either by anesthetizing the joint with intra-articular injections of local anesthetic (20–22,24–28) or by blocking the medial branches of the dorsal rami that supply the painful joint (19,23,25,28).

However, intra-articular blocks are disadvantageous in that they are technically demanding and time consuming, and patients risk significant procedural pain, allergy to contrast medium and septic arthritis. In less experienced hands, patients might also risk technical misadventure with damage to neural or vascular tissue.

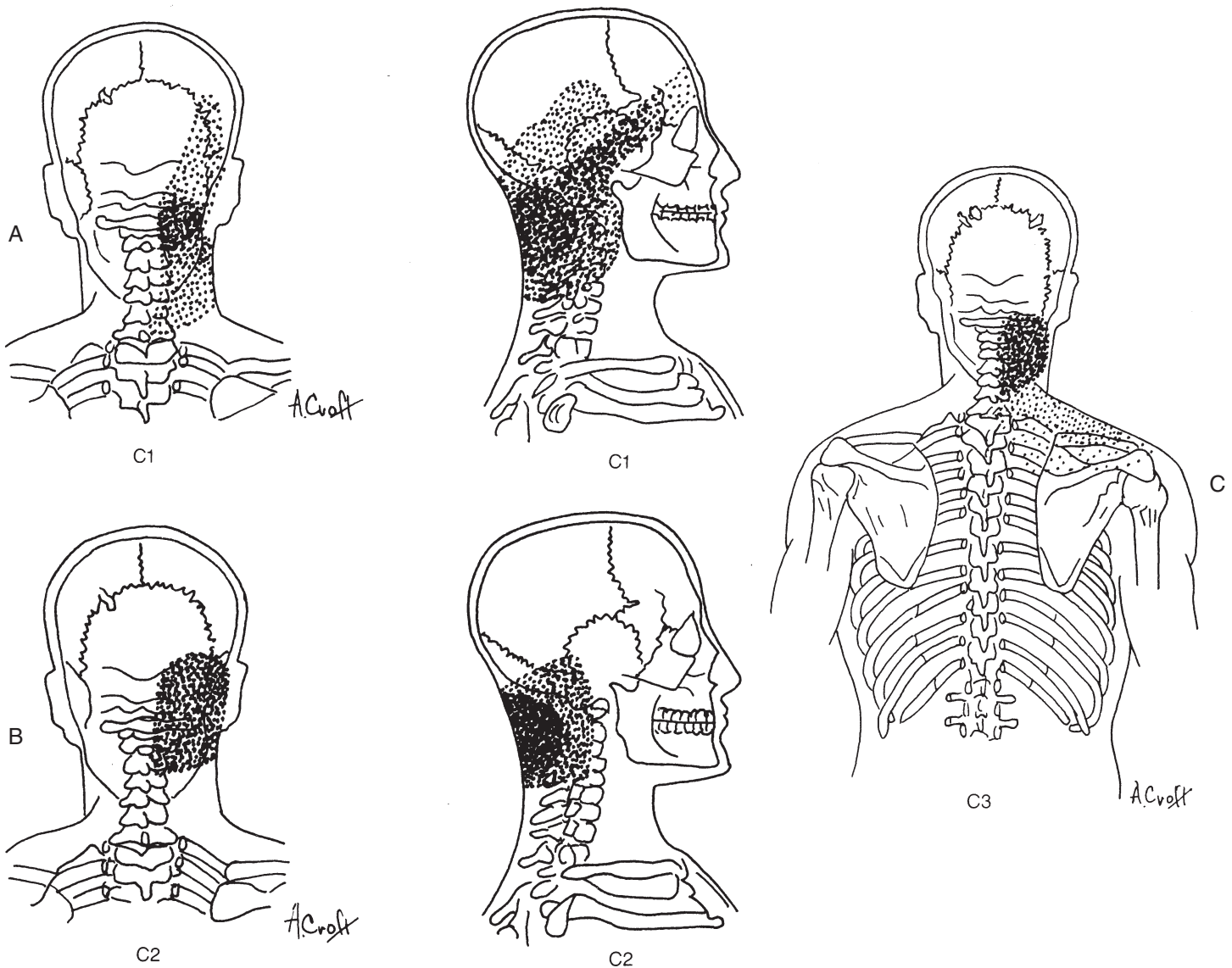
A series of 71 consecutive patients with post-traumatic headache was studied using randomized, double-blind, comparative local anesthetic blocks. Of the 55 patients who completed investigation, 27 had their headache relieved by blocks of the C2–3 zygapophysial joint. This constitutes a prevalence of 49% with a 95% confidence interval of 36% to 62%. The prevalence of headache referred from lower cervical zygapophysial joints was smaller but not insignificant. Seven percent had headache from C3–4, 4% from C4–5, 13% from C5–6 and 2% had headache that was relieved by blocks of the C6–7 zygapophysial joint.

It may be that the atlanto-occipital or atlanto-axial joints are the source of pain in the other 29% but this hypothesis remains to be explored.

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► **Angus-Leppan H, Lambert GA, Michalick J. Convergence of Occipital Nerve and Superior Sagittal Sinus Input in the Cervical Spinal Cord of the Cat. *Cephalalgia*, 1997; 17(6):625–630.**

**ABSTRACT** Co-existence of facial and occipital pain may occur in occipital neuralgia, migraine and cluster headache; suggesting convergence of trigeminal and cervical afferents. Such convergence has been shown in humans and other animals, but the site and extent of this are uncertain. In anaesthetized adult cats, the superior sagittal sinus and occipital nerve were stimulated electrically, and extracellular recordings made in the dorsolateral area of the upper cervical cord using glass-coated tungsten electrodes. Of 49 units in 10 cats, 33 (67%) had input from the superior sagittal sinus and the occipital nerve. Thirteen (27%) had superior sagittal sinus input and 3 (6%) had occipital nerve input. Convergent receptive fields were identified mechanically in 7 units. These experiments in cats show convergent input from occipital nerve and superior sagittal sinus on dorsolateral area units in two-thirds of cases studied. This experimental site



► **FIGURE 8-3** Patterns of pain seen after interspinal injection of 6% saline solution into 140 normal volunteers as described by Feinstein. More darkly shaded areas represent the more frequently localized areas of pain. **A.** C1 distribution. **B.** C2 distribution. **C.** C3 distribution.

of trigeminocervical convergence may relate to referral of pain in occipital neuralgia and other headaches. ■

Cross synapses between trigeminal and cervical primary afferent fibres in the upper cervical spinal cord have been suggested in the cat (6,7) and in man (8). In conscious humans, stimulation of cranial arteries and dura mater caused occipital and cervical pain (9, 10). Electrical stimulation of the first (3) or the second (11) cervical root during surgery caused periorbital pain. Cervicogenic headache often involves pain in the neck radiating to the frontal area, and may respond to blockade of the C2 roots, the facet joints and the occipital nerve (12). Certain unilateral headaches may be relieved by C2-3 rhizotomies, decompression, avulsions or blockade of the greater occipital nerve (11-17).

Neurons in the upper cervical cord, as well as the trigeminal nucleus caudalis, respond to cranial vessel

stimulation, which is trigeminally mediated (18-21). In the dorsolateral area (DLA) of the cord, which contains the lateral cervical nucleus (LCN), neurones are activated by stimulation of cranial blood vessels such as the superior sagittal sinus (SSS). These neurones receive convergent input from facial receptive fields (RFs), and many are nociceptive (20). There is convergence of afferent fibres from SSS, tooth pulp and skin in the area (22).

Head pain may be associated with limb pain, for example in migraine (31,32). Referred limb pain was seen in 1-2% of patients with migraine, similar to the incidence of hemiplegic migraine (31, 32). The convergence of trigeminal, cervical and cutaneous input in the DLA provides a possible mechanism for these clinical observations.

- **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(8):534–539.**

➤ **Editorial Comment**

This paper explores the clinical significance of Hack's connective tissue bridge (Chapter 3, pages 88-92). Vernon's four categories for classifying etiological mechanisms of cervicogenic headaches were reviewed as follows:

- *Extrasegmental* refers to cervical ligaments and myofascial structures.
- *Intersegmental* refers to the cervical articulations, ligaments, and deep intersegmental muscles of the upper cervical spine.
- *Infrasegmental* deals with the nerve supply of the cervical intervertebral foramina.
- *Intrasegmental* deals with the spinal cord and medullary dorsal horn, including the trigeminocervical nucleus.

Comments were made about the extreme sensitivity of the spinal dura and how adverse tension from cervical joint dysfunctions could cause cervicogenic headaches.

- **Frazer WJ. Severe Headache—Diagnosis and Treatment. *Digest Chiropr Economics*, 1989; 31(5):20–21.**

*This is the classic subluxation recognized by John Grostic, Sr.—the atlas, skull complex subluxation (the ASC subluxation).*

*First, in the event of a chronic upper cervical subluxation, there is an increase in neuronal stimulation coming from the torqued meninges. The stress messages flooding the central nervous system increase the operating level of those structures, and this increases the need of these structures for metabolic oxygen in the central apparatus. Classically, the response of the brain to an increased demand for oxygen is to dilate the cranial arteries.*

*Second, along with the increased demand for oxygen-carrying blood, there is a biophysical crimping of the arterial pathway. This has a limiting effect on blood transport due to crimping of the intertransverse spinal arteries at the cervical subluxation. Occlusive pressure then hydraulically reduces the available blood flow to the circle of Willis, and thus to the intracranial arterial structures.*

*Examination of the patient's posterior neck with the neurocalometer or nervoscope will establish the existence or not of the ASC subluxation.*

*To date, I have found only one procedure that consistently creates an improvement. This is the Grostic pro-*

*cedure for adjusting the upper cervical ASC subluxation. Other procedures such as master cervical, atlas rotary, and Palmer toggle have produced inconsistent results.*

*For my own satisfaction I have also prechecked my equations by applying kinesiologic challenge. In 99 percent of cases, this provided the confirmation that would contribute to the correction of the ASC subluxation.*

*Then the patient would be adjusted following Dr. Grostic's equations. Subsequently, the patient should be rechecked with the nervoscope. Correction will have removed the "S" curve.*

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- **Seletz E. Whiplash Injuries. *JAMA*, 1958; 168(13):1750–1755.**

➤ **Editorial Comment**

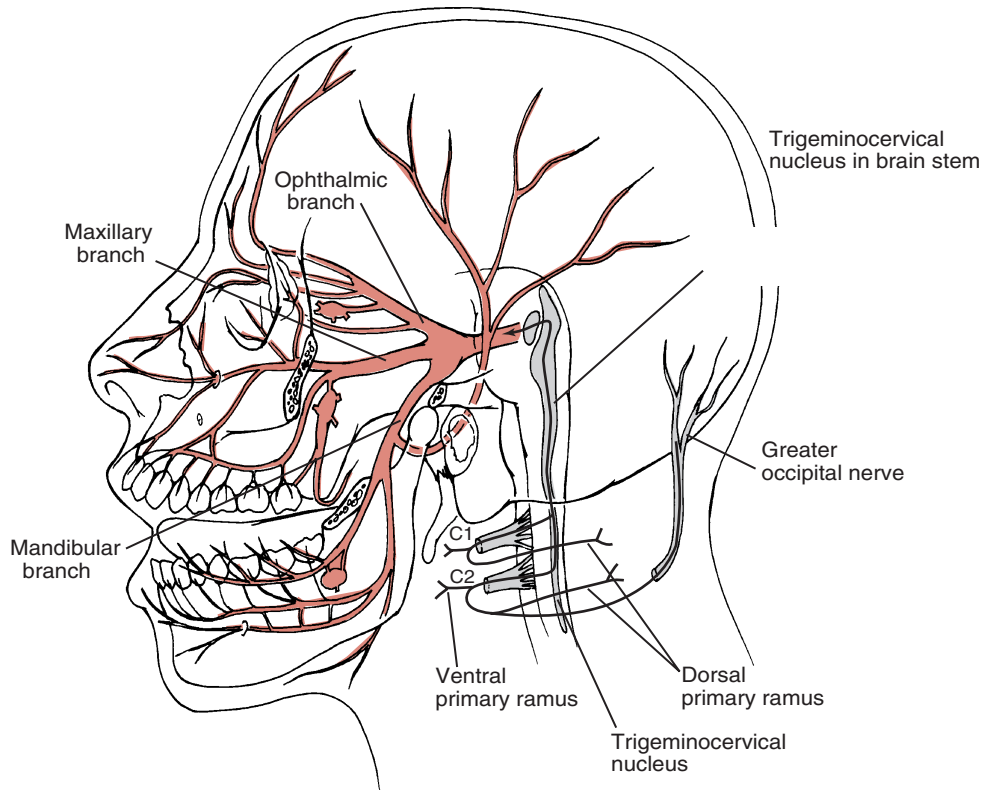
The author discusses how most headaches related to whiplash are from an injury to the C2 nerve root. He points out that the vulnerability of the C2 nerve root is due to the fact that there are no pedicles or facet joints in the region. Its point of exit between C1-C2 is also the area of greatest rotation of the head and neck. The author notes that C2 nerve root irritation is most likely to be interpreted as arising from the ophthalmic field of the trigeminal nerve. This gives the patient the feeling of hemicrania, with pain radiating behind the corresponding eye. Seletz gives a neurological explanation similar to the trigeminocervical nucleus afferent-efferent dysfunction that is discussed by Bogduk and others. He states that many "*headaches are not headaches at all, but really a pain in the neck.*"

Seletz also discusses the vulnerability of the vertebral artery in the upper cervical spine and how this can be injured in a whiplash. He relates the following symptoms to disturbed blood flow in the vertebral artery: vertigo, ataxia, diplopia, migraine-like headaches, hemicrania with nausea and vomiting, disturbed speech and swallowing, and unsteadiness of gait.

Trigeminocervical nucleus dysfunction is one of the most plausible explanations for the neuroanatomical basis of cervicogenic headaches projecting to the facial region. The trigeminocervical nucleus (TCN), or trigeminal spinal tract, descends down through the C3 region of the spinal cord. The TCN is not a nucleus in the classical sense; as Bogduk states, "*...it is not distinguished by a distinct cytoarchitecture or any other intrinsic morphological features. Rather, its rostral and caudal limits are defined by the common distribution of primary afferent terminals of the trigeminal and cervical nerves.*" This group of gray matter receives nociceptive afferents from all three branches (ophthalmic, maxillary, and mandibular) of the trigeminal nerve and from the sensory roots of C1-C3 (Fig. 8-4). Nociceptive upper cervical afferent input will synapse with second-order nociceptive neurons in the TCN. These second-order

neurons also receive noxious input from trigeminal afferents coming from the face, head, teeth, mouth, and scalp. When cervical afferent input is relayed to the thalamus, a neurological “fumble” can occur. This convergence phenomenon can result in nociceptive signals being sent to the wrong area of the cerebral cortex. Instead of feeling the pain in the neck exclusively, it is expressed in the trigeminal fields. Upper cervical noci-

ceptive input can arise from an occipito-atlanto-axial subluxation and from pain-sensitive structures such as apophyseal and synovial joints, disc annulus fibrosus, spinal ligaments, vertebral body periosteum, suboccipital muscles and their attachments, C1–C3 nerve roots and dorsal nerve root ganglions, and the vertebral arteries.



▶ **FIGURE 8-4** The trigemincervical nucleus, its relationship to the anterior and posterior primary cervical afferents, and the three divisions of the trigeminal nerve.

## Cervical Joint Dysfunction and Headaches

- ▶ **Ng SY. Upper Cervical Vertebrae and Occipital Headache. *J Manipulative Physiol Ther*, 1980; 3(3):137.**

**ABSTRACT** . . . Twenty-six X rays of patients who suffered from occipital headache were compared statistically to twenty-five sets of X rays of patients who have no cranial and/or cervical symptoms with regard to cervical curvature, anteroposterior, lateral and rotational disposition of the upper cervical vertebrae. Results show that C1 and 3 show significantly greater degree of lateral inclination in the symptomatic group, suggesting that there is a definite degree of association between abnormal upper

cervical statics and occipital headache. (abstract abridged) ■

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- ▶ **Jirout J. Comments Regarding the Diagnosis and Treatment of Dysfunctions in the C2-C3 Segment. *Man Med*, 1985; 2:16–17.**

### ▶ **Editorial Comment**

Jirout found that aberrant rotation of C2-C3 is related to headaches.

- **Pfaffenrath V, Dandekar R, Mayer ET, Hermann G, Pollmann W. Cervicogenic Headache: Results of Computer-Based Measurements of Cervical Spine Mobility in 15 Patients. *Cephalalgia*, 1988; 8(1):45–48.**

➤ **Editorial Comment**

A computer-based radiological assessment of flexion and extension views was used to examine 15 cervicogenic headache patients and 18 controls. The researchers found statistically significant hypomobility at C0–C2, with an overall impaired mobility of the C0–C5 articulations in the cervicogenic headache group. The occipito-atlantal segment was found to have the most evident hypomobility; hypermobility was evident at the C6–C7 segment. These quantitative findings did not correlate with the results of the qualitative radiological analysis.

- **Boquet J, et al. Lateralization of Headache: Possible Role of an Upper Cervical Trigger Point. *Cephalalgia*, 1989; 9(1):15–24.**

➤ **Editorial Comment**

The doctors in this study found an ipsilateral upper cervical trigger point in 21 of 24 patients with unilateral headaches. In 18 of 24 patients, the palpatory protrusion was also found during the headache-free period. The protrusion appeared to be a laterally developed C2 spinous process found during the X-ray assessment. An electromyographic study revealed latent trapezius hyper-tonicity on the same side of the headache, even during the headache-free period.

- **Jaeger B. Are “Cervicogenic” Headaches Due to Myofascial Pain and Cervical Spine Dysfunction? *Cephalalgia*, 1989; 9(3):157–164.**

➤ **Editorial Comment**

This investigation from the department of anesthesiology of UCLA School of Medicine tried to determine whether the pain from cervicogenic headaches could be due to referred symptoms from myofascial trigger points. Jaeger also looked at any correlation with cervical spine dysfunction. Eleven cervicogenic headache patients were evaluated and various trigger points and nonmyofascial tender points were found. All of the patients showed some evidence of cervical spine dysfunction. Of the 11 patients, 10 had specific segmental dysfunction of the upper cervical spine. A noninvasive interdisciplinary pain management program treated 5 patients with a goal of treating the cervical spine dysfunctions and myofascial pain. These patients reported a significant decrease in frequency and intensity of their

headaches during a 2-year follow-up. The author concluded that myofascial trigger points may play an important role in causing cervicogenic headaches and that cervical segmental dysfunction is a common finding with these patients. It was recommended that conservative care be provided before surgery.

- **Jensen OK, Justesen T, Nielsen FF, Brixen K. Functional Radiographic Examination of the Cervical Spine in Patients With Post-Traumatic Headaches. *Cephalalgia*, 1990; 10(6):295–303.**

➤ **Editorial Comment**

This Danish study found that patients with posttraumatic headaches had decreased motion primarily affecting C2–C3, C5–C6, and C6–C7 segments. The analysis of correlation with pain index revealed C1–C2 and C5–C6 (C6–C7) as the most important segments involved.

- **Sakuta M. Significance of Flexed Posture and Neck Instability as a Cause of Chronic Muscle Contraction Headache. *Rinsho Shinkeigaku*, 1990; 30(3):254–261.**

➤ **Editorial Comment**

The author examined 826 patients (572 female and 254 male) with muscle contraction headaches (MCH) with the use of electromyography (EMG) and dynamic X-ray analysis. The results showed that most MCH patients have a tendency to flex their head downward at the onset of the headache. The EMG showed continuous discharge of the posterior neck muscles as long as this posture was maintained. However, looking up usually caused the EMG discharge to subside. These findings are interesting in that the sustained cervical flexion seemed to induce the headache. Chapter 3 reveals how cervical flexion can cause stress on the spinal cord as a result of the rigid attachment of the dentate ligaments. It is possible that the connective tissue bridge of the rectus capitis posterior minor muscle (see Chapter 3, pages 88–92) may also play a role in this posturally induced headache syndrome.

- **Goldstein J. Posttraumatic Headache and the Postconcussion Syndrome. *Med Clin N Am*, 1991; 75(3):641–651.**

*Therefore, sprain of the cervical neck and exacerbation of disc disease or pre-existing spondylosis may occur, resulting in significant muscle contraction headache.*

*Straightening of the normal or lordotic curve gives credence to a diagnosis of sprain or spasm of the cervical spine, which may result in headache.*

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- **Vernon H, Steinman I, Hagino C. Cervicogenic Dysfunction in Muscle Contraction Headache and Migraine: A Descriptive Study. *J Manipulative Physiol Ther*, 1992; 15(7):418–429.**

► **Editorial Comment**

This study explored the prevalence and findings of cervicogenic dysfunction in subjects with muscle contraction and tension-type (MCH) headache and common migraine without aura (CM). The location of the headaches and the prevalence of neck (90%) and upper back pain (41%) that accompanied MCH and CM were revealed. The authors found that 77% of all subjects and 89% of females exhibited a significant reduction, absence, or reversal of the normal cervical lordosis for both headache groups. Dynamic X-ray studies revealed that 97% of all subjects exhibited at least one significant intersegmental joint restriction from C1 to C7, while 43% exhibited dysfunction at four or more segments. Flexion and extension at C0-C1 was reduced in 90% and 70% of subjects, respectively. Motion palpation revealed that 84% of CM and MCH subjects had at least two major fixations from occiput to axis. Pressure algometry revealed that 92% of CM and 85% of MCH subjects had at least one tender point (TP) in the upper cervical region. The most common locations for TPs were the C2-C3 segments and the lateral occipital and suboccipital regions. The authors concluded that the neck plays an important, underestimated role in the manifestation of adult benign headaches.

- **Nagasawa A, Sakakibara T, Takahashi A. Roentgenographic Findings of the Cervical Spine in Tension-Type Headache. *Headache*, 1993; 33(2):90–95.**

**ABSTRACT** *Roentgenographic studies were carried out on 372 patients with tension-type headache and 225 normal control subjects to determine relationships between straightened cervical spines, low-set shoulders, and cervical spine instability. A great majority of the patients with tension-type headache were found also to have straightened cervical spines. Patients with tension-type headaches may have a restricted progression of the cervical spinal lordosis, which results in a straightened cervical spine. The flexor muscles of the head and neck prevent physiological lordosis of the cervical spine and their sustained chronic contraction may be a principal cause of a straightened neck. The low-set shoulder was frequently seen in patients with tension-type headache, and it may result in traction of the brachial plexus, which gives rise to pain in the neck and shoulders. (abstract abridged) ■*

*Riley<sup>9</sup> reported that postural abnormalities, such as a flexed posture, cause increased tension in the occipitalis muscle and this results in TTH.*

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- **Meloche JP, et al. Painful Intervertebral Dysfunction: Robert Maigne's Original Contribution to Headache of Cervical Origin. *Headache*, 1993; 33(6):328–334.**

**ABSTRACT** . . . *For headache of cervical origin due to painful intervertebral dysfunction, the most frequent dysfunctional mobile segment is located at the C2-C3 level. This induces pain mostly in the posterior parts of the head and cellulalgia in the C2 and C3 dermatomes. Painful tumefaction is also found over the posterior aspects of the facet joints on palpation at this level.*

*Painful intervertebral dysfunction is very frequently found in chronic daily headaches. (abstract abridged) ■*

*An important cause of PID is trauma. The typical example is whiplash injury which frequently results in several dysfunctional vertebral cervical segments. PID also results from repeated microtrauma at work, in sleep or in sports. PID is also related to postural overload at work or to bad postures.*

*Usually, pinching and rolling the skin is not painful and it can be easy to pulled from the underlying structures (Figure 6). However, cellulalgic skin is very difficult to pinch and roll and it is very painful.*

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- **Watson DH, Trott PH. Cervical Headache: An Investigation of Natural Head Posture and Upper Cervical Flexor Muscle Performance. *Cephalalgia*, 1993; 13(4):272–284.**

**ABSTRACT** *In this study, 60 female subjects, aged between 25 and 40 years, were divided into two equal groups on the basis of absence or presence of headache. A passive accessory intervertebral mobility (PAIVM) examination was performed to confirm an upper cervical articular cause of the subjects' headache and a questionnaire was used to establish a profile of the headache population. Measurements of cranio-cervical posture and isometric strength and endurance of the upper cervical flexor muscles were compared between the two groups of subjects. The headache group was found to be significantly different from the non-headache group in respect to forward head posture (FHP) ( $t = -5.98, p < 0.00005$ ), less isometric strength ( $t = 3.43, p < 0.001$ ) and less endurance ( $t = 8.71, p < 0.0005$ ) of the upper cervical flexors. A statistically significant relationship was also established between natural head posture and isometric endurance of the upper cervical flexor musculature which demonstrated that FHP corresponded with a low endurance capacity ( $X^2 = 13.2; p < 0.01$ ). The outcome of this study highlights the need to screen for cervical etiology in patients who are suspected of suffering from common migraine. ■*

*Jull (14) found that the incidence of unilateral and bilateral headache was almost equal. This is borne out in the present study. The unilateral cervical headache rarely*

changes sides, as can occur in migraine headache (16). In this sample none of those subjects with unilateral headache reported it changing sides.

Any area of the head may be involved, but the most common areas recorded for cervical headache are frontal, retro-orbital, temporal, and occipital (14, 16–20).

Whilst an absence of upper cervical pain or neck pain does not necessarily negate a cervical cause of headache (14,21–22) a survey of 96 headache patients found that 88% reported coexistence of occipital, suboccipital or neck pain. This finding supports those of earlier authors (23–29) and is further supported by the results of this sample.

The results of Jull's (14) survey revealed that 58% of patients awoke with their headache. In the current study 50% (15) of the subjects reported headache on waking. This feature has been reported with respect to cervical headache by other authors (22,23,28,32).

According to Edeling (13) and Jull (4), a common precipitating factor is that of emotional tension, to which 45 and 32.2% of patients respectively linked the onset of their headache. In our study tension was implicated in 73.3% ( $n = 22$ ) of subjects.

Martin (34), after reviewing the literature on tension headache, concluded that the inconsistency of results reported by different authors showed that there was no simple direct relationship between contraction of scalp muscles and headache. This view is supported by Bogduk (11). Indeed, studies by Martin and Matthews (35) and Anderson and Franks (36) showed no significant difference in the amplitude of electro-myographic recordings from forehead and neck muscles in patients with tension headache than in a normal controlled group. Considerable doubt then exists as to the causative role of excessive muscle contraction in tension headache (37). Therefore, there is a real possibility that tension headache is an unrecognized cervical headache, having been a convenient rather than inquiring diagnosis for chronic headache.

Authorities agree that cervical headache is commonly precipitated or aggravated by sustained neck posturing or neck movements (14,16,21,22,28,31,38). This is borne out in the present study, where 69.8% ( $n = 21$ ) of subjects related the onset to this cause. This is in accordance with the survey by Jull (14) in which 51.0% of patients associated their headache with sustained neck flexion or neck movements. Almost a third of Edeling's (13) patients related their headache to neck movement or posture.

The headache group in our study had a higher incidence of dysfunction of the upper cervical joints than the non-headache group. This is particularly important when assessing postural changes because the articular capsules of the cervical spine are highly innervated by mechanoreceptors which contribute significantly to postural and kinaesthetic sensation (39,40).

The resultant hyperactivity or shortening of the posterior cervical musculature places the occiput in exten-

sion relative to the upper cervical spine, tipping the face upwards. To maintain the horizontal position of the otic (vestibular) and bipupilar planes, the individual subconsciously flexes the lower cervical spine (relative to the thoracic spine), thus adopting a forward head posture. This conceivably results in joint dysfunction which in turn leads to abnormal afferent information affecting the tonic neck reflex and encouraging the gradual adoption of a forward head posture.

Human skeletal muscle fibres have been classified according to their characteristics. Type I of slow twitch fibres are resistant to fatigue, and their contraction rate is slow (46,47). Type II, or fast-twitch, fibres can be subdivided into IIa, IIb and IIc fibres. The type IIb fibres fatigue easily but contract quickly, whilst the IIa fibres are more resistant to fatigue than IIb (but less resistant than type I fibres) and also exhibit a rapid contraction rate. Less is known of the IIc fibres, but they appear to be an intermediate form of fast-twitch fibre and usually make up only a small percentage of total fibre populations (46–48).

Postural correction and re-education should be an integral part of both prevention and management of patients with cervical headache.

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► **Treleaven J, Jull G, Atkinson L. Cervical Musculoskeletal Dysfunction in Post-Concussional Headache. *Cephalalgia*, 1994; 14(4):273–279.**

**ABSTRACT** Persistent headache is a common symptom following a minor head injury or concussion, possibly related to simultaneous injury of structures of the cervical spine. This study measured aspects of cervical musculoskeletal function in a group of patients (12) with post-concussional headache (PCH) and in a normal control group. The PCH group was distinguished from the control group by the presence of painful upper cervical segmental joint dysfunction, less endurance in the neck flexor muscles and a higher incidence of moderately tight neck musculature. Active range of cervical motion and postural attitude were not significantly different between groups. As upper cervical joint dysfunction is a feature of cervicogenic causes of headache, the results of this study support the inclusion of a precise physical examination of the cervical region in differential diagnosis of patients suffering persistent headache following concussion. ■

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► **Pritchard D. EMG Levels in Children Who Suffer from Severe Headache. *Headache*, 1995; 35(9):554–556.**

► **Editorial Comment**

This study examined electromyographic levels in the neck and forehead muscles in a group of 12 children complaining of severe headaches. The study group was

compared to a matched group of 12 headache-free children. The results showed the children suffering with severe headaches had very tense neck muscles.

- **Aromaa M, Sillanpää ML, Rautava P, Helenius H. Childhood Headache at School Entry: A Controlled Clinical Study. *Neurology*, 1998; 50(6):1729–1736.**

#### ➤ Editorial Comment

Six-year-old Finnish children with headaches disturbing their daily activities (n = 96) and an asymptomatic group of children (n = 96) participated in this clinical trial. The results showed that young children with headaches had statistically more bruxism, tenderness in the occipital muscle insertion regions, tenderness in the temporomandibular joints, and travel sickness than the unaffected group. The authors recommended palpating occipital muscle insertions and temporomandibular joints to help improve the headache assessment of children.

- **Jull G, Barrett C, Magee R, Ho P. Further Clinical Clarification of the Muscle Dysfunction in Cervical Headache. *Cephalgia*, 1999; 19(3):179–185.**

#### ➤ Editorial Comment

A craniocervical flexion test was used to assess the contraction of the deep neck flexors in 15 subjects with cervicogenic headaches and 15 controls. The results showed a trend toward a higher frequency of abnormal responses to passive stretching of the muscles examined in the cervical headache group, but only the upper trapezius was significantly different from that of the controls. However, the deep neck flexor muscle contraction was significantly inferior in the cervical headache group. Deep neck flexor performance appears to have more potential in identifying musculoskeletal involvement in cervicogenic headaches. This deep cervical muscle dysfunction can be caused by an upper cervical subluxation.

- **Ashina M, Bendtsen L, Jensen R, Sakai F, Olesen J. Muscle Hardness in Patients with Chronic Tension-Type Headache: Relation to Actual Headache State. *Pain*, 1999; 79(2–3):201–205.**

*In addition, it has recently been reported that the pericranial muscles are significantly harder, i.e. they have a higher consistency, in patients with chronic tension-type headache than in healthy controls (Sakai et al., 1995). This finding was made possible by the development of a new instrument, a so-called hardness meter (Horikawa et al., 1993).*

*Muscle hardness has only been investigated in patients with chronic tension-type headache in one previous study (Sakai et al., 1995), which included 30 patients*

*with chronic tension-type headache and 223 healthy controls. Pericranial muscles in patients were significantly harder than in controls.*

*The most important finding in the present study was that muscle hardness recorded in patients on days with headache did not differ from hardness recorded on days without headache. This indicates that muscle hardness is permanently altered in chronic tension-type headache and that muscle hardness does not fluctuate with actual pain. The mechanisms leading to the increased muscle hardness are largely unknown. It is possible that sustained tonic contraction of muscle due to permanent dysfunction in the central nervous system (Bendtsen et al., 1996) contributes to the muscle hardness and the increased tenderness. Thus, increased muscle activity has been detected in patients with chronic tension-type headache associated with muscular disorders on days without headache (Jensen et al., 1998). However, other factors such as tissue edema or metabolic alterations due to microcirculatory disturbance may also contribute to increased tenderness and muscle hardness (Henriksson and Lindman, 1993). In addition, the increased hardness could reflect hyperexcitability of muscle fibers due to “an idiomuscular reflex” caused by the applied pressure.*

*In the present study we also found a significant correlation between the muscle hardness and the local tenderness.*

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- **Placzek JD, et al. The Influence of the Cervical Spine on Chronic Headache in Women: A Pilot Study. *J Man Manipulative Therapy*, 1999; 7(1):33–39.**

**ABSTRACT** *This study compares selected posture, mobility, strength and endurance variables in subjects with chronic headaches to the same features in asymptomatic subjects. Two convenience samples of 10 female subjects were obtained: 1) those who experience chronic headache, mean age of 34.2 years (SD = 11, range = 23–57), and 2) a group not experiencing headache, mean age of 30 years (SD = 9.6, range = 21–50). Measurements compared: 1) cervical range of motion in flexion, extension, rotation, and lateral flexion, 2) cervical strength in flexion and extension, 3) forward head posture (FHP), 4) forward shoulder posture (FSP), and 5) endurance testing of the anterior cervical musculature between the two groups.*

*Statistical analysis was completed using the Kruskal-Wallis test. The headache group was found to have significantly less cervical extension ROM ( $p < 0.05$ ) and lower strength for both the cervical flexor ( $p = 0.001$ ) and cervical extensor ( $p < 0.01$ ) muscle groups; in addition the endurance of the anterior cervical musculature was significantly decreased ( $p = 0.001$ ) as compared to*

the controls. Forward head and forward shoulder posture measurements did not differ between the two groups. ■

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- **Kovacs A. Subluxation and Deformation of the Cervical Apophyseal Joints. *Acta Radiol*, 1955; 43:1–15.**

#### ➤ Editorial Comment

Kovacs found cervical subluxations in 22 of 40 chronic headache sufferers. For 20 of these 22, anteflexion traction was found radiographically to correct the subluxations and subjectively to relieve the headaches. Kovacs also studied 54 postmortem cases, and he demonstrated chronic subluxations by radiography.

- **Lewit K. Ligament Pain and Anteflexion Headache. *Eur Neurol*, 1971; 5(6):365–378.**

#### ➤ Editorial Comment

Lewit's paper explores the issue of anteflexion headache, which is produced by flexing the head forward for long periods. He feels that stressed upper cervical ligaments cause this type of headache. The anteflexion headache is frequently found in young, hypermobile patients, and trauma is frequently found in the history of these patients. In the late 1960s, Gutmann referred to this condition as "Schulkopfschmerz," which was at one time considered a psychological condition. Gutmann has also noted that the posterior arch of atlas approaches the base of the occiput when the head is flexed. This is observed on flexion radiographs. A statement is made in reference to how a "cyphosis" in the upper cervical spine causes a cyphosis of the brain stem that results in most of the related symptoms. The author

also makes an interesting comment: "... the anteflexion of the atlas relative to the axis is compensated for by the retroflexion of the head against the atlas. This may be a protective mechanism against overstretch of the spinal cord and medulla, which are considerably stretched on anteflexion of the cervical spine." Lewit studied 41 subjects in late adolescence with anteflexion headaches and found that a significant percentage had hypermobility of the craniocervical joints. Manipulation was carried out and was successful in most cases.

- **Wackenheim A. Functional Atlanto-Occipital Block. *Neuroradiology*, 1971; 3(2):80–81.**

#### ➤ Editorial Comment

Atlanto-occipital "functional block" is a cause of headaches.

- **Lewit K. Pathomechanisms of Cervical Headaches. *Psychiatr Neurol Med Psychol (Leipz)*, 1977; 29(11):661–671.**

#### ➤ Editorial Comment

Lewit describes several dysfunctions that play a role in cervicogenic headaches. These conditions include various forms of muscle tension, postural dysfunction, pain arising from the posterior arch, and vertebral artery involvement.

These studies from the medical and chiropractic literature show a correlation between a cervical biomechanical dysfunction and headaches. The correction of this dysfunction should be given preeminence over pharmacological palliative care.

## Cervicogenic Headache

- **Sjaastad O, Saunte C, Hovdahl H, Breivik H, Grønbnæk. "Cervicogenic" Headache. An Hypothesis. *Cephalalgia*, 1983; 3(4):249–256.**

#### ➤ Editorial Comment

Sjaastad et al. discuss the following symptoms that can occur during a headache attack: slight lacrimation, conjunctival injection, runny nose, tinnitus, erythema in the forehead or temporal region, diffuse flushing, lid edema, ipsilateral blurring, and reduced vision. Severe attacks can result in "migrainous" phenomena such as nausea, loss of appetite, and vomiting. Phonophobia and photophobia occur infrequently, and some patients complain of dizziness and difficulty swallowing during sympto-

matic periods. They stated that some patients complain of intermittent ipsilateral diffuse or radiating shoulder and arm pain. The authors concluded that bilateral cases of cervicogenic headaches can occur.

- **Sjaastad O, Fredriksen TA, Stolt-Nielsen A. Cervicogenic Headache, C<sub>2</sub> Rhizopathy, and Occipital Neuralgia: A Connection? *Cephalalgia*, 1986; 6(4):189–195.**

#### ➤ Editorial Comment

These Norwegian authors discuss various headache-related issues and state that bilateral cases of cervico-