Some Research and Clinical Evidence in support of Treating Cervicogenic Headaches by Massage Therapy
Embriologically, “The head is formed from the first two cervical segments (except the mandible, which is formed by the third). The first and second cervical vertebra are also derived from these two segments. Hence, on anatomical grounds, lesions of the occipito-atlanto-axial joints may set up pain felt to spread to any part of the head.” - James Cyriax (1975).
Trigeminocervical complex

Trigeminal n. → V2 → Trigeminocervical complex → C1, C2, C3
The Trigeminocervical Complex (TCC)

“The trigeminocervical complex and migraine: current concepts and synthesis.”

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Abstract

Neurones in the trigeminocervical complex are the major relay neurones for nociceptive afferent input from the meninges and cervical structures; therefore, they are the neural substrates of head pain. This review highlights the importance of two basic mechanisms in headache physiology: convergence of nociceptive afferents and sensitization of trigeminocervical neurones. These physiologic findings have clinical correlates such as hypersensitivity and spread and referral of pain frequently seen in patients with primary headache, such as migraine. Special reference is made to the influence of structures from the upper cervical spine in generating and contributing to migraine headaches. The pathophysiology and functional relevance of these basic mechanisms to headaches is discussed in the context of recent experimental findings with regard to pain processing

The Trigeminocervical Complex (TCC)

“Migraine and the neck: new insights from basic data.”

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Abstract

The clinical presentation of pain in patients with migraine showing spread and referral of pain throughout the trigeminal and cervical innervation territories accompanied by hyperalgesia and allodynia indicates a dynamic trigemino-cervical interaction. The physiologic mechanisms may be convergence of trigemino-cervical afferents and central sensitization of trigemino-cervical neurons leading to dynamic neuroplastic changes during migraine. This review highlights the clinical phenotype and mechanisms of how nociceptive input from neck structures of the upper cervical spine are integrated into the trigemino-cervical system. The nociceptive input into the spinal cord also is subject to a modulation by segmental mechanisms in the spinal cord and by inhibitory projections from brain stem structures such as the periaqueductal gray. The functional relevance of these basic mechanisms is discussed with reference to recent studies using neurostimulation of afferent nerves aiming at pain modulation in patients with migraine.

The Trigeminocervical Complex (TCC)

“MASSAGING OVER THE GREATER OCCIPITAL NERVE REDUCES THE INTENSITY OF MIGRAINE ATTACKS” – “Evidence for inhibitory trigemino-cervical convergence mechanisms” [Elcio Juliato Piovesan1,2, Fabrizio Di Stani3, Pedro André Kowacs1, Rogério Andrade Mulinari2, Victor Hugo Radunz2, Marco Utiumi2, Eder B Muranka2, Mario Luiz Giublin1, Lineu César Werneck1,2]

ABSTRACT - Activation of the trigemino-cervical system constitutes one of the first steps in the genesis of migraine. The objective of this study was to confirm the presence of trigemino-cervical convergence mechanisms and to establish whether such mechanisms may also be of inhibitory origin. We describe a case of a 39-years-old woman suffering from episodic migraine who showed a significant improvement in her frontal headache during migraine attacks if the greater occipital nerve territory was massaged after the appearance of static mechanical allodynia (cortical sensitization). We review trigemino-cervical convergence and diffuse nociceptive inhibitory control (DNIC) mechanisms and suggest that the convergence mechanisms are not only excitatory but also inhibitory.

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Trigeminocervical complex

Trigeminal n. → V1 → V2 → V3

C1
C2
C3
“The intermingled impulses then travel up to the cortex of the brain. The cortex is unable to distinguish the precise area from which the impulses arose, so information from the C1-C3 neck structures are indiscernible from trigeminal impulses. In other words there is the classic neurologic condition of ‘referred pain.” (Rothbart 1996). The trigeminocervical nucleus incorporates the marginal zone, the substantia gelatinosa and the nucleus proprius of the grey matter of the cervical spinal cord and the homologous divisions of the trigeminal nucleus. In both the cord and the trigeminal nucleus, these areas are the main centres involved in the transmission of nociceptive information, i.e. pain. Therefore the trigeminocervical nucleus can be viewed as the nociceptive nucleus for the entire head and neck. (Bogduk Grieves).
Sympathetic Nervous System
innervation of the Head

Head and neck nerve plexuses.
Most of the sympathetic nerve supply to the head and neck is derived from the superior cervical ganglion of the sympathetic chain... Postganglionic axons of sympathetic nerves form plexuses that extend superiorly to the head and inferiorly to the neck. The plexuses give off branches to supply sweat glands in the skin, smooth muscle in skeletal and skin blood vessels, and the smooth muscle of the arrector pili. Axons from the plexuses also join branches of the trigeminal nerves (cranial nerve V) to supply the skin of the face, the salivary glands, the iris, and the ciliary muscles of the eye.

Cervical Ganglion

Internal carotid artery and nerve plexus

Superior cervical ganglion

Middle cervical ganglion

Inferior cervical ganglion
Sympathetic Nervous System

Innervation of the Head

• The superior cervical ganglion (SCG) from which the SNS provides its signals for tissues, glands and organs in the head and neck is situated in front of C2-3.

• It is deep in the sheath encircling the internal carotid artery and internal jugular vein. And is anterior to the longus capitis muscle.
The **SCG provides sympathetic innervation to:**

- Choroid plexus and the blood vessels within the cranium (i.e., smooth muscle)
- Anterior 2/3 of the dura mater
- Pineal gland
- Eyes (both for dilating pupil and for the lens)
- Vestibular system
- Tympani muscle
- Lacrimal glands, nasal glands
- Salivary glands
- Thyroid gland
- Plus, smooth muscle in the face, head and neck (blood vessels, erector pili, sweat glands...)
“Cervicogenic headache” covers a wide variety of symptoms or headache classifications.

It includes pain and other symptoms that come from a variety of sources in the neck: muscle, joint, ligament, vascular, and neurological.

The area of focus is on all of the tissues and structures that make up what we would call the upper cervical spine (Occiput-C1-2-3), the trigeminocervical complex and the trigeminal nerve (& and all that it innervates).
“The pathophysiology and source of pain in this condition have been debated… but it is believed to be referred from one or more muscular, neurogenic, osseous, articular, and vascular structures in the neck… The trigeminocervical nucleus is an area of the upper cervical spinal cord where sensory nerve fibers in the descending tract of the trigeminal nerve (trigeminal nucleus caudalis) are believed to interact with sensory fibers from the upper cervical roots. This functional convergence of upper cervical and trigeminal sensory pathways allows the bidirectional referral of painful sensations between the neck and trigeminal sensory receptive fields of the face and head.”
Cervicogenic Headache

• This classification allows us to include tension headaches, migraines, or any class of headaches that involves the neck-shoulder girdle and/or head & face as amenable to manual therapies.
TABLE 2: Clinical characteristics of cervicogenic headache

• Unilateral head or face pain without sideshift; the pain may occasionally be bilateral
• Pain localized to the occipital, frontal, temporal, or orbital regions
• Moderate-to-severe pain intensity
• Intermittent attacks of pain lasting hours to days, constant pain or constant pain with superimposed attacks of pain
• Pain is generally deep and non-throbbing in character; throbbing may occur when migraine attacks are superimposed
continued...

- Head pain is triggered by neck movement, sustained or awkward neck postures; digital pressure to the suboccipital, C2, C3, or C4 regions or over the greater occipital nerve; valsalva, cough, or sneeze might also trigger pain
- Restricted active and passive neck range of motion; neck stiffness
- Associated signs and symptoms can be similar to typical migraine accompaniments including nausea, vomiting, photophobia, phonophobia, and dizziness; others include ipsilateral blurred vision, lacrimation, and conjunctival injection or ipsilateral neck, shoulder, or arm pain

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Neurological Structures

• **Trigeminocervical Complex**
• **Suboccipital nerve** (dorsal ramus of C1) innervates the occipital-atlanto joint (O-C1)
• **C2** spinal nerve gives rise to the *greater occipital nerve* and its dorsal root ganglion innervate the atlantoaxial (C1-2) and C2-3 zygapophyseal joints.
  
  – **C2 neuralgia** is typically described as a deep or dull pain that usually radiates from the occipital to parietal, temporal, frontal, and periorbital regions.
  
  – A sharp or shock-like pain is often superimposed over the constant pain.
  
  – Ipsilateral eye lacrimation and conjunctival injection are common associated signs.
  
  – Arterial or venous compression of the C2 spinal nerve or its dorsal root ganglion have been suggested as a cause for C2 neuralgia in some cases.
Greater Occipital Nerve (C2)

Lesser Occipital Nerve (C2-3)

Third Occipital Nerve (C3)
GALEA APONEUROTICA

OCCIPITAL BELLY (OCCIPITALIS) OF EPICRANUS MUSCLE

GREATER OCCIPITAL NERVE (DORSAL RAMUS OF C2)

3RD OCCIPITAL NERVE (DORSAL RAMUS OF C3)

SUBOCcipital nerve (DORSAL RAMUS OF C1)

GREAT AURICULAR NERVE (CERVICAL PLEXUS C2,C3)

LESSER OCCIPITAL NERVE (CERVICAL PLEXUS C2,C3)

DORSAL RAMUS OF C2

DORSAL RAMUS OF C3

MEDIAL CUTANEOUS BRANCHES OF DORSAL RAMI OF C4,5,6
Neurological Structures

• Third occipital nerve (dorsal ramus C3) has a close anatomic proximity to and innervates the C2-3 zygapophyseal joint.
  – This joint and the third occipital nerve appear most vulnerable to trauma from acceleration-deceleration (“whiplash”) injuries of the neck
  – Pain from the C2-3 zygapophyseal joint is referred to the occipital region, but is also referred to the fronto-temporal and periorbital regions
Fig. 5. Distribution of innervation.
-C2P, Posterior ramus of C2;  
-C2A, anterior ramus of C2;  
-C3A and C3P, anterior (A) and posterior (P) rami of C3.

Eyebrow Pinch-roll - C2-3 facet; also, skin thickened ipsilaterally

Jaw Pinch-roll: for C2

From “Cervicogenic Headache” by Robert Maigne, MD
Neurological Structures

“Sensory afferent nerve fibers from upper cervical regions have been observed to enter the spinal column by way of the spinal accessory nerve before entering the dorsal spinal cord... It is believed that the close association between sensorimotor fibers of the spinal accessory nerve and spinal sensory nerves allows for a functional exchange of somatosensory, proprioceptive, and nociceptive information from the trapezius, sternocleidomastoid and other cervical muscles to converge in the trigeminocervical nucleus, ultimately resulting in the referral of pain to trigeminal sensory fields of the head and face.” which means →

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Referred Pain – TrP’s

The inter-relationship between the upper cervical sensory nerves, their passage into and through the trigeminocervical complex and the Accessory Nerve (Cranial Nerve XI) which supplies the Upper Trapezius & Sternocleidomastoid muscles, etc. goes a long way to explain the neurological connections that Under-lies the Myofascial Trigger Point (TrP) referral patterns into the head and face.
Just in case you wanted more....

The key structures involved in primary headache appear to be the large intracranial vessels and dura mater the peripheral terminals of the trigeminal nerve that innervate these structures the caudal portion of the trigeminal nucleus, which extends into the dorsal horns of the upper cervical spinal cord and receives input from the first and second cervical nerve roots (the trigeminocervical complex) the pain modulatory systems in the brain that receive input from trigeminal nociceptors.

The innervation of the large intracranial vessels and dura mater by the trigeminal nerve is known as the trigeminovascular system. Autonomic symptoms, such as lacrimation and nasal congestion, are prominent in the trigeminal autonomic cephalalgias, including cluster headache and paroxysmal hemicrania, and may also be seen in migraine. These autonomic symptoms reflect activation of cranial parasympathetic pathways, and functional imaging studies indicate that vascular changes in migraine and cluster headache, when present, are similarly driven by these cranial autonomic systems. *Migraine and other primary headache types are not "vascular headaches"; these disorders do not reliably manifest vascular changes, and treatment outcomes cannot be predicted by vascular effects.*
The cervical plexus is formed by the ventral primary rami of spinal nerves C1 through C4, with a small contribution from C5. Peripheral nerves arising from the cervical plexus innervate most of the anterior and lateral muscles of the neck and supply sensory fibers to part of the head as well as to much of the neck.