Some Research and Clinical Evidence in support of Cervicogenic Headaches

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).*

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

Curr Pain Headache Rep. 2003 Oct;7(5):371-6.

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.

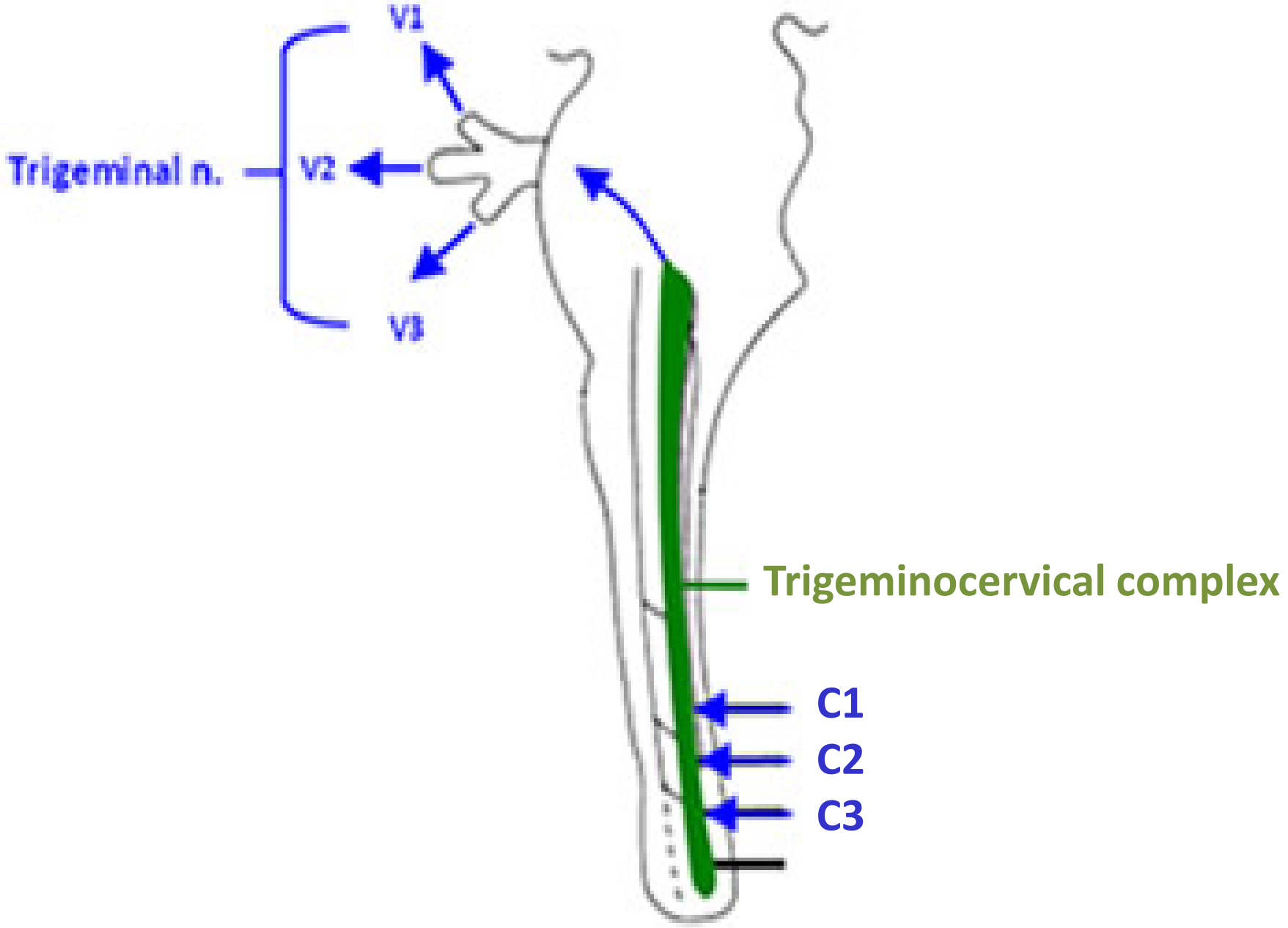
Curr Pain Headache Rep. 2005 Jun;9(3):191-6

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.

Arq Neuropsiquiatr 2007;65(3-A):599-604


V1
Trigeminal n.
V2
V3
Trigeminocervical complex
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 (figure16.5). 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.

From **Anatomy and Physiology, Sixth Edition, Seeley–Stephens–Tate,** The McGraw–Hill Companies, 2004

Cervicogenic Headache

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- "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).

Cervicogenic Headache

"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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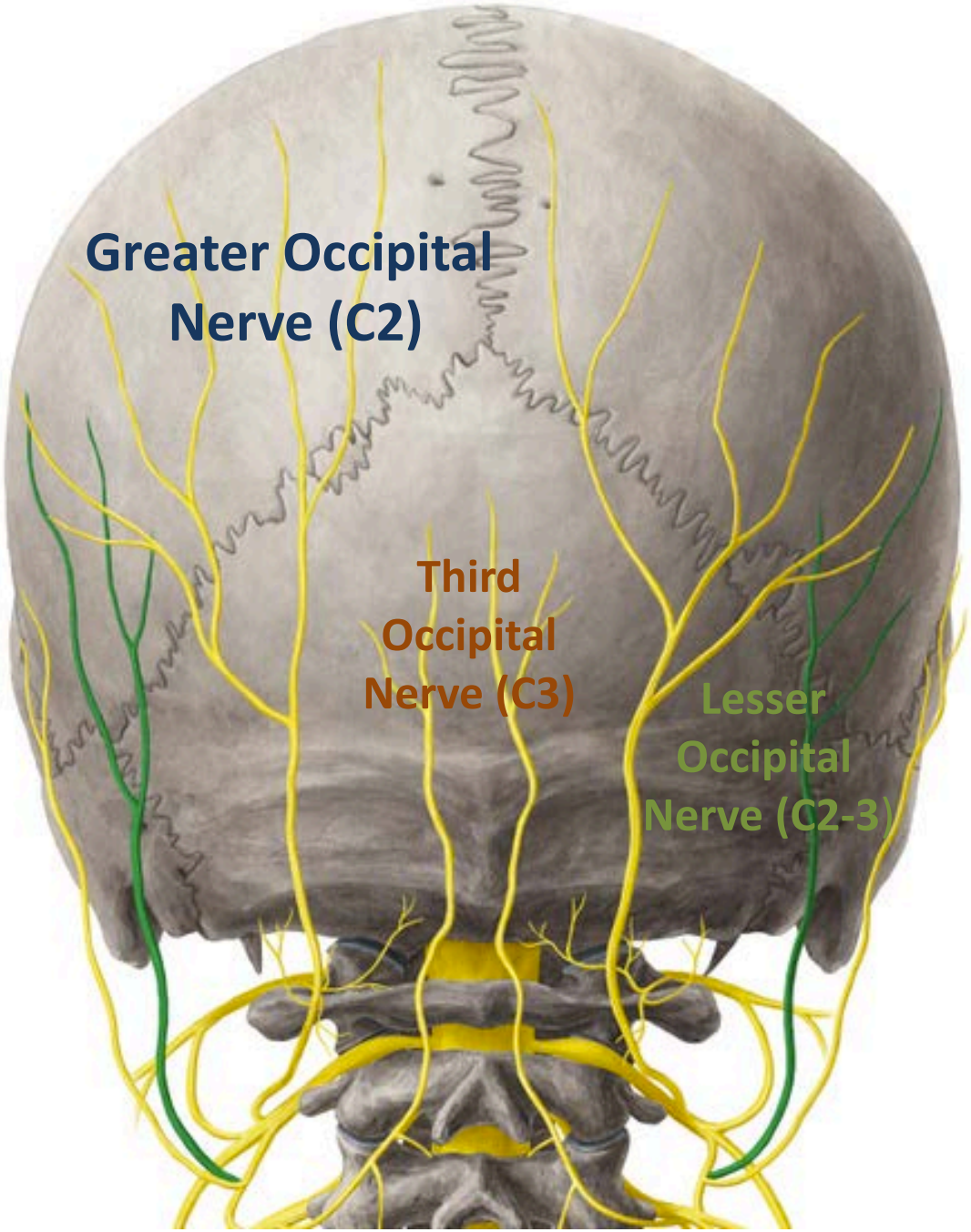
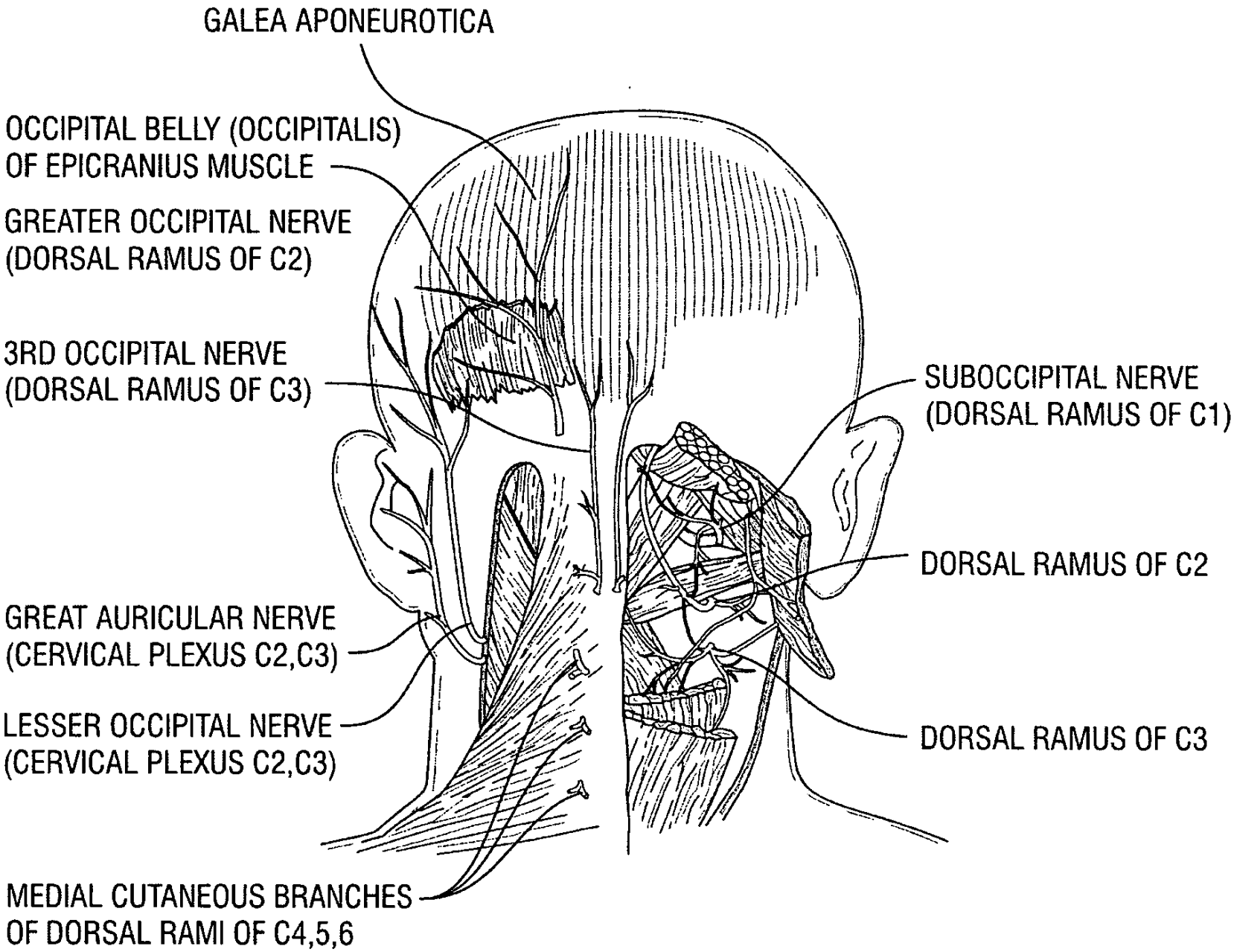
Neurological Structures

- **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.

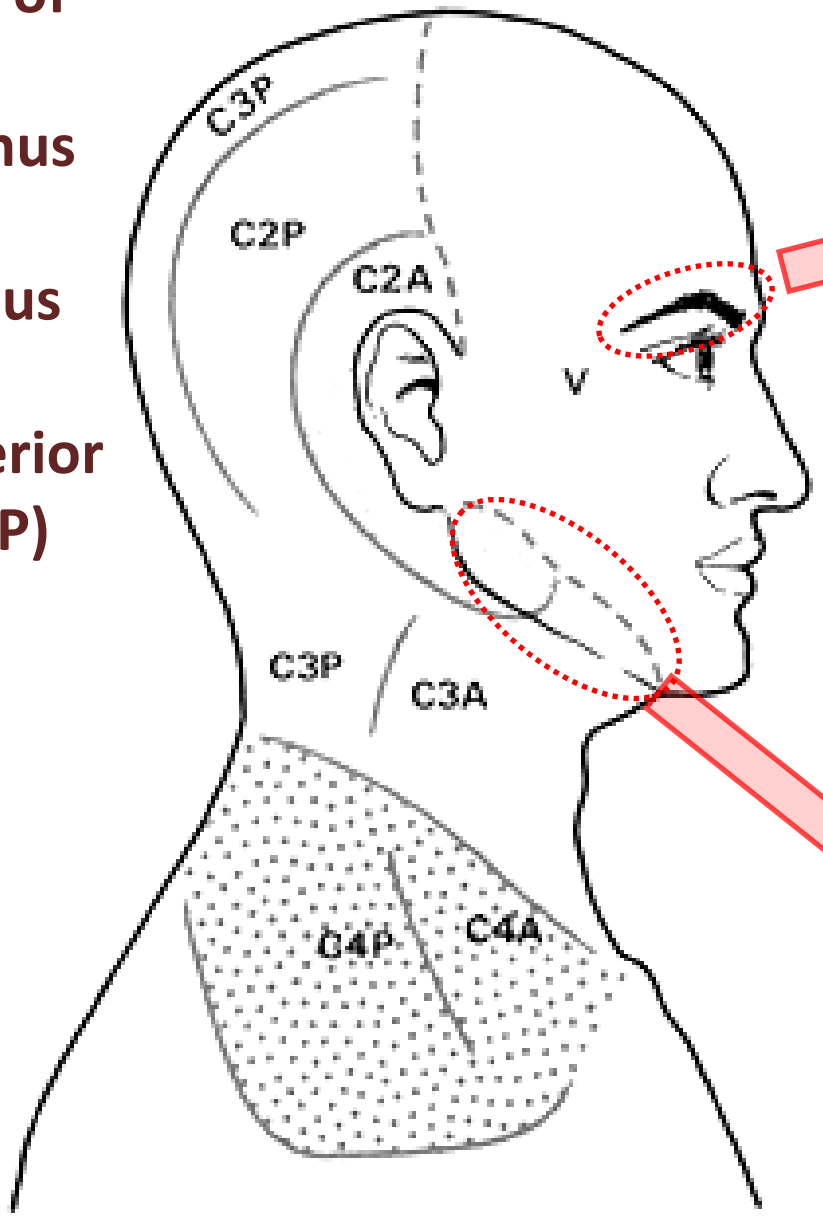

Greater Occipital Nerve (C2)
Third Occipital Nerve (C3)
Lesser Occipital Nerve (C2-3)

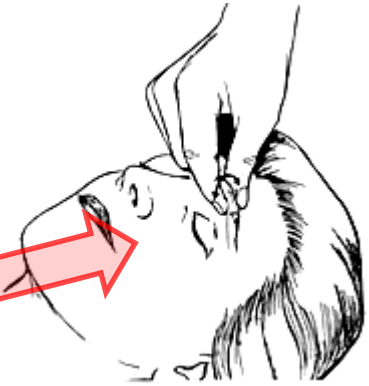

GALEA APONEUROTICA
OCCIPITAL BELLY (OCCIPITALIS) OF EPICRANIUS MUSCLE
GREATER OCCIPITAL NERVE (DORSAL RAMUS OF C2)
3RD OCCIPITAL NERVE (DORSAL RAMUS OF C3)
GREAT AURICULAR NERVE (CERVICAL PLEXUS C2,C3)
LESSER OCCIPITAL NERVE (CERVICAL PLEXUS C2,C3)
MEDIAL CUTANEOUS BRANCHES OF DORSAL RAMI OF C4,5,6
SUBOCCIPITAL NERVE (DORSAL RAMUS OF C1)
DORSAL RAMUS OF C2
DORSAL RAMUS OF C3

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 frontotemporal 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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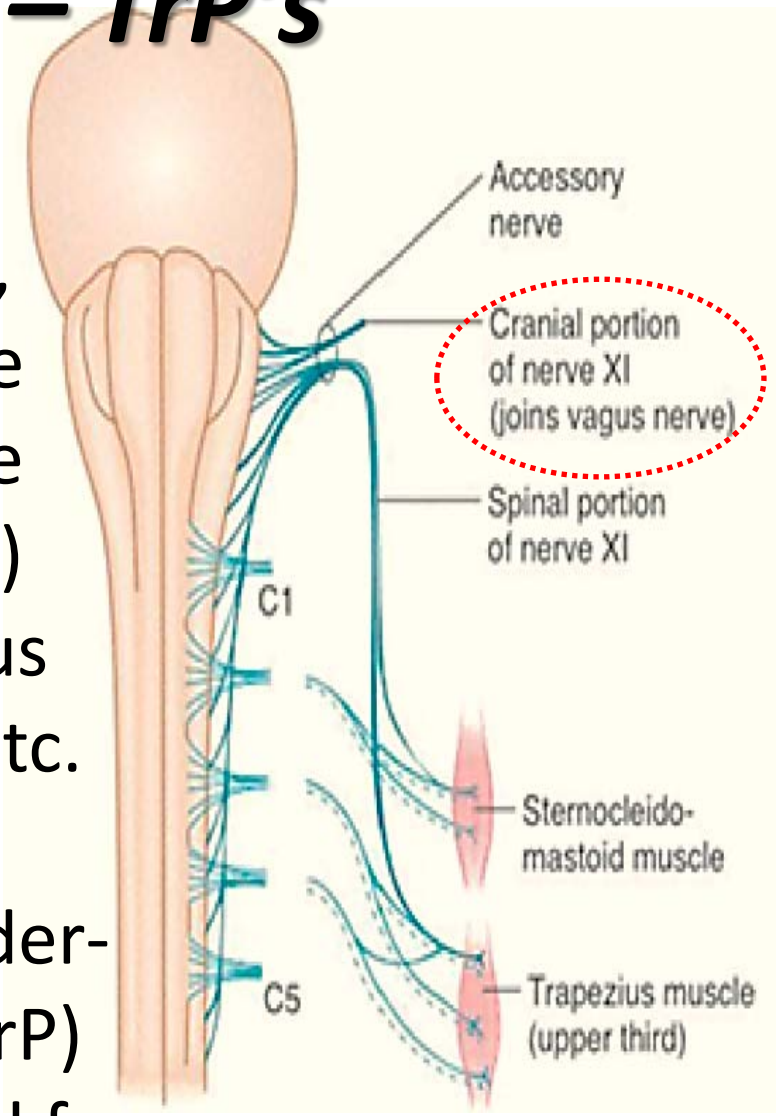
Referred Pain – TrP's

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.



Cranial Nerve XI: Accessory

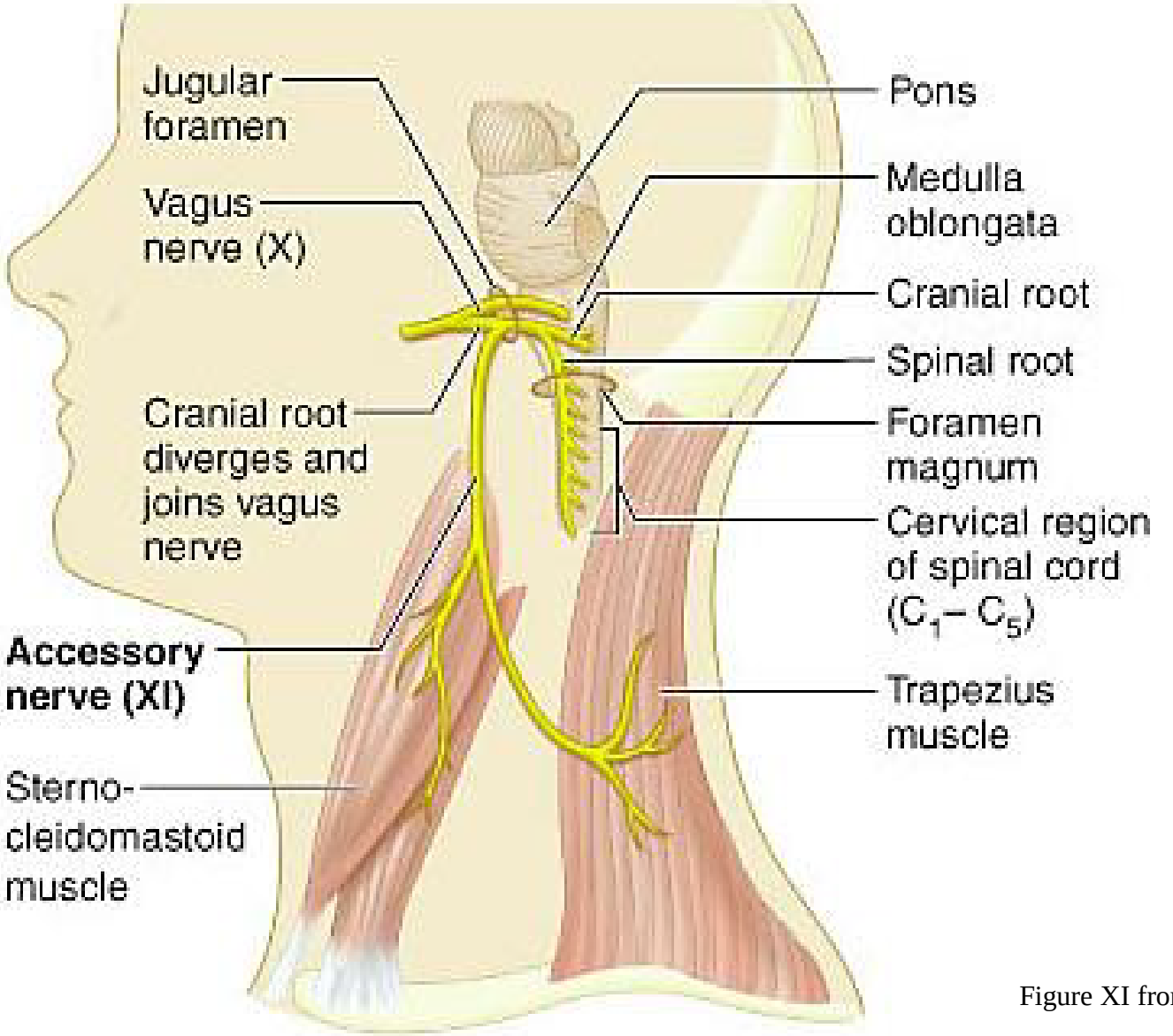
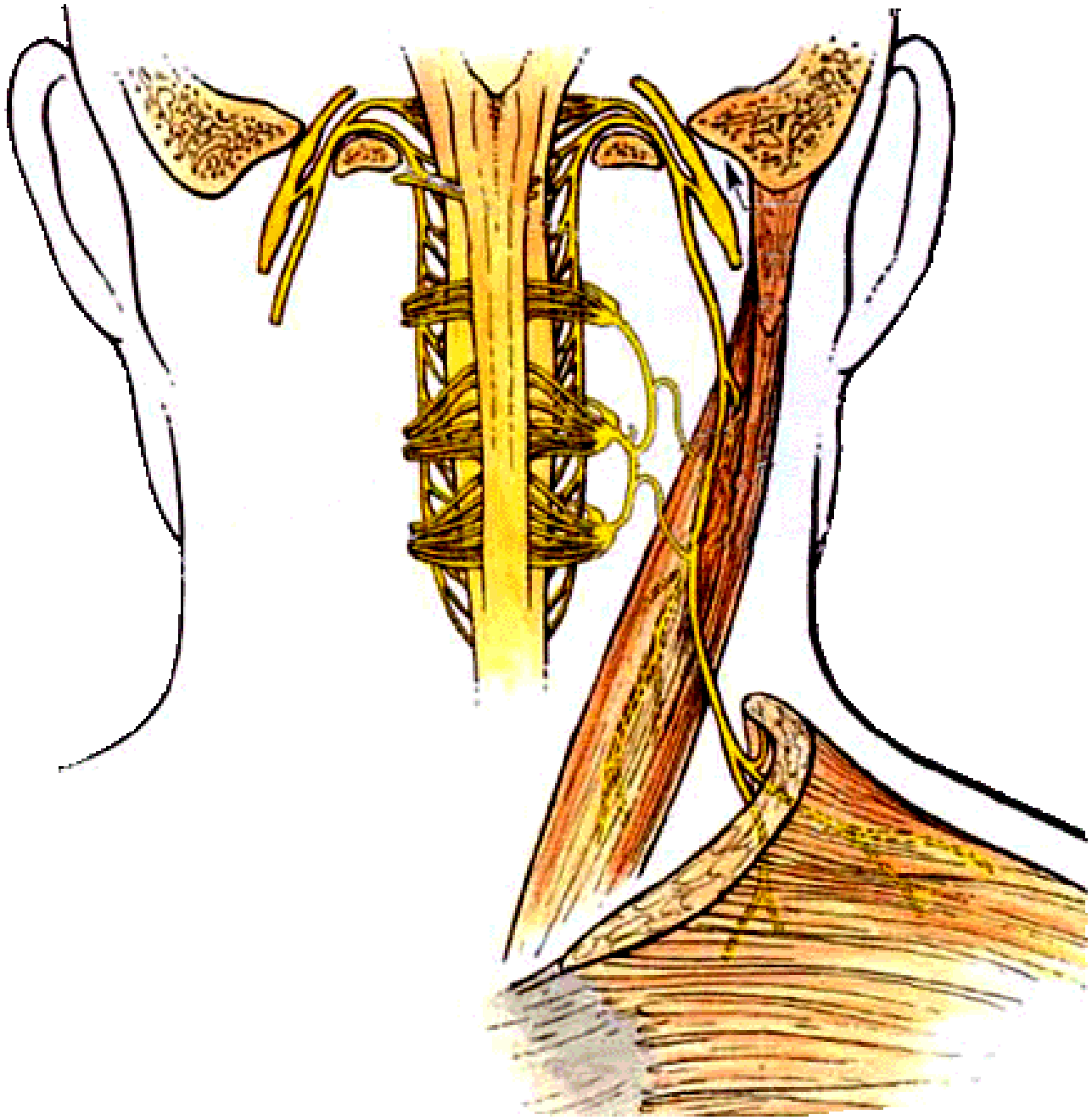
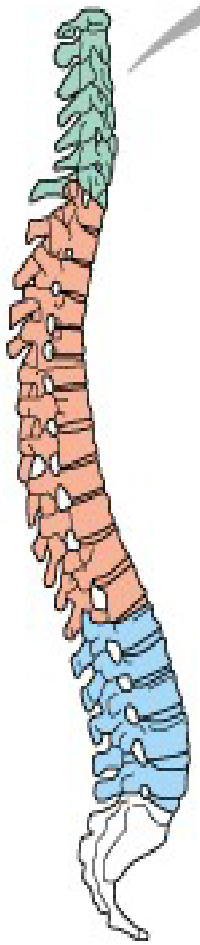


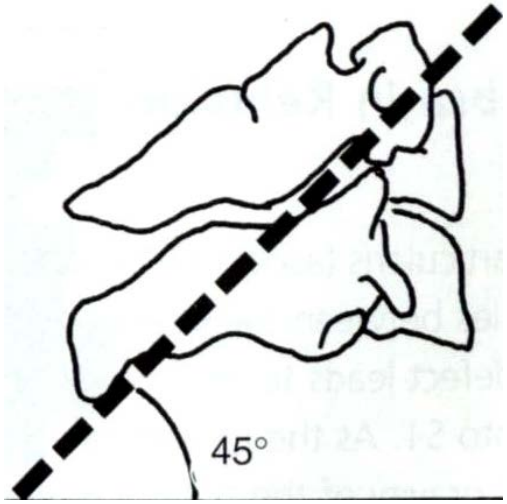
Figure XI from Table 13.2

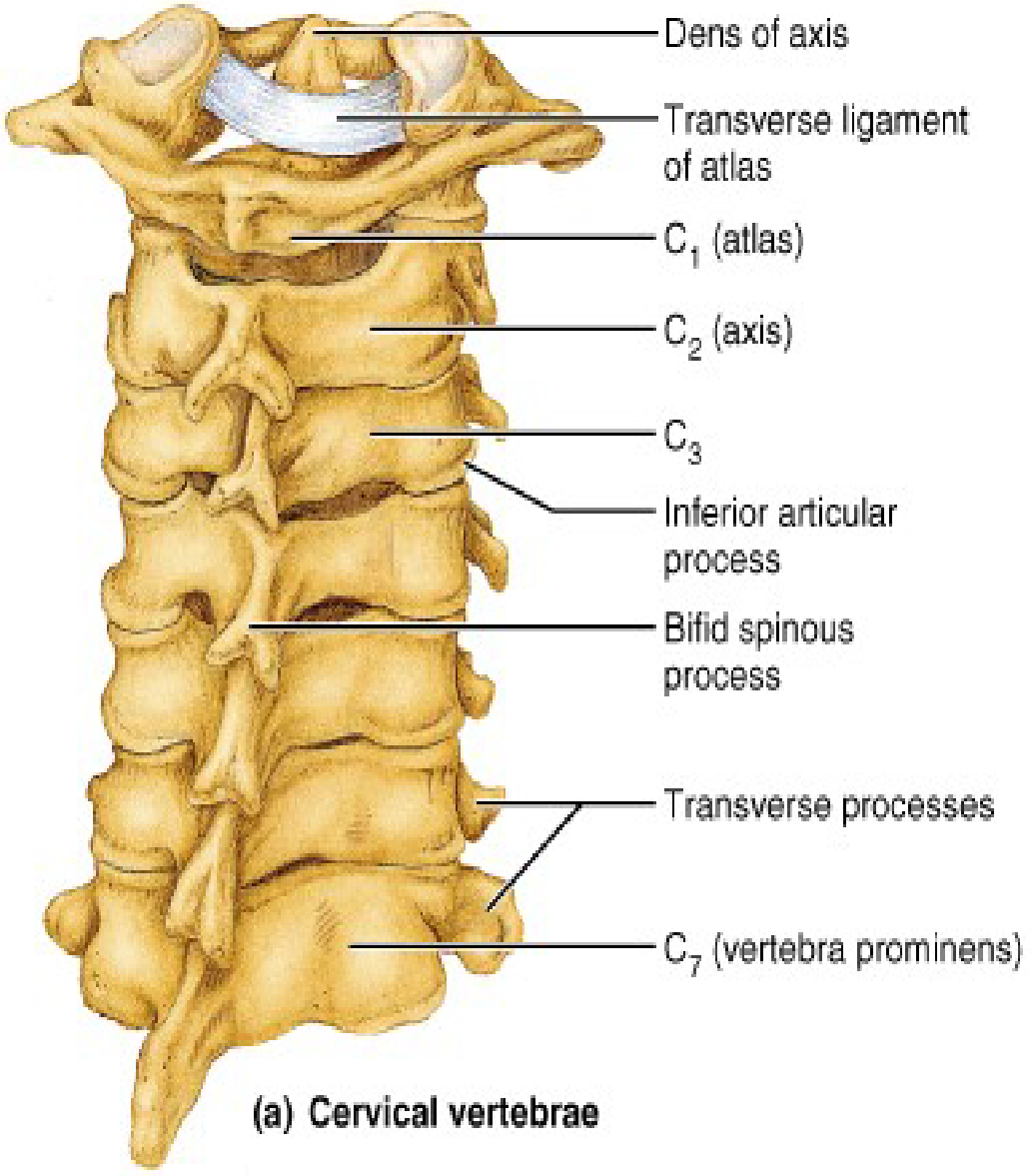


On average the total curve of the lordosis from O-C7 is 40^{o}

The C1-C2 vertebrae are shaped in such a way that they provide most of this curvature.







(a) Cervical vertebrae

from "The anatomy and pathophysiology of neck pain"
by Nikolai Bogduk, Phys Med Rehabil Clin N Am 14 (2003) 455–472

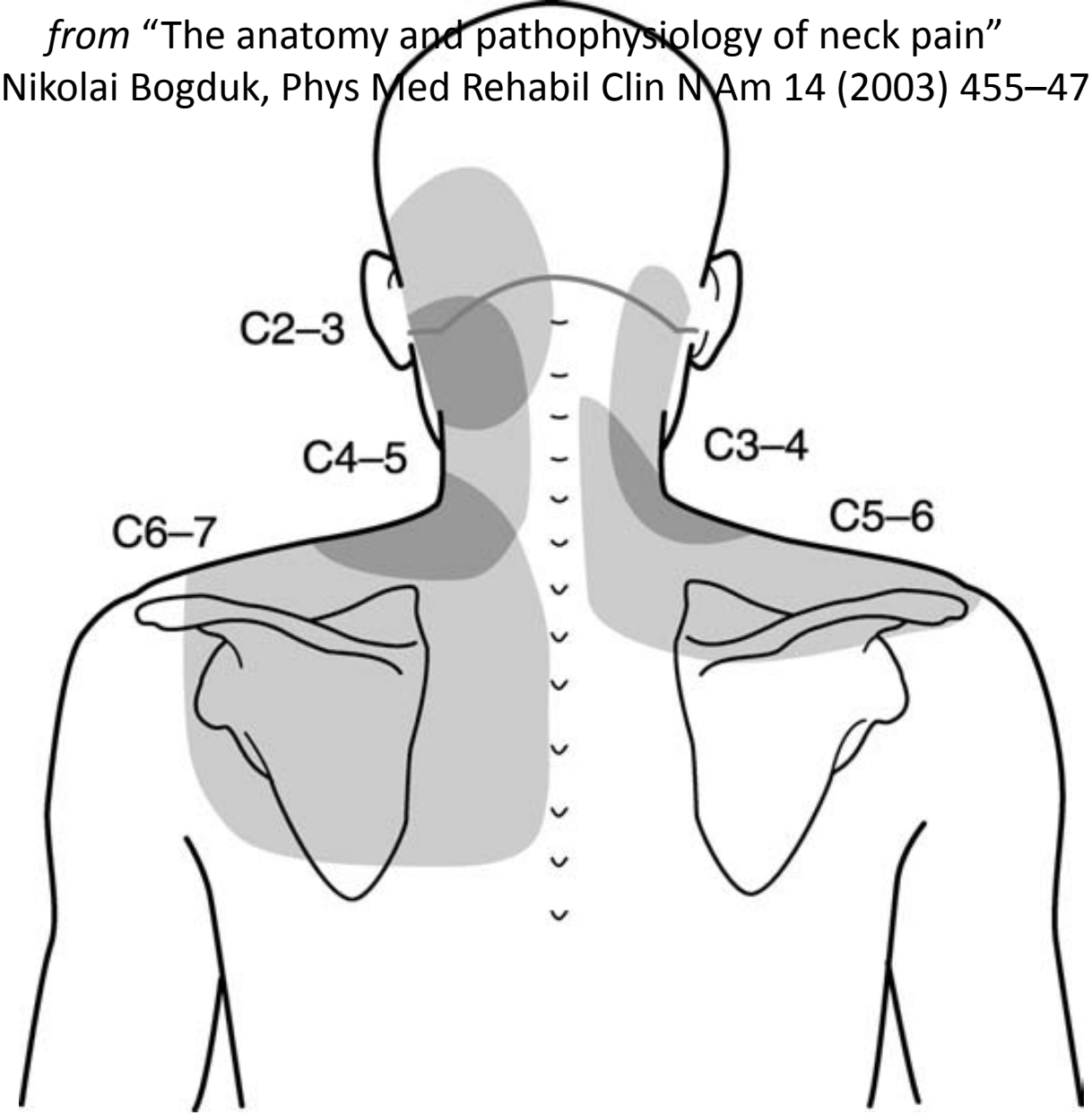


Fig. 1. The distribution of pain following stimulation of the zygapophysial joints indicated.

Assessment & CHx

Red Flags

- Nuchal rigidity (Px on moving neck/head)
- Pain while swallowing
- Severe trauma
- S/S of heart or organ dysfunction/impairment
- Changes of Levels of Consciousness (LOC)
- Dysphasia (speech impairments since onset)
- CNS signs (sensation, motor, reflexes); or ANS S/S such as pilomotor, changes in gland secretions, or other tissue texture changes
- Hx RA, Down's Syndrome, alcohol or drug abuse