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Research Article

The Under-Recognized Cervicogenic Headache and the Role of Anterior Cervical Discectomy

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Abstract

Headaches, while a common complaint of patients, are predominantly self-limiting and benign. Causes of headaches can vary. Headaches are classified according to their etiology such as migraine, tension and cluster headaches. A unique class of headaches that also exists but oftentimes is missed are cervicogenic headaches (CGH). Cervicogenic headaches are common but not well recognized by the medical community mainly because there are many overlapping features with migraine headaches, tension headaches and other types of benign headaches. They are usually assumed to be migraine headaches and imaging of the brain either by MRI or CT comes back negative; however, cervicogenic headaches are a class of headaches distinct from other headaches and only imaging of the cervical spine can elucidate the root cause. It is a known fact that headaches are a very common secondary symptom before a patient undergoes neck surgery for cervical stenosis or herniated disc, but these headaches are not well quantified pre- and post-operatively [1,4].

The author's study explains the features of cervicogenic headaches and what makes them different from the other headache types they can mimic. This study also examines the radiological features that can predict if headaches can be resolved after spinal cord decompression via anterior cervical discectomy and fusion (ACDF). The radiological features examined in this article include the Torg ratio and the space available for the cord (SAC). This study further quantifies post-operative results of anterior cervical discectomy and fusion with VAS (visual analog scale), NDI (neck disability index), and SF-12 (Short Form 12). The neuroanatomy of the trigeminal nerve fibers in the upper cervical spine will be explained in detail and the theories on causation of CGH will be reviewed. Ultimately, most cervicogenic headaches can be reduced or eliminated after successful ACDF surgery and the reason why may be explained by decompression of nerve fibers passing to and from the spinal trigeminocervical nucleus.

Keywords: *Cervicogenic Headaches (CGH); Anterior Cervical Discectomy and Fusion (ACDF); Space Available for the Cord (SAC); Visual Analog Scale (VAS); Neck Disability Index (NDI); Short Form 12 (SF-12)*

Introduction

Headache has been underestimated, under-recognized and undertreated throughout the world. The World Health Organization (WHO) estimates that half of the adult population suffers from headache on a regular basis and only a minority of people with headaches are diagnosed appropriately by their health care provider [1].

Headaches are a common chief complaint in the internal medicine, neurology, and neurosurgical office. Additionally, many emergency room visits are due to headache. First and foremost, it is imperative to assess whether a headache could be related to a life-threatening condition such as a ruptured aneurysm or a brain tumor. History taking is a crucial part of the differential diagnosis in this type of head-

aches where an aneurysm is often described as the "worst headache of my life" and a brain tumor is often describe as a dull headache sometimes heralded by seizure.

When patients visit neurological physicians for neck and back pain, headaches are not commonly quantified during history for spinal issues [5]. Yet, headache in the setting of cervical spinal stenosis is an important item in the history to document with great detail since it is a major co-symptom of cervical stenosis that spinal surgeons can improve and oftentimes eliminate, by decompressing the cervical spinal cord and nerve roots through surgery.

The most under-recognized headache among spine surgeons is cervicogenic headache (CGH). CGH is a form of headache that involves referred pain from the neck. It accounts for about 15 - 20% of chronic and recurrent headaches [2] and is misdiagnosed in about 50% of cases [3]. It is important to differentiate cervicogenic headaches from migraine and tension-type headaches (Figure 1). Cervicogenic headaches have the feature of occipital location and are triggered by neck movement. The male to female ratio is evenly distributed, unlike migraine and tension-type headaches. Associated symptoms such as aura or photophobia are absent in cervicogenic headaches.

DIFFERENTIAL DIAGNOSIS OF HEADACHE

Clinical features	Cervicogenic headache	Migraine	Tension-type headache
Female:Male	50:50	75:25	60:40
Lateralization	Unilateral without sideshift	60% unilateral with sideshift	Diffuse bilateral
Location	Occipital to frontoparietal and orbital	Frontal, periorbital, temporal	Diffuse
Frequency	Chronic, episodic	1-4 per month	1-30 per month
Severity	Moderate-severe	Moderate/Severe	Mild/moderate
Duration	1 hour to weeks	4-72 h	Days to weeks
Pain character	Non-throbbing, and non-lancinating, pain usually starts in the neck	Throbbing, pulsating	Dull
Triggers	Neck movement, and postures, limited ROM, pressure over C0-C3	Multiple, neck movement not typical	Multiple, neck movement not typical
Associated Symptoms	Usually absent or similar to migraine but milder, decreased ROM	Nausea, vomiting, visual changes, phonophobia, photophobia	Occasionally decreased appetite, phonophobia or photophobia

Figure 1: *Differential diagnosis of headache showing the special features of CGH.*

The term cervicogenic headache was coined by Norwegian neurologist Dr. Ottar Sjaastad in 1983. In 2015, Sjaastad and fellow researchers authored a paper to stress the lack of progress in correctly identifying and treating this common condition [4]. A simple Pubmed search finds over 27,000 abstracts for migraine headache but only about 900 abstracts for CGH.

There are many types of headaches spine surgeons should be aware of when a patient presents with radiculopathy or myelopathy and headaches. CGH has different features than other headaches. In CGH, the history will show headaches occurring in the back of the head in a patient with concomitant radiculopathic and/or myelopathic signs and symptoms classic triad (Figure 2) of cervicogenic headaches is:

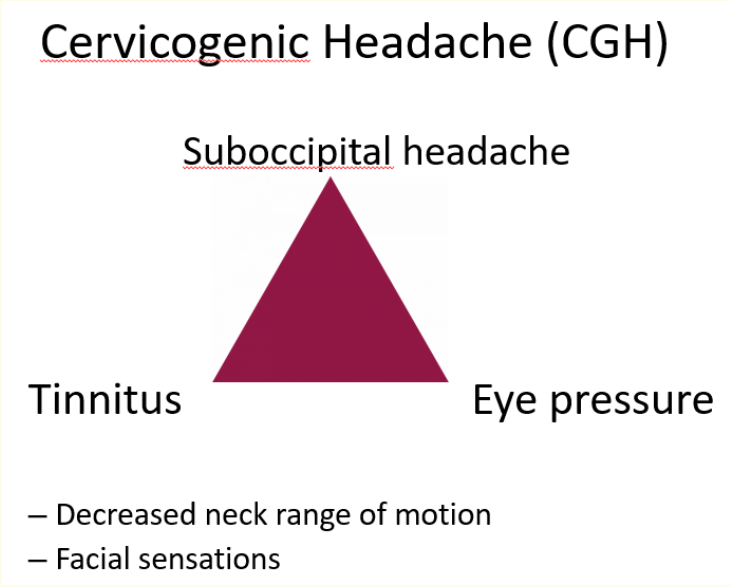


Figure 2: *The triad of CGH is suboccipital headache, tinnitus, and eye pressure.*

- Suboccipital headache
- Pressure behind the eyes
- Tinnitus or a fullness in the ears.

Through this study, the author determined about 75% of patients with cervicogenic headaches display all three of these features.

It is known from neuroanatomy that the trigeminal nerve has both cranial and cervical components. The trigeminocervical nucleus is where the descending tract of the cranial trigeminal nerve communicates with adjoining trigeminal nerves in the cervical spine. This is known neuroanatomically as the trigeminothalamic tract (Figure 3). This is why some cervicogenic headache patients have the above triad of symptoms and sometimes present with the added phenomenon of facial paresthesias. Diagnostic and therapeutic strategies for cervicogenic headaches involve cervical traction and facet blocks. Both therapies will temporarily reduce headaches and will positively predict those patients who will respond well to anterior cervical discectomy. While anterior cervical discectomy is not advised for patients with headache alone, it is the author's observation that it serves as an effective procedure to reduce or eliminate cervicogenic headaches in the setting of moderate or severe cervical stenosis causing radiculopathy and/or myelopathy that has exhausted conservative treatments such as medication and physical therapy.

MRI measurements, which are important in the context of CGH, are the Torg ratio and the SAC. The Torg ratio is the ratio of the spinal canal on sagittal imaging to the corresponding vertebral body (Figure 4). A ratio of less than 0.8 is suggestive of cervical stenosis. The SAC measurement is determined by subtracting the sagittal diameter of the spinal cord from the sagittal diameter of the spinal canal. SAC measurements less than 5 mm are indicative of spinal stenosis. Sagittal canal diameter less than 12 mm alone is also accepted as indicative of cervical spinal stenosis.

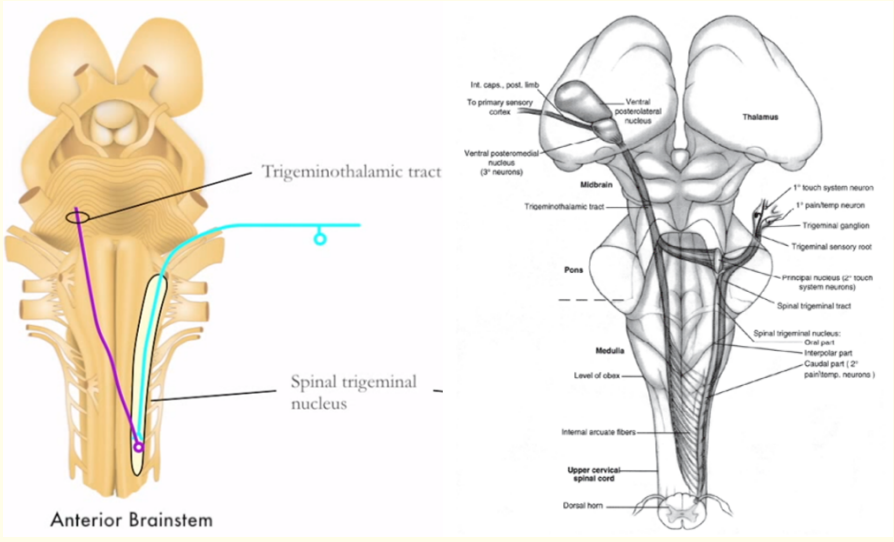


Figure 3: *The neuroanatomy of the trigeminal fibers that descend into the cervical spine, namely the trigeminothalamic tract and spinal trigeminal nucleus.*

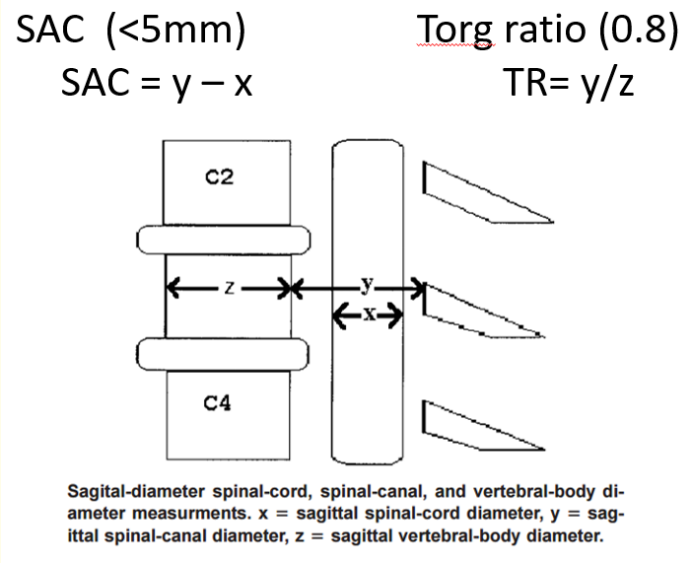


Figure 4: *Diagrammatic representation of the SAC (space available for the cord) and the Torg ratio.*

Based on the author's observation, it is rare to see a patient with CGH not have both a Torg ratio of less than 0.8 and a SAC less than 5 mm. This is an independent observation by the author from research which was presented at the Southern Neurosurgical Society meeting

in 2016 [5]. Radiologists reading MRI films rarely use these terms and ascribe compression of the spinal cord subjectively as mild, moderate, or severe. There is great inter-reader variability in radiology readings and perhaps using Torg and SAC measurements would be useful for more accurately and consistently confirming cervical stenosis on an MRI.

ACDF using a Smith-Robinson approach is the most common neurosurgical procedure which removes the disc from an anterior approach and replaces it with a PEEK (Poly-Ether-Ether-Ketone) cage. In select patients who present with myelopathy and headache, ACDF can provide long-lasting relief of cervicogenic headaches. This is an under-recognized treatment for CGH worldwide and a PubMed search about CGH and reduction with ACDF returned less than 10 abstracts in the worldwide medical literature.

Background

According to the WHO, 47% of people suffer from persistent headaches at some point in their life.[1] Headaches are estimated to cost the world economy $160 billion per year. Cervicogenic headaches are a type of headache which are common but not well recognized and are often misdiagnosed as a migraine or tension headache. The author's study explored results of surgery for CGH in properly selected patients: those with a triad of sub-occipital headaches, tinnitus, and symptoms of eye pressure.

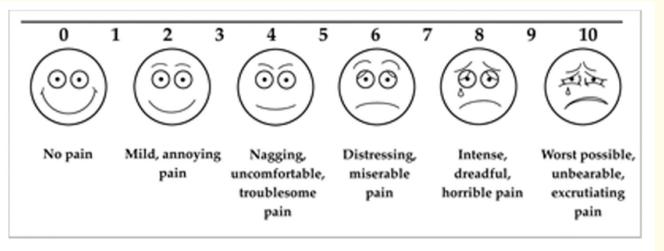
Most of the time, a physician will order an MRI or CT scan of the brain which will come back normal when the true culprit of the headache has a root cause in the cervical spine. Headaches are a very common symptom in the setting of cervical stenosis causing radiculopathy and myelopathy and therefore are a common symptom before anterior cervical discectomy and fusion. These patients will exhibit arm, hand pain or numbness with headache as a co-symptom. After failing conservative treatments for six weeks or more, they may be offered surgery depending on what their MRI results show. Moderate or severe stenosis at the cervical spinal cord level is an indication that a patient may be a good surgical candidate.

CGHs are not well quantified pre-operatively and post-operatively when the decision is made to perform cervical surgery. Neurosurgeons may focus on pain, weakness, and numbness of an extremity in the setting of stenosis of the cervical spinal cord, yet there is usually an important co-symptom of cervicogenic headache in a patient with cervical stenosis. ACDF is the standard of care in the setting of symptomatic cervical stenosis of over six weeks and the cervicogenic headache component of this cervical condition may be expected to improve after surgery.

Methods

CGH is a type of headache resulting from cervical disc degeneration, stenosis, and/or facet joint arthritis. Fifty-five consecutive patients with signs and symptoms of radiculopathy and/or myelopathy with concurrent CGH were selected for ACDF after failing more than six weeks of conservative treatment. Conservative treatments are defined as physical therapy, analgesics, bedrest, traction, home exercise directed by a physician, and oral non-steroidal medications. Those who noted improvement after conservative treatments were not selected for surgery and continued conservative treatments.

Visual analog scale (VAS), Neck Disability Index (NDI), and Short Form 12 (SF-12) were analyzed pre-operatively, and at 1, 3 and 6-month intervals post-operatively (Figure 5A-5C). The visual analogue scale (VAS) is commonly used as the outcome measure for such studies. It is usually presented as a 100-mm horizontal line on which the patient's pain intensity is represented by a point between the extremes of "no pain at all" and "worst pain imaginable". The NDI is a patient-completed, condition-specific functional status questionnaire with 10 items including pain, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. The NDI has sufficient support and usefulness to retain its current status as the most commonly used self-report measure for neck pain [6]. The SF-12 is a health-related quality-of-life questionnaire consisting of twelve questions that measure eight health domains to assess physical and mental health.



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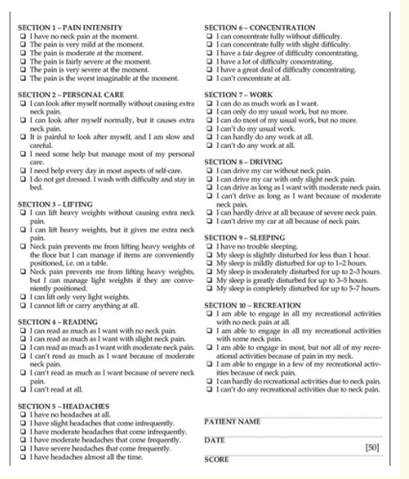

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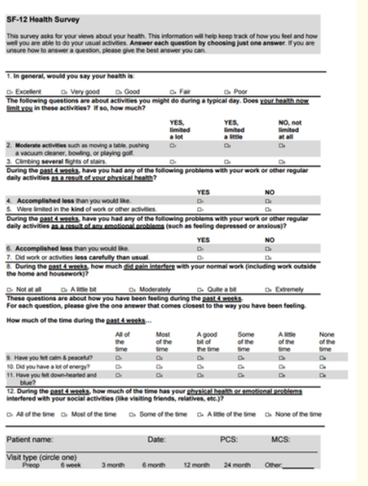

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Figure 5A-5C: *The Visual analog scale, Neck Disability Index score, and the Short Form- 12 were used as post-operative parameters in this study*

The most common level operated in this study was C5-C6. Eighty-six levels were treated in 55 patients. Twenty-nine were female and 26 were male. The average age was 58.4 years old. Radiological findings of Torg and SAC (space around the cord) were analyzed in all patients.

Results and Discussion

All 55 patients noticed improvements in the radiculopathic and/or myelopathic signs and symptoms as would be expected from uncomplicated surgery for moderate to severe cervical stenosis. The great majority of the 55 patients noticed complete resolution of CGH. The average operative time of the cases was 58 minutes and there were no infections or other surgical complications. One patient had surgery two years later after developing adjacent level disease.

As it pertains to CGH, the results were as follows:

- VAS improvement was 82% at one month, 87% at three months, and 90% at six months, $n = 51$, $p < 0.01$.
- NDI improvement was 70% at three months, and 80% at six months, $n = 51$, $p < 0.01$.
- SF-12 (MCS and PCS) improved at three months in 59.5% of patients and 63% at six months.
- Many patients noticed complete resolution of headaches after ACDF. Radiological findings that were predictive of complete resolution of CGH were a Torg ratio < 0.8 and SAC < 5 mm.

Conclusion

ACDF is the definitive treatment of CGH in the context of radiculopathy and/or myelopathy. Patients who stand to improve the most are those with a triad of suboccipital headaches, unilateral pressure behind-the-eye and tinnitus in addition to radiological features on MRI with a Torg ratio of less than 0.8 and a SAC of less than 5 mm.

It is thought that the spinal trigeminothalamic tract plays a significant role in the pathophysiology of the CGH pain since pathways of this tract travel into the upper cervical spinal cord. More neuro-anatomical studies of this observation, possibly with functional imaging, are forthcoming.

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