The Neglected link in Headache

(Occipital-Atlanto-Axial Complex Instability)

By Mahan Chehrenama, D.O.

As Headache Medicine specialists, we routinely evaluate patients whose symptoms have been dismissed, or unappreciated by well-intentioned clinicians. Most of our patients do not have pathologic abnormalities on physical examination or ancillary testing. However, the position and alignment of the skull base (occipital condyles) first cervical vertebrae (atlas), and the second cervical vertebrae (axis) is overlooked by physicians, thereby accounting for the absence of any "abnormalities" on physical examination.

In many chronic headache sufferers, the clinician's failure to detect an abnormality on examination of the head and neck is due to a fundamental lack of understanding of a very unique biomechanical relationship. This biomechanical relationship is unfortunately taken for granted. The relationship of the atlas as a turntable between the skull base and the axis can be called the occipito-atlanto-axial complex (OAAC). The OAAC has anatomic complexity allowing for greater degree of movement with a propensity for instability. As the stability of OAAC is compromised, misalignments pursue with a plethora of symptoms. In order to remain focused on evaluation and management of headaches, the other neurologic and musculoskeletal symptoms will be deferred in this article.

The head has an average weight of about 8-17 lbs. This spherical structure has to be held up by a single vertebrae weighing only 2 ounces. From a biomechanical standpoint, the meeting of the two components must occur under an optimally balanced fulcrum in order to prevent misalignment. The atlas (C1) is the most freely mobile of all vertebrae, and it pivots around the axis (C2). These vertebrae are held together by ligaments. The advantage of such mobility is that we can move our head through a tremendous range in multiple directions. The disadvantage lies in its propensity to be unstable.

The anatomic architecture is very particular along the superior lateral masses of the atlas (biconcave, cup-shaped, inclined from 30-60 degrees) and the inferior surface of the occipital condyles (biconcave, reciprocally inclined) allowing for a rotation of the atlas around the occipital condyles. The OAAC does not have any intervertebral disc, and hence can respond to even a slight force. The atlas acts as a turntable between the skull and the axis. The atlanto-axial joint is a pivoting joint, where one bone rotates about the other.

The consequences resulting from a loss of the normal anatomical relationship between the components of the OAAC includes severe atlanto-axial instability, atlanto-axial rotatory subluxation, and C1/C2 fractures. Numerous articles in the medical and surgical literature discuss the severe pathological issues related to these conditions. However, it is the subtle, or more unusual clinical symptomatology that is potentially the largest contributor to the persistent headache subtypes that are so often seen by Headache Medicine specialists. Such patients often masquerade amongst our most common difficult-to-treat patient populations.

Your head should sit level on your neck and the rest of your skeletal frame below. This is called the orthogonal position, or the 90 degree angle. Even the most minimal shift in this

angle can cause nerve irritation. The most likely nerves to be irritated are C1 and C2, progressing to the branches of the occipital nerves. In addition to the nerves, the ligaments responsible for maintaining the structural stability of the OAAC are likely to experience excessive strain or pull, adding their own instability to the phenomenon. The sub-occipital triangle is a triad of muscles, bordered by the rectus capitus major, oblique capitus superior and oblique capitus inferior. The dorsal rami of C1, as well as the third part of the vertebral artery emerge through this triangle. A misalignment at OAAC or C1-C2 can lead to localized muscle spasm in the sub-occipital triangle which can be very difficult to isolate, and therefore abolish given their depth and small size.

Some muscle attachments in this area have been described as being intimately attached to the underlying spinal dura matter. In particular the rectus capitis posterior minor muscle and ligamentum nuchae attachments to the spinal dura suggest a “myodural” bridge. The latter may account for a distinct mechanism affecting pain in head.

The propensity for instability from a biomechanical standpoint is extremely high in the region of the axis, atlas, and occipital condyles. Sometimes this instability or subluxation is triggered or caused by an obvious insult, such as a motor vehicle accident with whiplash, and or a sports-related concussion. Other times, the triggering event is a seemingly trivial injury, which has long been forgotten or was never considered as a possible causative event. Additionally, minor daily micro-traumas such as yanking, twisting, or sleeping in a particular position or recurring incidents (bumping the head against a cabinet, or dental procedures) may contribute to instability of the aforementioned structures.

There is no one headache type or clinical scenario that is specific for misalignment or subluxation. The headache location can be localized to the posterior occiput (the most expected site) or located in temples, crown of head, or across the front (related to the referral pattern of the scalp’s sensory nerves). The headache may be bilateral or unilateral. The pain from the nerve irritation due to entrapment, kinking, stretching, localized inflammation or scarring can be sharp, shock-like, burning, stabbing, throbbing, or dull. Associated features such as nausea, photophobia or phonophobia may occur with the headache.

The key, for the clinician, is to remain vigilant for the potential presence of this instability, regardless of headache subtype or presentation. One has to observe and palpate as the primary modality to screen for OAAC instability. The physician must observe the posture of the patient, including when and how the patient tends to hold his/her head as they reveal their history and/or during the examination. Patients may have an obvious or subtle head tilt. They may have no tilt, but rather a limited range of motion with head turning. The patient can have full range of motion with rotation but the tilt may be off the horizontal axis once asked to perform flexion or extension. Rarely, there may be a misalignment of C2 > C1, altering the pattern of presentation. Usually there is some degree of tenderness in the area of instability, combined with muscle tension, as well as superimposed occipital nerve tenderness or tenderness proximal along the course of the C1/C2 nerve roots. Palpation can provide further evidence for an architectural issue in this vulnerable area.

Certainly, a primary peripheral nerve irritation, caused by architectural misalignment, can lead to provoked migraine like features, with secondary central sensitization. It should be noted that the brainstem and in particular the trigeminal nucleus are located near the

foramen magnum and upper cervical spinal canal. This eloquent region, has been the focus of headache research as a generator beyond peripheral nociception. As headache specialists, we have a variety of options to treat and manage the end stage pathology of a more magnified headache syndrome, but addressing the potential peripheral cause can lead to more substantial management and resolution of the headache condition.

Once instability of the OAAC region is suspected, correlation with triggering mechanisms may provide further evidence as to whether this subluxation is symptomatic or possibly incidental. The presence of an asymptomatic subluxation in this area is a matter of debate amongst clinicians from varied disciplines. By focusing on headache evaluation, one can correlate triggers and symptoms accordingly. If the typical headache triggers are not readily noted (i.e. hormonal changes, weather fluctuations, stress, or dietary causes), the possibility of altered structural alignment as a trigger should be considered.

We have certainly become more vigilant regarding avoidance of a head forward posture in our headache population, but the more nuanced misalignments are commonly over-looked. Once instability is diagnosed and felt to be potentially contributing to the pattern of headaches, then varied treatment options can be considered. Certainly manual medicine has always provided benefit for a variety of cervicogenic causes, but misalignment or subluxation of the occipital-atlanto-axis complex requires a very specific targeted therapeutic approach. The junction of the head and neck cannot be treated as cervicogenic. Re-alignment is the goal. The latter can be achieved with a variety of upper cervical techniques, generally falling into two categories: (1) Manual manipulation or (2) Instrumentation. Given the eloquent anatomy of OAAC and the adjacent brainstem, arteries and ligaments, the least amount of force targeted directly to correct this misalignment is preferred.

Manual approaches are numerous (including Palmer in the 1920s, followed by Grostic, Blair, NUCCA as developed by Dr. Gregory, Kale Brainstem, and Sutter's approach, as well as cranio-sacral therapy (Dr. Sutherland in 1930s), massage and OMT techniques. Most hands-on treatments cause inadvertent added muscle tension and require repeat intervention.

The use of precisely-targeted instrumentation utilizing the least amount of force (vibratory impulse) is preferred by patients and clinicians. This includes Atlas Orthogonal (as developed by Dr. Roy Sweat in the 1970's), Laney Instrumentation (with added torque factor developed in the early to mid-1990's), and Cowin approach (more recent Australian version). Each approach is conceptually similar and utilizes detailed x-ray analysis to verify and confirm the clinician's suspicions and findings, as well as to decide the angle and degree of adjustment required. All have evolved along with modern imaging to include digital systems with upper cervical software to aid in the analysis of the upper cervical misalignment.

The purpose of the adjustment is to reduce stress on the nervous system and improve neurologic function, while providing spinal stability so that the correction can hold. All of the instrument guided techniques perform the same function, but Atlas Orthogonal is more specific and gentle without any added torque or thrust. Using the Atlas Orthogonal Percussion Adjusting Instrument, the patient is positioned comfortably on the specialty adjustable table, and precise mechanical adjustment is performed in a very gentle manner to realign the atlas or axis. A post-procedure x-ray is used to determine how much correction has been made, and if additional corrections are necessary. Most patients only require 1 or 2 adjustments and only

with particularly difficult or long-term misalignment, they may require a number of repeated adjustments.

There are numerous providers that use the manual approach, but too few with dedicated training and use of specialized instrumentation (Less than 400 Atlas Orthogonists in the USA). Of course, there is a need for further clinical research supporting the correlation of occipital-atlanto-axial subluxation with persistent headaches that remain unresponsive to standard treatment options. This type of biomechanical research would encompass numerous variables, and dedicated interest on behalf of headache specialists.

A particularly large population affected by this instability, is the athlete (or soldier) with persistent post-concussive headaches. The biomechanical forces that cause a concussion, are generally the same forces causing instability in this region. Repetitive concussions, as well as a single event in a particularly prone individual with hyper-flexibility, can lead to added ligamentous laxity, which may prevent a more lasting correction and treatment. Factors influencing joint stability includes the shape of articular surfaces, ligaments, muscle tone and strength, gravity, as well as atmospheric pressure.

Another population that may also be of potential interest, includes those with TMJ dysfunction and chronic intractable headaches. The mechanisms of these two joints (OAAC as well as the TMJ) are closely related, biomechanically very complex, and require further detailed evaluation.

We should begin by looking for this highly prevalent OAAC instability in our headache patients, and then pursue the targeted treatments accordingly. Identification of such patients and correlation with previous headache management will be key for further analysis. A closer working relationship with atlas orthogonists may shed light on a much-neglected link between structural anatomy and headaches.

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