



Micheline Clawson

What are symptoms of whiplash?

The symptoms that result from a whiplash injury to the neck and cervical spine are varied and complex. As a result of this, patients are described as suffering from the "Whiplash-Associated Disorder." A more accurate and up-to-date description of the symptom complex is the "Cranial Cervical Syndrome." I will refer to this clinical entity as the WAD/CCS for the remainder of this section.

It is important to note that these symptoms are most often transient or temporary. They come and go, and the symptoms themselves are often quite variable. In that regards alone, patients often are most commonly shifted from one health provider to another. The health practitioners often do not understand the nature of the problem. The patient is often treated with high dose narcotics and often eventually told that they are malingerers – faking the symptoms- or that they are psychologically unbalanced and need psychiatric care. Typically, we see patients, on average, three years (and sometimes over ten years) after the whiplash injury because of this shunting of patients from one provider to another.

The most apparent and most debilitating symptom that develops after a cervical whiplash injury are intractable headaches.

The nature of migraine headaches is varied, therefore, I will review those elements of that are most relevant to whiplash and WAD/CCS.

Within minutes, but more often, hours or a few days after a whiplash injury, no matter how apparently minor or obviously intense, many victims begin to experience headaches. These headaches grow in intensity, frequency, and duration over time. Most of these patients have no personal or family prior history of headaches.

Most patients describe these headaches as pounding and throbbing. Some patients experience a tight pressure in their head, sometimes described as knife-like or like a bad tightening around their skull. For those patients who have had migraine headaches in the past, the post-whiplash headache is often described as similar in character, but often much more intense and more frequent.

When experiencing a headache, patients usually describe wanting to be left alone in a quite dark room, and want to try to sleep off the headache. Nausea, and sometimes vomiting is associated with the headaches. Patients often have to leave work or school while experiencing these headaches.

On occasion, coincident with the headache, as in classic migraines, the patient has a warning or aura – often simply a surge in their neck pain, or a neurological change such as word-finding difficulties or weakness.

Eventually these headaches become so debilitating that patients develop difficulty in focus, concentration, short and long term memory, and the general ability to function. They lose their jobs or drop out of college and their social and family life are severely affected.

The whole picture of these headaches places them in the category of intractable migraines. However, most often medications commonly prescribed to treat migraines are not effective.

Whiplash Associated Disorder and the Cranial Cervical Syndrome

Symptoms are usually transient (they come and go) and may include:

- Confusion, Concentration Difficulties, Inability to perform duties at work or in school as a result of the Headaches described above from neck trauma
 - Severe neck pain, pain between the shoulder blades
 - Pain radiating down the arms, back, or legs from the neck
 - Weakness in the arms, dropping objects, fine motor dyscoordination such as change in penmanship, difficulty buttoning, or opening jars
 - Lower extremity weakness, balance problems, veering, falling
 - Bladder incontinence, sexual dysfunction
 - Double vision, change in vision, loss of color vision
 - Facial weakness or numbness
 - Swallowing difficulties, gastric emptying syndrome
 - Myoclonic jerking movements, often repetitive and at night, mistaken for true epilepsy or seizures
 - Autonomic disorders including tachycardia, orthostatic hypotension (primary cardiac issues must be ruled out by cardiac testing), excessive sweating
 - Secondary depression, insomnia, anxiety, loss of social relationships and disruption of personal and Romantic relationships due to the above symptoms
-
-

- **What is neck injury? What is whiplash? How does it happen?**

- There are approximately six million rear end collisions that occur every year in the United States alone. In fact, it is likely that if you are studying this website, you yourself has been a victim of such a collision. The typical scenario is that the victim is stopped at a red light or behind traffic, most often seat belted in place, and a vehicle whose driver is not properly attending to the road, fails to appreciate you are stopped and hits the back of your car.
- Now, as you are seat belted, your body is essentially fixed to the seat, however, your head is not. Your head, therefore, acts like a twenty five pound bowling ball and “whips” forward. Typically, air bags, designed to prevent this, do not deploy except in a head-on crash. In being propelled forward, your head puts enormous forces onto the neck. In other words, your cervical spine experiences a terrific set of strain forces. After your skull reaches the maximum distance it can go forward, as limited by a stretched neck, the skull then bounces back towards the headrest, almost as if connected by a rubber band to your body. This cycle can then be repeated a few times till you and the vehicle come to a complete stop.
- It turns out that the speed of the impact is not the only determining factor as to whether a neck injury can occur out of this event. What determines the amount of strain or stretch force applied to your neck is the force impulse from the collision – in other words, the brief period of time over which the collision actually takes place. The take away message here is that an enormous amount of study has proven that low impact low speed injuries can have devastating effects on the cervical spine as well as high speed collisions.

Diagnosis of whiplash injury:

- Upon presentation to the appropriate medical provider, trained in understanding the nature of whiplash injuries, whether it be a few days or years after the accident, a detailed history will be elicited from you and a comprehensive physical examination will be performed.
- You will then undergo a series of complete radiological imaging studies. The first will include routine x-rays of your cervical spine, then a CT scan and, finally, an MRI scan of the cervical spine. It is at this point that things often go sour for the injured patient. Despite the progression of your symptoms, there is a high probability that

ALL of these radiological studies will be interpreted as normal. Both you and your health provider will be left in a terrible quandary – with no explanation of your symptoms, no effective treatment can be offered.

- The problem is that the conventional x-rays, CT scanning, and even standard MRI scanning, where you are lying flat in the scanner, are not designed to detect, what we now know are the underlying causes of the Whiplash Associated Cranial Cervical Syndrome.
- In order to effectively diagnose the Syndrome, you will need two additional studies. The first, and most important, is the [Cervical Digital Motion X-ray \(C-DMX\)](#) and the next is the upright positional cervical MRI scan (CpMRI).
- DMX is a low radiation computerized digital video fluoroscopic movie of your cervical spine in MOTION. This modality of study facilitates the analysis of the relative stability of the vertebra of the cervical spine, not seen on any conventional static method of X-ray, CT, or regular MRI study. We can use the C-DMX to determine, in particular, if the top two cervical vertebra, C1 and C2, slide abnormally relative to each other. As will be explained below, this is a key to understanding, and, hence, treating, post-whiplash migraine headaches.
- Upright positional MRI scanning facilitates the analysis of the cervical spine in sections revealing damage of important and sensitive ligaments of the spine..
- The scanner is designed to be more open and allows the patient to bend their neck in multiple positions during the study.
- This allows for a detailed analysis of spinal elements, such as the vertebra, discs, ligaments, spinal cord, brainstem, and the vertebral arteries under physiological stress, such as occurs during and after a whiplash injury.
- A much greater understanding of the injuries underlying your symptoms can thereby be obtained, and, therefore, an effective treatment plan can be devised.

• **How does whiplash affect the cervical spine?**

- Your cervical spine consists of a set of vertebral building blocks, held together by the discs, in front, and facet joints, in back. All of this, in turn, is held together by the ligaments in front of, in the middle of, and in the back of the spine.
- In your mind's eye, view these ligaments for the moment as heavy elastic bands. Upon impact with the head thrown forward, the bands can throw the head back and forth; or they can stretch out of shape, leaving the building blocks of the spine loose and unstable upon each other; or the band can tear or rupture, causing one building block to abnormally slide on another, or even completely dislocate with respect to the other vertebrae.
- If the cervical spine is rapidly stretched, or at worst, even dislocated, during the accident, damage can occur to the spinal cord and exiting nerve roots. Permanent

cervical spinal cord injury can occur resulting in devastating neurological impairment. We will not focus on this topic in this overview.

- Additionally, with the ligament damage, can come degeneration of the ligaments and discs overtime. In turn, the disc can dehydrate and fragment and herniate. Thus, the disc fragment can push on the adjacent nerve root, or the spinal cord, causing fluctuating pain and neurological signs and symptoms. We will not focus on this issue either in this portion of the overview.
- On the other hand, the damage caused by a whiplash can be subtle, and more often than not, can be limited to the upper two vertebrae of the cervical spine, that is C1 and C2. Dr. Franck's (neurosurgeon) extensive clinical research has led to an understanding of the crucial relationship of post-whiplash instability of C1 with respect to C2, and the symptoms of intractable migraine headaches and the Whiplash Associated Cranial Cervical Syndrome.

-

• **Whiplash Injury, C1-C2 Ligament Injury, and Cervical Instability**

- The focus of this paper is a concentration on the upper two cervical spinal vertebra; C1 (the Atlas) and C2 (the Axis), along with the lower skull (the Occiput). (A separate paper on the impact on the lower cervical spine may be studied in another section of this website).
- Recall that in addition to the larger ligaments common to the rest of the spine, there are three very small ligaments (the left and right Alar ligament and the central Transverse ligament) hold these structures together. The motion of the Occiput on C1 (primarily flexion and extension) and of C1 on C2 (primarily rotation) are limited by these three ligaments in order to protect the upper spinal cord from injury.
- In a whiplash injury, the forces applied to the skull can cause these ligaments to stretch, or even tear. If that type of event occurs, there will be ligamentous laxity or looseness at C1 and C2 and, possibly at the Occiput. Now, if the ligaments connecting the Occiput and C1 and C2 are truly stretched out of shape, then very abnormal motion of C1 on C2 and of the skull on C1 can occur. In particular, for example, the Occiput can pitch forward on C1. Alternatively, the ring of C1 can pitch forward on the upward peg of C2 (the Odontoid or Dens) and cause forward instability of C1 with respect to C2.
- Of most interest is LATERAL sliding of C1 with respect to C2, when you tilt your head to the right or left. C1 is only supposed to rotate on C2. It is not supposed to laterally slide, certainly by not more than one or two millimeters. Whiplash injuries frequently cause injury to the Alar and Transverse ligaments of C1 and C2. In turn, this causes LATERAL instability of C1 on C2, whereby, C1 can slide, on average,

nearly five millimeters (a quarter of an inch), and up to 9 millimeters (a half an inch) sideways on C2. This can have serious consequences, both in the short and long term, for the victim.

What are the consequences of lateral instability of C1 with respect to C2?

- In worst case scenarios the forces involved can cause a fracture, often devastating, of C1 or C2. In turn, this event can cause profound neurologic deficit or even death. However, more often, a complex syndrome develops over time called the Whiplash Associated Disorder (WAD) or Cranial Cervical Syndrome (CCS). The primary symptom of intractable post-whiplash migraine headache and many of the associated symptoms are described in an adjoining section discussing the symptoms “qualifying” patients for surgery.
- There other causes of whiplash injury to the cervical spine. Basically, any trauma can cause the whiplash phenomenon in the neck, at any age, and at virtually any intensity. These include sports injuries, accidental injuries sustained when playing with children, and diving accidents, to name but a few.

Other Symptoms of Whiplash

In addition to intractable headaches, a whiplash injury to the neck can cause a host of other symptoms – hence the terms Whiplash Associated Disorder/Cranial Cervical Syndrome. These symptoms vary widely over time as regards their intensity and location and characteristics. Physical therapy, although it may be a useful adjunctive treatments, most often does not lead to a long term resolution of the problem. These symptoms may include:

- Neck pain – along with headaches, neck pain will develop within minutes, hours, or days of the incident causing the whiplash. The pain is most often paracervical, that is, it involves the muscles of the neck adjacent to the actual spine. Patients experience burning knifelike pain, severe spasms, tenderness, and limitations in range of head and neck motion. The pain will often spread to the trapezius muscles above the shoulders. These pains often predict for a migraine headache.
- Radiating or “Radicular” Pain: Patients will report shooting or constant pains in the arms, back, and legs, usually originating in the neck.
- Weakness in the arms, dropping objects, fine motor dyscoordination (such as changes in penmanship, difficulty with buttoning or opening jars), as well as numbness and “pins and needles” (paresthesia).

- Lower extremity weakness, balance problems, veering off when walking, and experiencing multiple falls.
 - Bladder incontinence and sexual dysfunction. Marital and romantic relationships are often severely affected by these phenomena.
 - Double vision (diplopia), change in visual acuity, or loss of color vision.
 - Facial weakness or numbness.
 - Swallowing difficulties (dysphagia), choking on food, and gastric emptying syndrome (gastroparesis).
 - Myoclonic jerking movements, often repetitive and at night, mistaken for true epilepsy or seizures
 - Autonomic disorders: Patients will be told they have "POTS" – postural orthostatic tachycardia – the symptoms of which include a rapid pulse and drop in blood pressure when standing. Cardiac testing should be done to rule out a cardiac issue that can be treated. Some patients have excessive sweating ("hyperhidrosis").
 - Secondary depression, insomnia, anxiety, loss of social relationships and disruption of personal relationships
-

Most patients who are experiencing the WAD/CCS Syndrome are shunted from one health provider to another. The reasons for this are simple: Medical providers are trained to logically group the neurological symptoms presented by the patient into categories that can be localized or pin-pointed in terms of medical drug treatments. When that is accomplished, a medical rational treatment program can be designed. However, in the case of whiplash, the symptoms are so variable over time that localization to one area in the nervous system or spine is not necessarily obvious.

Therefore – as one practitioner fails to understand the problem, another takes their place. A vicious cycle begins, whereby the patient is told "nothing can be done" or ineffective long term solutions are instituted. Eventually, after seeing two, three, or literally dozens of health providers, and traveling often to many countries for help, patients give up. Eventually they are told they are faking the problem, and end up in psychiatric care or chronic pain management clinics, being administered narcotics such as methadone, morphine, oxycontin, to name but a few.

However, Dr. Franck, building on an extensive body of fascinating research described in the medical literature, has developed an understanding and well-tested theory of the causes of this syndrome. We can, in fact, now localize or pinpoint the causes of this syndrome. As a result, a highly effective minimally invasive surgical treatment for this debilitating syndrome is being performed by Dr. Franck. Patients from all over North America and Europe have been treated with excellent results.

What is the Cause of Post-Whiplash Intractable Migraine Headaches, Whiplash Associated Disorder, and Cranial Cervical Syndrome?

We can now explain the cause of these often horrendous symptoms and the whole gamut of patient complaints after whiplash injuries, based on a new understanding of the underlying anatomy.

Recall that normally the brain is fed oxygen by its blood supply of four major vessels.

Anteriorly, or towards the front part of the brain, the blood supply originates from the two carotid arteries. Classically, stroke or transient ischemic attacks (TIA's – reversible mini-strokes), occur because of hardening of these arteries.

Posteriorly, or towards the back of the brain, the blood supply originates from the two vertebral arteries. These are the arteries that we are interested in for an understanding and treatment of whiplash.

Now, remember that the vertebral arteries run adjacent to the cervical spine, and, in fact, travel through channels in the each cervical vertebra (the foramen transversarium). When the vertebral arteries finally arrive at the uppermost cervical vertebra, C1 or the Atlas, they curve up and over the lamina or ring of the Atlas and enter the skull to supply the back part of the brain.

The four critical areas supplied by the vertebral arteries include the upper cervical spinal cord, the cerebellum (involved in balance and fine motor control), the occipital lobes (the part of the brain involved in vision), and most importantly, the brainstem.

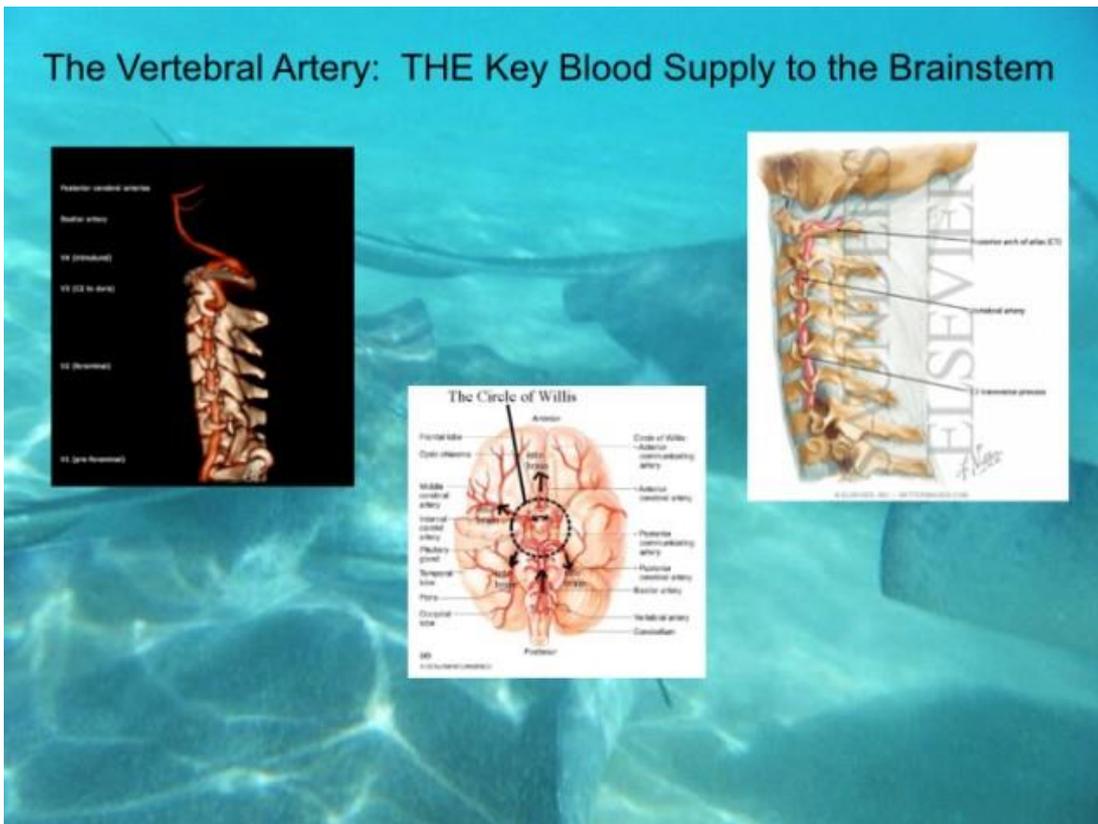
The brainstem is the "core of the brain". All the information handled by our brains from the outside world and from inside our bodies has to travel through the brainstem via complex nerve tracts – similar to transmission lines. Further, all commands from the brain on down through the spinal cord to our muscles and organs travel through the brainstem.

The brainstem itself, not only is a way station for all of this "to and from" data and commands, but also a critical command center. It is composed of hundreds of groups of nerve cells serving specific functions called nuclei.

These focal groups of cells or nuclei control our level of consciousness. Essentially, they keep us awake and aware. In extreme cases of damage in a major trauma the patient will be in a coma.

Other functions include regulation of our vital functions – blood pressure, pulse, breathing, sweating, digestion, bladder and sexual function, to name a few.

The brainstem also controls all sensation via its transmission lines, and all cranial nerve functions – that is nervous control of the head – vision, facial sensation and movement, chewing, swallowing, eye movement, tearing, again to name a few.



So consider all four of these critical areas of the brain, especially, the brainstem, function because they are fed oxygen by the two vertebral arteries, measuring less than an eighth of an inch in diameter, which are located on, and intimately connected to the cervical spine.

Now, recall that normally, the various ligaments connecting the vertebral building blocks of the cervical spine and the skull, limit the motion of each vertebra relative to each other. Recall also that the vertebral artery runs through channels on the side of each vertebra. Therefore, the stretch or tension exerted on the vertebral arteries by movement of the neck and head is limited.

Now, in a whiplash injury, these ligaments may get damaged – sometimes severely so. This is particularly true as regards the Alar ligaments and Transverse ligaments, connecting C2

(the axis), C1 (the Atlas), and the Occiput (Bottom of the skull). As explained before, the Cervical DMX and the Upright MRI demonstrate that in whiplash damage to these ligaments causes abnormal lateral, side to side, sliding of C1 on C2.

This lateral sliding causes abnormal tension on the vertebral arteries. We have demonstrated this in the operating room by directly observing that vertebral artery flow is disrupted by the laxity and abnormal loose movements of C2 and C1.

Abnormal tension on the vertebral arteries causes a wave of spreading contraction in these vessels and this may be the origin of the severe intractable headaches. These post-whiplash disabling headaches are most often described as pounding and throbbing, characterizing them as "common migraine" headaches. This subjective feeling reflects the vascular nature of the headache – waves of vascular contraction and dilatation.

Further, abnormal tension on the vertebral arteries is demonstrated to disrupt their flow and especially affects the small arteries that perforate into the brainstem and supply oxygen to various critical areas. This is especially true of the portion of the vertebral arteries before they join together further up in the brainstem to form the basilar artery.

Therefore, with abnormal lateral sliding of C1 on C2 after whiplash injury, the brainstem is temporarily or transiently deprived of oxygen – hence, the various critical nuclei of nerve cells temporarily cease to function. The patient, thus experiences all of the various strange and unusual symptoms of the Cranial Cervical Syndrome. Hence, the patients are experiencing transient brainstem reversible mini-strokes – or "posterior fossa TIA's" – the posterior fossa being that part of the skull in which the brainstem resides.

There is more: Recall that many whiplash patients who sustain Alar and Transverse ligament damage develop inflammation at C1-C2 in the spinal canal. A mass develops in that area which we describe as C1 Capsulosynovitis. Further, many of these patients also develop a sinking of the posterior part of the brain, including the cerebellum, into the opening of the skull base – the foramen magnum, which is called Cerebellar Tonsillar Ectopia.

Together, these two phenomenon cause severe crowding and pressure on the brainstem and vertebral arteries, especially with flexion, extension, and rotation of the neck. Therefore, there is transient dysfunction of the brainstem, causing all the different and unusual symptoms of the Cranial Cervical Syndrome.

Finally, there is one more pathological phenomenon that may contribute to the Syndrome. Cerebrospinal fluid (CSF) is produced in the center of the brain in a space called the

ventricles. CSF is an “ultra-filtrate” of blood, and is essentially similar to ocean salt water. It also contains immune related proteins and other factors. The CSF circulates around the brain and spinal cord after leaving the ventricles and then is reabsorbed on the top of the brain.

After a whiplash injury that abnormally affects the upper cervical spine, as mentioned, the opening of the base of the skull, the foramen magnum gets compressed or crowded. This can be demonstrated to adversely affect the flow of CSF around the brainstem and spinal cord. This may play a role in the development of the Cranial Cervical Syndrome.