# Hypothesis: Osseous Spinal Injury & Reinjury As A Risk Factor, Biomarker and Etiological Factor in Sporadic ALS

by David A. Steenblock, MS, DO

**Abstract**

In my role as a practicing physician focused on neurological diseases and insults for over 28 years, I have handled a great many individuals with amyotrophic lateral sclerosis (ALS). Over time, I noticed that an inordinately high percentage of my sporadic ALS patients (sALS) patients presented with specific degenerative bone changes in their vertebral columns. In 2015 I conducted a retrospective study using data from 54 sALS patients whom I handled from 2011 to 2015 who had a CT scan of the cervical and/or lumbar spine. I found that 52 of the 54 had telltale signs of degenerative pathology and a history of spinal injury and (in many instances) reinjury to the original injury site. In order to help insure that my interpretation of the CT scans was accurate, I had a radiologist read them. He found that 52 of the 54 sALS patients had degenerative changes in their spinal columns, consistent with spinal nerve stenosis-induced injuries (but not spinal cord injuries).

These findings, in concert with findings reported by Garbuzova-Davis et al. and Valdes and Garbuzova-Davis, suggest this hypothesis: namely, that an initial traumatic injury to a part of the spinal column (usually the cervical spine) causes degenerative changes of the vertebral bones over time, which acts as a trigger for and player in the development of sALS.[1,2] If upheld, the posited linkage will provide researchers and physicians with a risk factor, diagnostic biomarker and etiological player in sALS.

**Keywords**: sporadic ALS, cervical trauma, blood-CSF barrier breaches, sALS etiology, cervical stenosis

## Introduction

Amyotrophic lateral sclerosis (ALS), as originally defined by French neurologist Jean Martin Charcot in 1874, involves the simultaneous involvement of the corticospinal tract and anterior horn cell neurons, the hallmark of which is the selective degeneration of motor neurons in the spinal cord, motor cortex, and brainstem.[3,4] At the end of the 19th century, British neurologist William Richard Gowers expanded on Charcot's early research, concluding that multiple progressive diseases affecting both the upper and lower motor neurons, once believed to be distinct, were actually syndromic variations of the same disease.[5]

The first description of sALS that relates to the hypothesis and findings reported in this article goes back to Gowers, who originally described the onset of the disease as initially affecting a peripheral appendage, then damaging other parts of the same limb as the disease progressed. After manifesting in a single limb, symptoms would then often appear in the other side of the body, particularly in the corresponding limb where the original symptoms began.[5,6] While these symptoms still puzzle researchers today, I have witnessed clinically that Gowers's observations hold true for most patients, and are clear hallmarks of the disease. What I found is that the disease often begins initially in areas where spinal injury and reinjury has occurred, which corresponds to motor neurons whose activity has been compromised, which is consistent with the unilateral weakness of the corresponding arm or leg that has been seen to develop soon after such trauma in the vast majority of my patients with sALS (2011–2015).

## Hypothesis

A number of risk factors for sALS have been identified; however, no published studies have revealed a specific risk factor that can both trigger disease onset and be treatable so as to remediate, slow, or halt its progression.[7] What I have uncovered in sALS patients is a pattern of cervical injury in young adulthood followed in time by arthritic changes and neuroforaminal stenosis. Many years later, a reinjury of the original injury site occurs, and shortly thereafter ALS symptoms develop. These clinical observations led me to posit that an initial cervical injury, followed later by a subsequent reinjury of the same area, is not incidental or inconsequential in sALS sufferers but causes degenerative changes of the vertebral bones over time, which acts as a trigger for and player in the development of sALS .

## Materials and Methods

Fifty-four sALS patient charts with CT scans of the neck and spine were selected, dating back to 2011. These represented all of the sALS patients whom I had seen during this 4-year period. Those with and without spinal pathology were included in the analysis. Patients with spinal pathology (n = 52), in the form of identifiable neuroforaminal stenoses visible on their CT scans (n = 336 injuries), then had their

➤

## Hypothesis

➤

injury site coded, tabulated, and graphed by location (cervical, lumbar).

As a primary means of determining the damage in the CNS, I made a point of reviewing the computerized tomography (CT) scans of my sALS patients to identify abnormalities of the cervical spine. I found them to be present in 52 out of my 54 sALS patients. Neuroforaminal stenoses, in particular, indicated areas of potential nerve damage and inflammation, and additional analyses revealed herniation from spinal disc avulsions, as well as other disc challenges (Figure 1).

A radiologist reviewed the CT scans and concurred with what I had seen and noted in terms of cervical bone pathology.

Figure 2 reveals that while some injuries were more common than others, the sheer magnitude of the documented injuries indicates a distinctive trend in the sALS population whom I studied.

Though the injuries may have been sustained in different locations along the spine (with most being cervical) and at different times throughout the patients' lives, the commonality is clear. And when compared with healthy individuals, these injuries clearly signal that repetitive spinal trauma is a unique risk factor for the disease (especially when it produces some type of spinal motor neuron constriction and or avulsion upon reinjury). Also, in my experience, *if* the patient does not have evidence of vertebral column bony pathology consistent with a constriction, avulsion, or injury of at least one spinal motor neuron, and in particular does not have cervical neuroforaminal stenoses, the original diagnosis of sALS should be reevaluated and other conditions considered anew.

What is especially telling about my simple study is this: In at least one anatomical study involving cadavers, it was revealed that 4.9% of adults had evidence of cervical stenoses.[8] With there being 12,187 ALS patients in the US, according to CDC statistics published in 2010–2011, 1 in 20 individuals would be expected to have evidence of cervical stenoses.[9] In my study population of 54 sALS patient, one would expect to see 2.65 cases of cervical stenosis, whereas I documented 52 cases in total.

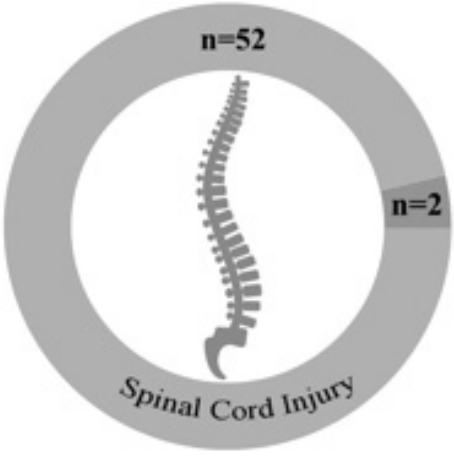



**Figure 1: Spinal Injury Versus Noninjury in Cases of Patients With sALS.**
Of the total tested sALS patients in this study (n = 54), 52 revealed evidence of spinal cord injury, while only 2 showed no signs on a CT scan or after physical examination.

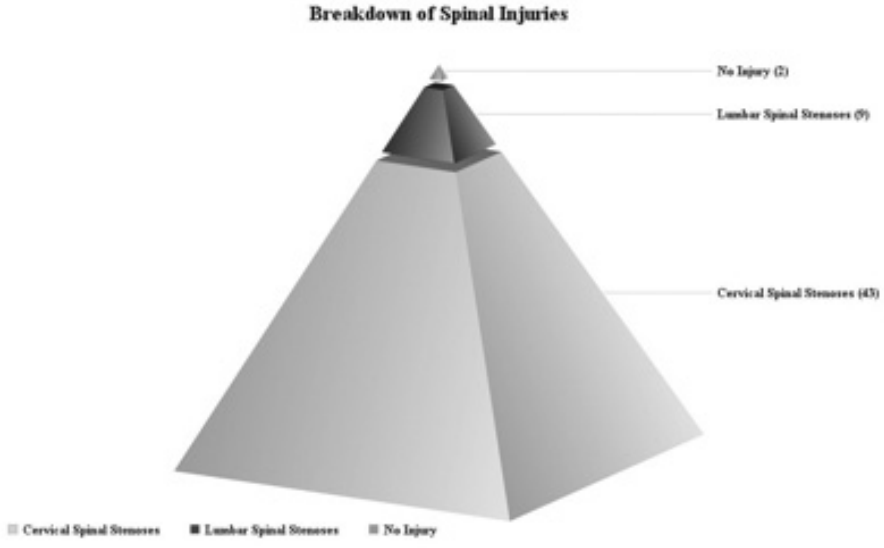



**Figure 2: Understanding the Breakdown of Spinal Injuries in Patients with sALS.**
Looking further into the distribution of injuries, we see that a total of 9 patients revealed lumbar spinal stenoses on a CT scan, while 43 showed cervical spinal stenoses. Two patients had no signs of injury.

**Discussion**

Trauma as a risk factor and antecedent trigger for sALS has been detailed in epidemiological studies for many years, while conflicting and contradictory evidence have left the research community unsure as to the connection between single incidence trauma, multiple incidences of trauma and the initiation and pathoprogression of sALS.[2] For scientists investigating single incidences of trauma, the correlation between such events and the disease are nearly nonexistent in many cases and tenuous at best in others.[10] However, for researchers who have studied patients with multiple traumas, the relationships are clear and are seen to have significant correlations to the damage seen in the CNS.[11] By investigating populations with a higher incidence of repeated trauma, such as athletes and soldiers, scientists have posited that trauma be considered as a risk factor or trigger for the disease.[11,12] However, while some studies have even found that military veterans who experience head injuries, for example, are as much as 2.33 times more likely to develop ALS than other veterans who avoided such traumas, current reports lack detailed documentation of the exact damage sustained.[13]

Physicians who do neurologic exams of patients with trauma-related motor neuron issues, or other suspected conditions involving compromised motor neuron functioning or degeneration, routinely have cervical spine CT scans one to rule out cervical myelopathy or radiculopathy as treatable causes following the onset of symptoms. During 40 years of clinical practice, I have noted and casually evaluated the relationship between sALS and cervical vertebral osteoarthritis, disc compression, disc avulsion, neuroforaminal stenosis, and so on of the cervical spine, as seen on CT, MRI, and X-rays in patients of mine suffering

from the disease (FIgures 3 and 4). Regrettably, the correlations that I found were dismissed out of hand by specialist colleagues, all of whom indicated that these abnormalities of bony structures of the spine had no bearing on the disease, since no cord compression was seen. On the other hand, my clinical sense told me that there had to be some type of relationship between the consistency of vertebral bony structural abnormalities routinely seen in ALS patients' CT scans and the etiology of the disease.

Contrary to common neurological teachings and dogma concerning this disease, my patients presented with outright neck or back pain and/or chronic aches and discomfort involving the posterior neck. These symptoms were usually present for many years, to the point that they are deemed relatively "normal" by them. When vigorously palpated, the areas overlying the neuroforaminal stenoses as seen on the CT are tender and painful, indicating a chronic inflammatory process. Published research into disc herniations and avulsions indicate that there is a strong correlation between spinal nerve compression and greater pain sensitivity, due to the fact that spinal injuries such as these cause decreased blood flow, not only in the spinal nerve but also in the connected nerve fibers that radiate pain to the corresponding extremities.[14]

I found that upon careful questioning of sALS patients and their families, most recalled a cervical injury that they had dismissed or forgotten. Occasionally the patient and family could not remember a specific trauma incident, but the patient still had palpable tenderness over the posterior cervical spine overlying the neuroforaminal stenoses, as seen on their CT scan. Infrequently the patients were diagnosed as having a radiculopathy, yet little or no neuroforaminal stenoses will be seen on the CT image. These patients invariably have (a) palpable tender spot(s) over the perispinal process at the location where the nerve is being compressed. These tender areas are believed to be areas of nerve root avulsion or constriction, for some other reason than the bony neuroforaminal stenosis, as is seen in most other patients.

While this posited correlation of spinal column injury (and often reinjury of the same area) with sALS onset lies at the heart of my hypothesis and is testable, scientists and physicians who work with ALS will naturally ponder how such bone pathology could trigger this insidious disease process.

➤

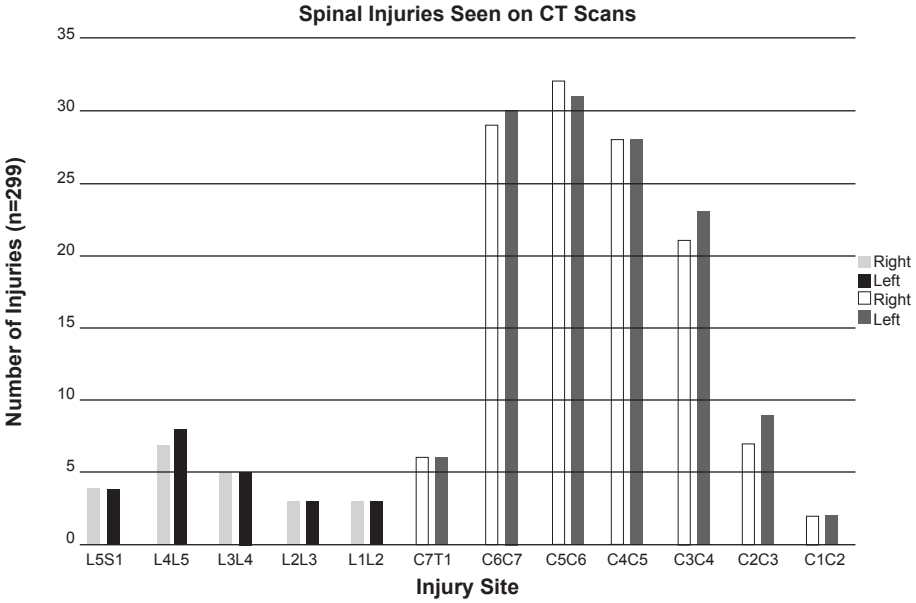



**Figure 3: Distribution of Spinal Injuries, Specific to Site.**
Combined onto one graph, both distributions of lumbar and cervical spinal stenoses are accounted for in this diagram, to illustrate the extent and location of all injuries.

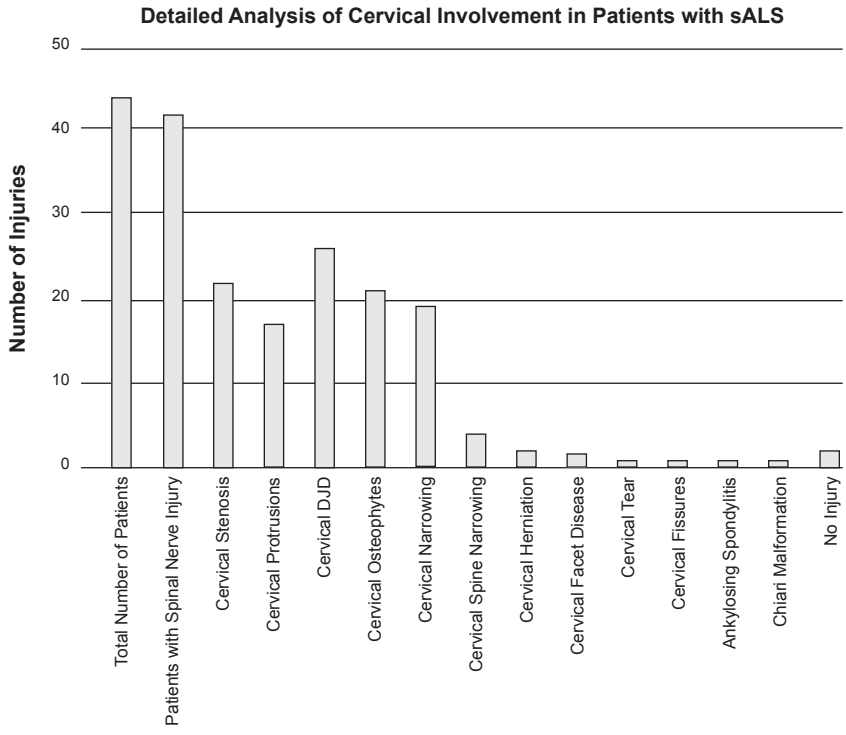



**Figure 4: Detailed Analysis of Cervical Involvement in Patients with sALS.**
Looking into the injury sustained by these patients, we have found that cervical involvement occurs in 12 distinct types of injury. Here they are characterized in this bar graph individually, illustrating the many types of biomarkers physicians can look for to help in discovering a cause or trigger for sALS.

## Hypothesis

➤

What I suspect is that spinal column injury and reinjury creates a "breach" in the blood–spinal fluid barrier that becomes inflamed and admits neurotoxic misfolded proteins, pro-inflammatory cytokines, activated monocytes, and so on, into the central nervous system. It is anticipated that this process is responsible for the CSF aggregates linked to motor neuron destruction, and that this process may stimulate execution of necroptosis in astrocytes, which is selectively destructive to motor neurons.

Interestingly, the descriptions of the neurovascular components of ALS described by Garbuzova-Davis and Sanberg in 2014 are in my opinion consistent with the spinal motor nerves being recently reinjured and developing a blood-CSF barrier breach or breaches.[15]

One way in which blood–CSF barrier breaches might be readily (and noninvasively) revealed is by having Fonar Upright MRI scans done of sALS patients. This sophisticated scanner was used in one seminal study which linked craniocervical trauma and resulting pathology in multiple sclerosis patients to dynamically visualized abnormalities in CSF hydrodynamics, which is hypothesized by the authors of the study as to play an "important etiologic role in the genesis of Multiple Sclerosis."[16]

### Concluding Remarks

If the correlation of spinal column osseous pathology caused by injury (and reinjury) to the onset of sALS is upheld in subsequent research, it follows that earlier diagnosis and treatment of the disease swifter and more certain. Accordingly, it is my sincere hope that researchers and clinicians reading this article will question their patients with respect to a history of both remote and recent neck injuries, then study their patients' cervical spine CT images and palpate to identify areas of inflammation (especially those that point to the presence of a blood-CSF barrier breach). In those patients presenting with evidence of injury or recent reinjury, I would urge these professionals to examine them for neuroforaminal stenoses and spinal motor axonal constriction, then to tabulate, analyze, and publish findings that substantiate the hypothesis I have posited herein, bring it into question, or overturn it entirely.


### Disclosure of Interests

Other than seeing and treating sALS patients as a licensed physician, I have no other conflicting interests.

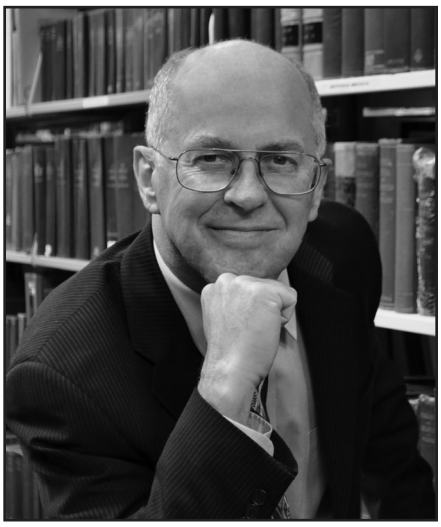
### Acknowledgments

Thanks to Donna Hanna, ND, for input on data analyses and graphing, and to Anthony G. Payne, NMD, PhD, and Ryan Wallace for writing, formatting and editorial input.


### Notes


1. Garbuzova-Davis S, Rodrigues MC, Hernandez-Ontiveros DG, et al. Amyotrophic lateral sclerosis: a neurovascular disease. *Brain Res*. 2011;1398:113–125.
2. Valdes EG, Garbuzova-Davis S. Brain and spinal cord trauma as a risk factor for amyotrophic lateral sclerosis: a mini-review. *Open J Neurosci*. 2013;3–4.
3. Hovden H, Frederiksen JL, Pedersen SW. Immune system alterations in amyotrophic lateral sclerosis. *Acta Neurol Scand*. 2013;128:287–296.
4. Charcot JM. Sclérose latérale amyotrophique. In: *Oeuvres Complètes*. Vol 2. Paris. Bureaux du Progrès Mèdical: 249–266.
5. Turner MR, Swash M, Ebers GC. Lockhart Clarke's contribution to the description of amyotrophic lateral sclerosis. *Brain*. 2010;133(11):3470–3479.
6. Gowers WR. *A Manual of Diseases of the Nervous System*. Vol. 1. P. Blakiston's Sons & Company; 1896.
7. Ingre C, Roos PM, Piehl F, Kamel F, Fang F. Risk factors for amyotrophic lateral sclerosis. *Clin Epidemiol*. 2015;7:181.
8. Lee MJ, Cassinelli EH, Riew KD. Prevalence of cervical spine stenosis. Anatomic study in cadavers. *J Bone Joint Surg Am*. 2007 Feb;89(2):376–380. PubMed PMID:17272453.
9. Prevalence of amyotrophic lateral sclerosis – United States, 2010–2011 [Web page]. CDC. http://www.cdc.gov/mmwr/preview/mmwrhtml/ss6307a1.htm.
10. Pupillo E, Messina P, Logroscino G, et al. 2012.
11. Lehman EJ, Hein MJ, Baron SL, Gersic C.M. Neurodegenerative causes of death among retired National Football League players. *Neurology*. 2012;79(19):1970–1974.
12. Haley RW. Excess incidence of ALS in young Gulf War veterans. *Neurology*. 2003;61(6):750–756.
13. Schmidt S, Kwee LC, Allen KD, Oddone EZ. Association of ALS with head injury, cigarette smoking and APOE genotypes. *J Neurol Sci*. 2010;22–29.
14. Shchurova EN, Khudyaev AT. Relationship between the blood flow in a spinal nerve root and its functional state in patients with lumbar disk hernia. *Hum Physiol*. 33(1):69–74.
15. Garbuzova-Davis S, Sanberg PR. Blood-CNS barrier impairment in ALS patients versus an animal model. *Front Cell Neurosci*. 2014;8:21.
16. Damadian RV, Chu D. The possible role of cranio-cervical trauma and abnormal CSF hydrodynamics in the genesis of multiple sclerosis. *Physiol Chem Phys Med NMR*. 2011;41:1–17. PubMed PMID:21970155.


◆




Dr. David A. Steenblock earned his BS degree from Iowa State University, then an MS in biochemistry and doctor of osteopathy (DO) degree from the College of Osteopathic Medicine and Surgery in Des Moines, Iowa. His postdoctoral training included three years at Case Western Reserve University, one year at the Oregon Health & Sciences University, and a clinical rotating internship at Providence Hospital in Seattle, Washington.

During the late 1970s he founded the first integrative medicine clinic west of the Mississippi River. In the years since, he has done pioneering clinical work including the use of hyperbaric oxygen therapy to treat stroke (starting in 1989), live cell therapy 1991–2001 (Mexico), umbilical cord stem cell therapy (Mexico from 2001) and, since 2005, stem cell rich bone marrow aspirate concentrate (BMAC) therapy for a variety of conditions.

In October 2015 he was awarded the Academy of Comprehensive Integrative Medicine's (ACIM) "Lifetime Achievement Award" at its NeuroRegeneration Conference (Orlando, Florida) in recognition of his many years of contributions "to the betterment of mankind and the advancement of integrative medicine."

In 1978 Dr. Steenblock saw his first ALS patient, who had severe degenerative spine disease but did not have cord compression and was told by specialists that the osteoarthritis and perispinal calcification had nothing to do with the disease process. This observation led to a lifetime of observing ALS patients in regard to their having chronic degenerative joint disease and trying to determine how this relates to the underlying disease processes. Dr. Steenblock's clinic is devoted to understanding and treating this disorder with a state-of-the-art approach. To this end he has a microbiology lab to study the patient's biofilms and how to treat this effectively and also a state-of-the-art molecular biology lab with a variety of instruments including a flow cytometer, FT-IR spectrophotometer, and HPLC. Currently there are three PhD molecular biologists working with Dr. Steenblock, who is in charge of the research.

Dr. Steenblock's e-mail address is Drsteenblock@yahoo.com. His clinic phone number is 800-300-1063 and his websites include www.strokedoctor.com,www.stemcellmd.org, and www.stemcelltherapies.org.