

Industrial Injuries to the Upper Extremities, Part I

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Double Crush Syndrome: the Great Impostor of Industrial Carpal Tunnel Syndromes

Most industrial safety programs and projects have been directed at the lower back. Lower back injuries generally are related to incident or single occurrence injuries, which makes them easier to document as work-related. Because most upper extremity injuries are related to repetitive microtraumas or occupational injuries, they didn't fit the industrial definition of work-related injuries, and thus went unrecorded for many years. With the recognition of both incident and occupational injuries, repetitive motion injuries have come into the forefront of injury prevention programs.

Carpal tunnel syndrome is one of the fastest growing recordable industrial injuries in America. The latest statistics indicate that recordable repetitive motion injuries to the upper extremities are rapidly approaching or may have surpassed low back injuries. With this ever-increasing reporting of extremity neuropathies, each practitioner in any physical medicine field will face the challenge of accurate diagnosis of the presenting symptoms and, possibly of even more importance, to find the true cause of the symptoms.

Carpal tunnel syndrome is probably the most diagnosed and potentially misdiagnosed upper extremity condition related to work injuries. Many conditions diagnosed as carpal tunnel syndrome are in fact another condition, such as double crush syndrome. "It is known from clinical investigations that there is an over representation of carpal tunnel syndromes in patients suffering from cervical radiculopathy."¹ Patients misdiagnosed can undergo extensive and unnecessary treatment, including surgery, which costs industries thousands of dollars in lost time and medical payments.

Chiropractors who treat the cervical spine for patient complaints related to carpal tunnel type symptoms are often chastised by the medical community. Many IME physicians incorrectly deny claims as medically unnecessary, because of a lack of knowledge of entities such as double crush syndrome. IMEs may only look at the area of expression of symptoms at the wrist/hand region, missing the multiple other sites that could be causing or contributing to the symptoms.

The theory of double crush in the literature of medicine challenges the medical field to open their minds to the notion of proximal irritation that contributes to distal expression of symptoms. This revolutionary concept in medicine is almost comical to the physician in the chiropractic field. Chiropractors from their very roots have accepted this hypothesis and because of this, the chiropractic profession is well equipped for the evaluation and treatment of potential multiple etiologies of upper extremity symptomatology. "The recognition of the cell body and axon as being

parts of one cell, continuous from the spinal cord to the periphery, helps to understand why compression at one level might induce functional changes also at other levels."² "The interaction between nerve cell bodies and their peripheral targets, mediated via bidirectional axonal transport, is of fundamental importance for our understanding of pathophysiology of nerve compression lesions."³

Using differential diagnosis, the chiropractor can assist industries in their fight to reduce both costs and injuries related to the upper extremities. Perhaps even more importantly, this ability saves patients from misdirected care. The following information and references are provided to both assist the chiropractor with differential diagnosis of industrial injuries to the upper extremity, and to assist in the defense against false denial of treatment of necessary procedures to the upper extremity.

What is Double Crush?

The hypothesis for double crush was first expressed by Upton and McComas in a Lancet⁴ research article. They found electrophysiological evidence of cervical neural lesions associated with carpal tunnel and ulnar nerve entrapment syndromes. The researchers concluded that the neural lesions in the neck resulted in serial constraints of axoplasmic flow of nerve fibers. Thus, distal neural function could be impaired when single axons, having been compressed in one region, become especially susceptible to damage in another. Subsequent studies have reinforced the theory of Upton and McComas.

A more recent article⁵ found that "acute and chronic compression of peripheral nerves can induce changes in intraneural microcirculation and nerve fiber structure, increase vascular permeability (with subsequent edema formation) and impair anterograde and retrograde axonal transport, all of which contribute to the clinical symptoms and deterioration of nerve function."⁶ "The cell body response is probably an expression for lack of neuronotrophic factors synthesized by Schwann cells or target tissues. Sick nerve cell bodies will not be able to manage an adequate anterograde axonal transport, and the proximal part of the axon may thereby suffer from a deficient supply of materials. In this way a proximal nerve compression may hypothetically predispose a distal area of the nerve to increased susceptibility to irritation."⁷

Osterman found that with a more proximal root compression less involvement or compression of the median nerve across the carpal tunnel was required to produce symptoms."⁸ Hurst et al.⁹ studied 1,000 cases of carpal tunnel syndrome and found a significant incidence of bilateral carpal tunnel syndrome in patients with cervical arthritis. They felt that double crush syndrome predisposes a person to carpal tunnel syndrome, and may be an explanation for some of the failures following carpal tunnel surgery.

Golovchinsky¹⁰ pointed out in a 1995 study that cervical radiculopathy was found in 91.8% of cases with entrapment syndromes. Where there was severe cervical radiculopathy, the authors found an increase in the severity of motor fiber impairment while the sensory fibers remained the same. They concluded that "damage of the proximal stretch of nerve fibers can provoke or facilitate development of peripheral nerve entrapment syndromes. Consequently, thorough evaluation and aggressive treatment of neck problems may be indicated in cases of double crush syndrome."

As with any concept, there are pro and con opinions. A recent study by Clawson¹³ investigated whether diseased nerves are more prone to entrapment neuropathy than normal nerves. While the author's conclusion "casts doubts" on the hypothesis of double crush, if you look closely at the

results, the tests documented that nerves with amyotrophic lateral sclerosis and ulnar nerve entrapment underwent a more rapid axonal loss than nerves with a single pathology (amyotrophic lateral sclerosis or ulnar nerve entrapment). While in the author's opinion there was "casted doubt" on single site or condition which could cause double crush syndrome, their research still demonstrated that upper extremity disorders involving multiple sites or conditions caused axonal loss in the nerve which could lead to double crush syndrome.

Evaluation and Differential Diagnosis

Carpal tunnel syndrome is by far the most diagnosed (right or wrong) upper extremity condition. While multiple etiologies for upper extremities exist, most physicians' research has been directed towards occupational repetitive motion induced injuries. Employers have used pre-employment screening as a tool in an attempt to decrease upper extremity injuries, however, the implementation of the Americans with Disabilities Act has made the majority of pre-employment screenings illegal. Ergonomists, industrial physicians and occupational nurses have all concentrated on wrist position, but because of long course of nerves and the vulnerability of the nerve at multiple sites, many positions and compression areas go unevaluated.

Proper industrial history, including all aspects related to the upper extremity nerve path, should be evaluated by the chiropractor to ensure no nerve compression sites are overlooked. Evaluation of median nerve compression in the wrist or even forearm (without regard to the potential for proximal compression in the elbow, shoulder or cervical spine) may decrease both the rate and ability for the injury to recover.¹¹ The clinician needs to inquire about body positions at work, along with cycles of action of the tasks required of the patient's job. Both recovery and work times need to be recorded to assist with total understanding of the functional and physiological requirements of the position.

The clinical history should elicit the patient's complaints of pain, sensory disorders, loss of motor function, and functional joint motions. Questions related to development of the symptoms, areas involved, aggravations of the condition, previous treatments or physicians, medications which could affect the condition or potentially cause the condition, and any systemic conditions such as diabetes which would affect nerve function.

The clinician also needs to look at all contributing factors that may lead to a compression syndrome: repetitive muscle contraction; body posture; increased fluid volumes; or decreased volume of any of the many anatomical canals.

The range of compression causes are almost endless: fibrositis; cervical spondylosis; arthritis; spinal stenosis; herniated cervical disc; cervical ribs; pregnancy; apical lung tumors; and muscular anomalies. Examples of potential areas of compression are:

1. median nerve forearm compression syndrome (compression in the distal third of the humerus beneath a supracondylar process and the ligament of Struthers compresses on the median nerve);
2. scalenus anticus compression syndrome (nerve is compressed in the lower trunk of the brachial plexus region between the anterior and medial scalene muscles and the first rib);
3. pectoralis minor syndrome (occurs at the attachment of the coracoid process); and
4. pronator compression syndrome (compression of the median nerve at or near the pronator muscle).

Niwa, et al.¹² used the following criteria to diagnosis double crush syndrome. While not inclusive of all possible criteria, it provides documented research guidelines for the chiropractic physician to assist in the diagnosis of double crush syndrome:

1. radiological evidence of cervical spondylosis or ossification of posterior longitudinal ligament of the cervical spine on x-ray films;
2. MRI imaging of spinal cord compression;
3. neurological deficits in the upper extremities; and
4. clinical and or electrophysiological evidence of entrapment neuropathies in the upper extremities, namely carpal tunnel syndrome, diagnosed by pressure provocative or nerve conduction velocity tests.

Treatment Outline

The physician who will have the highest level of success treating upper extremity conditions is armed with a wide array of treatment options that take into account the multiple causes outlined above, including treatments aimed at muscular, bony, fibrotic, nervous, edemous tissues and systemic systems.

Treatment options include: spinal manipulation; joint mobilization; spray and stretch technique; deep tissue massage; cross-friction massage; therapeutic stretching; and rehabilitation programs aimed at modification of postures and contributing activities.

Conclusion

When looking at industrial repetitive microtrauma injuries of the upper extremities, the physician must investigate not only the activity that potentially generated the condition, but also what factors may have impaired the patient's recuperative capabilities to heal.

The human body has great recuperative powers given the opportunity to repair itself. All that is generally needed for recovery under normal use are sufficient intervals of rest between episodes of work cycles. But with compression of the proximal nerve, which is found in a double crush syndrome, the body's tissue resistance decreases and the need for recovery time increases, causing symptoms along the path of the distal portion of the nerve and subsequent tissues innervated by that nerve.

The astute practitioner will take a wide open look at the many possible factors that may be contributing to the compression or interference of proper nerve axonal flow: factors which could be affecting areas of the body producing symptoms distant from the actual compression site. As the literature comes full circle and supports the view of proximal irritation contributing or causing distal expression of dysfunction, it becomes increasingly frustrating how chiropractors have chosen to forget this fundamental concept. Hardly a week goes by without a doctor of chiropractic calling our offices for assistance with an upper extremity case that has not responded to care. The doctor proudly names a battery of tests that confirm a focal lesion in the wrist region, but has ignored any investigation proximal to the complaint, including the cervical spine.

When diagnosing and treating upper extremity injuries, don't forget to investigate the nervous system from its most proximal origin to its most distal reaches for a potential double crush syndrome component.

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