

***Dr Habib J. Khoury***  
***PLASTIC AND RECONSTRUCTIVE SURGERY***

**PATIENT EDUCATION FOR:  
CUMULATIVE TRAUMA DISORDER**

**THE PROBLEM:** There has been a remarkable increase in what is termed cumulative trauma disorder (CTD) in the last 20 years. Other terms for this problem include repetitive stress injury (RSI) and overuse syndrome. In spite of the many terms used to describe this syndrome, a common clinical presentation is recognized. The increasing number, rising cost, frequent failure of surgery and physiotherapy to relieve symptoms combined with the fact that the majority of the symptoms are entirely subjective and difficult to measure makes the diagnosis controversial.

Associated with this disorder are a number of problems (ganglion, arthritis, tendinitis) that are relatively easily managed. A much more difficult problem is a nonspecific upper extremity pain syndrome. Patients typically complain of pain involving the entire upper extremity, including the neck, upper back and shoulder. They describe numbness or “pins and needles” in the arm and hand when they use their arms, especially above their head. Numbness and pain at night are typical as are tension headaches in the back of the neck or base of the skull.

**THE ANATOMY:** The nerves that supply the muscles and skin in the upper extremity leave the spinal cord in a complicated organization of nerve fibers, roots and bundles, which is termed the brachial plexus. In the neck, the brachial plexus lies between two small, tight, fibrous-like muscles which are called the anterior and middle scalene muscles. These muscles attach to the first rib in the front of the chest and the transverse processes of the cervical vertebrae at the side of the neck. These are respiratory type muscles and are not required for any critical neck or shoulder function. They can, however, especially when they become tight, compress the brachial plexus in the region of the neck. Compression of the brachial plexus is termed thoracic outlet syndrome (TOS). The five bundles of nerve roots (C5, C6, C7, C8 and T1) that

form the brachial plexus enter the upper arm after dividing and then rejoining to become the median, radial and ulnar nerves.

**The ulnar nerve** runs along the inside of the arm behind the elbow and into the hand to give feeling to the ring and small fingers and function to the muscles for grip strength, primarily in the little, ring and occasionally the middle fingers. It controls the muscles for most of the pinch strength, and it controls the small muscles in the hand that coordinate fine movements, with the exception of muscles that lift the thumb up and out of the palm. The ulnar nerve is susceptible to compression, pinching and stretching behind the elbow (cubital tunnel syndrome). When the elbow is straight, just like the skin behind the elbow is loose, the ulnar nerve is loose. When the elbow bends, just like the skin behind the elbow is loose, the ulnar nerve is loose. When the elbow bends, just like the skin becomes tight, the ulnar nerve becomes tight. (You can demonstrate this yourself.) Whenever the elbow is bent, pressure builds up in the ulnar nerve and blood supply decreases in the ulnar nerve.

**The median nerve** runs down the arm and into the forearm. In the forearm just below the elbow there is a muscle called the pronator teres muscle that allows you to move your hand into a palm-down position. If this muscle becomes tight or overused, it can compress the median nerve in the forearm. The median nerve then continues down into the region of the wrist and travels into the hand through the carpal tunnel. The carpal tunnel is located in the first part of the palm of the hand where there is a strong ligament connecting the wrist bones. This creates a tunnel beneath the ligament. The median nerve and the 9 tendons which bend the fingers and thumb go through the tunnel. The median nerve supplies the muscles of the thumb that allow you to lift the thumb away from the palm and supplies sensation to the thumb, index, long, and part of the ring fingers. Whenever the wrist is moved away from a flat or neutral position, the pressures increase in the carpal tunnel and/or the median nerve becomes stretched. This will interfere with the blood supply to the nerve and cause carpal tunnel syndrome.

**The radial nerve** spirals around the humerus (the arm bone) and enters the forearm to provide muscle function to the tendons which straighten the wrist and fingers. A sensory branch of the radial nerve runs between two tendons in the forearm to provide feeling over the top of the thumb, index and long fingers in the back of the hand. This nerve can be compressed between these two tendons, especially when the hand is held in a palm-down position and the wrist is bent towards the small finger.

**THE CAUSE OF CTD:** There are positions of your arm, forearm and hand which will cause pressure on various nerves or result in muscle imbalance.

#### **CAUSE OF CTD**

**Nerve Compression:** When a sensory nerve is compressed, patients will describe “pins and needles” and numbness. When a motor nerve is compressed, patients describe aching, weakness and eventually loss of muscle bulk. The positions of most and least risk are:

3

Most Risks Least Risk Causing Wrist Flexion/extension (moving up or down) Flat (neutral) Carpal Tunnel Forearm Pronation (palm down) Supination (palm up) Median nerve

forearm compression Elbow Flexion (bent) Extension (straight) Cubital Tunnel Arms Elevated (up) Lowered TOS

**A double or multiple crush phenomenon** means that when a nerve is compressed or pinched at one point it is more susceptible to mild compression both above and below the area of the first compression. This explains why patients may be symptomatic from multiple levels of minor nerve compression and yet electrodiagnostic studies and nerve conduction studies remain normal. As well, once you develop one level of nerve compression, you are more likely to develop another nerve compression problem. Some diseases can act as a “first” crush, including cervical disc disease or arthritis in the neck, diabetes, thyroid disease, or excessive use of alcohol.

**Muscle Imbalance:** Abnormal postures, positions or movements of the head, neck and arms are assumed during many activities. These postures will not only pinch or compress nerves, but will also result in muscle imbalance.

A poked-forward position of the chin and rolled forward position of the shoulders will place the scalene (S) muscles in the neck and the pectoralis minor (PM) muscle in the shoulder in shortened positions. These muscles will become tight, and when patients try to stretch them, pain and discomfort will result. In order to relieve this, patients will try to take the tension off these muscles by assuming an even more poked-forward position of the chin and rolled-forward position of the shoulders. A vicious cycle ensues. Individuals who do a considerable amount of keyboarding will keep their forearms in a palm down position for the majority of the day. This will allow the pronator teres muscle to shorten.

When it becomes short and tight, it can compress the median nerve in the forearm. This same palm-down position will also cause two tendons in the forearm to compress the radial sensory nerve, producing numbness over the back of the hand. The hunched-over position of the neck and shoulders results in a curving of the lower back. This will lengthen important back muscles called the middle and lower trapezius (MT, LT) muscles and shorten the serratus anterior (SA) muscle. When a muscle is either too long or too short, it is at a functional disadvantage and becomes weak. When the middle and lower trapezius muscles and the serratus anterior muscle become weak, patients have difficulty using their arms above their heads. Similarly, when one group of muscles becomes weak and is underused, another group of muscles will be overused to compensate. The muscles that tend to compensate for elevation of the arms are the upper trapezius (UT) muscles and the muscles in the neck and upper shoulder regions. When these muscles become overused, they become painful. Thus, the positions of most and least risk for muscle imbalance are:

Most Risk Least Risk Forearm Palm down (Pronation) Palm up (Supination) Shoulders Rolled forward Pulled back Chin Poked forward Tucked back Back Curved forward Up straight

**TREATMENT:** Patients must be aware of the positions that make both the nerves at risk for compression and the muscles at risk for imbalance and then change activities and postural patterns at work, home and even during sleep. For example, workstations should be as low as possible to take pressure off the nerves in the neck. Excessive bending of the elbows should be avoided. Talking on the phone will require either compression of the ulnar nerve if the elbow is bent or “pinching” of the telephone between the neck and shoulder, which will result in tightening of the scalene muscles. A headset would be recommended or a speakerphone. Holding your arms a little lower on the steering wheel with the elbows a little straighter will decrease some of the pressure on the nerves of the neck and elbow region. Arms should be down by your side when sleeping at night. Night splints can be worn to keep the wrist in a neutral position to treat carpal tunnel symptoms. An elbow pad can be worn 24 hours a day. This will provide some padding around the ulnar nerve, prevent you from coming into full elbow flexion, and remind you to avoid elbow flexion. A soft neck roll can be worn at night. Start with one roll and then progress to two. These rolls are like fancy sleeping pillows except they move with your head at night. These rolls will take some of the tension off of the tight muscles in the neck which otherwise must continue to work hard during the night to support your head in whatever position it finds itself. In sitting, a towel roll or low back support will support you in a more upright position and remind you to “sit up straight”. For those who work at a desk, frequent mini breaks during the day to move the palms from a palm-down position to a palm-up position will stretch out the tight pronator teres muscle and unload the radial sensory nerve between the two tendons in the forearm.

**PHYSIOTHERAPY:** Physiotherapy is a key part to treatment for CTD. The therapy must, however, be carefully planned and organized or it is likely to flare or exacerbate symptoms. The first goal of physiotherapy is to regain a range of normal pain-free movement. This will require supervision by a skilled physiotherapist, but involves the following:

**Chin retraction exercises:** Begin in a lying position with pillow support behind the head and then progress to chin tucks in a sitting position.

**Stretching exercises:** Once a pain-free range of movement has been recovered, only then are strengthening exercises started. These exercises will often start with the patient lying down. This will eliminate the extra force of gravity. Strengthening exercises will strengthen particularly middle and lower trapezius muscles and the serratus anterior muscle. Patients will have to be shown how to put these muscles back into a normal length and then how to strengthen these muscles. In general, the use of weights is not necessary and, in fact, can be counterproductive. Similarly, general strengthening exercises can be dangerous, as the tendency is to use the muscles that are already overused because patients are “good at” using these muscles and do not know how to use the weak muscles.

**OTHER FACTORS:** As part of the problem with CTD is muscular, it is important to improve the overall function of the muscles. This is done by improving all muscles in the body through an exercise program. A progressive energetic walking program is recommended. Patients should keep a calendar and mark the distances walked and the time spent walking. A weight program for those who are overweight is encouraged. As well, some women with very large breasts will benefit from breast reduction surgery, as the large breasts tend to encourage a rolled-forward and poor posture.

For most individuals, it has taken many months, and probably years, of poor posturing and positioning of the upper extremity, neck and shoulders to develop these CTD problems. Thus, the treatment for this is time-dependent and will likely take several months before significant improvement is seen. The program

is entirely patient-dependent, meaning that patients must thoroughly understand the process and be actively involved in treating these problems, modifying their activities at work, away from work and even during sleep. The home exercise program must be done on a daily basis.

**WHAT ABOUT WORK?:** These problems usually develop over many months, if not years. Experience shows that rest alone does not cure the problem. The tight muscles must be stretched out and the weak muscles must be strengthened if the muscle imbalance problem is to be cured. An aggressive effort towards avoiding positions which increase pressure around the nerves must be taken. It may take a few months before the symptoms start to resolve. It is highly recommended that individuals stay at work, but make every effort to modify workstations and especially avoid overhead activity as much as is possible. During the workday, breaks that are available should be utilized to do chin tucks, neck stretching and upper back muscle strengthening exercises.

**WHAT ABOUT SURGERY?:** If tests of hand sensibility and/or the nerve conduction studies are normal, this suggests that the problem is indeed multiple sites of minor nerve compression. These multiple sites will give patients symptoms, but at no one site is there enough irritation to suggest that surgery would be particularly beneficial. In the majority of patients, these multiple sites of minor nerve compression can be treated with conservative management as described above. Failure to relieve symptoms after several months of conservative management in the presence of abnormal nerve conduction studies is an indication for surgery at the level of the carpal tunnel (see carpal tunnel brochure) of the cubital tunnel (see cubital tunnel brochure). With thoracic outlet syndrome the results of specific physiotherapy exercises described above will give relief of symptoms in 90% of patients. Therefore, surgery at this level is rarely necessary and significant complications have been reported following surgical treatment for TOS (see thoracic outlet syndrome brochure).

**IN SUMMARY:** The incidence of CTD is recognized with increasing frequency. The vast majority of problems can be controlled, if not completely eliminated, with a simple but strict exercise program and modifications of positions and postures of the head, neck, back, and arms that put nerves at risk for compression and muscles at risk for unhealthy patterns of imbalance.

Lines can be drawn through this figure to illustrate Nerve Compression your specific problem(s) and whether or not associated problems such as tendinitis exist. The abnormalities seen in the nerve tissue span a broad spectrum from subtle changes to actual “dead” nerve fibers. Note that the “time line” for developing nerve compression can be years and that other systemic problems such as diabetes, obesity, rheumatoid arthritis and alcoholism will make you more susceptible to nerve compression.

In the hypothetical patient at right, the vertical lines show the patient’s problems to be multi- factorial but not likely to require surgery.