

## **Current Developments in the Prevention and Treatment of Repetitive Motion Injuries of the Upper Extremity**

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**ABSTRACT:** Cumulative trauma is a condition associated with the musculoskeletal system and is due to repetitive use of that body part. There are often other aggravating factors, such as: cold environments, vibration or awkward positioning of the work site. Some cumulative disorders of the upper extremity include: carpal tunnel syndrome, DeQuervain's disease, and lateral epicondylitis. Special testing may be involved in carpal tunnel syndrome, such as Tinel's or Phalen's test and an EMG. All have similar treatment methods of using nonsteroidal medications, heat, and injections. To further treat these conditions, jobs need to be modified to decrease the risk factors, and education of the worker needs to be completed.

Repetitive motion injuries, also known as cumulative trauma disorders, are widespread in many occupational fields. Cumulative trauma is associated with the musculoskeletal system (for example cardiac arrhythmias is not accumulative trauma disorder). The parts of the musculoskeletal system includes bones, muscles, nerves, tendons and ligaments. When the musculoskeletal system is over-used, or involved in repetitive motion, then trauma can result. And this trauma is known as cumulative because it occurs over a period of time. Of particular interest are the cumulative trauma disorders of the upper extremity. These trauma disorders include: carpal tunnel syndrome, DeQuervain's disease and lateral epicondylitis. The purpose of this paper is to discuss each of these three disorders, the anatomy involved, risk factors, treatment and prevention of the disorder.

Let's first look at carpal tunnel syndrome. Carpal tunnel syndrome describes a condition that is associated with compression of the median nerve at the wrist (See Figure 1). In the wrist there are several structures. There are carpal bones which form almost a cup shape. In that cup are many tendons, known as flexor tendons. There are also some nerves. Most of these structures are held in the cup by a thick band known as flexor retinaculum. If you look at the palm of your hand and place your thumb and little finger together, then a tendon jumps out at the wrist. This tendon is known as the palmaris longus.

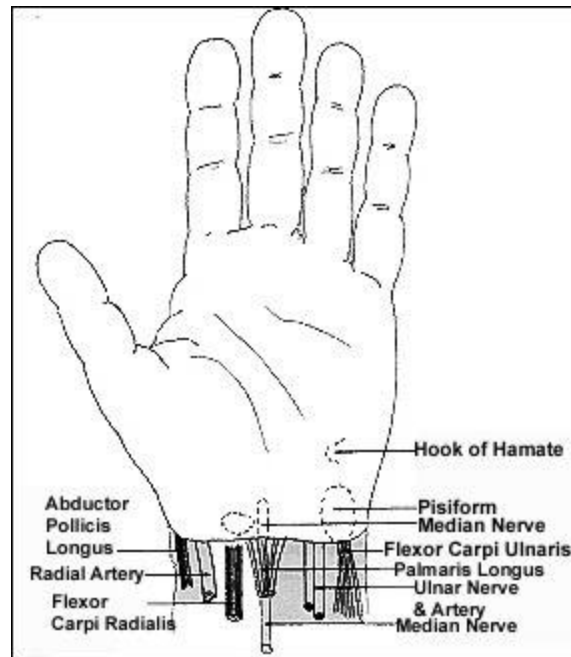


Figure 1.

This tendon is not held in place by the flexor retinaculum, but it is important because the median nerve lies under this tendon, so it helps us know the position of that nerve. The median nerve is held in place by the flexor retinaculum, and if compression by other components of the carpal tunnel or the retinaculum occurs, then numbness or weakness of the hand can result; this can lead to carpal tunnel syndrome. There are many etiologies for carpal tunnel syndrome. And many of these are not necessarily related to work injuries. Persons with wrist fractures are at risk for edema and swelling of the wrist which can then lead to entrapment of the median nerve and cause carpal tunnel syndrome. Rheumatoid arthritis, gout, and other inflammatory disorders can also cause carpal tunnel syndrome. Pregnancy is a great risk factor. Some studies have shown that greater than twenty-five percent of women in the their last three months of pregnancy are at risk because of overall swelling and this would include the carpal tunnel itself. Additional list of medical illnesses that can be associated with carpal tunnel syndrome include diabetes, infection, local tumors, and even possible hereditary conditions. Not only are medical issues associated but again work related injuries. There are a great variety of types of workers who have been thought to be at increased risks for carpal tunnel syndrome: the typist or computer operator, because of repetitive motion, the sign language interpreter, because of, again, repetitive motion and often not taking enough breaks during her job to rest the wrists and hands. Other jobs include the jackhammer worker because the vibration can cause local trauma and edema, the meat cutter who uses electrical knives because of vibration, and the cashier who operates the cash register. This has lead some people to believe, because of such a diversity of types of employment has been associated with carpal tunnel syndrome, that hereditary or medical conditions are more the source of the problem. Nevertheless, there have also been many studies to indicate the syndrome is indeed associated with work injuries. And because of that thought, let's look at some of the jobs that nursery workers do and see why they could be at risk.

The tree nursery workers often are repetitively using their wrists and hands, flexing their hands

to put the seedlings into holders, sorting the trees, and bundling the trees. The repetitive flexing is a great risk factor. In addition, these workers are often in a cold environment. The cold causes slowing of the nerves, and also causes any edema or inflammatory agents that have become involved in the wrist to stay in the wrist longer, causing increased pressure, and further compromise to the carpal tunnel itself. Finally, some of the workers are also involved in having the wrist in a rather awkward position that is usually not anatomically normal, and this will then cause inflammation to the wrist. Again, with the cold and repetitive trauma, the inflammation will stay and it will be a prolonged problem. When workers develop carpal tunnel syndrome there are several symptoms that they develop. Generally, there is a numbness in the median nerve distribution which involves the first three digits of the hand (thumb, second and third finger). Sometimes the worker describes it as radiating in the hand and it is often difficult to know whether it is really the first three fingers or throughout the hand. If you have ever experienced a foot, leg or arm falling asleep, you can recall how difficult it is to describe the exact region that has fallen asleep. This is the same problem that occurs when patients are asked to describe where exactly the numbness is located. Sometimes this numbness is more often present at night. This is because the person keeps the wrist in a flexed position while they sleep, further compromising the tunnel, and causing compression on the nerve, and therefore causing symptoms. There can also be night pain associated with the hand, wrist, elbow and shoulder. If carpal tunnel syndrome is severe enough, patients can experience weakness of the hand, particularly the thumb muscles (i.e., abductor pollicis brevis). This is because these muscles are typically innervated by the median nerve.

Some simple tests that can be completed to determine if carpal tunnel syndrome is present, such as tapping on the wrist, known as Tinel's test. If tapping at the wrist causes radiation of numbness into the first three digits, then this would be a positive Tinel's test and could be indicative of carpal tunnel syndrome. Another test that can be completed, the Phalen's test, is to flex the wrist so that the dorsum of the hands are in contact. Again, there should be numbness radiating into the first three digits.

Additional testing that can be completed to determine if carpal tunnel is present, is to look for weakness, as well as sensory loss. Your physician would probably complete these tests. Additional testing that can be completed is that of electromyography better known as EMG. The purpose of this test is to look specifically at the function of the median nerve, and to determine if there is slowing across the carpal tunnel itself, which again suggests carpal tunnel syndrome. This test usually has two parts. The first part is simply stimulating the nerve or giving it an electrical shock to see how quickly the nerve will respond. The next part may involve inserting a small pin or small needle into different muscles, the abductor pollicis brevis for example, to determine if there is any evidence of nerve damage. This test may be completed by the physician prior to treatment. Often this test is completed if surgery is a consideration for treatment.

Let's look at some of the treatment options, and let's consider first the conservative treatment options. These include a cock-up wrist splint, rest or use of the opposite hand for activities, steroid injections, nonsteroidals, ultrasound and exercises. The cock-up wrist splint is generally one of the first line treatments done for carpal treatment. They do prevent dorsiflexion of the wrist and help to stretch the carpal tunnel, thereby ideally decompressing the median nerve.

The splints can be worn at work and are designed so that not to inhibit digit use. The splints are often worn at night as well, to again keep the wrist in the correct position and to stretch the carpal tunnel. Some patient's prefer only to wear these at night and not during the work period. Nonsteroidal medications such as Ibuprofen, Lidocaine, Naprosyn, Relafen can be used. The purpose of the nonsteroidal medications used is to help decrease any inflammatory response which may also help decrease symptoms.

Other treatments that have been used include exercises, (See Figure 2), which usually involve stretching of the carpal tunnel, and again, are thought to decrease compression of the median nerve. Some physicians have prescribed ultrasound. Another conservative treatment that has been included is the of injection of local steroid into the carpal tunnel.

An additional treatment that can be completed is to look at the workplace to help decrease some of the causing factors. For example, many workers in the nursery tree field often use gloves to help protect their hands, but do these gloves indeed decrease the cold? There are many other medical conditions, particularly those associated with vascular instability, in which workers also need to wear gloves to help protect them from the cold. This is well known among the patients and by the medical field. But often patients who are at risk for carpal tunnel syndrome do not think to wear gloves to help avoid this condition.

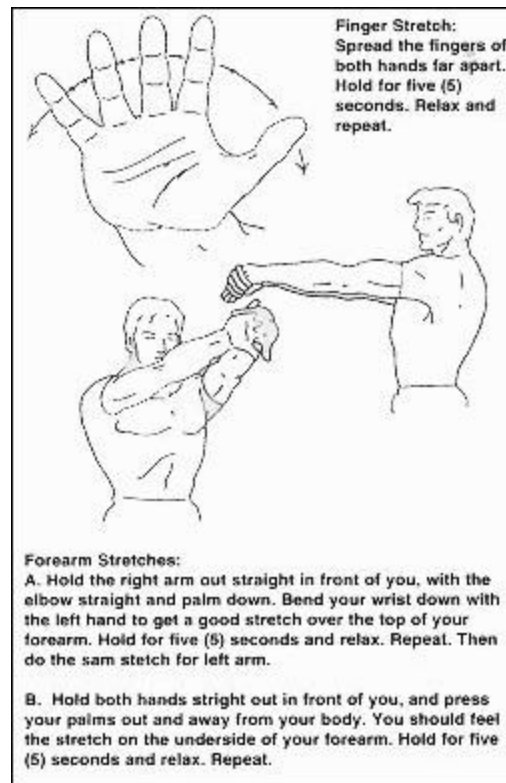


Figure 2. Exercises for Preventing Cumulative Trauma Disorders

Additional preventative measures that could help at work would be to rotate the job sites so that patients are not always doing the same type of repetitive job with their wrist. They also should take frequent rest breaks. In addition, they need to begin using the non-dominant arm to help rest the dominant side, and again decrease risk. Other issues that could be looked at in the work sites would be automating jobs that are highly repetitive, but may be easily operated by machinery. Finally, if the patient does fail at any conservative treatment, then surgery would be a consideration. Usually before surgery is completed, the patient has completed a good trial of conservative treatment. They may also have completed an EMG. If the EMG is ordered, and there are quite distinctive and severe signs of carpal tunnel syndrome, then conservative treatment may not be indicated. One other condition that I would like to mention briefly is that of lateral epicondylitis, also known as "tennis elbow".

Extensor tendons insert onto the lateral epicondyle, and again, with a repetitive use of the wrist, can cause irritation. The treatment is very similar to that of carpal tunnel syndrome, including local steroid injections, nonsteroidals, and ultrasound. There is also a splint that can be used for this condition, known as a tennis elbow band (See Figure 3).

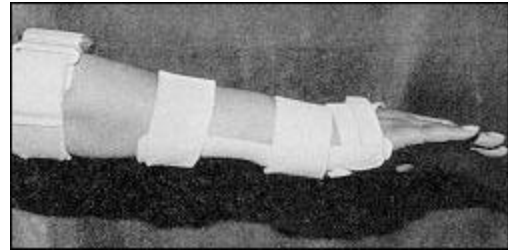


Figure 3. Cockup splint with tennis elbow cuff.

This band is worn a few inches distal to the insertion of the tendons. The purpose of this band is to cause compression of the extensor muscle belly itself, thereby relieving the insertion of the tendon. When the person then contracts the extensors of the forearm, most of the contraction is at the site where the band is thereby not causing further irritation, or further repetitive trauma to the tendon itself, so that decreased inflammation can occur. Over time, the symptoms of tennis elbow should resolve. Occasionally, patients do have to have surgery for resection of some of the soft tissue, and possibly even the bone around the lateral epicondyle, to allow further movement of the tendon. This again is highly uncommon.

One other condition, known as DeQuervain's tendonitis is simply a condition of three tendons involved in the movement of the thumb, and cause tendonitis usually at the anatomical snuff box, which is on the dorsum (back of the hand) at the base of the thumbs. Again, the reason for this is often trauma or even repetitive use. The treatment for this, once again, is similar to that of carpal tunnel syndrome. This involves nonsteroidal medications, injections of local steroids and ultrasound. A wrist splint, very similar to the cockup splint can also be used.

In summary then, there are at least three conditions of repetitive trauma of the upper extremity. These are often treated in a very similar fashion and also have similar risk factors. The carpal tunnel syndrome involves mostly compression of the median nerve resulting in pain and numbness. In lateral epicondylitis, there is irritation and inflammation of the extensor tendon, and in DeQuervain's disease, there is irritation of three radial innervated tendons of the thumb. Rest, nonsteroidal medications, ultrasound, local injections of steroid, and bracing are typical conservative treatments that could be tried.

Carpal tunnel syndrome can also be further diagnosed by specific maneuvers, such as the Tinel's and Phalan's test, as well as an EMG. Surgical treatment could also be considered for carpal tunnel. Again, for prevention of each of these conditions, repetitive use needs to be limited, the other non-dominant hand should be used when possible, multiple rest breaks taken, and alternate job positions. In addition, carpal tunnel syndrome is also thought to be related with vibration as well as cold, and these should be minimized. For further information concerning these conditions, I recommend that you discuss this with your physician.

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