Carpal Tunnel Syndrome

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Summary

Carpal tunnel syndrome is a very common condition where the median nerve gets pinched at the wrist and hand. The patient can experience pain, weakness and burning feelings in the hands and fingers. The involved fingers are usually the thumb, index (pointer), long (middle) and half of the ring finger. Causes are due to changes in anatomy, general medical illnesses and possibly work-related conditions. Treatments include supports, therapy, steroid injections or surgery. The diagnosis is usually made by history and physical exam and a nerve conduction study that checks the speed and function of the nerves. Non-operative and operative treatments have been successful in most patients having carpal tunnel syndrome. The treatment outcomes of open and endoscopic carpal tunnel release have been shown to be the same at three months.

Background Information

The median nerve travels from the shoulder and upper arm area down the forearm and into the wrist underneath muscles. It enters the hand through the carpal tunnel underneath the transverse carpal ligament. The carpal tunnel is bordered on the deep surface (floor) by four bones and the superficial surface (roof) by the transverse carpal ligament. There are 10 structures passing through the carpal tunnel including nine flexor tendons that bend the fingers at each knuckle as well as the median nerve. The median nerve is usually the most shallow structure in the carpal tunnel. There are different ways that the nerve splits in the area of the carpal tunnel depending on the patient. In some patients, branches of the nerve go through the transverse carpal ligament (the structure released during surgery) and this can put you at risk during surgery.

The nerve moves chemical and electrical signals to reach muscles in the hand. It also allows the opposite movement of signals to allow for sensation or feeling. The normal pressure in the carpal tunnel is approximately 2.5 mmHg (millimeters of mercury) when directly measured. Slower blood flow to the nerve and swelling around the nerve occurs when the pressure reaches 20 to 30 mmHg. When the pressure is greater than 30 mmHg the nerve signal itself slows. If the pressure stays at this level for a long time a conduction block can occur. A conduction block occurs when the pressure stops the traveling of the signal along a part of a nerve that is still together.

Why do we get it?

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Acute or quick onset carpal tunnel syndrome is caused by a quick increase in pressure that stays high within the carpal tunnel. This sometimes requires emergency surgery. Common causes of acute carpal tunnel syndrome include infection, bleeding, trauma to the wrist and piercing injuries. Chronic or long term carpal tunnel syndrome is more common. It can be caused by physical irregularities, medical illnesses, due to activity or idiopathic (unknown cause).

Most of the cases of carpal tunnel syndrome do not have a reason for developing. Women get it more commonly than men and older patients get it more commonly than younger patients. The look of the tissue under a microscope shows swelling and scar tissue without much inflammation. It has been found that the greatest pressure across the nerve occurs at the thickest portion of the ligament. This ligament is cut during a carpal tunnel release surgery, which opens the tunnel and drops the pressure. Physical abnormalities may also be present with carpal tunnel syndrome including extra arteries, infections, cysts or masses in the carpal tunnel. Swelling, bleeding and scar tissue can result after injuries. These can put increased pressure on the nerve. Carpal tunnel syndrome is usually found in patients that are overweight, or have diabetes, rheumatoid arthritis, hypothyroidism, kidney failure, alcoholism and in pregnant women. Some drugs and medications can also raise the risk of carpal tunnel syndrome. Carpal tunnel syndrome can also be caused by repetitive use of the wrist and fingers as well as repetitive injury to the palm of the hand while using machines that have more vibrations. A lot of wrist flexion and wrist extension have been shown to increase the pressure in the carpal tunnel. A direct connection between work and carpal tunnel syndrome has never been shown in the medical literature.

How do we diagnose it? What are the symptoms?

A detailed history and physical examination can help in making the diagnosis of carpal tunnel syndrome. Symptoms include pain at night while sleeping or first thing in the morning, numbness, tingling and burning in the thumb, index and middle finger. Sometimes the pain and strange feelings can move up the arm. Patients often shake the hands to help get rid of the symptoms. Numbness or weakness in other fingers and in other parts of the hand or wrist does not mean that you do not have carpal tunnel syndrome. There can be unusual connections in the forearm (Martin Gruber Anastomosis) and wrist (Riche-Cannieu Anastomosis) that can explain these changes. When symptoms get worse, patients complain of dropping things, weakness and trouble with fine motor skills such as buttoning buttons.

Evaluation of the patient should include a physical examination of the cervical spine (neck) and the entire upper extremity. Atrophy (muscle loss) must be noted. Movement and muscle strength testing is performed. Grip and pinch strength amounts may be recorded. Spurling's maneuver and cervical spine assessment can help in ruling out a pinched nerve in the neck (cervical radiculopathy). This is done by leaning the patient’s head towards the affected side and pushing downward pressure to the patient’s head. Tapping over the nerve in the palm of the hand (Tinel’s sign) may cause a tingling response and should be done in all areas where the nerve may be pinched or compressed. Reflexes should be measured and a good check of the nerves and vessels of the arm should be done. Two point
discrimination (checking patient’s ability to feel one or two points) and monofilament testing (feeling different amounts of pressure from different diameter small wires) can also be done to decide if there are nerve compression problems. The monofilament tests are better for diagnosing carpal tunnel syndrome whereas the two point discrimination is better at determining if a nerve has been severed from a cut or trauma.

Putting pressure over the median nerve at the carpal tunnel for 30 seconds can cause numbness or tingling in the fingers (Durkin’s Compression Test). Phalen's test is done with the wrists bent all the way for 60 seconds with the backs of the hands touching and the reverse Phalen’s test is done with the wrists extended all the way for 60 seconds with the palms of the hands touching. These tests are helpful in detecting carpal tunnel syndrome when they bring on numbness in the fingers. A hand diagram is a picture that the patient draws to indicate where the symptoms are felt in the hand and fingers. None of these tests are 100% accurate. An important combination of tests includes a positive Durkan’s compression test, a positive hand diagram, night pain and abnormal monofilament testing.9

Diagnostic studies/testing

Nerve conduction testing can be used to help diagnose carpal tunnel syndrome. The nerve conduction tests are done to check the speed and quality of the nerves and how they spread or conduct the signals. A nerve is excited and the reaction in an attached muscle is measured. Nerve conduction testing can help tell apart between carpal tunnel syndrome and other nerve compression problems. It can be used as a starting point to compare with studies done in the future to check for return of the disease or incomplete release. Nerve conduction studies do not have to be positive to diagnose carpal tunnel syndrome. Carpal tunnel syndrome is a clinical diagnosis and is not based on nerve testing. Mild cases may not have positive nerve test results.10-13 An electromyogram or EMG checks electrical activity in muscles. When chronic or severe carpal tunnel syndrome is present, the EMG can show increased activity in the muscles when inserting the needle and can find out the amount of muscle reacting to the needle insertion. It can determine if there are changes in the function of the muscles of the thenar eminence, at the base of the thumb in the palm of the hand, (including the abductor pollicis brevis muscle) indicating long term compression or pinching of the median nerve.

Imaging (x-rays, MRI) is usually normal in patients with carpal tunnel syndrome. Ultrasound or MRI may show that the area/size of the median nerve is bigger or the nerve may look flattened. Imaging can be helpful for finding a mass (tumors) and abnormalities of the nerve and tendons running through the carpal tunnel.14-15 Lab tests are usually normal in patients with carpal tunnel syndrome, but certain patient groups are more likely to get the disease. These patients may have unusual results on routine lab tests. Carpal tunnel syndrome is more common in patients with diabetes mellitus, hypothyroidism, low vitamin B12, low folate, vasculitis, fibromyalgia as well as rheumatoid arthritis and abnormal lab results may be present in these patients.
Non-operative treatment

Holding the wrist in a middle-of-the-road position without a lot of wrist flexion or extension can be helpful at night as well as sometimes during the day during certain activities. Some splints may give up to 20° to 30° of extension. It is best if the splint holds the wrist straight at 0° with the back of the hand in line with the back of the forearm. Steroid injections can be used in the treatment of carpal tunnel syndrome; however the effects may be only short-lived. Anti-inflammatory medications (NSAIDs), oral steroids and vitamin B6 have been used to try to improve symptoms in carpal tunnel syndrome. Oral steroids have been shown to be effective in short-term treatment. Vitamin B6 treatment has not shown major improvement over time. In acute cases, and in chronic cases when there are muscle changes in the thenar eminence (muscles in the palm at the base of the thumb) and when non-operative treatment fails, surgical treatment is indicated.¹⁶⁻²²

A steroid injection into the carpal tunnel can be useful in treating the symptoms, forecasting the results of surgery and confirming the diagnosis. 87% of patients who get some relief after an injection have had better symptoms after surgery. Those who had no change in their symptoms after injection only had better symptoms after surgery 54% of the time.²³ A single injection of steroid has been shown to help symptoms in 76% of patients at 6 weeks but only 22% had no symptoms at 1 year.¹⁷ The steroid injections may work better in patients with milder symptoms. When injecting steroids, blood glucose (sugar) may need to be checked mainly in diabetic patients. Different ergonomic changes to help patient comfort with different desk chairs and computer keyboards have not stopped or decreased the symptoms of carpal tunnel syndrome. Iontophoresis (using an electric charge to deliver medication through the skin) with bracing and medication may improve symptoms like steroid injections.²⁴ Ultrasound shows some short-term improvement. Therapy can also be helpful using nerve and tendon gliding exercises, which can increase blood flow and lower pressure within the carpal tunnel. For patients who do not do exercises, 71% had a carpal tunnel release surgery compared to the people who did the exercises, having only 43% that needed surgery.²⁵⁻²⁷ At this point, laser therapy has been shown to be no better than placebo or fake treatment.²⁸

Operative treatment

The surgical treatment of carpal tunnel syndrome includes cutting the transverse carpal ligament (roof) and this can be done by an open, mini-open or endoscopic (using small incisions and a camera) techniques using one or two cuts in the skin. Anesthesia can be done under general anesthesia (completely asleep), regional block (numbing the arm), local anesthesia (numbing the surgical site only) or a combination of these methods.

Open carpal tunnel release is done through an incision in the palm of the hand. The size of the incision can be different depending on patient make-up and surgeon choice. The palmar fascia and transverse
carpal ligament (roof) are cut at the ulnar border. Care is taken to protect the ulnar artery as it reaches the mid-palm area. Care is taken to protect the motor branch of the median nerve (supplies the thumb muscles at the base) and palmar cutaneous branch of the median nerve (gives sensation at the base of the thumb in the palm). Internal neurolysis (releasing scar tissue from the nerve), epineurotomy (opening the outer covering of the nerve) and tenosynovectomy (cleaning inflammation off of the tendons) are usually not needed for a first time carpal tunnel release surgery.29-31

Endoscopic methods were introduced for carpal tunnel release surgery secondary to pain, tenderness at the incision site and time out of work. One and two incision methods have been done. It takes practice to be comfortable doing any endoscopic carpal tunnel release surgery. Reasons to avoid an endoscopic carpal tunnel release are wrist stiffness (due to positioning problems), synovitis (inflammation around the tendons) and tumors in the carpal tunnel (as they should be removed with an incision).

Limited (small) incision carpal tunnel release procedures use special cutting guides to try to minimize the incision size in the palm of the hand. Research studies have not figured out the best surgical procedure nor the best patient for each type of procedure.

Outcomes/Results of treatment/Prognosis

In a clinical trial, it was found that surgery and local steroid injection may give the same short term help. Local injection was shown to be better in the short-term but surgery showed better useful effects at one year. Other studies have shown better improvement of symptoms after surgery at five months compared to people treated with injections.32,33

Endoscopic carpal tunnel surgery has a faster recovery time compared to open carpal tunnel release. The difference is about 2 to 3 weeks sooner to go back to work. There are no differences in the final long term effects between endoscopic and open carpal tunnel release surgeries. At three-months there were no differences between the two groups in a recent study. Approval rates were worse in the endoscopic group secondary to a 5% rate of needing to repeat the surgery with an open method.34-37

Bilateral (involving both hands) carpal tunnel release can be effective and worthwhile. There is no major change in function after release of both hands at the same time as opposed to doing the surgeries at different times. This is an individual choice that both doctor and patient should talk over in detail.38-40

Wrist supports are not necessary after carpal tunnel surgery. Using a splint has not improved the final result of surgery but it is still commonly used. Movement of the wrist can be recommended for most patients after surgery.41-43

Major risks of the surgeries include injury to an artery, the main median nerve, branches of the median nerve and infection. Smaller risks or problems from the surgeries can be thick scar tissue, pillar pain (pain in the palm of the hand on the sides of the incision site), partial release of the transverse carpal
ligament, tendons sticking together, finger stiffness and recurrence or return of the disease. A common problem is pillar pain. It occurs in 25% of surgical cases and is usually gone by three months after surgery. The most common problem of endoscopic carpal tunnel release is partial release of the ligament with continued symptoms or return of the disease. Other structures at risk during endoscopic surgery are the nerves going into the middle and ring finger, flexor tendons and the ulnar artery.\textsuperscript{34-36,44,45}

Return of carpal tunnel syndrome can occur and unfortunately repeat surgery has a lower success rate in getting rid of the symptoms. Neurolysis (opening the outer covering of the nerve) of the median nerve with a covering of fat or muscle tissue can be done. The nerve can also be wrapped with a vein or a fake tube in cases that need a second release. Risk factors for poor surgical results include: unsettled legal action, major alcohol use, poor mental health and poor patient functional scores.\textsuperscript{46-49}

Authors Preferred Treatments

For all patients, non-operative treatment is used at the start unless the patient has weakness, loss of muscle, constant symptoms or has failed non-operative treatment for a long period of time. Non-operative treatment with supports, therapy, activity changes and injections using ultrasound to make sure of correct placement of the steroid, are tried first. Nerve studies are ordered as a test before surgery to be sure of the diagnosis and to check the severity of the disease. Patients with milder carpal tunnel syndrome, those with both hands involved and those who need a faster return to work may benefit from endoscopic carpal tunnel release. If the disease has advanced to moderate or severe on nerve tests, if there are constant symptoms or there is loss of muscle in the hand, then I prefer a limited open carpal tunnel release with a 2-3 cm incision. This allows the surgeon to see the entire ligament making sure there is a complete release which lessens the chance of return. This can also be done on both hands at the same time.

Conclusion

Carpal tunnel syndrome is a very common problem with significant work-related and financial impacts. Many risk factors exist but most often the cause is not known. History and physical examination as well as nerve conduction testing are useful in making the diagnosis. Non-operative treatments include: supports, oral medications, therapy, ultrasound and steroid injections. Surgical treatments include: open, limited open and endoscopic carpal tunnel release. These procedures can provide good symptom relief however they each have limits, as well as risks. The results of open and endoscopic surgery have been shown to be equal after three months. There may be a small short term advantage to endoscopic carpal tunnel release but there is a risk of partial release and need for a second surgery done through an open procedure in about 5% of patients.
Bullet Points

Carpal tunnel syndrome is a very common problem with significant work-related and financial impacts.

Many medical problems are linked to carpal tunnel syndrome but the cause is usually unknown.

Non-operative choices may include: supports, oral medications, therapy, ultrasound, iontophoresis and steroid injections.

Surgical choices include: open, limited open and endoscopic carpal tunnel release.

Ergonomic changes and laser therapy probably have little effect on carpal tunnel syndrome.

Open and endoscopic carpal tunnel release surgeries have equal results at 3 months.

References


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