

Carpal Tunnel Syndrome

Carpal tunnel syndrome (CTS) is caused by the compression of the median nerve, which runs through a small channel in the wrist on the palm side. Under normal circumstances, there is very little pressure on the median nerve because the carpal tunnel is inflexible. It is surrounded by bone on three sides and tough ligament on the fourth side.

People with CTS experience numbness, tingling, and pain in the first three fingers of the affected hand (or hands). The pinky finger is usually spared, which often provides a valuable clue in the diagnosis of the condition.

CTS is the most common peripheral nerve compression syndrome, affecting about 2.1 million American adults (Chung KC 2003; Pritsch T et al 2004). It tends to be more prevalent among women than men. Any activities that involve highly repetitive use of the hands, especially flexion of the fingers, can result in CTS. People at risk include those who use computers, as well as carpenters, grocery checkers, assembly-line workers, meat packers, violinists and pianists, and mechanics. Hobbies such as gardening and needlework can sometimes bring on the symptoms, while sports such as rowing, golf, tennis, downhill skiing, archery, competitive shooting, and rock climbing also place pressure on the hand and wrist joints. In addition, the syndrome can be caused by underlying disorders that affect the carpal tunnel, including arthritis, thyroid problems, gout, and diabetes. Finally, pregnant women are at risk of developing CTS.

The nerve compression associated with CTS is due to fibrous bands of tissue that form inside the carpal tunnel, squeezing the median nerve. Although CTS is linked to repetitive stress, the underlying cause—which would explain why some people suffer from it and others don't—is unknown. Newer research has uncovered some of the chemical changes that occur in response to mechanical injury among people who suffer from CTS. Although CTS is technically a noninflammatory condition (because there is no systemic inflammation and the immune system is not activated), it is characterized by localized increases in many pro-inflammatory chemicals in the tissue of the carpal tunnel itself.

Researchers have discovered that prostaglandin-2, vascular endothelial growth factor, and interleukin-6 are all elevated in the carpal tunnel tissue of people with CTS. These inflammatory factors act directly on tissue by increasing the ability of fluids and small molecules to cross from the blood into the tissue itself, and they may stimulate the growth of fibroblasts, which are responsible for forming scar tissue (Kuhn MA et al 2002). However, levels of interleukin-1, a pro-inflammatory chemical, are the same in people with CTS and people without the condition, which implies that those with CTS do not have a full-blown, systemic inflammatory response. Instead, evidence suggests that the underlying cause of CTS may be an increase in specific local inflammatory factors in response to mechanical stress that causes increased vascular permeability and perfusion (or movement of fluid through the tissues of the carpal tunnel), which leads to the deposition of scar tissue (fibrosis) that characterizes CTS (Bland JD 2005; Hirata H et al 2004; Freeland AE et al 2002; Tucci MA et al 1997).

Researchers have also uncovered evidence that the condition may be linked to inherited anatomy in the wrist. People who have family members who suffer from CTS in both hands are more likely to develop the condition themselves, suggesting there may be a genetic influence or that familial similarities in the size and anatomy of the wrists may cause a predisposition for CTS (Alford JW et al 2004).

SYMPTOMS AND DISEASE PROGRESSION

The early symptoms of CTS typically include tingling or burning in the parts of the hand that receive innervation from the median nerve. These include the palm and the palmar sides of the middle three fingers, as well as the palm side of the wrist. Pain may also radiate up the arm to the shoulder and sometimes the neck, causing stiffness. These symptoms are caused by an increased volume of tissue in the carpal tunnel (Armstrong TJ et al 1984; Werner RA et al 1997).

In many cases, patients complain of waking in the middle of the night with pain and a feeling that the whole hand is asleep. Careful investigation usually shows that the little finger is unaffected because the ulnar nerve rather than the median nerve services that finger.

This can be a key piece of information in making the diagnosis. If you awaken with your hand asleep, pinch your little finger to see if it is numb. Other complaints include numbness or growing weakness while using the hand for gripping activities, such as sweeping and hammering, or during repetitive finger flexion activities, such as typing.

As the condition worsens, daytime paresthesia (a sensation of prickling or tingling of the skin) can become common. The prickling is aggravated by activities such as typing, playing piano, using a computer mouse, driving, holding a book or phone, and combing

hair. In long-standing or severe cases of CTS, the muscle group at the base of the thumb might degenerate because of loss of nerve supply, diminishing manual dexterity. This condition may cause difficulty with daily activities such as buttoning clothes and holding small objects. Pain and tingling can also occur in the forearm, elbow, shoulder, and neck. If the condition is allowed to progress, the muscles supplied by the median nerve in the hand may become weak and degenerate. This results in an inability to bring the thumb into opposition with the other fingers, hindering the grasp.

In advanced stages of CTS, the individual nerve cells making up the median nerve can lose their protective layers of myelin. Disruption of the myelin sheath results in impaired conduction of nerve impulses and eventually leads to damage of the axons themselves, producing potentially permanent nerve injury (Werner RA et al 2002).

UNDERLYING DISEASES AND CONDITIONS CONTRIBUTING TO CTS

The following diseases and underlying conditions are associated with CTS:

Tendonitis. CTS can arise from irritation and inflammation of the tenosynovium, a slippery substance covering the tendons. Different types of arthritis can directly cause inflammation of the tenosynovium, including rheumatoid arthritis, osteoarthritis, reactive arthritis, and tendonitis. Repetitive stress injuries can also cause tendonitis.

Pregnancy. CTS was found in 28 percent of pregnant women in their third trimester, although 80 percent of the pregnant women with CTS were asymptomatic (Atisook et al 1995). The condition usually subsides after delivery, although new mothers who maintain a flexed wrist posture while feeding or holding their babies may be prone to CTS (Smith ER 2003).

Diabetes. Diabetes is also associated with several musculoskeletal disorders of the hand that can be debilitating, including CTS. Maintaining good glycemic control improves or prevents the development of these hand conditions (Schiavon F et al 2004).

DIAGNOSIS OF CTS

In most cases, CTS is diagnosed by the presence of symptoms and specific sensitivities to movement. The following tests may be used to confirm the diagnosis:

1. Phalen's test, or wrist flexion, checks for pain, tingling, or numbness that may suggest carpal tunnel problems.
2. Tinel's test, in which the doctor taps the inner wrist directly over the median nerve, may produce pain, tingling, or numbness and may result in a diagnosis of CTS.
3. Nerve conduction studies may be conducted in some cases to measure how quickly nerve impulses are conducted through the nerve. These tests allow physicians to detect CTS very early in the disease course.
4. MRI studies may be performed in selected, atypical cases when symptoms may not match classic CTS or there is concern about another diagnosis

CONVENTIONAL TREATMENT AND LIFESTYLE CHANGES

The treatment of CTS is dictated by the cause, the duration, and the amount of compression of the median nerve. If the disease is secondary to another problem, such as arthritis or gout, treatment of the primary condition will often resolve the CTS.

In most cases caused by repetitive stress or whose cause is unknown, treatment usually relies on a combination of medications and lifestyle changes, such as splinting and avoidance of activities that aggravate the condition. Splints, available in pharmacies, may be helpful in milder cases. They keep the wrist extended and allow limited use of the fingertips.

Physicians may prescribe nonsteroidal anti-inflammatory drugs (NSAIDs) to reduce pain, diuretics to relieve pressure, and vitamin B 6 . There is controversy, however, over the effectiveness of NSAIDs, which also have potentially serious side effects, and diuretics. While NSAIDs are effective for short-term flare-ups, long-term results with NSAIDs have been poor (Wilson JK et al 2003). Oral steroids may also be prescribed (Chang MH et al 1998).

For people who don't respond to the initial treatment, injections of corticosteroids directly into the carpal tunnel may be recommended. Newer research has shown that a single injection of methylprednisolone, at doses up to 60 mg, may be effective at long-term relief and that a second injection may not be necessary (Wong SM et al 2005; Dammers JW et al 2005). A single injection is best because it avoids the complications associated with corticosteroid injections, including nerve damage and relapse.

In the most severe cases, surgery to relieve pressure in the carpal tunnel is also an option. During surgery, the carpal ligament (the "roof" of the carpal tunnel) is surgically separated to relieve the pressure. Alternatively, the procedure can be performed endoscopically to reduce recovery time and the size of the surgical wound.

For moderate cases, in which surgery isn't required, or for patients who haven't responded to aggressive intervention or surgery, two additional treatments, low-level laser acupuncture and transcutaneous electrical nerve stimulation, may be recommended. They are often used together. During low-level laser acupuncture, a red laser penetrates the shallow acupuncture points of the hand. A trained acupuncturist or doctor must perform this procedure. Additional acupuncture points may be treated on the forearm or up to the shoulder area, according to the distribution of radiating pain (Branco K et al 1999).

In addition to medication and surgery, people with CTS can use a number of strategies to improve their condition, including the following:

1. Take more frequent breaks from the pain-causing movement.
2. Wear wrist splints at work or at home at night during sleep. Wearing splints at night is important because fluid redistributes throughout the body while people recline, increasing in volume in the upper part of the body and producing increased pressure in the carpal tunnel.
3. Wear a forearm brace, a narrow cuff worn just below the elbow that reduces fluid content in the carpal tunnel.
4. Use cooling pain gel on the wrist. Many of these gels contain methylsalicylate, an aspirin-like substance. Before regular use, consult with your physician about possible drug interactions.
5. Have someone massage your neck, shoulders, and back to relieve tension in the forearm and wrist.
6. Use a wrist rest in front of your keyboard and keep your keyboard level, not elevated, at your computer workstation.
7. Some larger companies offer ergonomic consultation for their employees (Morse LH 1986). If it is available, make use of it.

NUTRITIONAL THERAPY TO REDUCE PRESSURE

Nutritional approaches to CTS are based on reducing pressure in the carpal tunnel and relieving pain.

Vitamin B 6. Although more studies are needed, evidence suggests that vitamin B 6 has a place in treatment of CTS and should be considered as a nutritional therapy (Aufiero E et al 2004)

If CTS is severe, nutritional therapies are unlikely to reverse it. However, while surgery will take pressure off the nerve, it does not correct for nutritional deficiencies. Likewise, steroid injections will not correct vitamin B deficiencies.

Vitamin B 6, given in conjunction with vitamins B 1 and B 12, has a pain-killing effect that is due to inhibition of the body's natural pain conduction system. Studies have shown that vitamin B 6 is effective in relieving the pain associated with CTS, and there is evidence that B 6 deficiency may cause CTS (Jurna I 1998; Holm G et al 2003). One study, which noted the controversy surrounding the use of NSAIDs and nighttime splints, recommended that 200 mg vitamin B 6 daily be included in treatments for CTS (Holm G et al 2003).

Vitamin B 6, however, should be used with caution since high doses over the long term can cause damage to the central nervous system or neuropathy (damage to peripheral nerves).

There is evidence that vitamin B 6 will not work properly except in combination with adequate amounts of other B vitamins. In one individual, vitamin B 2 use for five months caused "nearly complete disappearance" of CTS (Folkers K 1984).

Enzymes. Serrapeptase (or serratiopeptidase), a proteolytic enzyme, shows promise in the treatment of CTS. This proteolytic enzyme, which digests protein, is produced by bacteria in the gut of silkworms and digests their cocoons. When this enzyme is isolated and coated in the form of a tablet, it has been shown to reduce swelling (Esch PM et al 1989). Significant improvement in electrophysiological parameters was reported in patients with CTS who received serratiopeptidase daily for six weeks (Panagariya A et al 1999).

Nutrition to Relieve Inflammation

Although people with CTS do not have elevated markers of systemic inflammation, there is no doubt that localized inflammation in the wrist contributes to their condition. Thus, any nutrient that reduces inflammation might be able to help relieve the symptoms of CTS. Unfortunately, however, few natural anti-inflammatories have been studied in the context of CTS. Most research dollars are directed toward surgery or pharmaceuticals rather than nutritional approaches. Nevertheless, the following nutrients have been shown to reduce inflammation in other diseases:

- **Fish oil.** Fish oil is rich in omega-3 fatty acids. These fats have shown anti-inflammatory effects in a number of diseases, including cancer, atherosclerosis, and autoimmune disorders (Babcock TA et al 2005). Fish oil works by down-regulating the levels of pro-inflammatory cytokines, which are shown to be elevated in people with CTS (Nielsen AA et al 2005). Among people with arthritis, which is also characterized by localized inflammation, fish oil, in conjunction with vitamins A, C, and E and selenium, can reduce inflammation and provide an important defense against the oxidative stress that occurs in inflamed

joints (Miggiano GA et al 2005). Oxidant stress within the joints has also been implicated in CTS (Sud V et al 2005).

- **Curcumin.** A component of the spice turmeric, curcumin has well-known anti-inflammatory properties. A review of 300 scientific papers on curcumin found that it can inhibit pro-inflammatory cytokines and that significant curative effects have been observed in experimental animal models of a number of diseases, including atherosclerosis, cancer, diabetes, intestinal diseases, and many others (Bengmark S 2006).
- **Ginger.** The anti-inflammatory properties of ginger have been known for centuries, and studies have shown clearly that ginger extracts can reduce inflammatory cytokines (Zhou HL et al 2005; Grzanna R et al 2005). Specifically, ginger has been shown to reduce the inflammation associated with joint disorders such as arthritis (Phan PV et al 2005; Frondoza CG et al 2004).

Lifestyle Changes

A wealth of clinical data confirms that lifestyle changes can help ease the suffering of those afflicted with CTS. However, there is no single “magic motion” or change that will work for everyone. People with CTS should consider the suggestions below to determine what works for them.

1. When sleeping, cock the wrists upward instead of bending them downward to minimize pressure in the carpal tunnel. A splint will help maintain this position.
2. At home or work, minimize repetitive hand movements when possible.
3. Alternate between activities or tasks to reduce the strain on the body.
4. When using the wrists, keep them straight and let the arms and shoulders share the stress.
5. Use the whole hand or both hands to pick up an item.
6. Avoid holding an object the same way for a long time.
7. Adjust your desk, chair, and keyboard so you are in the best possible position: back straight, feet flat on the floor or resting on a footrest, knees level with or slightly lower than your hips, shoulders in a neutral position (neither forward nor back), elbows bent at a 90-degree angle, forearms parallel to the floor, and wrists straight.
8. Take breaks at least once an hour to rest, shake your hands, massage the palms and backs of your hands, and do a few stretches and loosening movements of the shoulders and arms before settling back to work.
9. Keep hands warm, with gloves if necessary.
10. Get regular aerobic exercise such as walking or swimming.
11. Cut down on caffeine and smoking, which may reduce blood flow to your hands. Nerve tissue is the most sensitive to reduced blood flow.
12. If your work requires using tools, avoid holding an object or tool the same way for a long time.
13. Minimize time using vibrating tools. If that is not possible, stop frequently and follow the warm-up program below.

According to a report published by the American Academy of Orthopaedic Surgeons , a simple warm-up routine such as the following may greatly reduce the incidence of CTS.

- Hold your hands in front of you as if pushing on a wall. Count to five.
- Relax your wrists and fingers.
- Make tight fists with both hands.
- Bend both fists downward. Count to five.
- Repeat each step 10 times.
- Then shake arms loosely while they are hanging at your sides.

LIFE EXTENSION FOUNDATION RECOMMENDATIONS

Life Extension recommends that people with CTS avoid activities that aggravate their condition. They should also provide the best possible working conditions for their wrists. Alternative therapies might also be considered. Massage, yoga, and acupuncture have been studied and found to have varying degrees of effectiveness. In addition to a comprehensive preventive lifestyle program, CTS sufferers should consider the following supplements:

- **Vitamin B6** —200 milligrams (mg) daily. Caution should be exercised, however, because high doses of vitamin B 6 have been linked to neuropathy.
- **Serrafazyme serrapeptidase enzyme**—2 tablets twice daily between meals
- **Fish oil (omega-3 fatty acids)**—4000 mg daily, containing at least 1400 mg eicosapentaenoic acid and 1000 mg docosahexaenoic acid
- **Ginger extract**—1000 mg daily
- **Curcumin**—800 to 1600 mg daily
- **Vitamin A**—10,000 to 25,000 international units (IU) daily
- **Vitamin E**—400 IU daily

- **Selenium**—200 micrograms (mcg) daily

CARPAL TUNNEL SYNDROME SAFETY CAVEATS

An aggressive program of dietary supplementation should not be launched without the supervision of a qualified physician. Several of the nutrients suggested in this protocol may have adverse effects. These include:

Curcumin

- Do not take curcumin if you have a bile duct obstruction or a history of gallstones. Taking curcumin can stimulate bile production.
- Consult your doctor before taking curcumin if you have gastroesophageal reflux disease (GERD) or a history of peptic ulcer disease.
- Consult your doctor before taking curcumin if you take warfarin or antiplatelet drugs. Curcumin can have antithrombotic activity.
- Always take curcumin with food. Curcumin may cause gastric irritation, ulceration, gastritis, and peptic ulcer disease if taken on an empty stomach.
- Curcumin can cause gastrointestinal symptoms such as nausea and diarrhea.

EPA/DHA

- Consult your doctor before taking EPA/DHA if you take warfarin (Coumadin). Taking EPA/DHA with warfarin may increase the risk of bleeding.
- Discontinue using EPA/DHA 2 weeks before any surgical procedure.

Ginger

- Do not take ginger if you have a bile duct obstruction or gallstones. Ginger may stimulate bile production.
- High doses of ginger (6 grams or more) can cause damage to the stomach lining and ulcers.
- Ginger can cause allergic skin reactions.
- Consult your doctor before taking ginger if you take blood thinners such as warfarin (Coumadin). Ginger can increase the risk of bleeding.

Selenium

- High doses of selenium (1000 micrograms or more daily) for prolonged periods may cause adverse reactions.
- High doses of selenium taken for prolonged periods may cause chronic selenium poisoning. Symptoms include loss of hair and nails or brittle hair and nails.
- Selenium can cause rash, breath that smells like garlic, fatigue, irritability, and nausea and vomiting.

Vitamin A

- Do not take vitamin A if you have hypervitaminosis A.
- Do not take vitamin A if you take retinoids or retinoid analogues (such as acitretin, all- *trans* -retinoic acid, bexarotene, etretinate, and isotretinoin). Vitamin A can add to the toxicity of these drugs.
- Do not take large amounts of vitamin A. Taking large amounts of vitamin A may cause acute or chronic toxicity. Early signs and symptoms of chronic toxicity include dry, rough skin; cracked lips; sparse, coarse hair; and loss of hair from the eyebrows. Later signs and symptoms of toxicity include irritability, headache, pseudotumor cerebri (benign intracranial hypertension), elevated serum liver enzymes, reversible noncirrhotic portal high blood pressure, fibrosis and cirrhosis of the liver, and death from liver failure.

Vitamin B6

- Individuals who are being treated with levodopa without taking carbidopa at the same time should avoid doses of 5 milligrams or greater daily of vitamin B6.

Vitamin E

- Consult your doctor before taking vitamin E if you take warfarin (Coumadin).
- Consult your doctor before taking high doses of vitamin E if you have a vitamin K deficiency or a history of liver failure.
- Consult your doctor before taking vitamin E if you have a history of any bleeding disorder such as peptic ulcers, hemorrhagic stroke, or hemophilia.
- Discontinue using vitamin E 1 month before any surgical procedure.

For more information see the Safety Appendix

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