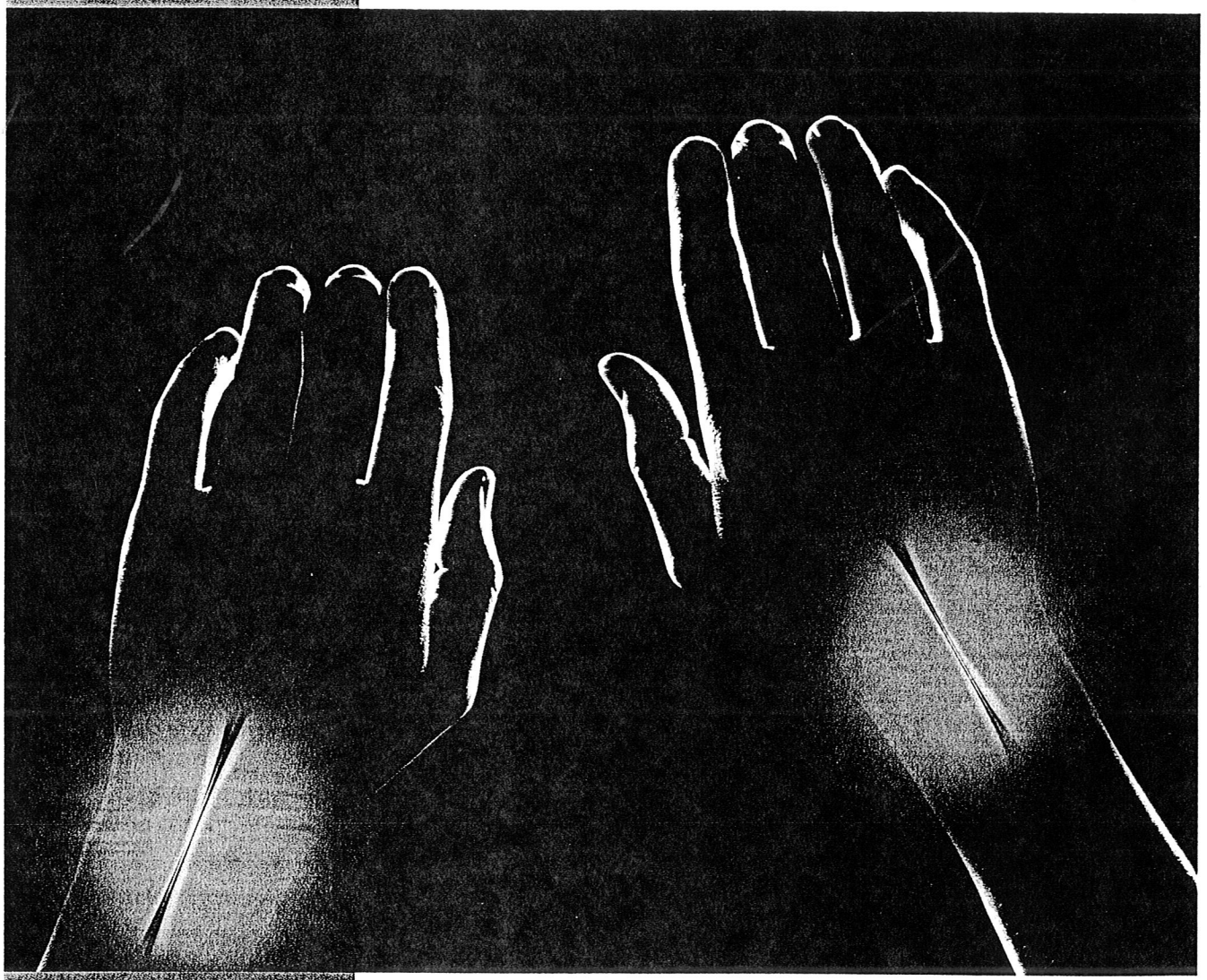
Carpal Tunnel Syndrome and Repetitive Stress Injuries

Ways to Avoid It and Work With It



A Rolfer's perspective

By Siana Goodwin
Illustrations by Peter Anthony
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On a daily basis, massage therapists across the country assist their clients in the prevention of, and recovery from, carpal tunnel syndrome (CTS) and related repetitive stress injuries (RSI). Ironically, CTS also sharply limits and sometimes ends the careers of many massage therapists. But it need not be so. Let's take a look at the anatomy and biomechanics of CTS and related syndromes, and through our understanding of the structural and behavioral origins of this disorder, find ways to prevent it from "impinging" on your own body.

Understanding Structure

Structurally, three sides of the carpal tunnel are formed by carpal bones, and the fourth side by a broad ligament. The bellies of the prime muscular movers of the hand lie in the forearm. The force of these muscles is delivered to the hand by long tendons. Eight of these tendons pass through the carpal tunnel, along with the median nerve. If any one of these nine elements becomes slightly inflamed, it puts pressure on all the other elements, resulting in more inflammation for all members of the group. A vicious cycle begins.

Tips for Reducing Carpal Tunnel Symptoms

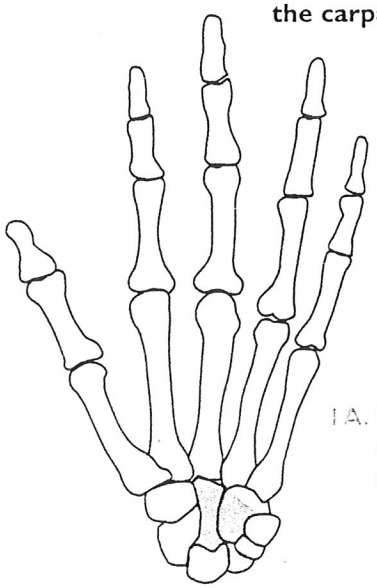
- Minimize time spent with the hands in a pronated position. Any degree of supination in your work is an improvement. Study your body's position while you work.
- Find keyboards which rise toward the middle. Split keyboards also help.
- Move your hands down from the 10 o'clock and 2 o'clock positions on the steering wheel. Your hands will be more supplanted the lower they are on the wheel.
- Keep your hands moving – frequent small variations in hand position reduce repetitive strain.
- Find better ways to rest your hands. When you are not working, let your hands rest palm up. This opens the space between the ulna and radius, and reduces compression on the palmar surface of the hand, wrist and forearm.

Anti-inflammatory medication may be useful, but it is difficult to deliver the pharmaceutical to tendons because of their low vascularization. A surgical approach is to lengthen the ligament forming the palmar boundary of the carpal tunnel, thereby increasing the volume in the tunnel. This surgery is often quite successful, but I believe prevention is preferable to surgical correction.

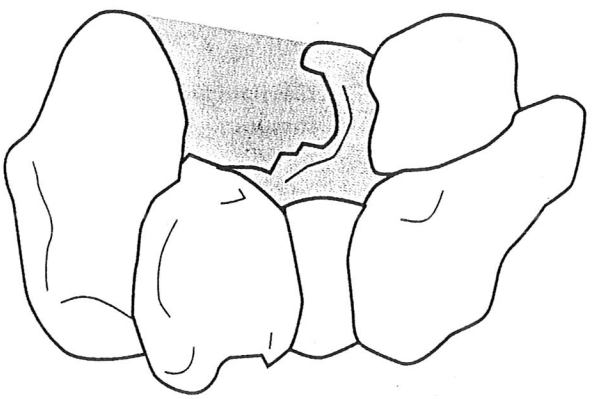
It's very common for people to refer to all RSIs of the hand and arm as "carpal tunnel." I have even heard injuries to the elbow being called "carpal tunnel in the elbow." The specific condition of CTS is an impingement of the activity of the median nerve. Presence of CTS is identified by electromyography which determines the conduction capacity of the nerve. Impingement of the nerve results in pain and tingling in the hand, and muscle weakness in its intrinsic muscles, especially the flexor and opponens pollicis. In severe cases of CTS, these muscles atrophy.

There are conditions that can precede the onset of CTS and these can also produce symptoms of pain and numbness. Usually these are caused by prolonged muscle tension resulting →

Fig 1A-1B **The shaded area in both illustrations shows how the carpal bones define three sides of the carpal tunnel.**



1A. Palmar view of the skeletal hand.



1B. Proximal view of the carpal tunnel.

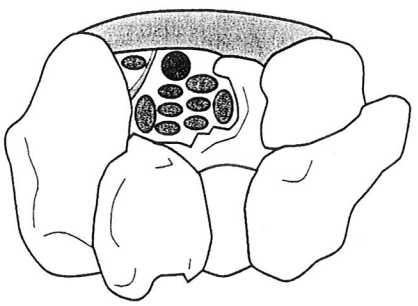
in the restriction of blood flow. When this occurs, not only do muscles and nerves not receive the nourishment they need for repair, but the removal of metabolites from normal muscle functioning is also lessened. The result is edema of surrounding tissues and increased pressure and tension in the area. Many RSI and CTS problems occur in a cycle of tension: restriction of blood flow, edema and consequent further restriction of movement – all potentially leading to severe problems.

The muscle tension that's part of RSI may be due to repetitive movement or it may be a somato-emotional event resulting from psychological stress. In the long cycle of micro-injury that produces symptoms of RSI, bodywork can be of great help in reducing tension and edema, increasing blood flow and encouraging different movements which may reduce or reverse painful symptoms.

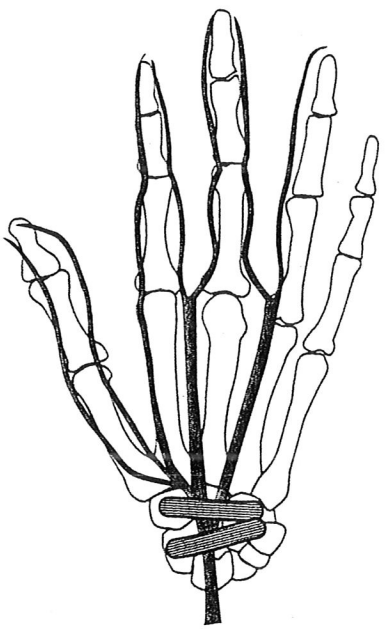
From a Rolfer's Eye

Rolfing can be especially well-suited for this kind of work because of its emphasis on altering patterns of movement and strain throughout the entire body, as contrasted to working only for symptom relief. Rolfers are trained to consider the whole body in looking for an overall pattern of tension or restriction in movement, of which the complaint – RSI or some other condition – is one manifestation. Thinking about the anatomy of the upper limb, for example, illustrates the sense of this. In the hand, while there are numerous muscles that facilitate finger movements (having origins and insertions only in the metacarpal and/or phalangeal bones), the flexors and extensors of the digits and wrist have their origins either in the bones of the forearm or the arm itself. The structural relationship of the forearm to the arm is of course affected by the muscles which cross the elbow. Now we can see a relationship between the muscles of the wrist and those of the arm. The action of the muscles of the arm is also affected by the position of the arm in its socket, relating to the muscles which have origins in the scapula; their function is affected by the muscles spanning between scapula and torso. (Readers familiar with *Massage & Bodywork* columnist Tom Myers' explanation of the "anatomy trains" in the body will recognize a similar sequence here.)

From another point of view, tracing the path of the nerve supply to the wrist and hand through this overlapping complex of muscles back to the origins of the brachial plexus in the neck will demonstrate that compression of the median nerve (or radial or ulnar nerve) may occur at any point in its length. To



2A. Carpal tunnel proximally, including tendons and nerve.



2B. The palmar aspect of the hand, showing the course of the median nerve.

Fig 2A-2B

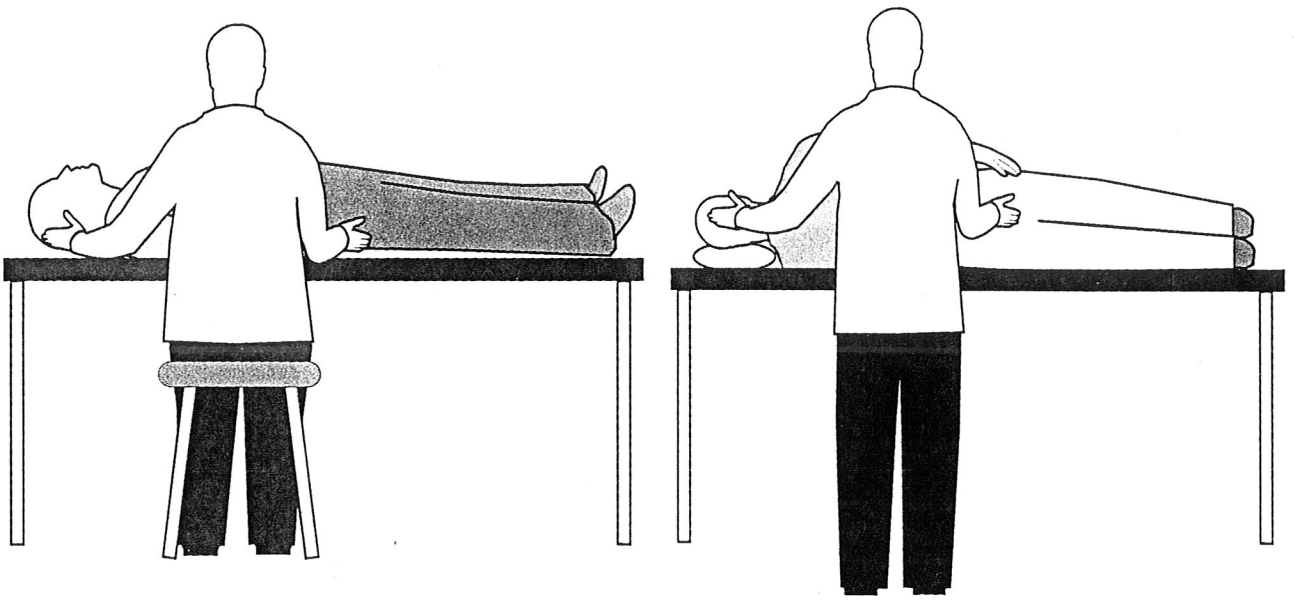
As we know, inflammation starts with repetitive strain, often combined with poor body mechanics. Prevention comes largely by avoiding repetitive motion, using proper body mechanics and focusing on more effective rest when the hands are not in use for either work or play.

the eye of the Rolfer, a complaint of pain in the hand or wrist may have an origin anywhere along this path. And the manner in which a Rolfer palpates and gathers information from the body, through the web of fascia, can lead her to feel connections related to the complaint, but perhaps distant from it. Two elements are important in this equation: the connectivity of the tissue and the layering of tissue in the body.

Anatomical studies from the West emphasize the separation of muscles and tissues, and we are prone to think of the body as being composed of separate parts stuck together in some mysterious way. However, fascia is a continuous web throughout the body, and it is possible to feel the connection between distant restrictions through it. If a Rolfer or other bodyworker, instead of addressing a tight muscle, can experience the corresponding patterns of tension in the fascia, whole patterns of concurrent strain throughout the body will present themselves. Similarly, the concept of working in the fascial web allows distinctions within muscles, which appear in the concept of layers. Since fascia surrounds not only the gross structures of muscles, organs and bones but also muscle bundles, fasciculi and even individual muscle cells, it is possible to develop a refined approach to working at layers of tissue. The body can be experienced tactily, not only as a collection of muscles, but as infinite layers of connective tissue, any one of which will contain not only muscle fibers, but also portions of other fascially-encased structures. It's not unusual to find restrictions at a particular layer within the limb which may not be present at other layers. For instance, the surface muscle tissue of the wrist flexors may appear quite soft, easily compressible to the touch, but hard at a deeper level. What we think of as a muscle that we could dissect from the arm, often has differences in consistency within it. It is in layers of tissue that the differences are felt.

Putting It Into Practice

It was my background as a Rolfer, in looking for overall patterns in the body, and in experiencing the body in fascial layers, that allowed me to make some connections between different phenomena I observed while working at Starkey Laboratories in Eden Prairie, Minn. Starkey – one of the world's largest manufacturers of custom hearing aids – was plagued with a high number of repetitive stress injuries, →



3A. Rock and glide with hands under body.

3B. Rock and glide in side-lying position.

Fig 3A-3B

Pressure directly on the carpal tunnel ligament reduces the space in the carpal tunnel, therefore it's important to avoid prolonged pressure in this area. Avoid using your hands under the client's body where weight will lie on the carpal tunnel. Craniosacral therapists and others who have their hands under the body for long periods know how painful or deadening this can be to the hands. Most work done with the hands under the body can be done with the person in a side-lying or prone position.

including carpal tunnel syndrome. My job was to reduce their employee incidence of RSI. When I first started, I assumed it to be entirely a problem of the wrist, since that is where the median nerve supplying the muscles of the hand is most vulnerable. But as I worked and studied more, I found a variety of different factors were at play in the injuries people were suffering.

While many of the employees had pain and numbness of the hand or fingers associated with RSI, each had different kinds of jobs. Some were office workers who used computer keyboards, while others were technical workers involved in manipulating small objects by hand or with tools, often kneading or squeezing compressible material or constantly moving their hand between pronation and supination within a small range of movement. In addition, many of these latter employees worked in a confined posture, while constantly gazing into a microscope.

As a result of my work, I found the following conditions also involved in complaints that qualified as RSI syndromes:

- *Tension in the cubital and proximal flexor compartment associated with continuous flexion of the elbow and sometimes associated with repeated movement between pronation and supination.*

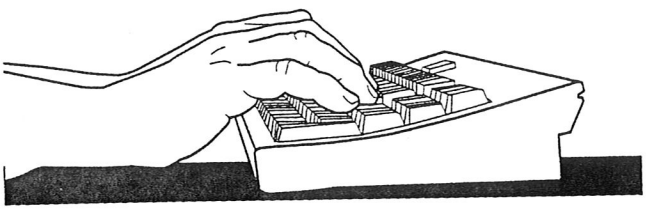
I consider this to be overworking of the biceps, especially irritation of the distal tendon, from continual small movements. From the viewpoint of fascial consideration, disturbances or stresses within fascial structures may also be important factors in RSI. Tension can be created in the fascia of the flexor compartment because of the attachment of the distal biceps tendon. Besides attaching directly to the radius, it also spreads out into the flexor fascia in an aponeurosis. If we consider that tension in the fascia can create stress on muscles, it is possible tension in the biceps attachment can produce tension in the fascia to which it is attached. This may contribute to tension in the overall flexor compartment.

- *Restriction of supination.*

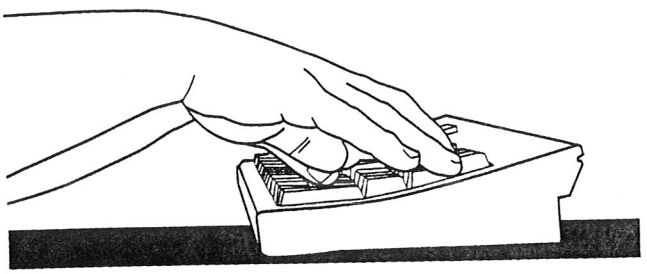
Most work with the hands is done from a pronated position. One of the observations of Rolfing is that when a particular position is maintained, so that muscles have a repetitive pattern of contraction, surrounding fascia changes to support the muscle contraction. It often becomes inflexible so that the muscle is unable to return to a lengthened, resting state. In the case of repetitive motion of the hands and arms, this shortening →

Fig 4A-4C

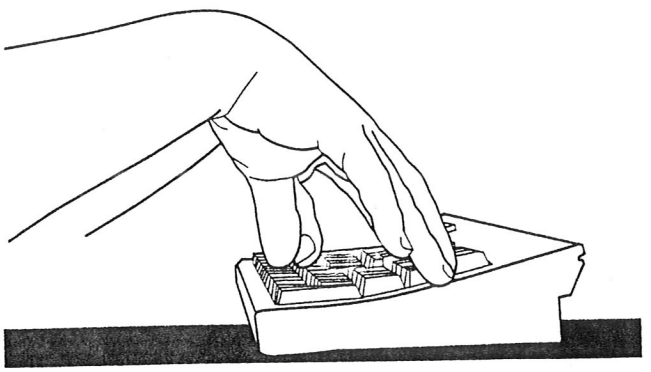
If you use a computer keyboard, do not let the base of your hand rest on the table. Before we had word processors we had typewriters, and in those days carpal tunnel syndrome was far less frequent. We didn't even have a name for it. Typewriters could not be operated with the base of the hand resting, but required up and down motion of the whole hand.



4B. Hands in motion on keyboard, base of hand resting.



4A. Hands in motion on keyboard, base of hand in air.



4C. Hands in motion on typewriter.

in the pronators of the forearm leads to a condition where the forearm, even when relaxed, is always in partial pronation. This can easily be seen when a person is lying supine, with arms at the sides, and the forearm rests with the thumb pointing vertically, rather than laterally.

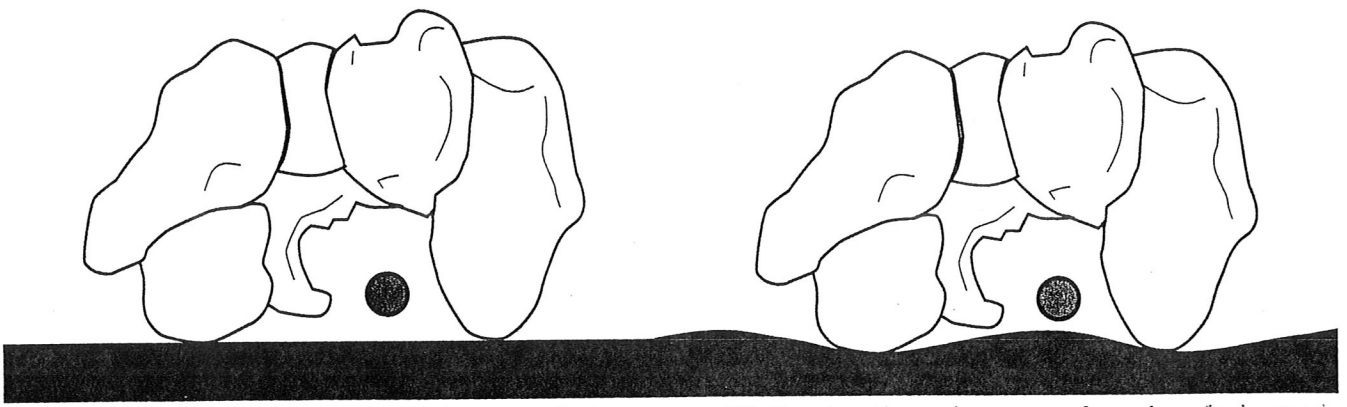
A further problem with this condition is that when the forearm is pronated or partially pronated, the interosseous space is compressed, and in pronation the wrist and finger flexor muscles are also compressed. Since the median nerve lies deep in the tissue of these muscles, this kind of squeezing may create additional pressure on the nerve proximal to the carpal tunnel. As the muscle shortening impedes the ability of the forearm to fully supinate, continual contraction of the interosseous fibers also impedes their ability to fully extend and allow the arm to come into supination. (See the sidebar for working with this problem)

- *Over-contraction of the opponens and flexor pollicis; contraction of the palmar fascia, particularly at the retinaculum of the wrist; and compression of the carpal joints, particularly the trapezium-scaphoid.*

These conditions were most common to workers whose jobs required gripping and manipulating small objects. Again, the repeated contraction of muscles results in an inability for the muscle to return to a full resting state. The appearance of the hand when these conditions are present is that the space across the base of the hand, between the ends of the first and fifth metacarpals, seems narrow – the hand cannot open wide. The thumb and little finger may look as though they're moving toward each other. Sometimes the palm seems to have a little valley in it at the center of the wrist.

The fascia of these intrinsic muscles of the hands is continuous with the thicker fascia that forms the roof of the carpal tunnel, the retinaculum of the wrist. As with the condition of tension in the bicipital aponeurosis in the forearm, continuous tension in the muscle contributes to inelasticity in the retinaculum, as well as an actual narrowing of the space of the carpal tunnel.

We don't usually consider the mobility of the carpal bones as a factor in repetitive strain, since their mobility is relatively limited. However, the gliding joints between these small bones provide the flexion, extension and rotational movement of the wrist. When movement in the wrist is limited, and muscles and fascia begin to lose their elasticity, this gliding property of the joints can be irrecoverable, as their surfaces jam and fluidity in the joint



5A. Resting the wrist on a hard surface may feel uncomfortable over the bones, but protects the carpal tunnel.

5B. Resting the wrist on a soft surface feels good over the bones, but puts more pressure on the carpal tunnel.

Fig 5A-5B

Soft, cushy rests have been developed to put under the base of the hand and wrist when using a keyboard. Initially these feel better; however, when the bones on the sides of the carpal tunnel rest on a hard surface, the central expanse of the carpal tunnel is somewhat protected from deep compression. When the base of the hand rests on a soft surface, the bones on the sides of the tunnel sink into the soft surface and the central span of the tunnel may receive more pressure. If you use a keyboard, treat it like a typewriter. Keep your wrists up off the desk, this will usually require lowering the keyboard or raising your seat.

is reduced. It is also important to remember the bones of the wrist form the "floor" of the carpal tunnel. We generally think of trauma in this area resulting from compression within the tunnel by inflammation of tendons; it is a bit of a leap to consider that restriction in the "roof" of the tunnel, the retinaculum, may also be a factor. It's an even bigger leap to think restriction in the floor might also be a problem, but I believe, at the very least, mobility in the wrist bones helps with the problem of fluid movement in this area, which can help diminish inflammation and edema, precursors to more serious repetitive strain problems.

• *Tension in thumb extensors, sometimes resulting in pressure on the radial nerve.*

This was an unusual condition, only appearing in people whose jobs demanded repetitive use of a wide, rather than a narrow grip. Presenting complaints were numbness in the wrist and hand on the dorsal side. Obviously, this would indicate some difficulty with the radial nerve supply, rather than the median or ulnar nerves. The problem, again, was often in the compression of fascial structures associated with tendons – in this case, the tendons of the extensor pollicis muscles. The dorsal surface of the forearm would often have a peculiar flattening of the tissue approximately two inches above the wrist, where these muscles would be in continuous contraction.

• *Tension in the neck and shoulders, and anterior movement of the scapula on the ribcage.*

Neck and shoulder tension in our society is so common we seldom think of it as anything other than just a condition of living. However, whenever I found another condition of muscle tension that seemed to be a precursor to serious RSI problems, I always found neck and shoulder tension. For the majority of people I worked with, this kind of tension was exacerbated by their working position which demanded the head be inclined forward. While it is possible for typists to alter the position of their keyboard and computer monitors, it was not, at least initially, possible for people who worked with microscopes to do so. Over the course of the years I worked at Starkey, various changes were made in the microscope mounting systems that allowed workers to maintain a more upright posture.

Before these changes were made, working to relieve tension in the neck and shoulder girdle was critical. When you consider the roots of the nerves in the arms and hands are in the lower cervical

See Carpal Tunnel, p78

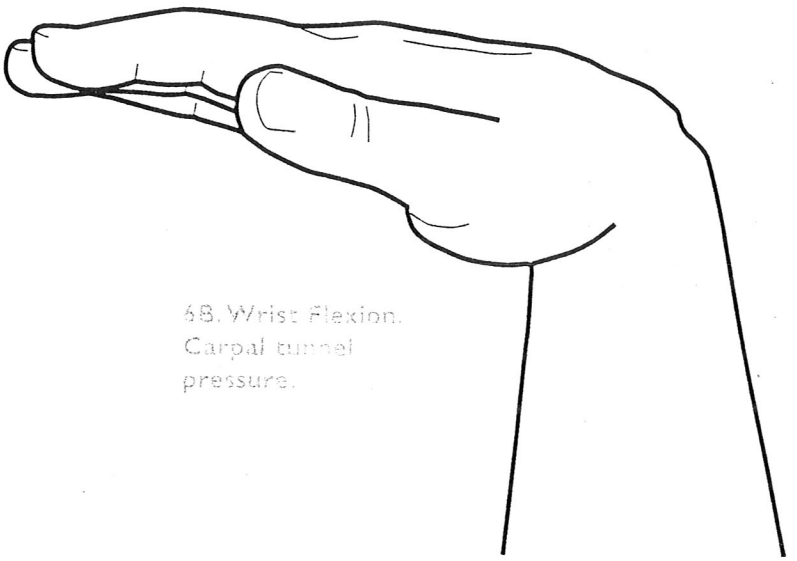
11 Hints to Reduce Hand Strain For You and Your Clients

1. Vary your tasks. Mix several activities in the course of a day to reduce repetitive activity.
2. When performing a repetitive task, frequently vary the way you are using your hands. Even small variations help.
3. Avoid working with your elbows bent at an angle less than 90 degrees. Too much bend at the elbow compresses blood vessels and nerves.
4. Spend most of the time with your wrists in a near-neutral angle. Flexion puts strain on the carpal tunnel, but extension places three times as much strain when the wrist is flexed.
5. Minimize time resting the wrists on surfaces when the hand is in a palm-down position. This compresses the carpal tunnel and other vulnerable structures.
6. Minimize time spent with the hand in a palm-down position: thumb or palm up is better. The palm-down position compresses tissues deep between the long bones of the forearm. If you must work with the hand palm down, put your hand in the thumb-up position every moment you can when you are on breaks or off-duty.
7. Minimize time spent contracting or narrowing the palm of the hand (closing thumb and little finger together). This position contributes directly to carpal tunnel pressure.
8. Let your shoulders and breathing be as relaxed as possible in any task.
9. If you use a computer more than one hour a day, then utilize two or three different mouse styles. Changing your mouse at least every hour and making frequent, small adjustments in the angles in your hand use on the keyboard will help reduce repetitive strain.
10. Get regular exercise. One factor which may contribute to carpal tunnel is low cardiovascular condition of the body, as not enough blood circulates in the hand area to support a high level of activity in the hands.
11. If you use your hands on the job, choose leisure activities which do not use the hands. Play soccer rather than racquet sports. Sing rather than play the guitar.

See Technique, p76

Technique, from 73

Spend most of your time with your wrists near neutral. When you deviate from neutral, choose flexion in preference to extension. When you must extend your wrists, limit the time spent extended to a minimum. Gorillas have the good, instinctual sense to walk on their knuckles rather than their palms, thereby preventing (albeit unknowingly we presume) their own carpal tunnel problems.



6B. Wrist Flexion. Carpal tunnel pressure.

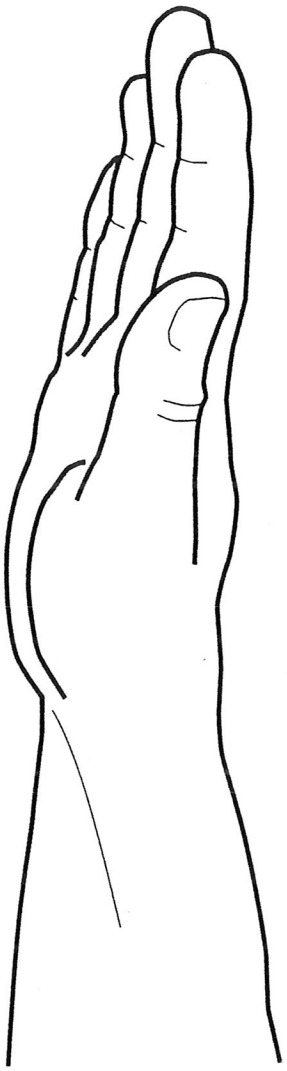
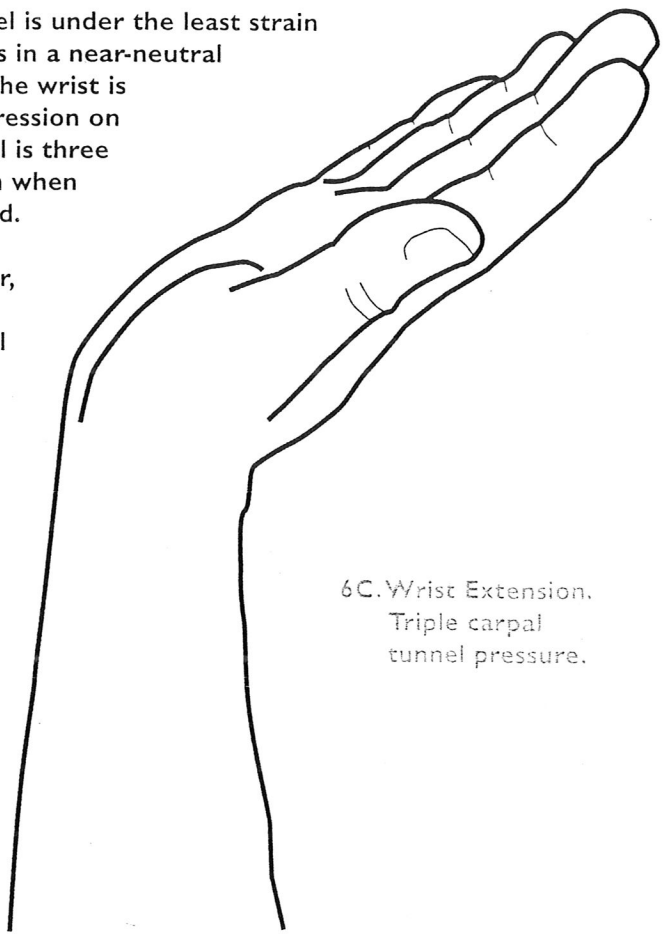


Fig 6A-6C

The carpal tunnel is under the least strain when the wrist is in a near-neutral position. When the wrist is extended, compression on the carpal tunnel is three times more than when the wrist is flexed. When the wrist is flexed, however, compression on the carpal tunnel is still increased.



6C. Wrist Extension. Triple carpal tunnel pressure.

6A. Wrist Neutral. No carpal tunnel pressure.

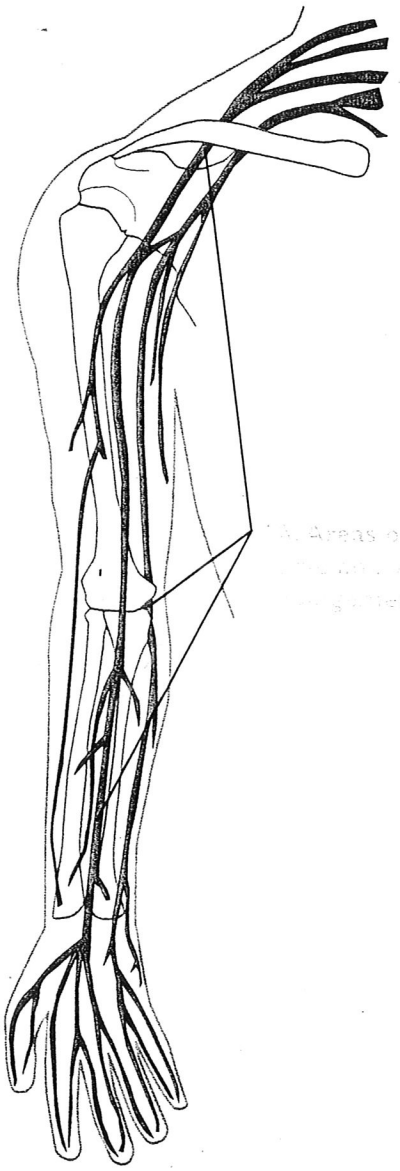


Fig 7A

The nerves and tendons which pass through the carpal tunnel may get their initial irritation proximal to the carpal tunnel. The irritation may not be so noticeable until it is magnified by entrapment in the CT. Immediately proximal to the hand are the ulna and the radius. In the motions of pronation and supination, the full length of the radius rotates; however, the rotation is of a different kind at each of the two ends of the radius. At the elbow end of the forearm, the radius rotates around its own axis within the annular ligament. At the wrist end of the forearm, the radius rotates around the ulna. This functional difference between the two ends makes the shafts of the two bones move closer to each other in pronation and away from each other in supination.

Working With Incomplete Supination

Dealing with incomplete supination is one example of how the Rolfing perspective allowed me to work with, as well as speculate about, the variety of conditions associated with CTS and RSI.

The approach I took was based on two precepts I hold in Rolfing: 1) movement allows for both release and re-education – manipulation with movement is more effective than manipulation alone; and 2) using the idea of planes of fascia, we can access deep structures indirectly by working anywhere in the plane of the deep structures.

When the forearm doesn't completely supinate, I consider both the lack of complete relaxation in the pronators and the probable tension in the interosseous membrane. It seems inefficient to try to affect the interosseous membrane by direct pressure through the muscle tissue of the forearm. However, one can access tissue deep to the flexor compartment by sliding under the edge of the flexor compartment along the medial ulnar shaft. If the client slowly pronates and supinates the forearm while I continue to apply direct pressure along this plane between the flexor compartment and the bone, a deep release can be felt. Additionally, relatively light pressure can also be directed across the body of the pronator teres, which allows that muscle to come to more complete relaxation when it is not being actively used.

I generally will have my client move into pronation at the start of the movement, then slightly increase pressure as the movement goes toward supination. An increase in intensity of the preferred position at the beginning of the movement allows a greater contrast to the feeling of supination, and as the movement is repeated with the practitioner's hands working with the tissue, the sensation of movement and the contrast between pronation and supination act to educate the neuro-myofascial system into a new balance. Just a few repetitions of movement will bring about a significant increase in the movement of supination.

– Siana Goodwin

Carpal Tunnel, from p73

vertebrae, it's easy to see why it's important to have free movement and release of muscle tension in the neck. I also found it was import-ant to work with restrictions in the shoulder girdle. Continuous forward inclination of the head compresses the upper ribs, often shortening pectoralis minor and encouraging the scapula to slide forward on the ribcage. This increases the chances of compression of the brachial plexus near its origin site.

Conclusion

Management of repetitive stress is critical to all those who make a living with their hands. Massage therapists and bodyworkers are in the peculiar position of both needing to protect their hands and of assisting others in resisting the effects of RSI. A thorough understanding of the anatomy involved in RSI and the factors that contribute to stress are important for the practitioner, both for well-being and therapeutic effectiveness. For the practitioner, working in ways that minimize pressure on vulnerable tissues helps keep the strain to a minimum. In treating others, being aware that symptoms of RSI caused by restrictions anywhere in the fascial and neural chains can lead to more thorough treatment. RSI is the result of a combination of factors, and these factors must be taken into consideration – for both the health of the practitioner and the client.

Siana Goodwin has been a practicing Rolfer since 1980. From 1992-98, she worked with Starkey Laboratories, Inc. to reduce RSI incidence through Rolfing. Within one year, the company had reduced its workers' compensation costs by 87% and currently maintains that reduction. She is a mentor to new Rolfers and teaches workshops in working with RSI and in Rolfing processes. For information about her work, e-mail sbg49@earthlink.net *or call 612/722-0049. Jeff Burch can be reached via e-mail at* darkwood@rio.com.

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Adding to the list of items contributing to the CTS dilemma is the happy problem of the opposable thumb. Our prehensile thumbs allow us much greater dexterity than other creatures. The cost of this dexterity, however, is carpal tunnel compression. When the thumb and little finger are brought together, the base of the hand is narrowed. Prolonged or frequently repeated narrowing of the base of the hand persistently compresses the carpal tunnel. When you are working on clients, avoid narrowing the base of the hand whenever possible. Use maneuvers which require this motion as little as possible. Many people unconsciously narrow the base of the hand even when it is not necessary. Watch for and avoid this narrowing. For example, when driving a car, let your thumbs be on the outside of the steering wheel.