Body Mechanics

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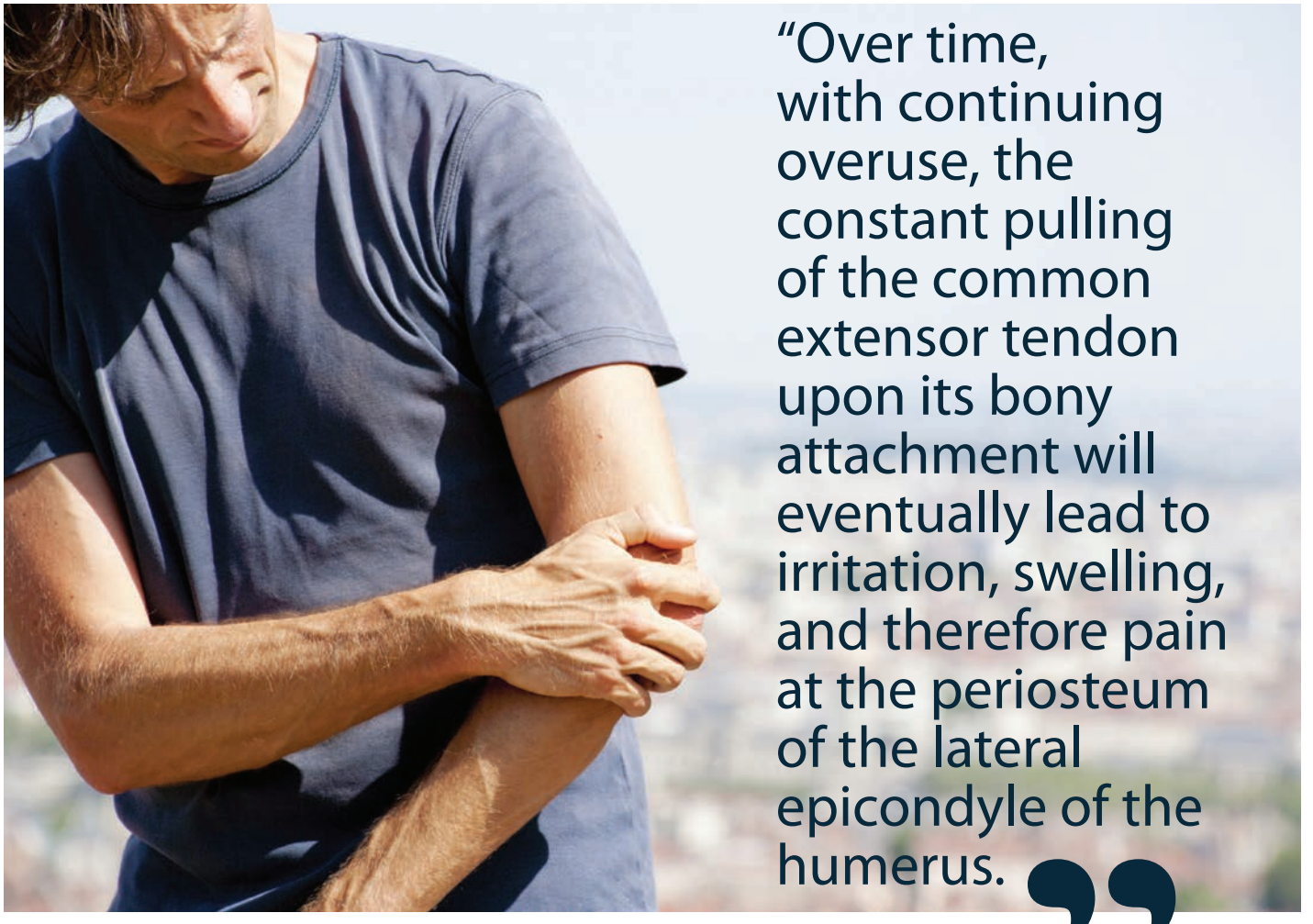

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Tennis Elbow

Tennis elbow is the term given to the condition that involves inflammation or degeneration of the myofascial tissue of the common extensor belly/tendon of the posterior forearm and/or inflammation of its lateral epicondyle attachment on the humerus (Figure 1). For this reason, tennis elbow is also known as lateral epicondylitis or lateral epicondylosis. The term lateral epicondylitis is applied when swelling is present (*itis* means swelling); lateral epicondylosis is applied when swelling is no longer present and the tendon begins to degenerate instead (*osis* is a general term for condition). Tennis elbow is so named because playing tennis is often the cause of this condition.

CAUSES

Even though playing tennis can cause tennis elbow, it is not necessary to play tennis to have this condition. Effectively, the cause of tennis elbow is any overuse of the muscles that contribute to the common extensor belly/tendon. (Note: It is common to refer to this structure as the *common extensor tendon* because the tendons of these muscles blend into one another, but the associated muscle bellies also usually blend into one another, therefore the term *common extensor belly/tendon* is actually more appropriate.) These muscles are the extensor carpi radialis brevis, extensor digitorum, extensor digiti minimi, and the extensor carpi ulnaris (see Figure 1). As evident in their names, these muscles create extension, specifically extension of the hand at the wrist joint as well as extension of the fingers at the metacarpophalangeal and interphalangeal joints. Therefore, excessive postures and activities that engage wrist and finger extension can potentially cause this condition.

If playing tennis is the cause of tennis elbow, it is usually the backhand stroke that is involved. When hitting this stroke, the wrist joint should stay in neutral position and not extend. If someone has improper form and instead extends the hand at the wrist joint during the stroke, it requires concentric contraction of the wrist extensor muscles and therefore stresses musculature of the common extensor belly/tendon (Figure 2a). However, even if the player maintains the hand in the proper neutral position, it is still possible to develop tennis elbow because maintaining a neutral wrist position when striking the ball still requires contraction of the muscles of wrist extension. But instead of contracting concentrically, they contract isometrically to stabilize the hand at the wrist joint against the force of the ball striking the racquet, which would otherwise cause the wrist joint to collapse into flexion (Figure 2b). Therefore, if a player plays against someone who hits more forcefully than they are used to, and/or if the player plays for longer than they are used to, the muscles and their common belly/tendon may be overused and injured.

Of course, tennis is not the only activity that requires finger and wrist extension. Other examples include working at a check out counter, a carpenter or other manual laborer holding and swinging a tool, a musician playing an instrument, or even a massage therapist working on clients/patients.

However, if extension of the wrist and fingers were the only cause of tennis elbow, this condition would not occur as often as it does. There is another activity that many therapists do not realize is a major contributor to tennis elbow, that is flexing the fingers to make a fist or grip an object. To flex the fingers, we engage the flexor digitorum superficialis, flexor digitorum profundus, and the flexor pollicis longus muscles. However, when these muscles contract to flex the fingers, they also create a pulling force on the hand that would flex it at the wrist joint. To stabilize the wrist joint and prevent it from flexing, we need to isometrically contract extensor musculature of the wrist. The muscle that is most commonly engaged for this function is the extensor carpi radialis brevis. If you observe and palpate the posterior wrist slightly lateral/radial to the midline when making a fist, you can usually see and feel the distal tendon of the extensor carpi radialis brevis contract and tauten (Figure 3). Therefore, extended periods of time spent gripping an object can lead to tennis elbow. Examples abound: gripping a tool such as a wrench or screwdriver, holding a steering wheel, gripping a tennis racquet when hitting

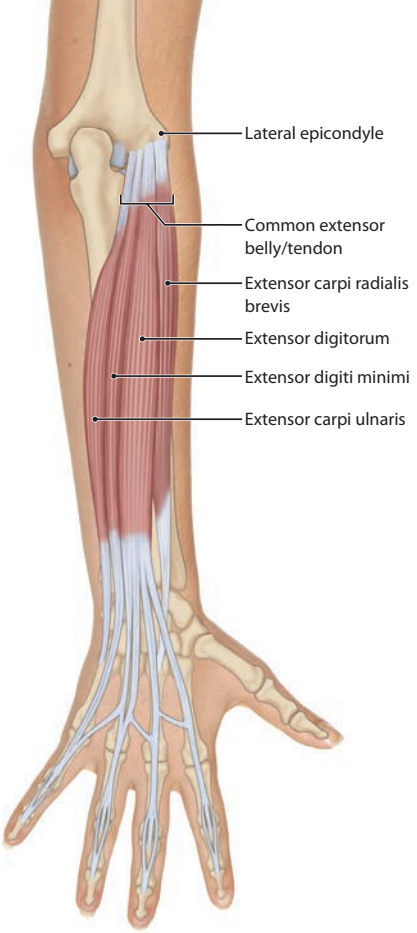

FIGURE 1 Tennis elbow involves the myofascial tissue of the common extensor belly/tendon and its lateral epicondyle attachment on the humerus. Posterior view of the right forearm. *Modeled from Muscolino, JE The Muscular System Manual – The Skeletal Muscles of the Human Body, 3rd Edition. 2010. Elsevier.*

FIGURE 2 Hitting a backhand stroke in tennis requires contraction of the wrist extensor muscles. A, Extending the wrist joint during the stroke requires concentric contraction of the wrist extensor musculature. B, Holding the wrist joint straight during the stroke requires isometric contraction of the wrist extensor musculature.

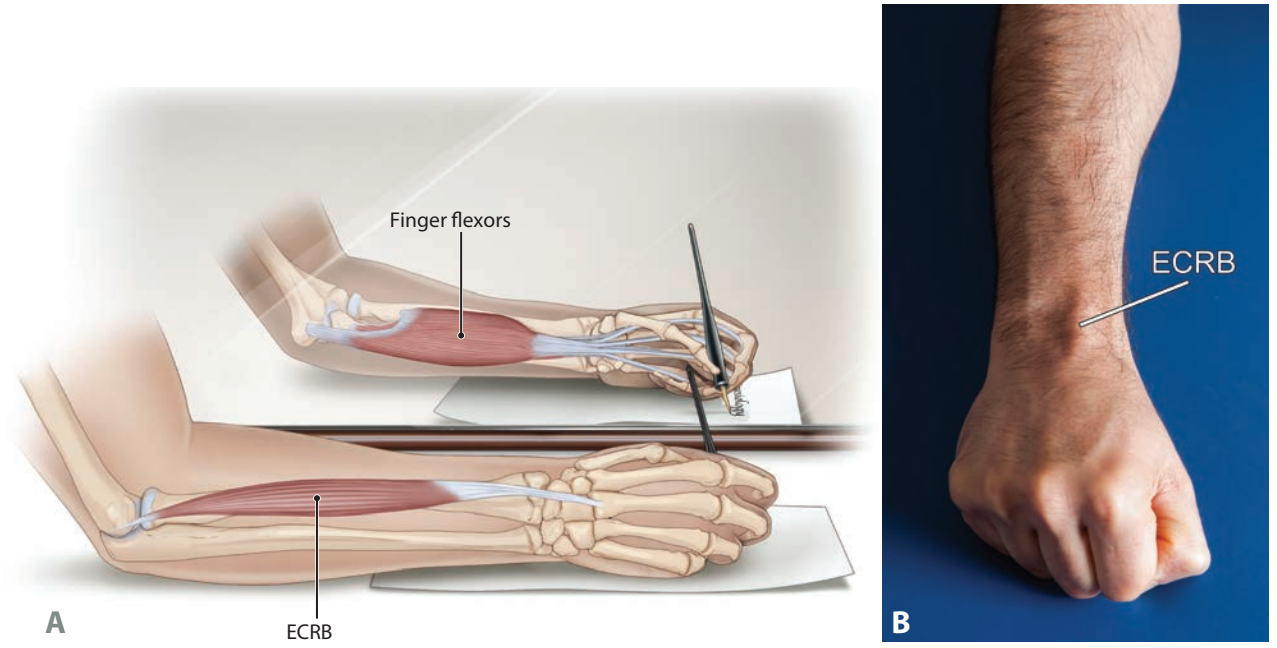

FIGURE 3 Gripping an object requires stabilization of the hand at the wrist joint, usually by the extensor carpi radialis brevis (ECRB). A, contraction of the extensor carpi radialis brevis can be seen when the fingers flex to hold an object. B, contraction of the ECRB can be seen when making a fist. *Figure 3A is modeled from Neumann, DA Kinesiology of the Musculoskeletal System, 2nd Edition. 2010. Elsevier.*

a backhand or forehand, gripping a pen or pencil when writing, or simply holding a cell phone. Given how often we hold/grip objects, it is easy to see why tennis elbow is such a common condition.

In addition to repeated microtraumatic overuse of the muscles of the common extensor belly/tendon, a direct physical macrotrauma to the common extensor belly/tendon or the lateral epicondyle of the humerus, such as a bang, fall, or sudden powerful overstretch of the associated musculature can also contribute to tennis elbow.

SIGNS AND SYMPTOMS

The most common symptoms of tennis elbow are pain at the common extensor belly/tendon and tightness of the associated muscles. This tightness might be global tightness of the entire belly or bellies of the associated muscles, or might manifest as myofascial trigger points. The pain will usually occur with contraction of the associated muscles, whether it is concentric or eccentric contraction during motion, or isometric stabilization contraction. Pain as well as tightness will also be evident with palpation of the proximal bellies of the associated musculature and their proximal common extensor tendon. Pain might also occur when the muscles of the common extensor tendon are stretched; this would occur when the hands and/or fingers are actively or passively moved into flexion. If the tightness of the musculature of the common extensor tendon is sufficient, it might also cause decreased active or passive flexion range of motion of the wrist joint. Due to its role in stabilization of the wrist joint, the most commonly affected muscle with tennis elbow is the extensor carpi radialis brevis.

Over time, with continuing overuse, the constant pulling of the common extensor tendon upon its bony attachment will eventually lead to irritation, swelling, and therefore pain at the periosteum of the lateral epicondyle of the humerus. Therefore, even though this condition is technically named for the lateral epicondylar attachment, pain at the lateral epicondyle itself does not usually occur until this condition has progressed to be more chronic and severe.

In the early stages of this condition, in addition to pain, swelling is also usually present at the common extensor belly/tendon and can often be felt on palpatory examination. The swelling can also spread to the lateral epicondyle, which is often visible; look for the bony contours of the lateral elbow to be less evident compared to the other side of the client's body. In later stages of this condition, usually after a period of six months or more, the swelling gradually recedes and degeneration of the collagen construct of the common tendon begins to occur. As this transition in pathophysiology occurs, the description of this condition changes, as previously mentioned, from lateral epicondylitis to lateral epicondylosis. Due to the degeneration of the tendon and the continued pull of muscular contraction, tearing of the tendon may also occur (Figure 4).

If tennis elbow is left unresolved for a very long time, because its underlying cause is overuse and irritation of the extensor musculature of the posterior forearm, tendinitis of the distal tendons of these muscles at the wrist joint is a possible consequence.

Why the Extensor Carpi Radialis Brevis?

The long finger flexors cross the wrist joint, therefore stabilization by a wrist extensor is needed to prevent these muscles from flexing the hand at the wrist joint when they contract to flex the fingers to hold/grip an object or make a fist. But why does the central nervous system choose the extensor carpi radialis brevis as the stabilizer in this scenario? After all, any wrist extensor muscle could create a force of wrist extension that could prevent wrist flexion and thereby stabilize the wrist joint. The answer to this question becomes clear when we look at the other four wrist extensor muscles that could potentially be used to stabilize the wrist. They are the extensor digitorum, extensor digiti minimi, extensor carpi radialis longus, and extensor carpi ulnaris.

The extensor digitorum and extensor digiti minimi are finger extensors as well as wrist extensors. Therefore, if either of them were chosen, it would oppose finger flexion, which is the desired joint action in this scenario; therefore they are not good candidates. The extensor carpi radialis longus and extensor carpi ulnaris attach distally on the metacarpals, so they do not cause finger extension. However, they cross the wrist joint far from the frontal plane axis of motion; in other words, they cross far from the center of the wrist. The extensor carpi radialis longus crosses far to the radial side; the extensor carpi ulnaris crosses far to the ulnar side. Therefore, if either of these muscles had been chosen, it would have created an unwanted frontal plane action (radial deviation for the extensor carpi radialis longus and ulnar deviation for the extensor carpi ulnaris) that would then require

ASSESSMENT

Knowing how to assess tennis elbow is an extension of our understanding of the underlying pathomechanics of the condition. Active range of motion or manual resistance to extension of the hand at the wrist joint or the fingers at the metacarpophalangeal and interphalangeal joints will likely cause pain because the associated musculature contracts and pulls on the common extensor belly/tendon and lateral epicondyle of the humerus (Figure 5AB). Active or passive flexion of the wrist or fingers would also likely elicit pain because it stretches the associated musculature and therefore pulls on the common extensor tendon and the lateral epicondyle (Figure 5C). Passive extension of the hand or fingers is usually negative to pain because the affected muscles are neither contracted nor stretched. Because the extensor carpi radialis brevis is most often affected, active radial deviation may also show positive for pain. Given the irritation, swelling, and degeneration of the common extensor tendon, and the irritation and swelling of the lateral epicondyle, and the tightness of the associated musculature, local palpation would also likely elicit pain.

Medically, tennis elbow is usually diagnosed via ultrasound. This is an accurate way to assess/diagnose the extent of possible degeneration and/or tearing of the common extensor tendon.

DIFFERENTIAL ASSESSMENT

Tennis elbow is a fairly simple and straight-forward condition to assess. The most likely condition that needs to be differentially assessed is the pres-