Body Mechanics

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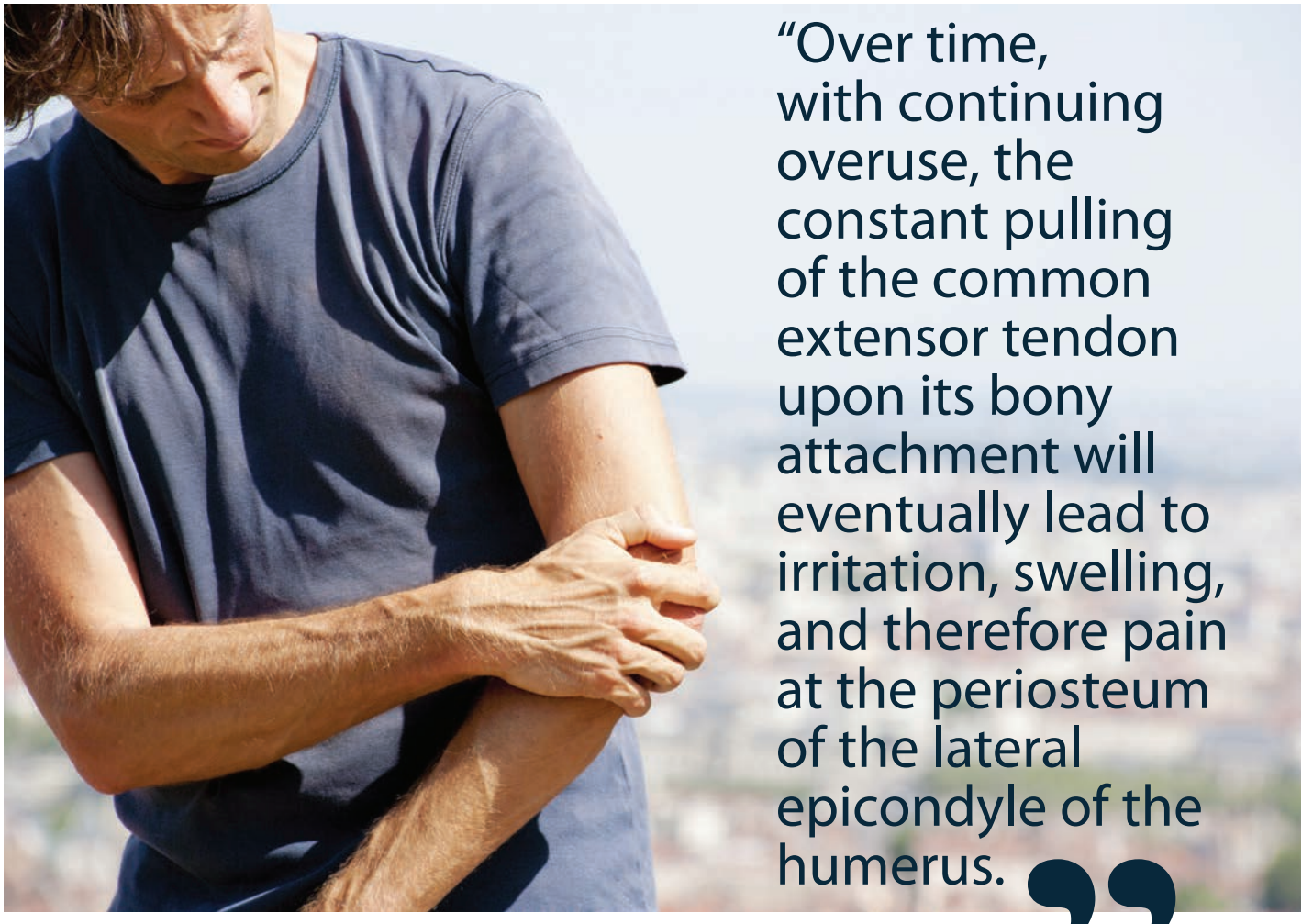

> "Over time, with continuing overuse, the constant pulling of the common extensor tendon upon its bony attachment will eventually lead to irritation, swelling, and therefore pain at the periosteum of the lateral epicondyle of the humerus."

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

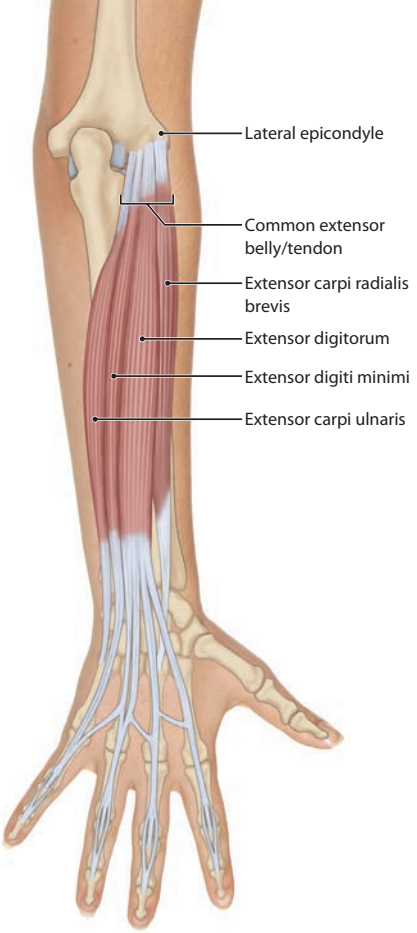

FIGURE 1 Tennis elbow involves the myofascial tissue of the common extensor belly/tendon and its lateral epicondyle attachment on the humerus. Posterior view of the right forearm. *Modeled from Muscolino, JE The Muscular System Manual – The Skeletal Muscles of the Human Body, 3rd Edition. 2010. Elsevier.*

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.

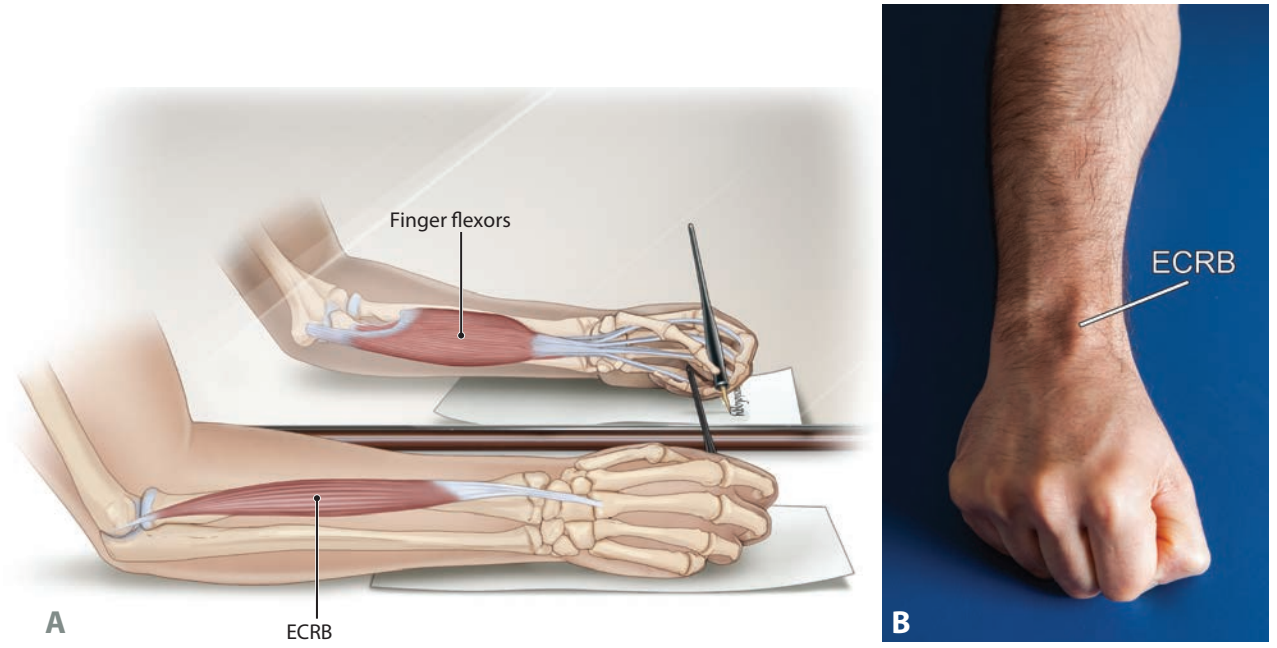

FIGURE 3 Gripping an object requires stabilization of the hand at the wrist joint, usually by the extensor carpi radialis brevis (ECRB). A, contraction of the extensor carpi radialis brevis can be seen when the fingers flex to hold an object. B, contraction of the ECRB can be seen when making a fist. *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 engagement of another muscle to cancel out the unwanted frontal plane motion that each of them would have created. The extensor carpi radialis brevis neither moves the fingers nor crosses far from the center of the wrist. Therefore, it is the best choice to stabilize the wrist when flexing the fingers.

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-

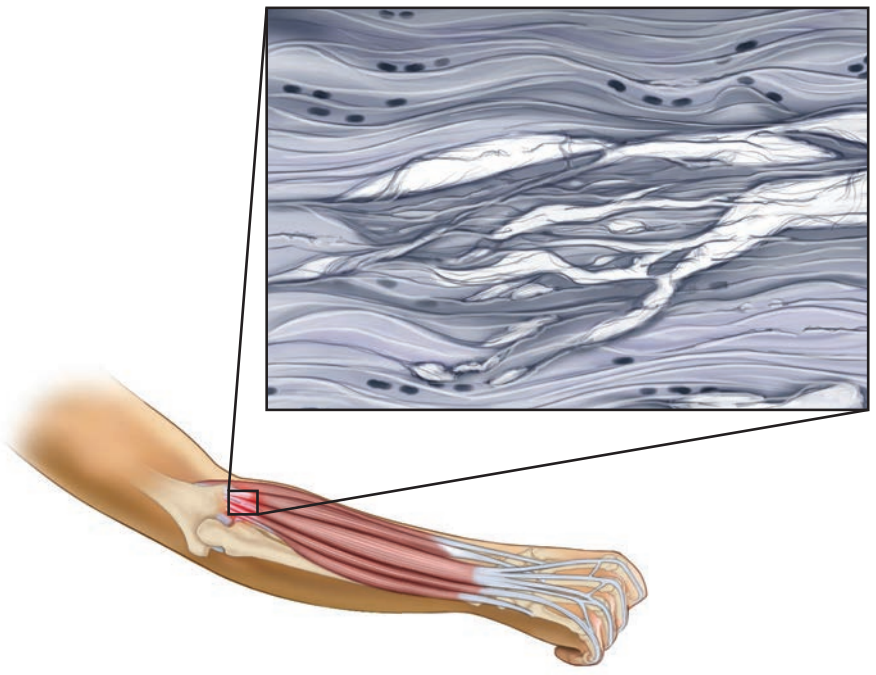

FIGURE 4 Chronic tennis elbow usually results in degeneration of the collagen structure of the tendon. Tears (seen in the figure as white areas) may also occur within the tendon.

ence of myofascial TrPs in the bellies of the common extensor muscles. However, the presence of these TrPs could also be considered to be part of the overuse and consequent tightness of the common extensor musculature, and therefore a part of tennis elbow itself. Wrist tendinitis of the muscles of the common extensor tendon will likely show positive for the same active and passive ranges of motion, but the predominant location of the pain will be at the wrist region instead of the elbow.

The only other condition that might be confused with tennis elbow is dysfunction of the head of the radius, whether it is with its articulation with the humerus at the elbow joint or with the ulna at the proximal radioulnar joint. However, dysfunction of the radial head does not commonly occur and would not show positive during physical examination with contraction or stretching of the musculature of the common extensor tendon.

MANUAL TREATMENT

Tennis elbow is primarily caused by overuse and tension of the muscles of the common extensor tendon, therefore treatment should be directed to their myofascial tissue. A good protocol to follow involves fascial spreading, longitudinal and cross fiber strokes, and pin and stretch to the posterior forearm. Because these muscles cross the wrist, joint mobilization of the carpal bones may also be beneficial.

Begin with mild to moderate pressure fascial spreading strokes to the entire forearm with concentration on the proximal posterior forearm. Longitudinal strokes to the posterior forearm are performed proximally to distally, with your pressure decreasing as the muscles transition from bellies to tendons. Cross fiber work should be focused on the com-

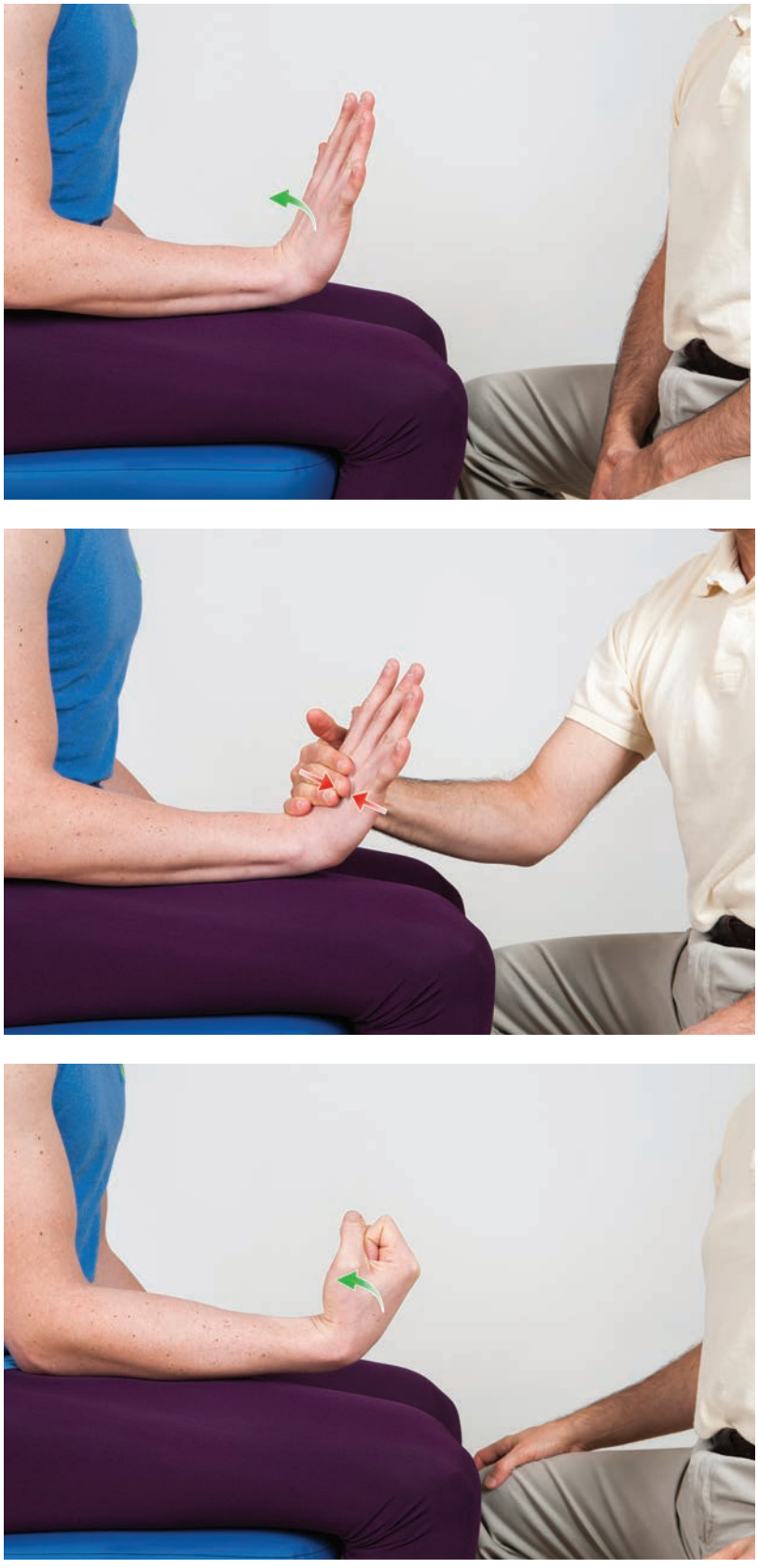

FIGURE 5 Assessment of tennis elbow. A, Active extension of the hand and fingers. B, Manual resistance to extension of the hand. C, Active flexion of the hand and fingers.

mon extensor tendon tissue near the lateral epicondyle (Figure 6). If the client is presenting with lateral epicondylitis, depth of pressure can be deep, but should not be so deep that inflammation is increased. Icing is also an important part of the treatment protocol for tennis elbow when inflammation is present. If the area is tender, icing can be done before soft tissue manipulation to decrease sensitivity and allow for deeper work. Icing is also beneficial after soft tissue manipulation is done to minimize possible swelling as a result of the soft tissue work.

FIGURE 6 Cross fiber strokes to the common extensor tendon.

However, if the condition has entered the chronic degenerative phase of epicondylosis, the treatment approach changes. Some therapists advocate extremely strong cross fiber pressure, often with the use of tools. One technique and brand of tools is called Graston Technique. The purpose of this deep work is to actually create inflammation so that fibroblasts are drawn into the region to facilitate the healing process of the degenerated collagen fibers. Because inflammation is desired, ice would not be used as part of the care.

For both epicondylitis and epicondylosis, pin and stretch can be performed by holding sustained pressure on the musculature as the client's hand and fingers are passively or actively flexed (Figure 7). This technique mechanically focuses the stretch on the region of musculature that is between the pinned point of the muscle and the attachment that moves; in other words, between the point of application of pressure and the wrist. If the client's flexion motion is performed actively, the reciprocal inhibition reflex is initiated. This increases the efficacy of the stretch by adding a neural component that inhibits/relaxes the target extensor musculature, thereby allowing for a better stretch. Each successive repetition of pin and stretch should move the point of sustained pressure farther distally down the posterior forearm.

Once direct care to the posterior forearm/wrist/hand region has been done, it is wise to work the entire upper quadrant on that side. Begin at the neck, and work your way down into the upper back, shoulder region, arm, anterior forearm, and hand. Although these regions are not directly responsible for tennis elbow, they may be involved in dysfunctional postural and movement patterns that may contribute to and perpetuate the tennis elbow.

What's in a name?

It is interesting to note that the technical name for tennis elbow, lateral epicondylitis, is named for the inflammation of the bony epicondylar attachment of the associated musculature and not for the myofascial soft tissue that is the true progenitor of the condition. This shows the bias that Western Medicine has for hard bony tissue and the lack of emphasis that it places upon soft tissue. It is true that once this condition is far enough advanced, there will be inflammation of the lateral epicondyle (actually even this is soft tissue inflammation because it is the periosteum soft tissue of the epicondyle that is inflammed), but unless the lateral epicondyle is inflamed due to direct trauma, lateral epicondylitis begins as an overuse condition of the muscles of the common extensor belly/tendon. In this regard, the early stage of tennis elbow, before it would even be assessed as tennis elbow, would likely be marked by tightness of the musculature. With continuing overuse, the fascial tissue of the common tendon would then exhibit pain and tenderness. If allowed to progress, it would only be much later that the myofascial overuse of this condition would place sufficient physical stress upon the epicondyle to cause actual pain at the bony attachment site. Given the causative mechanism of the tennis elbow, perhaps a better name would be *common extensor myofascitis*.

FIGURE 7 Pin and stretch of the extensor musculature of the forearm. A, Performed passively. B, Performed actively.

SUMMARY OF MANUAL TREATMENT PROTOCOL FOR TENNIS ELBOW

1. Fascial spreading strokes to the forearm
2. Longitudinal strokes to the posterior forearm
3. Cross fiber work to the common extensor tendon
4. Pin and stretch to the posterior forearm
5. Ice the common extensor belly/tendon
6. Joint mobilization of the carpals
7. Work entire upper quadrant on that side

PRECAUTIONS/CONTRAINDICATIONS

When working on a client who has tennis elbow, be aware that very deep pressure may translate to the radial nerve. The radial nerve passes into the forearm on the posterior side, deep to the musculature of the common extensor tendon.

Epicondylitis or Epicondylosis?

When tennis elbow is acute, in other words, the client has lateral epicondylitis, it is primarily a condition of inflammation. Therefore, care is directed at removing the cause and decreasing the inflammation. For this reason, ice is often included as part of the treatment regimen. However, with chronic tennis elbow, in other words, lateral epicondylosis, the inflammatory process is past. Therefore, beyond removing the initial cause of the condition, care is oriented toward increasing blood flow and inflammation to the region so that fibroblasts can be drawn into the region to mend and repair the degenerated collagen. In these cases, the use of ice is contraindicated and very deep work aimed at creating inflammation is indicated.

However, conditions do not magically change from acute to chronic like flipping a switch. Rather, there is a transition time during which attributes of both epicondylitis and epicondylosis are present. This means that the client is still experiencing some inflammation but is also beginning to have degeneration of the collagen matrix of the common extensor tendon. The difficulty arises when the client presents during this transition time. In these cases, a decision has to be made whether to approach the treatment regimen as if the client has epicondylitis or epicondylosis. Making this decision can be challenging. One approach can be to begin with one approach and treat the client in this manner twice a week for three weeks. If no improvement has occurred, then try the other approach. Of course, a more definitive direction is afforded if an ultrasound has been done so that the exact state of the pathomechanics is understood.

SELF-CARE FOR THE CLIENT

Self-care is an extremely important aspect of the treatment for tennis elbow. The client should be advised to avoid offending postures and activities as much as possible; foremost among these are repetitive extension activities of the hand and fingers and holding/gripping objects for long periods of time. Frequent stretching of the hand and fingers into flexion should be done (unless common extensor tendon tears are present, in which case vigorous stretching should be avoided). If inflammation is present, icing should be done; clients may also choose to take over-the-counter anti-inflammatory medication. If the condition has progressed to epicondylosis, icing and anti-inflammatory medication is contraindicated. If and when signs and symptoms of the condition have resolved, strengthening the forearm/hand musculature should be recommended.

MEDICAL APPROACH

Whenever conservative manual therapy care is not successful, referral to a physician should be considered. Medical management for lateral epicondylitis usually involves prescription steroidal anti-inflammatory medication such as cortisone, as well as cortisone injections. If the degenerative phase of lateral epicondylosis is present, prolotherapy injections, including platelet rich plasma (PRP) injections can be very beneficial. In worst-case scenarios, surgery may be done to remove degenerated collagen tissue as well as mend tears. ■

Case study:

Glenn is a high school English teacher. Over the past year, he has noticed right forearm pain near his elbow. The pain has been getting steadily worse as the school year has progressed. He especially notices the pain when gripping the pen to grade papers. In the past few weeks, he has even experienced pain when holding the steering wheel of his car to drive to work. Glenn finally decided to seek care and went to a massage therapist who does clinical orthopedic work.

The therapist performed active and passive range of motion of the hand at the wrist joint. Active flexion and extension produced pain at the common extensor tendon, as did passive flexion and manual resistance to extension; passive extension was asymptomatic. Active radial deviation against resistance also elicited pain. Palpation at the common extensor belly revealed tightness and pain. Mild inflammation and palpatory pain were also found at the common extensor tendon and the lateral epicondyle of the humerus. The therapist also performed assessment tests for thoracic outlet syndrome and space-occupying lesions in the neck; these conditions tested negative.

Given the results of the assessment tests and the presence of swelling, an assessment of lateral epicondylitis tennis elbow was made. The therapist recommended two one-hour massages per week for four to six weeks. Each session consisted of approximately five minutes of myofascial spreading, followed by 20-30 minutes of deep tissue work to the right forearm, including moderate to deep cross fiber work to the common extensor belly/tendon. Ice was then applied to reduce possible inflammation as a result of the work. The remainder of the time was spent working the rest of Glenn's right upper quadrant with deep tissue work to the anterior forearm, arm and shoulder region; and moist heat, deep tissue work, stretching, and joint mobilization to the upper back, neck, and left upper extremity. Glenn was given self-care instructions including stretching and ice. He was also given recommendations to avoid overuse of his forearm muscles, including using a wider pen that has a rubber grip so that less strength is needed to grip it.

At the end of six weeks, Glenn's symptoms had abated approximately 80 percent. Care was continued at once per week for another six weeks to remedy the remaining symptoms. For proactive self-care, Glenn continues to receive clinical orthopedic massage once or twice each month.

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