

THE ELBOW & FOREARM COMPLEX

CHAPTER 18

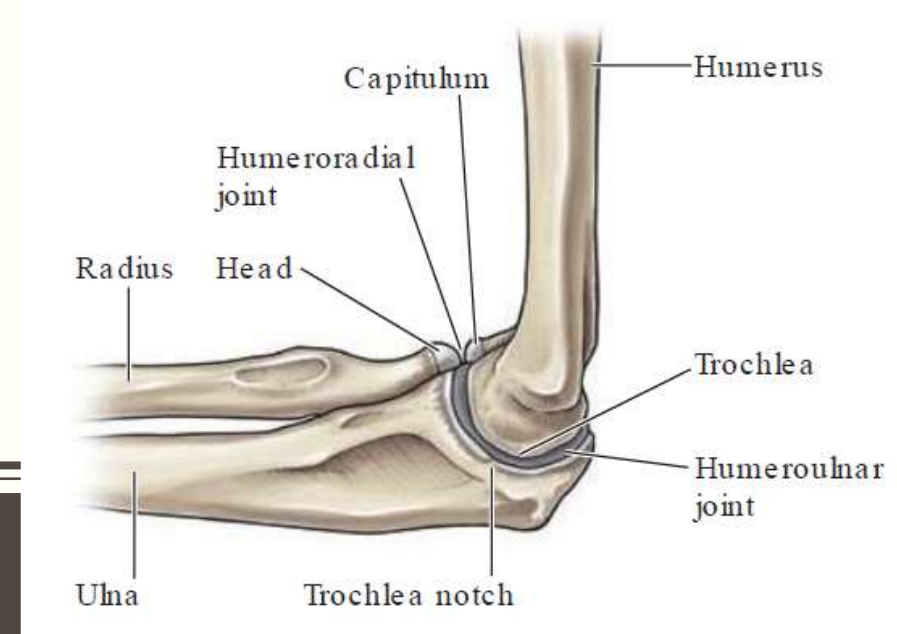
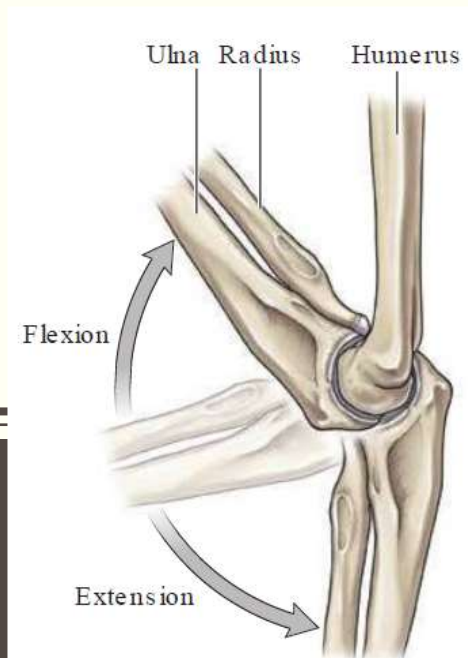


TABLE 17-4

Differential Diagnosis of Elbow Pain According to Symptom Location

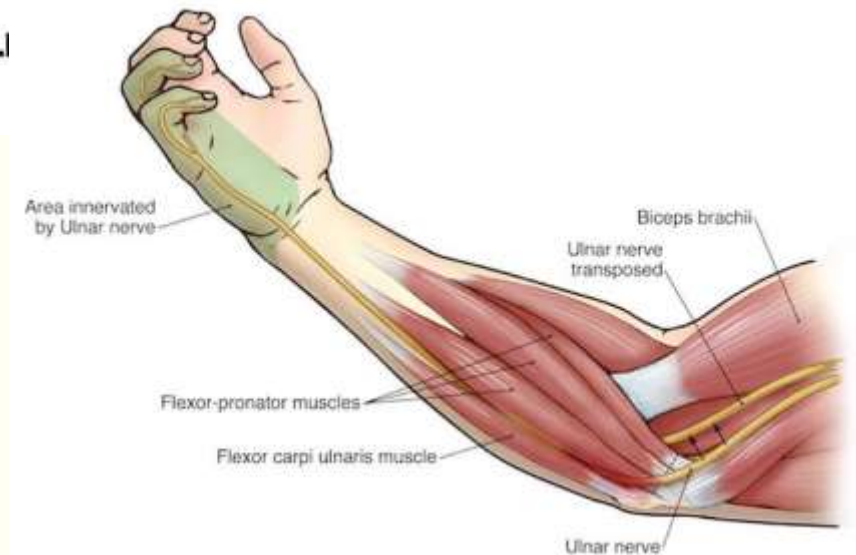
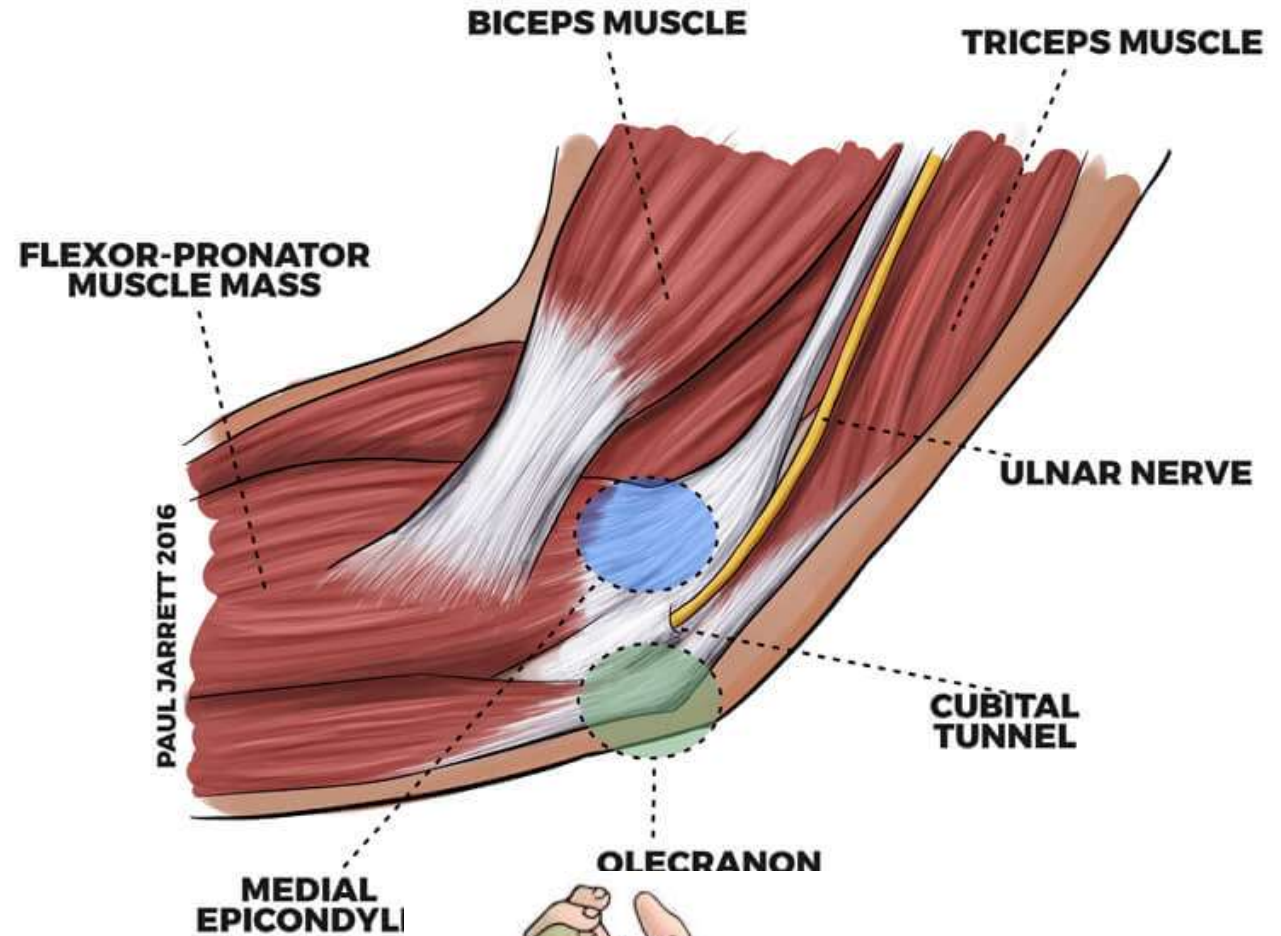
Location	Possible Disorders
Anterior	<ul style="list-style-type: none"> Anterior capsular strain Distal biceps tendon rupture/tendinopathy Dislocation of the elbow Pronator syndrome (throwers)
Medial	<ul style="list-style-type: none"> Medial epicondylitis Ulnar collateral ligament injury (MCL) Ulna neuritis or ulnar nerve subluxation Flexor-pronator muscle strain Fracture Little league elbow in skeletally immature throwers Valgus extension overload overuse symptoms
Posteromedial	<ul style="list-style-type: none"> Olecranon tip stress fracture Posterior impingement in throwers Trochlear chondromalacia
Posterior	<ul style="list-style-type: none"> Olecranon bursitis Olecranon process stress fracture Triceps tendinopathy
Lateral	<ul style="list-style-type: none"> Capitellum fracture Cervical radiculopathy—referred pain Lateral epicondylitis Lateral collateral injury Osteochondral degenerative changes Osteochondritis dissecans (Panner's disease) Posterior interosseous nerve syndrome Radial head fracture Radial tunnel syndrome Synovitis

Referred Pain and Nerve Injury in the Elbow Region

Common Sources of Referred Pain Into the Elbow Region

Radicular symptoms from the C5 and C6 nerve roots have been reported in patients with lateral elbow pain and from the C6 and C7 nerve roots with medial elbow pain.

- Nerve Disorders in the Elbow Region** *Ulnar nerve.* The ulnar nerve courses posteromedial to the olecranon process where it enters the cubital tunnel. After leaving the cubital tunnel, it passes between the two heads of the origin of the flexor carpi ulnaris. The most common sites for compression of the ulnar nerve in the elbow region are in the cubital tunnel and between the two heads of the flexor carpi ulnaris.

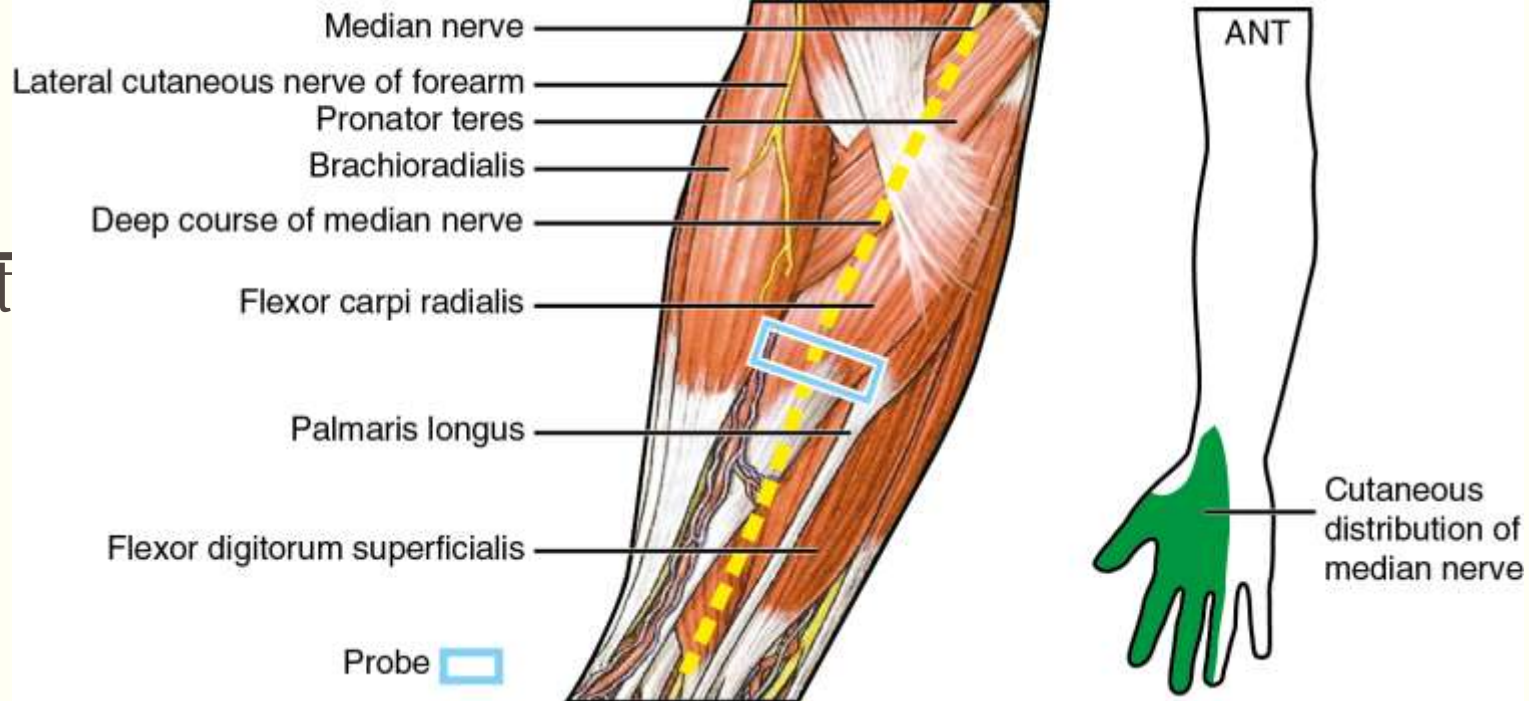


Radial nerve

- The radial nerve pierces the lateral muscular septum anterior to the lateral epicondyle and passes between the brachialis and biceps medially and the brachioradialis, extensor carpi radialis longis, and extensor carpi radialis brevis laterally. Within an area 3 cm proximal or distal to the elbow, it branches into the posterior interosseous nerve and superficial sensory nerve. The posterior interosseous nerve branch travels posterior to enter the radial/supinator tunnel (canal) between the two heads of the supinator at the arcade of Fröhse. Common sites of compression include under the extensor carpi radialis brevis, at the Arcade of Fröhse, and at the distal edge of the supinator muscle



■ **Median nerve.** The median nerve courses anteriorly deep in the cubital fossa, medial to the tendon of the biceps and brachial artery, where it is well protected. The nerve then progresses between the ulnar and humeral heads of the pronator teres muscle and dips under the flexor digitorum profundus muscle. Entrapment may occur between the heads of the pronator teres muscle, under the Ligament of Struthers, by the bicipital aponeurosis or deep to the flexor digitorum superficialis.



CLINICAL PEARL

The joint capsule of the elbow complex is thin but strong and is reinforced medially and laterally by ligaments. Anteriorly, the capsule contributes 38% of the resistance to valgus force and 32% of the resistance to varus force in full extension.³ The capsule of the joint does not respond well to injury or prolonged immobilization and often forms thick scar tissue, which may result in flexion contractures of the elbow.⁴⁻⁶

CLINICAL PEARL

The carrying angle serves to direct the ulna laterally during extension and increase the potential for elbow flexion motion, as the offset allows room anteriorly for approximation of the muscles of the arm and forearm. The carrying angle is approximately 11–14 degrees in males and 13–16 degrees in females.⁹⁻¹¹

The resting or open-packed position for the humeroulnar joint is 70 degrees of flexion with 10 degrees of forearm supination. The close-packed position is full extension and maximum forearm supination. For the part of the joint between the coronoid process and the humerus, the close-packed position is maximum flexion. The capsular pattern is much more limitation of flexion than extension.¹²

CLINICAL PEARL

The resting, or open-packed, position of the humeroradial joint is extension and forearm supination. The close-packed position is approximately 90 degrees of elbow flexion and 5 degrees of supination. There is no true capsular pattern at this joint, although clinically an equal limitation of pronation and supination is observed.

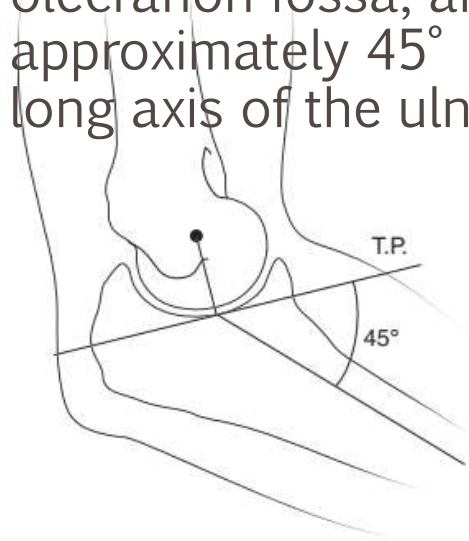
CLINICAL PEARL

The resting, or open-packed, position for the proximal radioulnar joint is 70 degrees of flexion and 35 degrees of forearm supination. The closed-packed position is 5 degrees of forearm supination. The capsular pattern is

minimal to loss of motion, with pain at the end ranges of pronation and supination.¹²

Joint Hypomobility

- **Humeroulnar Articulation**
The convex trochlea articulates with the concave olecranon fossa.
Resting position. Elbow is flexed 70° , and forearm is supinated 10° .
Treatment plane. The treatment plane is in the olecranon fossa, angled approximately 45° from the long axis of the ulna



Repeat the movement 6-10 times for up to three sets

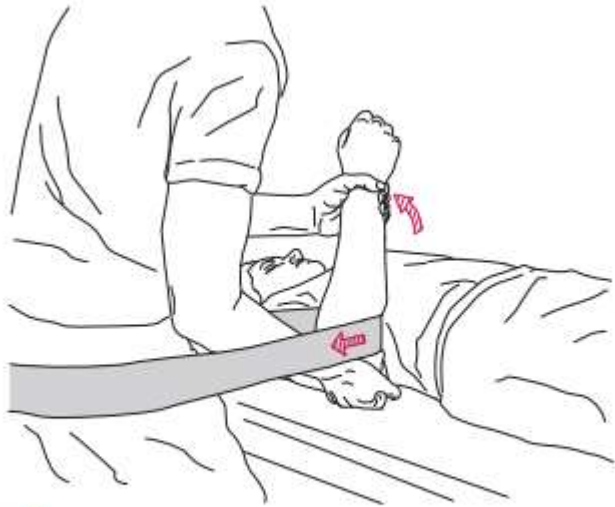


FIGURE 18.3 Mobilization with movement (MWM) to improve elbow flexion. A lateral glide is applied to the proximal ulna while the patient actively flexes their elbow, followed by a passive end-range stretch.



BOX 18.5 Specific Precautions After Total Elbow Arthroplasty

ROM Exercise

- Perform ROM exercises only within the arc of motion achieved during surgery.
- To reduce postoperative stress on a repaired triceps mechanism, avoid end-range flexion during assisted ROM and active, antigravity elbow extension for 3 to 4 weeks.
- Also avoid early, end-range elbow flexion to decrease stress on the incision and reduce the risk of compromising wound healing.
- If elbow stability is questionable after an unlinked total elbow arthroplasty, limit full extension of the elbow and rotation of the forearm, particularly supination past neutral, to avoid overload on repaired lateral ligaments for 4 weeks. With an unlinked replacement, the greatest risk of instability is when the elbow is extended beyond 40° to 50°. ⁷
- If symptoms of ulnar nerve compression are noted, avoid prolonged positioning or stretching into end-range flexion.

Strengthening Exercises

- Postpone resisted elbow extension for 6 weeks (or as long as 12 weeks) if a triceps-reflecting approach was used.
- When strengthening the shoulder, apply resistance above the elbow to eliminate stresses across the elbow joint.

- Weight training using moderate and high-loads is not appropriate after total elbow arthroplasty.

Functional Activities

- Avoid lifting or carrying any objects with the operated extremity for 6 weeks or objects greater than 1 lb for 3 months.
- If the triceps mechanism was detached and repaired, avoid pushing motions, including propelling a wheelchair; pushing up from a chair; and using a walker, crutches (other than forearm platform design), or a cane for at least 6 weeks or as long as 3 months.
- If an unlinked replacement was implanted, do not lift weighted objects during daily tasks with the elbow extended to avoid shear forces across the lateral ligament repair, which could contribute to posterolateral instability.
- Limit repetitive lifting to 1 lb for the first 3 months, 2 lb for the first 6 months, and no more than 5 lb thereafter. Never lift more than 10 to 15 lb in a single lift. ^{7,34,61}
- Do not participate in recreational activities, such as golf, volleyball, and racquet sports, that place high-loads or impact across the elbow.

Myositis ossification

- *The terms myositis ossificans and heterotopic or ectopic bone formation are often used interchangeably to describe the formation of bone in atypical locations of the body*

- Formation of bone in atypical location of body
- Heterotopic bone formation in muscle – tendon unit, capsule or ligamentous structure



Common sites & etiology

Prevalence following elbow fracture 40%

Most commonly located at the posteromedial aspect of the elbow. comminuted fracture of the radial head, a fracture dislocation (supracondylar or radial head fracture) of the elbow, or a tear of the brachialis tendon.

Patients with concurrent traumatic brain injury or spinal cord injury, or patients with burns to the extremities, have a much higher risk in developing this complication.

Additional risk factors include delayed internal fixation and use of bone graft and/or bone-graft substitute.

More severe HO is associated with concomitant distal humeral fracture, triad injury, and elbow fracture-dislocation

Delay in intervention increases the risk While some believe that too much motion or aggressive stretching following injury exacerbates, may occurs due to a lack of motion.

There is no evidence or consensus to indicate that overstretching or participation in physical therapy contributes to HO





In brachialis muscle or joint capsule

- Trauma (comminuted fracture of the radial head , a fracture dislocation (supracondylar or radial head fracture) of the elbow
tear of brachialis tendon
- TBI / SCI
- Burns
- Post Immobilization stretch

Aggressive stretch Flex



Clinical presentation of HO involves a restriction of joint motion after an inciting trauma. Palpation of a locking sensation at terminal extension or flexion is also an indication of HO rather than of joint contracture



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- Heterotopic ossification begins approximately 2 weeks after the injury, and the patient often presents with swelling, warmth, and pain.
 - As the process continues, the warmth, erythema, and swelling will gradually resolve, which may be accompanied by a gradual loss of elbow motion.
 - Palpation of the distal brachialis muscle is tender. After the acute inflammatory period, heterotopic bone formation is laid down in muscle between, not within, individual muscle fibers or around the joint capsule within a 2- to 4-week period.
 - This makes the muscle extremely firm to touch. Although this condition can permanently restrict elbow motion, in most cases, the heterotopic bone is largely reabsorbed over several months and motion usually returns to near normal

The elbow should be kept at rest in a splint, which should be removed only periodically during the day for active, pain-free ROM.

Rest should continue until the boney mass matures and then resorbs.

If the capsule also is involved, surgical excision of heterotopic bone from muscle or TEA is necessary only in rare instances.

Management

- Prophylaxis use of NSAIDs should be considered for those at high risk for developing HO.
- If there are gastrointestinal contraindications, radiation therapy may also be considered.
Surgical excision may be considered when the HO is symptomatic and/or restricts the functional arc of motion at the elbow, especially if it interferes with the patient's activities or ability to participate.
- If treated operatively, the elbow is frequently managed with continuous passive motion and a hinged adjustable orthoses.
- Passive stretching should be introduced with extreme caution in the inflamed, posttraumatic, and/or postsurgical elbow when ROM is initiated to avoid exacerbating the inflammation, which may result in elbow contracture

CLINICAL PEARL

Severe progressive pain not affected by movement, persistent throughout the day and night, and associated with systemic signs may indicate referred pain from malignancy.

CLINICAL PEARL

Sudden swelling in the absence of trauma suggests infection, inflammation, or gout.

Overuse Syndromes:

- Current evidence has shown that the traditional terms, *tendinitis* or *epicondylitis*, do not accurately reflect the true pathology of these conditions. The evidence has demonstrated that these conditions are **degenerative in nature and do not reflect an inflammatory process** as indicated by a lack of inflammatory cells, but rather involve **dysfunctional vascular and fibrous tissue and disorganized collagen**.
- The terms *tendinosis* and *tendinopathy* refer to the **degenerative changes** in the tendon tissue, which includes immature fibroblastic and vascular elements, resulting in weakening of the tendinous structure.

Lateral Elbow Tendinopathy (Tennis Elbow)

Tennis elbow is commonly referred to as lateral epicondylitis (despite current literature), lateral epicondylalgia, lateral epicondylosis, or lateral elbow tendinopathy.

Symptoms include pain over the lateral epicondyle of the humerus, primarily with gripping activities. Activities requiring firm wrist stability, such as the backhand stroke in tennis, or repetitive work tasks that require repeated wrist extension, such as computer work or pulling weeds in a garden, can stress the musculotendinous unit and cause symptoms. The primary structure involved is the origin of the extensor carpi radialis brevis muscle, although the extensor digitorum is also involved in approximately 50% of patients. Positive tests of provocation include palpation tenderness on or near the lateral epicondyle, pain with resisted wrist extension performed with the elbow extended, pain with resisted middle finger extension, and pain with passive wrist flexion with the elbow extended and forearm pronated.

Medial Elbow Tendinopathy (Golfer's Elbow)

Golfer's elbow, also known as medial epicondylitis, medial epicondylalgia, or medial epicondylosis, involves the common flexor/pronator tendon at the tenoperiosteal junction near the medial epicondyle.

It is associated with repetitive movements into wrist flexion, such as swinging a golf club, pitching a ball, or work-related grasping and lifting heavy objects. Concomitant ulnar neuropathy may be an associated finding. Positive tests of provocation include palpation tenderness on or near the medial epicondyle, pain with resisted wrist flexion performed with the elbow extended, and pain with passive wrist extension performed with the elbow extended.

Etiology of Symptoms

Repetitive use or eccentric strain of the wrist or forearm muscles.

➤ micro damage and partial tears, usually near the musculotendinous junction when the strain exceeds the strength of the tissues and when the demand exceeds the repair process.

➤ With repetitive trauma, fibroblastic activity and collagen weakening occurs.

➤ Recurring problems are seen because the resulting immobile or immature scar is re-damaged when returning to activities before there is sufficient healing or mobility in the surrounding tissue.

Nonoperative Management of Overuse Syndromes: Protection Phase

- **Decrease Pain**
 - *Immobilization.*
 - *Pain reduction.*
 - *Patient instruction.*
 - *Cryotherapy.*
- **Develop Soft Tissue and Joint Mobility**
 - *Cross-friction massage.*
 - Neuromobilization*
 - Soft-tissue mobilization*
 - Muscle mobility techniques.*
- **Maintain Upper Extremity Function**

Non-operative Management :Controlled Motion and Return to Function Phases

- Increase Muscle Flexibility

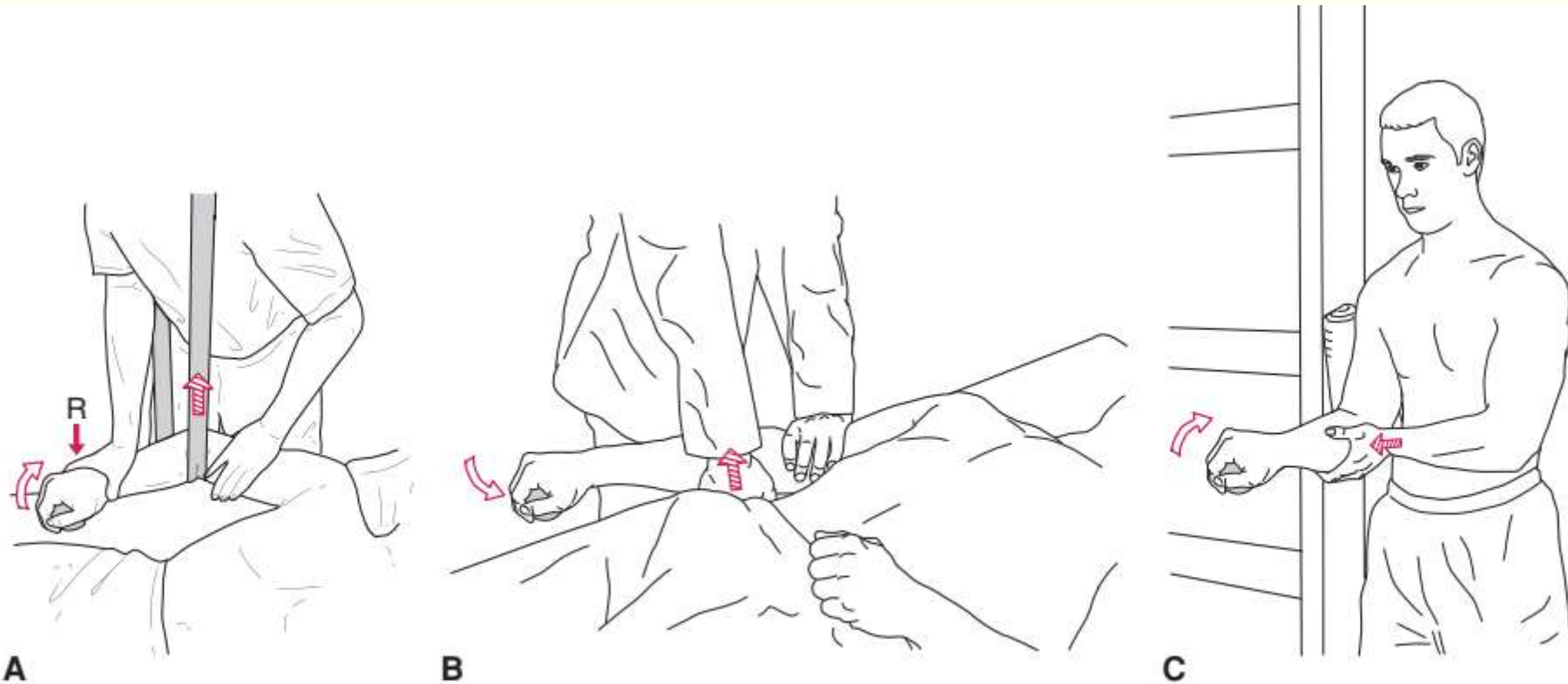
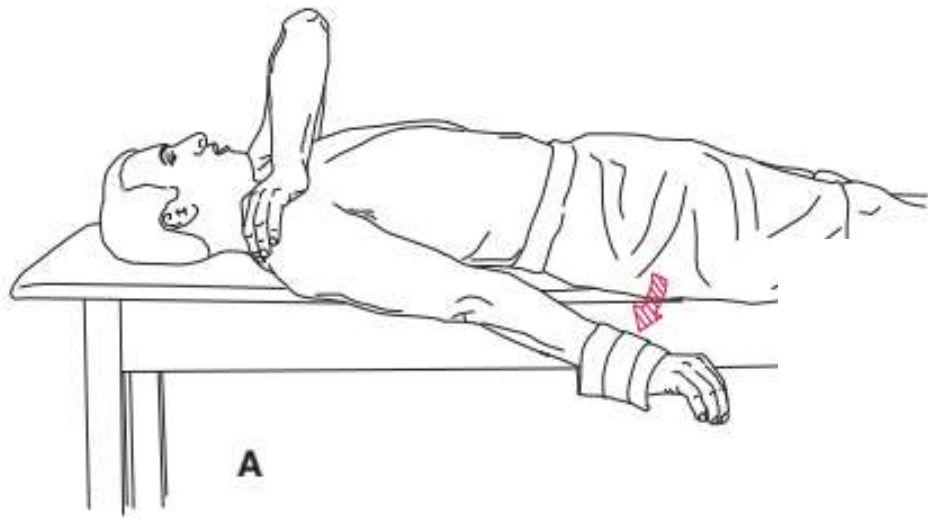
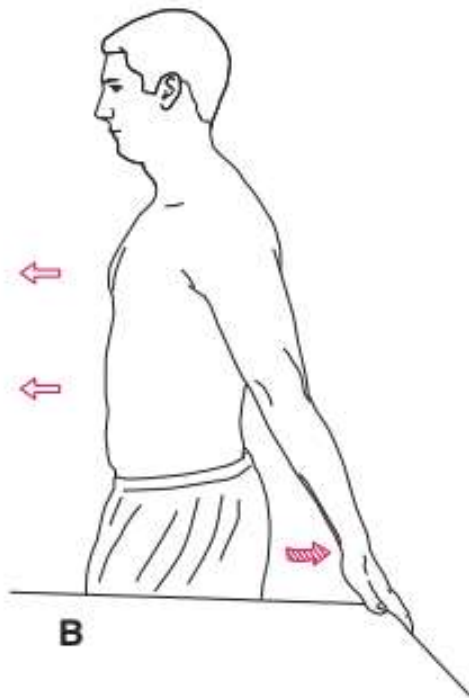


FIGURE 18.6 MWM for lateral epicondylitis. Lateral glide is applied to the proximal forearm **(A)** with active wrist extension, **(B)** with patient squeezing a ball, and **(C)** with self-mobilization.

Exercise Interventions for the Elbow and Forearm



A

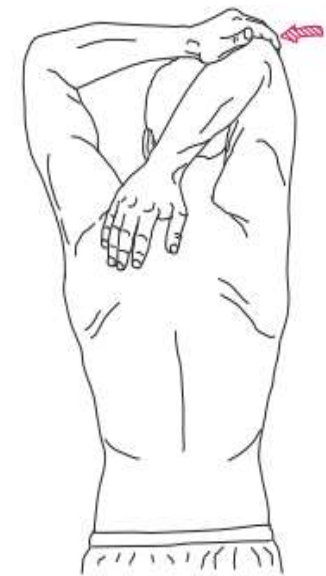


B

FIGURE 18.7 Self-stretching the biceps brachii musculotendinous unit includes stretching the long head across the shoulder joint (A) supine and (B) standing.



FIGURE 18.9 Self-stretching the forearm into supination. The forearm may be stabilized on a table (as pictured) or at the patient's side. It is important to maintain elbow flexion to prevent shoulder rotation and to apply the stretch force against the radius, not the hand.



Self-stretching the triceps brachii musculotendinous stretching the long head across the shoulder joint.

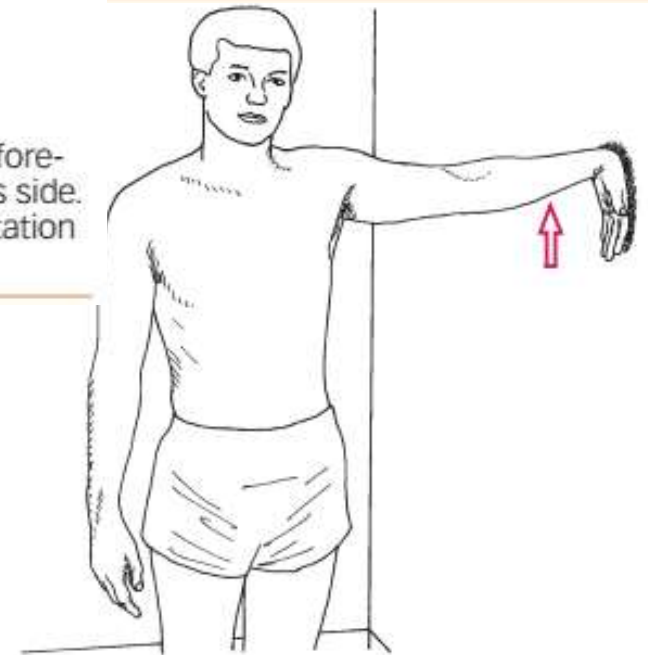


FIGURE 18.10 Self-stretching the wrist extensor muscles.

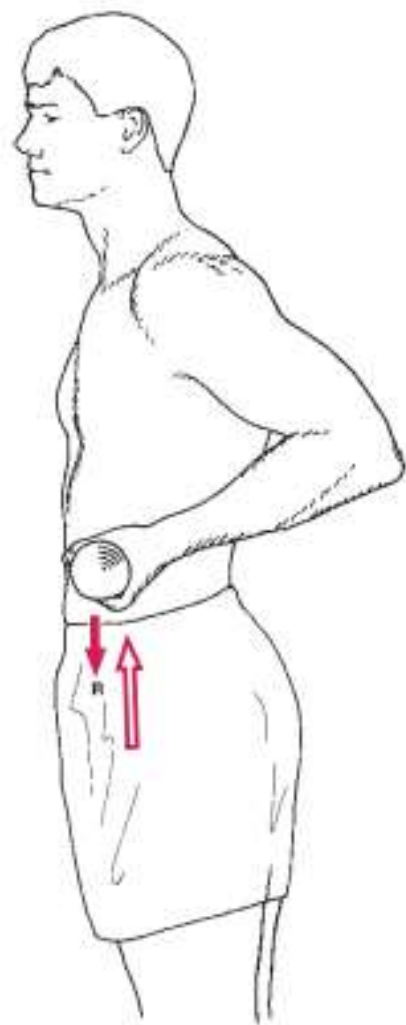


FIGURE 18.11 Resisting elbow flexion with emphasis on the biceps brachii. The shoulder extends as the elbow flexes with the forearm in supination. This combined action lengthens the proximal portion of the musculotendinous unit across the shoulder while it contracts to move the elbow, thus maintaining a more optimal length-tension relationship through a greater ROM.



FIGURE 18.12 Resisting elbow extension, beginning with the long head of the triceps brachii on a stretch.

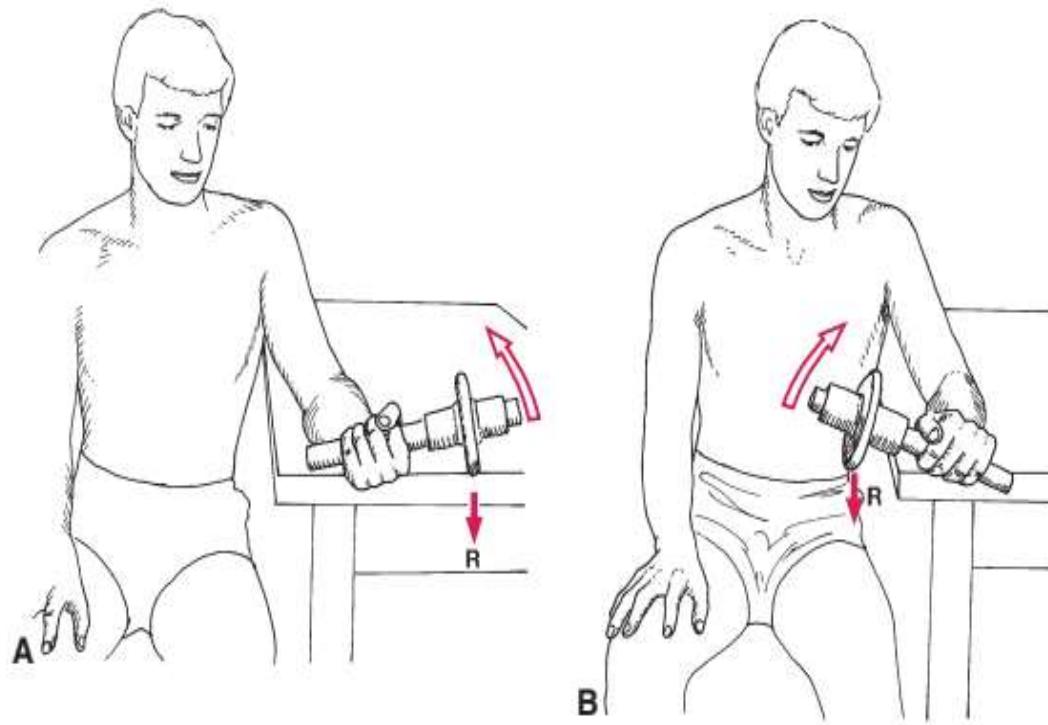


FIGURE 18.13 Mechanical resistance exercise using a small bar with an asymmetrically placed weight for strengthening **(A)** forearm pronators and **(B)** supinators. The bar also can be rotated through a downward arc to affect the other half of the range for each muscle by placing the weight on the ulnar side of the hand.

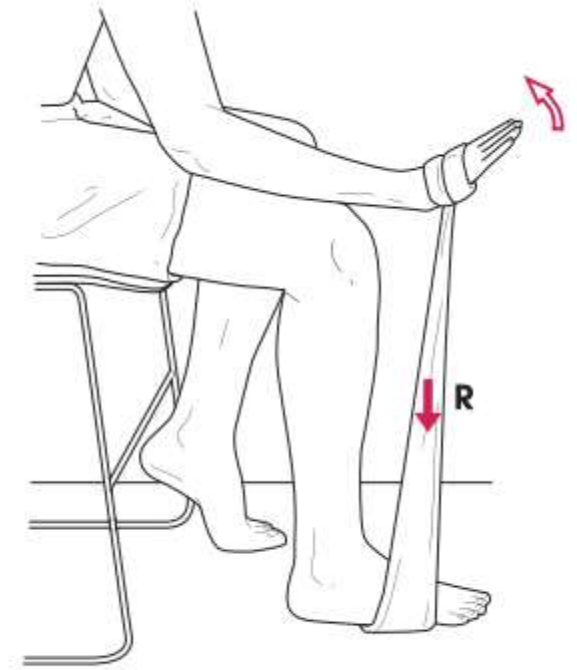


FIGURE 18.14 Strengthening the wrist extensors using elastic resistance without the use of grasp.

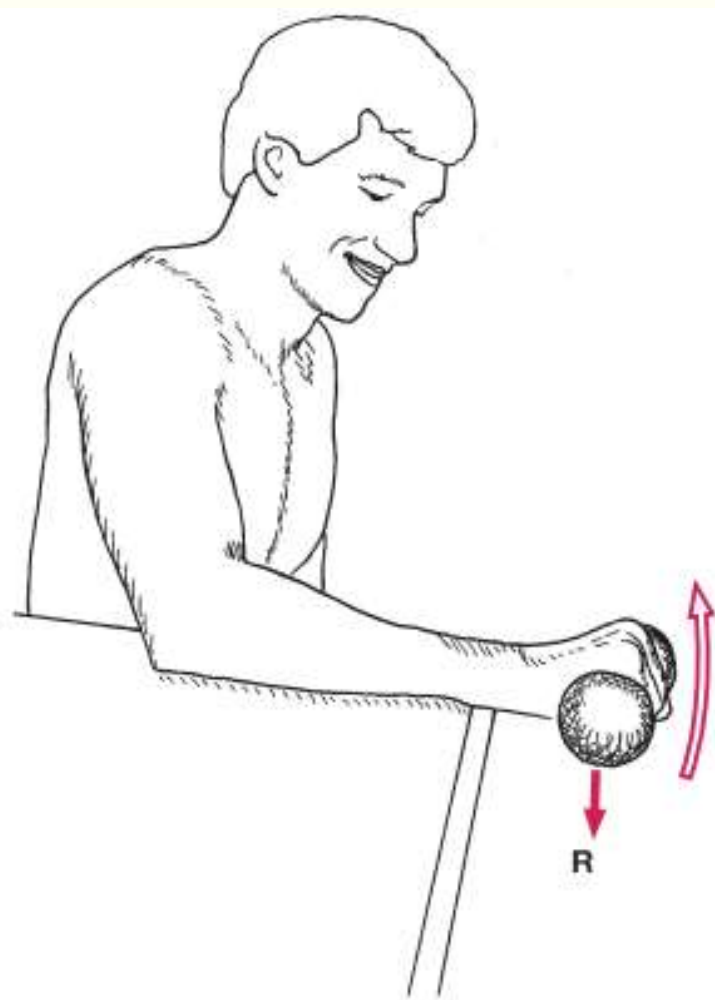


FIGURE 18.15 Strengthening the wrist extensors while grasping a handheld weight for resistance.

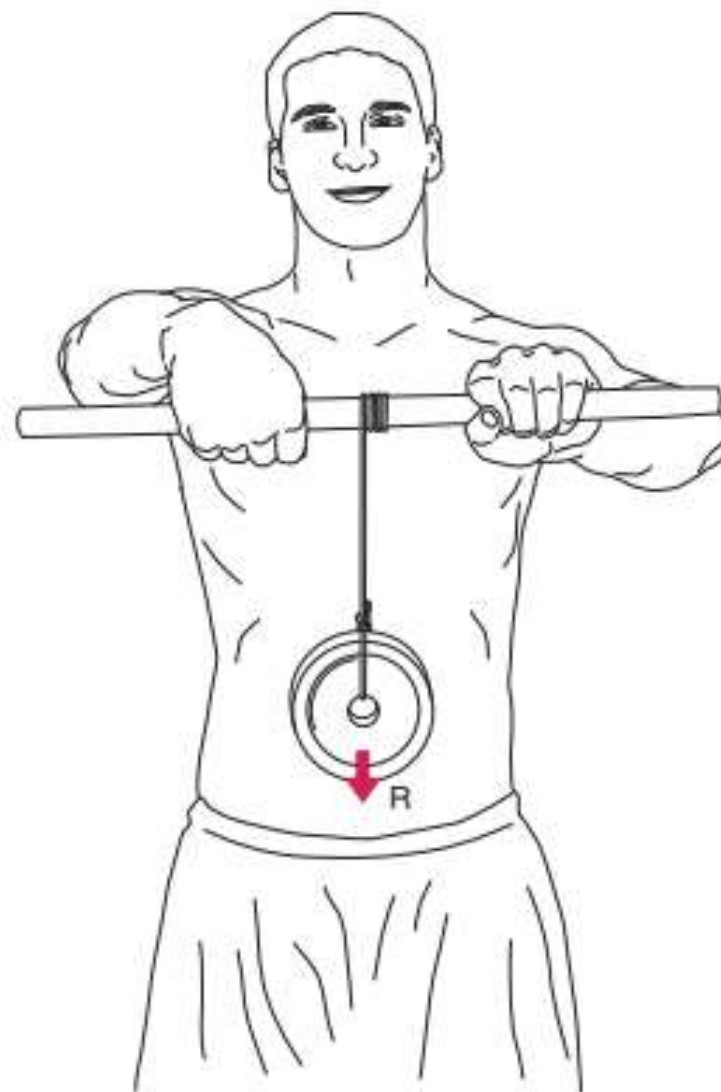


FIGURE 18.16 Wrist roller exercise to strengthen grip and develop the wrist extensors. This exercise requires stabilization in the shoulder girdle and elbow muscles. The elbows may be flexed or the forearms supinated to emphasize the elbow flexors or muscles of the medial epicondyle, respectively.

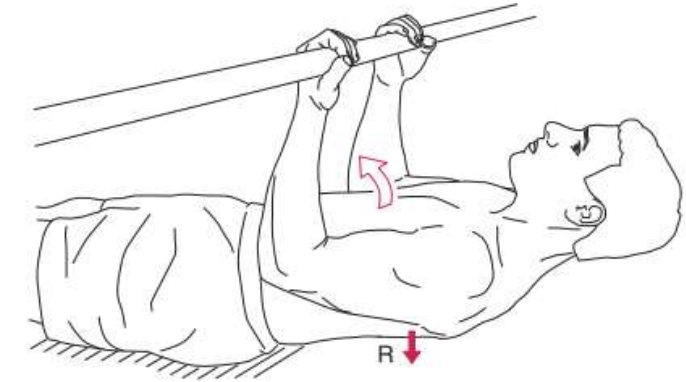


FIGURE 18.18 Closed-chain, modified chin-up using top half of body weight for resistance to strengthen the elbow flexors. This exercise may be performed in a bed with an overhead trapeze.

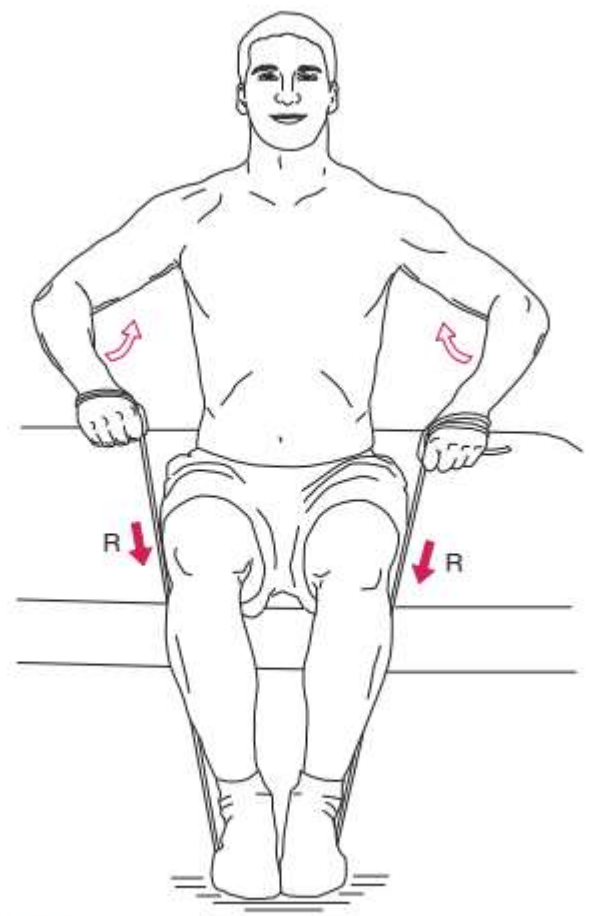


FIGURE 18.17 Bilateral pull-up against elastic resistance.

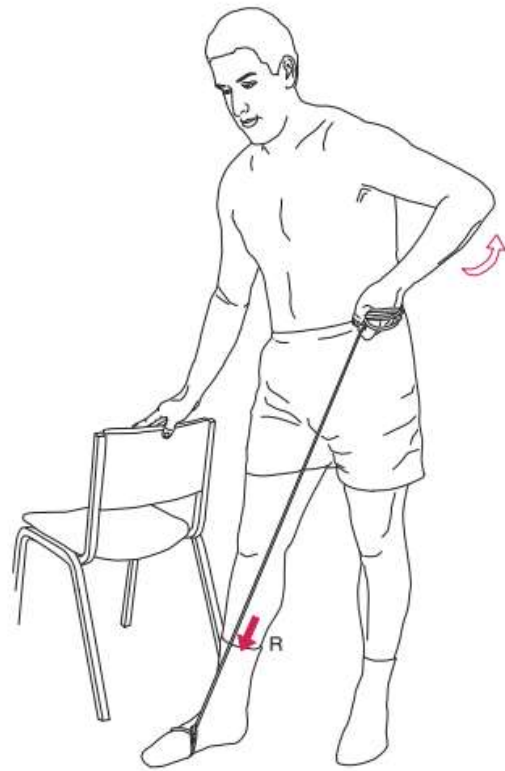


FIGURE 18.19 Simulation of a "lawn mower pull" for functional strengthening of the upper extremity.

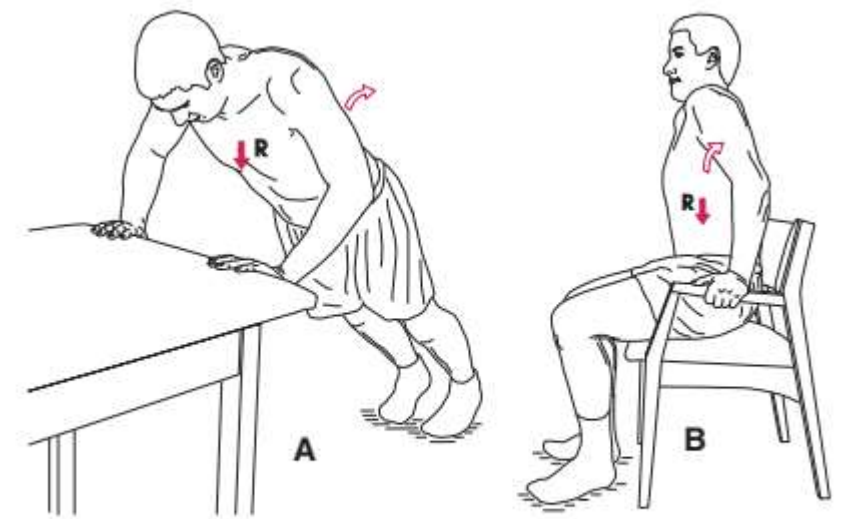


FIGURE 18.20 Closed-chain strengthening of the triceps. (A) Modified push-up. (B) Seated push-up.

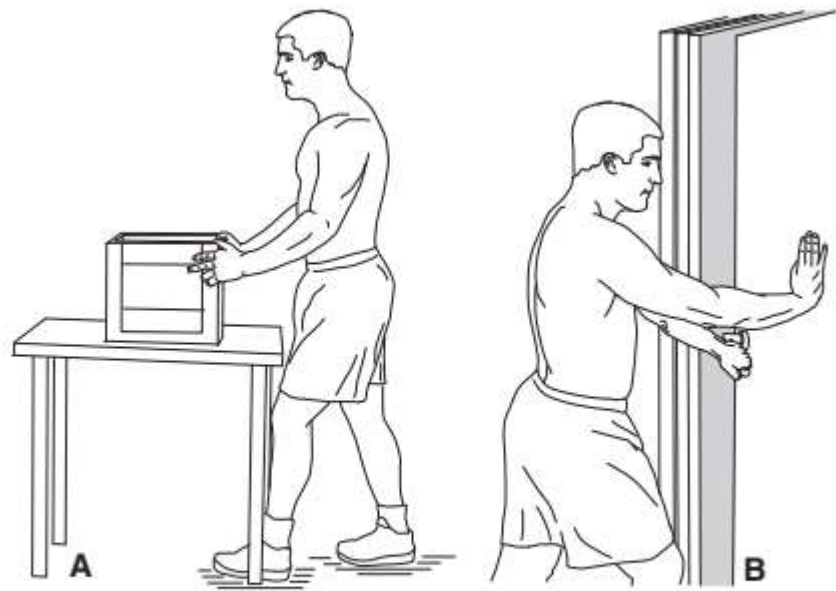


FIGURE 18.21 Strengthening the triceps with pushing activities. **(A)** Pushing weighted objects across a table. **(B)** Depressing a door handle and pushing open a door.

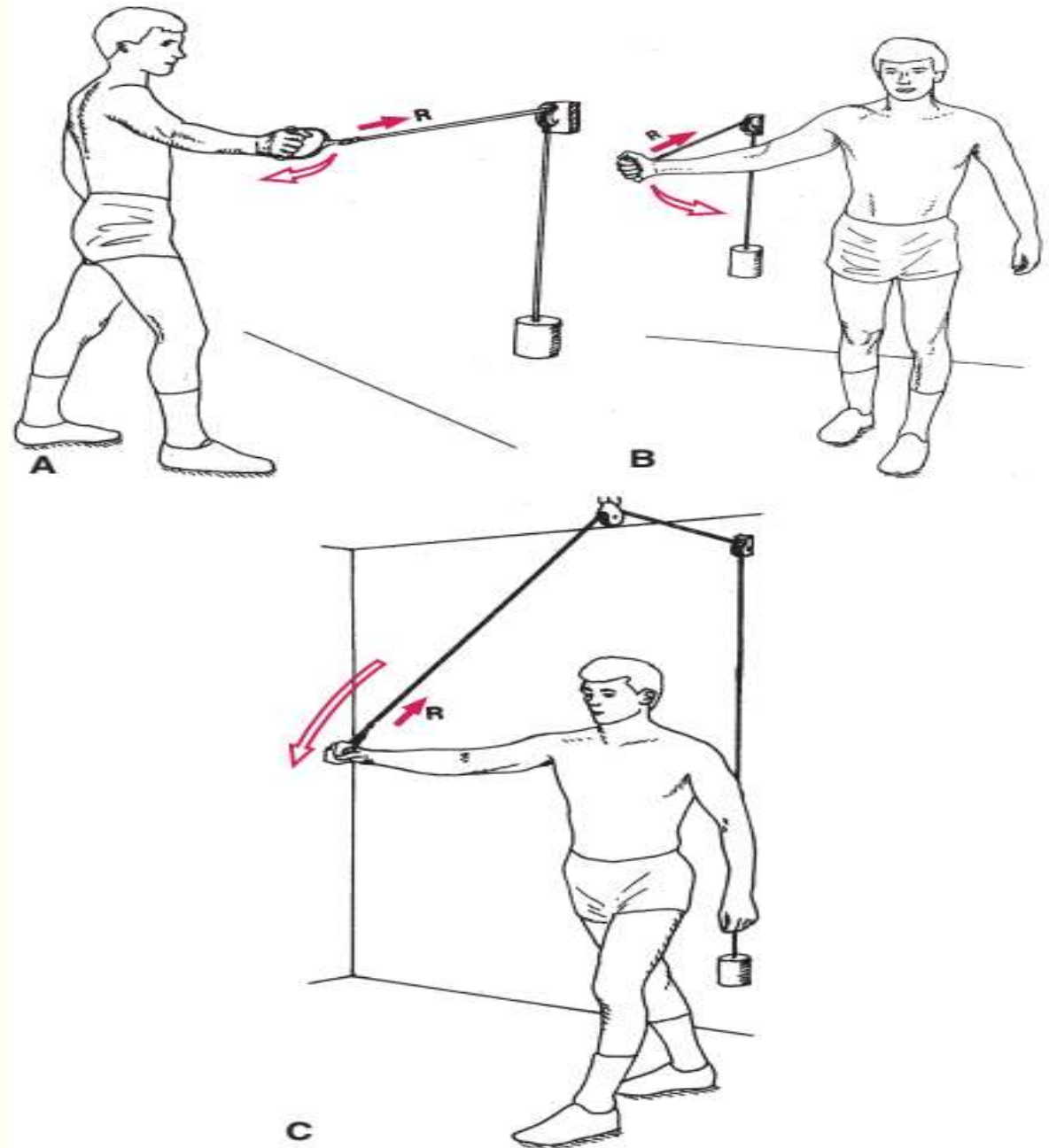


FIGURE 18.22 Mechanical resistance exercise using wall pulleys to simulate tennis swings. **(A)** Backhand stroke. **(B)** Forehand stroke. **(C)** Serve.

Wrist & hand

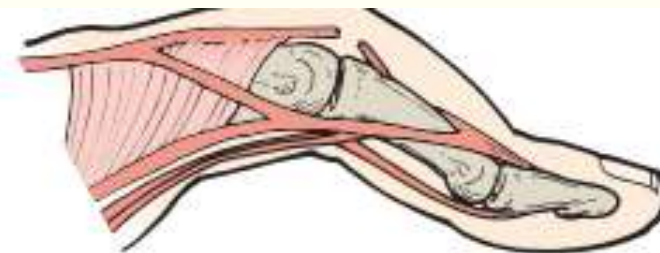
Joint Hypomobility:

Nonoperative Management

- Pathologies, such as rheumatoid arthritis (RA) and degenerative joint disease (DJD), affect the joints of the wrist and hand and may have a significant effect on participation and functional abilities of an individual as a result of pain, impaired mobility, and potential joint deformities. Impaired joint, tendon, and muscle mobility also occurs any time joints are immobilized due to fractures, trauma, or surgery



A Swan-neck deformity



B Boutonnière deformity



MWM of the wrist.

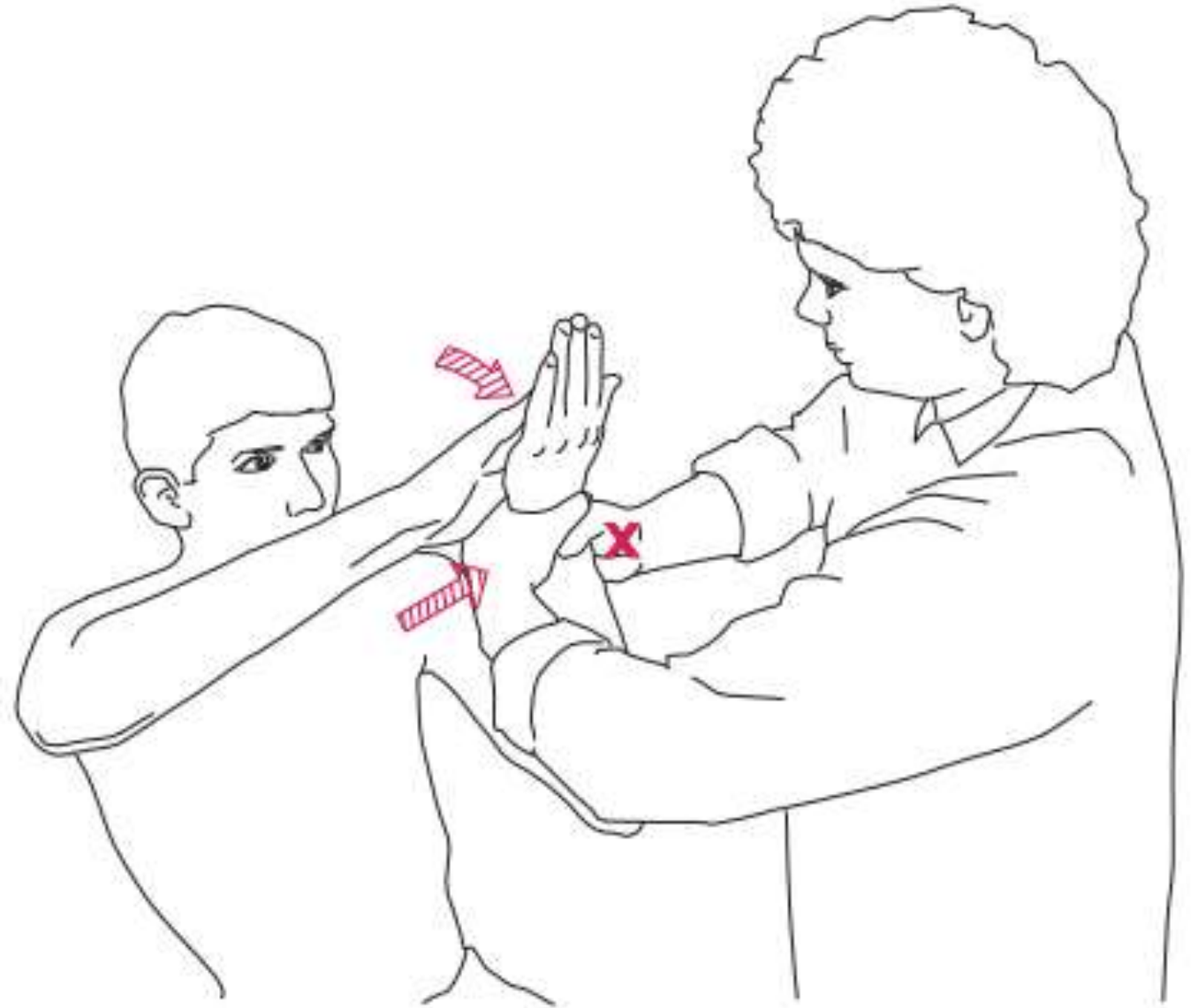
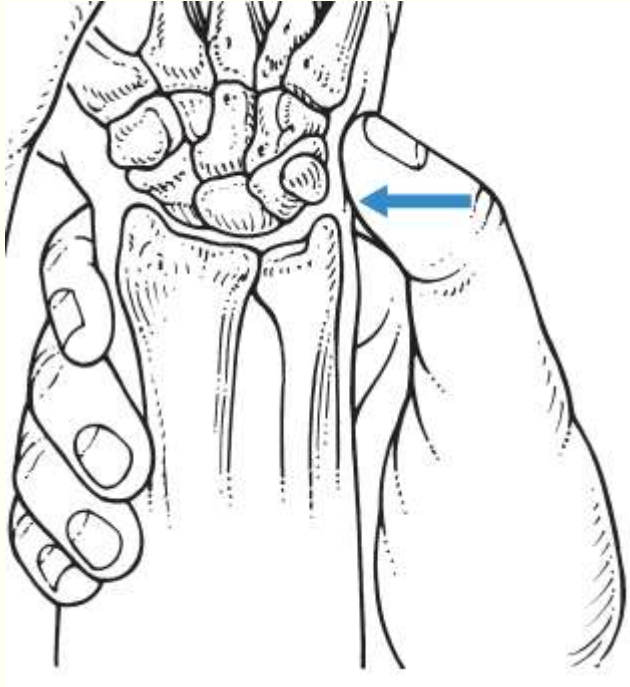
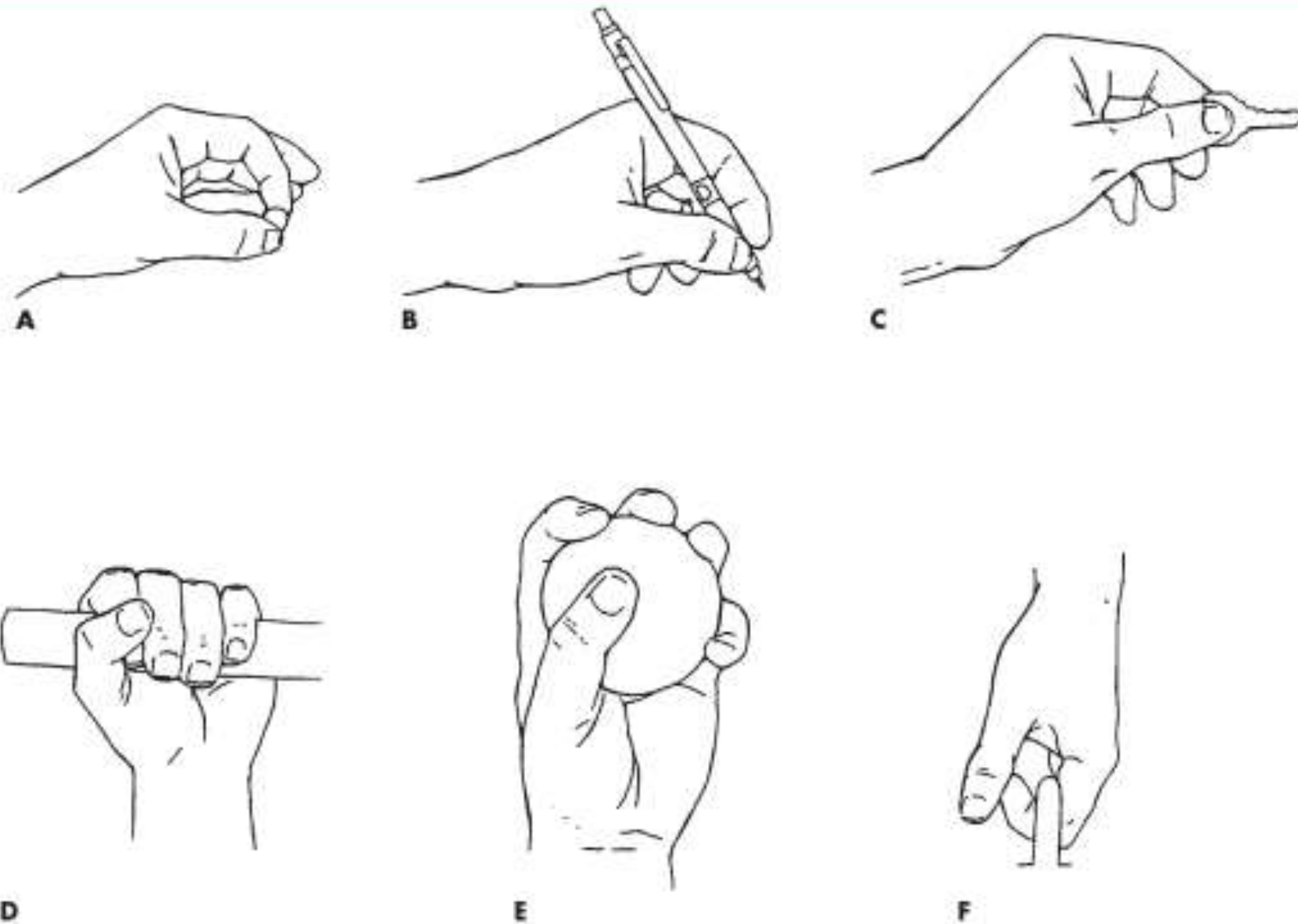


FIGURE 19.7 Mobilization with movement (MWM) to increase wrist flexion or extension. Apply a very gentle lateral glide while the patient actively flexes or extends the wrist and then applies a passive stretch force with his other hand at the end of the range.



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- A. Tip
 - B. Palmar
 - C. Lateral
 - D. Cylindrical
 - E. Spherical
 - F. Hook

FIGURE 16-24 Prehension grips. Pinch: (A) Tip. (B) Palmar (three-jaw chuck). (C) Lateral. Grasp: (D) Cylindrical. (E) Spherical. Hook: (F) Hook. (Reproduced with permission from Prentice WE, Voight ML: *Techniques in Musculoskeletal Rehabilitation*. New York: McGraw-Hill, 2001:342.)

Flexor Tendon-Gliding Exercises

Clinical Pearl

Tenderness with palpation in the anatomic snuffbox suggests a scaphoid fracture but can also present in minor wrist injuries or other conditions

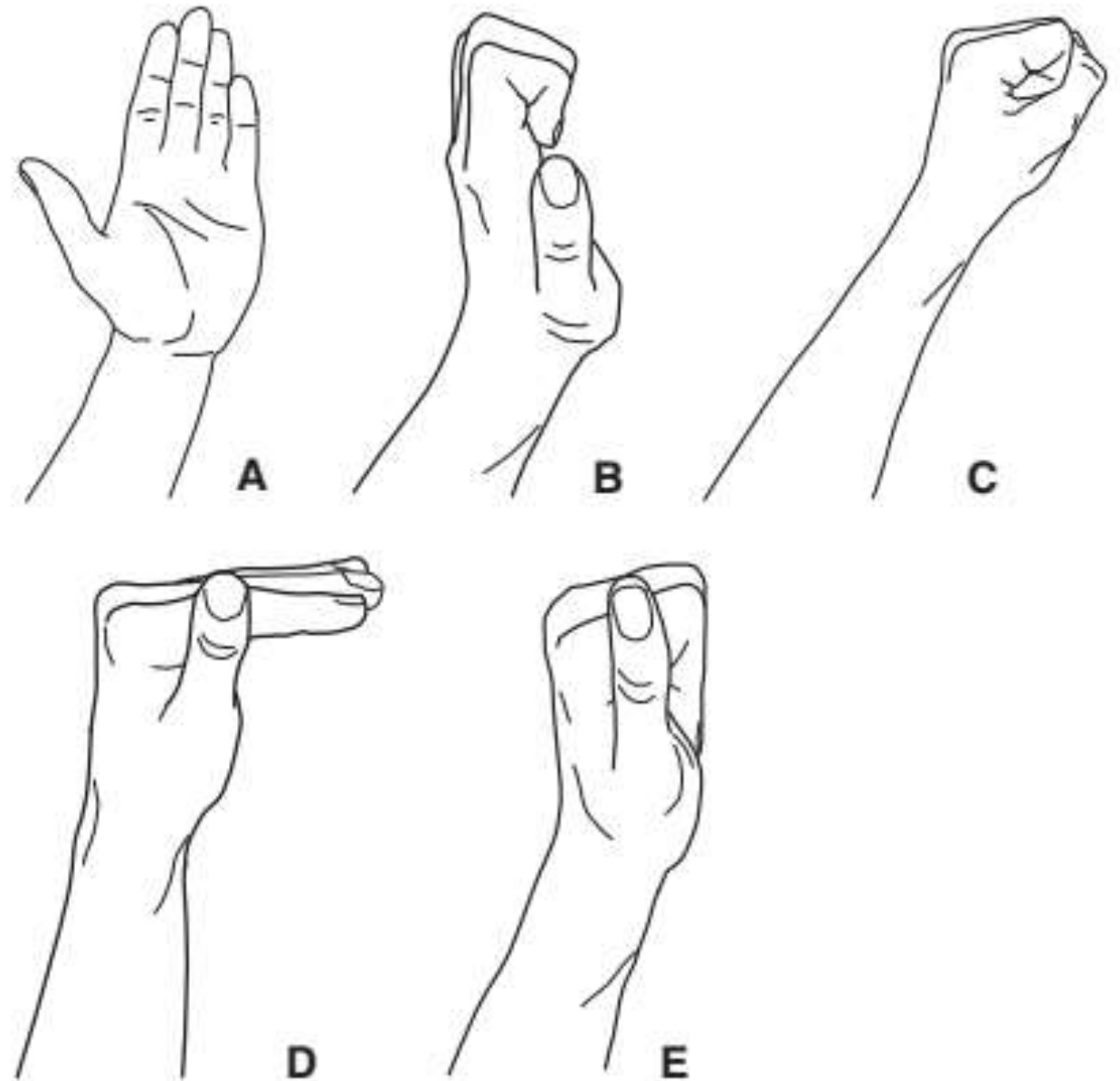


FIGURE 19.16 The five finger positions used for flexor tendon-gliding exercises: **(A)** straight hand, **(B)** hook fist, **(C)** full fist, **(D)** table top (intrinsic plus), and **(E)** straight fist.

DE QUERVAIN'S SYNDROME

De Quervain's syndrome is relatively common.

Tenovaginitis of the first dorsal compartment, or de Quervain syndrome, is the most common tendinitis of the wrist in athletes. It is generally believed to be an inflammation and swelling of the synovial lining of the common sheath of the abductor pollicis longus and the extensor pollicis brevis tendons where they pass along the distal-radial aspect of the radius.

History.

Pain is felt over the distal-radial aspect of the radius, perhaps radiating distally into the thumb or even proximally up the forearm.

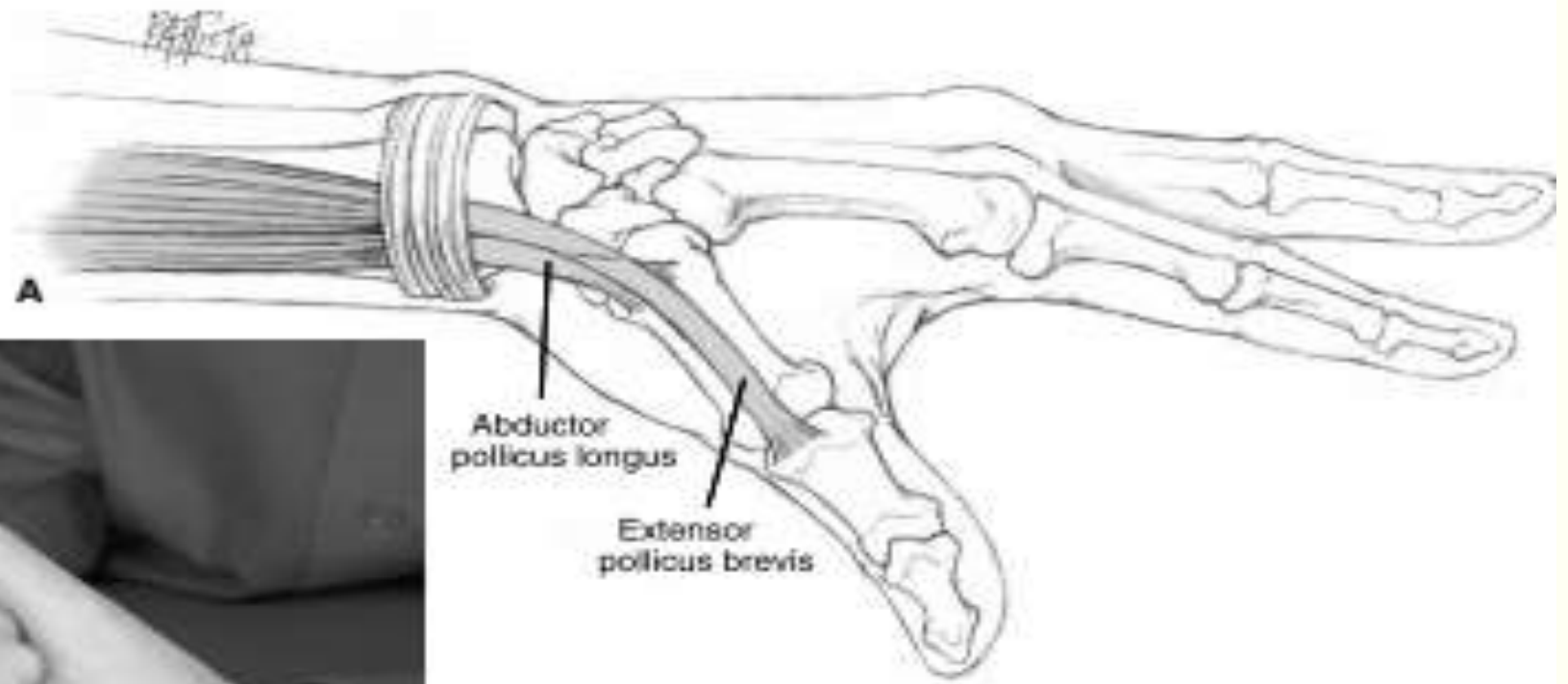
The onset is usually insidious. The patient notes pain primarily with activities involving thumb movements, such as wringing or grasping activities


Physical Examination

This condition must be differentiated from osteoarthritis of the trapezium–first metacarpal joint, also a fairly common disorder.

In osteoarthritis , A. and B. below are negative and joint-play movements at the trapezium–first metacarpal joint are restricted and painful.

- A. Pain on resisted thumb extension and abduction
- B. Pain on ulnar deviation of the wrist with the thumb held fixed in flexion. On this movement the tendons and the sheath are placed on a stretch.
- C. Tenderness to palpation over the tendon sheath in the region of the radial styloid process



B  (A) Extensor pollicis brevis (upper tendon) and abductor pollicis longus (lower tendon) and their common sheath. (B) Friction may be necessary at their shared sheath (de Quervain's) or where the muscles pass over the wrist extensors (intersection syndrome).

Management



Fig: Short opponens splint

A. The physician may elect to inject the sheath with a corticosteroid preparation or a local anesthetic. Surgical incision of the sheath is occasionally performed.

B. If injection is not contemplated or if it is unsuccessful, a trial of ultrasound and friction massage (to the shared sheath) where the muscles pass over the wrist extensors; for a 1- or 2-week period, on a basis of three to five times a week, is warranted. The goal of this program is to maintain and increase mobility of the tendons within the sheath and to help resolve the chronic inflammatory process.

In more severe or persistent cases, temporary restriction of thumb movements with a small opponens splint should be considered to prevent continued irritation to the inflamed sheath process

Ganglion

A ganglion is a fluid-filled cavity that originates from the joint capsule or tendon sheath. It is very common at the wrist. It occurs dorsally, most often over the scapholunate joint, as well as at the palmar aspect, usually at the trapezioscaphoid joint.

Its aetiology has been debated for many years and various hypotheses have been presented: retention cyst, herniation of tendon or capsular synovia, bursal transformation, neoplasia, or **mucinous degeneration of fibrous tissue**, the last of these being the most widely accepted theory

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- The main complaint is the presence of a swelling that was not there before.
 - It may sometimes be painful either at rest or during movement.
 - The size may vary and so does its consistency: it can be either very soft or quite hard, giving the impression of a bony structure. When the ganglion grows, the neighbouring tissues may become compressed and there may be pressure on nervous tissue as well

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- Many techniques have been used to treat this condition, varying from crushing the ganglion (e.g. pressure with the thumbs or a firm slap with a book) to aspiration and infiltration with a steroid or sclerosant solution. These measures usually lead to temporary cure but recurrences are frequent because the cause has not been treated.
 - More consistent results are obtained by surgical removal, although the risks associated with surgery may be more undesirable than the minor symptoms associated with the presence of a ganglion

Carpal Tunnel Syndrome

~~Carpal tunnel syndrome is very common. It is more common in women than men, and it rarely affects young people. So-called idiopathic or classic carpal tunnel follows certain patterns and is endemic in people with certain occupations such as keyboard operators, hairdressers, and dental hygienists.~~

The cause varies. Carpal tunnel syndrome occurs primarily as a **thickening** of the transverse carpal ligament. In certain instances it is attributable to some known disorder **involving increased pressure** within the carpal tunnel. Such situations include a displaced fracture of the distal radius, a lunar or perilunar dislocation, and swelling of the common flexor tendon sheath.

Excessive wrist flexion and extension will also increase pressure in the carpal tunnel. Conditions associated with carpal tunnel include **tenosynovitis** from overuse or from rheumatoid arthritis or internal pressures such as lipoma, diabetes, and pregnancy.

In most cases, the cause is not readily determined. Some believe it to be a vascular deficiency of the median nerve at the carpal tunnel, whereas others believe direct pressure to the nerve is the cause. Symptoms and signs accompanying this disorder are more suggestive of a pressure phenomenon.

History

- A. Onset of symptoms—usually insidious, unless they follow trauma resulting in fracture, dislocation, or swelling of the wrist
- B. Nature of symptoms—The complaint is most often that of paresthesias (pins and needles) felt into the first three or four fingers. The patient is most troubled by being awakened at night, usually in the early morning, from paresthesias in the hand. The onset of paresthesias often occurs with activities involving prolonged use of the finger flexors, such as writing and sewing. Symptoms may also increase with static positioning (e.g., driving or reading a newspaper). Often the patient complains of clumsiness on activities requiring fine finger movements. At times a burning sensation is felt in the median nerve distribution of the hand as well. Subjective complaints of actual weakness are rare. The problem can be unilateral or bilateral.

Physical Examination

A. Observation. There may be some clumsiness with activities requiring fine finger movements, such as handling buttons or other fasteners.

B. Inspection. Some thenar atrophy may be noticed, but usually only in chronic cases.

C. Joint tests. Joint tests include active and passive ROM of the elbow, forearm, wrist, and digits and other relevant joints including a cervical scan examination.

D. Muscle tests. Thenar weakness is the first objective sign of carpal tunnel syndrome. According to Chow, it is the most valuable guide for evaluation of response to conservative therapy, and if thenar weakness is significant and persists, it indicates the need for surgery.

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- Neuromuscular tests
 1. Careful sensory testing may reveal some deficit in the tips or dorsal ends of the first three or four fingers (usually the second or third). However, mild or early cases sufficient to cause significant symptoms may not present with a detectable sensory deficit.
 2. Tinel's sign .
 3. Modified Phalen's test and reverse Phalen's sign are positive. A positive test produces numbness, tingling, or pins-and-needles within 30 seconds. The more inflamed the nerve, the faster the onset.
 4. Carpal compression test

Management

- Nonsteroidal anti-inflammatory drugs are a standard part of conservative therapy, and help to reduce the edema and inflammation of the synovium in the tunnel. It has been well documented that changing activities, such as providing exercise, or interruption of activities, whether assembly line work or keyboarding, is extremely effective in relieving symptoms. Advise the patient regarding activities requiring grasping, pinching, or fine finger movements such as needlework or woodworking.

SPLINTING

These patients often do remarkably well simply by wearing a resting splint for the wrist at night. The reason why this helps is not entirely clear, except that it maintains the wrist in a neutral position, the position of least pressure within the carpal tunnel. (For this reason it seems more likely that this disorder is a pressure phenomenon rather than a release phenomenon.) The patient can be shown how to don the splint without impairing venous return from fastening straps or wraps too tightly. The splint may or may not include the fingers. **It is usually unnecessary to wear the splint during the day.** However, if night use does not provide relief of symptoms, a several-day trial of continuous use of the splint followed by gradual weaning should be instituted. Whether the splint is worn continuously or at night only, after 1 or 2 weeks of relief from symptoms, use of the splint can gradually be decreased and eventually discontinued.

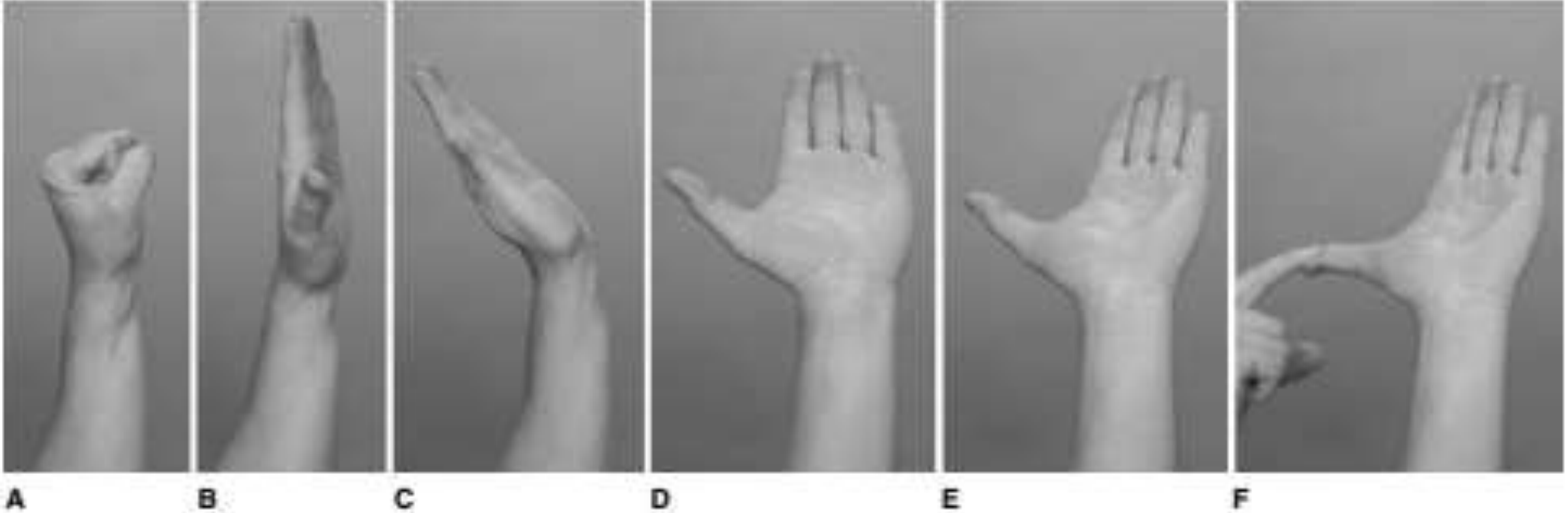
MANUAL THERAPY

- Nerve gliding exercises for mobilization of the median nerve described by Butler
- ~~tendon gliding exercises~~
- and soft tissue manipulation of carpal tunnel syndrome also help to relieve symptoms.

Other considerations include joint mobilization, including distraction of the radiocarpal joint , dorsal palmar glide of the radiocarpal joint mobilization of the pisotriquetral joint

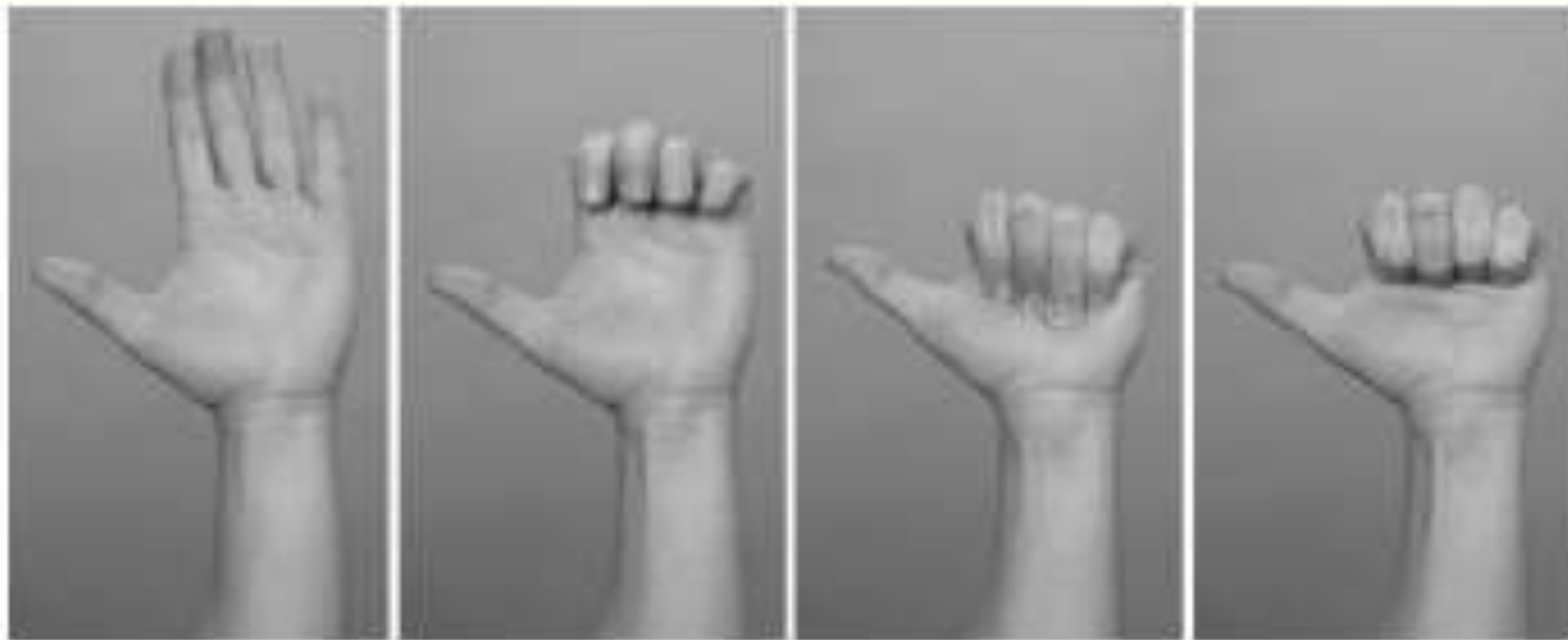
Progressive strengthening exercises in pain-free, symptom-free range of (1) elbow flexion–extension, (2) forearm pronation and supination, (3) wrist flexion and extension, and (4) grip should be included.

Only in persistent cases is surgery required to divide the flexor retinaculum and effectively relieve the pressure. Rehabilitation after release consists of wound care, if necessary; scar massage; and mobilization of the neurolyzed nerve. Tendon gliding exercises are used to improve ROM and isolation of tendons



Nerve gliding exercise for mobilization of the median nerve.

- (A) Wrist in neutral, fingers and thumb in flexion.
- (B) Wrist in neutral, fingers and thumb extended.
- (C) Thumb in neutral, wrist and fingers extended.
- (D) Wrist, fingers, and thumb extended.
- (E) Same as position D, with forearm in supination.
- (F) Same as position as E, with other thumb gently stretching thumb



A **B** **C** **D**

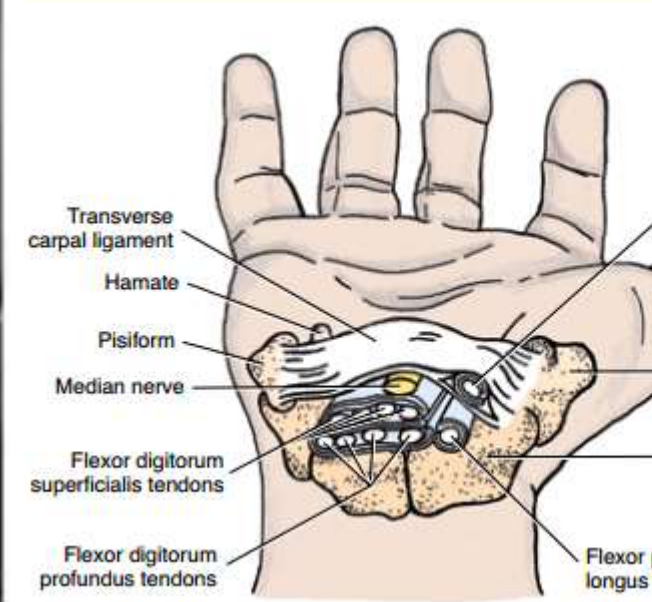
Tendon gliding exercises for the tendons passing through the carpal tunnel.
(A) Starting position with full finger extension.
(B) Ten repetitions of the hook fist,
(C) straight fist,
(D) and full fist are performed to maximize differential tendon gliding and full excursion of the tendons through the carpal tunnel.



A



B



Manipulation in carpal tunnel syndrome.

(A) Thumb pressure is applied along the attachment edges of the carpal ligament at the medial and lateral borders of the carpal bones. At the same time the patient's thumb is pulled into radial abduction with extension.

(B) Same as(A) except the patient's wrist and digits are hyperextended, further opening and extending the canal