Upper extremity disorders in Keyboard players

The ICSOM Study 1988

- 47/48 ICSOM orchestras reported 82% of musicians reported a “medical problem”
- 72% indicated that the problem affected their performance
- Peak age: 35-45

Hochberg 1983

"Keyboard and string musicians present with the greatest number of hand and arm problems"

- Right arms are affected twice as often as left arms
- The ring and small fingers are most commonly affected
- Female musicians are far more likely to be affected than men (Smaller hand size, small joint laxity) in overuse pain but less likely in movement disorders

Factors that impact

- Poor physical conditioning
- Long uninterrupted playing with multiple repetitions
- Poor posture, technique, practice routinue
- High stress: internal and external (deadlines)
- Peer and family pressure to “succeed”
- Depression

Extrinsic factors

- Sports participation 35%
- Household accidents 24%

  Lacerations, crush injuries
- Motor vehicle accidents 11%
- Falls 23%

Sports Injuries

Highest in school and recreational amateur musicians

Presentation of Disease

- Musicians are affected in two ways:

1. conditions caused by playing

2. outside activities that cause disease or injury that have special impact on musicians

Predominant complaints

- Pain
- Weakness
- Tightness
- Numbness
- Loss of muscle control

Playing can cause:

- Chronic neck strain; cervical disc disease cervical joint degeneration
- Rotator cuff tendinitis
- Thoracic outlet syndrome
- Low back strain
- Peripheral tendinitis
- Compressive neuropathy

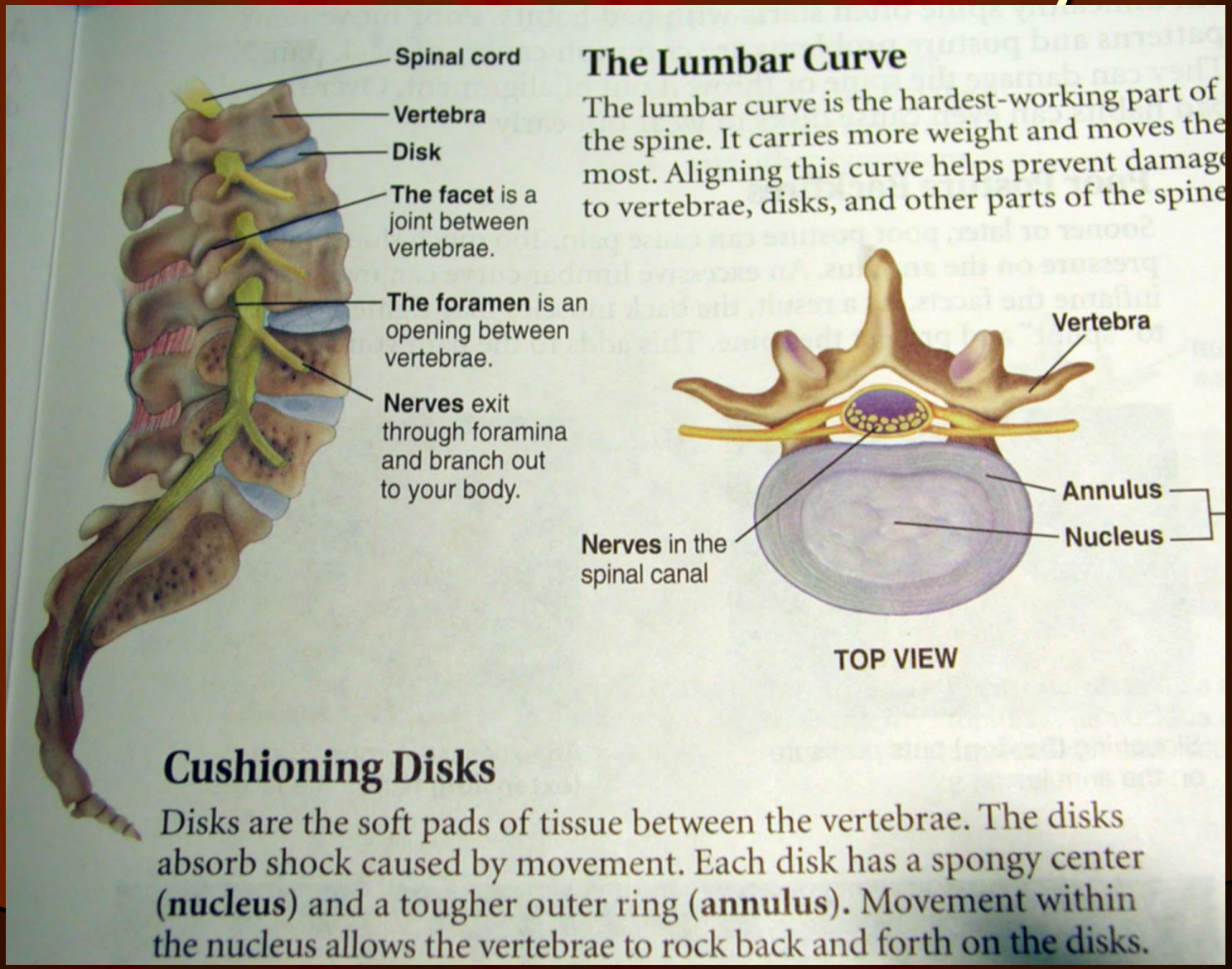
Treatment modalities

- Physical (exercise) therapy
- Medications oral and injected
- Technique change
- Instrument modification
- Practice regimen change
- Acupuncture
- Surgery

Low Back and Neck problems

- Dynamic movement of muscles and joints can be maintained over long periods as it allows continuous blood flow to the area.
- Static postures limit blood flow causing muscle fatigue and constriction and unrelenting pressures on low back discs and facet joints.

The low back anatomy



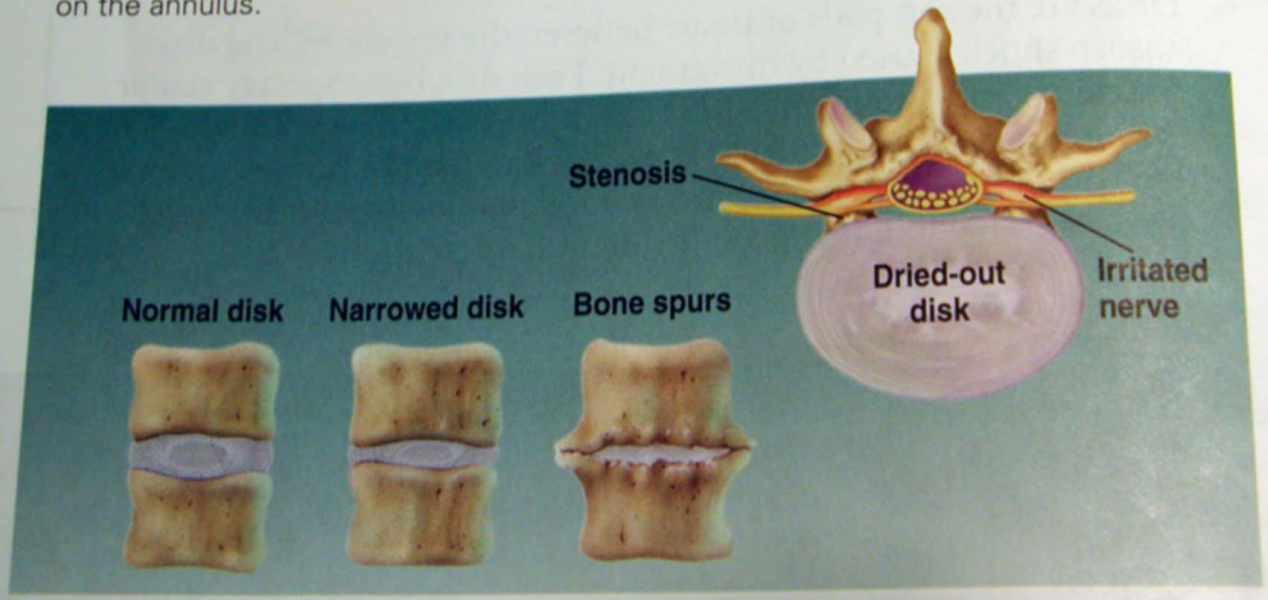
Poor postures

- Prolonged forward bending will strain the back and neck.
- Neck strain will radiate down the shoulders and arms and back pain will radiate down the legs
- Forward torso flexion with arms out stretched exacerbates the problem
- Numbness in the fingers and toes follow as nerves are compressed in the arms and legs

What can go wrong

Slouching **(flexion)** puts pressure on the annulus.

An excessive lumbar curve **(extension)** harms the facets.

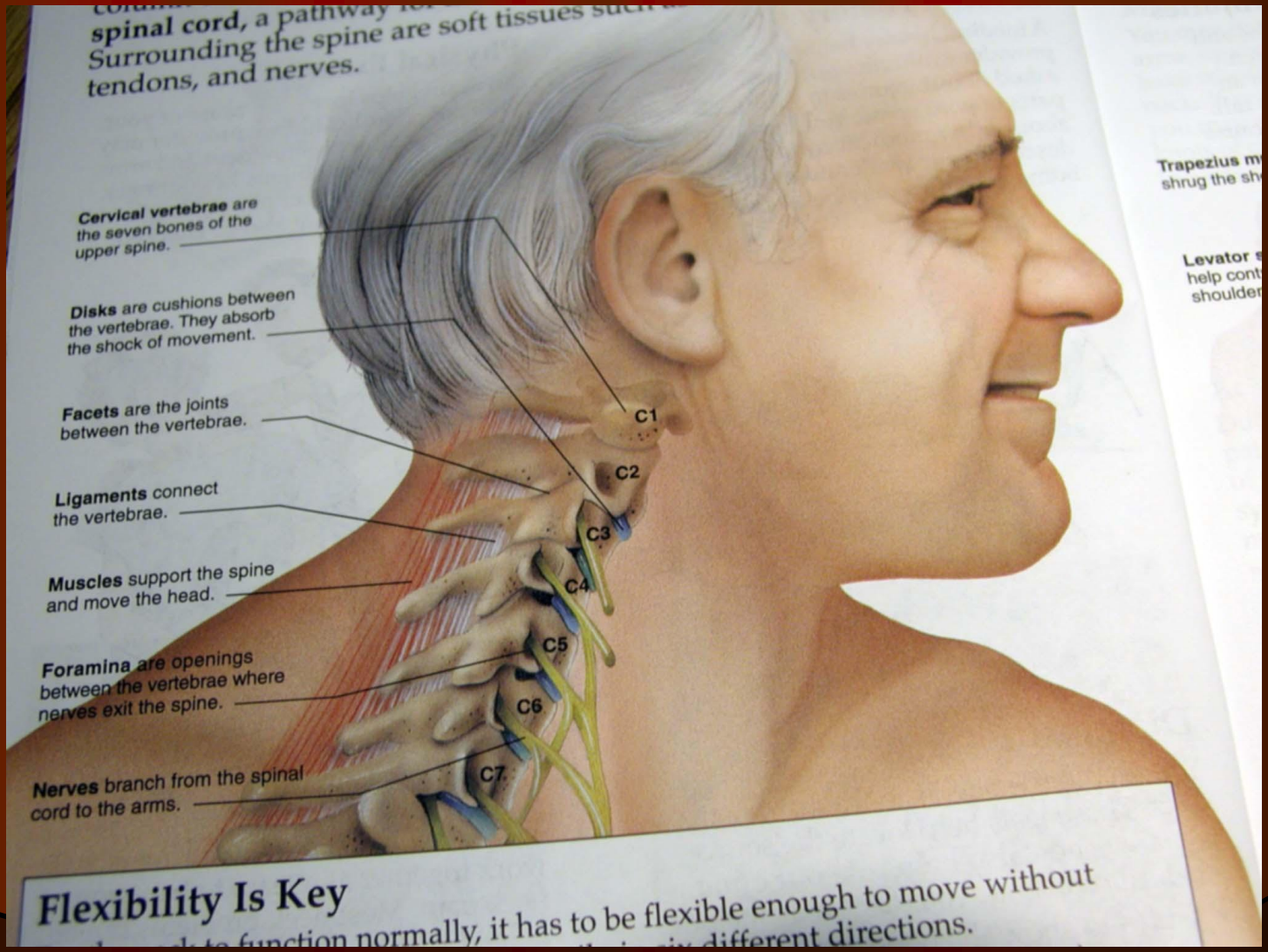


How Disks Wear Out

Disc Problems

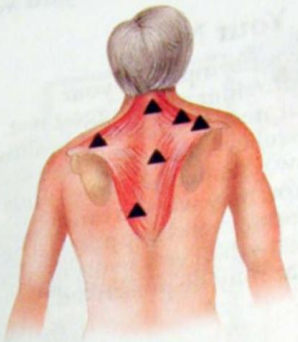
- Prolonged forward flexion of the back and neck will compress the discs between the spinal vertebrae
- The spinal discs have a tough rubbery outside and a gelatinous center
- Leaning forward will force the "jelly" to the back of the disc adjacent the nerve roots. If there is any preexisting injury causing a weakness or crack in the back of the disc, a bulge or herniation can result

The Cervical Spine



Common Symptoms

If you have a neck problem, you may have a variety of
Common symptoms range from muscle tension and pain to numb
or weakness in your shoulders or arms.

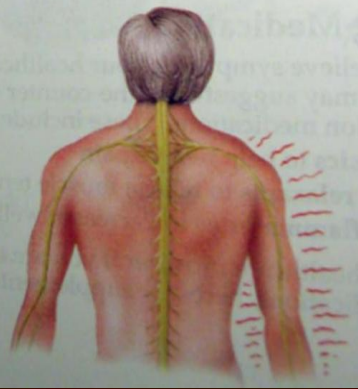


Muscle Tension and Spasm

You may not be able to move your neck, arms, or shoulders comfortably if you have muscle tension or stiffness in your neck. If your symptoms aren't relieved, you may experience muscle spasms, or knots of contracted tissue **(trigger points)** in areas of your neck and shoulders.

Aches and Pains

Dull aches in your head or neck, sharp pains, and swelling of the soft tissue of the neck and shoulders are common symptoms. If there is pressure on the nerves in your neck, your arms or hands may be painful **(referred pain).**



Numbness or Weakness

If the nerves in your neck are injured, you may experience numbness, tingling, or weakness in your shoulders, arms, or hands. These symptoms arise when disks or bone spurs press on the nerves in your neck.

Back and neck

- Twisting movements cause shearing of the disc tissue hastening degeneration.
- Disc bulges or herniation will cause pressure on spinal nerve roots causing local or radiating pain down the arms (neck) or legs (back)

Risky Postures

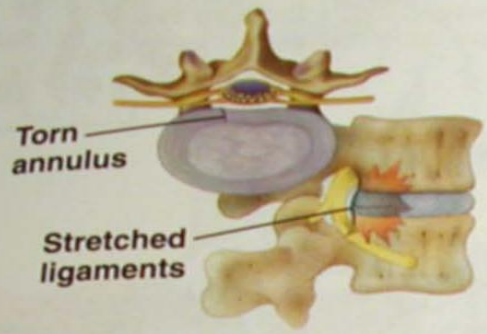
- Standing or sitting for prolonged periods
- Neck: tilting, rotating, head cock in flexion or extension
- Torso: bending, twisting, leaning forward or backward
- Shoulders: lifting, twisting, rolling forward

“Problem keyboard techniques”

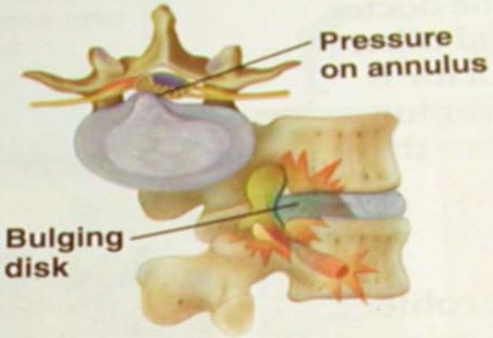
- Octaves
- Chords
- Fortissimo
- Arpeggio
- Presto
- Staccato
- Wide extended passages- crossovers

Management

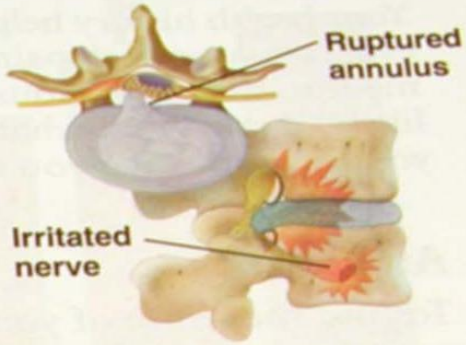
- Initial management includes postural adjustment, NSAIDS, muscle relaxants, oral steroids, firm supportive mattress, cervical pillow and physical therapy
- If there is unremitting pain or + neuro or systemic findings then imaging is needed
- X-ray, CT scan, MRI +/- contrast
- Surgery for specific lesions only



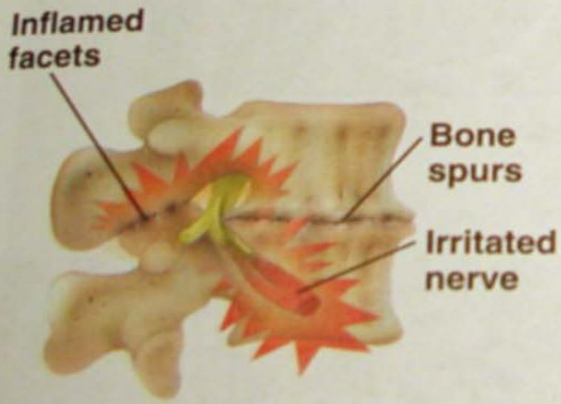
Torn annulus. A sudden movement may cause a tiny tear in an annulus. Nearby ligaments may stretch.



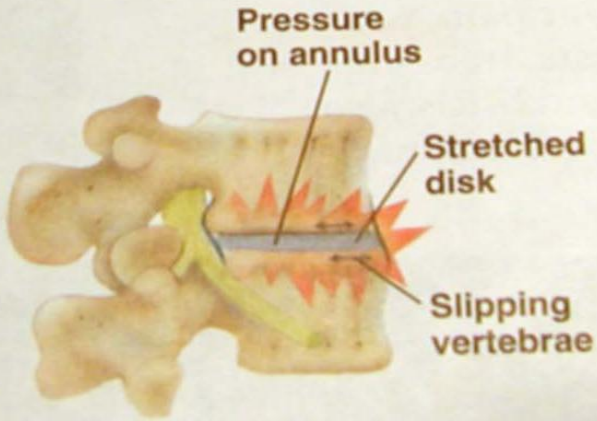
Bulging disk. As a disk wears out, the nucleus begins to bulge into the annulus.



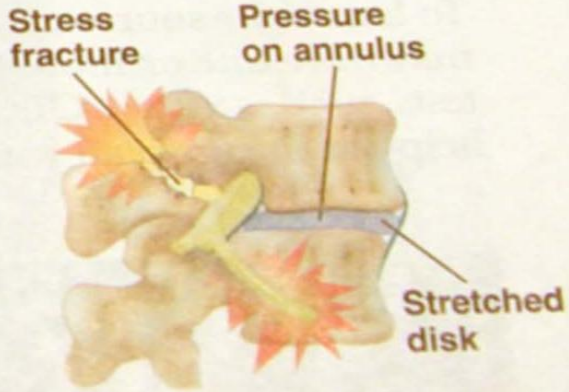
Ruptured disk. As a disk ruptures, its nucleus can squeeze out and irritate a nerve.



Arthritis. As disks wear out over time, bone spurs form. These growths can irritate nerves and inflame facets.



Instability. As a disk stretches, the vertebrae slip back and forth. This can put pressure on the annulus.



Spondylolisthesis. A crack (stress fracture) can develop in a vertebra. This may put pressure on the annulus, stretch the disk, and irritate nerves.

Conservative treatment

- Conservative treatment is not synonymous with non- operative treatment
- Conservative treatment is usually the most simple straightforward approach to achieve the optimal result
- This can be non operative or operative depending on the circumstance

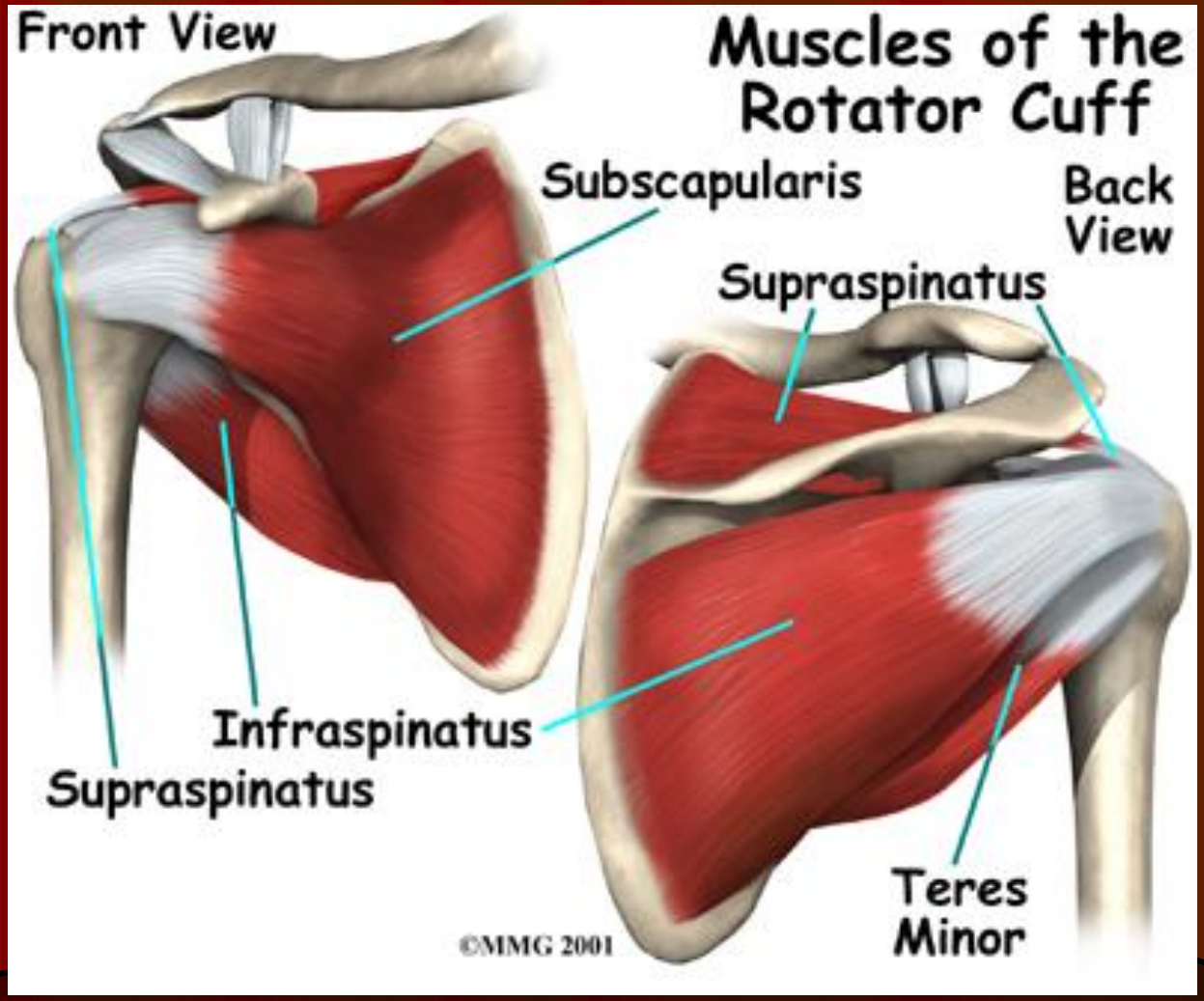
Home stretches

Non operative treatment

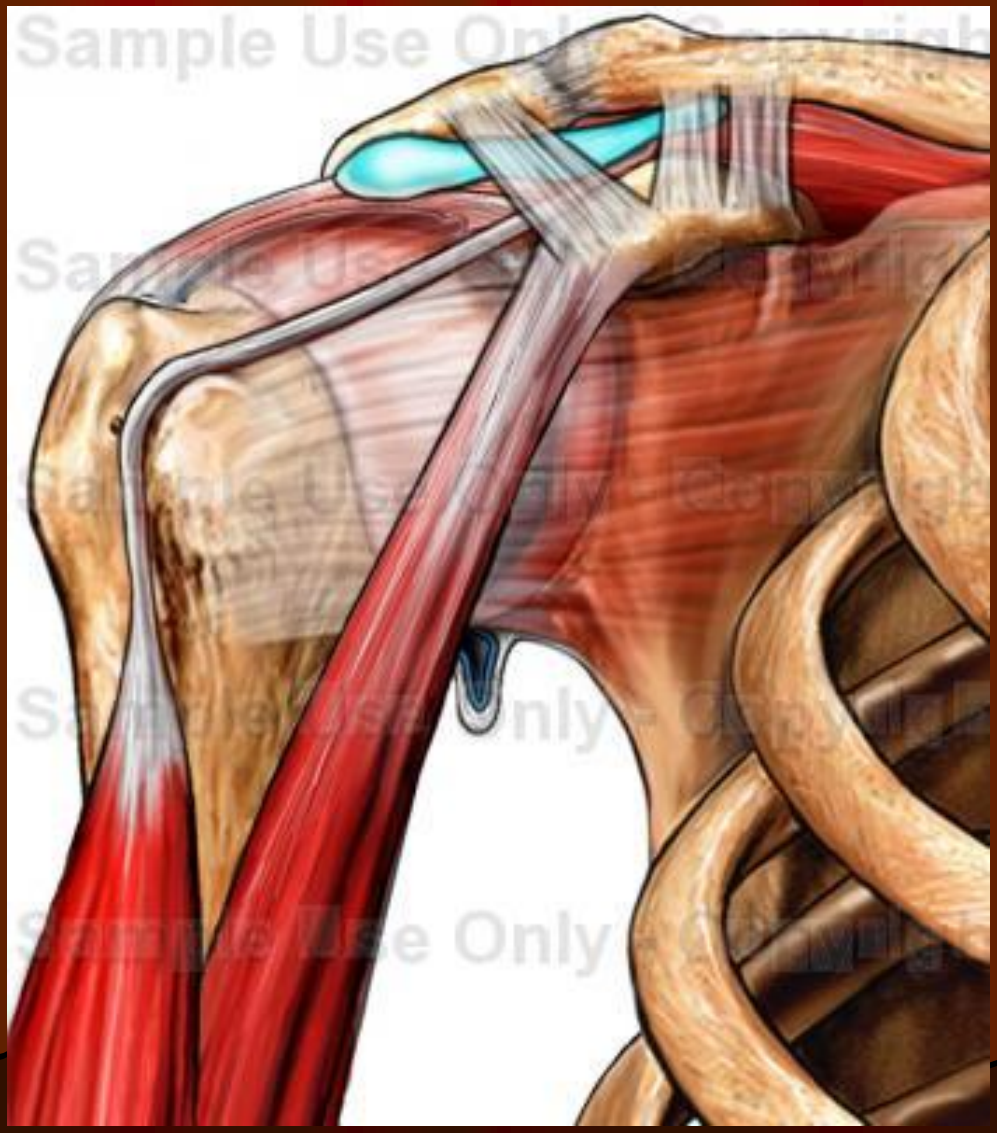
- Is not open ended
- At 6-12 weeks tissue atrophy and weakness set in if the primary problem is not addressed
- The best outcomes occur when the treatment allows the earliest return of movement and strengthening

Surgery can be extremely beneficial to musicians if the indications are strict and a well planned rehabilitation and return- to -play program are executed

Rotator Cuff Anatomy

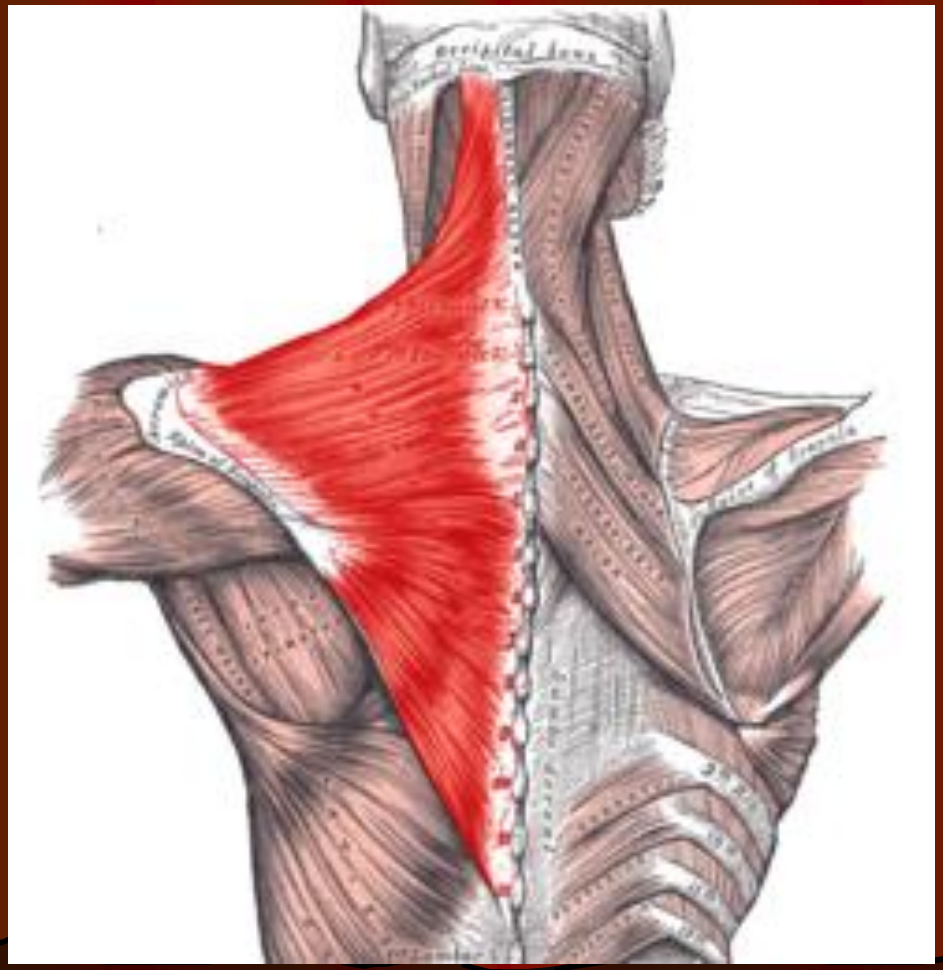


Shoulder Bursae



Trapezius muscle

shoulder shrug, moves scapula, arm raise



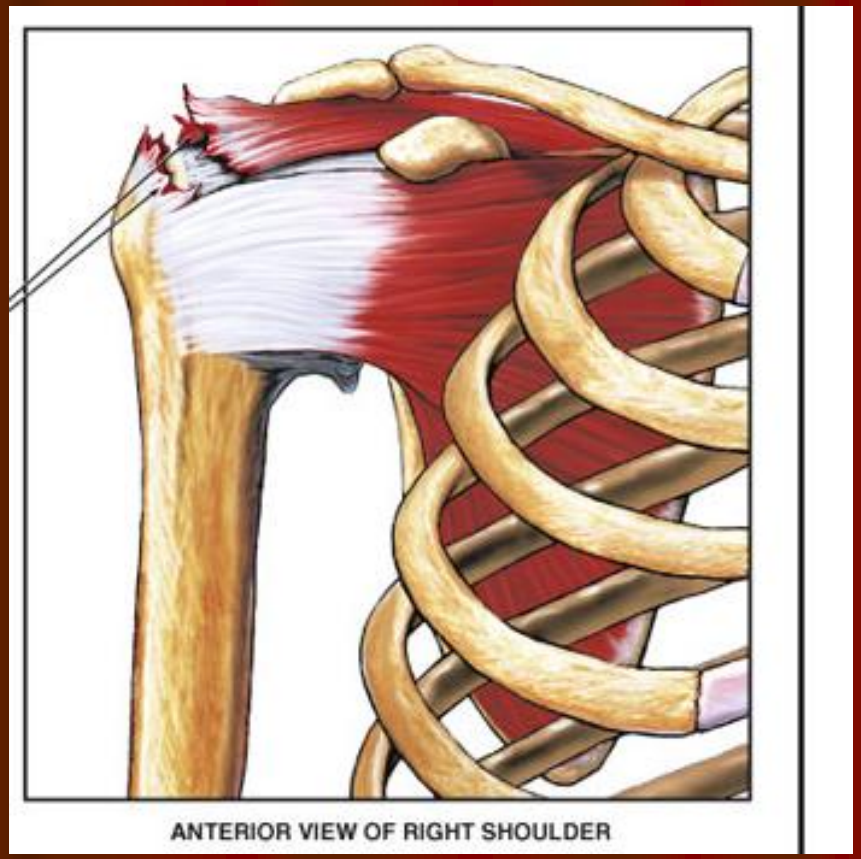
Rotator Cuff Tendinitis/Bursitis

- Pain, worse at night that can radiate up the side of the neck or down the lateral arm (about 1/3)
- Weakness with painful inability to raise the arm at the side or around the back
- Over time joint stiffness develops (frozen shoulder)

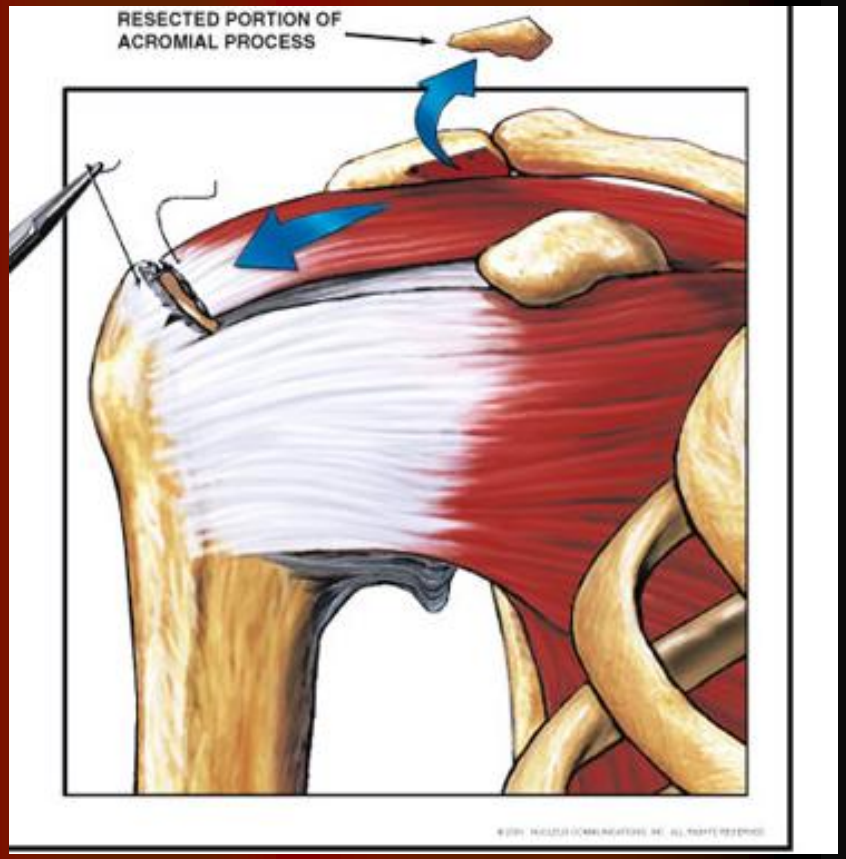
Mechanism

- Degeneration in Supraspinatus muscle from chronic overuse with loss of blood supply to its tendinous insertion on the humerus causes a superior migration of the humerus under the acromion.
- Impingement and bursal inflammation follows.
- Left alone a degenerative rotator cuff tear will follow

FULL THICKNESS ROTATOR CUFF TEAR WITH SUBSEQUENT SURGICAL REPAIR



ANTERIOR VIEW OF RIGHT SHOULDER



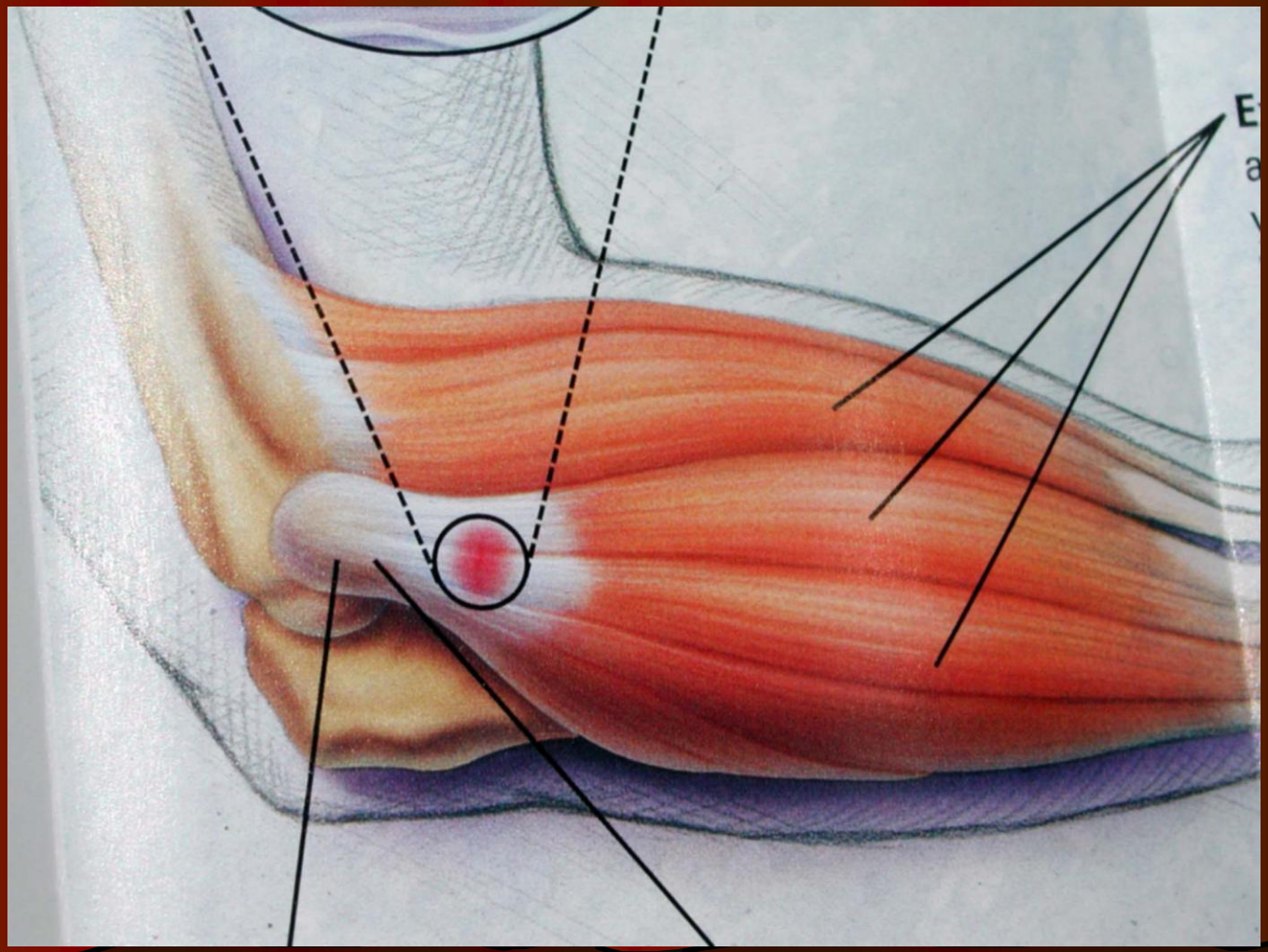
Management

- For the keyboard: avoid forward droopy shoulders, leaning backward or overarching the upper back
- Check for shoulder weakness apart from the pain. Careful physical exam check for instability, initial x-ray ..calcifications,OA
- One cortisone injection in the subacromial space and /or the AC joint
- NSAID'S, rest, ice, physical therapy

Management

- Over 75% resolve with above measures
- With persistent pain, further imaging needed…MRI to check for rotator cuff inflammation/tear
- Rule out gall bladder, cardiac, lung, neck problems
- Arthoscopic or open rotator cuff decompression or repair
- Post op rehabilitation

Lateral Epicondylitis
(tennis elbow)



Presentation

- Pain at the lateral border or the elbow
- Can last for years, cyclic
- Worse with overhand lifting
- Progressive arm weakness

Management

- Rest, ice and splinting
- Counterforce band
- Avoidance of over-handed lifting
- Rehabilitation exercise
- Steroid injection
- PRP injection
- Coblation
- Open surgery

EXERCISE TREATMENT FOR TENNIS ELBOW

Developed by Allan M. Levy, M.D.

Heat 3-5 min Stretch x 3 20 seconds Strengthen 5 lbs 20 reps

I. Arm Curl (Standing)

Hold a dumbbell with your palm facing forward and your hand at your side. Bend your elbow and lift the weight to your shoulder. Slowly lower the weight to the starting position.

Forward Lateral } Flies

II. Reverse Arm Curl

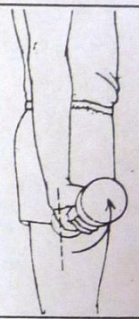
Hold a dumbbell with your palm facing backward and your hand at your side. Bend your elbow and lift the weight to your shoulder. Slowly lower the weight to the starting position.

III. Wrist Curl

Hold the dumbbell with your arm down by your side and your elbow locked. With your palm facing forward, flex the wrist forward all the way and then let it back down.

IV. Reverse Wrist Curl

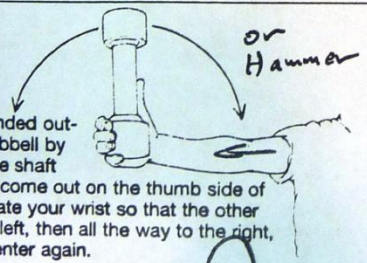
Put your arm down by your side and turn your hand so that the palm faces backward. Holding the dumbbell, flex your wrist forward as far as it will go and then let it down.



V. Unbalanced Wrist Rotation

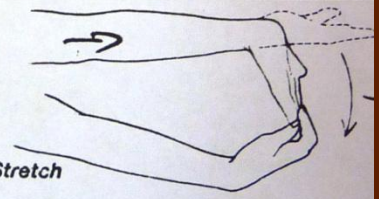
With your arm extended outward, hold the dumbbell by one knob so that the shaft and the other knob come out on the thumb side of your hand. Now rotate your wrist so that the other knob rotates to the left, then all the way to the right, and then back to center again.

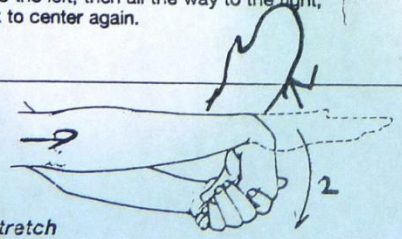
or Hammer



VI. Elbow Stretch (Palm Up)

Extend your arm straight out, that is, parallel to the floor with the elbow locked and palm facing up. With your other hand, push the palm and fingers of the extended hand toward the floor. Hold for 15 to 20 seconds.





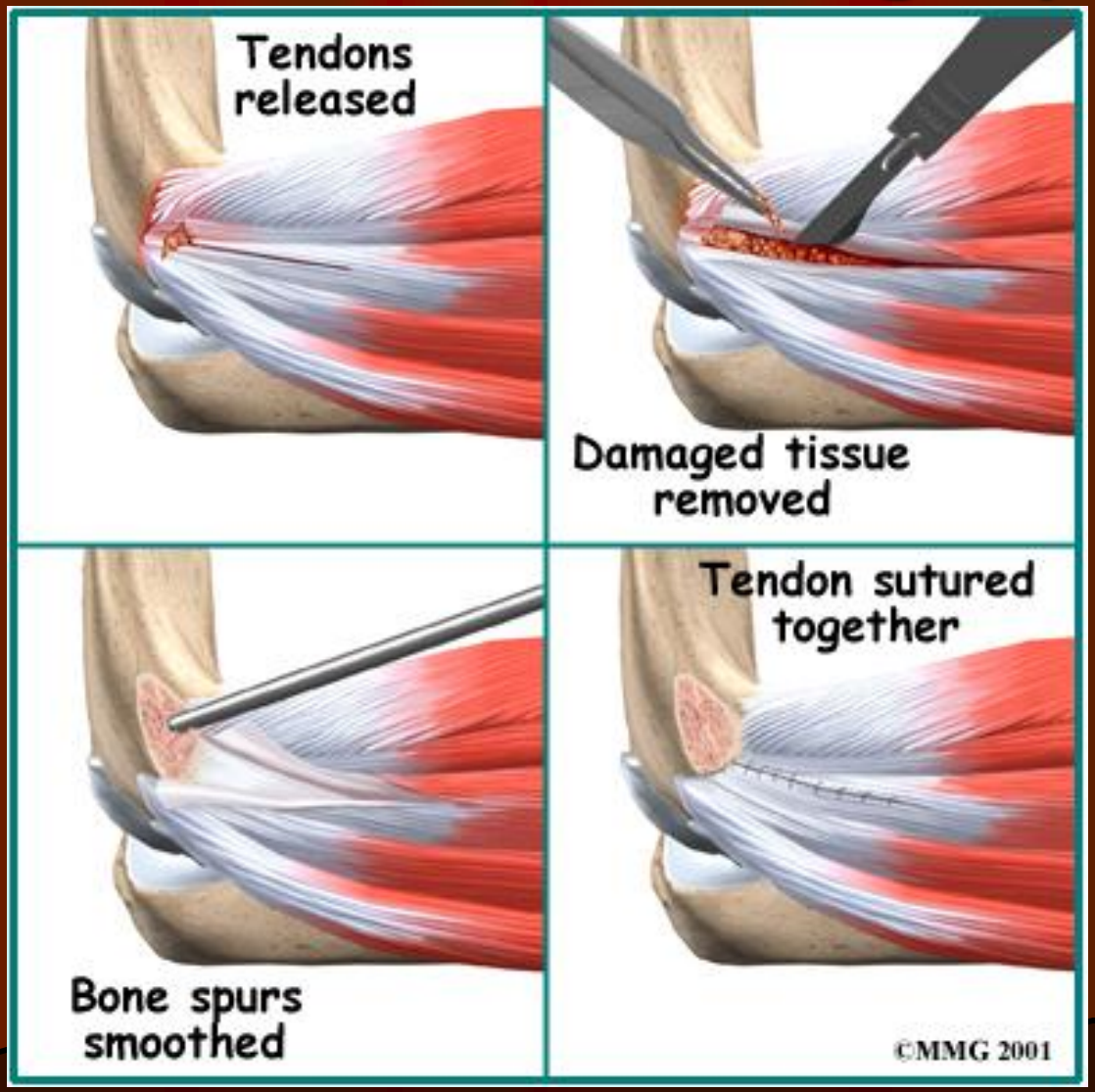
VII. Elbow Stretch (Palm Down)

Extend your arm straight out, that is, parallel to the floor with the elbow locked and palm facing down. Push the top of your hand and fingers of the extended hand down toward the floor with your other hand. Hold for 15 to 20

Exercises I - V should be done 50 times each, or to muscle exhaustion if this comes first. Start with 2-3 lb. dumbbell and increase weight as strength and pain allow. Try to work through pain unless it becomes severe.

Exercises VI & VII - 3-4 repetitions 3-3 times/day for each. Be sure elbow is completely straight to make stretch effective.

Tennis Elbow Surgery

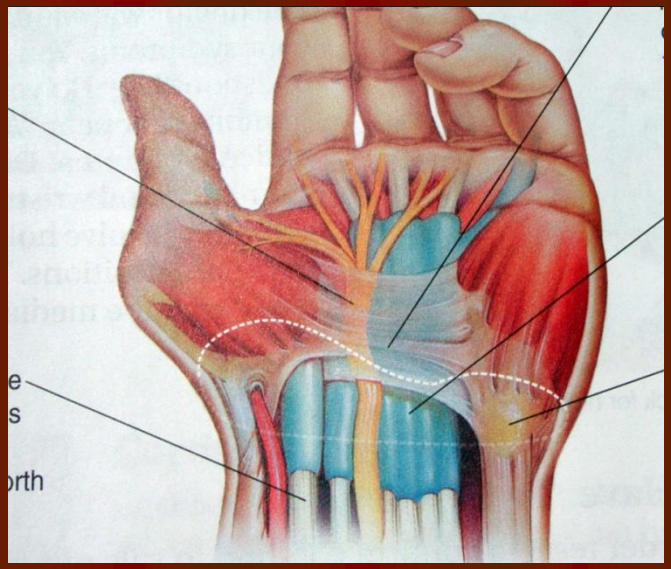


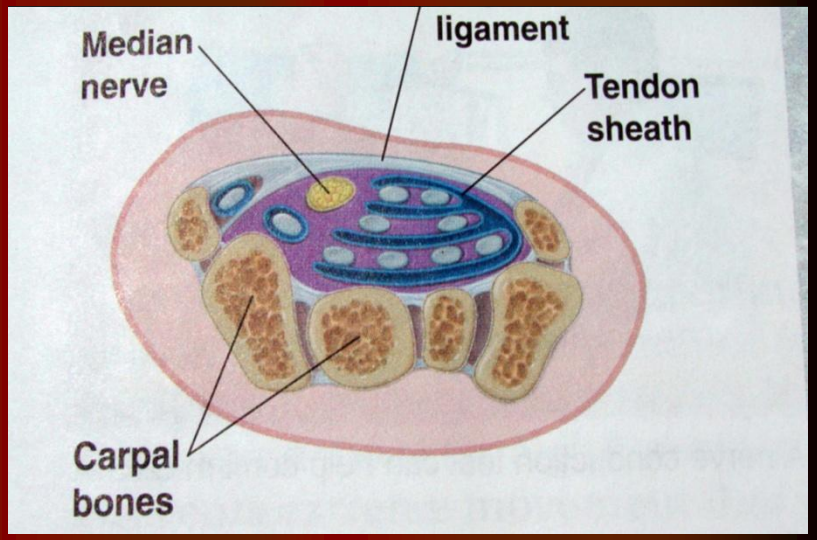
- Peripheral compressive neuropathies

1. Carpal tunnel syndrome
2. Cubital tunnel syndrome
3. Radial tunnel syndrome

- Myo-fascial pain syndrome

Carpal Tunnel Syndrome





Carpal tunnel anatomy

- 9 tendons and the median nerve enter the hand between the thenar and hypothenar muscles
- Tenosynovial thickening crowds out the nerve increasing pressure in the canal
- Pressure on the nerve cause the classic symptoms
- Poor posture while using the keyboard will increase pressure and symptoms

Risky postures

- Sustained wrist flexion extension, pinching
- Repeated micro-trauma by repetitive motion i.e. intense repeated up and down motion of the wrist causes swelling of the teno-synovium
- Holding the phone, driving, vibration

Symptoms

- Radiating night pain into the fingers and up the forearm, constant waking at night
- Numbness into thumb index middle fingers (can involve the whole hand)
- Severe clumsiness, loss of control, weakening grip,
- Progressive difficulty with activities of daily living.

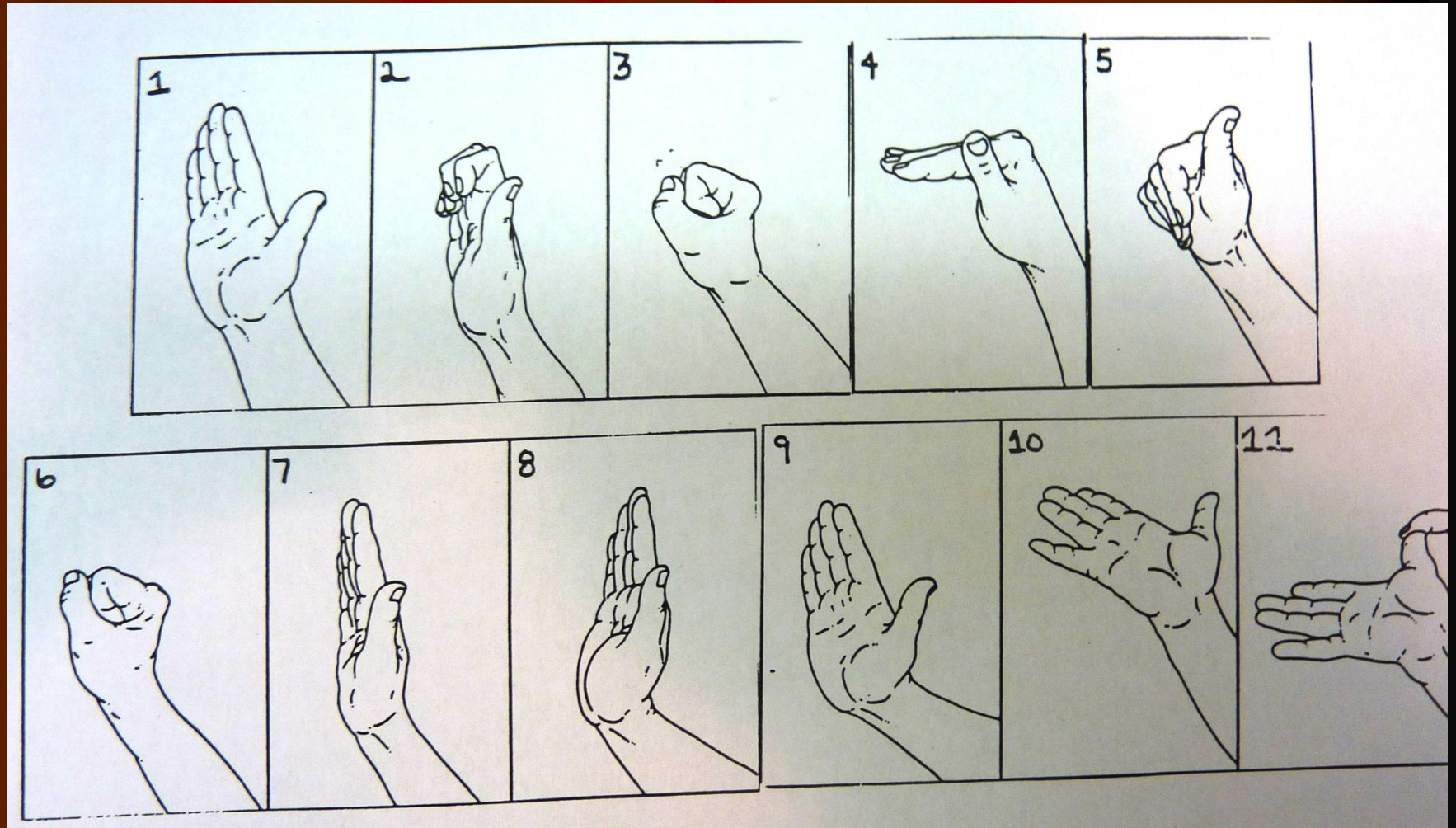
Management

- Technical, activity modifications
- Avoid extremes of flexion/extension and ulnar deviation (especially in forte playing)
- Keep wrist in neutral and avoid "roman arch technique" or "wrist cycling"
- Use whole forearm to raise and lower the hand
- While practicing take frequent rest breaks

Management

- Beware of non musical activities that can stress the wrist
- Computer use, knitting, bicycle riding, scissors,
- Wrist braces for night use to maintain neutral position while sleeping
- Nerve and tendon gliding exercise
- Contrast baths
- Electro-diagnostic studies
- Surgical intervention open or endoscopic
- “Return to play” rehab program

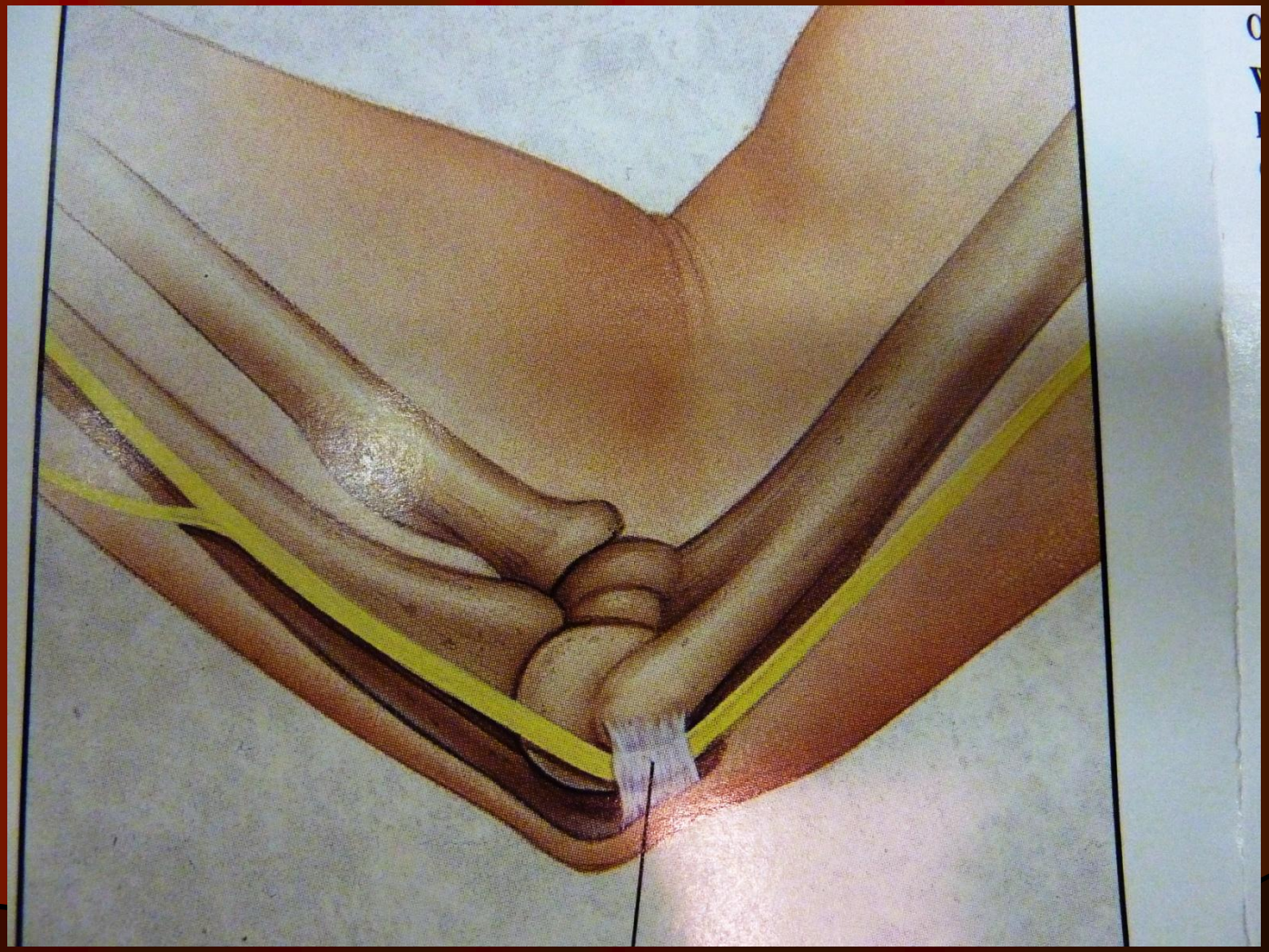
Nerve and Tendon Gliding Exercise



1. Hold each position for 7 seconds.
2. Perform each series of positions 5 times per day.

Electrodiagnostic Studies

Cubital tunnel anatomy



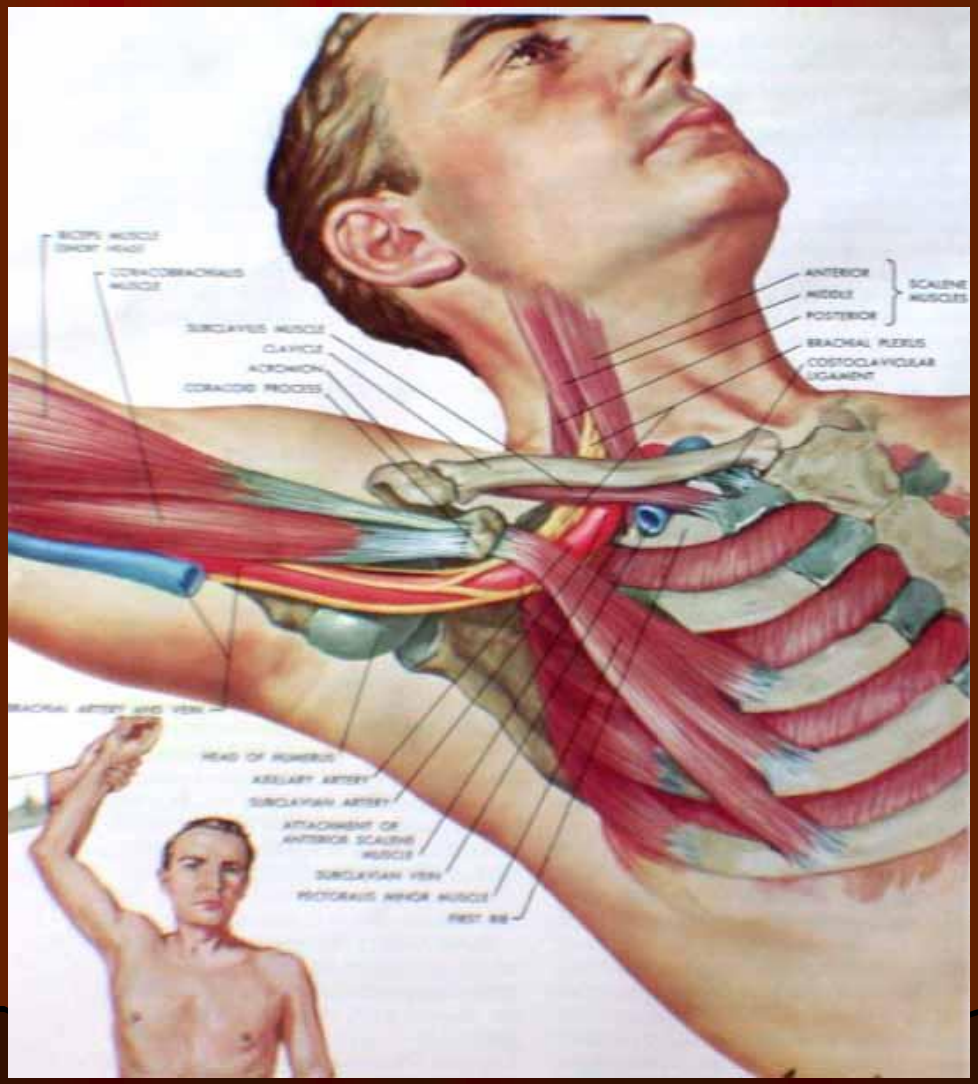
Cubital tunnel syndrome

- Entrapment of the ulnar nerve at the elbow
- Prolonged elbow flexion
- Numbness in the 4^{th} and 5^{th} fingers
- Weakness in the intrinsic muscles of the hand
- Shooting pain into the hand from the elbow
- Muscle atrophy in the hand--posturing

Management

- Night bracing in a long arm brace in 30° flexion
- Nerve gliding exercise
- Avoid prolonged elbow flexion postures
- Avoid repetitive elbow flexion/extension
- Avoid putting direct pressure on the elbow
- Surgery- ulnar nerve release/ transposition
- 75% can be treated non- operatively

Thoracic Outlet Syndrome



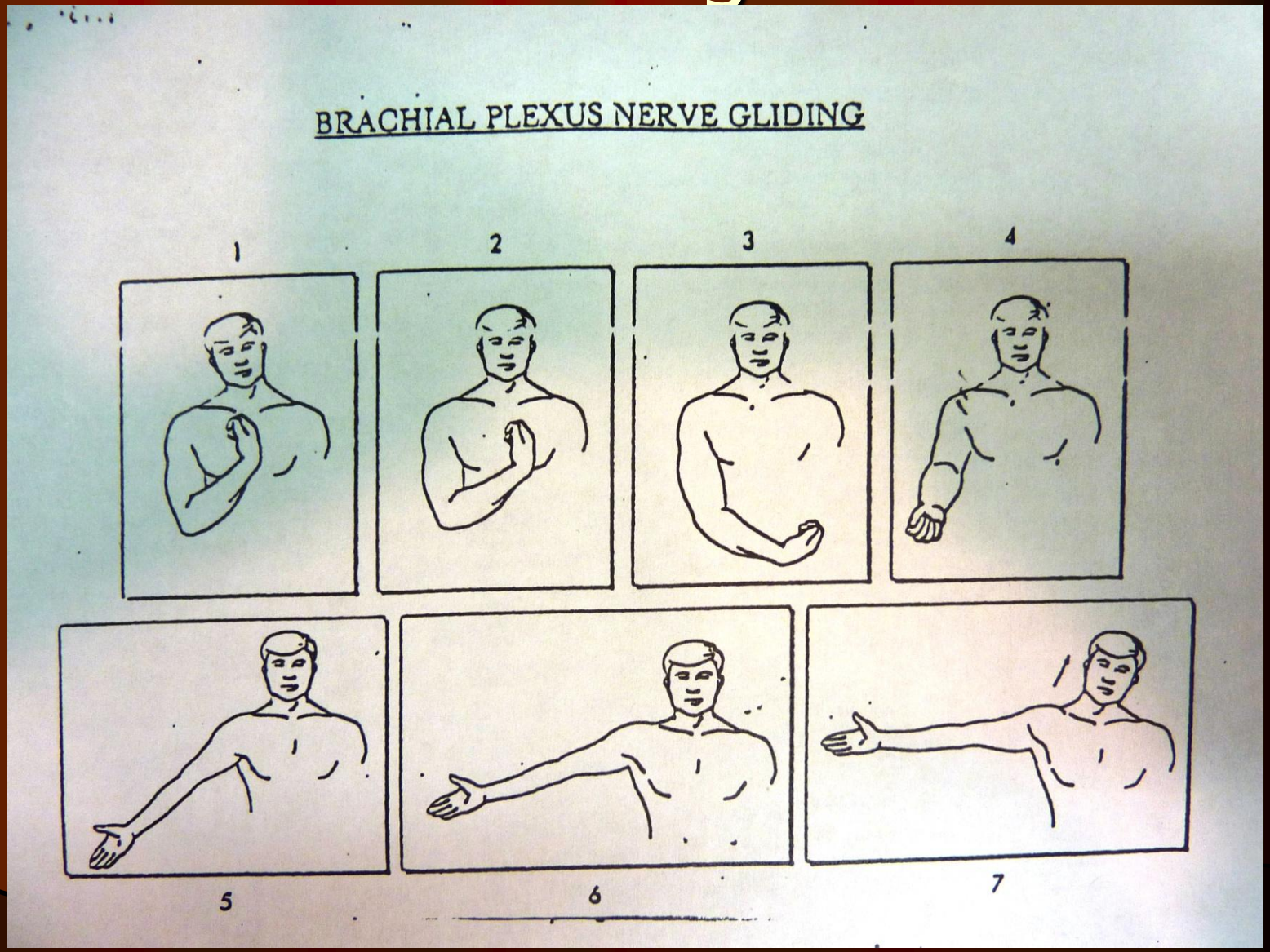
Thoracic outlet syndrome

- Compression of the nerves and arteries exiting from the chest and neck by the muscles at the side of te neck, collarbone ant the first rib
- More common in women with long necks and sagging shoulders, tight pectoral shoulders, tight neck muscles, collapsed chest posture.
- Double crush syndrome

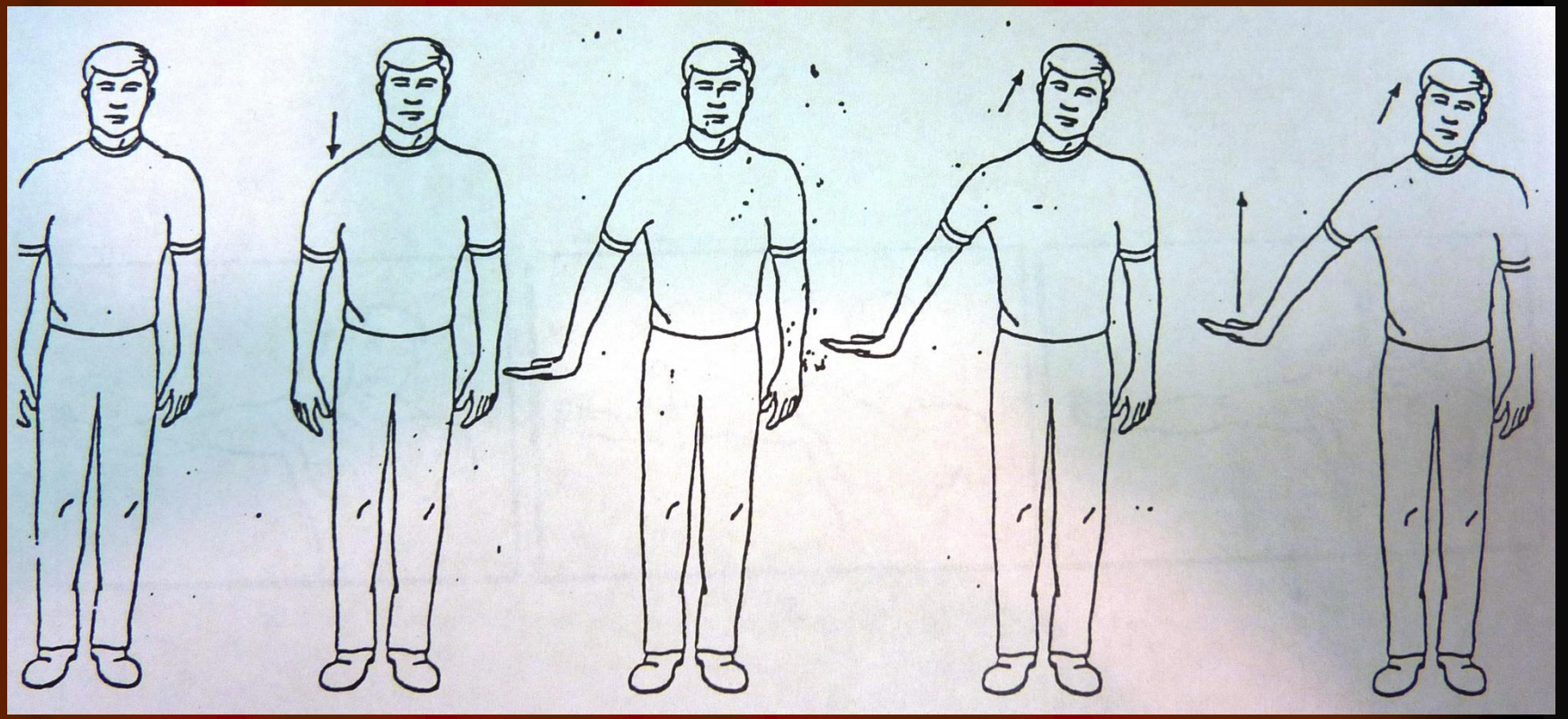
Thoracic Outlet Syndrome

- Common in people who have prolonged arm lifting postures
- Superficial breathing causing the scalene muscles to elevate the rib cage decreasing the space for the arteries and nerves
- Symptoms include whole arm pain, numbness and weakness in the hand skin color and temperature changes
- PT effective in > 90% the rest need resection of the first rib

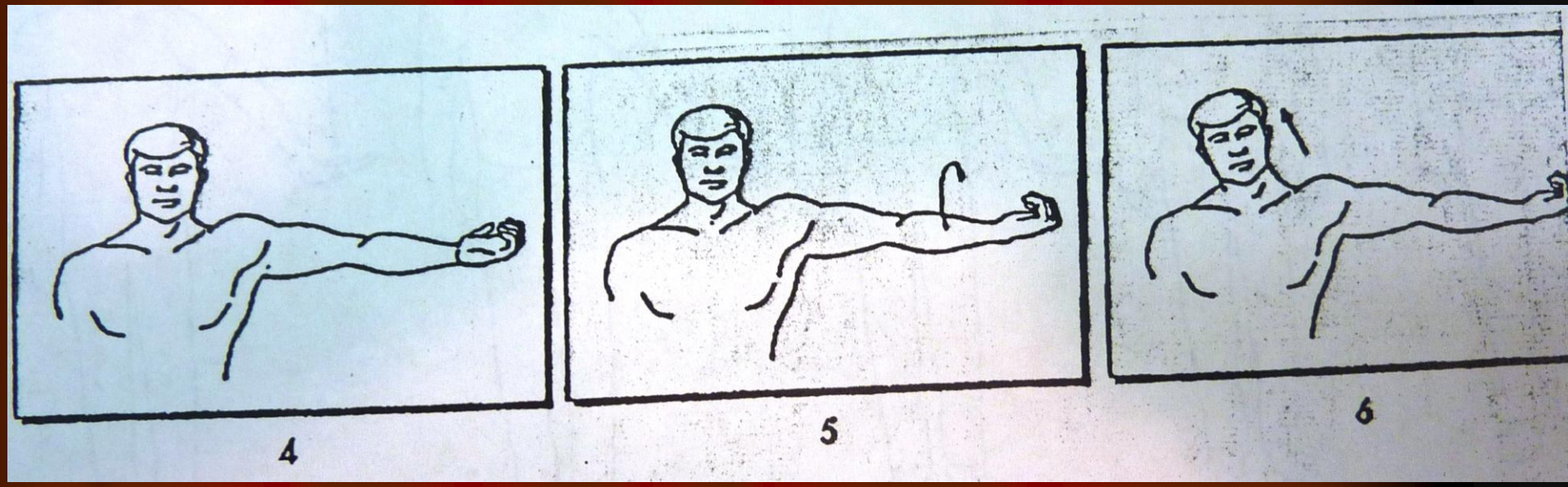
Arm nerve glides-1



Arm nerve glides-2



Arm nerve glides-3



Fibromyalgia

- “fibrosititis”. myofascial pain syndrome.
- Extremely common female> male x 10
- Trigger points involving muscles tendons ligaments up to 18
- Aching, stiffness, fatigue especially in am.
- Sleep disturbance
- Improper body mechanics
- Intramuscular “knotting” scarring with reduced blood flow

Fibromyalgia-2

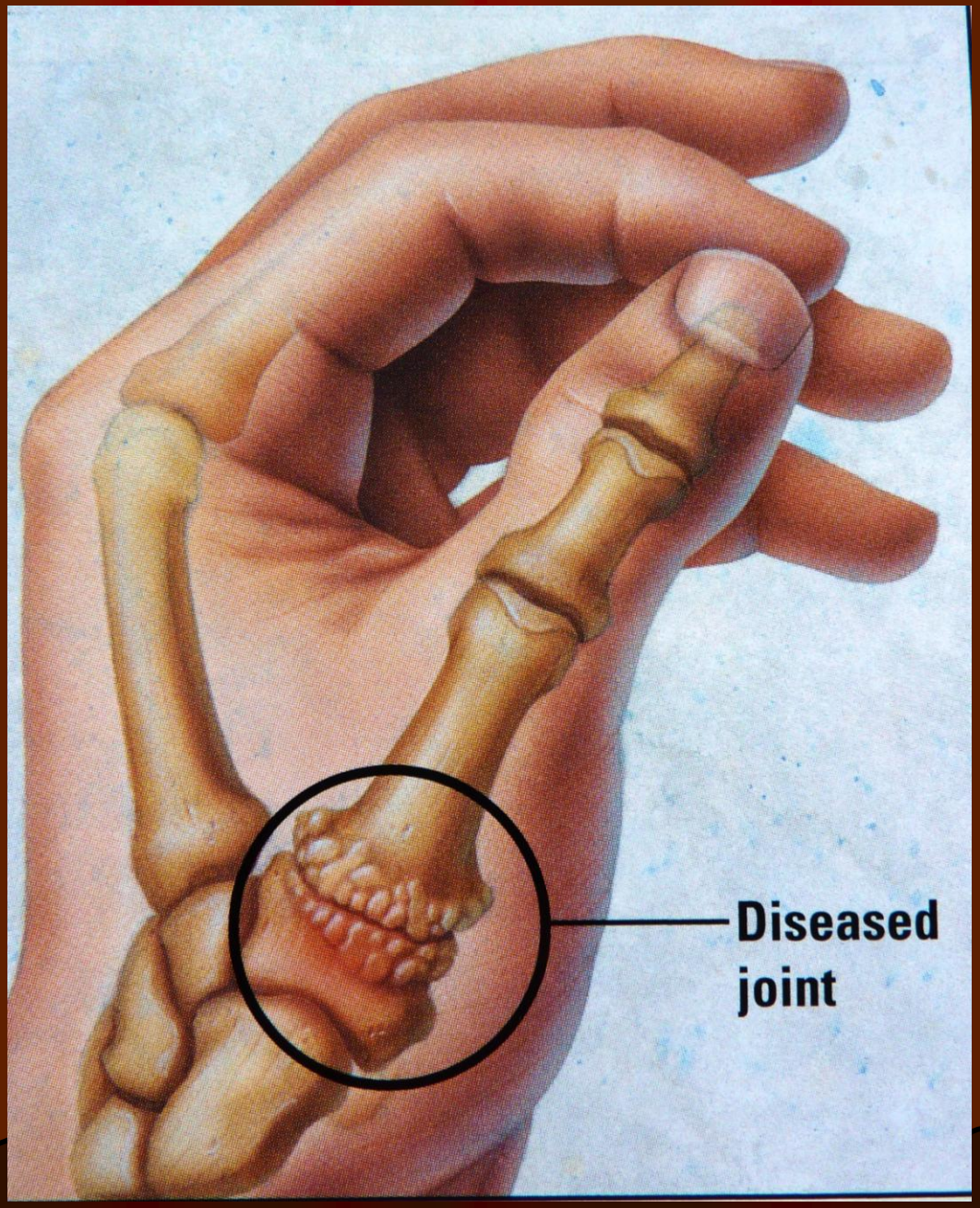
- Chronic pain worse with repetition,poor posture, stress, cold
- Not progressive, will not become arthritis
- Physical exam, labs are normal
- ?psychosomatic illness?

Fibromylagia management

- Lifestyle modification
- Aerobic exercise, yoga, massage (deep tissue…massage balls)
- Relaxation techniques—biofeedback
- Sympathetic therapy- E-stim
- Neurontin,Lyrica

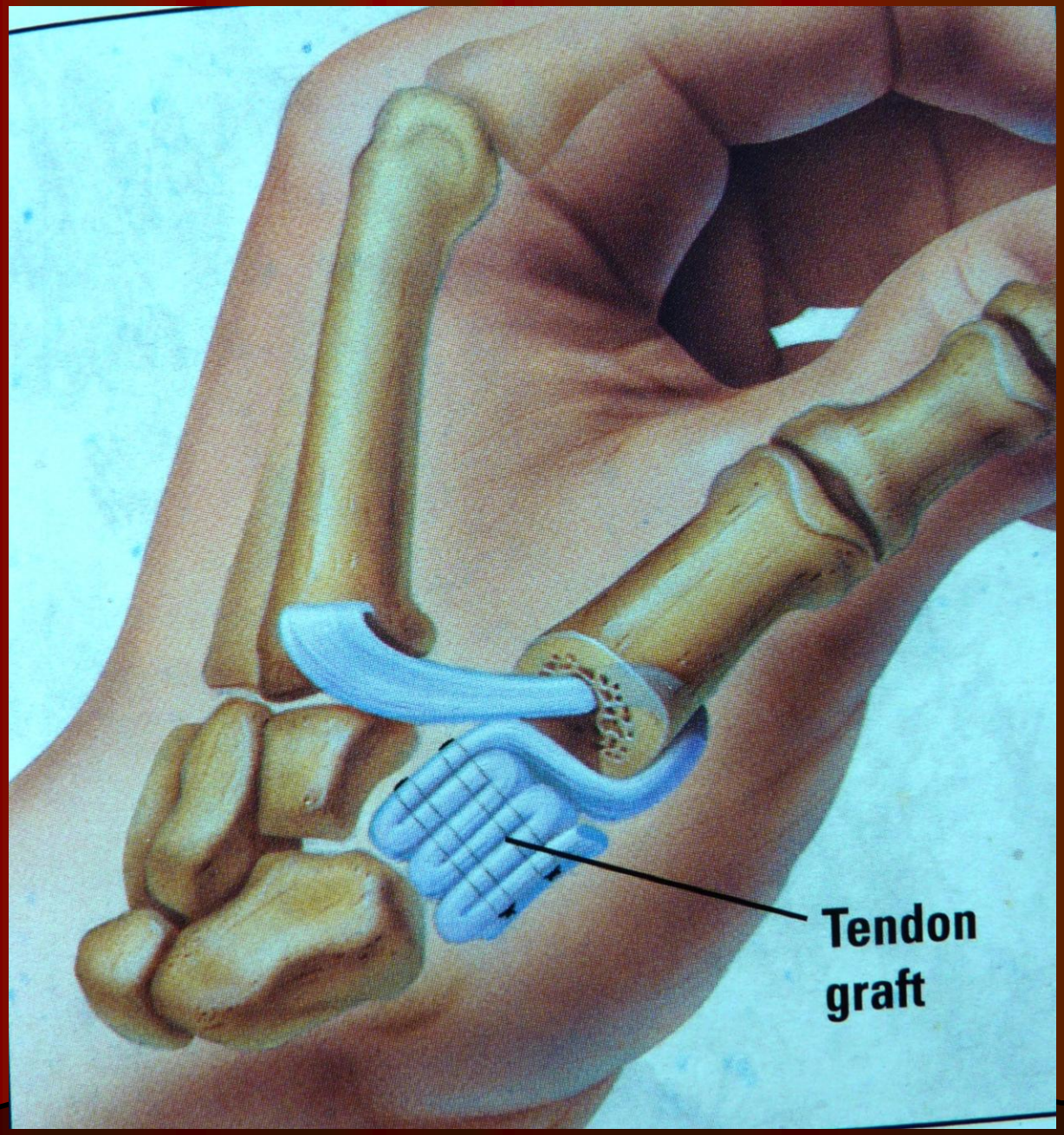
Thumb basal joint arthritis

- Osteoarthritis
- Presents in late 40's early 50's
- Pain, deformity, loss of strength, motion, dexterity
- "grinding" at the thumb base
- Progressive
- Loss of cartilage in the trapezium and ligament support at the metacarpal base

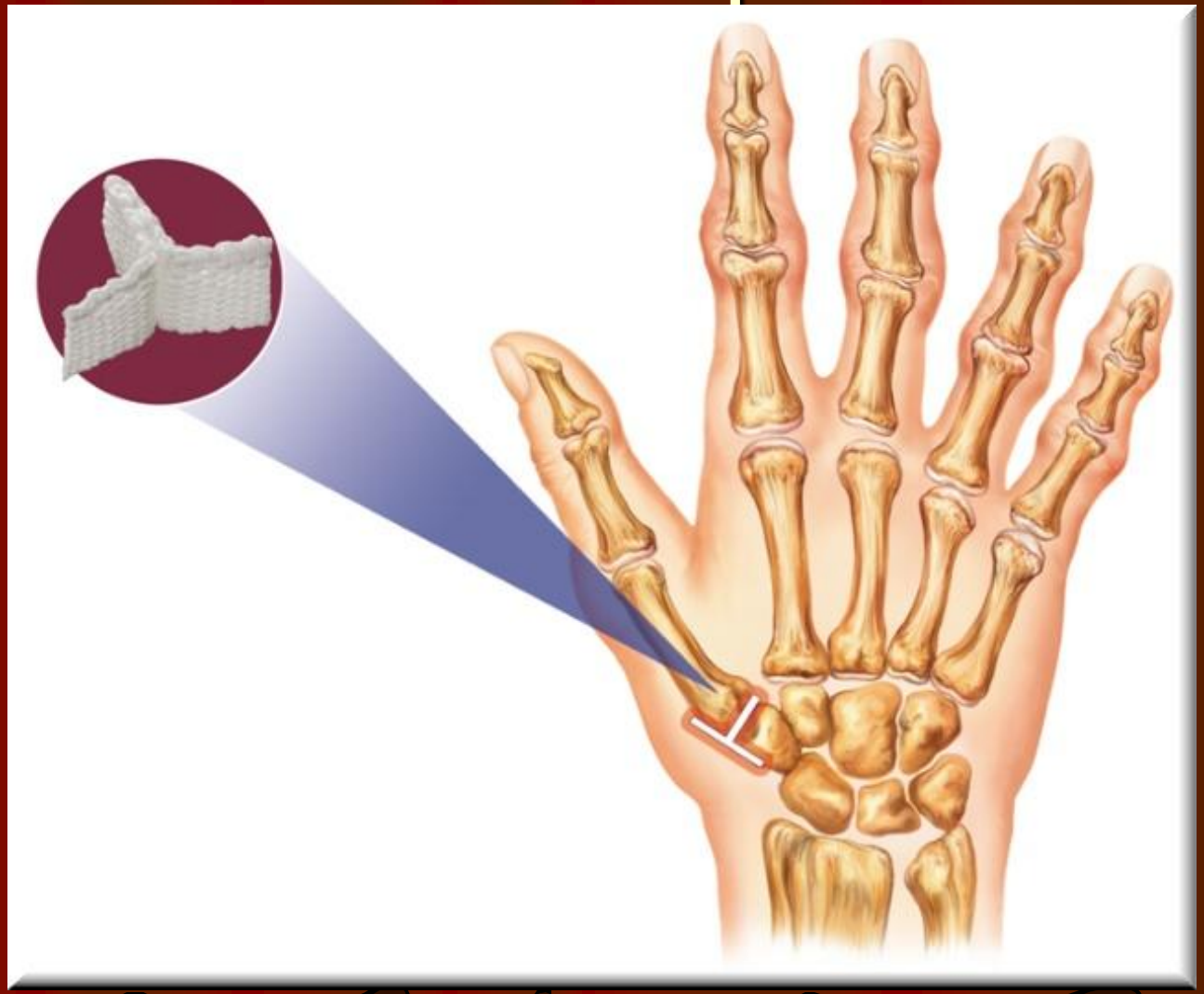

Diseased
joint

Basal Joint OA Management

- Early- NSAIDS, joint protection splinting, activity modification, contrast baths with ROM
- Steroid injection
- Surgery: Trapezectomy, interposition arthroplasty w/wo tendon transfer "Artelon" implants
- Early disease- Arthroscopy


Tendon
graft

Artelon implant

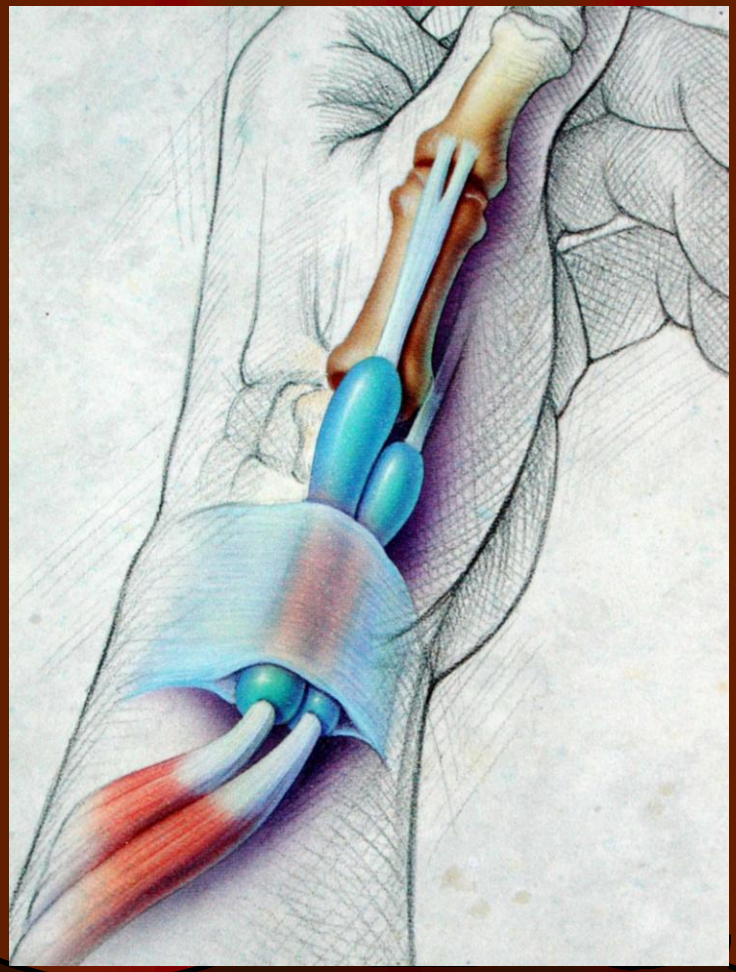


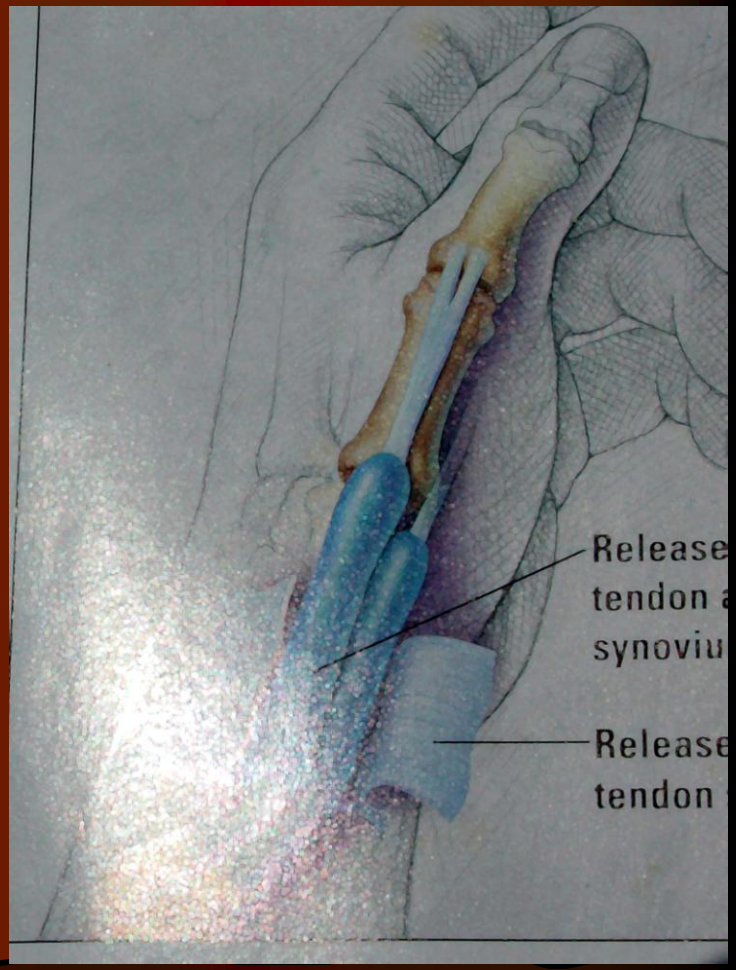
X-ray appearance

- Before surgery

- Post op

Dequervains Tenosynovitis

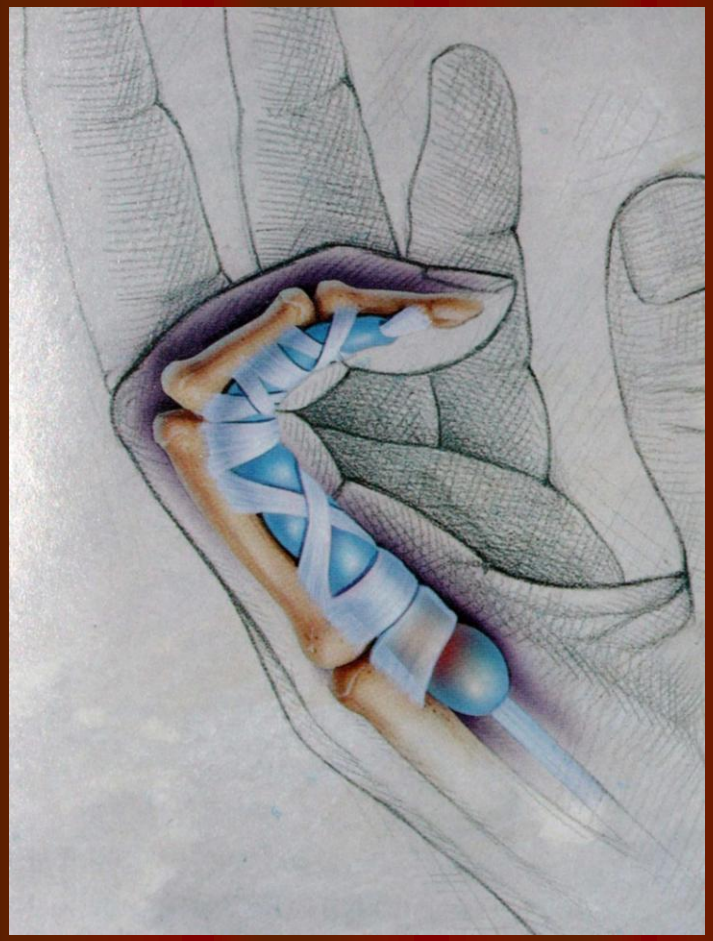




DeQuervain's tenosynovitis

- Progressive thumb sided wrist pain made worse with forceful thumb flexion
- Made worse by playing in ulnar deviation of the wrist (wide reaches)
- Steroid injection, braces, surgical release
- While playing the keyboard, minimize thumb angle under the hand when playing arpeggios if possible

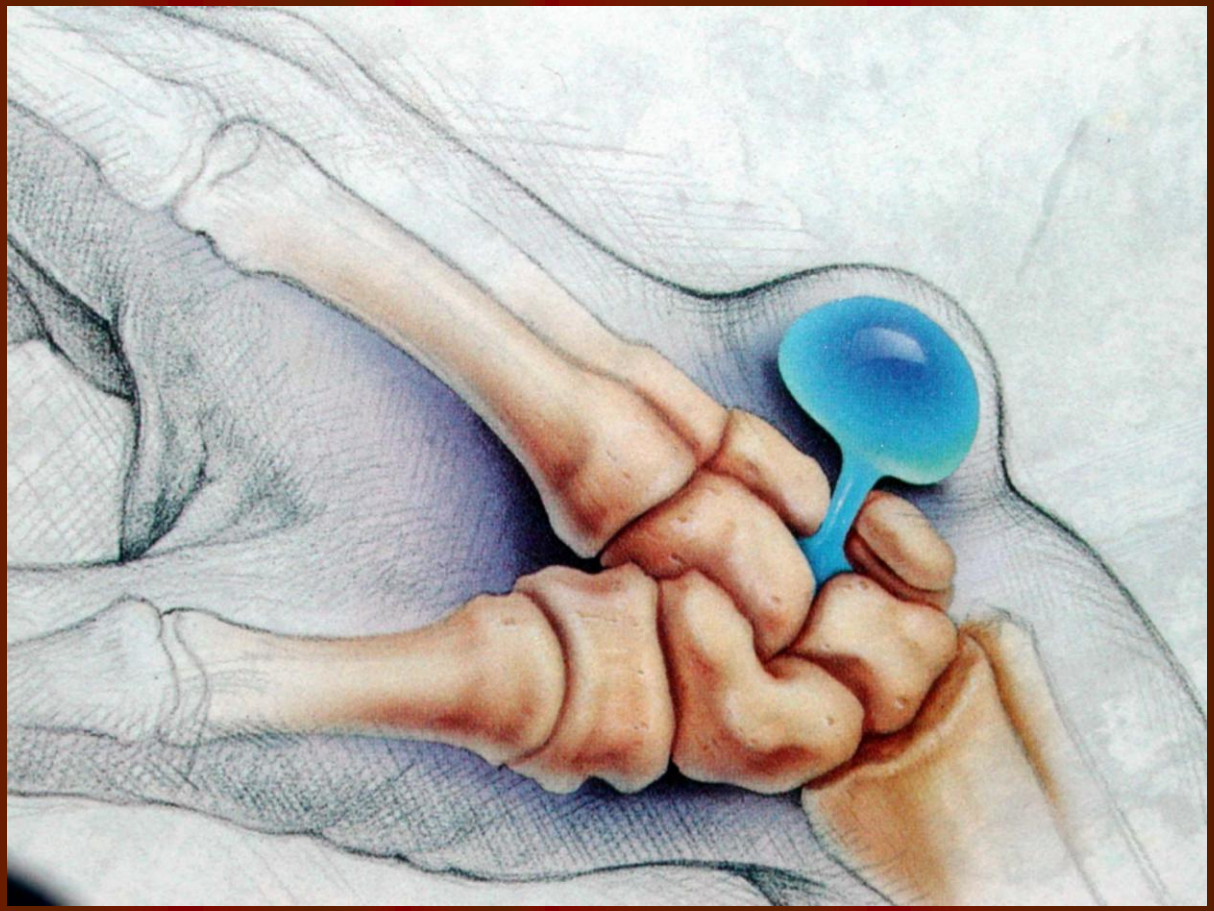
Trigger digits



Trigger digits

- Painful locking and popping when trying to flex and extend a finger or thumb
- Eventually fingers are stuck in one position
- More common in diabetics but cause really unknown
- Steroid injections 1 or 2
- Surgical release

Ganglion Cysts



Ganglion cysts

- Harmless mucous filled sacs that grow out of the wrist or finger joints or tendon sheaths
- Can cause wrist pain and weakness
- Aspiration common with high recurrence
- Surgery successful in about 90%

Nolan 1992 Med-art world congress

" the recurring tragedy among musicians are the inordinately longs periods of disability so often associated with easily correctable conditions…"

Technical notes

- The use of curved hand keyboard position reduces flexor tendon tensions and resultant force in finger joints
- Average force of keystrokes inversely proportional to playing experience
- Greater keyboard proficiency leads to effortless keyboard strike if the fundamentals are sound from an ergonomic viewpoint

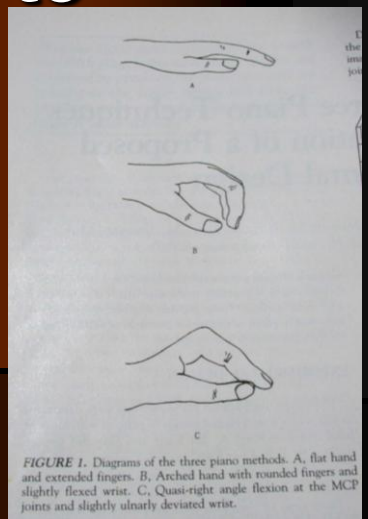


FIGURE 1. Diagrams of the three piano methods. A, flat hand and extended fingers. B, Arched hand with rounded fingers and slightly flexed wrist. C, Quasi-right angle flexion at the MCP joints and slightly ulnarly deviated wrist.

Knishkowy and Lederman 1986

- Thoracic outlet syndrome-1rst rib resected (2/9) improved
- Carpel tunnel syndrome (2/4) released, improved
- Ulnar neuropathy (1/3) released,improved
- Medial epichondylitis 1 improved but changed careers.

9 Professional musicians

- 7 chronic conditions
  - 5 returned to highest level of playing
  - 2 did not
- 2 acute conditions
  - both returned to highest level

Dawson 1990 MPPA

- 486 musicians
- 6-87 years old
- 52% male
- 48% female

End Results

- 66 Patients
- As symptomatic 88%
- Persistent difficulty 12%
- Complete return to play 79%
- Modified return/ no return 21%

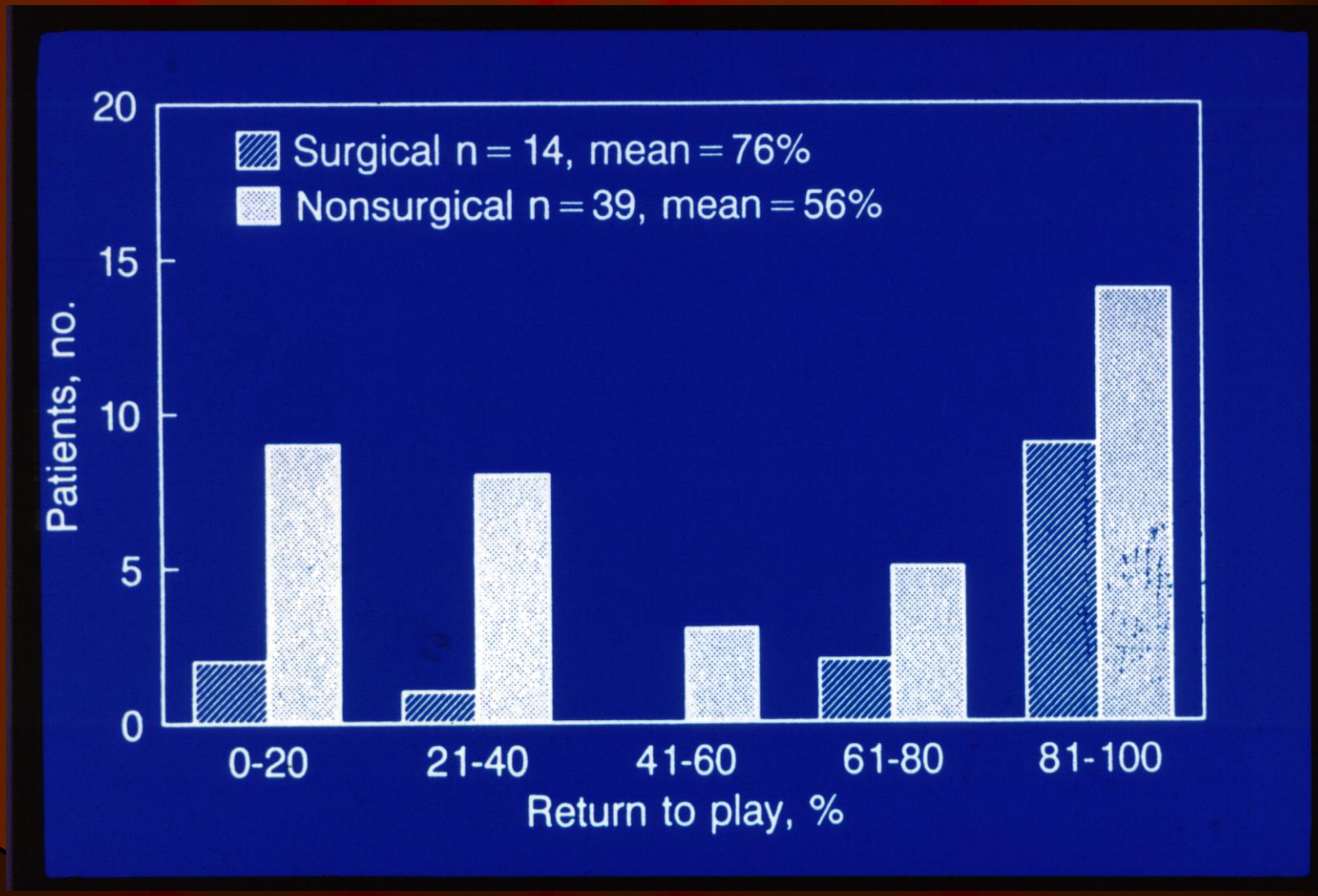
Poor prognosis/ long rehab time

- Late presentation
- Laceration
- joint contractures
- Nerve/ tendon injuries

Why is surgery usually a last resort?

- Many physicians and surgeons fail to see the benefits.
- Musicians think that they will be harmed by the surgery
- Musicians feel that surgeons are unfamiliar with their needs
- Fear of “losing control”

In general, surgery patients recover faster than non-surgical



Long term maintenance

- General conditioning
- Yoga
- Stress, Time management
- Repertoire, style change
- Ultimately, instrument or professional change

Thank You !