Prolotherapy 101

American Association of Orthopaedic Medicine
Workshop Coordinator: Andrew Kochan MD
March 2026 • Pensacola, Florida

Andrew Kochan, MD

- Nothing to disclose

Regenerative Medicine 101

- Review Theoretical Principles and Anatomy
- Assessment and Diagnosis
- Palpation and Marking and Structure
- Practice Management
  - Procedure-solutions and tools needed
  - Safety
  - Informed Consent
  - Documentation
  - Clinical Application
- Hands on practice for palpation, marking landmarks and osteopathic diagnosis

Regenerative Med. 101 Objectives

- Review Foundation Concepts and knowledge critical to developing a sound practice of regenerative medicine.
  - Biotensegrity
  - Healing Cascade
  - Musculoskeletal Anatomy
  - Introduction to Upper Extremity and Lower Extremity Assessment, Diagnosis, Palpation and Marking for Injection
  - Introduction to Head and Spinal Regenerative Medicine Practice and Principles
- Define: Regenerative Medicine, Orthopaedic Medicine, Regenerative Orthopaedic Medicine, Interventional Regenerative Orthopaedic Medicine, Prolotherapy, PRP, Stem Cells,

RM 101

- Several Definitions of Regenerative Medicine
  - **Regenerative medicine** is a branch of translational research[1] in tissue engineering and molecular biology which deals with the "process of replacing, engineering or regenerating human cells, tissues or organs to restore or establish normal function".[2] This field holds the promise of engineering damaged tissues and organs via stimulating the body's own repair mechanisms to functionally heal previously irreparable tissues or organs.[3]
  - The term "**regenerative medicine**" was first found in a 1992 article on hospital administration by Leland Kaiser. Kaiser's paper closes with a series of short paragraphs on future technologies that will impact hospitals. One paragraph had "Regenerative Medicine" as a bold print title and stated, "A new branch of medicine will develop that attempts to change the course of chronic disease and in many instances will regenerate tired and failing organ systems."[7][8]

NIH Definition

- Regenerative medicine is the process of creating living, functional tissues to repair or replace tissue or organ function lost due to age, disease, damage, or congenital defects. This field holds the promise of regenerating damaged tissues and organs in the body **by stimulating previously irreparable organs to heal themselves**. Regenerative medicine also empowers scientists to grow tissues and organs in the laboratory and safely implant them when the body cannot heal itself. Importantly, regenerative medicine has the potential to solve the problem of the shortage of organs available through donation compared to the number of patients that require life-saving organ transplantation.

Regenerative Medicine

- Noun: a branch of medicine studying the body's mechanisms for healing itself
  - http://www.dictionary.com/browse/regenerative-medicine

Orthopaedic Medicine

- Dr Cyriax, the “Father of Orthopaedic Medicine" developed the basics of a valuable diagnostic and therapeutic system, which is also subject to evolution. Some hypotheses have been refuted, others have been confirmed by qualitative research and others need more investigation. Several treatment techniques have been abandoned, others have been significantly improved.
- Modern Orthopaedic Musculoskeletal Medicine is a very strong diagnostic and therapeutic concept, which is an open vision system compatible with other views and approaches in the field of musculoskeletal medicine (e.g. McKenzie, Maitland, Mulligan). The concept of modern Orthopaedic Musculoskeletal Medicine provides a solid basis for all therapists who are involved in diagnosis and treatment of soft tissue lesions. http://www.cyriax.eu/

Orthopaedic Medicine

- The American Association of Orthopaedic Medicine was founded in 1983 by Paul Goodley MD and Kent Pomeroy MD who gathered physicians from the United States and Canada who had an interest in Orthopaedic Medicine, as an alternative to surgery. They saw the AAOM as an organization for the treatment of chronic pain and injury with manual medicine and non-surgical methods, including prolotherapy and other injection therapies.
- The founders realized that while there were several physician organizations which supported aspects of Orthopaedic Medicine, there was not a society specific to non-surgical Orthopaedic Medicine Physicians.

IROM

Interventional Regenerative Orthopaedic Medicine

Prolotherapy-Defined

- *noun* pro·lo·ther·a·py \ˌprō-lō-ˈther-ə-pē\
- Proliferative Injection Therapy (PIT)
- Regenerative Injection Therapy (RIT)
- "therapy for treating musculoskeletal pain that involves injecting an irritant substance (as dextrose) into a ligament or tendon to promote the growth of new tissue" (http://www.merriam-webster.com/medical/prolotherapy)
- Definition: Prolotherapy is injection whose primary intent is to repair connective tissue (that is, ligament, tendon or cartilage). The term Proli is Latin for "to grow." (http://www.aaomed.org/AAOM/files/ccLibraryFiles/Filename/000000000119/How-Injections-Work.pdf)

Core Concepts for Regenerative Medicine

- Biotensegrity
- Mechanotransduction
- Principles of Soft Tissue Healing

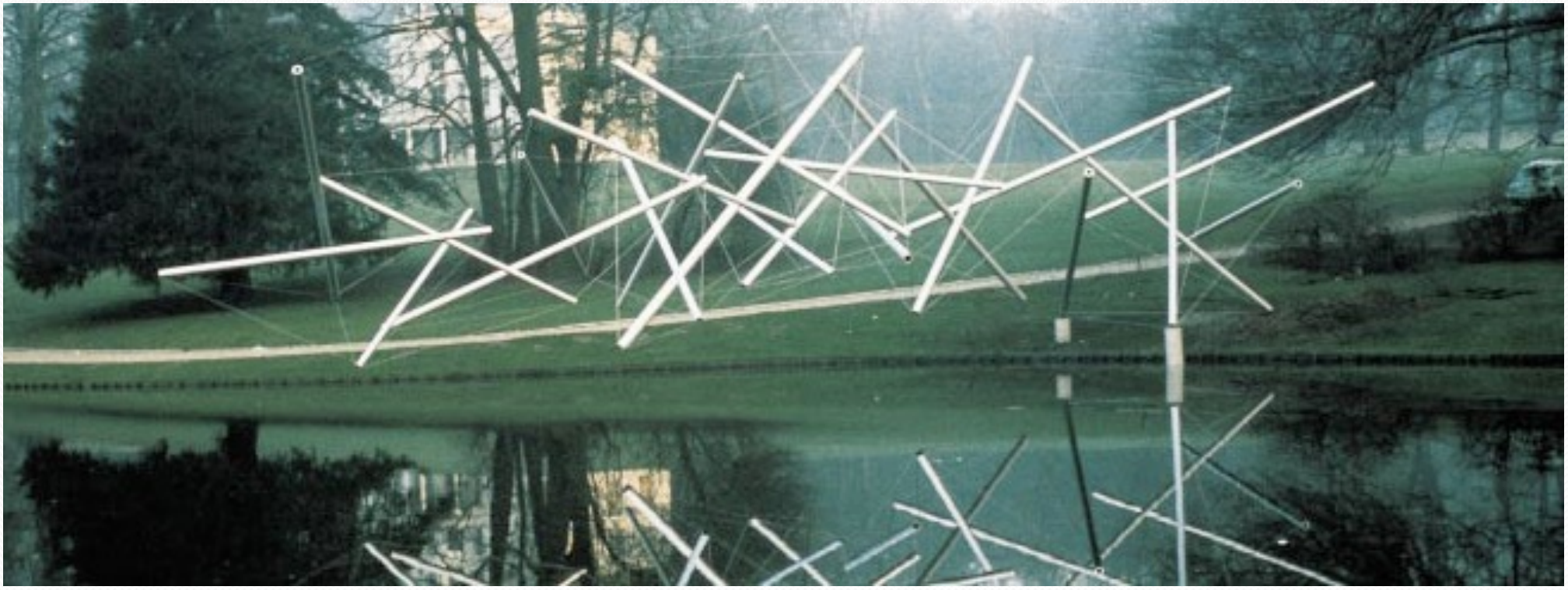
Buckminster Fuller on Tensegrity Structures

- Some brief clips from the "Lost Interviews" tapes with Buckminster Fuller, where Dr. Fuller discusses the nature of Tensegrity (or "Tensional Integrity") in structures.

- https://www.youtube.com/watch?v=7JwOX4PlO2A



K. Snelson





Stephen Levin MD

- Stephen Levin M.D., an orthopedic surgeon who coined the term biotensegrity has applied the principle to macro scale anatomy in papers and numerous lectures around the world for over 25 years. His vision of biomechanical biotensegrity is radical and comprehensive. (biotensegrity.com).

BIOTENSEGRITY

Dr. Stephen Levin:

"Tensegrity icosahedrons are used to model biologic organisms from viruses to vertebrates, their cells, systems and subsystems.

I regard the term "tensegrity" as conceived by R. Buckminster Fuller, who coined the term, and Kenneth Snelson, who first applied the mechanical principles to modern structures as an art form,

I have moved to the term 'biotensegrity' to consider tensegrity as a force vector concept as applied to biology.

There are only tension and compression elements in tensegrity systems**. There are no shears, bending moments or levers, just simple tension and compression, in a self organizing, hierarchical, load distributing, low energy consuming structure."**

- **http://www.biotensegrity.com/**

Donald Ingber

- Tensegrity and Mechanotransduction
- Donald E. Ingber MD PhD, Professor of Pathology at the Harvard Medical School, has done cellular research that has been widely reported in major scientific journals as well in Scientific American, The Architecture of Life, January 1998. He has found conclusive evidence that tensegrity provides the best explanation for the cytoskeleton of the cell, its movement and behavior.

Donald Ingber

- What does tensegrity have to do with the human body? The principles of tensegrity apply at essentially every detectable size scale in the body. At the macroscopic level, the 206 bones that constitute our skeleton are pulled up against the force of gravity and stabilized in a vertical form by the pull of tensile muscles, tendons and ligaments (similar to the cables in Snelson's sculptures). In other words, in the complex tensegrity structure inside every one of us, bones are the compression struts, and muscles, tendons and ligaments are the tension-bearing members. At the other end of the scale, proteins and other key molecules in the body also stabilize themselves through the principles of tensegrity.

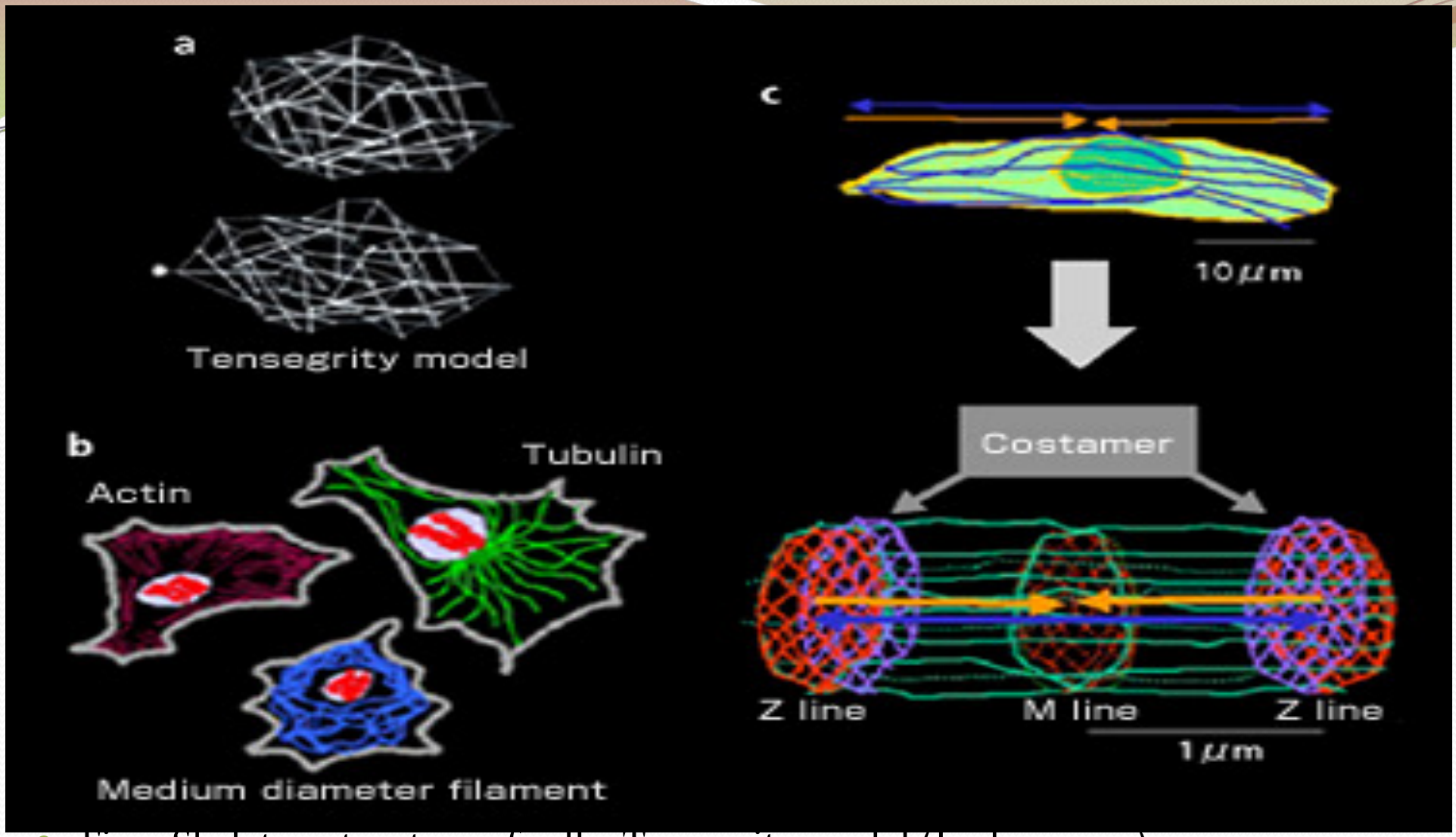
http://time.arts.ucla.edu/Talks/Barcelona/Arch_Life.htm

Donald Ingber on Tensegrity Architecture and Cell Structure

- This clip is from Dr. Donald Ingber's talk on "The Relevance of Tensegrity Architecture for Biology and Medicine" at the Synergetics Collaborative Fall 2005 Symposium on "Synergetics in the Arts" at the Noguchi Museum. Donald talks about how cell structure is inherently built on the principles of tensegrity.

- https://www.youtube.com/watch?v=AT5fsO95-qg

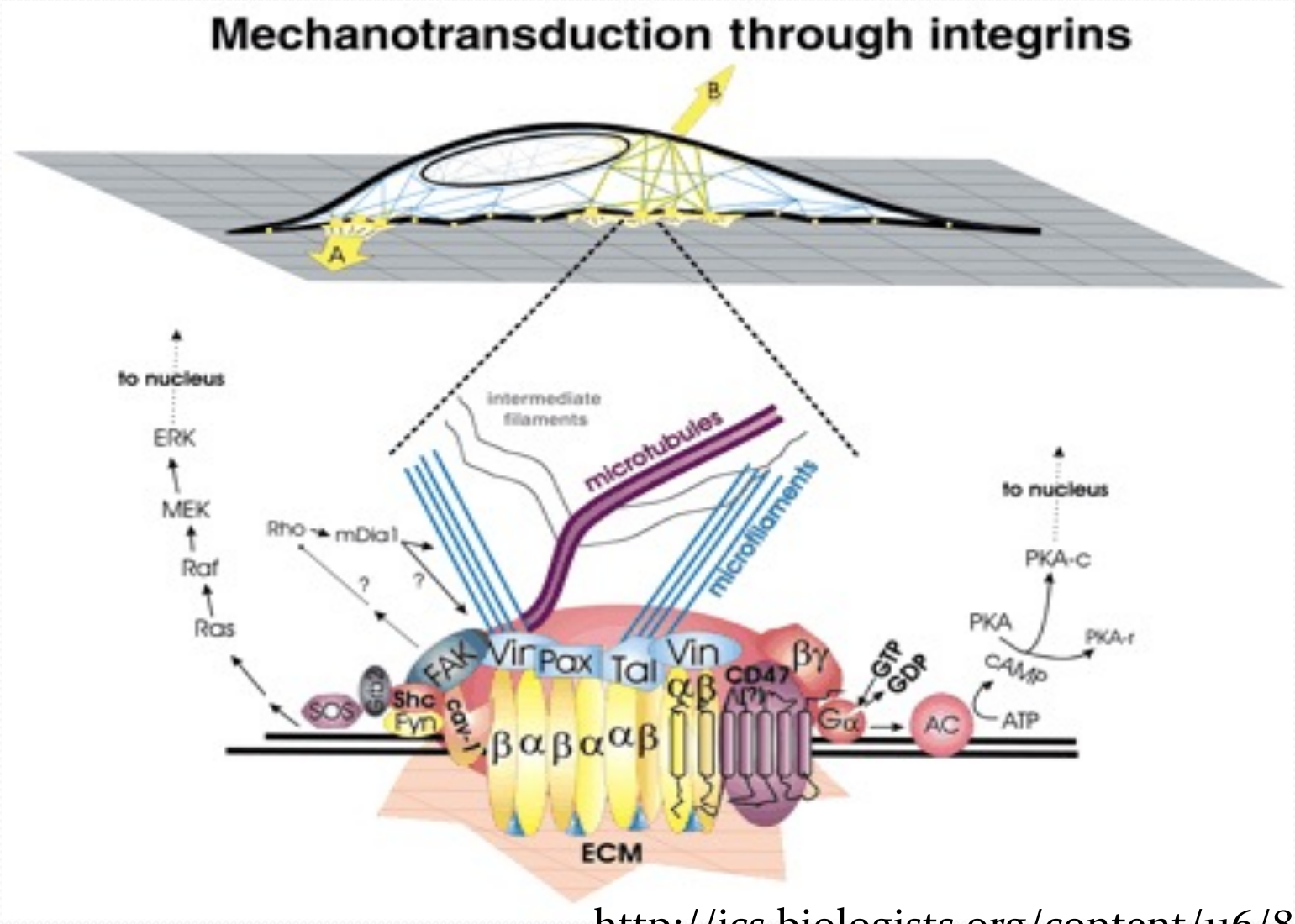
- Others such as Tom Myers, well known writer and teacher of Structural Integration (http://www.anatomytrains.us/),
- and George Roth a writer and chiropractor from Toronto (http://www.matrixinstitute.net/)
- both use the term in helping explain their practice and methodology but the usage is general and mostly metaphoric.
- http://www.intensiondesigns.com/geometry_of_anatomy.html



- Fig. 1 Skeleton structure of cella: Tensegrity model (Ingber, 1997)
  b: Three cytoskeletons
  c: Remodeling of cytoskeleton from myoblast to muscle fiber (cytoskeleton structure to produce sarcomere)
- http://www.isas.jaxa.jp/e/forefront/2004/atomi/

How structural networks influence cellular information processing networks Donald E. Ingber

Journal of Cell Science 2003 116: 1397-1408; doi: 10.1242/jcs.00360



http://jcs.biologists.org/content/116/8/1397

Mechanotransduction-part of the healing process

- How the body sends out information to stimulate the healing processes
- Effect of the needle on tissues – mechanical, injury, pressure
- Effect of the solutions used-chemical, physical pressure, stretch
- Chemotaxis

Biotensegrity-mechanotransduction-soft tissue healing

- Definition of Wound Healing
- Phases of Healing
- Mediators of Healing
- Factors Affecting the Healing Process
- “Stalled Wound Healing”

DEFINITION – wound healing

- Response of an organism to a physical disruption of a tissue/organ with an aim to repair or reconstitute the defect and to re-establish homeostasis.
- Can be achieved by 2 processes: scar formation & tissue regeneration.
- Dynamic balance between these 2 is different in different tissues.

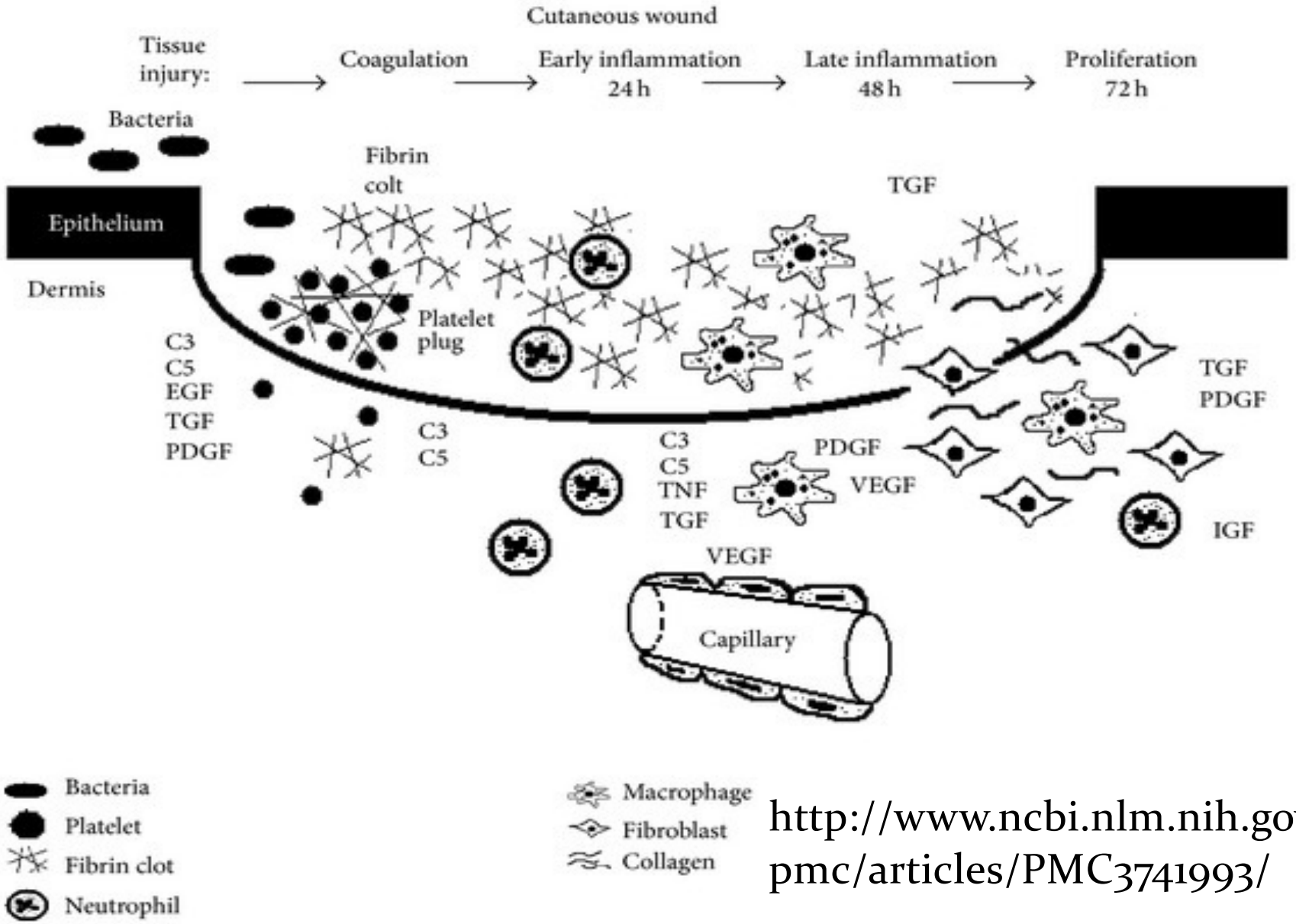
http://www.slideshare.net/sumeryadav/wound-healing-dr-sumer

Wound Healing

- Wound healing is a complex pathway of regulated reactions and cellular infiltrates. Normal wound healing is a dynamic series of events involving the coordinated interaction of blood cells, proteins, proteases, growth factors, and extracellular matrix components. The wound healing process can be divided into three phases:
- (1) inflammatory phase;
- (2) proliferative phase; and
- (3) maturational phase.

- Although different predominant cells characterize these three phases at differing times, a considerable amount of overlap can occur.
- Plast Surg Int. 2013; 2013: 146764.
- Published online 2013 Jul 24. doi: 10.1155/2013/146764
- The three phases of wound healing are associated with different growth factors and subsequent cellular infiltration. Various cytokines and complements are involved in the inflammatory phase.

Cutaneous wound healing in time



http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3741993/

Macrophage	Activities During Wound Healing
Activity	Mediators
Phagocytosis	Reactive oxygen species Nitric oxide
Débridement	Collagenase, elastase
Cell recruitment and activation	Growth factors: PDGF, TGF-, EGF, IGF Cytokines: TNF-, IL-1, IL-6 Fibronectin
Matrix synthesis	Growth factors: TGF-, EGF, PDGF Cytokines: TNF-, IL-1, IFN- Enzymes: arginase, collagenase Prostaglandins Nitric oxide
Angiogenesis	Growth factors: FGF, VEGF Cytokines: TNF- Nitric oxide

http://www.slideshare.net/sumeryadav/wound-healing-dr-sumer

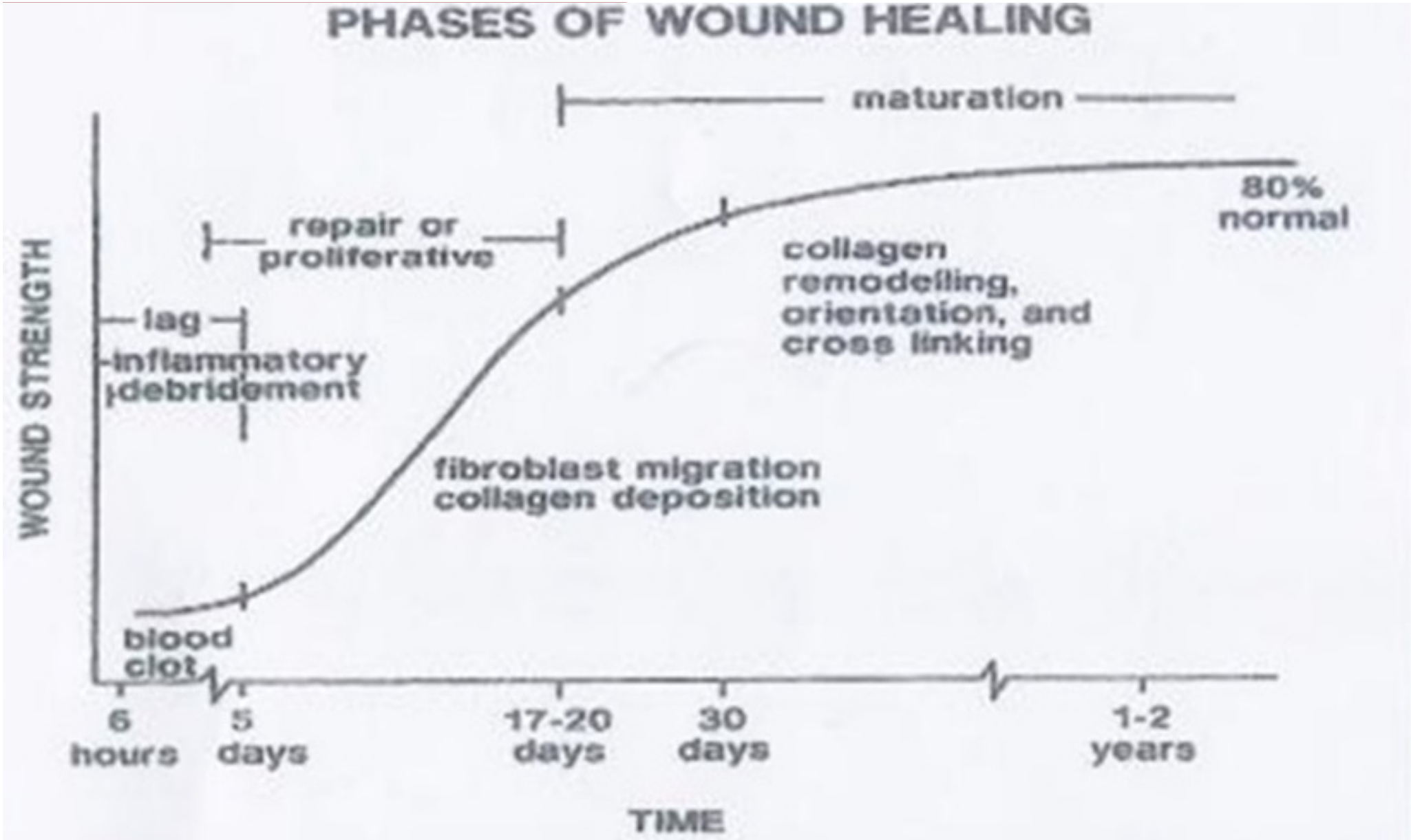
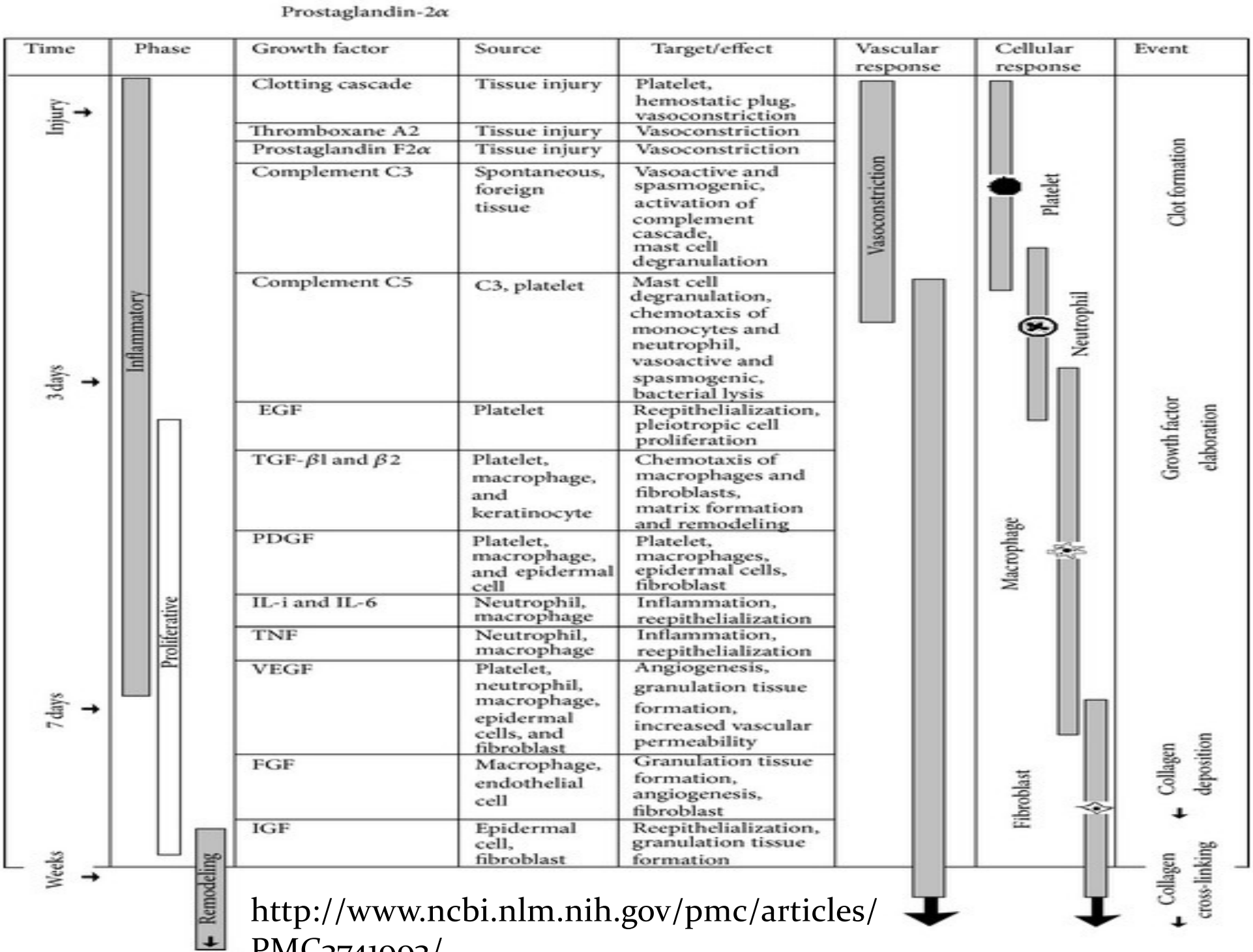
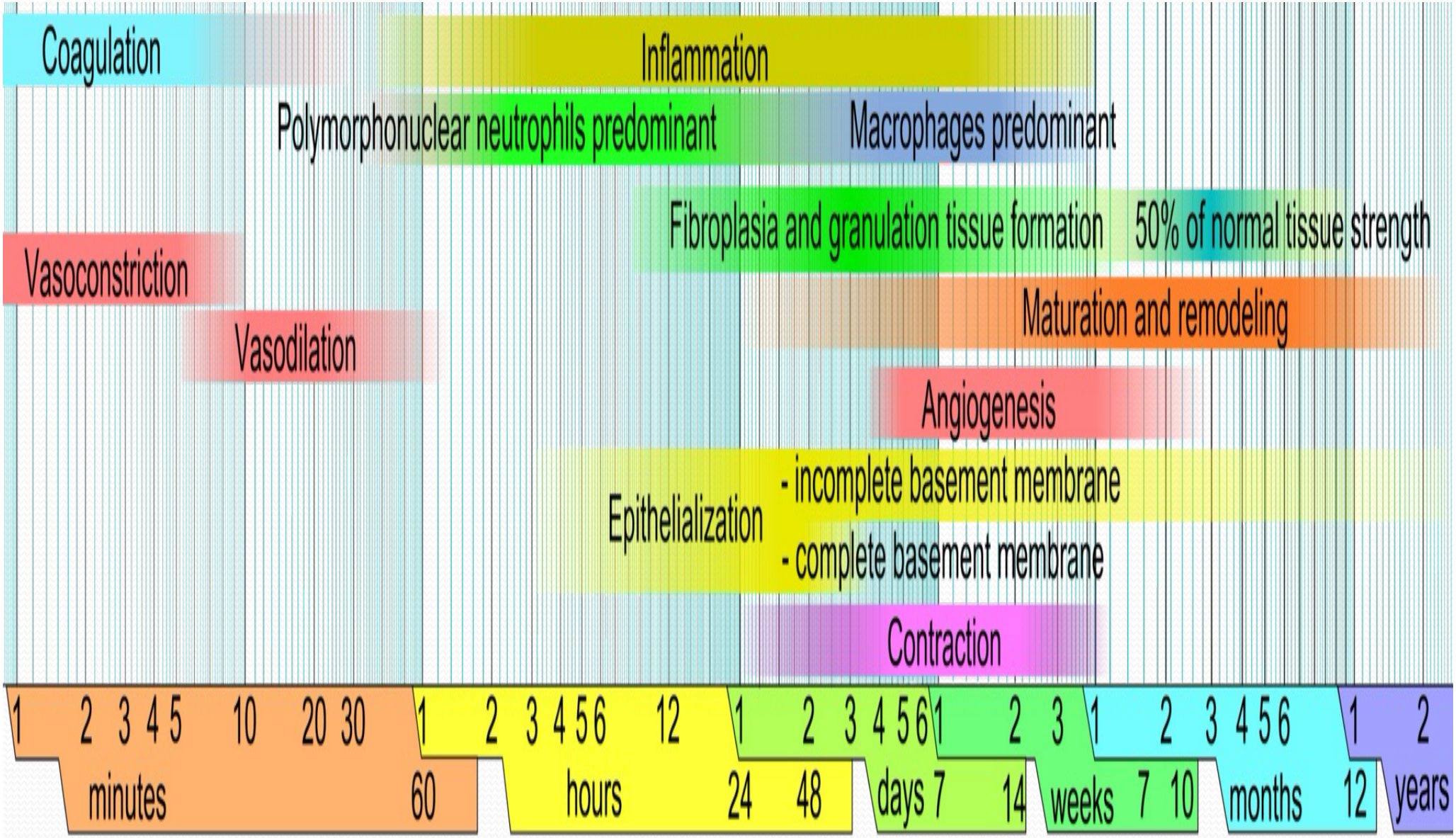


Figure 4–4. Changes in wound strength during the phases of wound repair. Note that the time axis is not to scale. (From Hosgood G, Burba DJ: Wound management and bandaging. *In* McCurnin DM [ed]: *Clinical Textbook for Veterinary Technicians*, 4th ed. WB Saunders, Philadelphia, 1998, p 477.)

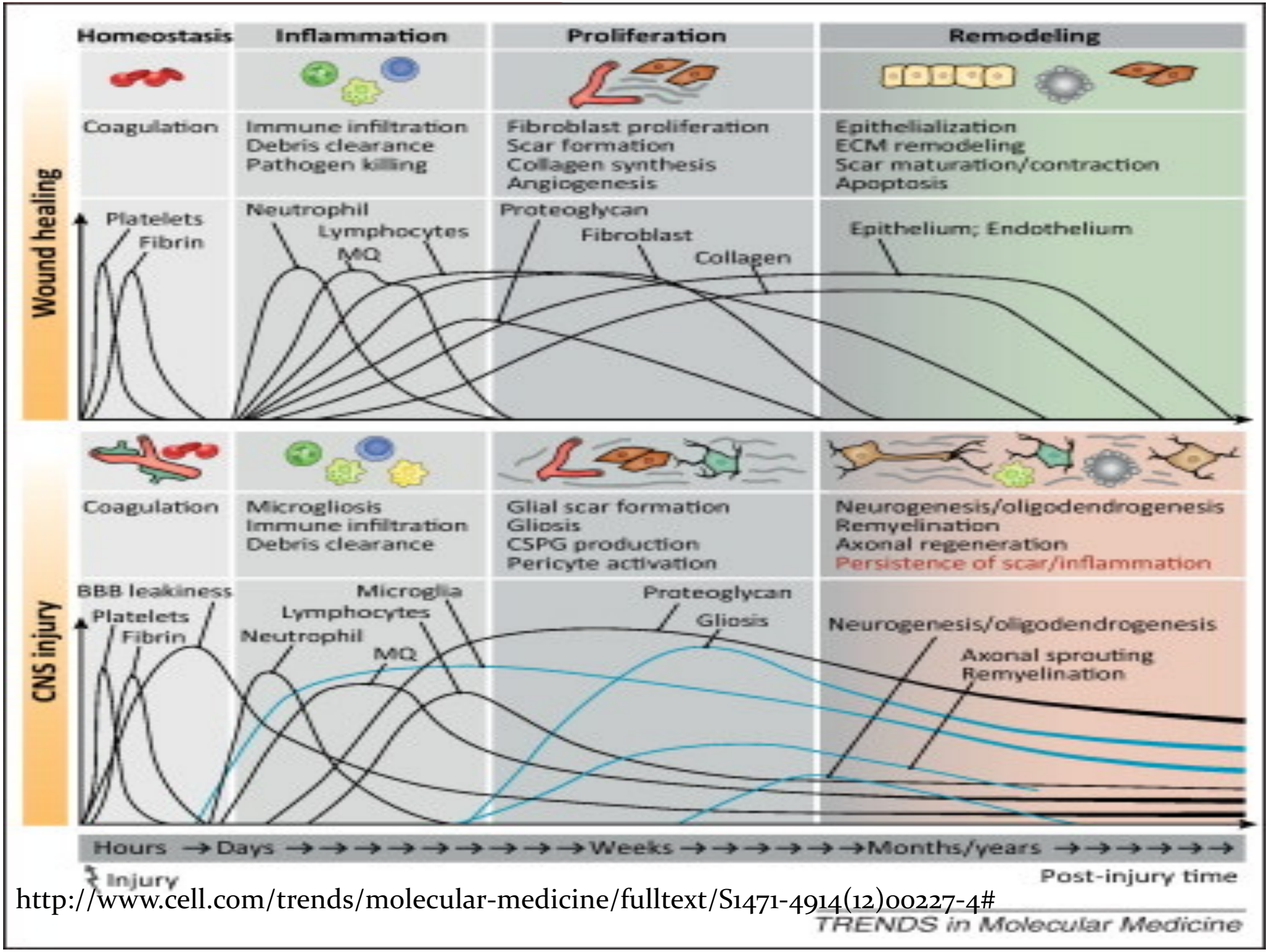


http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3741993/

Wound healing phases



https://en.wikipedia.org/wiki/Wound_healing#/media/File:Wound_healing_phases.png



http://www.cell.com/trends/molecular-medicine/fulltext/S1471-4914(12)00227-4#

Factors that affect the healing process

Table 1 - Local and systemic factors that affect the healing process

Factors that influence healing	
Local	**Systemic**
Type, size and location	Circulatory conditions
Vascular supply	Systemic infections
Infection	Metabolic changes
Movement	Malnutrition
Ionizing radiation – X-rays, radiotherapy	Hormones
Ultraviolet light	Immunosuppression

http://www.scielo.br/pdf/jvb/v6n3/v6n3a09.pdf

The "stalled wound"

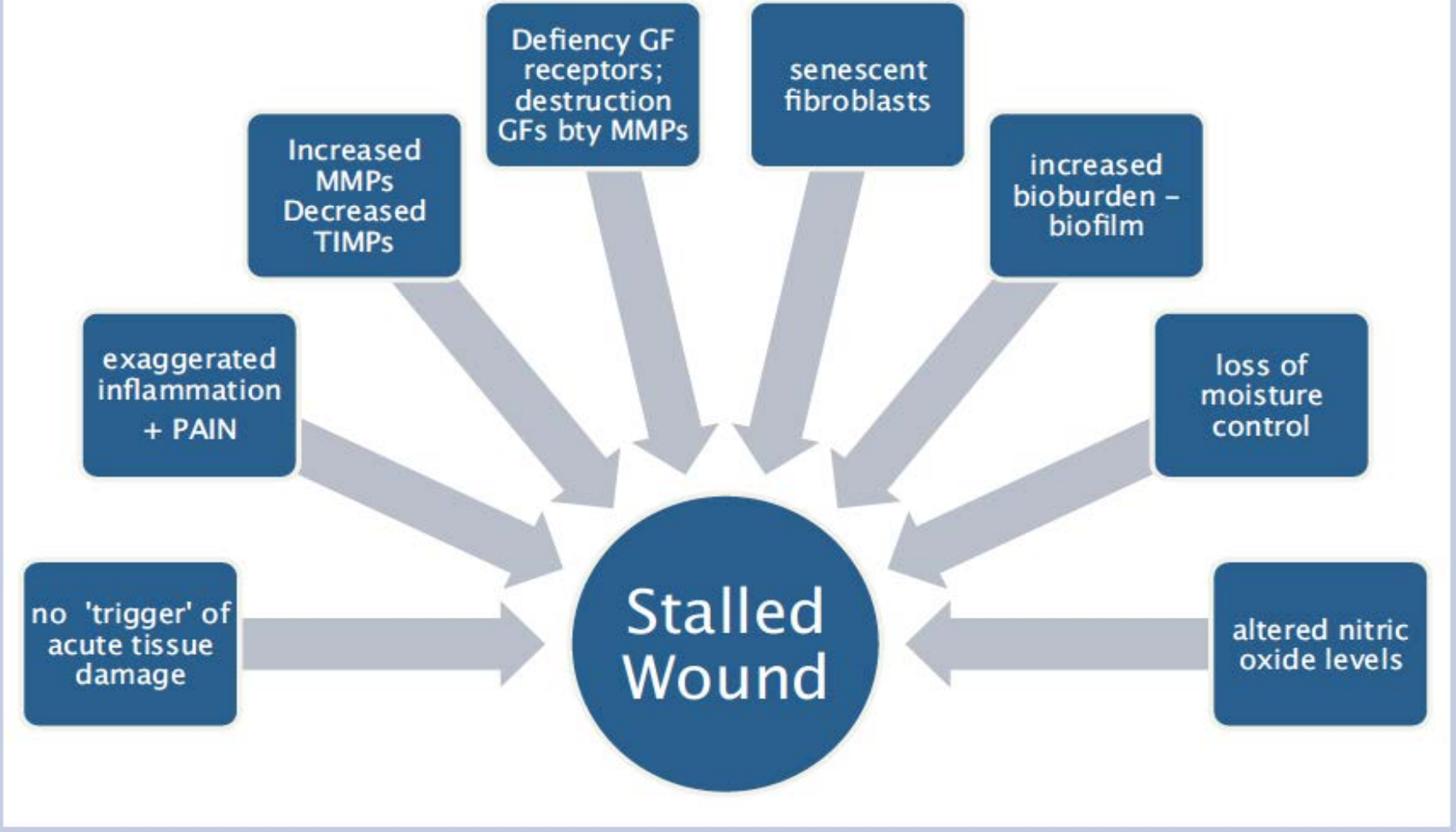


Figure 1. Schematic representation of the physiologic factors contributing to a stalled wound.

WOUNDS. 2012;24(3):58–66.

http://www.woundsresearch.com/article/deconstructing-stalled-wound

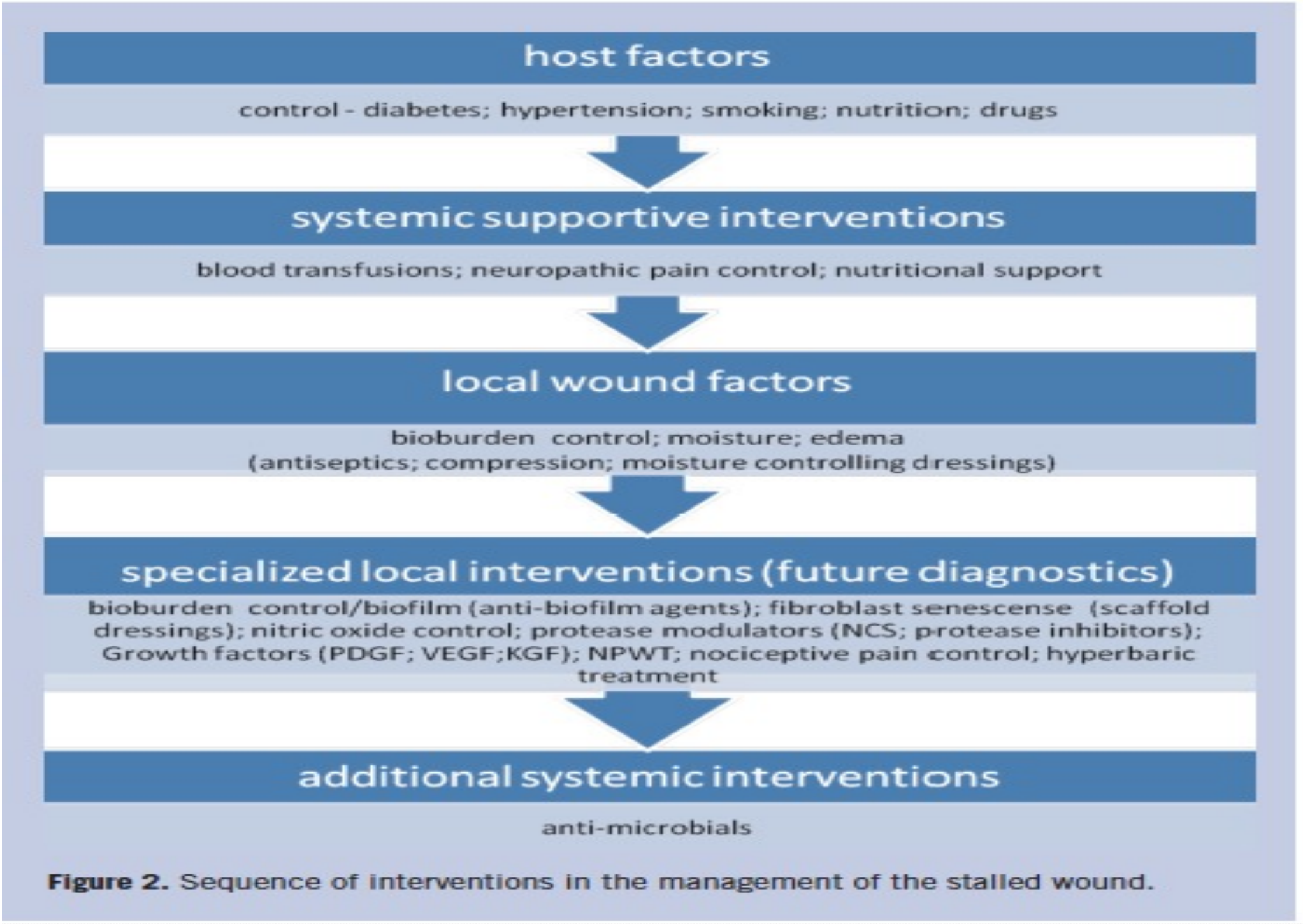


Figure 2. Sequence of interventions in the management of the stalled wound.

Regenerative Medicine

Prolotherapy/PRP/Stem Cells

A method to get out of the “stalled wound” status

Tools of Regenerative Medicine

- Prolotherapy
- Platelet Rich Plasma
- Stem Cells
- Peripheral Nerve Injections
- Fascial Injections
- Trigger Point Injections
- Scar treatments
- Neural Therapy
- Mesotherapy
- Prolozone

Regenerative Medicine

- **An evolving science and medical discipline**

Prolotherapy

- Diagnosis, Diagnosis, Diagnosis
- Anatomy knowledge-visualize the anatomy through your hands
- Palpation Skills
- Solutions and needles
- Safety and Complications

How do you make a Diagnosis?

- Start with history- when, how, what has been done, what are the symptoms now and where does it hurt.
- Physical examination- Flexion, extension, side bending, rotation, SLR, pelvic leveling and leg length, pelvic landmarks prone, tenderness of the iliac crest, spine, sacrum and attached ligaments
- Anatomy is king. You never quit learning it.

To Make a Diagnosis

- History and physical first.
- Radiologic- X-rays are helpful to access the degree of arthrosis and instability.
- MRI- You can see many things on an MRI that will never be clinically relevant and can send you off in irrelevant directions. I don't order one unless I'm ready send the patient to a surgeon/or documentation is required for medicolegal reasons- workman's compensation, MVA, disability.

Diagnostic and Therapeutic Blocks

- Can prove the location of the pain generator to you, the patient, the referring doctor, and the ins. co.
- Helps to define the universe of possible interventions for the pain (and what isn't a possible treatment)
- Prior to more aggressive or costly care
- After a long history of incomplete, inappropriate or just plain ineffective care
- Helps to silence the "noise" of the MRI findings

Structure and Function Relationships

- An understanding of structure and function relationships is essential to diagnosing the problem.
- The site of the patient's complaint of pain, is not always the source of the problem.
- Example: The fibula is a joint stabilizer for the hip and low back. If the patient is complaining of anterior hip capsule pain and contralateral shoulder pain, look at the fibular head and the ankle on the side of the hip pain.
- You must always assess above and below the area of concern.

Dermatomes, Myotomes and Sclerotomes

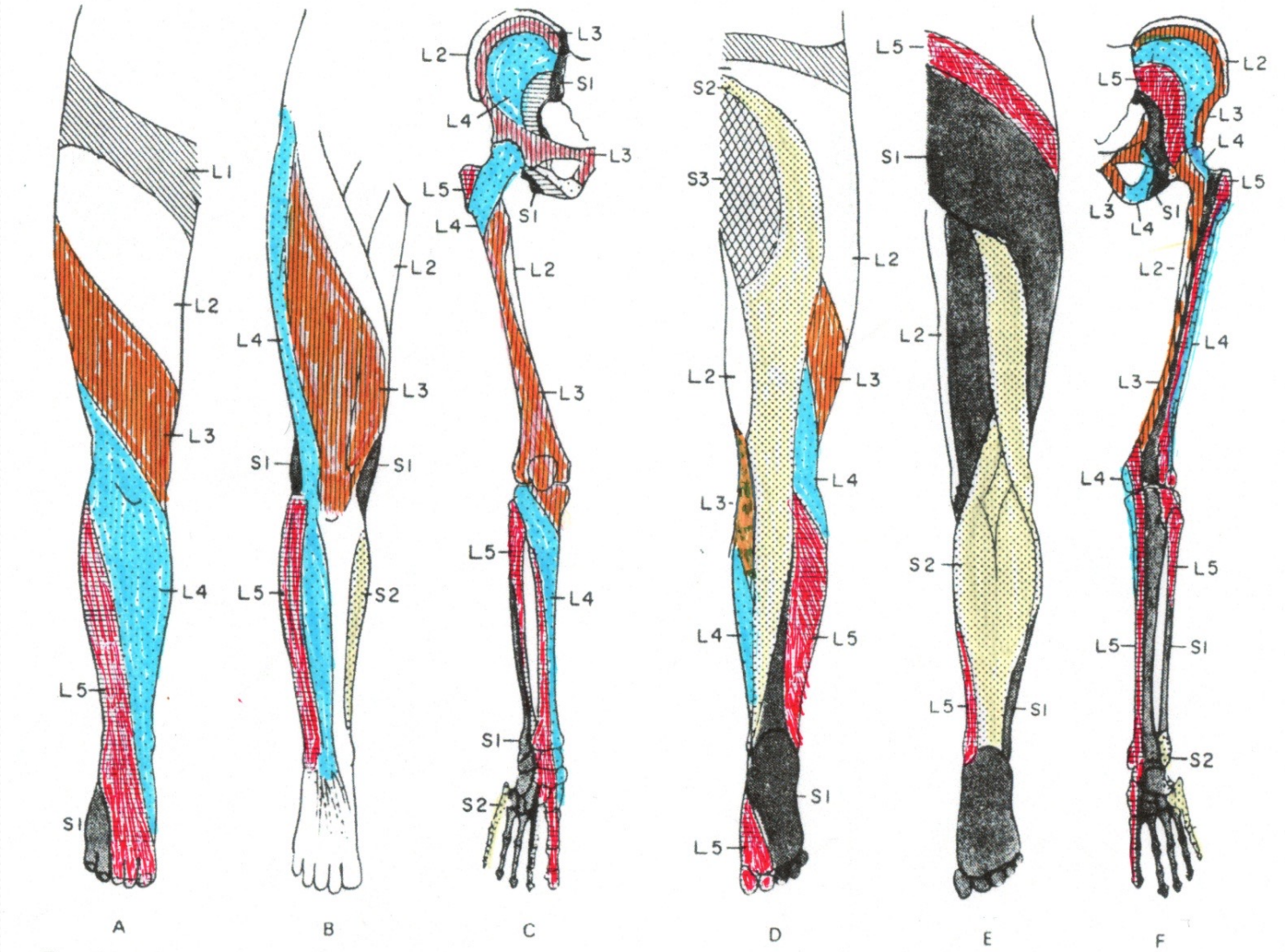


FIG. 70-35. Segmental nerve supply to the lower limbs. ***A.*** Anterior view showing dematomes, ***B.*** Anterior view showing myotomes. ***C.*** Anterior view showing sclerotomes. ***D.*** Posterior view showing dermatomes. ***E.*** Posterior view showing myotomes. ***F.*** Posterior view showing sclerotomes. See Chapter 6.

Dermatomes, Myotomes and Sclerotomes

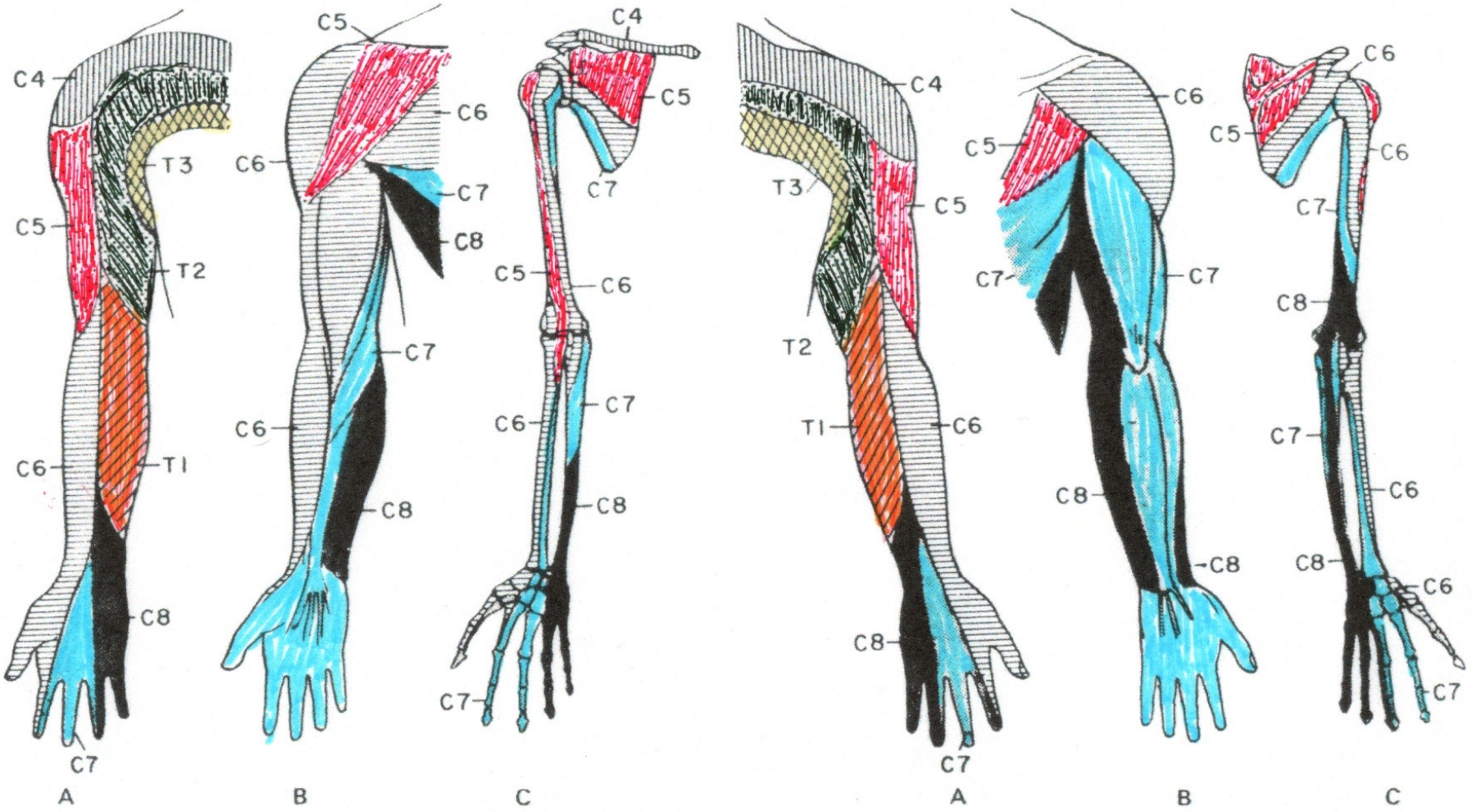
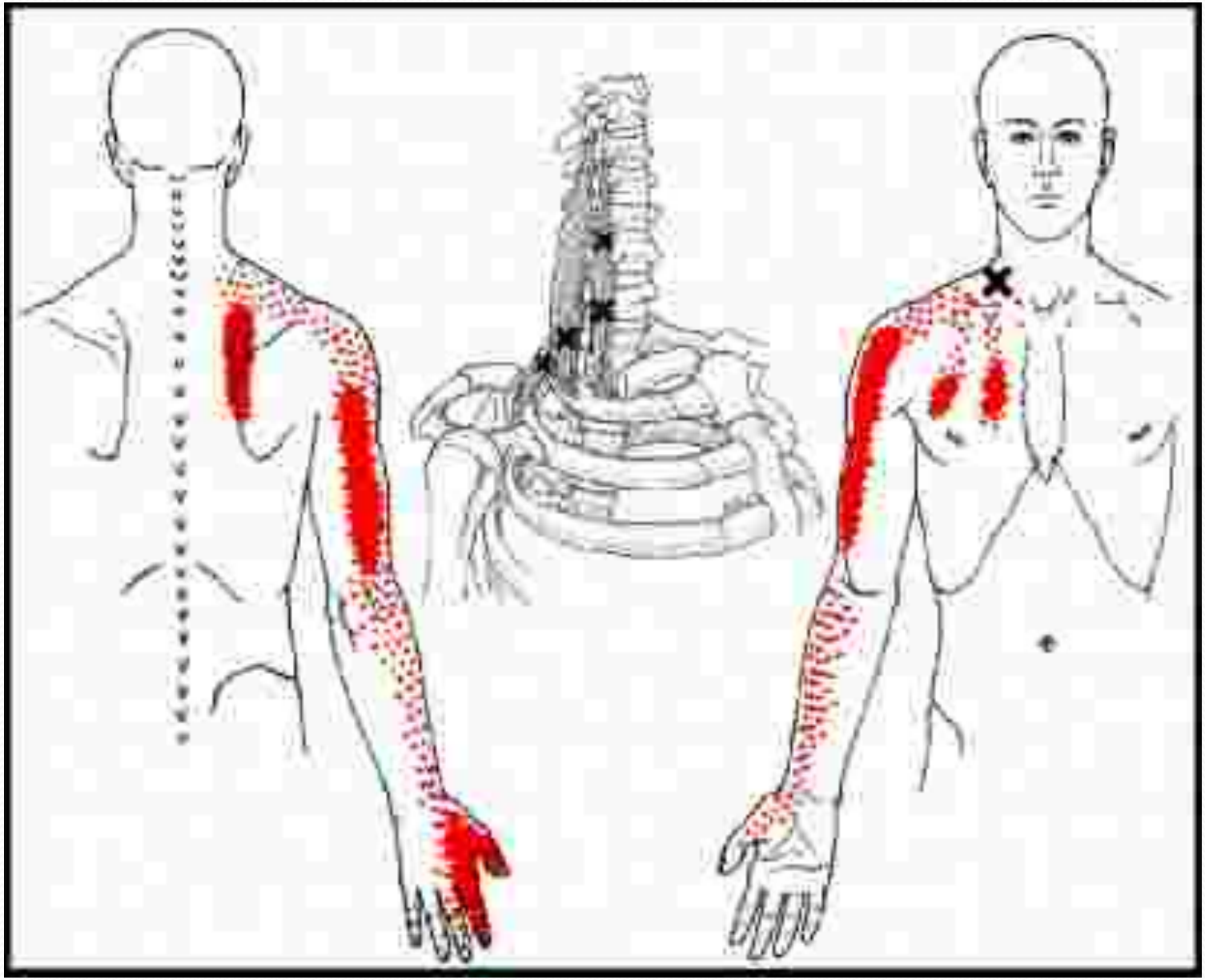
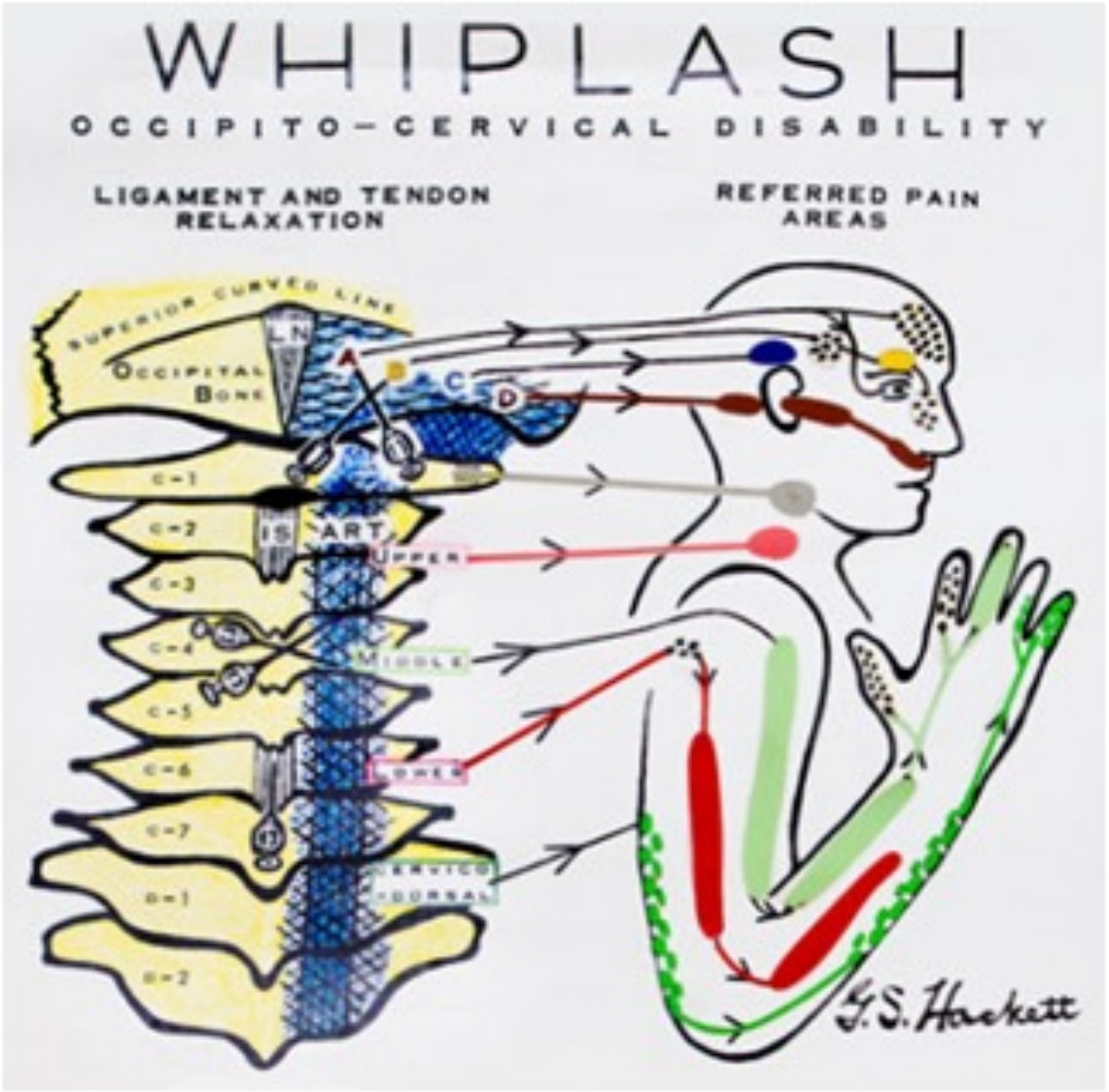


FIG. 46-17. Segmental nerve supply to the upper limb showing the anterior view (left) and posterior view (right). *A*. Dermatomes. *B*. Myotomes. *C*. Sclerotomes.

Trigger Point Referral Patterns



Hackett's Ligament Referral



PROLOTHERAPY SOLUTIONS

- Dextrose- 15% for extra-articular

  25%for intra-articular

Historically benefit was seen with:

- P2G (Ongley's Solution)- Dextrose, Glycerine and Phenol. If not responding.
- Pumice- for fibrous joints- AC & SC joint, proximal and distal tib-fib, SI and pubic symphysis, sternocostal jt.

Solutions – For Basic Prolotherapy

- Ropivicaine
- Dextrose
- Formula for Mixing Solutions

Preparation of Prolotherapy Solutions

To determine the % Dextrose in 10 ml of solution using D50

- If mix 5cc of 50% Dextrose with 5cc of solution get 25% Dextrose so 50% divided by 2= 25%
- If mix 1cc of 50% Dextrose with 9cc of solution get 5% Dextrose so 50% divided by 10= 5%
- If mix 2cc of 50% Dextrose with 8cc of solution get 10% Dextrose so 50% divided by 5= 10%

MECHANISM OF EFFECT

- Cellular Rupture
- Local Cellular Irritation
- Attraction of Inflammatory Mediators
- Attraction of Stem Cells
- Stimulate Release of Growth Factors
- Sclerosing Pathologic Neovascular Vessels
- Dextrose

The Role of Inflammation in Healing

- Inflammation is THE VITAL FIRST STEP in healing
- Initial inflammation is NOT the enemy
- Stopping inflammation inhibits the ability to heal and recover.
  - NSAIDs (Motrin, Daypro, Naprosyn etc)
  - Anti-Inflammatory Herbs (Tumeric, Boswellia, etc.)
  - Acetaminaphen (minimal interference)
  - Ice (Relative)

NSAIDS and Acetaminophen Inhibit Skeletal Muscle Protein Synthesis

- 24 males age 22-28 assigned to 3 groups
- Each group doing heavy eccentric exercise
- Muscle biopsies of vastus lateralis
- Skeletal muscle protein synthesis significantly degraded in the ibuprofen and acetaminophen groups
- "Ibuprofen and acetaminophen profoundly influence the anabolic response of muscle to this form of exercise."
- Trappe T et al. J Clin Endocrinol Metab, 2001

More Prolotherapy Solutions

- Autologous Blood- very painful
- PRP- Seems to be very helpful in recalcitrant tendinopathy, torn ligaments and moderate to severe arthitis
- [Sodium Morrhuate]- Not available any more
- Stromal Vascular Fraction Stem Cells- SVF
- BMC- Bone Marrow Concentrate Stem Cells
- Porcine Bladder Membrane
- Cultured Mesenchymal Stem Cells
- Purified Human Amniotic Membrane

Platelet Rich Plasma (PRP) Injection

- High concentration of growth factors introduced into the non-healing area
- Initiates a brisk inflammation response
- (Re)starts the healing cascade
- Accelerates healing
- Appears to be direct correlation between # of platelets & tissue healing
- Need at least 4-5X's normal concentration of platelets in blood



Scarpone M et al.

- Prospective study of 14 patients with rotator cuff tears on MRI
- All failed non-operative treatment
- All received 1 PRP injection
- 12 of 14 had statistically significant improvement at 8 weeks
- 6 had MRI evidence of complete healing
- No complications
- 2 patients went on to have surgery

Scarpone M et al.2005. Treatment alternative for symptomatic rotator cuff Tendonopathy for patients failing conservative treatment. Tx Pain

Sanchez et al

- Case-control study. Level of evidence 3
- 12 athletes underwent open repair after complete Achilles rupture
- 6 athletes had their repair augmented with PRP
- PRP group recovered ROM earlier
  - 7 weeks vs 11 weeks
- PRP group returned sooner to gentle running
  - 11 weeks vs 18 weeks

Sanchez M et al. 2007. Comparision of surgically repaired Achilles Tendons using platelet rich fibrin matrices. Am J Sports Med

Uses of PRP

- Uses in sports medicine
  - Tendinopathies /enthesopathies unresponsive to conservative therapy
  - Arthropathies / DJD
  - Non-operative partial muscle tears
  - Non-operative ligament tears
- Osteoarthritis
- Patellar tendinopathay
- Quadriceps tendinopathy
- ACL laxity / partial tear
- PCL laxity / partial tear
- Limited Meniscal tears
  - Visible on ultrasound
  - No significant mechanical sx
  - Patient does not desire arthroscopic surgery
- MCL grade 2 and 3 tears
  - Only when return to play interval is critical

TECHNIQUE PEARLS

- Aspirate prior to injecting near vascular structures
- Direct needle perpendicular to bone target
- Always inject on bone unless intra-articular
- The enthesis feels like gristle
- Inject in four quadrants at each site (use needle redirection or tissue slide techniques)
- Use smaller syringes when appropriate to save your joints.
- Always compress tissue when injecting

TECHNIQUE PEARLS

- Think of the needle as an extension of your body/mind
- Use needle to create a controlled tissue injury
- Use a long enough needle to get the job done and a shorter thinner needle when long needles are unnecessary.
- Don't bend your needle except if you mean to.
- Let your needle do the work and replace dull needles.

PALPATION

- The lighter you press the more you feel.
- The harder you press the more you feel the finger you are pressing with and the more insensitive it becomes.
- Need to modulate the pressure.
- Need to know the normal anatomy so you can anticipate the location and shape of what you are going to feel.

PALPATION

- Need to know the normal anatomy so you can anticipate the location and shape of what you are going to feel.
- Palpate perpendicularly to the edge you are trying to feel.
- Use the palm or a few fingers together to locate or feel for boney prominences.
- Check the edge from two directions and take into account the thickness of the interposed tissue.
- Perceived edge versus real edge

Palpation and Drawing Tips

There are many nuances to palpation that will make your drawings and thus injections more accurate and easier.

- Use more than one finger or even both hands when palpating and move one centimeter at a time.
- Push at a 90° angle to the surface you are attempting to palpate.
- If you are having trouble feeling a structure start palpating at a spot which is easier to feel and work your way one cm. at a time towards the target.
- If the drawing you made does not look correct /anatomic then it probably is not.
- Remember: the point is to get the needle on the correct spot.

SAFETY

- Patient-Diagnosis and Consent
- Procedure-safe practices in performing the procedure
- Solutions-proper preparation and handling of solutions and supplies
- Aftercare-patient instructions
- Informed Consent-document and get patient signature
- Office Procedures-safe practices
- Documentation of the procedure
- Proper billing for the procedure
- Malpractice Coverage-check with your carrier to be sure you are covered.
- Standard of Care-know the standard of care, has patient failed standard of care treatments?-document, document, document

Informed consent

- http://www.prolo.org/resources/Prolotherapy+Consent+form+only.pdf
- Many examples of forms on line
- If in doubt, check with your malpractice carrier for feedback as well.

INJECTION SAFETY

- NO RECAPPING NEEDLES
- No handing uncapped syringes to another person
- Keep the space neat and organized.
- Have the patient sit before letting them stand up after the procedure.
- Have an office procedure for needle sticks
  - Keep the patient to get a blood draw
  - Notification procedure
  - Prophylaxis

COMPLICATIONS

- Increased Pain
- Vaso-vagal episodes
- Bleeding/hematoma
- Numbness/Tingling
- Nerve Damage
- Dizziness
- Pneumothorax
- Infection
- Paralysis
- Bladder Incontinence
- Spinal or Cerebral Infarction
- Death
- No benefit

After Prolotherapy Advice

- Expect 2 to 3 days of stiffness and increased discomfort
- Post injection flare longer in hormonal or metabolic deficient
- Apply ice massage (not packs) and take pain medication as needed
- Avoid all NSAIDS for 14 days
- ROM activity only, avoid PRE or vigorous exercise
- Avoid forceful manipulative methods

HAND and WRIST

Prolotherapy – Hand/wrist

- **Targets** –Hand: Fingers, Thumb --Lateral ligaments, Intra-articular
  - **metacarpophalangeal joint (MCP)** – the joint at the base of the finger
  - **proximal interphalangeal joint (PIP)** – joint in the middle of the other 2 joints
  - **distal interphalangeal joint (DIP)** – the joint closest to the fingertip.
- **Ligaments** - Important ligaments of the hand are:
  - **collateral ligaments** – strong ligaments on either side of the finger and thumb joints, which prevent sideways movement of the joint
  - **volar plate** – a ligament that connects the proximal phalanx to the middle phalanx on the palm side of the joint. As the joint in the finger is straightened, this ligament tightens to keep the PIP joint from bending backward.
  - **radial and ulnar collateral ligaments** – a pair of ligaments which bind the bones of the wrist and provide stability
  - **volar radiocarpal ligaments** – a complex web of ligaments that support the palm side of the wrist
  - **dorsal radiocarpal ligaments** – ligaments that support the back of the wrist
  - **ulnocarpal and radioulnar ligaments** – two sets of ligaments that provide the main support for the wrist.

http://www.arthritis.org/about-arthritis/where-it-hurts/wrist-hand-and-finger-pain/hand-wrist-anatomy.php

Prolotherapy – Hand/wrist

- The main tendons of the hand are:
- **superficialis tendons,** which pass through the palm side of the wrist and hand, and attach at the bases of the middle phalanges. They act with the profundus tendons to flex the wrist and MCP and PIP joints.
- **profundus tendons**, which pass through the palm side of the wrist and hand, and attach at the bases of the distal phalanges. They act with the superficialis tendons to flex the wrist and MCP and PIP joints. They also flex the DP joints.
- **extensor tendons** of the fingers, which attach to the middle and distal phalanges and extend the wrist, MCP, PIP and DP joints.
- **flexor tendons,** nine long tendons which pass from the forearm through the carpal tunnel of the wrist. They diverge in the palm, where two go to each finger (one attaches at the DP and one at the MCP) and one goes to the thumb.
- **extensor pollicis brevis** and abductor **pollicis longus**, which run from the muscles in the top of the forearm and enable movement of the thumb

http://www.arthritis.org/about-arthritis/where-it-hurts/wrist-hand-and-finger-pain/hand-wrist-anatomy.php

Prolotherapy-Hand and Wrist

- Target Ligaments and Tendons-Hand/Wrist
  - The stronger ligaments are in two groups, intrinsic ligaments which are contained among the carpal bones and the extrinsic ligaments which cross between the radius and ulna, the carpal bones, and the metacarpal bones. The **scapholunate interosseus ligament is an essential intrinsic ligament of the wrist that connects the scaphoid and lunate carpal bones**, and it is one of the most frequently injured wrist ligaments. The extrinsic ligaments starting at the radius help with control the wrist movements, especially ones that include the scaphoid. One of the strongest extrinsic wrist ligaments is the radiolunate. It is important in rotating the scaphoid, and it is tense at the end of each wrist range of motion.

Prolotherapy – Hand/wrist

- The **carpus** is formed from eight small bones collectively referred to as the carpal bones. The carpal bones are bound in two groups of four bones:
  - the **pisiform**, **triquetrum**, **lunate** and **scaphoid** on the proximal end of the wrist
  - the **hamate**, **capitate**, **trapezoid** and **trapezium** on the distal side of the wrist.

Physical Examination-Resources

- Detailed article on physical examination of the hand: http://www.springer.com/cda/content/document/cda_downloaddocument/9781461494485-c1.pdf?SGWID=0-0-45-1491487-p176270751

- https://www.youtube.com/watch?v=DxWorodKOGs - video of exam hand and wrist

- Hand Anatomy Animated Tutorial
- https://www.youtube.com/watch?v=zyl6eoU-3Rg

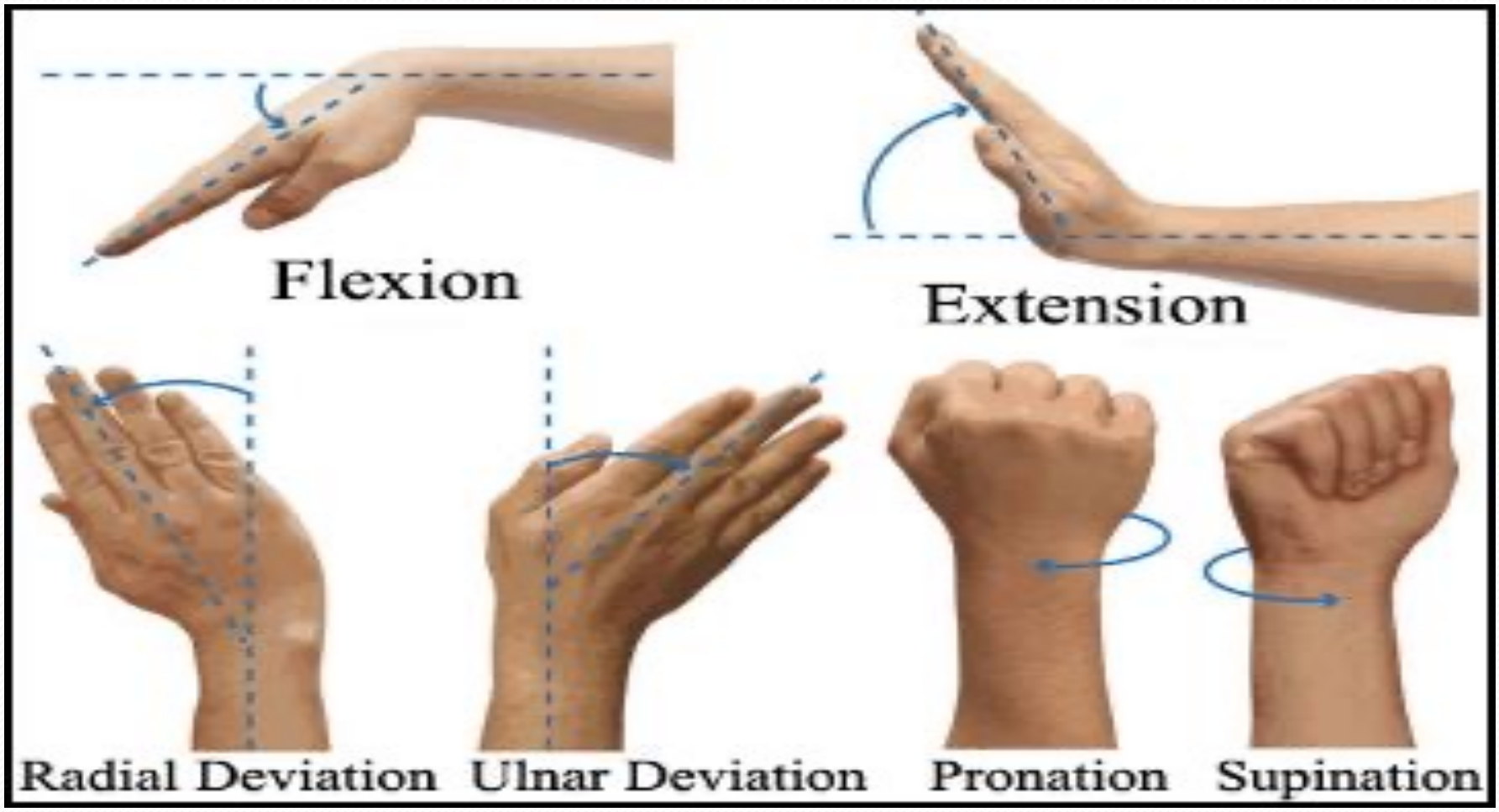
Clinical conditions with Ligament or Tendon pathology

- Osteoarthritis
- Rheumatoid arthritis
- Post-traumatic “stalled” wound healing
- Carpal Tunnel Syndrome
- TFCC tears
- Chronic wrist ligament sprains (stalled healing)
- Tendinosis

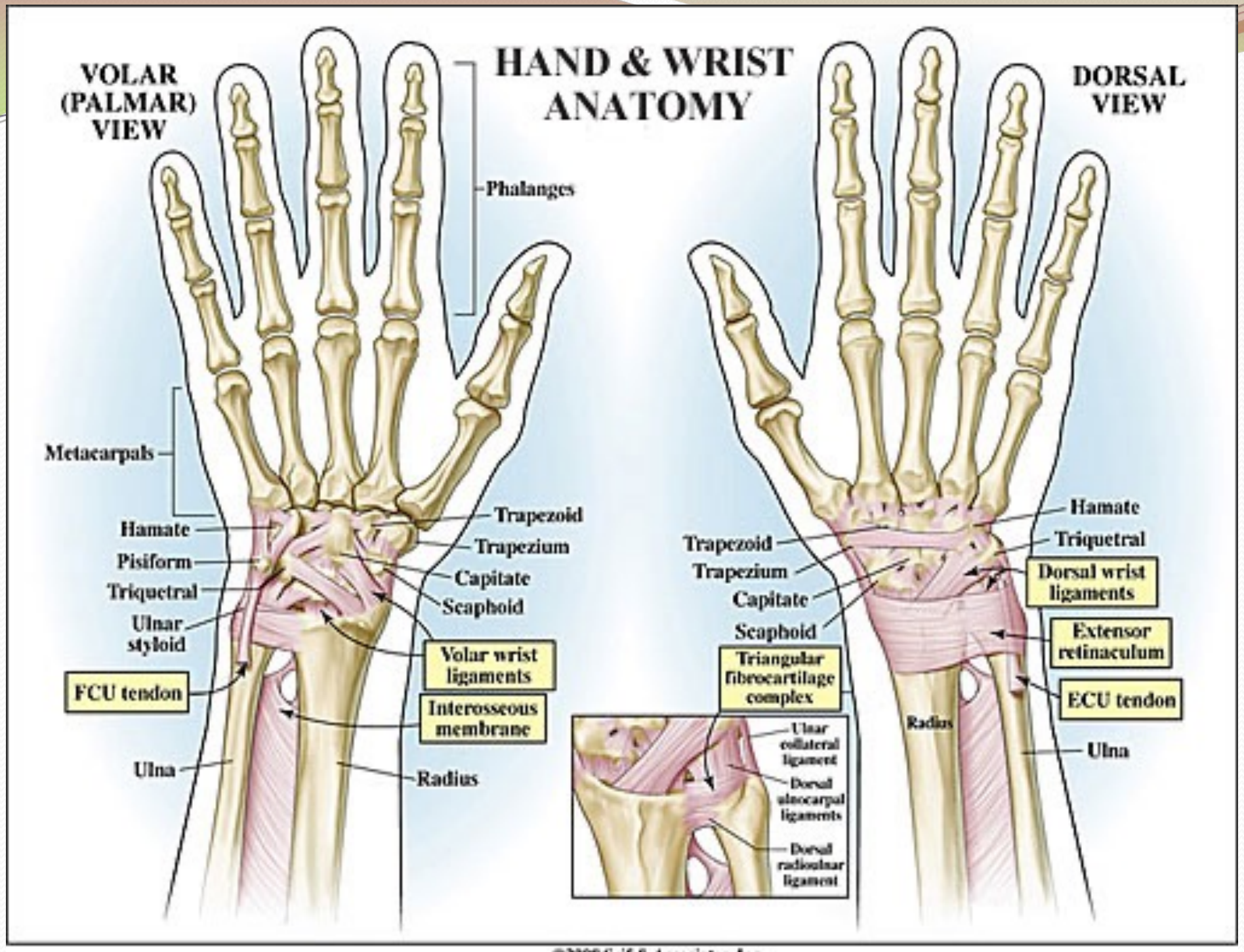
Evaluation and Diagnosis of Wrist Pain: A Case-Based Approach

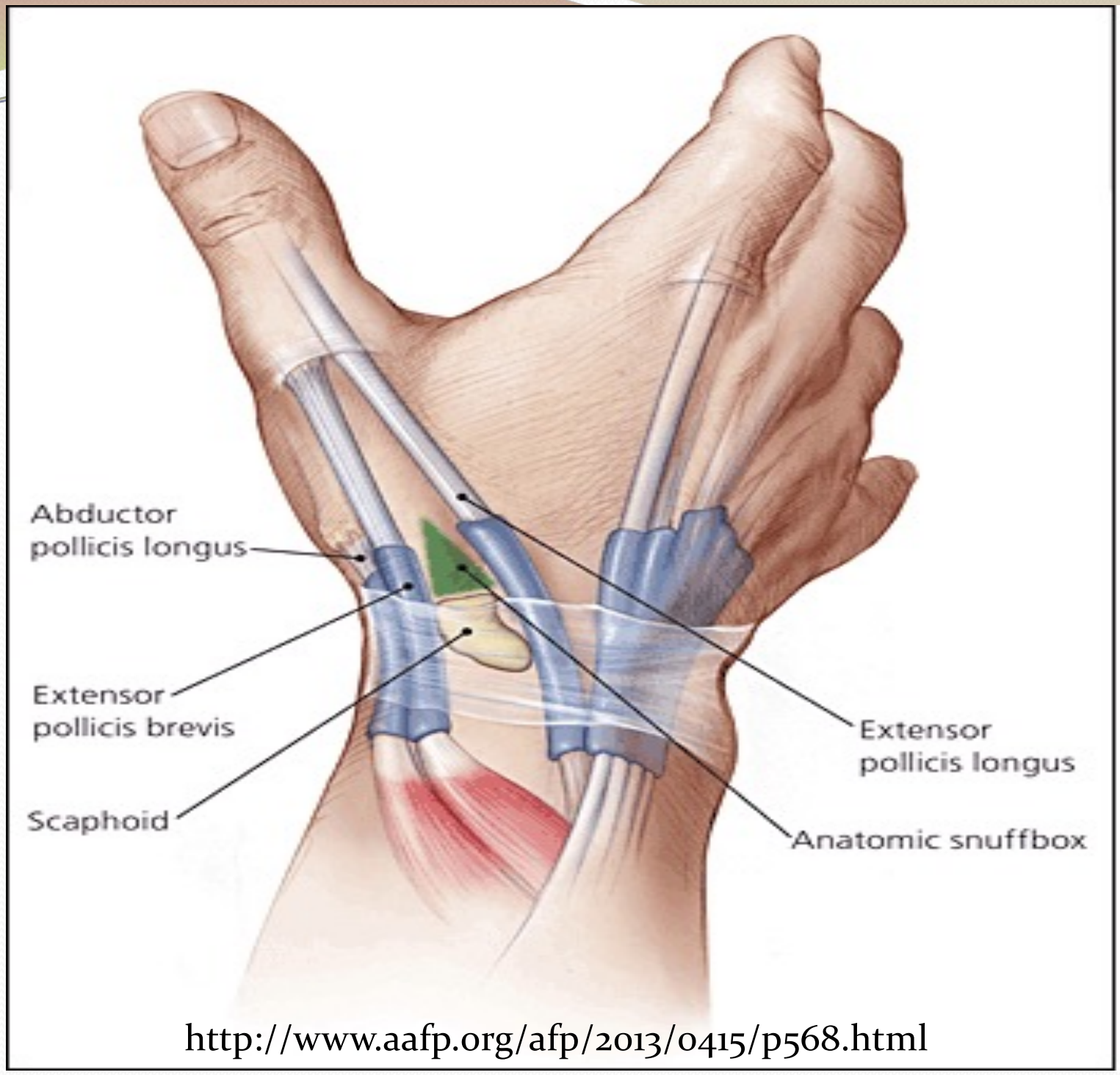
- **Acute Causes of Wrist Pain**
- **Subacute/Chronic Causes of Wrist Pain**
- **De Quervain Tenosynovitis**
- **When to image**
- **Standard of Care**
  - http://www.aafp.org/afp/2013/0415/p568.html

Wrist Motion



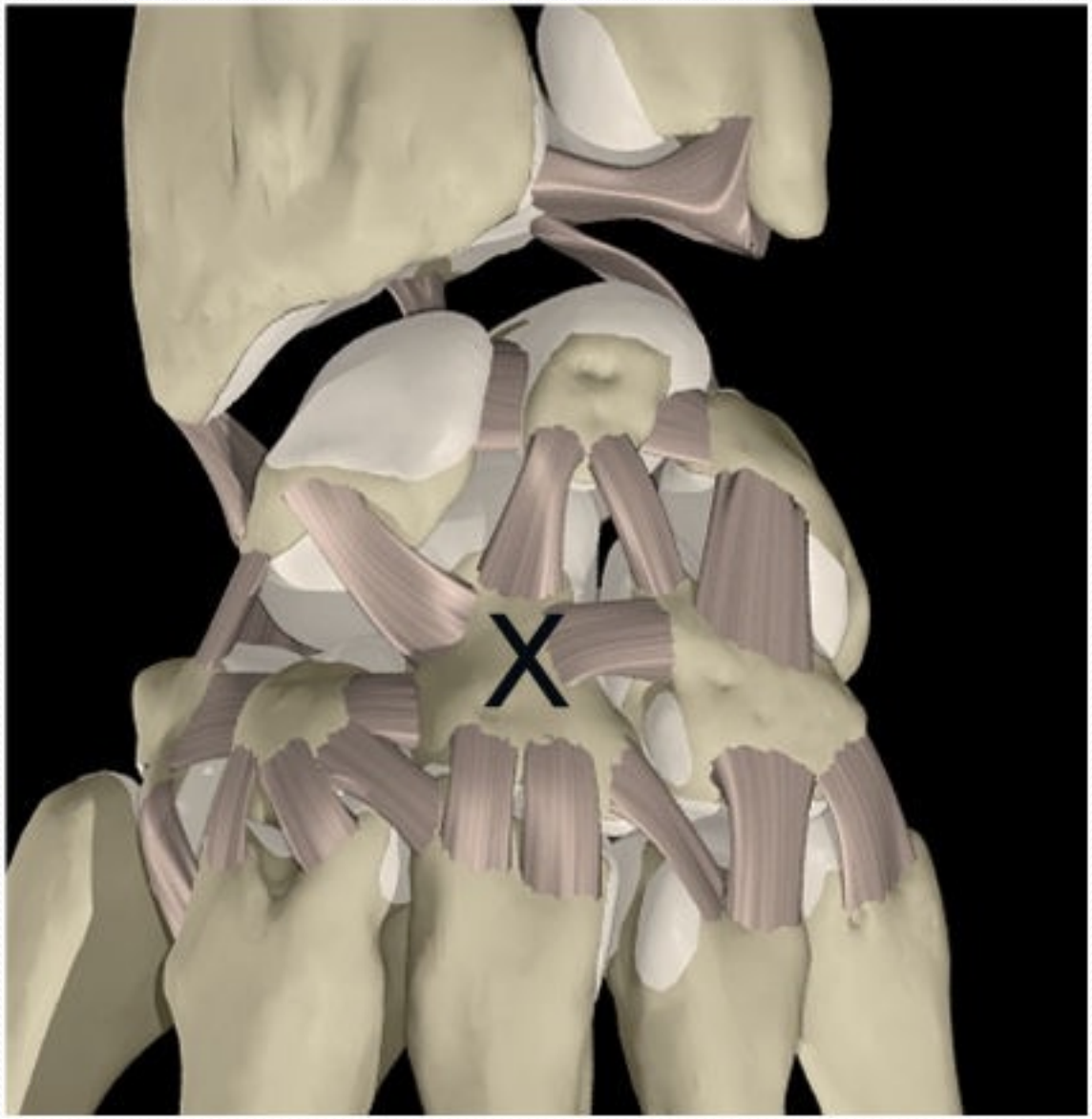
- (http://www.revolutionarytennis.com/Resources/wristandhandterm.jpeg)


HAND & WRIST ANATOMY
VOLAR (PALMAR) VIEW
DORSAL VIEW
Phalanges
Metacarpals
Hamate
Pisiform
Triquetral
Ulnar styloid
FCU tendon
Trapezoid
Trapezium
Capitate
Scaphoid
Volar wrist ligaments
Interosseous membrane
Ulna
Radius
Trapezoid
Trapezium
Capitate
Scaphoid
Triangular fibrocartilage complex
Ulnar collateral ligament
Dorsal ulnocarpal ligament
Dorsal radioulnar ligament
Hamate
Triquetral
Dorsal wrist ligaments
Extensor retinaculum
ECU tendon
Radius
Ulna
©2008 Seif & Associates, Inc.



http://www.aafp.org/afp/2013/0415/p568.html

Capitate

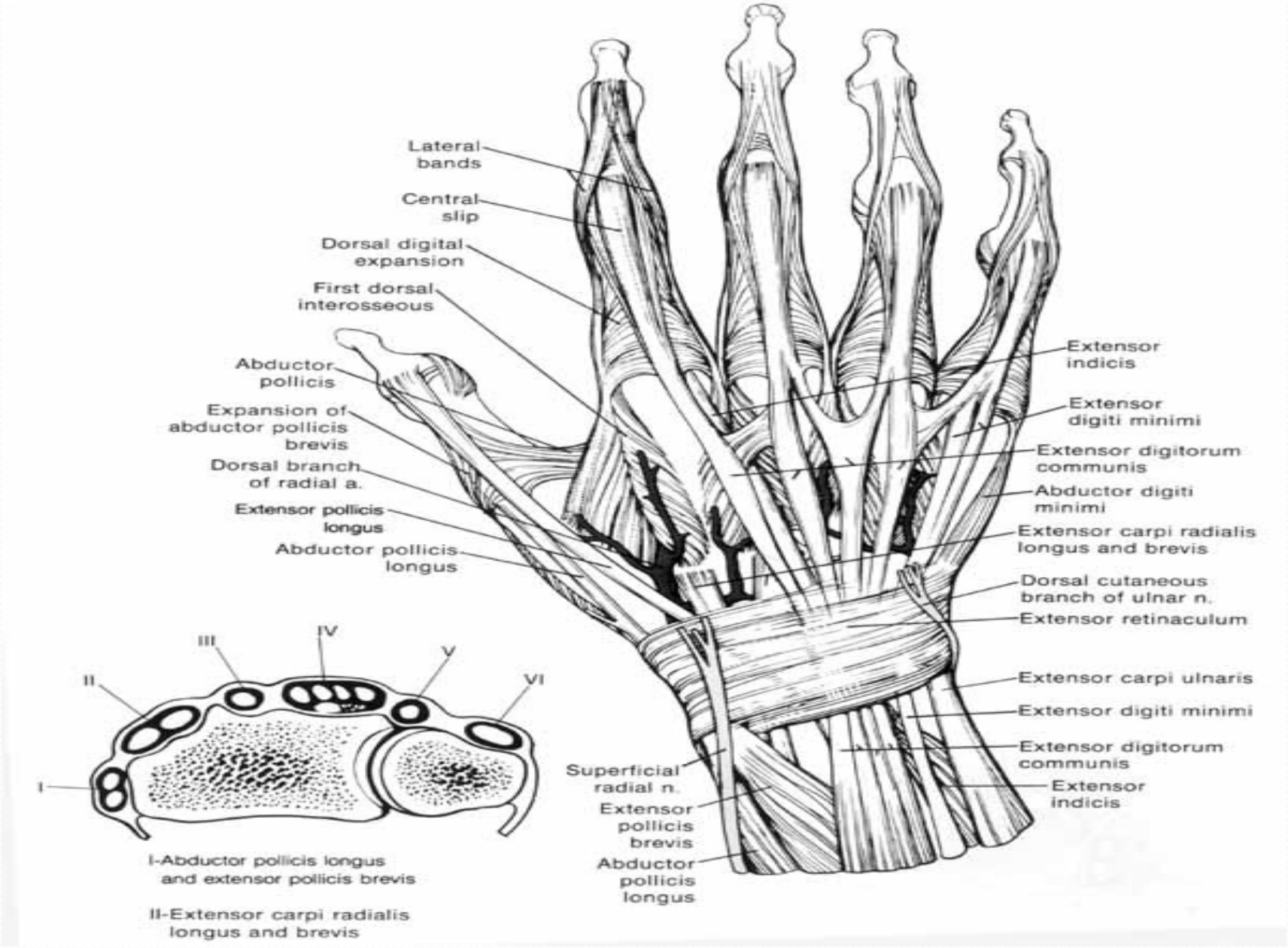


Wrist joint and Scapholunate Ligament

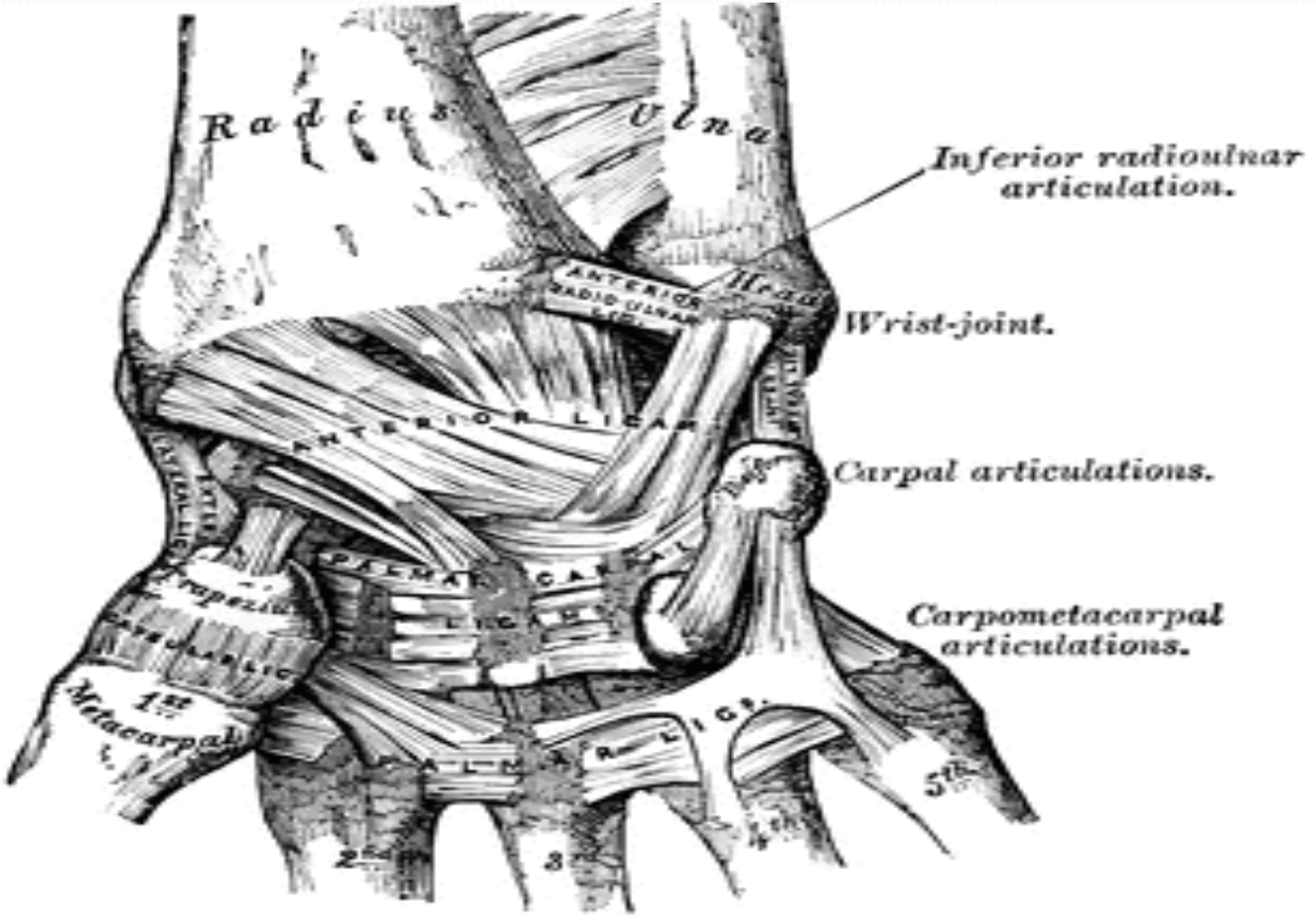




Hand-Dorsal Anatomy

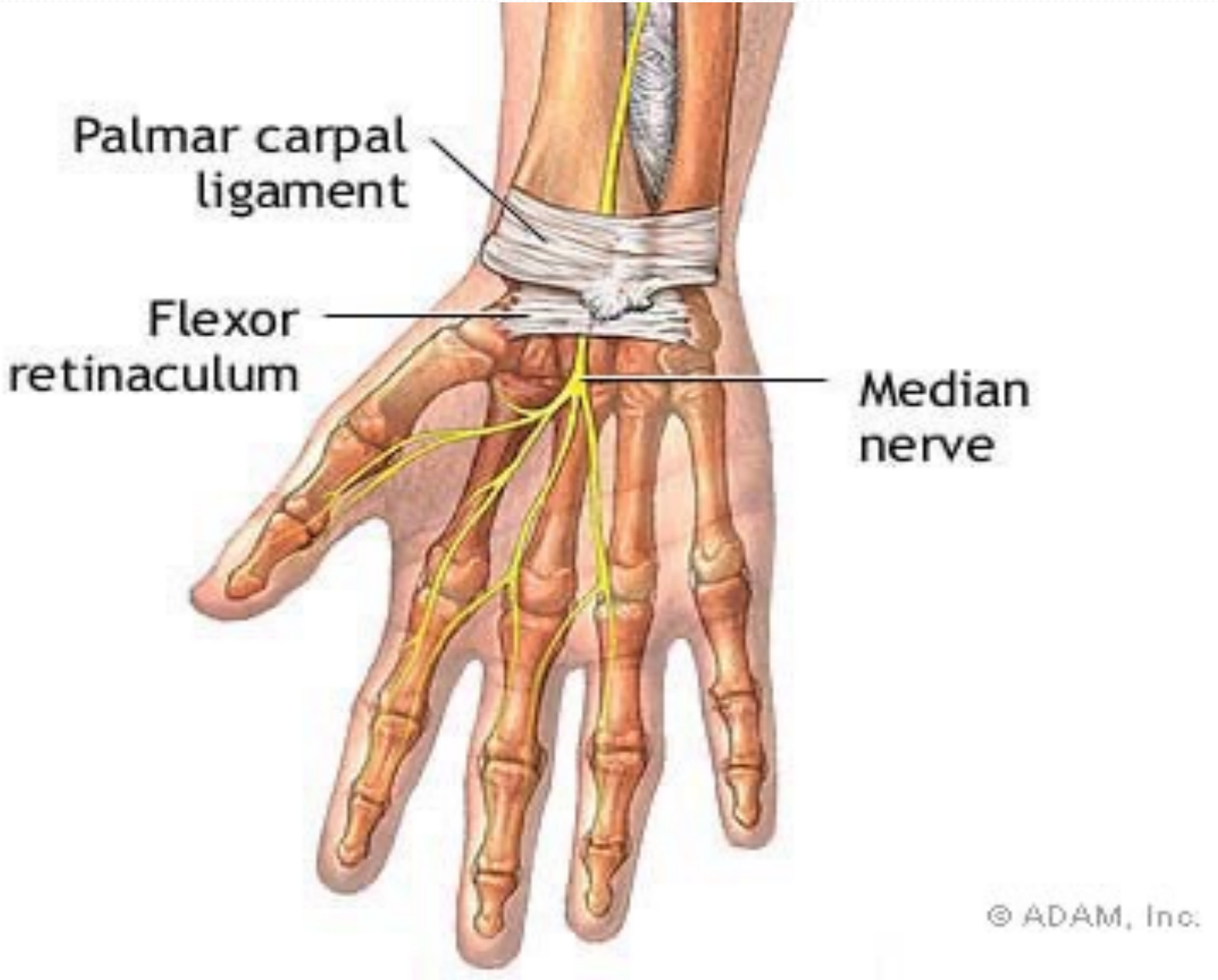


Palmar Ligaments

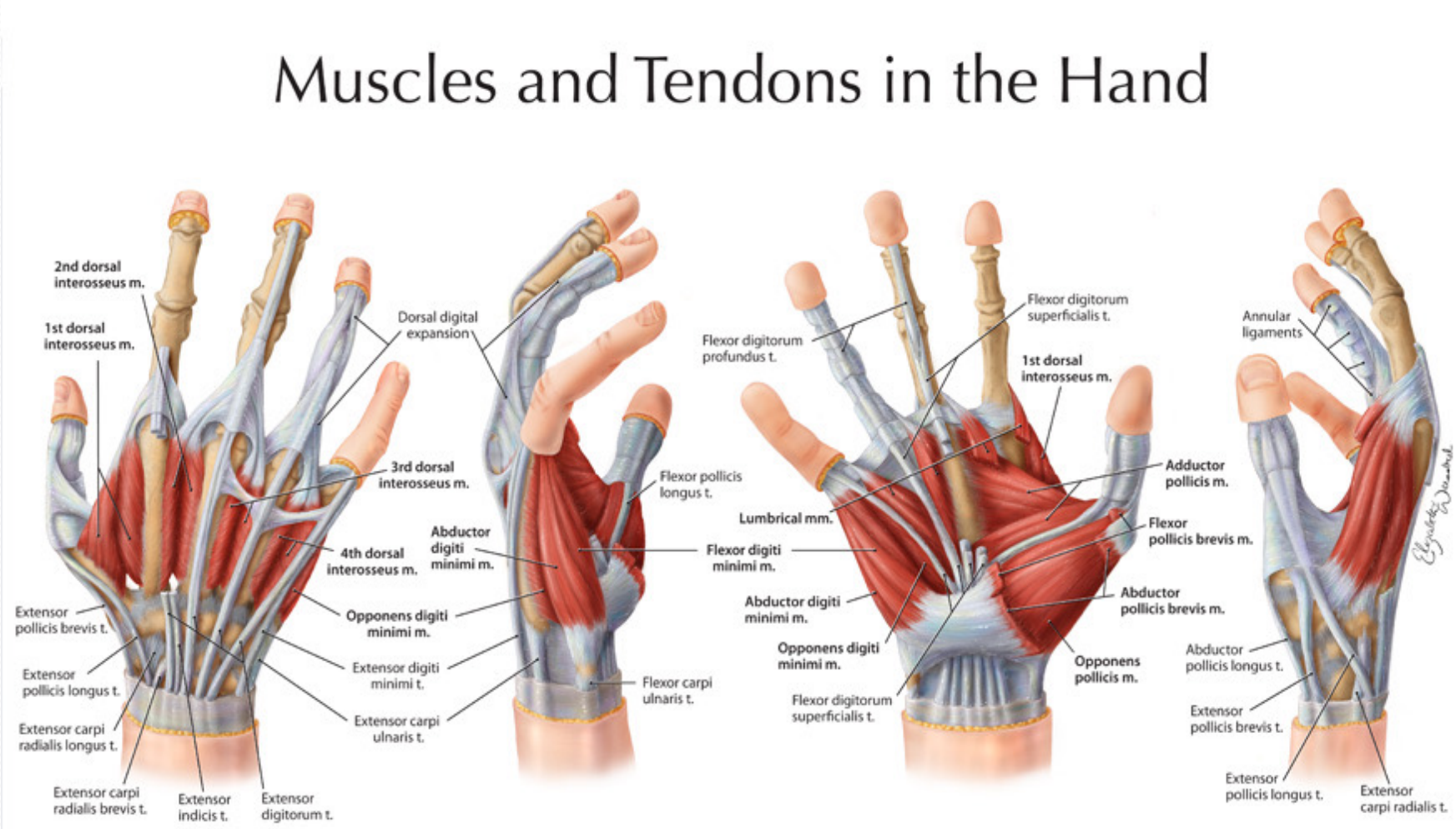


(http://etc.usf.edu/clipart/24200/24247/hand_ligamen_24247_sm.gif)

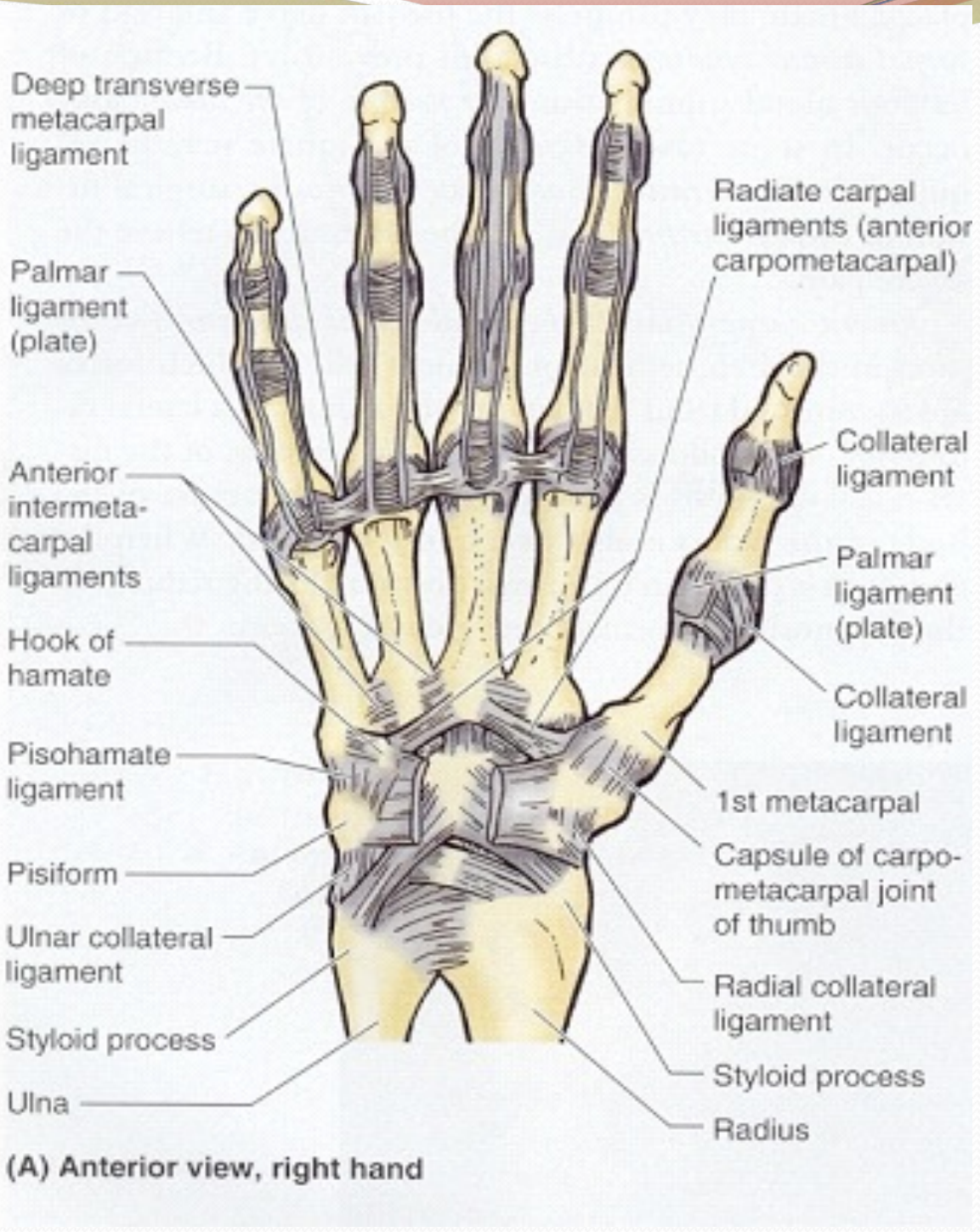
Palmar View


Palmar carpal ligament
Flexor retinaculum
Median nerve
© ADAM, Inc.

Hand and Wrist



Palmer View

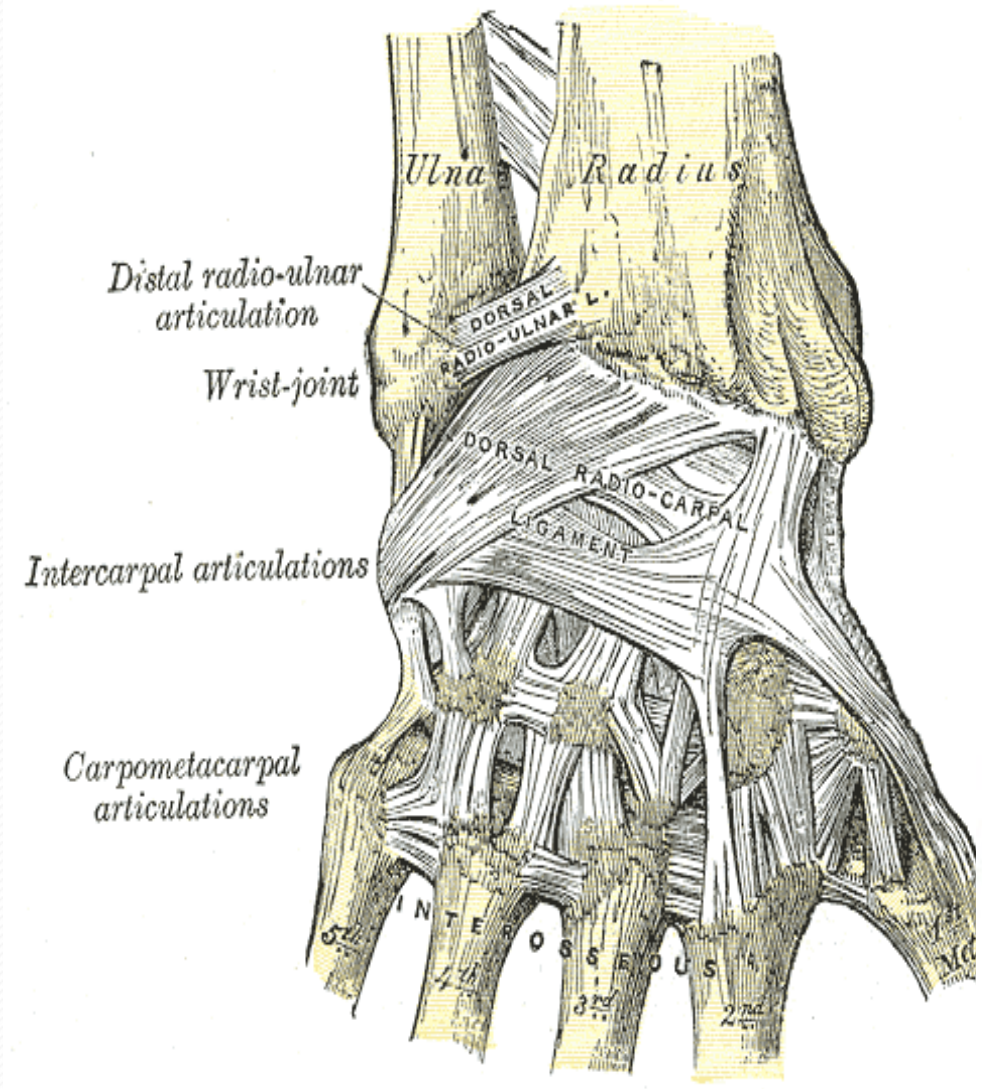


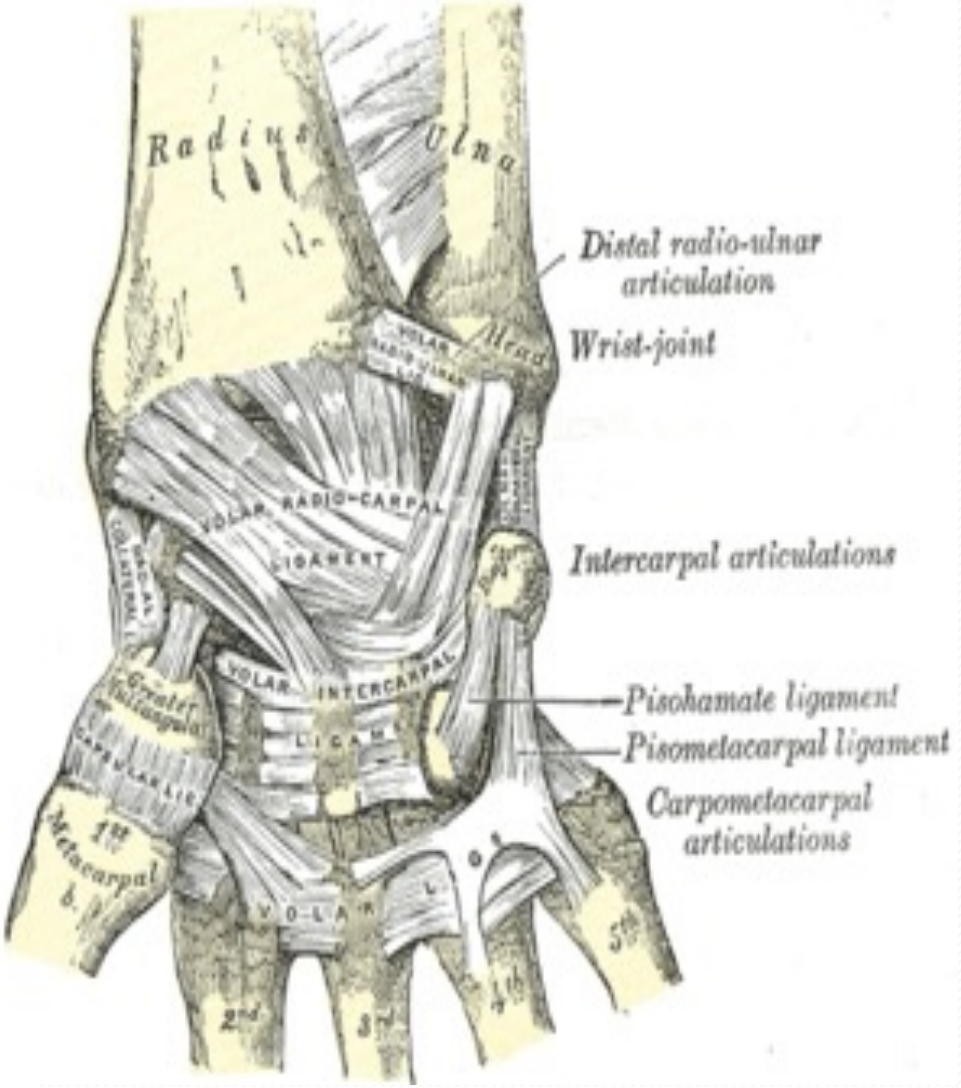
(A) Anterior view, right hand

Volar Wrist drawing

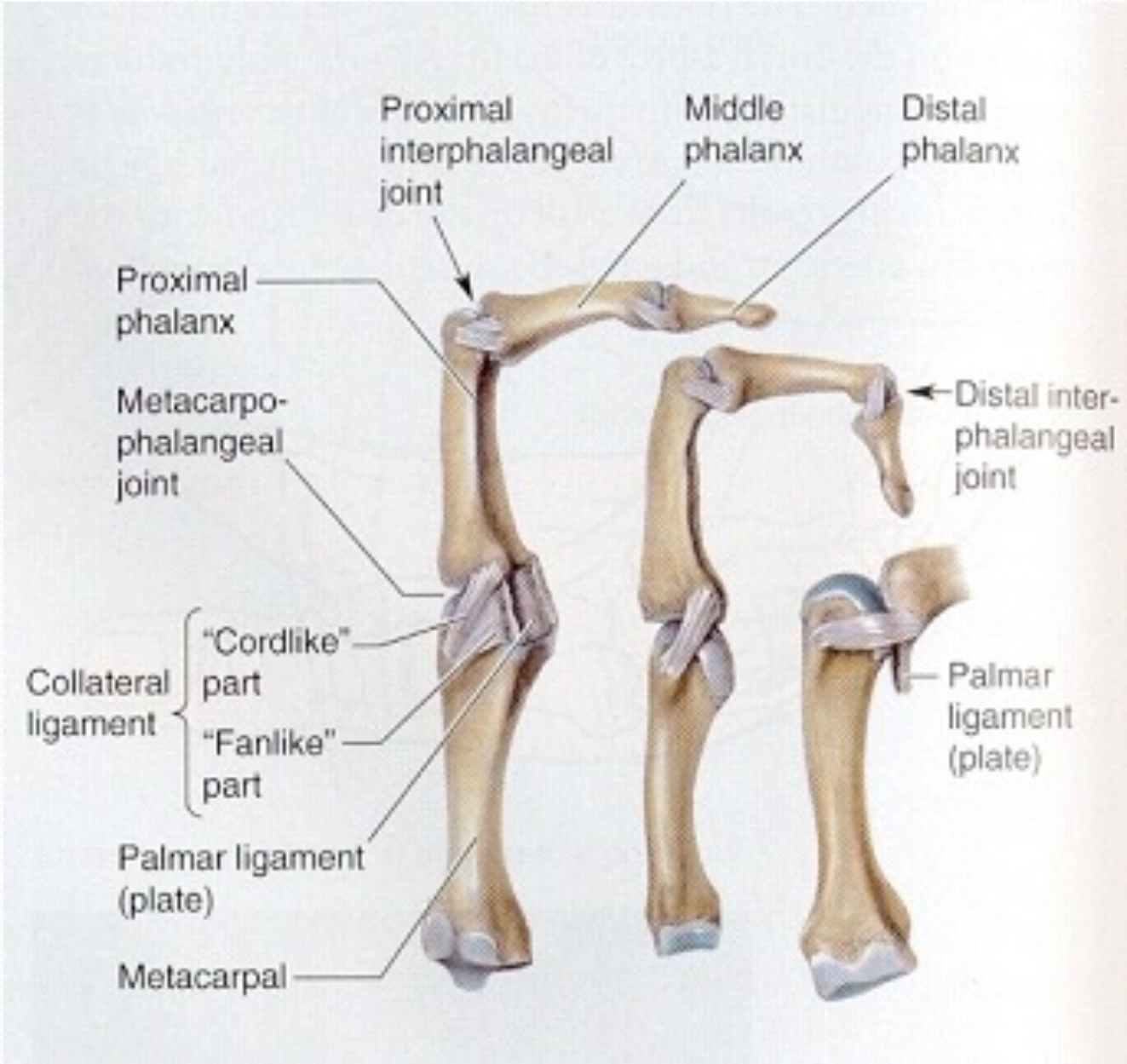


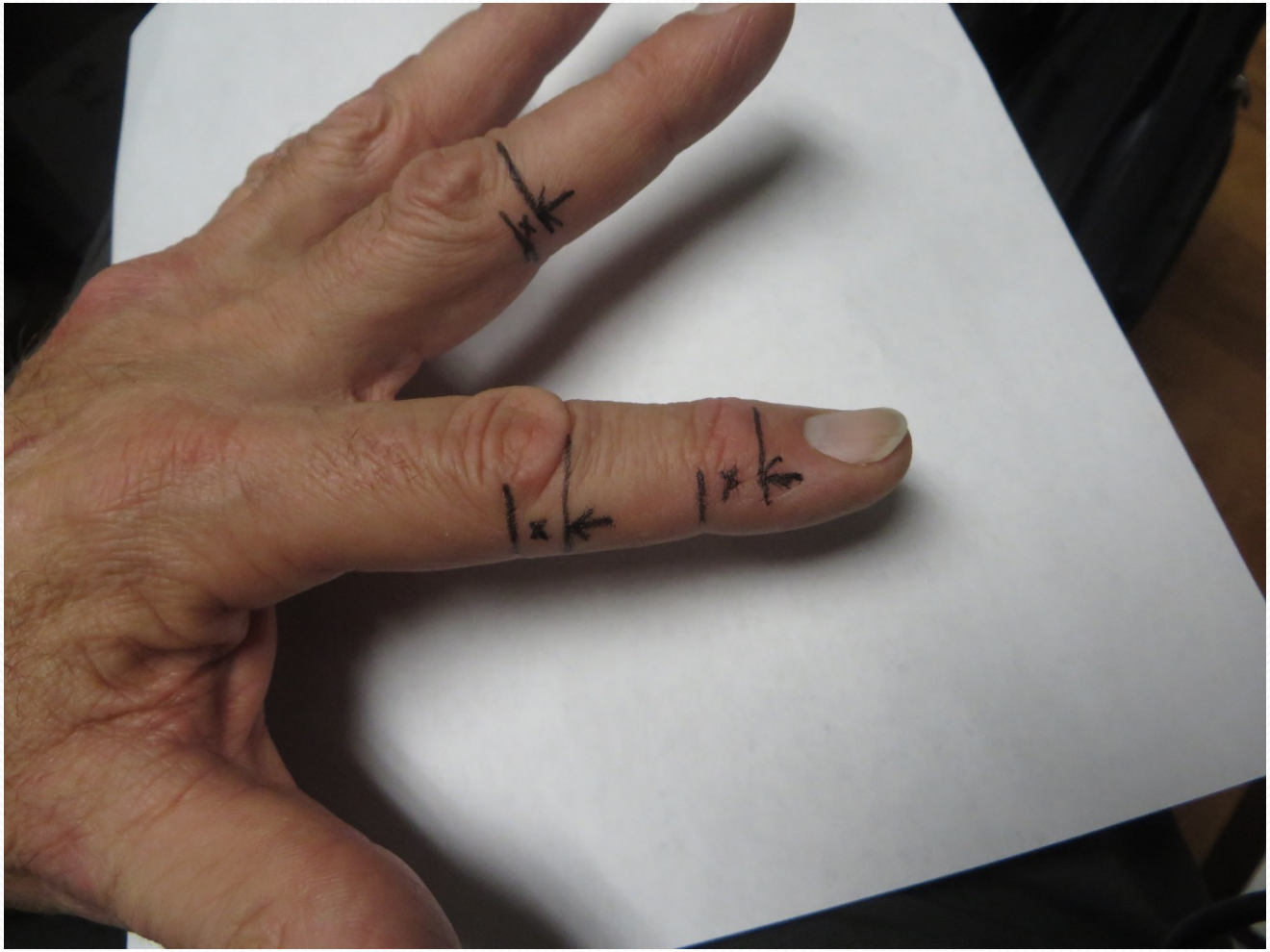
Wrist-dorsal and volar views

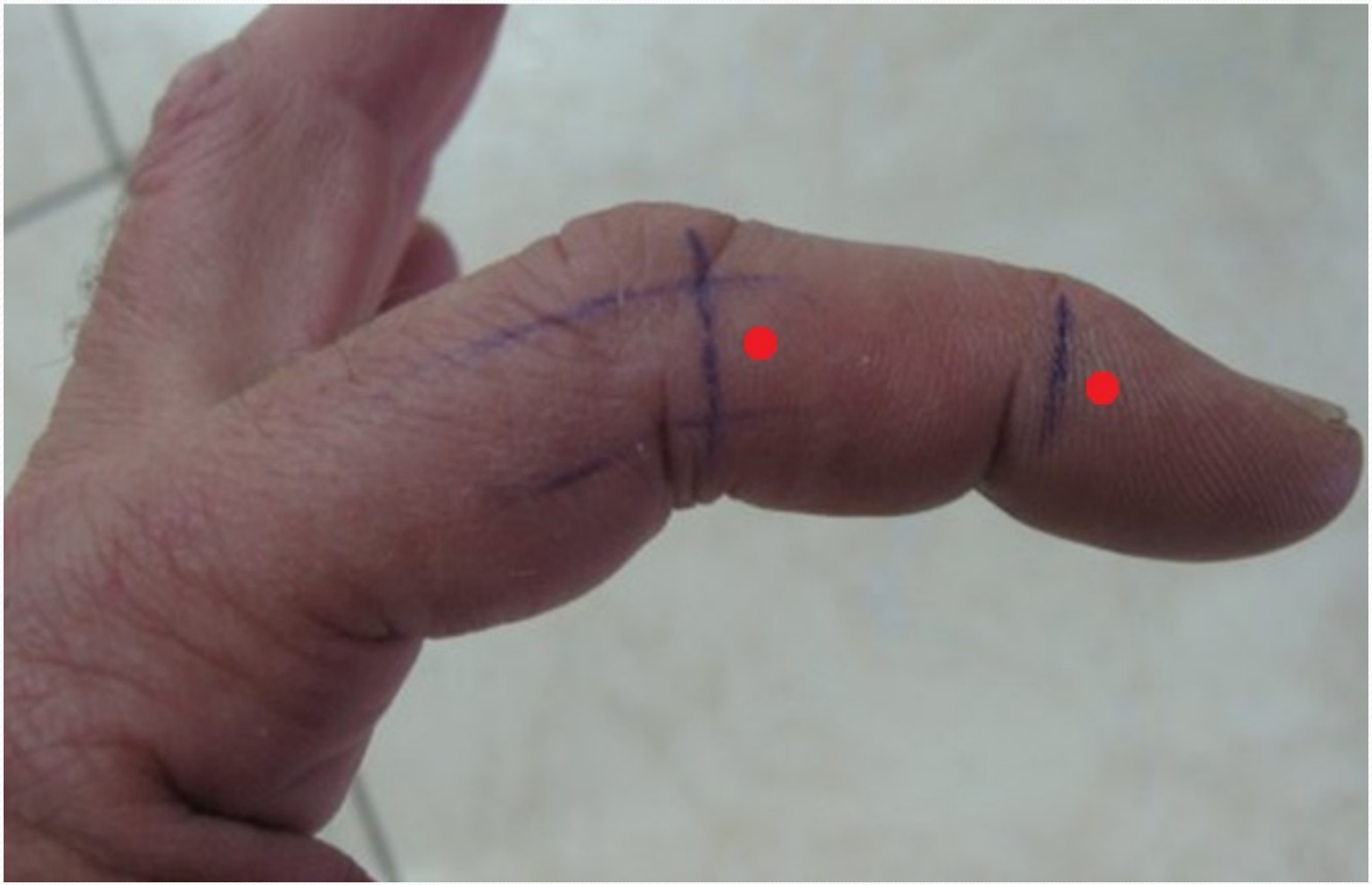




Finger ligaments



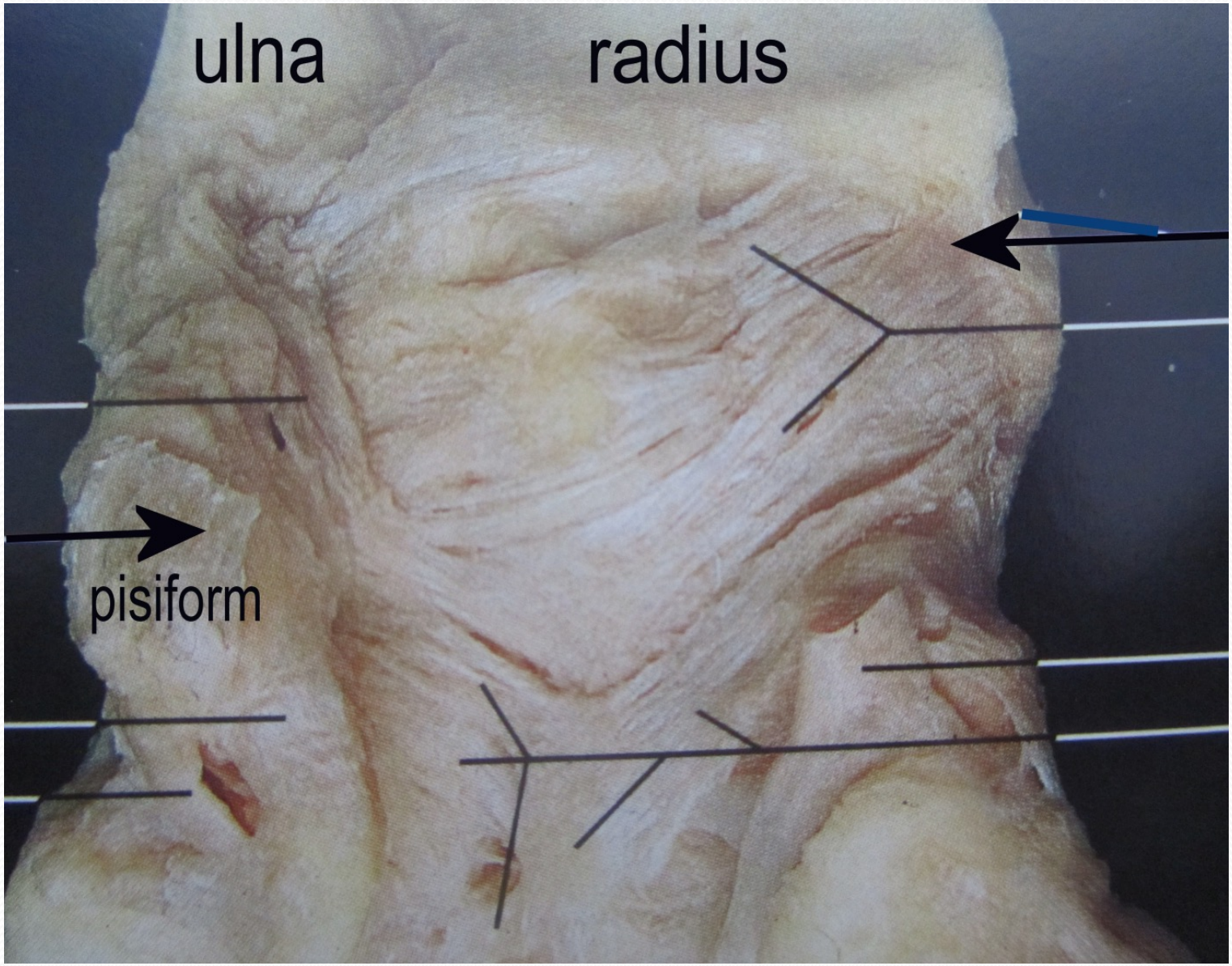

1×k
1×k
1×k



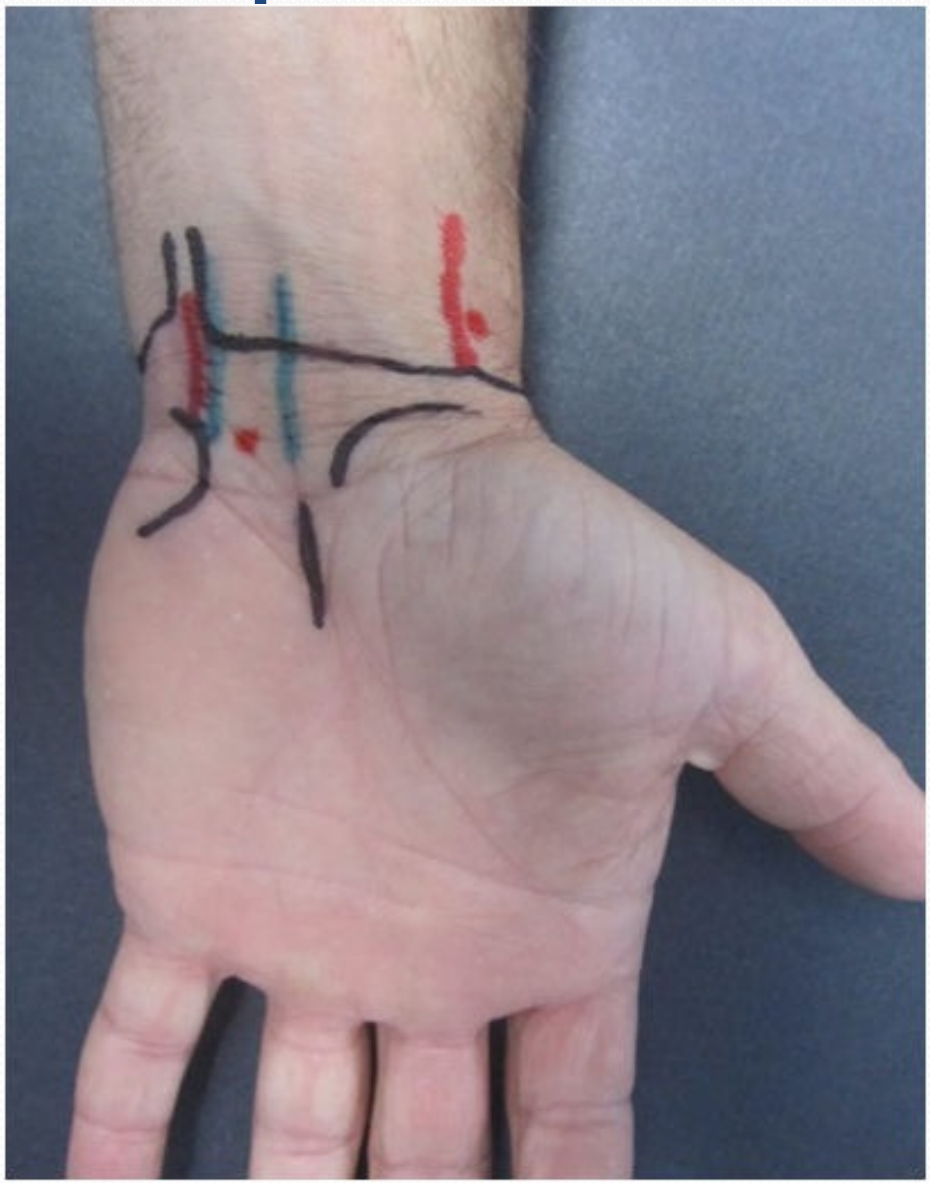
CMC and ST joints



Palmer-V



Injection of palmer-V



THE ELBOW



Elbow-physical Assessment

- https://www.youtube.com/watch?v=rNXZlbamJuY elbow exam
- Elbow Joint Flexion, Extension, Supination, Pronation https://www.youtube.com/watch?v=Zx5I40jhvpA coursera video
- Elbow Anatomy Animated Tutorial
  - https://www.youtube.com/watch?v=3l3-5Ij3JZ8
- Evaluation of elbow pain in adults: http://www.aafp.org/afp/2014/0415/p649.html

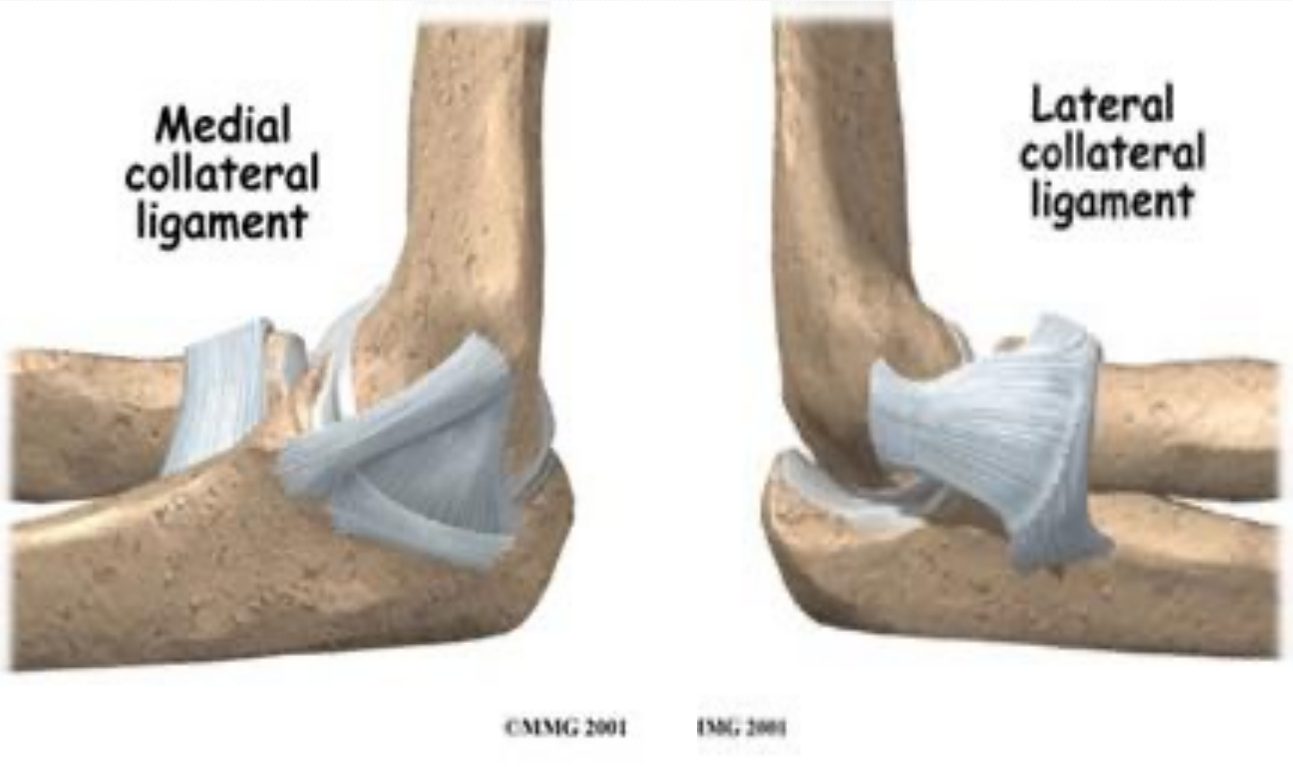
Selected Diagnostic Tests for Elbow Pain

- http://www.aafp.org/afp/2014/0415/p649.html

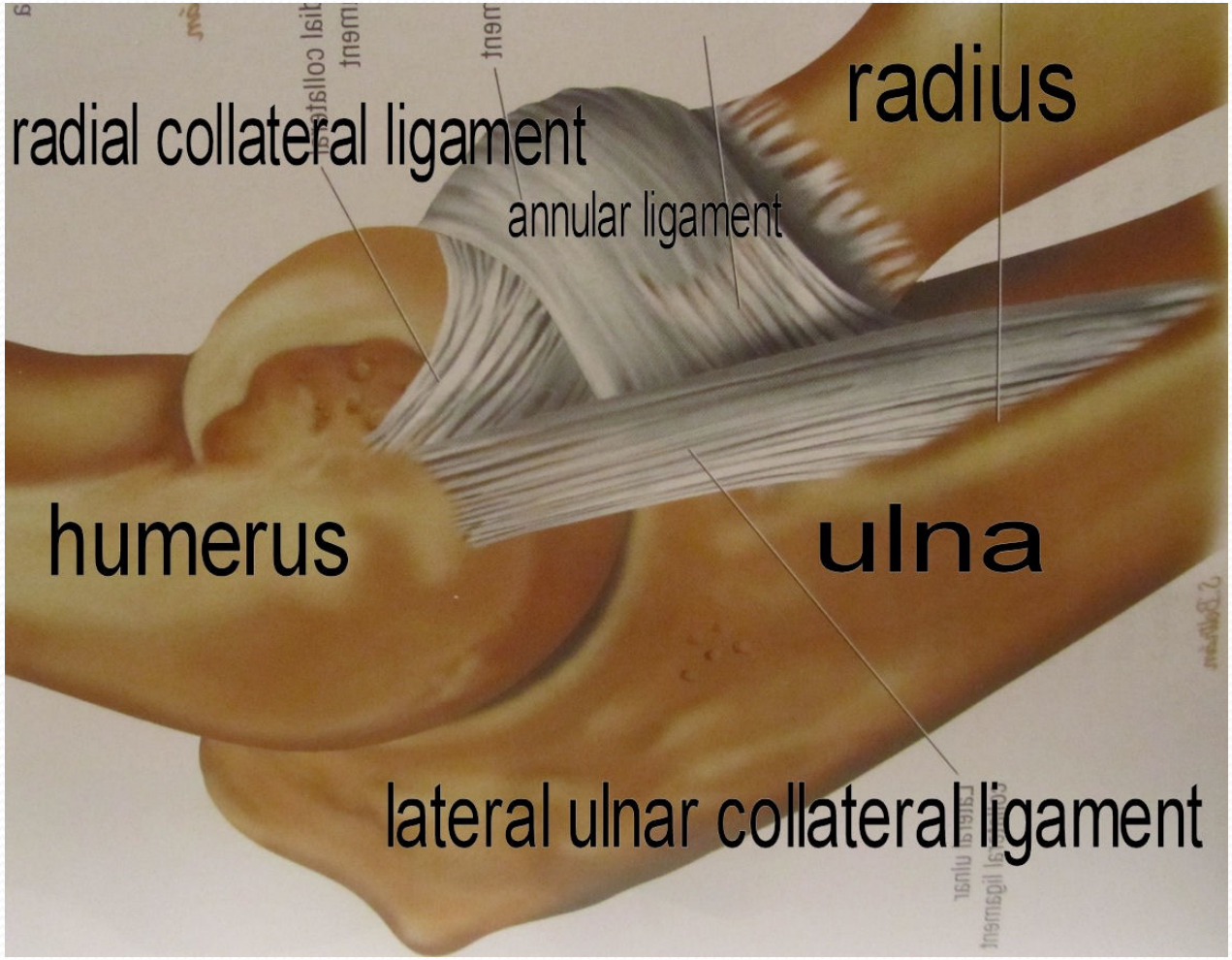
Current Concepts in Examination and Treatment of Elbow Tendon Injury Sports Health. 2013 Mar; 5(2): 186–194. doi: 10.1177/1941738112464761 PMCID: PMC3658379

- Injuries to the tendons of the elbow occur frequently in the overhead athlete, creating a significant loss of function and dilemma to sports medicine professionals. A detailed review of the anatomy, etiology, and pathophysiology of tendon injury coupled with comprehensive evaluation and treatment information is needed for clinicians to optimally design treatment programs for rehabilitation and prevention.

Elbow ligaments






radius
radial collateral ligament
annular ligament
humerus
ulna
lateral ulnar collateral ligament

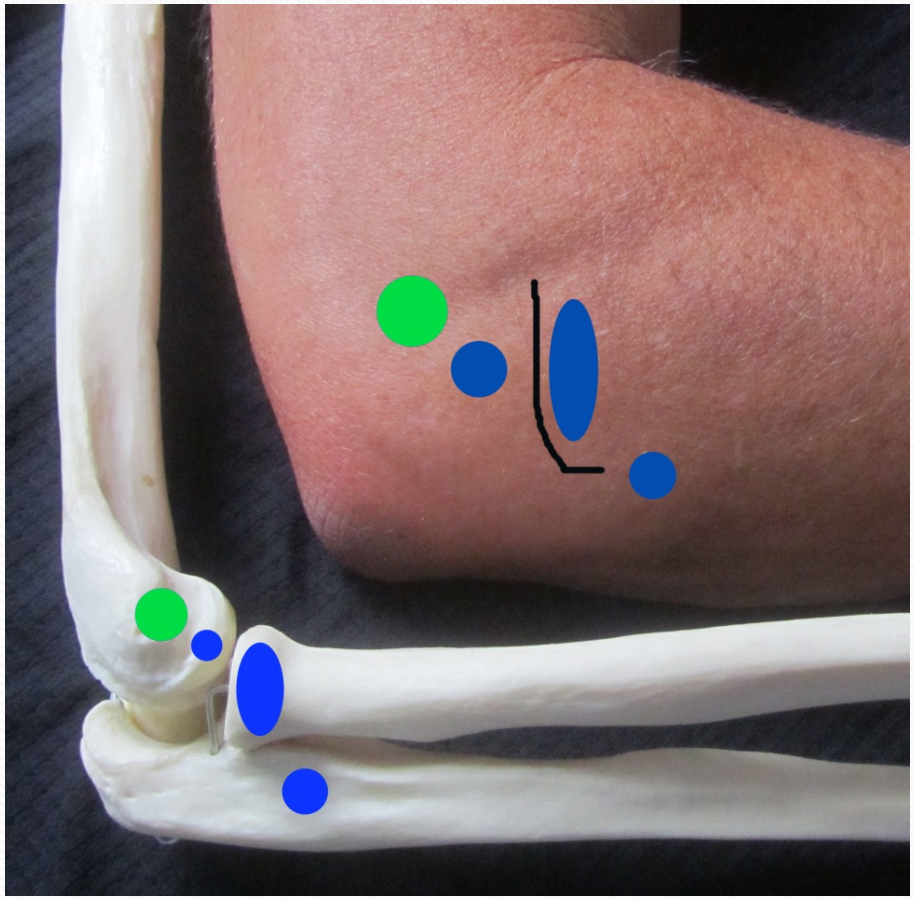
Drawing the Lateral Epicondyle



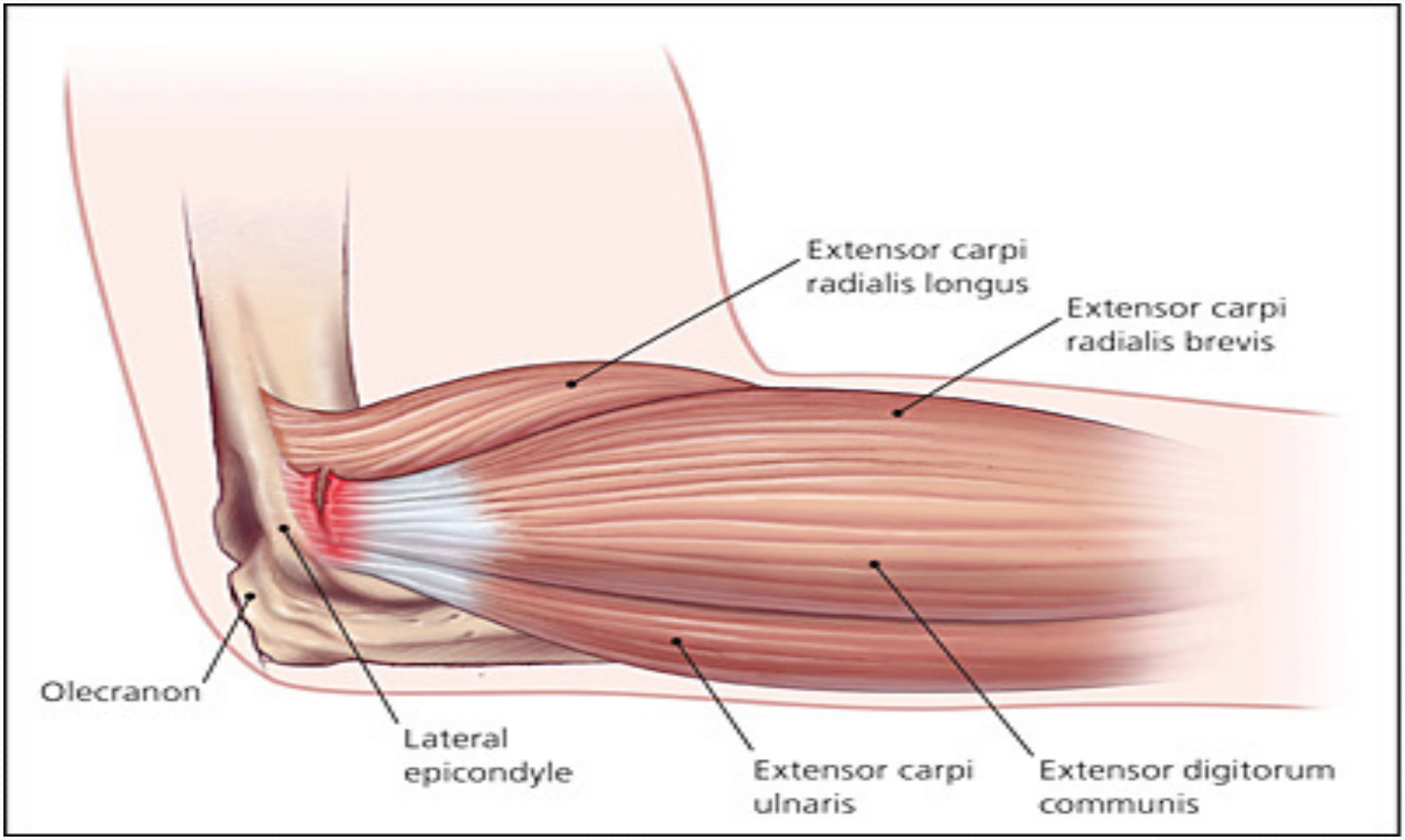
ATTACHMENTS LATERAL COLLATERAL LIGAMENT COMPLEX

Lateral Collateral Ligament Complex

1) Radial Collateral ligament
2) Lateral Ulnar Collateral ligament
3) Annular ligament

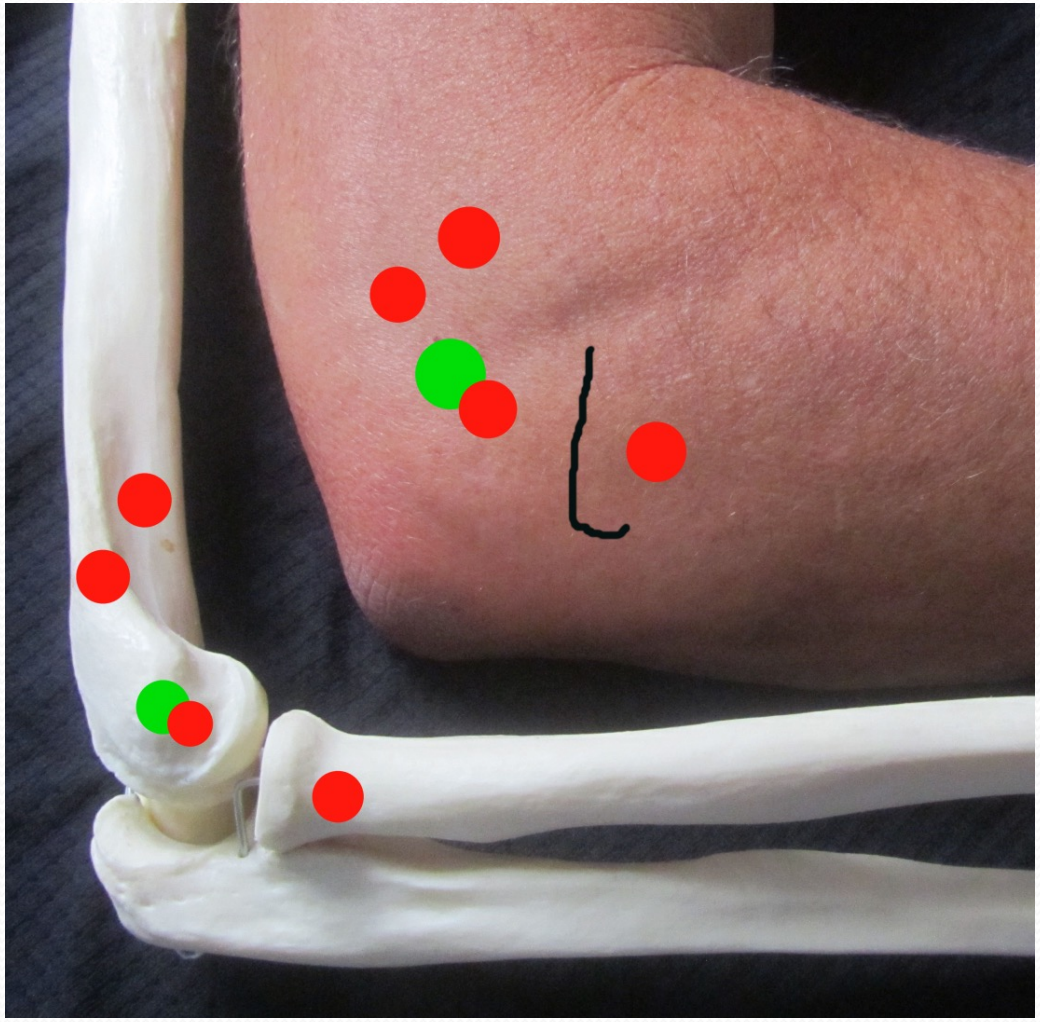


Lateral epicondyle and the origin of the common extensor tendon



http://www.aafp.org/afp/2014/0415/p649.html

Palpation of Lateral Tendons



PHYSICAL EXAMINATION OF THE LATERAL ELBOW

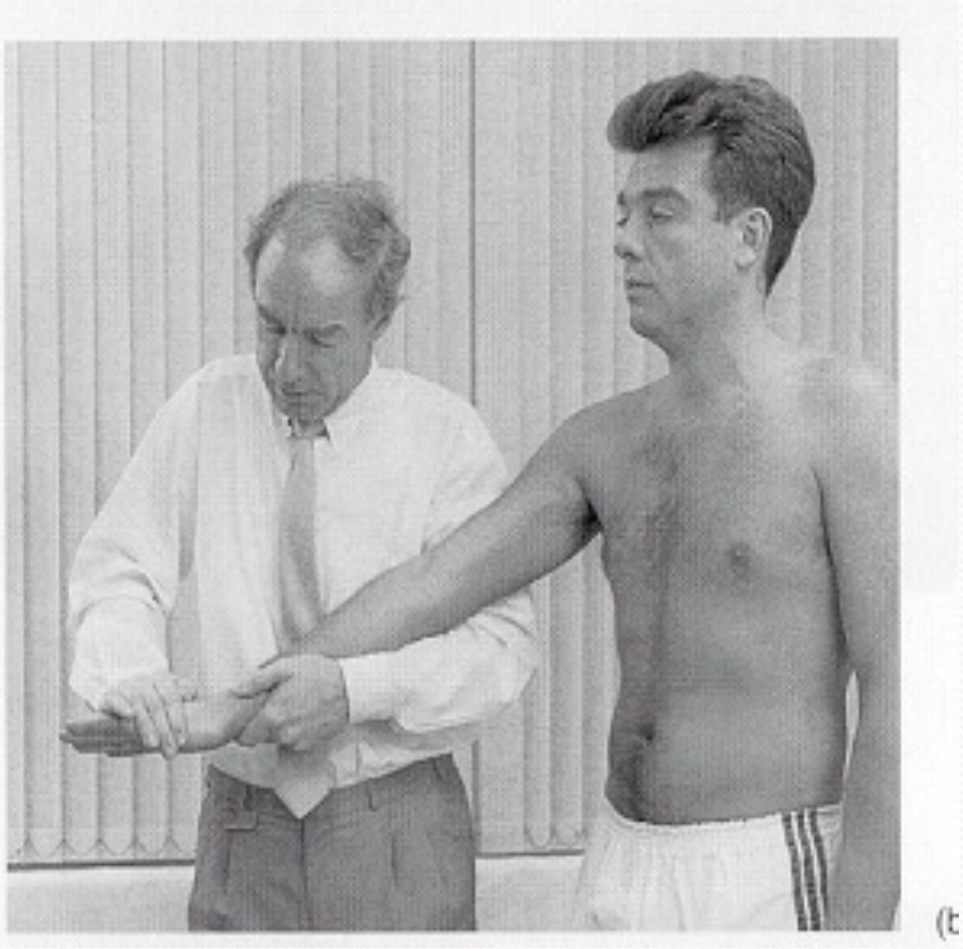
Lateral Epicondylosis

1) resisted wrist extension with the elbow in full extension

2) Hand grip strength with elbow in extension

3) Have patient point to pain

3) Palpation of tender areas



Treatment Options

- Prolotherapy- 15% Dextrose, 2mg Testosterone, P2G, Morrhuate
- Corticosteroid injection
- Physical Therapy
- PRP- especially if ligament or tendon torn on US
- PSI- can be done on acute or chronic injury for pain relief
- Ozone
- Mesotherapy-
- Acupuncture-
- BVT
- Manuel or Osteopathic treatment
- Adjunctive- Diet, Supplements, testosterone

PROLOTHERAPY TREATMENT OF LATERAL EPICONDYLOSIS

- Watch out for the radial nerve which lies just medial to the radial head and shaft. Injection done with forearm in pronation and radial nerve being pushed further medially
- Need to inject all painful spots
- Retest
- Consider intra-articular injection of prolo if patient not improving

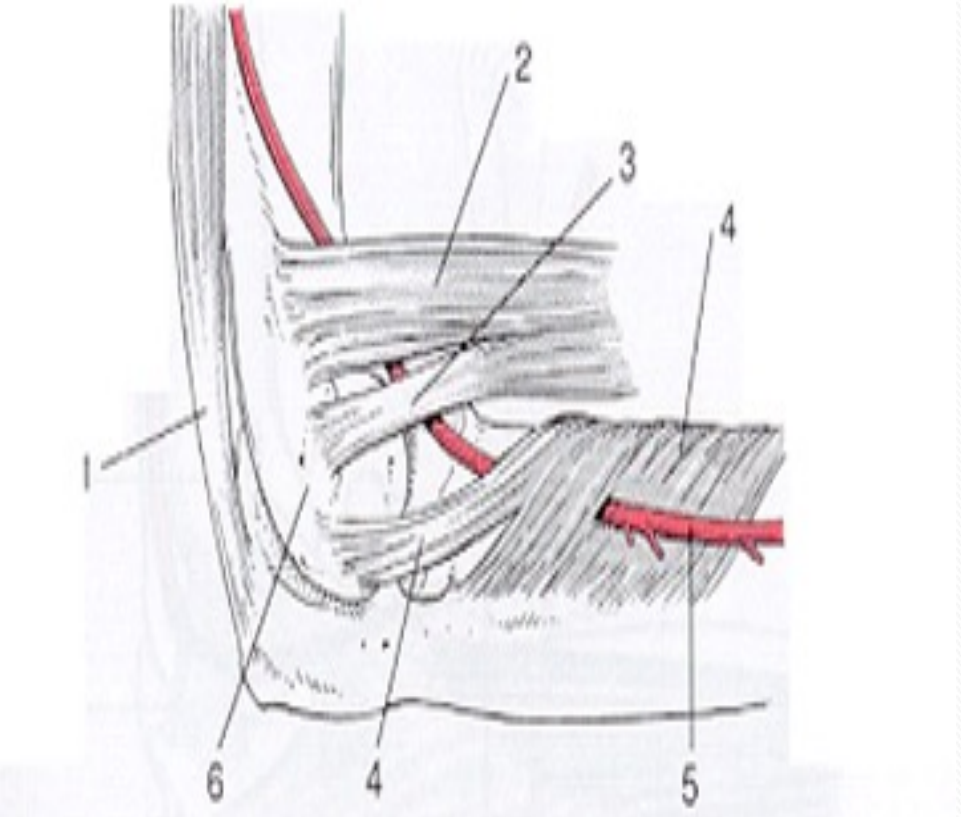


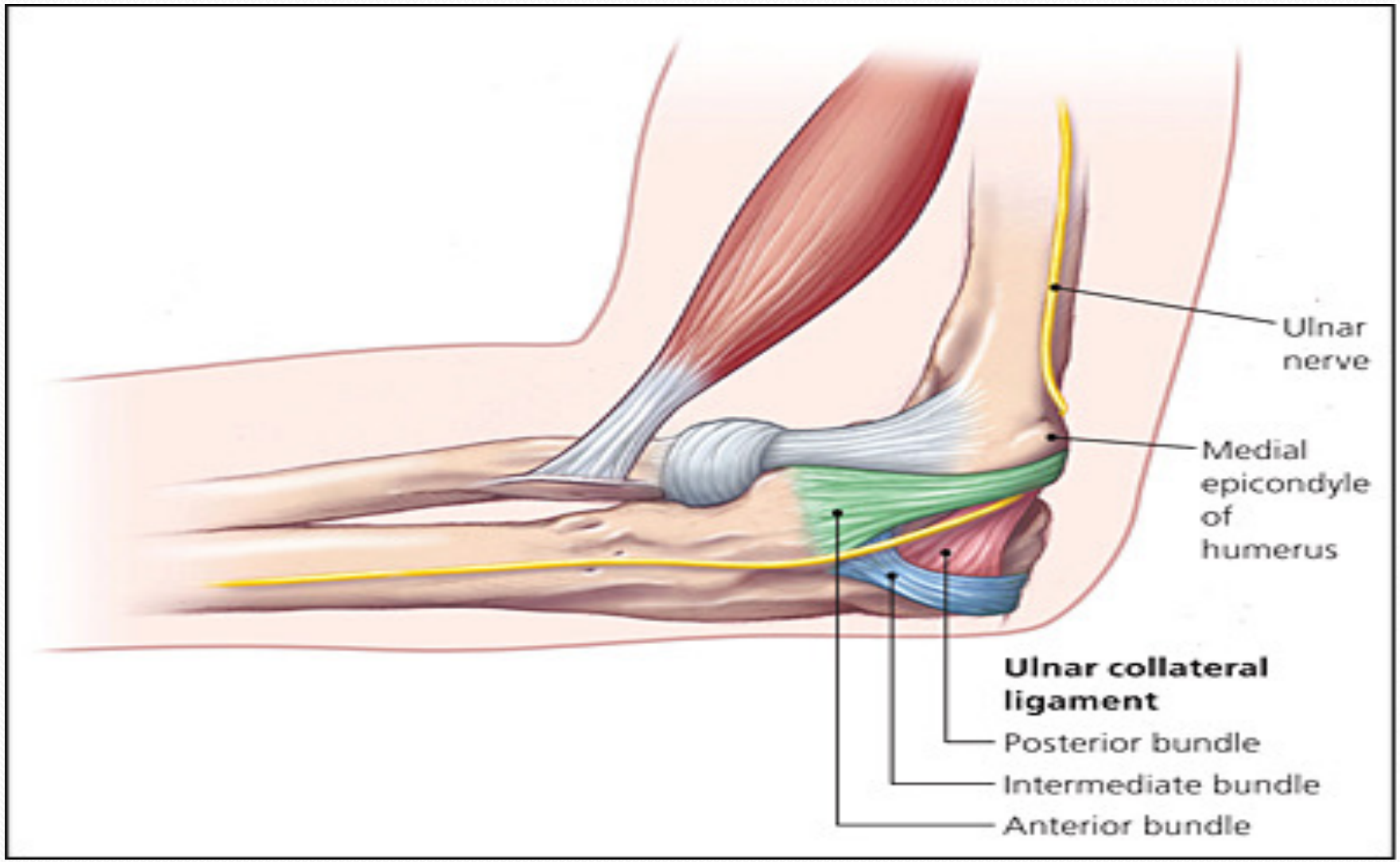
Figure 25.11 Lateral view of the extensors of the elbow: 1, triceps muscle; 2, extensor carpi radialis longus muscle; 3, extensor carpi radialis brevis muscle; 4, supinator muscle; 5, radial nerve; 6, lateral epicondyle.

Injection of Lateral Collateral Ligament Complex



- Push the radial nerve medially and inject more posteriorly than medially.
- Draw out the landmarks
- Stabilize the part to be injected.

Medial Elbow Anatomy



http://www.aafp.org/afp/2014/0415/p649.html

Course of Ulnar Nerve

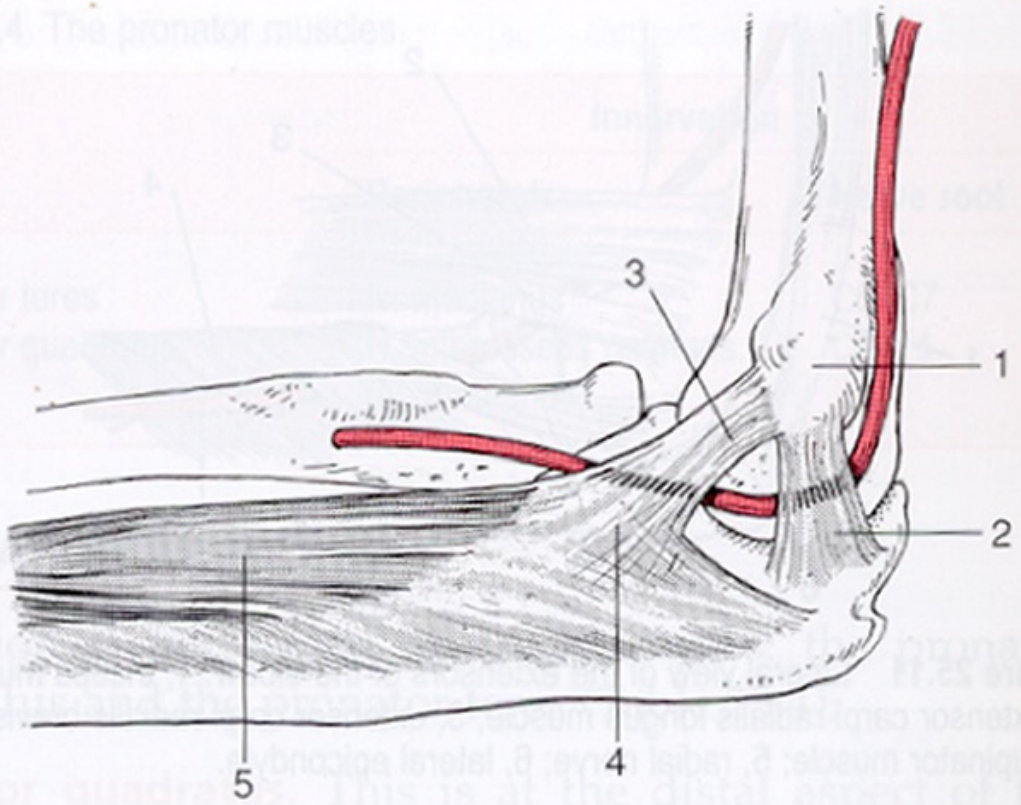
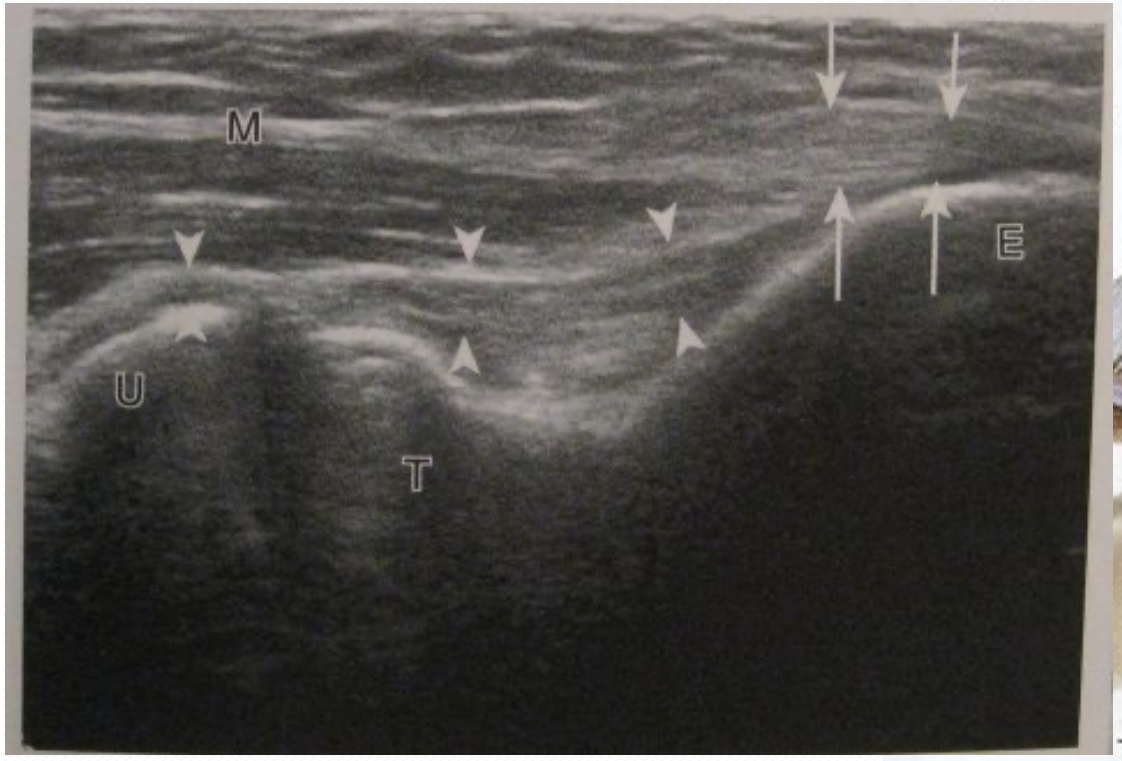
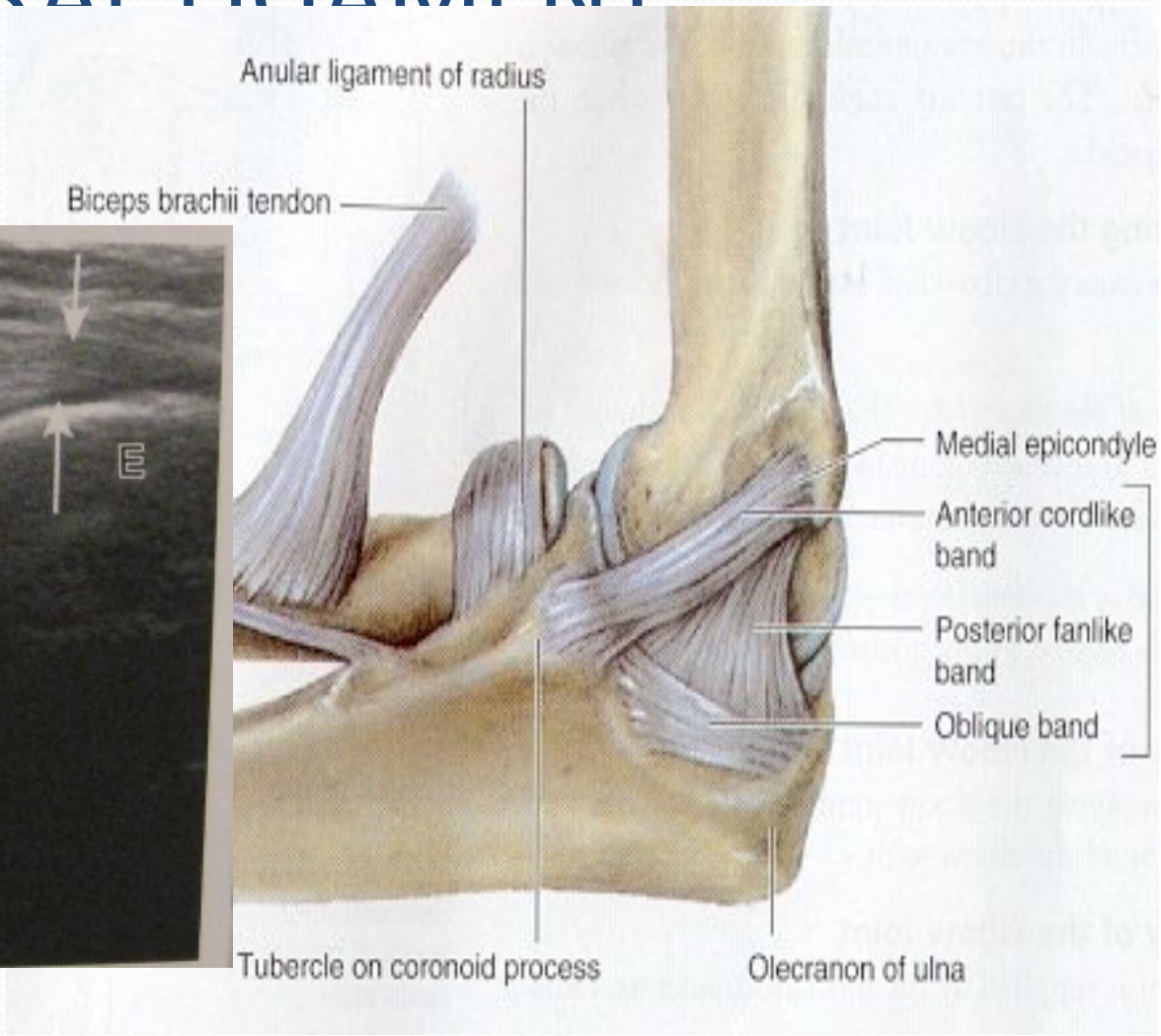


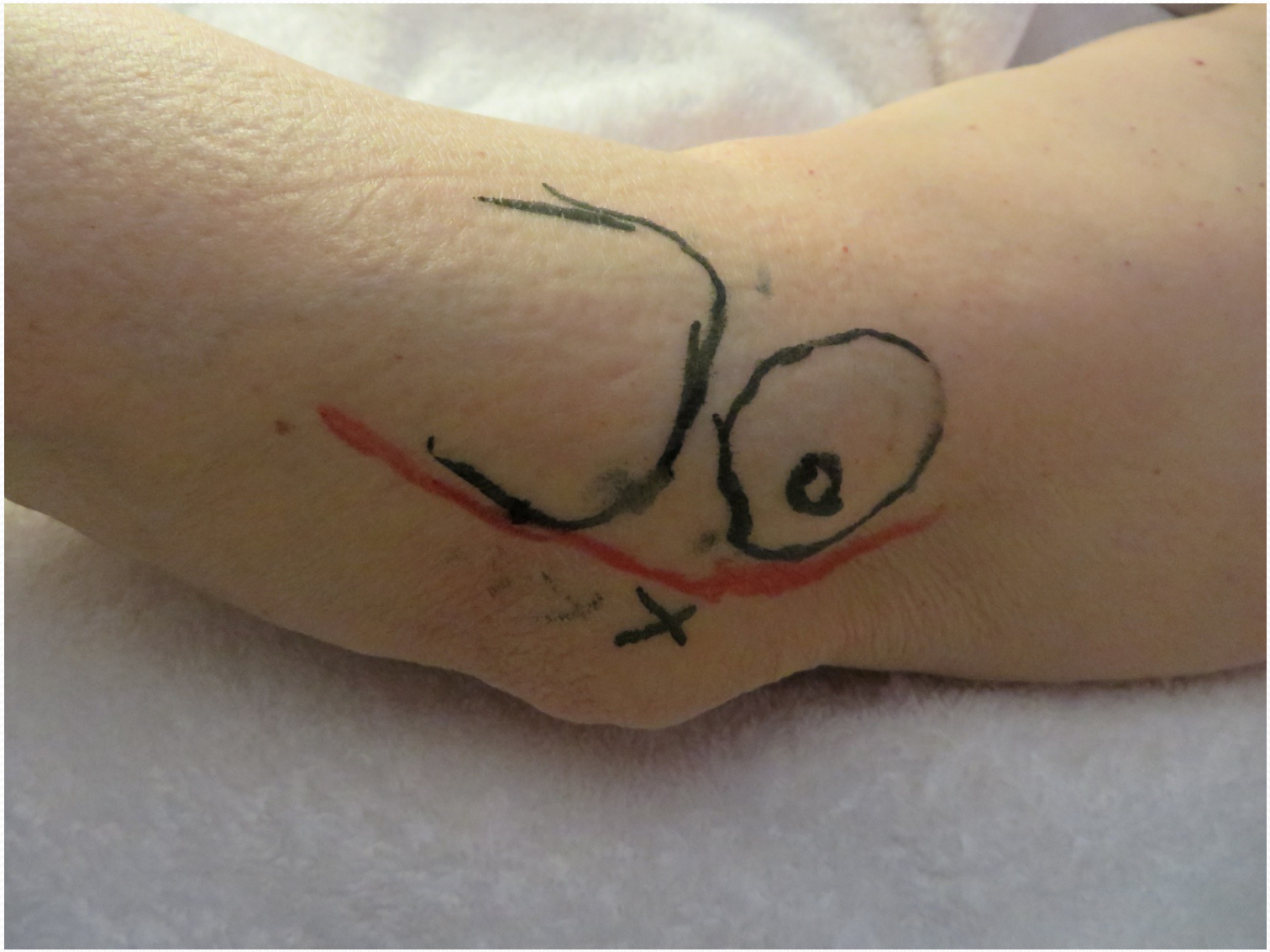
Figure 25.14 The course of the ulnar nerve through the cubital tunnel: 1, medial epicondyle; 2, medial collateral ligament (posterior part); 3, common flexor tendon; 4, aponeurotic arch; 5, flexor carpi ulnaris muscle.

ULNAR COLLATERAL LIGAMENT



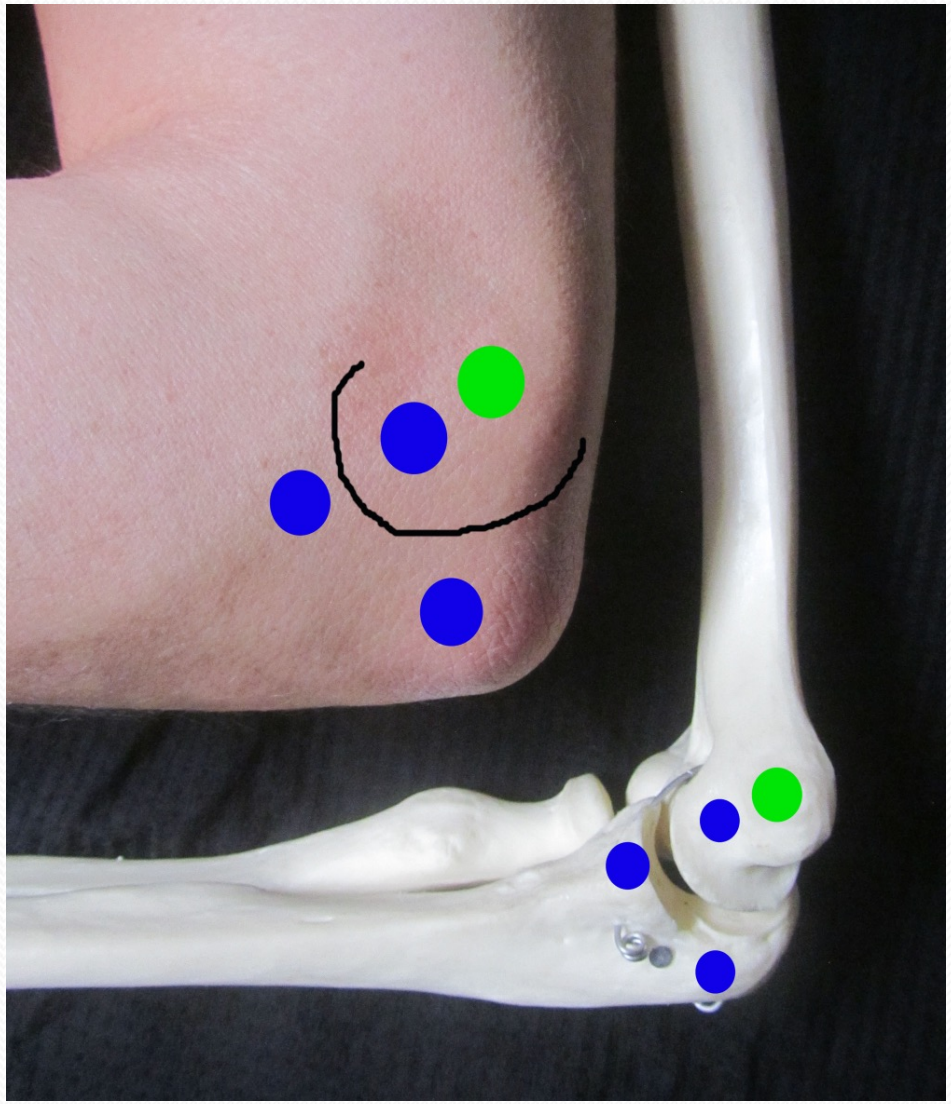


Drawing the Medial Epicondyle



Ulnar Collateral Ligament

- palpation of anterior, posterior and oblique bands origin and insertion
- Note the insertion of the posterior band of the UCL on the olecranon. It is tender at that point when injured.



PE of the UCL

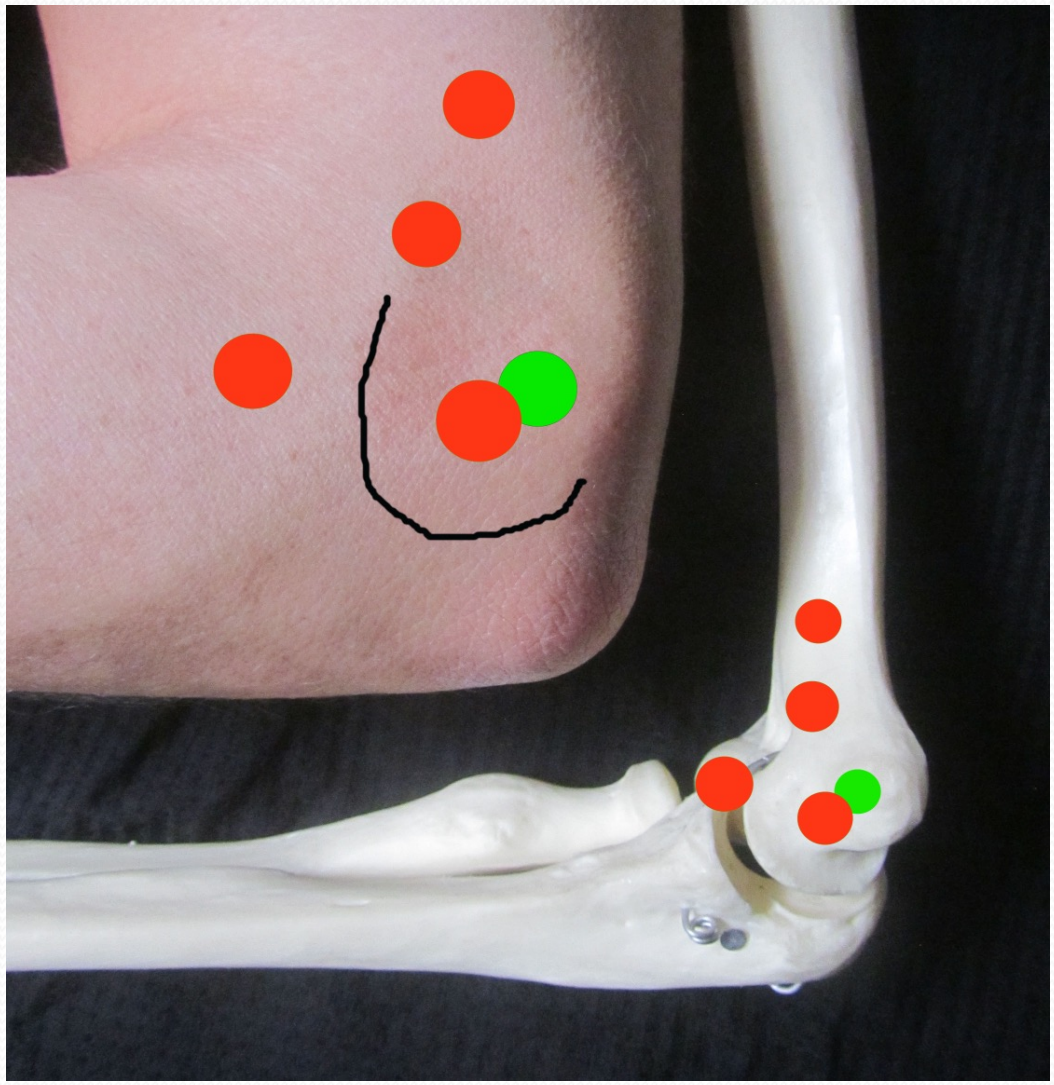
- valgus stress- milking maneuver



TENDONS OF THE MEDIAL ELBOW

Medial Epicondylosis

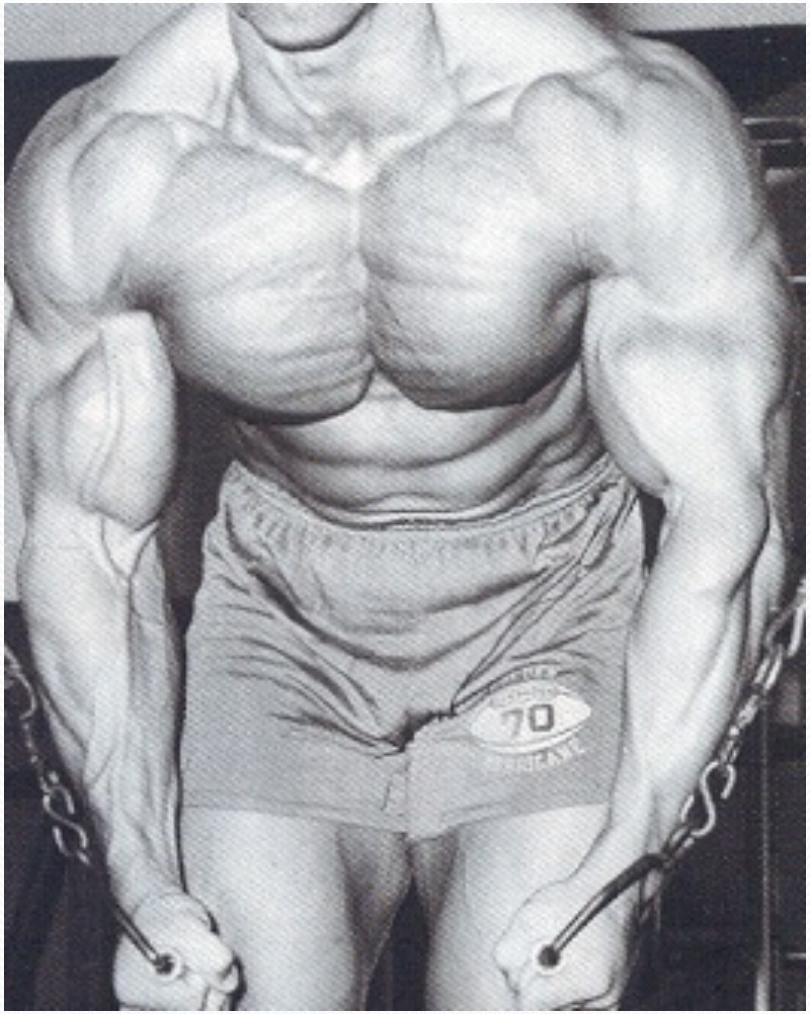
1) Anterior aspect of the medial epicondyle at the origin of the common flexor tendon.
2) 2 cm distal to medial epicondyle at musculo-tendinous junction



PHYSICAL EXAMINATION OF THE MEDIAL ELBOW

Medial Epicondylosis causes pain with

1) resisted wrist flexion with the elbow in extension
2) hand grip with the elbow in extension
3) direct palpation



Treatment Options

- Prolotherapy- 15% Dextrose, Testosterone, P2G, Morrhuate
- NSAIDS
- Cortico steroids
- Physical therapy
- PRP- especially if ligament or tendon torn on US
- PSI- can be done on acute or chronic injury for pain relief
- Ozone
- Mesotherapy-
- Acupuncture-
- BVT
- Manual or Osteopathic treatment
- Adjunctive- Diet, Supplements

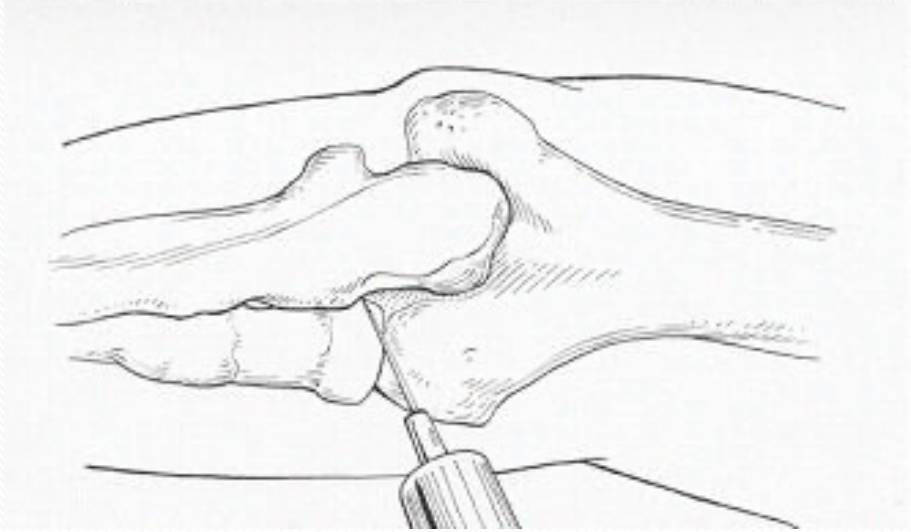
INJECTION TECHNIQUE MEDIAL EPICONDYLE

- Place fingers to isolate area to be injected and protect the nerve
- Drop straight down on the center of epicondyle to sound the depth
- 25 or 27 gauge needle
- Inject ½ -1 cc to tendons by peppering tissue.
- Work needle to superior and inferior end of epicondyle until numb and not painful on testing



Intra-articular Injection

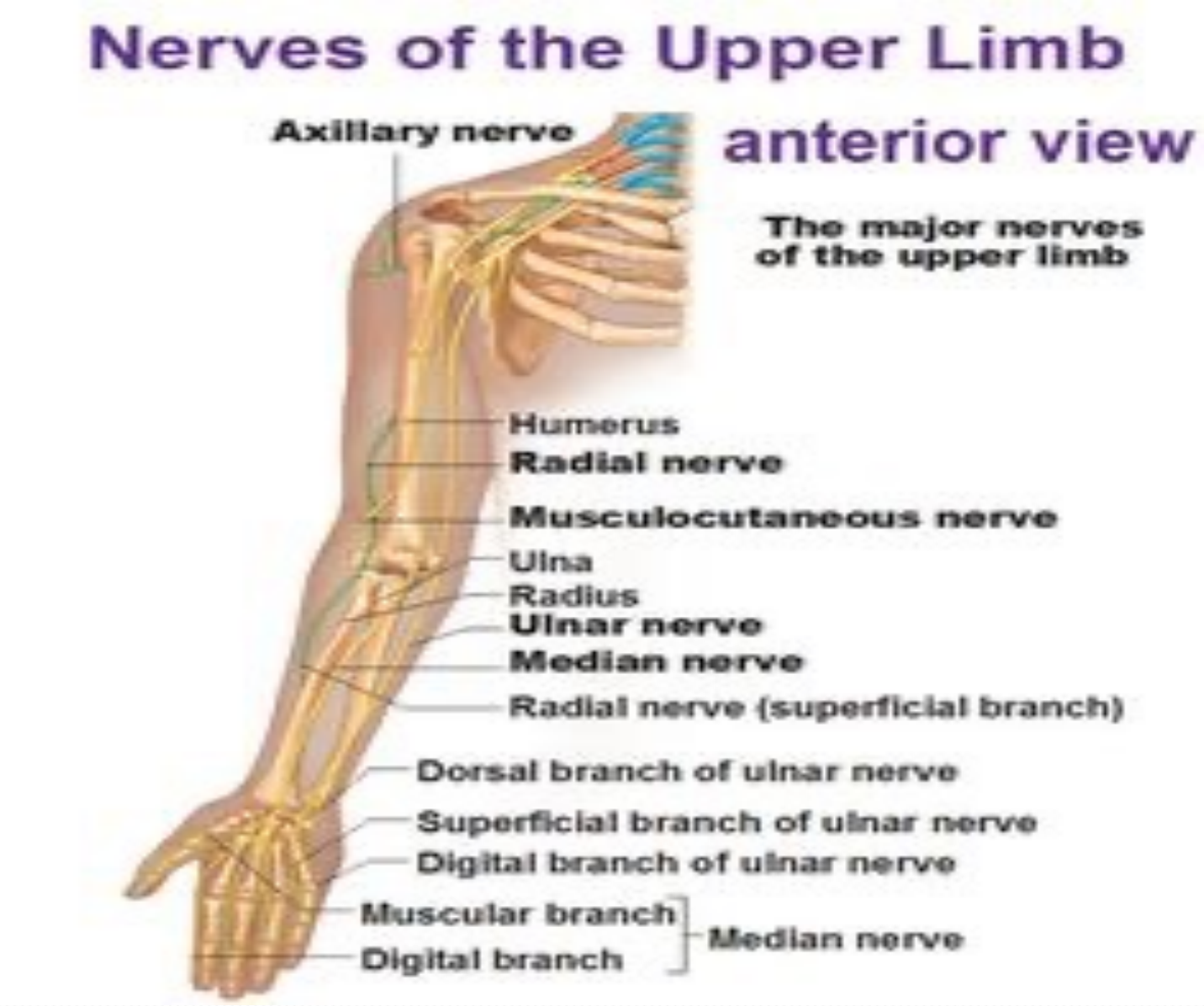




Alternative IA Injection



Structures to avoid-nerves

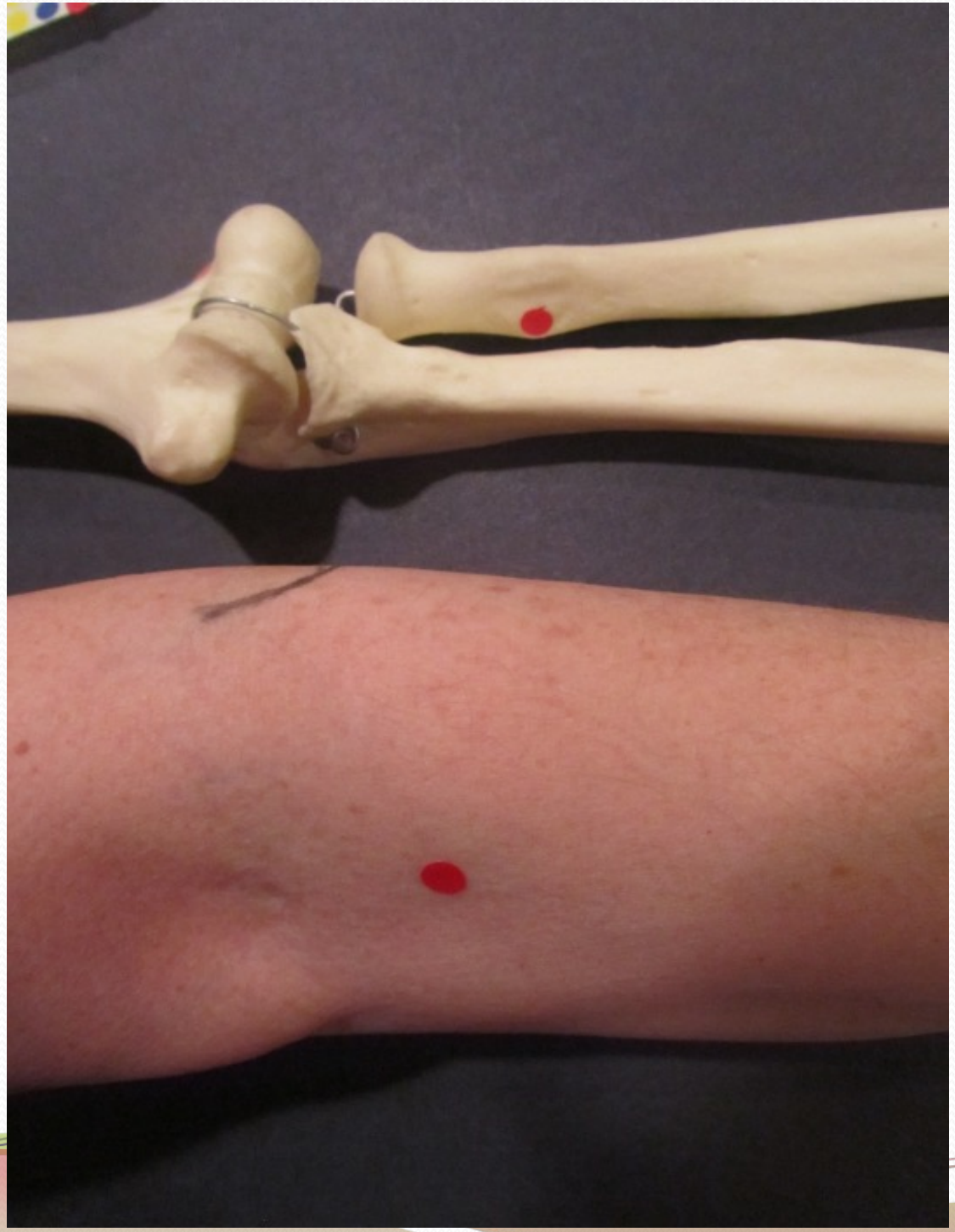


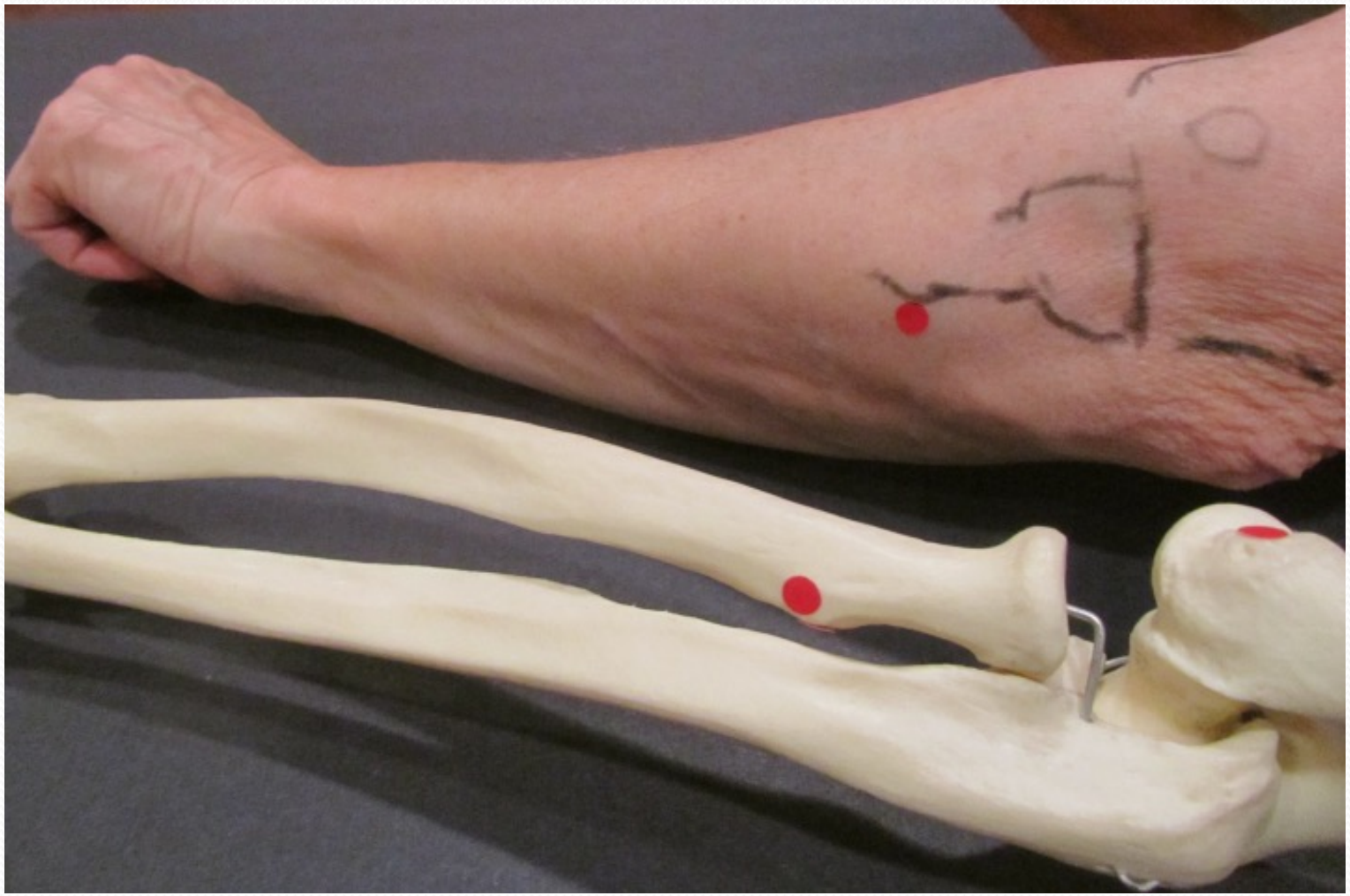
BICEPS BRACHII TENDINOSIS

Diagnosed by

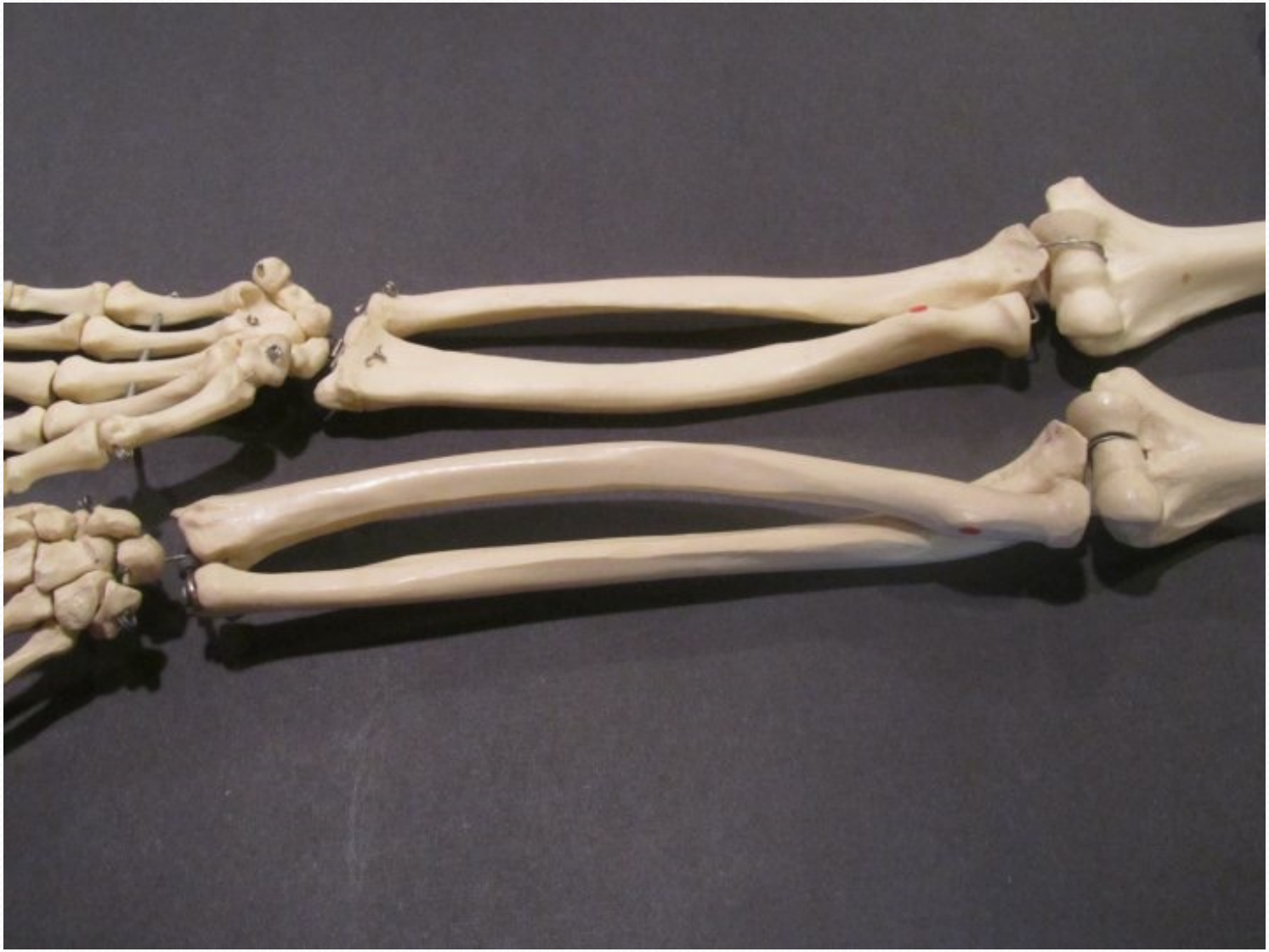
1) Pain and tenderness at radial tuberosity
2) Pain at the anterior elbow with passive forearm pronation
3) Pain with resisted elbow flexion and forearm supination

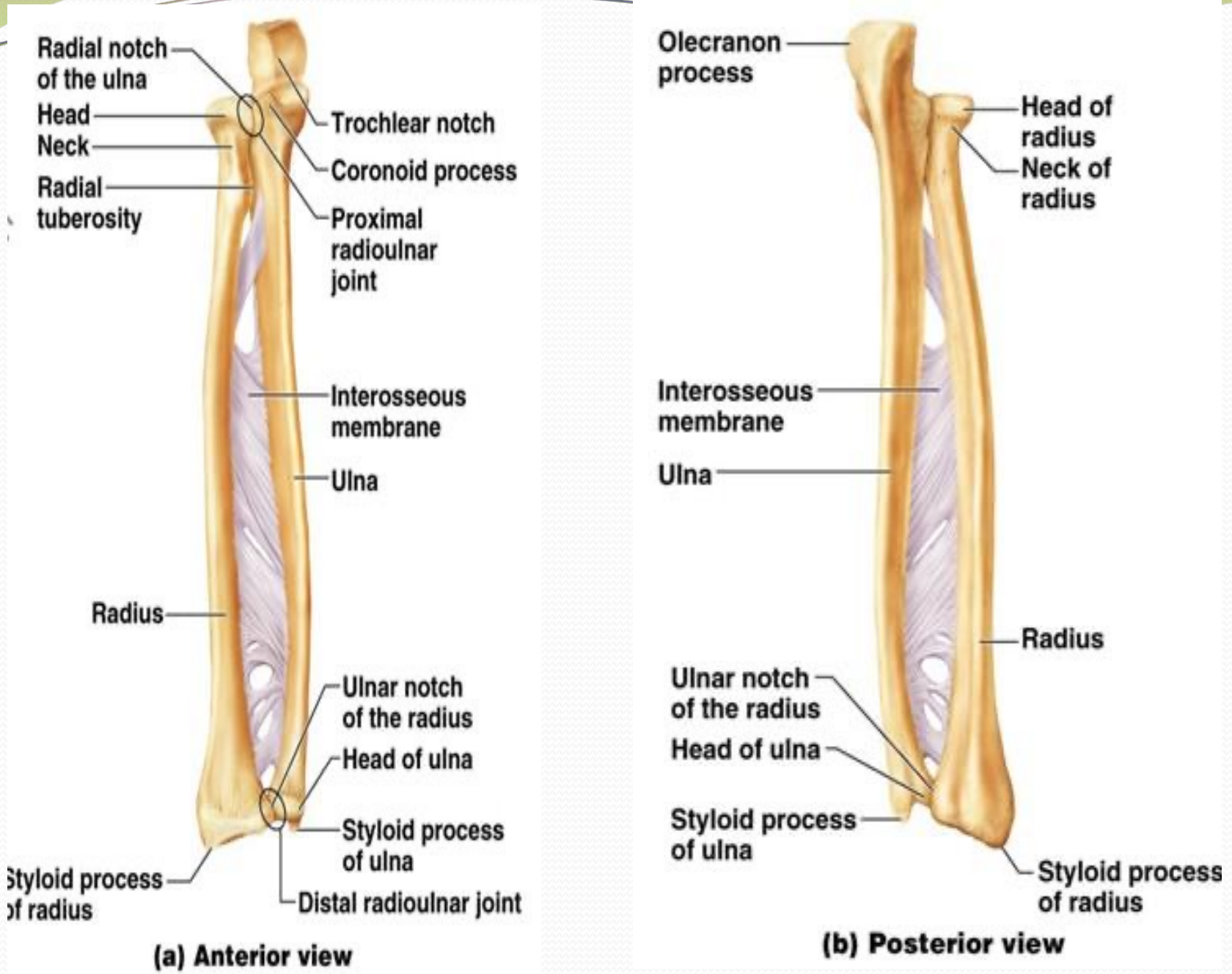






Biceps insertion with Pronation




Radial notch of the ulna
Head
Neck
Radial tuberosity
Trochlear notch
Coronoid process
Proximal radioulnar joint
Interosseous membrane
Ulna
Radius
Ulnar notch of the radius
Head of ulna
Styloid process of ulna
Styloid process of radius
Distal radioulnar joint
(a) Anterior view
Olecranon process
Head of radius
Neck of radius
Interosseous membrane
Ulna
Radius
Ulnar notch of the radius
Head of ulna
Styloid process of ulna
Styloid process of radius
(b) Posterior view

SHOULDER





A Remarkable Joint- Tensegrity



Targets for Drawing and Injection-

a partial listing

1. Sterno-clavicular joint
2. Acromioclavicular joint
3. Coraco-clavicular and Coraco-acromial Ligament
4. Acromion
5. Lessor tubercle and subscapularis
6. Greater tubercle and supraspinatus insertion
7. Infraspinatus insertion on greater tubercle
8. Intra-articular injection point
9. Posterior inferior gleno-humeral ligament
10. Levator scapulae insertion

Shoulder prolotherapy

- Intrarticular Injection
- Rotator Cuff Insertions of greater tubercle
- AC joint and ligaments
- Subacromial injection

Shoulder examination

- Shoulder Anatomy Animated Tutorials
  - https://www.youtube.com/watch?v=D3GVKjeY1FM&list=PLdFi-NEDU0HcJLwxK7Jn4kbvx-BUEDwPb&index=5
  - https://www.youtube.com/watch?v=f9kYF8K0HSs shoulder and neck exam
- Evidence Based Examination of the Shoulder https://www.amssm.org/2014_Annual_Meeting/SESSION%207/Session-7_O'Kane.pdf
  - Int J Sports Phys Ther. 2013 Aug;8(4):427-40.
- **A proposed evidence-based shoulder special testing examination algorithm: clinical utility based on a systematic review of the literature.**
  - http://www.ncbi.nlm.nih.gov/pubmed/24175129

Physical Exam

- Start with the neck and clear it

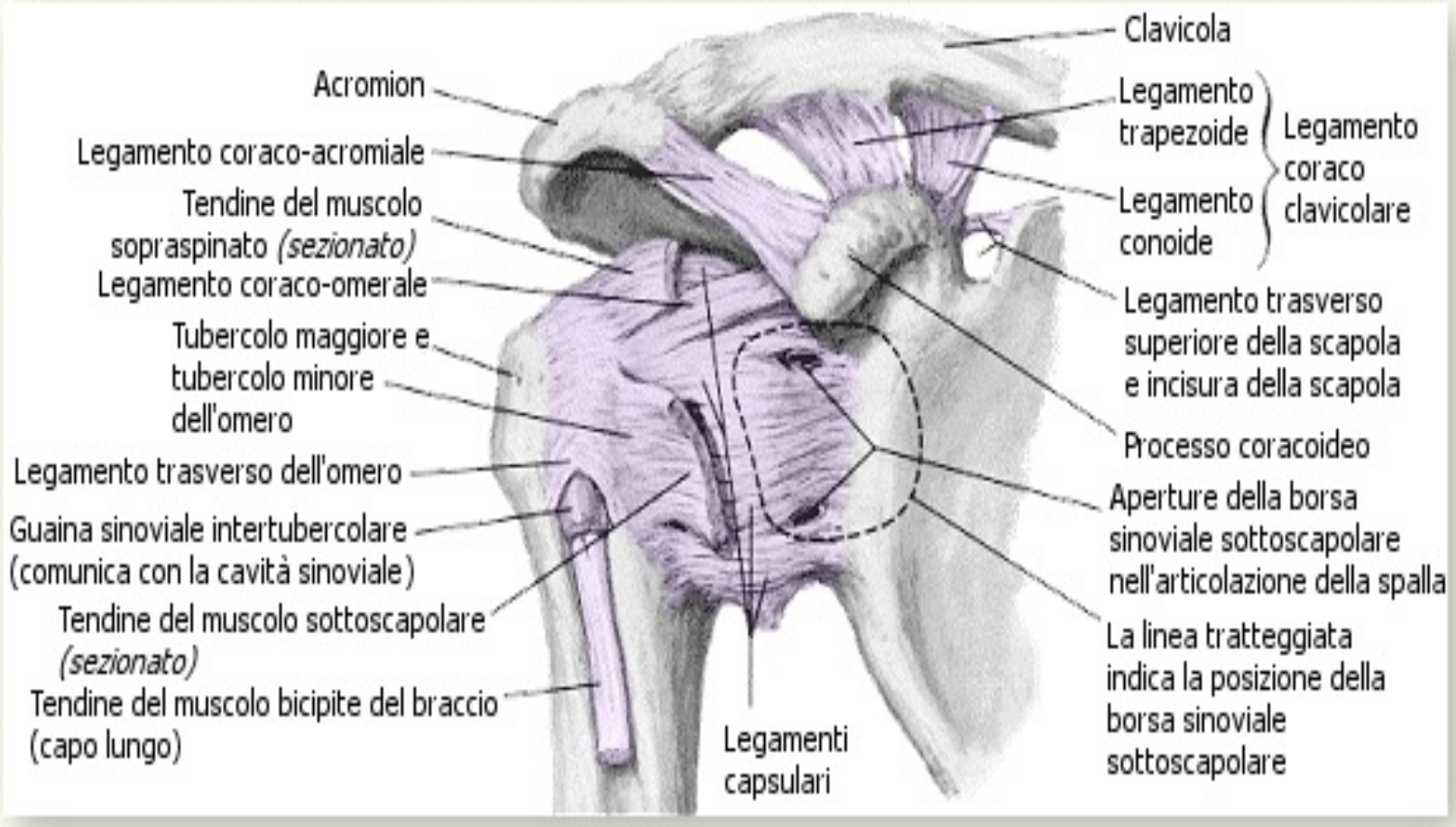
Then examine the shoulder

- Active and Passive ROM
- Flexion
- Abduction
- External Rotation in Neutral and 90 Abduction
- Internal Rotation in Neutral and 90 Abduction
- Adduction

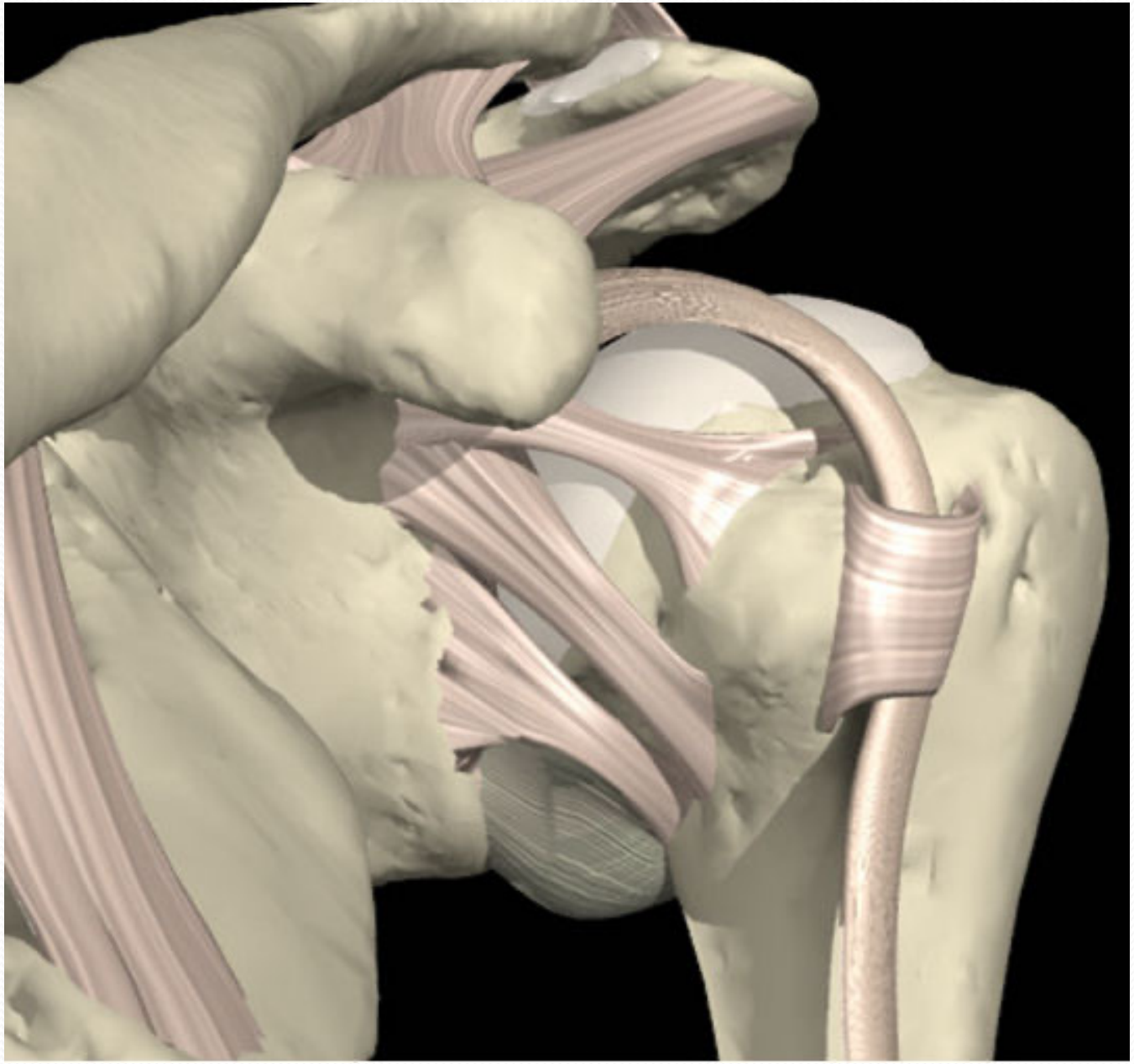
Note degree of motion and location of pain or other symptoms.

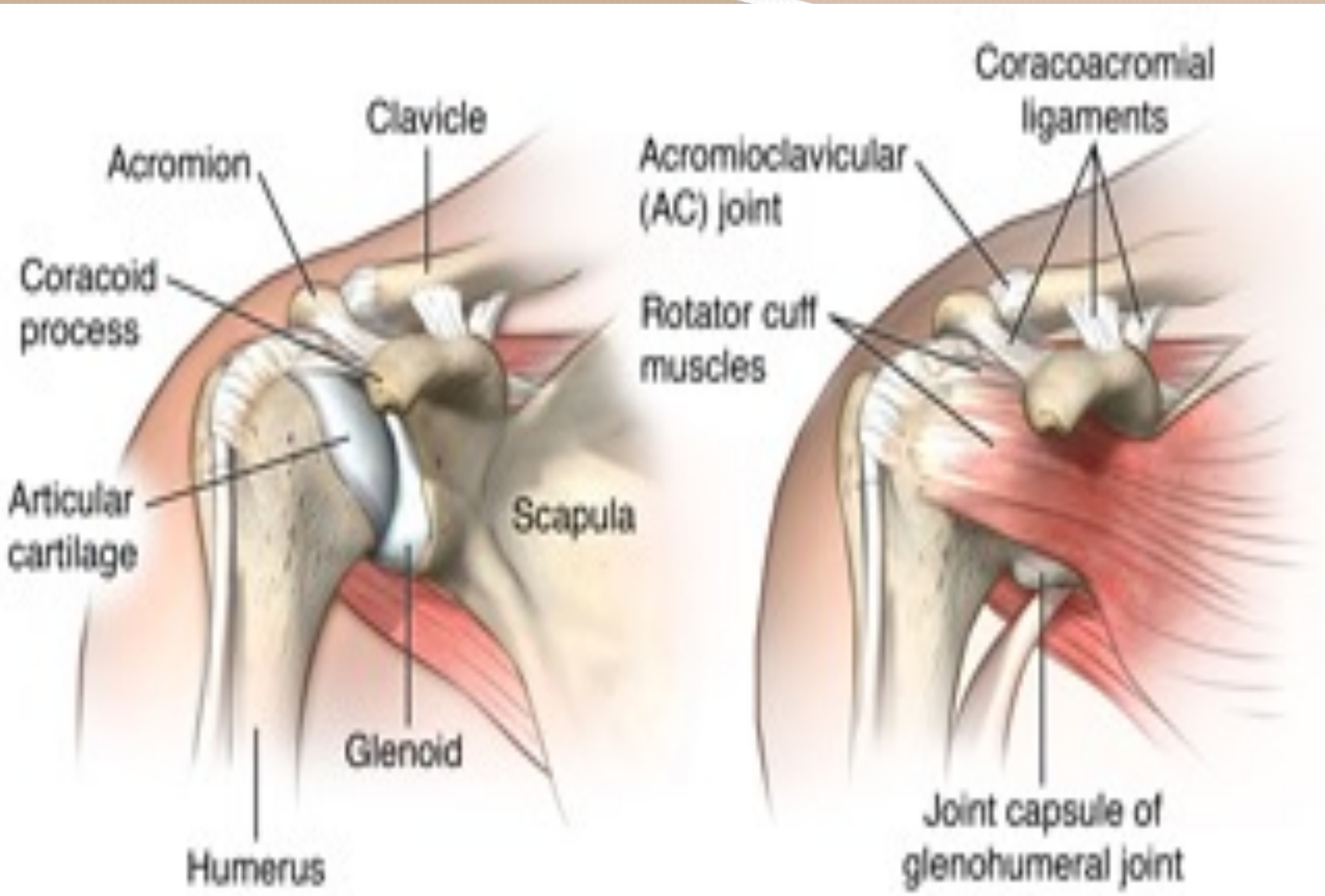
After you finish injecting the right structure(s) these motions should be improved and/or painless.

Shoulder ligaments



Anterior Shoulder Ligaments





Shoulder anatomy

Anterior Shoulder with the Biceps tendon in External Rotation



Scapular Spine and Superior Medial Angle



Thoracic Outlet and Acromion

