SCS Continuing Education
and
Three Phase CEUs
presents:

Anatomy and Radiography of the Wrist, Hand, and Fingers

by Shane Smith PTA, RT(R)

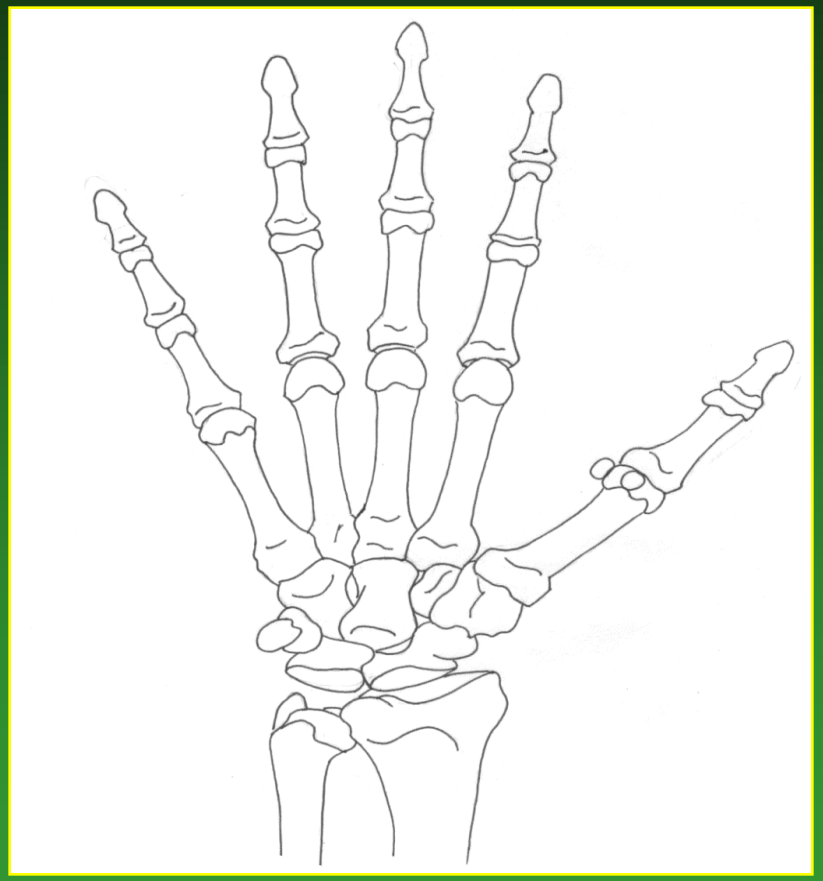
Introduction:

Hello and welcome to this program from SCS Continuing Education! Knowledge is the key to success for ourselves and our patients. This easy-to-use point and click program allows you to navigate through text and visual aides designed to provide a comprehensive view of the material covered. Please feel free to contact Shane Smith at ceuarmy@yahoo.com if you have any questions.

Course Abstract and Objectives:

The objective of this home study course is to provide the learner with a computer based tutorial that will give them the means to learn the anatomy and radiography of the wrist, hand and fingers. A mastery test will be administered at the end of this home study course in order to ensure that competency of the material has been achieved.

Anatomy and Radiography of the Wrist, Hand and Fingers



by Shane Smith PTA, RT(R)

CHAPTERS:

Fundamentals of the Wrist and Hand

Fundamentals of the Wrist and Hand:

In a rested position, the palm of the hand is concave. The thumb is located **90°** to the fingers and is of particular importance to the dexterity of the hand. Functional position of the wrist and hand has been determined to be:

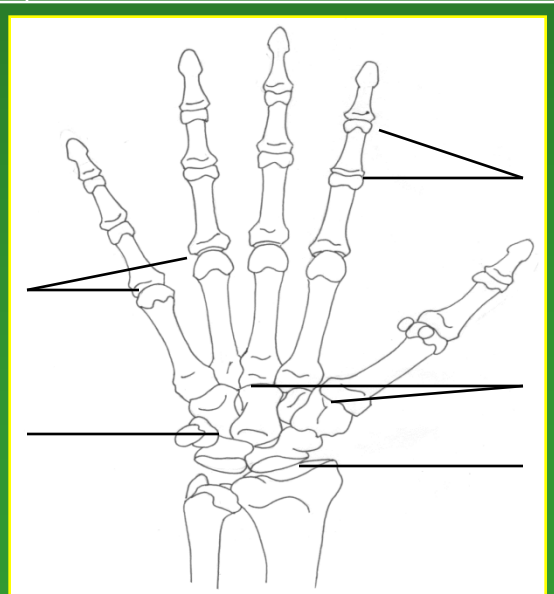
- **wrist complex**: **20° extension** and **10° ulnar deviation**
- **MCP joint**: **45° flexion**
- **PIP joint**: **30° flexion**
- **DIP joint**: **slight flexion**

Let's review the type of joints involved in the wrist and hand:

1. **ellipsoid (ovoid) joint**: oval surface of one bone fits into an elliptical cavity of another; biaxial, typically flexion/extension and abduction/adduction.
2. **gliding joint**: side to side or front to back slipping between nearly flat bones.
3. **hinge joint**: monaxial; flexion/extension.
4. **saddle joint**: biaxial; both bones contain concave and convex portions.
5. **synovial joint:** diathrotic; allows one or more types of free movement; contain articular cartilage, synovial fluid, synovial membrane and a fibrous capsule.

Fundamentals of the Wrist and Hand:

Joint	Bones involved	Type
radiocarpal (wrist)	**radius** and **carpals**	**synovial; ellipsoid**
intercarpal	**adjacent carpals**	**synovial; gliding**
carpometacarpal (digits **2-5**)	**carpals** and **metacarpals**	**synovial; gliding**
carpometacarpal (thumb)	**trapezium** and **1st metacarpal**	**synovial; saddle**
metacarpophalangeal	**metacarpal** and **proximal phalanx**	**synovial; gliding**
interphalangeal	**adjacent phalanges**	**synovial; hinge**



Bony Anatomy

Bony Anatomy:

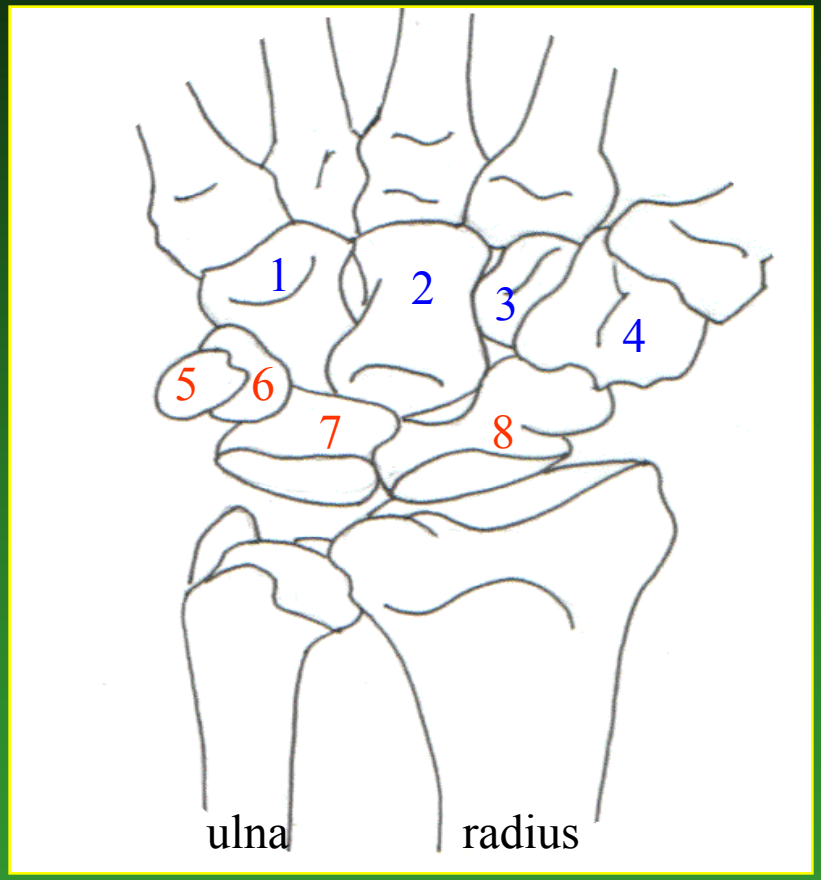
Let's begin by reviewing the bones of the right wrist in **anatomical** position:

Distal Row:

1. Hamate (unciform)
2. Capitate (os magnum)
3. Trapezoid (lesser multangular)
4. Trapezium (greater multangular)

Proximal Row:

5. Pisiform
6. Triquetral (triquetrum)
7. Lunate (semilunar)
8. Scaphoid (navicular)



Note: the ulna is not considered part of the wrist complex and is named for identification purposes only.

Bony Anatomy:

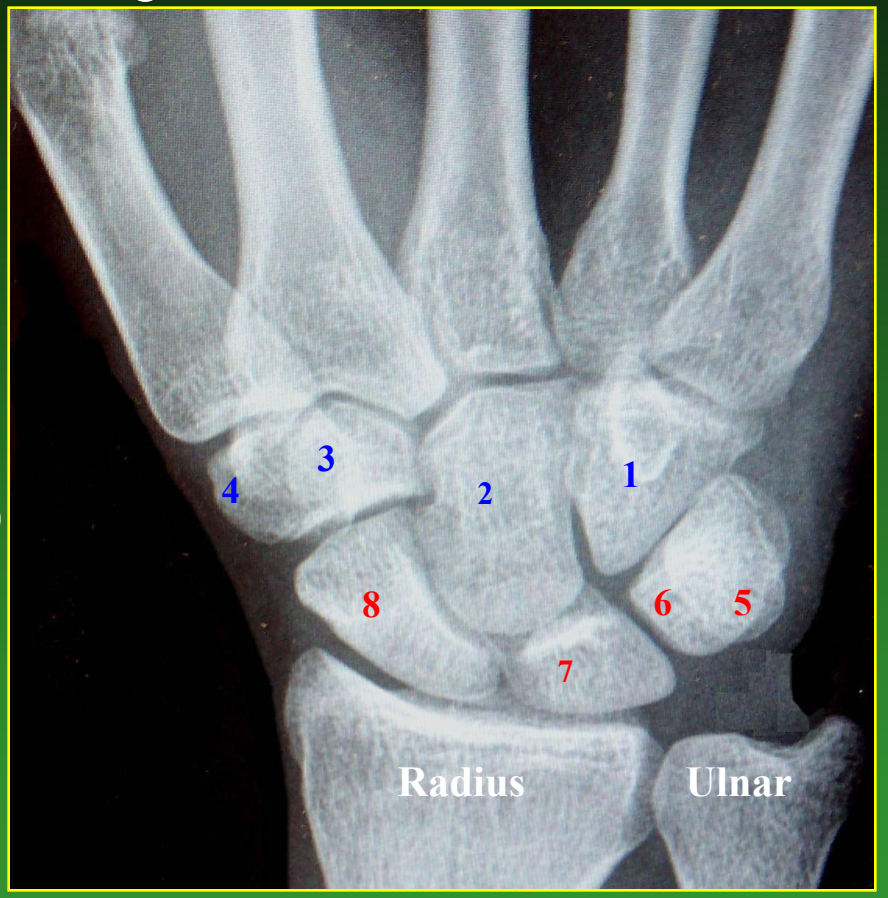
Let's identify the bones of this PA view of the right wrist:

Distal Row:

1. Hamate (unciform)
2. Capitate (os magnum)
3. Trapezoid (lesser multangular)
4. Trapezium (greater multangular)

Proximal Row:

5. Pisiform
6. Triquetral (triquetrum)
7. Lunate (semilunar)
8. Scaphoid (navicular)



Note: The PA wrist is obtained when the patient's hand is in a palm down position. This is not anatomical position

Bony Anatomy:

Now let's review the bones of the right hand in **anatomical** position:

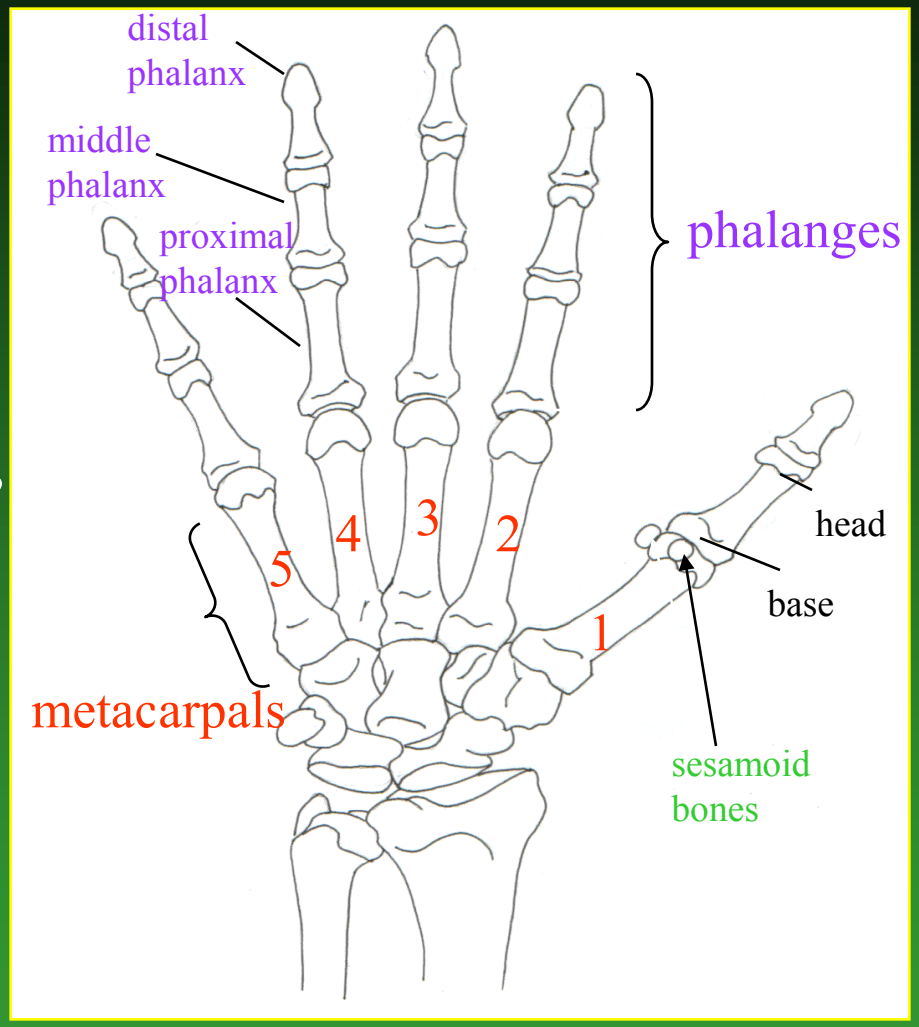
Metacarpals:

There are 5 metacarpals in the hand.

Phalanges:

Digits 2-5 have a proximal, middle and distal phalanx. The thumb (**pollicis**) does not consist of a middle phalanx, however, it does have two **sesamoid** bones.

- Both the Metacarpal and Phalanx have articulating surfaces; the **head** distally and the **base** proximally.



Bony Anatomy:

Let's review the bones of the left hand x-ray in this **PA** position:

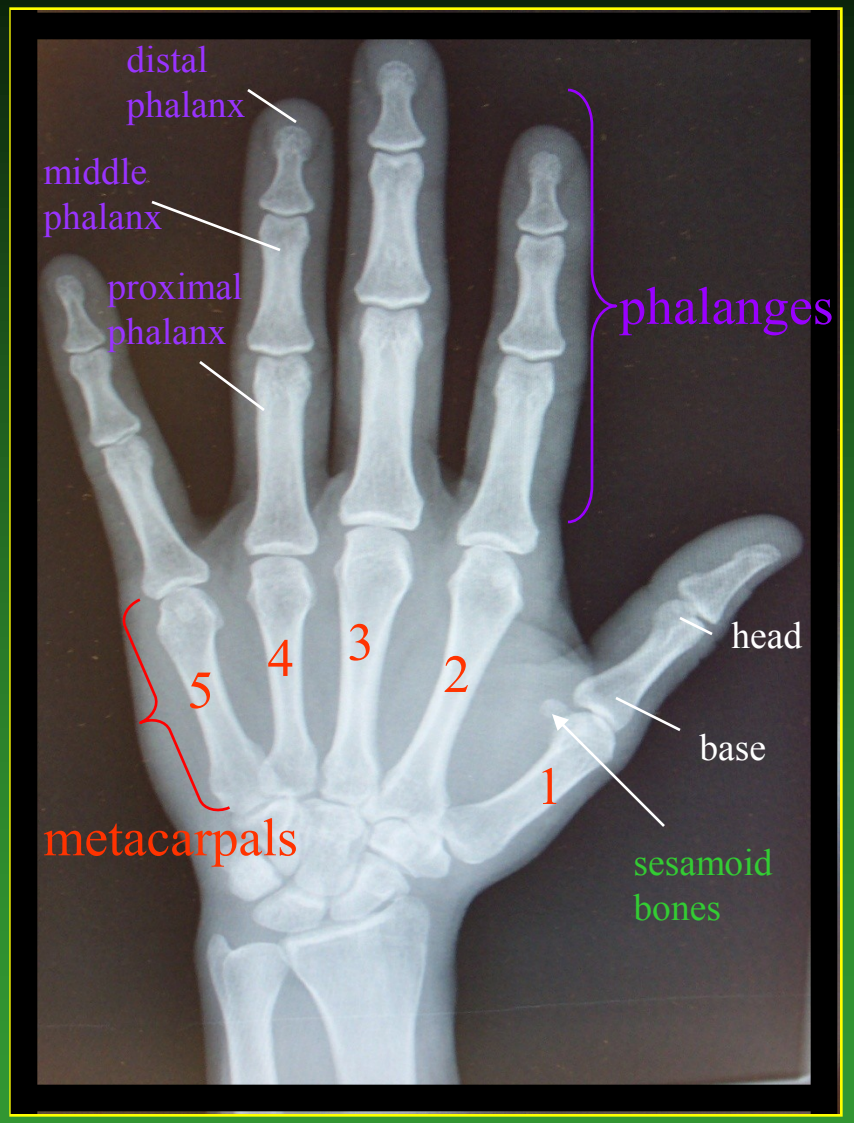
Metacarpals:

There are 5 metacarpals in the hand.

Phalanges:

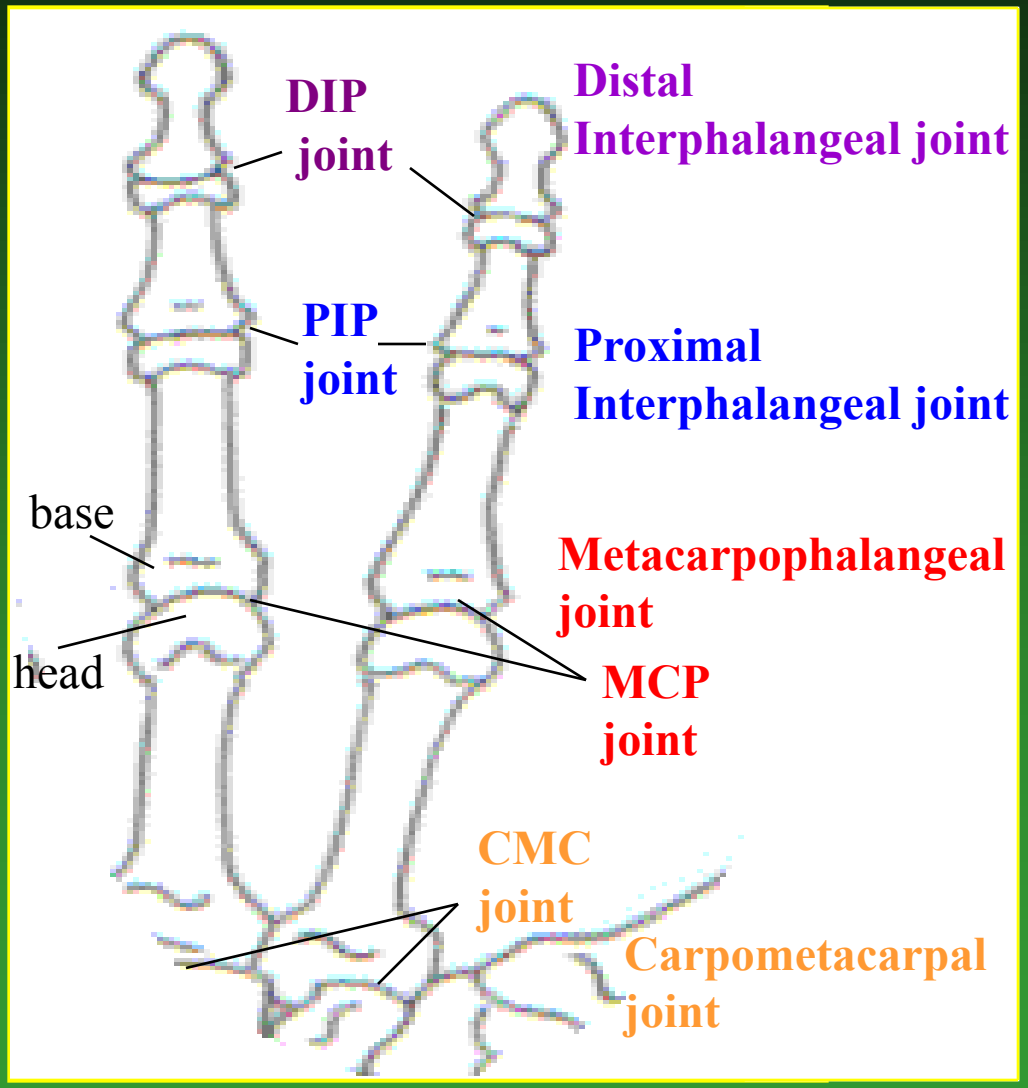
Digits 2-5 have a proximal, middle and distal phalanx. The thumb (**pollicis**) does not consist of a middle phalanx, however, it does have two **sesamoid** bones.

- Both the Metacarpal and Phalanx have articulating surfaces; the **head** distally and the **base** proximally.



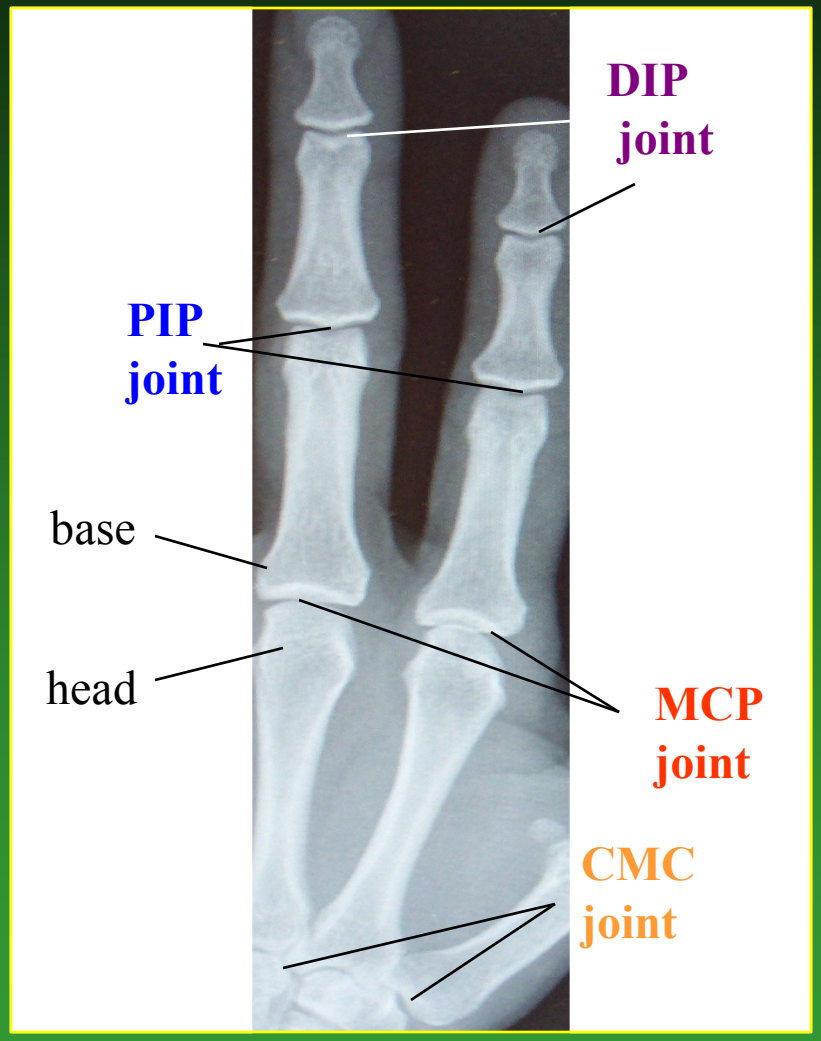
Bony Anatomy:

Let's take a closer look at the hand/fingers. The diagram below of the fingers of the right hand in **anatomical** position identifies the joints.



Bony Anatomy:

The x-ray below of the fingers of the left hand in a PA position identifies the joints.



Positioning

Positioning: General Guidelines:

- ✓ remove any jewelry that will interfere with the anatomy being radiographed.
- ✓ make patient as comfortable as possible; some positions that the patient must conform to and maintain in order for a diagnostic image to be obtained can be difficult due to disease process, trauma, etc. It is important to keep that in mind when positioning patients for an exam.
- ✓ always **shield** when possible; for the purpose of this program, shielding should always be utilized for radiography of the wrist and hand.
- ✓ use **collimation**; at minimum, collimation should not exceed the cassette size.
- ✓ the body part should be **parallel** to the film; the **central ray** (centering) should be **perpendicular** (**90°**) to the body part and the film.
- ✓ Lead markers should be used to identify **RIGHT** or **LEFT**.

Positioning: PA wrist:

- Place hand and wrist onto the cassette palm down.
- Center at the midcarpal area of the wrist.
- Include the distal radius and ulna, carpals and ½ of the metacarpals.

Positioning: PA Oblique wrist:

- Place hand and wrist onto the cassette at a **45°** angle.
- Center at the midcarpal area of the wrist.
- Include the distal radius and ulna, carpals and ½ of the metacarpals.

Positioning: Lateral wrist:

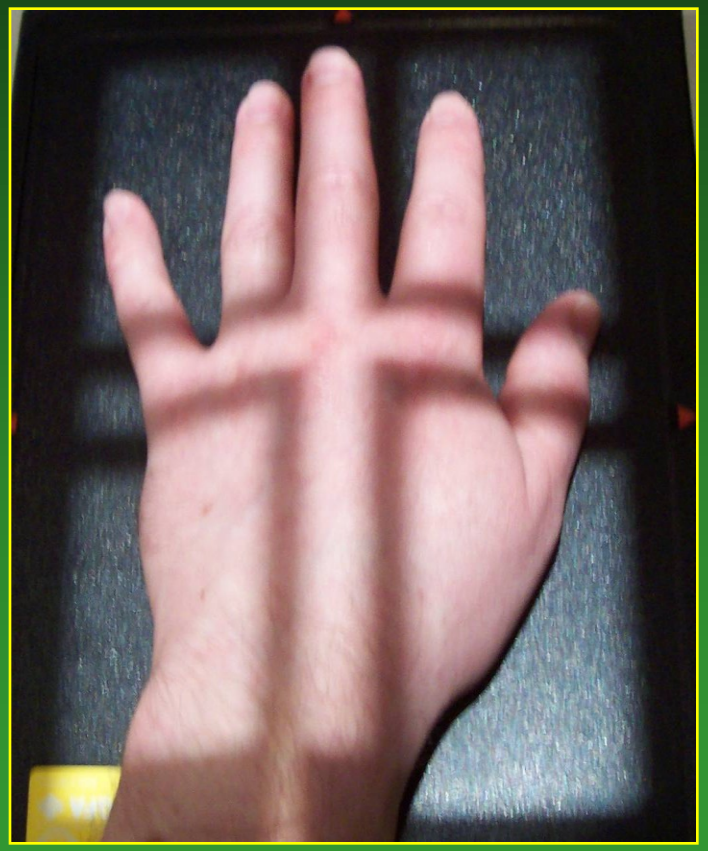
- Place the wrist onto the cassette in a lateral (thumb up) position.
- Center at the midcarpal area of the wrist.
- Include the distal radius and ulna, carpals and ½ of the metacarpals.

Positioning: PA Navicular:

- Place hand onto the cassette palm down with wrist in ulnar deviation (flexion toward ulnar side).
- Angle tube **10° - 15°** toward the elbow.
- Center at the navicular (scaphoid).
- Include the distal radius and ulna, carpals and proximal metacarpals.

Positioning: PA hand:

- Place pronated hand (palm down) onto the cassette.
- Center at the 3rd MP joint.
- Include the entire hand and distal radius and ulna.



Positioning: PA Oblique hand:

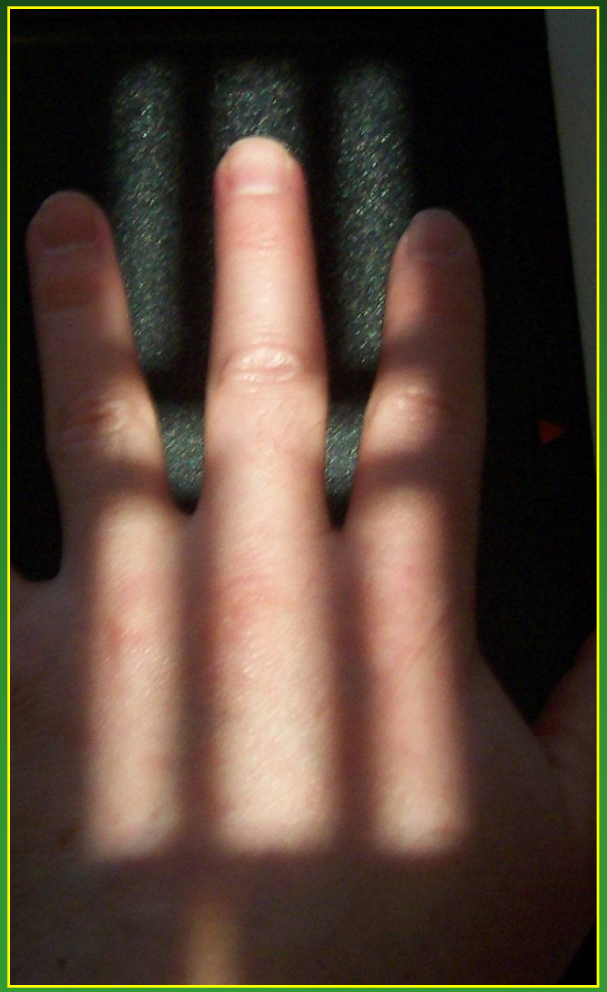
- Place pronated hand onto the cassette at a **45°** angle.
- Center at the 3rd MP joint.
- Include the entire hand and distal radius and ulna.

Positioning: Lateral hand:

- If possible, place hand in a “fan” lateral position (recommended) onto the cassette.
- Center at the 2nd MP joint.
- Include the entire hand and distal radius and ulna.

Positioning: PA finger:

- Place hand palm down onto the cassette.
- Center to the PIP joint.
- Include the entire finger and distal third of metacarpal.



Positioning: PA Oblique finger:

- Place hand, palm facing down, onto the cassette at a **45°** angle.
- Center at the PIP joint.
- Include the entire finger and distal third of metacarpal.

Positioning: Lateral finger:

- A mediolateral projection is utilized for the 2nd finger.
- Place finger onto the cassette from a thumb-down lateral position.
- A lateromedial projection is utilized for the 3rd, 4th and 5th fingers.
- Place finger parallel to the cassette from a thumb-up lateral position.
- Center to the PIP joint.
- Include the entire finger and MCP joint.

Positioning: AP thumb:

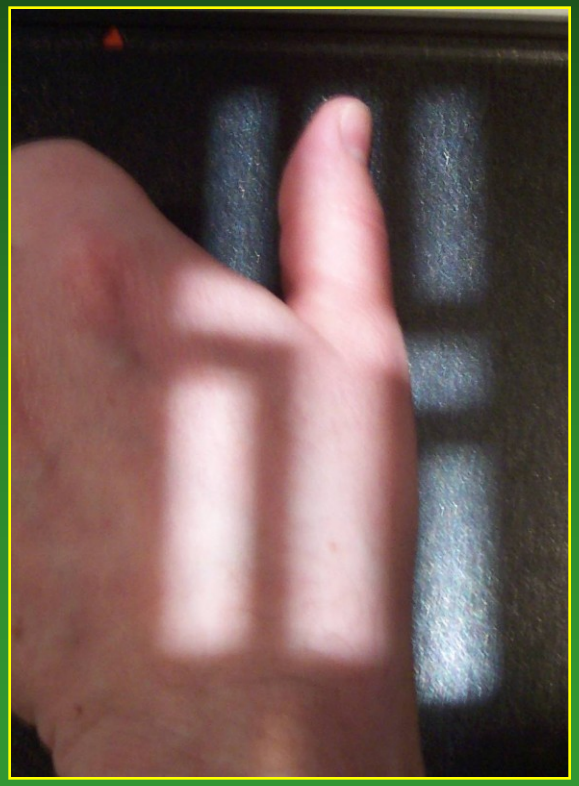
- Internally rotate hand until the back of the thumb can be placed onto the cassette.
- Center at the 1st MP joint.
- Include the entire thumb, CMC joint and trapezium.

Positioning: PA Oblique thumb:

- Place hand palm down onto the cassette.
- Center at the 1st MP joint.
- Include the entire thumb, CMC joint and trapezium.

Positioning: Lateral thumb:

- Curl fingers and place hand onto the cassette.
- Center at the 1st MP joint.
- Include the entire thumb, CMC joint and trapezium.



Technical Guidelines

Technical Guidelines:

- ✓ Radiography of the hand and wrist is done at a **40** inch **SID** (source image distance).
- ✓ Keep the body part as close to the cassette as possible in order to reduce **OID** (object image distance).
- ✓ Radiographs of the wrist and hand are of better diagnostic quality when an **extremity cassette** is utilized. **CR** (computerized radiography) does not use conventional cassettes or film. Instead, a digitized plate is utilized which can be programmed to act like an extremity cassette. The difference is, however, that it is advised to only put one image per cassette. Multiple images on one cassette do not always appear properly and are difficult to "window" correctly.
- ✓ Although x-ray machines vary, the general **kVp** ranges for radiography of the wrist and hand is between **50-65 kVp**.
- ✓ Adjustments in **kVp** and **MAs** should be considered in cases involving splints, casts, wraps, swelling, braces, etc.

MRI

MRI: Overview

A comprehensive explanation of MRI physics is outside the scope of this program but in order to appreciate the following slides and gain the most value from them, a simplistic overview is provided.

Magnetic Resonance Imaging (MRI) is an imaging process that utilizes a magnetic field to magnetize tissues of the body in order to create a radio frequency signal (RF) that will, with the assistance of **coils** and a computer, produce an image.

The magnetic field primarily affects tissues with an adequate amount of **hydrogen**. A high concentration of hydrogen will produce a strong signal and a bright area on the image while a low concentration will produce little or no signal. No signal will produce a black area with the signals in between producing gray areas, **contrast.**

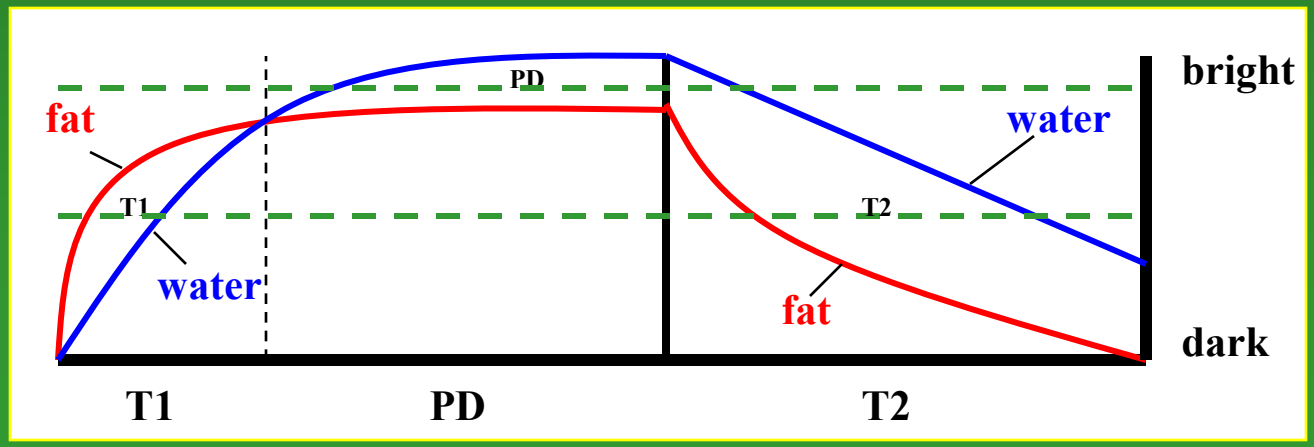
MRI: Tissue Characteristics and Contrast:

One advantage to MRI is the ability to utilize the variety of tissues in the body to produce contrast. The tissues of the body are divided into three characteristics: **T1**, **PD** and **T2.** Images produced in MRI are often described as being T1, PD or T2 "weighted." Let's use the diagram below to help define these terms as they relate to the image that is produced.

T1: on a T1 weighted image, **fat** is **bright** and **water** is **dark**.

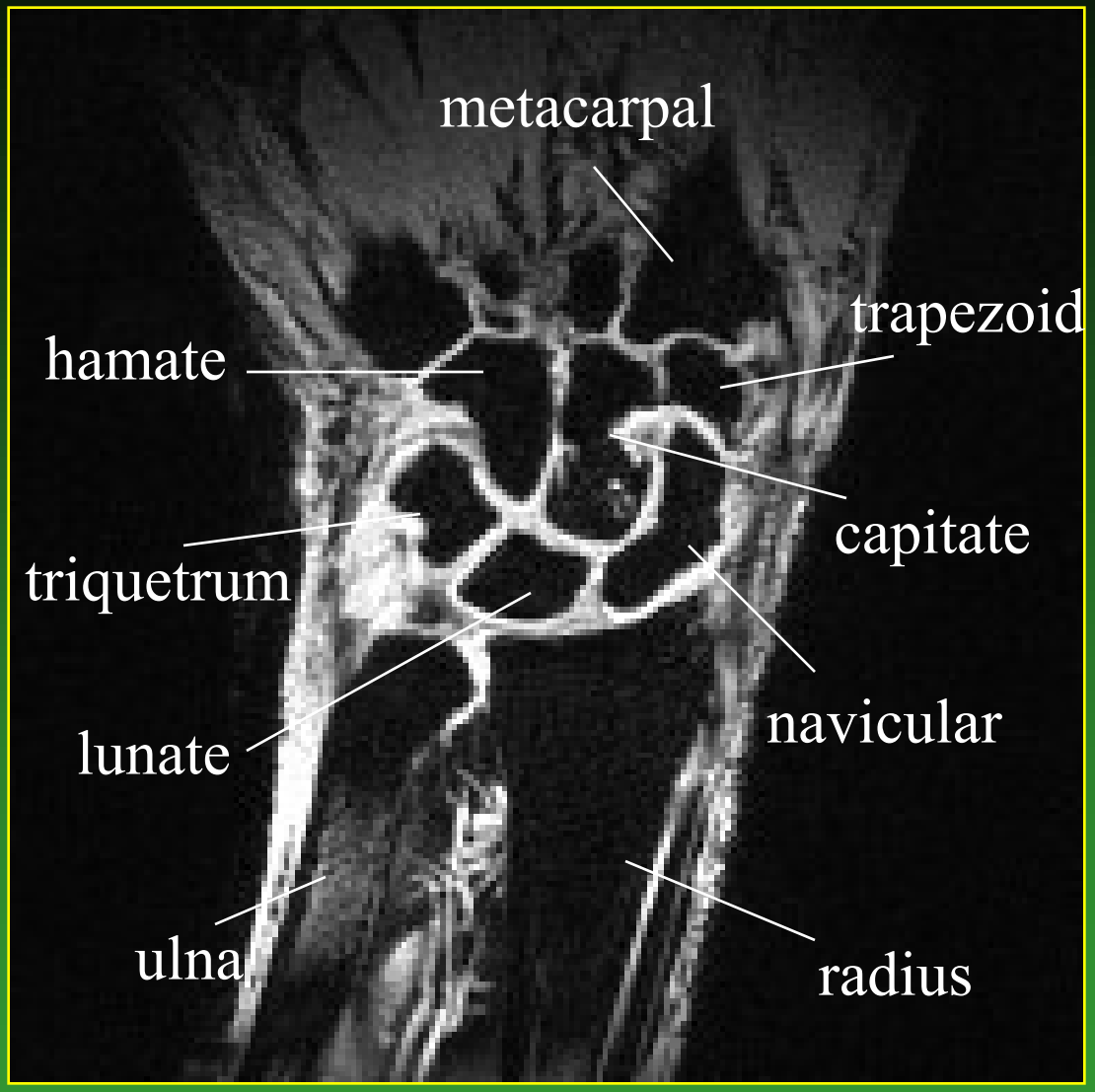
PD: on a proton density image, **water** is **bright** and **fat** is **dark** but the contrast between the two is less define.

T2: on a T2 weighted image, **water** is **bright** and **fat** is **dark** but the contrast is greater.



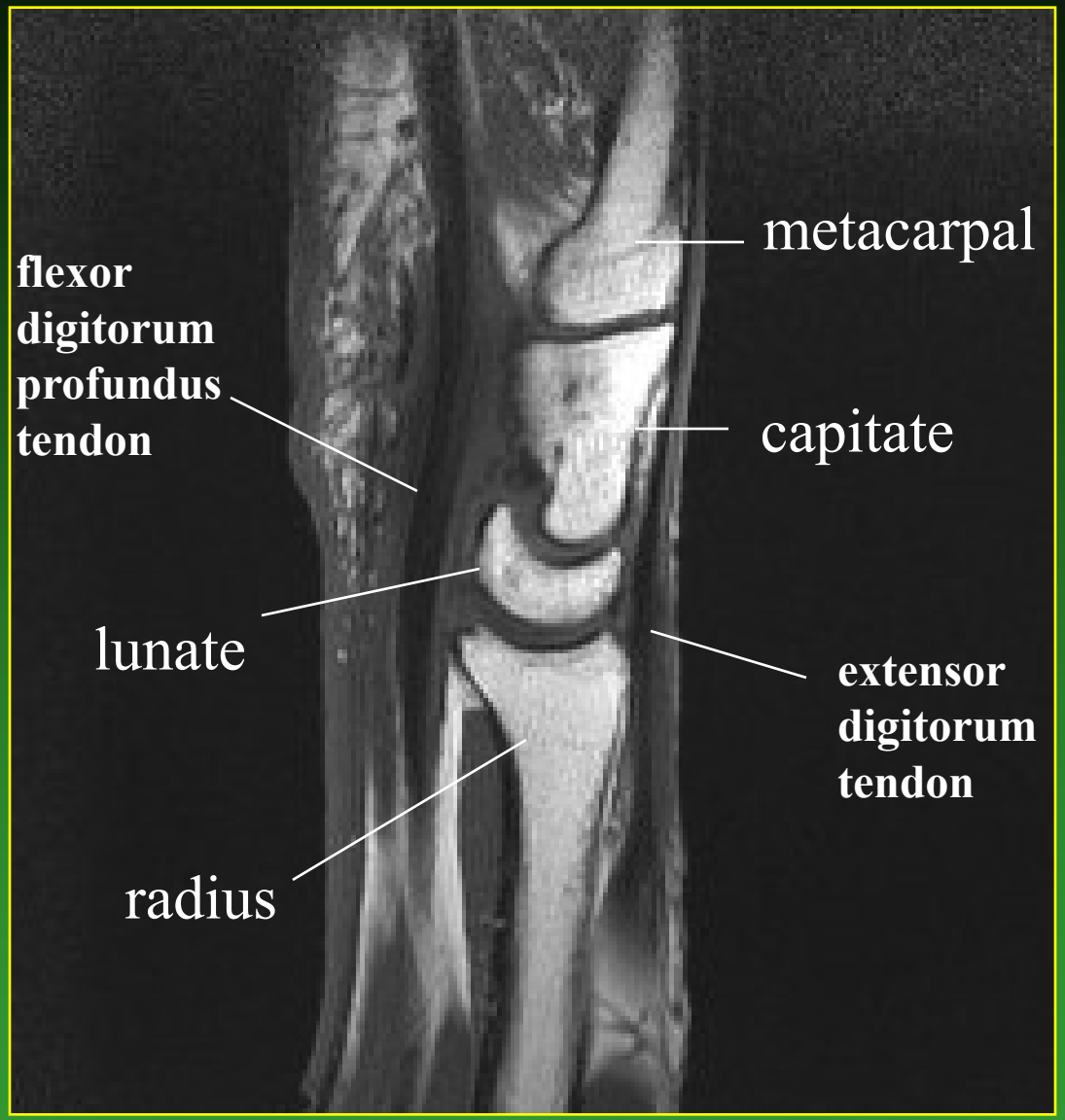
MRI: Coronal T2

The coronal view of the wrist in MRI is comparable to the PA view of the wrist in x-ray. The image to the right is one slice of a coronal sequence.



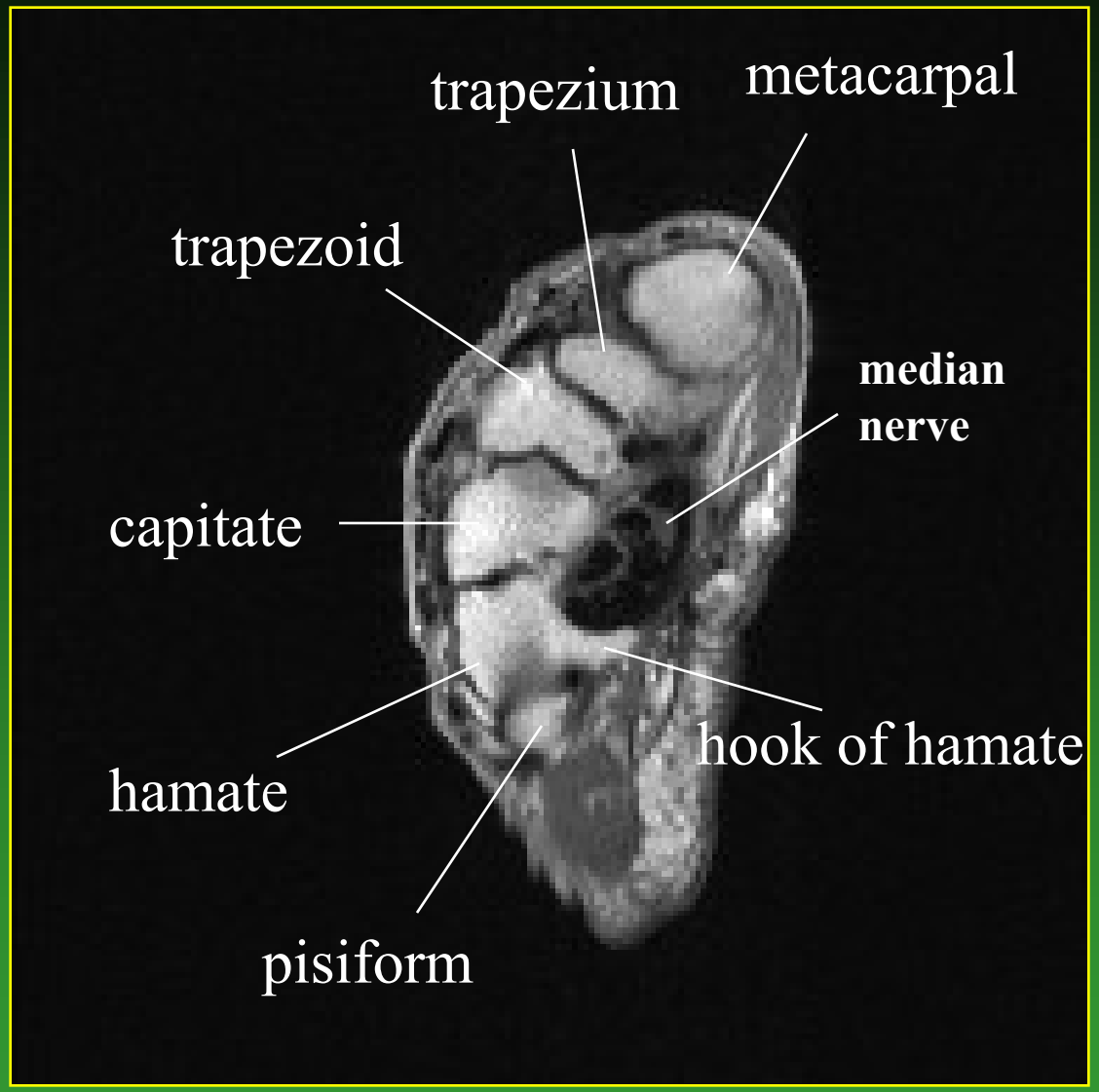
MRI: Sagittal T1

The sagittal view of the wrist in MRI is comparable to the lateral view of the wrist in x-ray. The image to the right is one slice of a sagittal sequence.



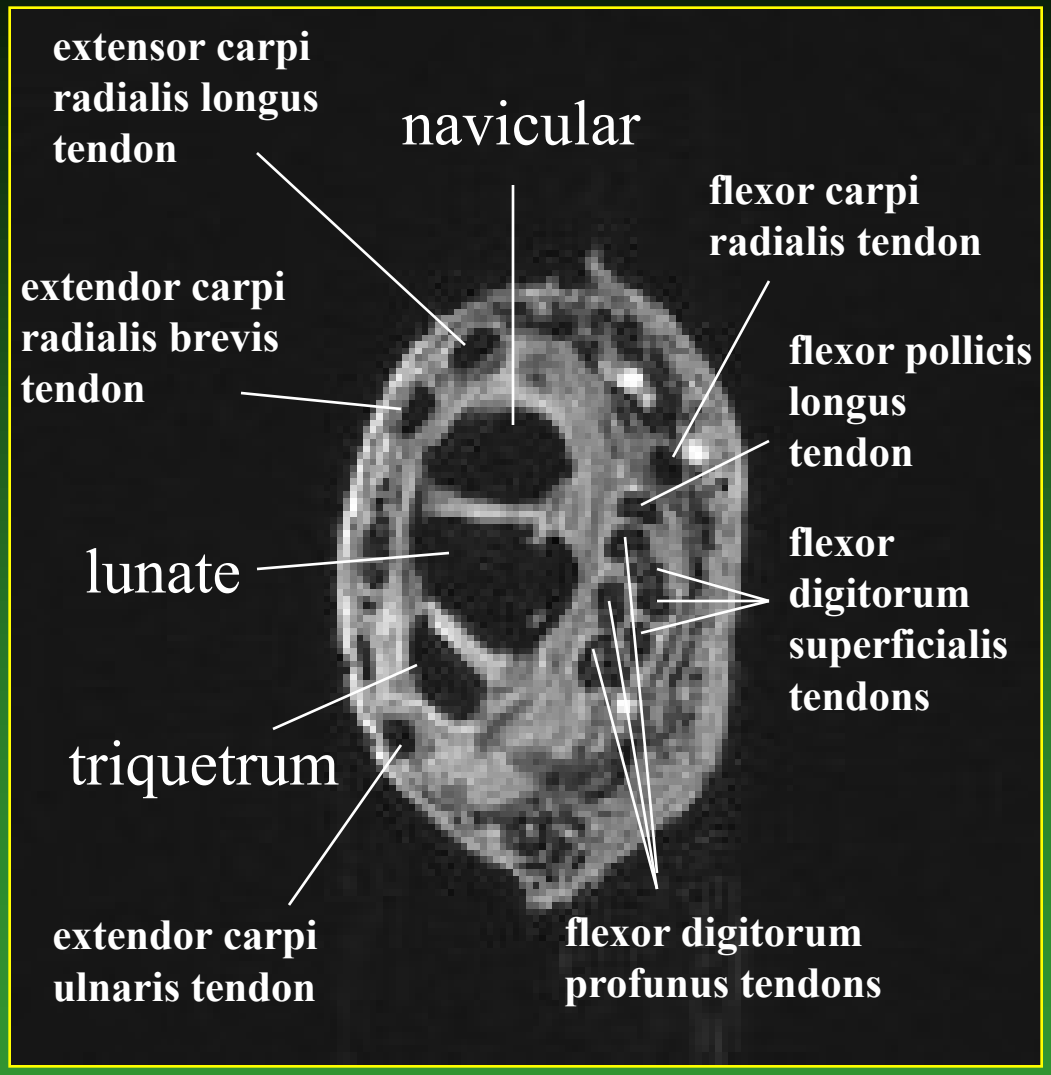
MRI: Axial PD_T2

The axial view of the wrist in MRI has no comparable view in x-ray. The axial slice is similar to slices in a loaf of bread. The image to the right is one slice of an axial sequence through the distal carpal row.



MRI: Axial T2

The axial view of the wrist in MRI has no comparable view in x-ray. The axial slice is similar to slices in a loaf of bread. The image to the right is one slice of an axial sequence through the proximal carpal row.



Common Clinical Findings

Common Clinical Findings:

Now that we've reviewed and understand the basic structure of the wrist and hand, let's review some of the common clinical findings.

1. Colles' Fracture

- a fall on an outstretched hand produces a supinating force on the wrist as the forearm pronates under the weight of the body; results in a transverse fracture of the distal radius with a displacement of the hand backward and outward; this combination produces a dinner fork deformity
- Rx: ice (swelling), splint, cast (closed reduction) or pins (external fixation)

2. Dupuytren's Contracture

-a painless thickening and contracture of the palmar fascia due to fibrous proliferation; results in flexion deformities of the finger(s) into the palm with loss of function (extension) of the finger(s) involved; associated with liver disease and long term use of phenytoin

-Rx: surgery

Common Clinical Findings:

3. Carpal Tunnel Syndrome

-compression of the median nerve between the flexor tendons and the transverse carpal ligament; primarily found in patients with history of prolonged (repetitive) manual work with hands (specifically wrist flexion) which puts pressure on the flexor retinaculum; results in pain and/or numbness which may radiate up arm

-Phalen's Test: hold wrist hyperflexion x 1 minute; positive test if sensation changes result

-Tinel's Sign: tap flexor retinaculum; results in tingling sensation if median nerve is compressed

-Rx: rest, temporary splinting, surgery, NSAIDs, iontophoresis, ice, heat

Common Clinical Findings:

4. Swan Neck Deformity

-hyperextension of the PIP joint and flexion of the DIP joint as a result of damage (frequently from rheumatoid arthritis) that causes hypermobility of the PIP joints and a migration of the lateral bands dorsally; results in a loss of the normal balance of forces around the PIP joint; may result in interossei muscles to become taunt

5. Boutonniere Deformity ("button hole")

-contracture of hand musculature which results in flexion of the PIP joint and hyperextension of the the DIP joint; results in a decrease of extensor power at the DIP joint

Common Clinical Findings:

6. Arthritic Changes

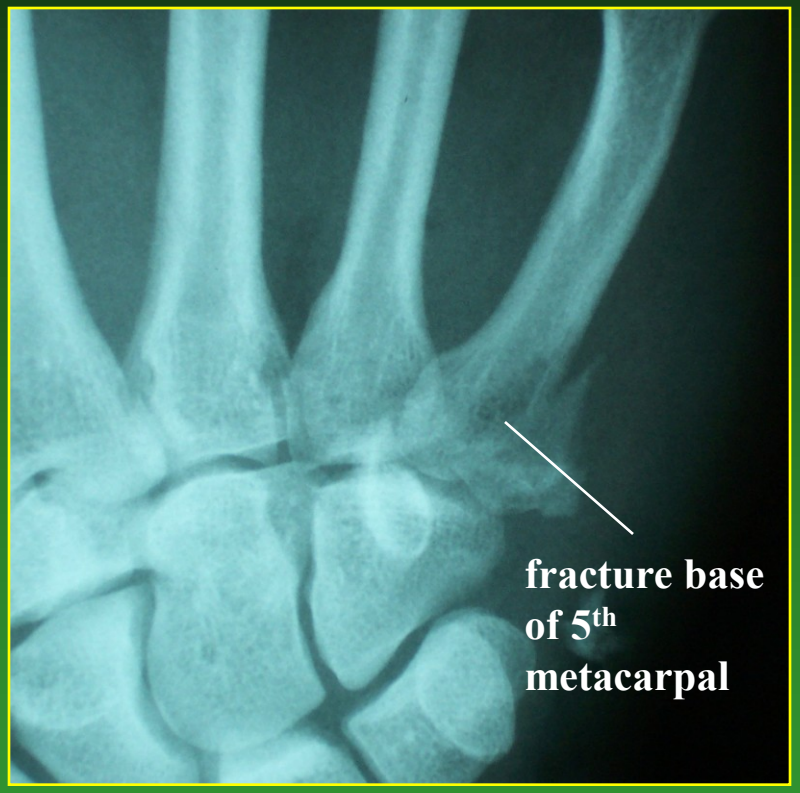
-**Osteoarthritis:** degeneration of articular cartilage so that the bony ends touch; friction between the bones worsens the condition; slow, symmetrical development of stiffness with minimal pain unless it is associated with trauma; usually associated with varus deformity in the IP joints distal to proximal

-**Rheumatoid Arthritis:** an autoimmune disease in which the immune system attacks its own cartilage and joint linings; usually occurs bilaterally; painful decreases in motion with varying degrees of inflammation; results in ulnar drift of fingers, crepitus and ankylosis (immobility of a joint) in wrist flexion

7. Boxer's fracture

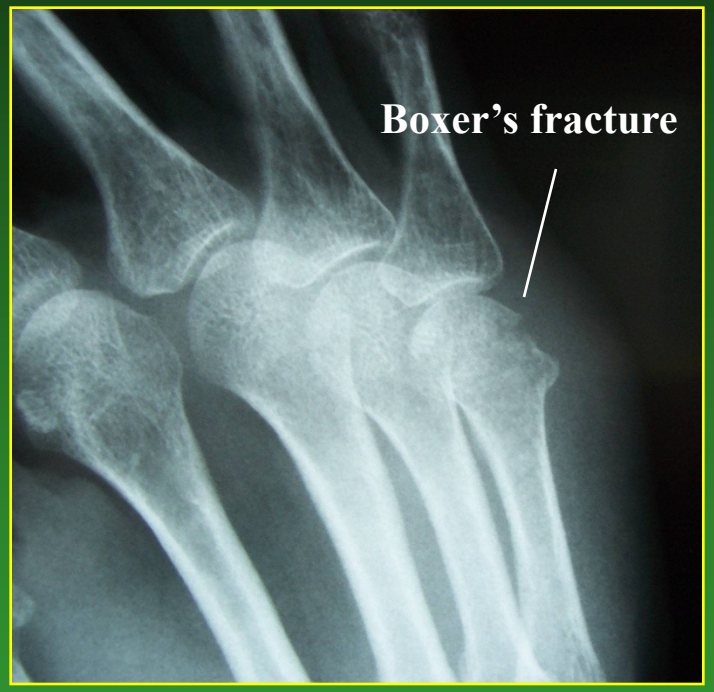
-fracture of the head of the 5^{th} metacarpal.

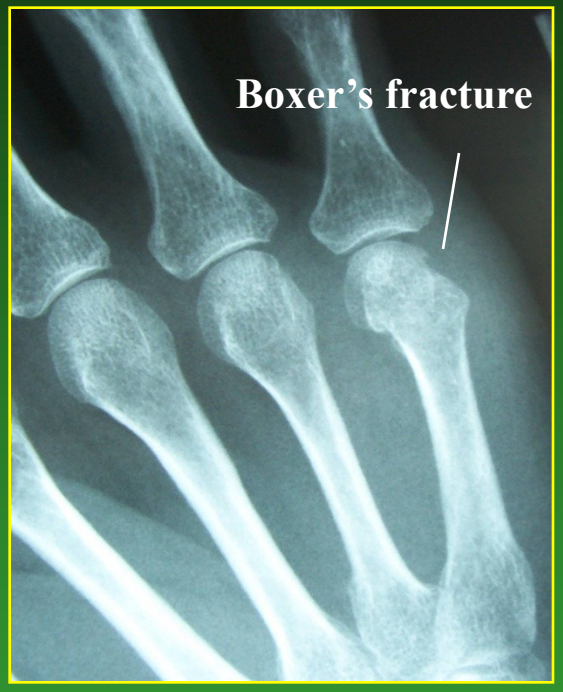
Common Clinical Findings:



Common Clinical Findings:

Common Clinical Findings:





Common Clinical Findings:

Conclusion:

- Radiography of the hand , fingers and wrist is done at a **40** inch **SID** (source image distance).
- Keep the body part as close to the cassette as possible in order to reduce **OID** (object image distance).
- Although x-ray machines vary, the general **kVp** ranges for radiography of the wrist and hand is between **50-65 kVp**.
- Adjustments in **kVp** and **MAs** should be considered in cases involving splints, casts, wraps, swelling, braces, etc.
- The body part should be **parallel** to the film and the **central ray** (centering) should be **perpendicular** (**90°**) to the body part and the film unless otherwise indicated.
- Always **shield** when possible; use **collimation**, identify **LEFT** or **RIGHT** by utilizing lead markers, remove jewelry that may interfere with anatomy and be conscious of patient comfort when positioning.

Test:

There are **60** questions on this test. All answers can be found within the context of this program. The "hint" button located next to each question will provide you the information needed to answer the question. At any time during the test you may skip a question and return to it later. You must successfully answer 70% of the questions in order to receive credit for the course. To access the test, please close out of this course by clicking the "x" in the top right corner.

Good luck!!!

References:

Norkin, Cynthia C. and Levangie, Pamela K.; Joint Structure & Function: A Comprehensive Analysis, Second Edition, F.A. Davis Co. Philadelphia, PA. 1992

Hislop, Helen J. and Montgomery, Jacqueline; Daniels and Worthingham's Muscle Testing: Techniques of Manual Examination, Sixth Edition, W.B. Saunders Co. Philadelphia, PA. 1995

Stalheim-Smith, Ann and Fitch, Greg K.; Understanding Human Anatomy and Physiology, West Publishing Co. St. Paul, MN. 1993

Thomas, Clayton L.; Taber's Cyclopedic Medical Dictionary, Seventeenth Edition, F.A. Davis Co. Philadelphia, PA. 1993

Bontrager, Kenneth L.: Textbook of Radiographic Positioning and Related Anatomy, Fourth Edition, Mosby Inc. St. Louis, MO. 1997

Tortora, Gerard J. and Grabowski, Sandra R.; Principles of Anatomy and Physiology, Ninth Edition, John Wiley & Sons, Inc New York, NY. 2000

Stoller, David W.; Magnetic Resonance Imaging in Orthopaedics and Sports Medicine, J.B. Lippincott Co. Philadelphia, PA. 1993

Sprawls, Perry; Magnetic Resonance Imaging Principles, Methods, and Techniques, Medical Physics Publishing, Madison, WI. 2000