Lumps and Bumps: Soft Tissue and Bony Masses of the Wrist

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Masses of the wrist (and hand) are common indications for patients to be referred for imaging.

Some patients may present with painless or painful masses; others present with pain from occult masses.
LEARNING OBJECTIVES

- Discuss the clinical features of wrist masses and approach to the work-up and evaluation
- Understand pertinent anatomy pertaining to these masses
- Become familiar with some wrist masses with characteristic features
- Focus is on wrist, but will discuss some hand
Usual Route
UNKNOWNNS
TISSUE ORIGINS

- Soft tissue
  - Connective Tissue
  - Adipose
  - Synovial
  - Neural
  - Vascular
  - Muscle
  - Mixed

- Osseous
THERE WAS NEVER A GANGLION IN THE WRIST THAT I COULDN’T FIND
“A very small ganglion cyst is seen just dorsal to the dorsal aspect of the scapholunate interosseous ligament, where it likely arises (series 4, image 11), and measures less than 1 mm in size.”
GANGLION CYST

- Most *common* soft-tissue mass in the hand & wrist (60%)\(^1\)
- Thought to arise from myxoid degeneration of connective tissue, commonly after minor trauma
- Contain mucinous fluid of glucosamine, albumin, globulin, & hyaluronic acid
- Wall is acellular with randomly oriented collagen
- *Lack of* synovial lining distinguishes ganglion from a *true* synovial cyst

GANGLION CYST

- **Location:** Commonly at dorsal scapho-lunate interval
  - 75% connect with dorsal S-L interosseous ligament in area of capsular attachment
  - Also volar radiocarpal joint
  - Can be intraosseous

- Dorsal ganglion may present with dull aching pain due to a constant relationship to terminal branches of the posterior interosseous nerve\(^2\)

- Terminal sensory branch of PIN in deep radial aspect of 4\(^{th}\) dorsal compartment\(^3\)

- Larger ganglions can compress branches of the superficial radial nerve\(^1\)

Ay S. Clin Anat 2005
GANGLION CYST

Extensor Indicis
Sensory branch to dorsal radio-ulnar ligament

Lister’s Tubercle Terminal branch

Lo Monaco M. Acta Neuro Scand 1985
Volar Ganglions

Terminal PIN?

Extensor Indicis

Lister’s Tubercle
GANGLION CYST

- **US & MRI:**
  - Both show a defined cystic lesion with a thin wall; often multilobulated
  - Intracystic hemorrhage or infection can complicate appearance

- **Arthrography:** Cyst should not (technically) communicate with joint space

- **Treatment:** Observation, closed rupture, cyst aspiration, surgical excision; can recur
Volar Ganglions

- 13-20% of hand/wrist ganglions
  - 2/3 = radio-scaphoid
  - 1/3 = scapho-trapezial
- Occult presentation less common than dorsal
- May present with sensory or motor symptoms of the median or ulnar nerves
- High recurrence with aspiration
- Higher recurrence with surgery than dorsal cysts
Volar Ganglions

Palmar Cutaneous Branch(es)?

FCR

Radial Artery & Veins
35 F w/ recurrent cysts

Radial Artery and Veins?

FCR
51 F w/ Enlarging Volar Wrist Mass After Minor Trauma
51-year-old Female w/ Enlarging Volar Wrist Mass After Minor Trauma
40 F w/ a Palpable Wrist Mass
40 F w/ a Palpable Wrist Mass
3 F w/ incidental wrist lump
Intraosseous Ganglion Cysts

- Commonly scaphoid and lunate
- May be primarily in bone or juxta-osseous with intra-osseous extension
- May be a cause of unexplained wrist pain
- MRI/CT helps with surgical planning
  - Currettage and bone grafting for large lesions

Magee TH. Radiology 1995
52 M casino dealer w/ dorsal wrist pain, no provided h/o trauma
GANGLION CYST

- When is imaging actually helpful?
  - Smaller or occult carpal ganglia, which can be very painful
- How accurate are we? 5
  - 160 patients w/ carpal ganglia:
    - 156 = ganglia
    - 4 = synovial tissue x 3; reactive changes w/ no cyst
  - Savings = $352 / pt = $55,263

McKeon K. J Hand Surg 2006
FAT
35  M painless thenar mass
LIPOMA

- Common solid cellular tumor with mature fatty tissue that can occur almost anywhere in the musculoskeletal system
- The wrist/hand is a common site for lipomas!
- Fibrous capsule usually too small to resolve with imaging
- **Locations:**
  - Thenar eminence most common site
  - Superficial > Intramuscular
  - Guyon canal or carpal tunnel or anywhere!!
- **CT:** Low fatty attenuation (-65 to 120 HU)
- **MRI:** High T1/T2, low SI on FS images, no internal enhancement although may see rim enhancement of displaced tissue or vessels
- **Treatment:** Excision if symptomatic; Recurrence rare

Capelastegui. Skeletal Radiol 1999
Thenar Eminence: Superficial
Thenar Eminence: Intramuscular

**Images:**
- **T2**
- **T1**
- **T1 FS +**
62 F with snuffbox mass
ARTHRITIDES/SYNOVIAL PROCESSES
ARTHITIDES & SYNOVIAL PROCESSES

- OA: osteophytes
- Arthritides:
  - Joint effusions
  - RA synovial proliferation = synovitis, tenosynovitis, bursitis
  - Gout: Tophi, tenosynovitis, bursitis
- Others:
  - Overuse tendonitis/tenosynovitis
  - Synovial (osteo)chondromatosis
  - PVNS/GCTTS
  - Infection
RHEUMATOID ARTHRITIS

- Synovial hypertrophy (pannus) with erosions, joint space narrowing and soft tissue swelling
- Tenosynovitis often presenting symptom, preceding erosive changes
- CT: Detects early subchondral erosions, insensitive for chondral lesions; Pannus enhances

MRI:
- Tenosynovitis
- Erosions +/- marrow edema
- Chondral loss
- Joint effusions
- Enhancing pannus

Harris ED. Kelley’s Textbook of Rheumatology 2005
Wright PE. Campbell’s Operative Orthopedics 2008
72 F with RA, growing “mass” in the palm of the hand
47 F with pain, tenderness, & fullness
47 F with pain, tenderness, & fullness

Synovial Hypertrophy
Bony Erosions
No Normal TFC
25 F w/ dorsal tenosynovitis

Intermediate FS

T1 FS +
53 F w/ dorsal and radial-sided pain/swelling: De Quervain’s Tendinosis/Tenosynovitis APL & EPB Soft Tissue Edema
64 F w/ swelling & carpal tunnel x 8 mo’s: TB
58 M w/ TB infection of right wrist
59 M w/ left wrist swelling & decreased ROM

Articular Erosions w/ Overhanging Margins

Soft Tissue Mass

Vascular Calcifications
59 M w/ left wrist swelling & decreased ROM

Extensor Tendon Tensynovitis

T2 Intense Mass w/ Carpal Bones Erosion/Destruction
Tophaceous Gout

- Marginated erosions with overhanging edges and soft tissue tophi
- Can often *mimic other processes*
- Commonly due to underexcretion of urate (90%) vs. overproduction; This patient had diabetes & renal failure
- **MRI**: Low T1/Heterogenous T2 tophi with variable enhancement
- **CT**: Gouty tophi
  - HU = 160
  - Dual energy CT (80/140 kV) may obviate joint aspiration, assess disease burden (rheumatologist’s love this!) \(^\text{12}\)
71 M painful Lt hand

Nicolaou. AJR 2010
60 M w/ right hand mass

Volar Soft Tissue Density?

Bony Erosions

Soft Tissue Density
60 M w/ right hand mass

Masses T1 Isointense to Muscle Displacing Tendons; Bony Erosions (arrowhead)

Masses Have Low T2 SI on Fat-Suppressed Images

Strong Enhancement
GIANT CELL TUMOR OF THE TENDON SHEATH (GCTTS)

- Reported to be second most common soft tissue mass of the hand
- Benign tumor of giant cells near joints/tendons, w/ intra- & extracellular hemosiderin
- Finger involvement >> wrist
- Extra-articular form of PVNS (same thing histologically and cytogenetically) \(^{13,14}\)
- Commonly asymptomatic & slow-growing
- Location: Volar > Dorsal
- Radiography: ± soft tissue mass; marginated pressure erosions of bone
- CT: High density mass from iron content, enhancing synovium
- MRI: low/intermediate SI on T1 & T2 SI w/ areas of low SI from hemosiderin, especially on T2*/GRE (causes blooming); intense contrast enhancement
- Treatment: Excision difficult, recurrence common (10-50%)

Nahra. Hand Clin 2004
Ofluoglu O. Ortho Clin N Am 2006
88 F w/ left hand mass

Case Courtesy of K. Chen, MD
60 M w/ wrist swelling
SYNOVIAL (OSTEO)CHONDROMATOSIS

- Non-neoplastic proliferation of cartilaginous nodules in the synovium of joints, bursae or tendon sheaths
- Monoarthropathy: knee > hip > shoulder > elbow
- In the wrist, extra-articular involvement is common (tenosyovium, bursa)
- Radiography:
  - Multiple calcified nodules of uniform size
  - Calcifications absent in ¼ to 1/3
  - Pressure erosions
- MRI:
  - Low signal nodules if mineralized
  - High signal fatty elements centrally if present
- Treatment: synovectomy & removal of loose bodies
60 M w/ wrist swelling
VASCULAR
41 M with proximal wrist & palmar mass

**Intermediate FS**
- Increased SI in dilated ulnar artery

**T1 FS +**
- Perivascular enhancement with no intravascular enhancement

**Intermediate FS**
- Tortuous, aneurysmal ulnar artery; proximal ulnar artery w/ normal flow void
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass

MRA
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass
41 M with proximal wrist & palmar mass

MRA
41 M with proximal wrist & palmar mass

Palmar arches and digital arteries supplied by radial artery

Abrupt termination of ulnar artery at the wrist
HYPOTHENAR HAMMER SYNDROME

- Due to chronic trauma to the hypothenar eminence, such as using the palm as a hammer or catching a baseball.
- Leads to aneurysm formation and/or thrombosis of the ulnar artery in the Guyon Canal, usually at the level of the hamulus; can compress branches of the ulnar nerve & cause digital ischemia.

**Angiography:** Two appearances
- Ulnar artery aneurysm with “corkscrew” appearance; digital artery emboli can be seen, especially 3rd through 5th fingers.
- Focal ulnar artery occlusion at hypothenar eminence.

**US:** Can help determine size of aneurysm, particularly when occluded.

**CT:** CTA useful for vascular mapping & can define bony lesions (including hamate fracture & relationship to hamulus).

**MRI:**
- Delineates extent of aneurysm/thrombosis.
- MRA shows similar findings as traditional angiography, but resolution is limited in the digital arteries.

**Treatment:** conservative, thrombolysis, resection, or vein graft interposition.
GUYON’S CANAL AND ULNAR NEUROVASCULAR BUNDLE

Ligamentum Flexorum

Ligamentum Carpi Palmare
GUYON’S CANAL AND ULNAR NEUROVASCULAR BUNDLE

Opponens digiti minimi
Ulnar Artery

Ulnar Vein’s

Ulnar Nerve and Branches
Deep motor, superficial sensory

PROXIMAL

DISTAL
46 M with mass in the palm and proximal wrist with flexion
46 M with mass in the palm and proximal wrist with flexion

Palmar arches & digital arteries supplied by radial artery

Occluded ulnar artery
46 M with mass in the palm and proximal wrist with flexion.

Occluded ulnar artery

Palmar arches & digital arteries supplied by radial artery.
46 M with mass in the palm and proximal wrist with flexion

Palmar arches & digital arteries supplied by radial artery

Occluded ulnar artery
46 M with mass in the palm and proximal wrist with flexion

- Occluded ulnar artery
- Palmar arches & digital arteries supplied by radial artery

Occluded ulnar artery
46 M with mass in the palm and proximal wrist with flexion

Palmar arches & digital arteries supplied by radial artery

Occluded ulnar artery
23 M violinist w/ right ulnar-sided right wrist mass

- Soft Tissue Density w/ Small Round Calcifications
- Soft Tissue Density w/ Small Round Calcifications
M violinist w/ right ulnar-sided right wrist mass

- Mass isointense to muscle w/ scattered focal hypointensities
- Increased T2 SI w/ scattered focal hypointensities
- Strong enhancement
VASCULAR MALFORMATION

- Vascular lesions = hemangioma & vascular malformations
- Hemangioma = true neoplastic endothelial proliferation
  - Hand is 3rd most common site
- Vascular malformation = not tumors, but errors of vascular morphogenesis, 2 possible classification schema
  - Vessel type: capillary, venous, arterial, & lymphatic
  - Flow type: high, low
**VASCULAR MALFORMATION**

- **Radiography:** *Phleboliths pathognomonic for venous malformations (VM’s)*
- **CT:**
  - Precontrast: Soft-tissue attenuating mass, phleboliths, ± fat
  - Postcontrast: Serpentine enhancement
- **MRI:**
  - High T2 in slow flow lesions, flow voids in AVM’s
  - Low SI from phleboliths
  - Fluid/fluid levels in lymphatic malformations
- **US:** heterogeneous mass w/ + Doppler flow & shadowing phleboliths (VM’s)
- **Angiography:** vascular mass, can perform therapeutic embolization
- **Treatment:** If resection is performed, wide margins necessary to minimize recurrence
NERVES
18 yo waitress with severe wrist pain

Case Courtesy of K. Chen, MD
18 yo waitress with severe wrist pain
LIPOFIBROMATOUS (FIBROLIPOMATOUS) HAMARTOMA

- Infiltration of *mature fat* in the nerve & separating axonal bundles w/ thickening of the individual bundles by perineural/endoneural fibrosis
- **Imaging Findings:** Enlarged nerve with numerous axon bundles surrounded by a substratum of fibrofatty tissue
- **Presentation:** Macrodactyly (25%), mass lesion, or compressive neuropathy; ± history of trauma
- **Location:** Median nerve > Ulnar nerve
  - Rarely in lower extremity
  - Can be multifocal
- **MRI:** Exam of choice & *considered diagnostic*
  - Classically: Enlarged cable-like axonal bundles (2-3mm) surrounded by T1 hyperintensity (lipid) in substratum
  - Atypical Appearance: T1 SI can be low in substratum if there is altered distribution of fibrous & fatty elements \(^{16}\)
- **US:** Longitudinally oriented alternating hyperechoic & hypoechoic bands
- **Treatment:** Excision not recommended as LFH is inseparable from nerve

Toms. *AJR* 2006
57 F w/ Palpable Volar Mass

No Volar Mass Appreciated
57 F w/ Palpable Volar Mass
46 M w/ right wrist pain and LFH

Typical Appearance, axial PD: Cylindrical longitudinally-oriented thin curvilinear zones of low signal (axon bundles) within a background of intermediate-high signal (lipid)
31 yo F w/ LFH: US Findings

Hypoechoic cablelike neural bundles separated by hyperechoic fat.

Toms. AJR 2006
46 M w/ Right Wrist Pain

Median Nerve (Arrow): Normal Low/Intermediate SI on All Sequences

Ulnar Nerve (Arrowhead): Multiple Thickened Low SI Axonal Bundles w/ Interspersed Fat (High T1 & Low SI on Fat-Suppressed Images)
35 M w/ palmar mass

T1 intermediate fusiform mass arising from the median nerve
35 M w/ palmar mass

Intermediate FS

T1 FS +

Int FS

PD

T1 FS +
PERIPHERAL NERVE SHEATH TUMORS

- Schwannoma & neurofibromas
- 8-9% found in the hand and wrist
- Schwannomas most frequently encountered neural tumor in the hand
- Schwannomas = encapsulated, from Schwann cells
- Neurofibromas = (usually) unencapsulated, from Schwann cells, fibroblasts, perineurial cells

MRI:
- Schwannomas = low T1, high/hetero T2, low signal capsule, eccentric with nerve
- Neurofibromas = Target T2 appearance, fusiform with nerve

Treatment: Schwannomas enucleated, neurofibromas left

35 M w/ palmar mass

- Thin hypointense fibrous rim
- Maintenance of a thin rim of surrounding fat
BONES
44 M s/p injury (driving a sign post)
CARPAL BOSS

- Common anomalous osseous structure, b/w trapezoid, capitate, and 2nd and 3rd MC’s
- From accessory ossification = os styloideum?
  - More often fused to bone, than separate ossicle
- Predisposes to localized OA
- May be confused clinically and coexist w/ ganglia
- Assoc. w/ ECRB and ECRL tendonitis/tenosynovitis
- Dorsal bony protuberance 2 & 3rd MCPJ’s
  - Special carpal boss view may be helpful
- MRI may demonstrate bone edema in symptomatic cases
- **Treatment:** Conservative (rest, NSAID, steroid injections), excision

Conway. Radiology 1985
44 M s/p injury (driving a sign post)
Radiography: Carpal Boss View

Straight Lateral

30° Supination

30° Ulnar Deviation

30° Supination & Ulnar Deviation

Conway. Radiology 1985
19 F gymnast w/ bilateral symptomatic carpal bос(es)
ACCESSORY OSSICLES OF THE CARPALS!!!

1=Os trapezium secundarium; 2=Os trapezoideum secundarium; 3=Os parastyloideum; 4=Os styloideum; 5=Os metastyloideum; 6=Os capitatum secundarium; 7=Os epitrapezium; 8=Os carpi centrale; 9=Os paranaviculare (intercalary bone between scaphoid and radius); 10=Os epilunatum; 11=Os epitriquetrum; 12=Os ulnostauroideum; 13=Os vesalianum manus; 14=Os ulnare externum; 15=Os hamulare basale & Os hamuli proprium; 16=Os gruberi; 17=Os subcapitatum; 18=Os praetrapezium; 19=Os paratrapezium; 20=Os pisiforme secundarium (os ulnare antebrachii); 21=Os triquetrum secundarium (os intermedium antebrachii, os triangulare); 22=Os hypolunatum; 23=Os radiale externum
PRIMARY OSSEOUS TUMORS

- Carpal bones: osteoid osteoma > osteoblastoma > chondroblastoma
  - Capitate and scaphoid more common

- Hand: Enchondromas predominate (>90%)
  - Proximal phalanges > MC’s
  - Chondrosarcoma most common malignant bone tumor

- Distal Radius/Ulna:
  - GCT’s (wrist 3rd most common site, radius most common bone in wrist)

Murray. *J Hand Surg Am* 1999
Osteoid osteomas

Radiolucent nidus with surrounding sclerosis
13 F Rt wrist pain x 2 months

Diagnosis: Osteoblastoma of the Pisiform
Enchondromas
59 M w/ palpable, painful mass of the right 4th finger
59 M Palpable, painful mass of the right fourth finger

Diagnosis: Chondrosarcoma
30 M distal radius mass x 2 mo’s

Geographic lytic lesion, ill-defined transition zone;

Cortical expansion and thinning

Soft tissue component
30 M distal radius mass x 2 mo’s

Diagnosis: Giant Cell Tumor of Bone w/ Secondary ABC
MUSCLES
Accessory/Anomalous Muscles

- Ext. Dig. Brevis Manus: Tender Mass/PIN compression
- Lumbrical in carpal tunnel syndrome
- Abberant flexor digiti minimi origin: Ulnar nerve compression
- Accessory Ext. Pollicis Longus: tender mass
- Palmaris longus: low lying muscle bellies/multiple slips
- Accessory abductor digiti minimi: Ulnar or median nerve compression
Extensor Digitorum Brevis Manus

Accessory muscle at the 4th dorsal compartment

Muscle & Soft Tissue Edema

T1

T2FS
Accessory Muscles

- Clinically confused with ganglia, soft tissue tumors, or tenosynovitis
- Can coexist with ganglia, confusing the clinical picture
- Doral accessory muscles prone to symptomatology due to limitation of space from a tight extensor retinaculum
  - Anomalous ext. indicis proprius
  - EDBM
  - Ext. medii proprius & ext. indicis et medii communis
- Volar muscles rarely may cause compression neuropathies:
  - Aberrant lumbrical in carpal tunnel
  - Accessory abductor digiti minimi
  - Palmaris longus variations

Ogura. J Hand Surg 1987
Wrist masses can be the result of benign tumors and non-neoplastic processes.
Radiography may be helpful in lesions with very characteristic features, but can often be nonspecific.
MRI is an excellent modality for problem solving and can definitively diagnose some conditions.
No Tail

ねずこの仲間ですが、
尾はありません。
REFERENCES