



Radiologic Visualization of the Ligaments, Tendons, and Bony Prominences of the Thumb Carpometacarpal (CMC) Joint

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Introduction:

- Compromise of ligament integrity leads to joint disease - including the thumb CMC joint.
- Radiopaque markers and paint are effective means to determine precise knee and ankle ligament and bony anatomy.
- We hypothesize that the spatial relationships surrounding the thumb CMC joint (ligaments, tendons and bony prominences) may be demonstrated on x-rays using radiopaque and digitized markers.

Methods:

- We identified and imaged soft tissue and bony landmarks around the thumb CMC joint in 12 cadaveric hands with AP, lateral and Robert's x-ray views using these 3 modalities:



Figure 1. Plain films highlighting the course of the volar APL and FCR (A, B) and the dorsal EPB and EPL (C, D) tendons. AP (A, C) and Robert's view (B, D) are shown. The FCR is ulnar to the APL (A), and courses directly distally (B). The EPB is radial (C) and volar (D) to the EPL.

- **Tantalum Paint:** The abductor pollicis longus (APL), extensor pollicis longus (EPL), extensor pollicis brevis (EPB), and flexor carpi radialis (FCR) tendons were painted with tantalum in 4 cadavers to highlight their position around the CMC.

- **Tantalum Beads:** Gross dissection identified the dorsal and volar ligamentous anatomy in 4 specimens; 2 hands were dedicated to the dorsal ligaments (dorsal radial, dorsal central and posterior oblique ligaments) and 2 hands to the volar ligaments (anterior oblique and ulnar collateral ligaments). The ligaments were identified from origin to insertion, outlined using 4 tantalum beads per ligament.

- **Micro-CT Simulated X-ray:** The volar metacarpal beak, trapezoidal groove, and dorsal ulnar tubercle were digitally marked on 3-D micro-CT images of 4 hands. Software volume rendering with intensity adjustment simulated plain x-rays.

Results:

- The ligaments, tendons, and bony prominences were readily visualized and identified with plain x-rays.
- **Tendon Course:** The 4 tendons crossing the CMC joint were identified with tantalum paint demonstrating the precise spatial relationship of the tendon to superficial and deep structures; we found tantalum paint inferior to beads in both clarity and challenge of application (Figure 1).



Figure 2. X-rays demonstrating dorsal (A, B, C) and volar ligaments (D, E, F) of the thumb's CMC joint. AP (A, D) Robert's (B, E) and lateral (C, F) views are shown. Abductor pollicis longus insertion (red), dorsal radial ligament (green), dorsal central ligament (orange), posterior oblique ligament (purple), anterior oblique ligament (blue), and ulnar collateral ligament (yellow).

- **Ligament Locations:** The 3 dorsal ligaments and 2 volar ligaments were outlined by tantalum beads on x-ray, demonstrating the oblique orientation of both sets of ligaments, and a fanning array of the dorsal ligaments (Figure 2).

- **Bony Landmarks:** The dorsal ulnar and radial tubercles, trapezoid ridge, and metacarpal volar beak were all identified, with the best correlation seen on the simulated Robert's view projection (Figure 3).

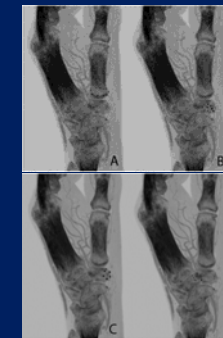


Figure 3. Coronal reconstruction of CT scans rendered to simulate a plain Robert's radiograph demonstrates A) metacarpal beak, B) trapezoid groove, C) dorsal radial tubercle, and D) dorsal ulnar tubercle.

Discussion and Conclusions:

- The ligaments, tendons, and bony prominences surrounding the CMC joint were identified on plain and simulated x-rays.
- These radiographic landmarks may provide clinically relevant information for imaging this complex joint with especial relevance to unstable fractures and CMC arthritis.