

In Vivo Measurement of the Thenar Muscles and First Dorsal Interosseous In Thumb Carpometacarpal Joint Osteoarthritis Using Ultrasound Imaging

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Introduction

- Thumb carpometacarpal (CMC) joint osteoarthritis (OA) is a significant medical problem
 - Age-adjusted incidence of 7% in men and 15% in women
- Joint stability has been implicated as a cause of OA
- Studies of ligaments around the thumb CMC joint showed:
 - The dorsal deltoid ligament complex is uniformly stout, robust, and has greatest sensory innervation
 - The anterior oblique ligament is thin, variable in location, hypocellular, and structurally consistent with capsular structure
- Other components of the joint, such as muscles, may also contribute to thumb stability; in particular, the thenar muscles and first dorsal interosseous
- Study Objective:** Quantify muscle size of abductor pollicis brevis (APB), opponens pollicis (OP), and FDI using ultrasound and compare between healthy controls and CMC OA subjects

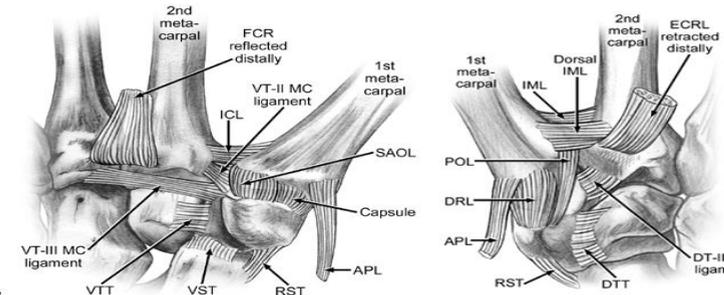


Figure 1. (A) Palmar view of the thumb CMC joint. SAOL represents the anterior oblique ligament. (B) Dorsal view of the thumb CMC joint. The dorsoradial ligament (DRL) and posterior oblique ligament (POL) are components of the dorsal deltoid ligament complex. Reproduced from R. A. Berger, A.-P. C. Weiss, *Hand Surgery* (Lippincott Williams & Wilkins, 1st Edition., 2004).

Methods

- Participants: 14 controls (23-78 years of age) and 8 severe thumb CMC OA subjects (46-80 years of age) recruited from Stanford Hand Clinic
- Real time ultrasound imaging (Logic E9, GE Healthcare) measured anatomical cross-sectional area (CSA) of APB, OP, and FDI muscles and length of metacarpal (MC) bone in both hands
- To scale muscle size by hand size: CSA was divided by MC bone length
 - This scaled CSA (sCSA) was used for all analyses
- Because OA subjects had bilateral disease, 2 hands of each subject were averaged to generate 1 sCSA value
- Unpaired t-test was used to compare means (two-tailed, alpha level = 0.05)

Ultrasound Imaging

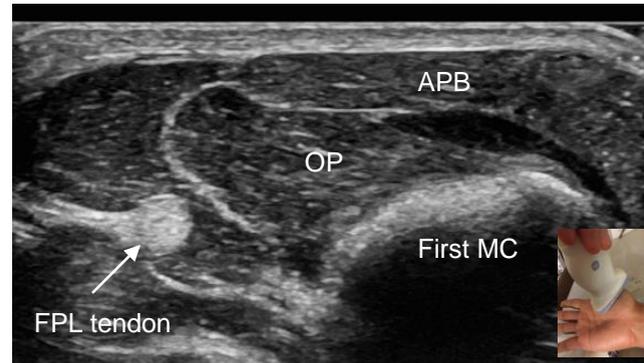


Figure 2. Ultrasound imaging of APB and OP muscles with probe in the short axis of the thenar eminence. The flexor pollicis longus (FPL) tendon and first MC bone are also identified in the image.



Figure 3. Ultrasound imaging of first MC bone with probe in the long axis of the thenar eminence.

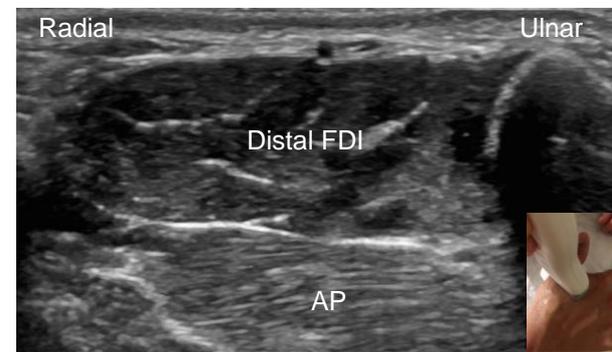


Figure 4. Ultrasound imaging of distal FDI with probe in the short axis of the muscle. Adductor pollicis (AP) is deep to the FDI.

Results

- sCSA for each muscle was lower in OA subjects compared with controls
 - sCSA for OP was statistically significantly lower in OA subjects compared with controls (Table 1)**

Table 1. Comparison of controls and OA subjects by muscle

Muscle	Controls (N=14) sCSA Mean (SD)	OA Subjects (N=8) sCSA Mean (SD)	P-value
APB	0.40 (0.10)	0.34 (0.08)	0.14
OP	0.48 (0.09)	0.37 (0.12)	0.04
Distal FDI	0.68 (0.07)	0.60 (0.12)	0.13

sCSA = scaled CSA

- Muscle sCSA in control group compared by handedness, age (≥ 40 / < 40), sex
 - No significant differences in each muscle sCSA by handedness or age
 - No significant differences for APB or OP by sex
 - Significant difference for distal FDI by sex ($p = 0.01$)**
- Comparisons between controls and OA subjects were stratified by sex
 - sCSA for distal FDI was statistically significantly lower in OA subjects compared with controls among females but not males (Table 2)**

Table 2. Comparison of controls and OA subjects for FDI stratified by sex

Distal FDI	Controls (N=7) sCSA Mean (SD)	OA Subjects (N=4) sCSA Mean (SD)	P-value
Males	0.73 (0.06)	0.72 (0.05)*	0.87
Females	0.64 (0.06)	0.51 (0.02)	0.001

*Based on N=3

sCSA = scaled CSA

Conclusions

- Ultrasound is a fast, noninvasive, effective method to measure hand muscles
- sCSA for each muscle (APB, OP, distal FDI) was lower in OA subjects relative to controls (significant for OP overall and distal FDI in females only)
- Future prospective studies may evaluate association between changes in muscle sCSA and CMC OA disease and validate this ultrasound method for identifying at-risk patients and evaluating interventions
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