The anatomy of thumb

- The thumb Carpometacarpal (CMC) joint

Distal Phalange
Proximal Phalange
Metacarpal
Carpal: Trapezium

Carpometacarpal (CMC)

Saddle joint
- Flexion-Extension
- Abduction-Adduction
Osteoarthritis in the First CMC Joint

- The first CMC joint
  - The primary location of osteoarthritis (OA) in upper extremity

- Prevalence
  - Gender: women
  - Age: 50 to 60 years old
  - 28% to 55% of women had the problem of the basal thumb pain

Factor of OA in CMC joint

- Ligament Laxity
- Incongruent
- Higher contact stress
  - Large changes in stress magnitudes
- Cartilage erosion

Knowledge of high and low weight bearing regions can provide a better understanding of the etiology osteoarthritis
Objective

- To investigate the contact mechanics & characteristics of the thumb carpometacarpal (CMC) joint
  - Cadaver experiment
    - Tendon loading test
- Specific aims
  - Develop a three dimensional computation model to determine the contact region
Tendons of CMC joint

- Extrinsic muscle: APL, EPL, FPL
- Intrinsic muscle: ADD, APB, FPB

Experiment

- Tendon loading test
- Apply different loadings on each individual tendon
  - APL, EPL, FPL, APB, ADD (Instrument constrain)
- 3 loading conditions
  - 200 g
  - 500 g
  - 700 g
- 4D CT was used to obtain the bone geometry image
The distance of joint space

- The distance between metacarpal and trapezium articular surface (Avizo)
- Average thickness of articular layer
  - Trapezium: 0.8 mm
  - Metacarp: 0.7 mm \cite{Koff, 2003}
- Justify criteria
  - Distance less than 1.5 mm mean contact of CMC joint

The displacement of CMC joint

- Displacement
  - Center point of articular surface in metacarpal bone
  - Unloading condition-loading condition
- Trapezium coordination system
Results & discussion

FPL

- 200 g
- 500 g
- 700 g
Contact pattern- FPL

- Trapezium

Distal view

APB
Contact pattern- APB

- Distal view

ADD
Contact pattern- ADD

- Distal view

EPL
Contact pattern - EPL

Distal view

0 g  200 g  500 g  700 g
Dorsal  Radial

Unlar  Volar

0 g  200 g  500 g  700 g

APL

0 g  200 g  500 g  700 g
Contact pattern - APL

- Distal view

Dispalcement

- In dorsal side, less ligament and muscle constrain the movement of metacarpal bone
Conclusion

- **Contact region**
  - Volar: FPL, APB, ADD
  - Dorsal: EPL, APL

- CMC joint have stable contact with the action of muscle in volar side (FPL, APB, ADD)

- The metacarpal bone slid out of CMC joint in the action of tendon (EPL, APL)

**Thanks for your attention**