Analyzing Femoral Cortical Bone Thickness Using Statistical Shape Modeling

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Hip Osteoarthritis

- Cortical bone contributes to the majority of load bearing within the hip.
- Understand how cortical thickness is distributed over femoral head in controls and cam FAI patients.
- Group differences indicate increased growth in anterosuperior and anterolateral regions of the head-neck junction due to location of cam lesion.

Data: Segmented femurs – controls (39), CAM-FAI (21)

Two views of shape differences between mean control and cam-FAI subjects.

Surgical Solution

Surgical debridement
- How much to ‘shave off’?
- From where?
- Can we quantify variation of thickness in femoral head?

Challenges

- Femurs have long and unequal shaft lengths.
- Need to focus particle positioning on “common” regions.
- Experts must annotate every data. Infeasible for a large dataset.
- If we want to analyze other part of data, redefine cutting planes for whole dataset.

Results

How different (offset + angle) are extrapolated planes from expert annotated ones?
- Maximum offset difference ~ 7 mm. Mean ~ 5 mm
- Maximum angle difference ~ 5°. Mean ~ 0.01°

Mean cortical thickness
- Increased cortical thickness in regions of cam lesion.
- Could be caused by bone remodeling in response to repetitive impingement

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