

# A New Impingement Index

## Combines the Effect of Femoral and Acetabular Morphology in Predicting Hip ROM from a Single CT Slice

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# Disclosures

**J Choi, RD Blackwell, SK Ismaily, R Mallepally**      No Conflicts to Report

## **Joshua D Harris, MD**

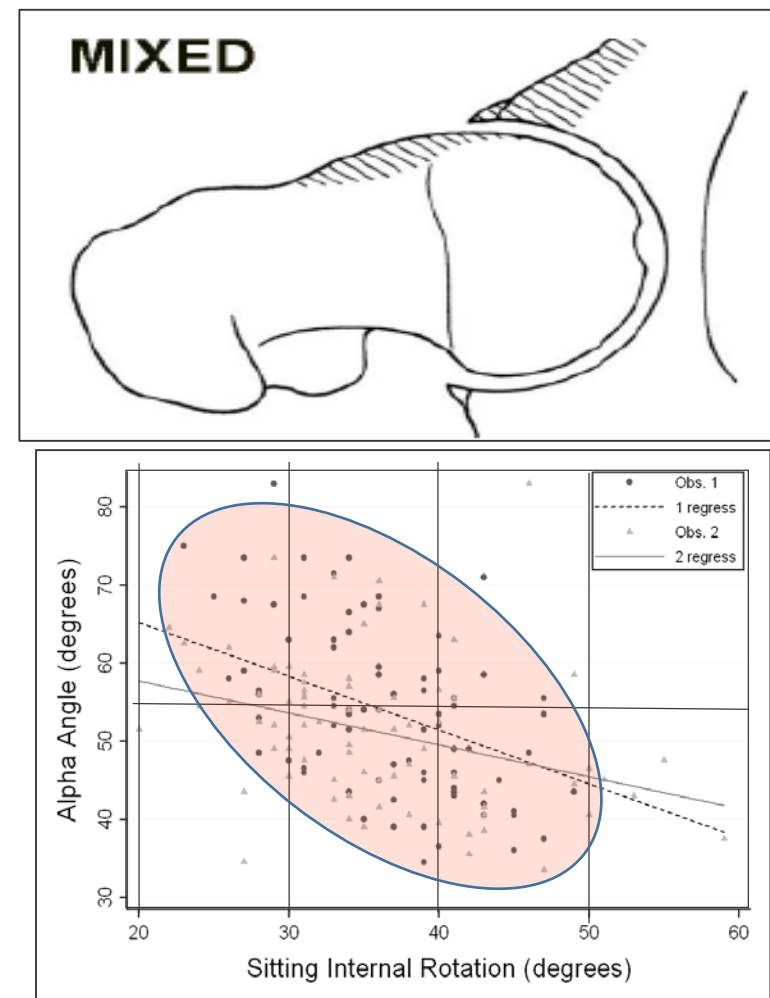
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# Inadequacies of current radiographic diagnosis

- ❑ No current methodology allows for a clinician to perform an efficient, but accurate FAI risk-assessment from a single radiographic slice
  - Multiple radiographic views (AP, lateral, Dunn,etc) are required for FAI identification
  - Most FAI cases however present as a **combination** of Cam and Pincer-type
- ❑ Alpha angle for CAM type FAI
  - Typical structural abnormalities (e.g. aspherical femoral head) primarily occur supero-laterally - Standard AP and lateral views may miss these abnormalities
  - Poor correlation between alpha angle and IR ( $r^2$ : 0.15-0.35)
- ❑ LCE (lateral center edge angle) for Pincer type FAI
  - Measurement subject to pelvic tilt/positioning



Peters et al 2010

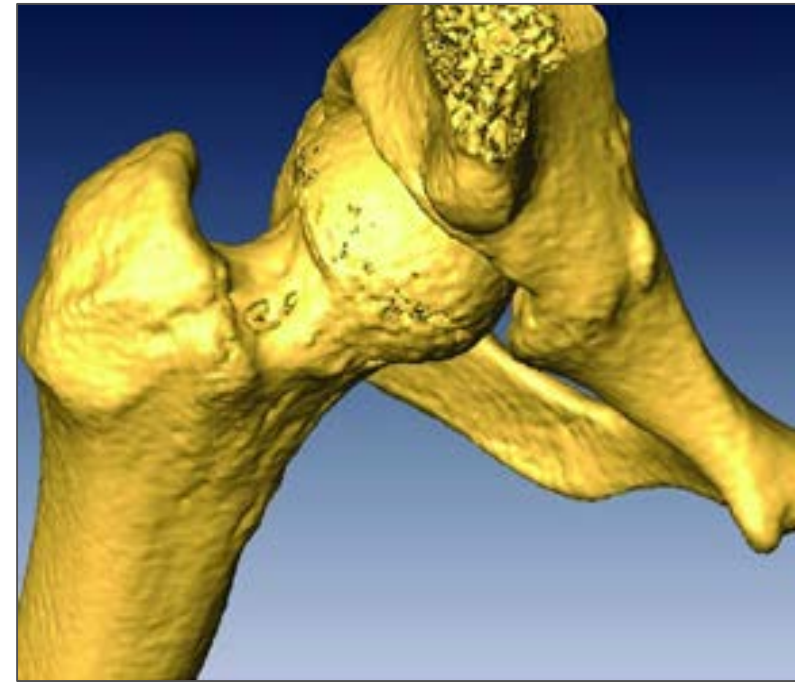
# A New Index to Predict Hip ROM is Needed

- ❑ A simple diagnostic tool for physicians to characterize combined form of FAI is necessary
- ❑ Functional impairment of joint motion would be more accurately predicted using an index derived from both femoral and acetabular parameters rather than either in isolation
- ❑ Thus we aim to examine the accuracy of alternative parameters as predictors of joint ROM in cases of mixed cam and pincer FAI.



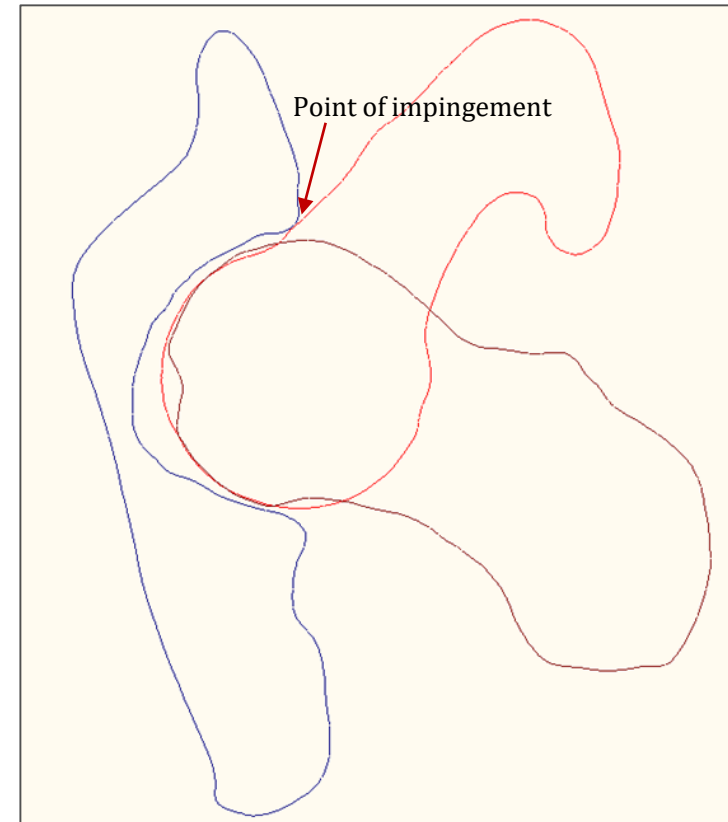
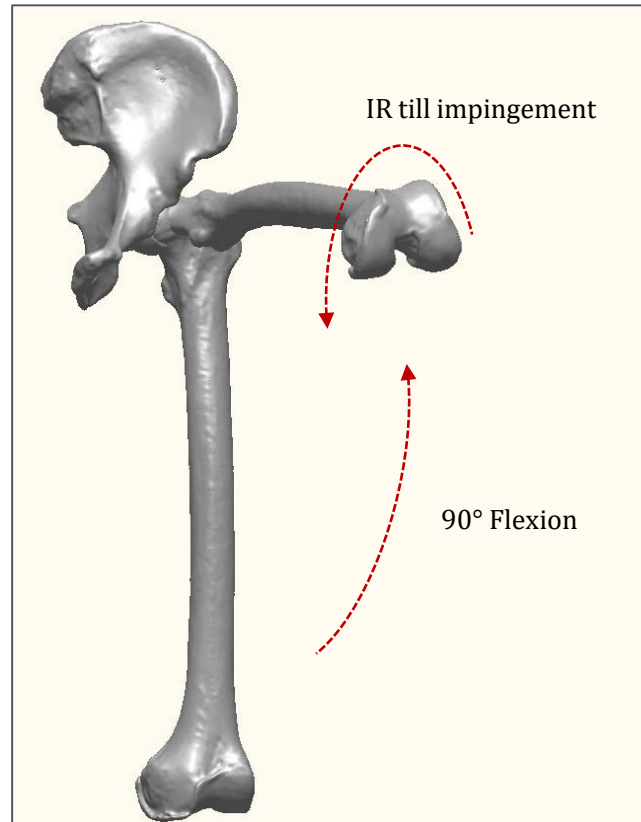
# Methods Used to Determine New Diagnostic Parameters

- ❑ CT scans of 31 hip joints with varying degrees of cam and pincer type FAI were used
- ❑ 3D solid models created by reconstruction of each set of CT scans.



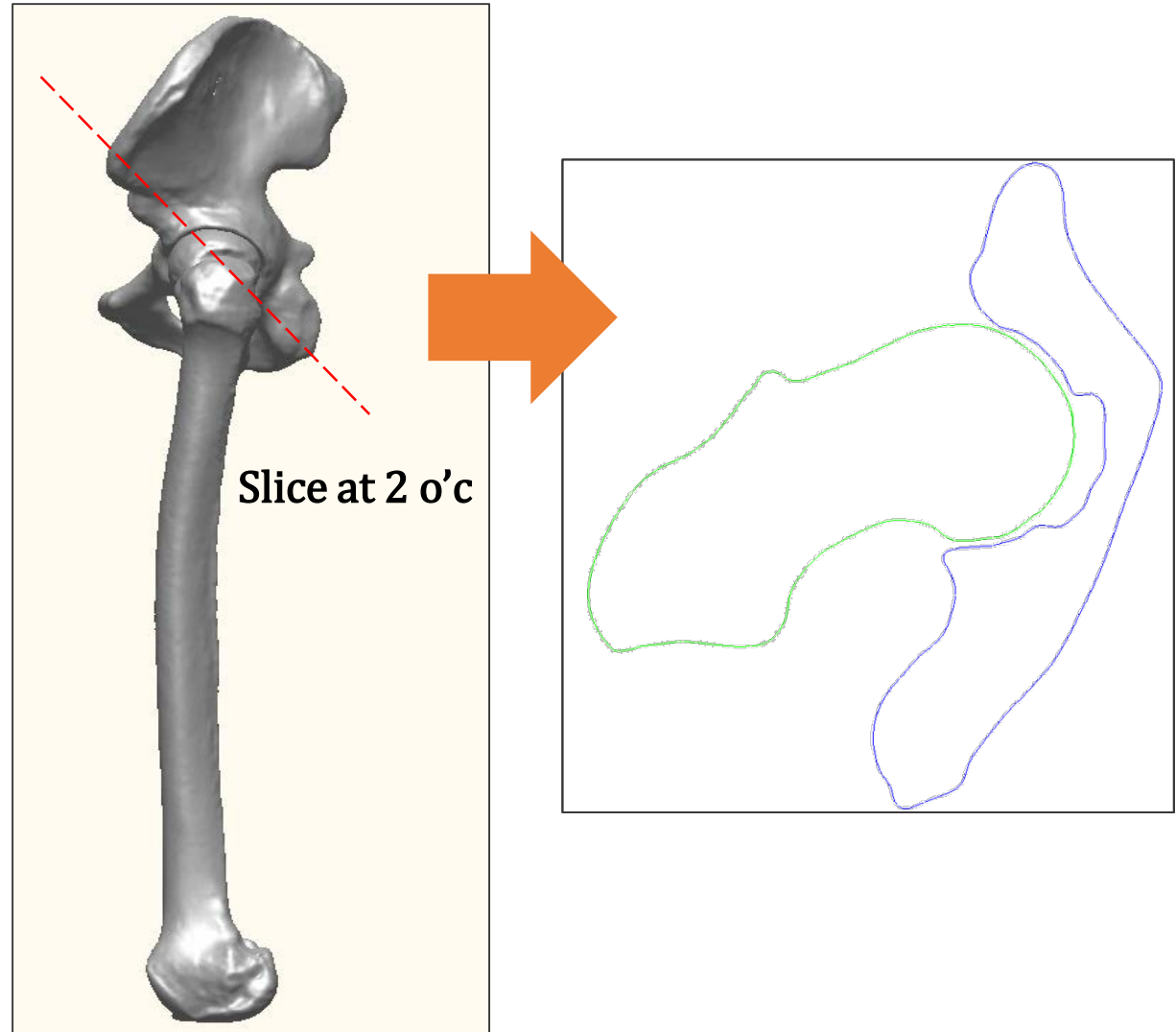
# Methods Used to Determine New Diagnostic Parameters

- ❑ ROM of each hip to impingement measured with custom software
  - Hips placed in 90° of flexion
  - Femur internally rotated till impingement



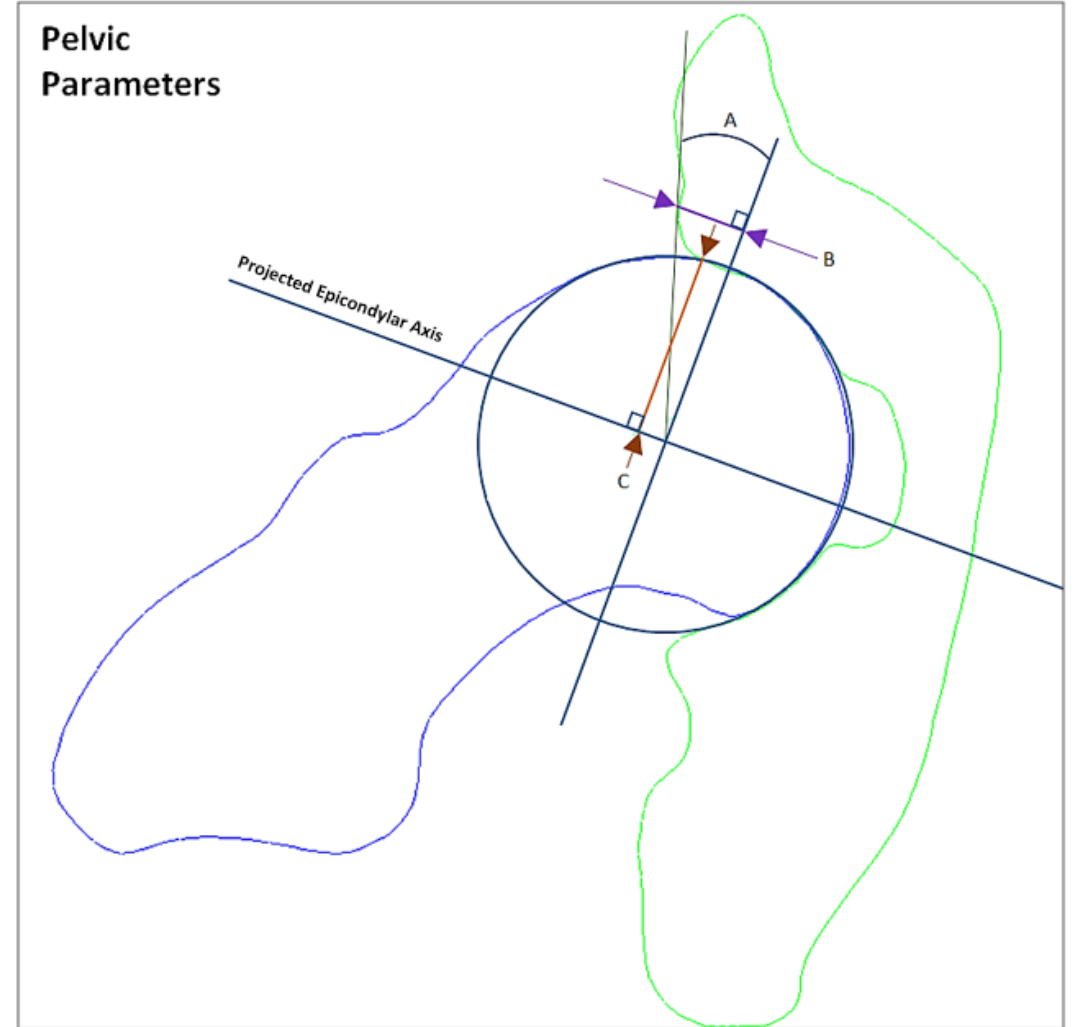
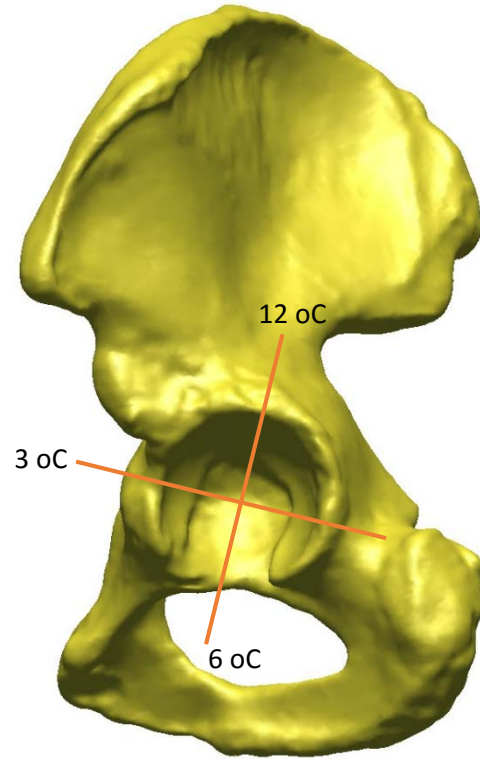
# Methods Used to Determine New Diagnostic Parameters

- ❑ A single CT slice was taken perpendicular to the acetabular rim at the 2 o'clock position (acetabular clock face) with the 3D model placed in neutral
- ❑ Intended to simulate appearance of hip on CT
- ❑ Epicondylar axis of the femur was projected onto the sectioned slices to create respective axes on the acetabular and femoral circle of best fit
- ❑ From this section, we measured 10 morphologic parameters via CAD and custom image analysis software



# Pelvic/Acetabular Parameters

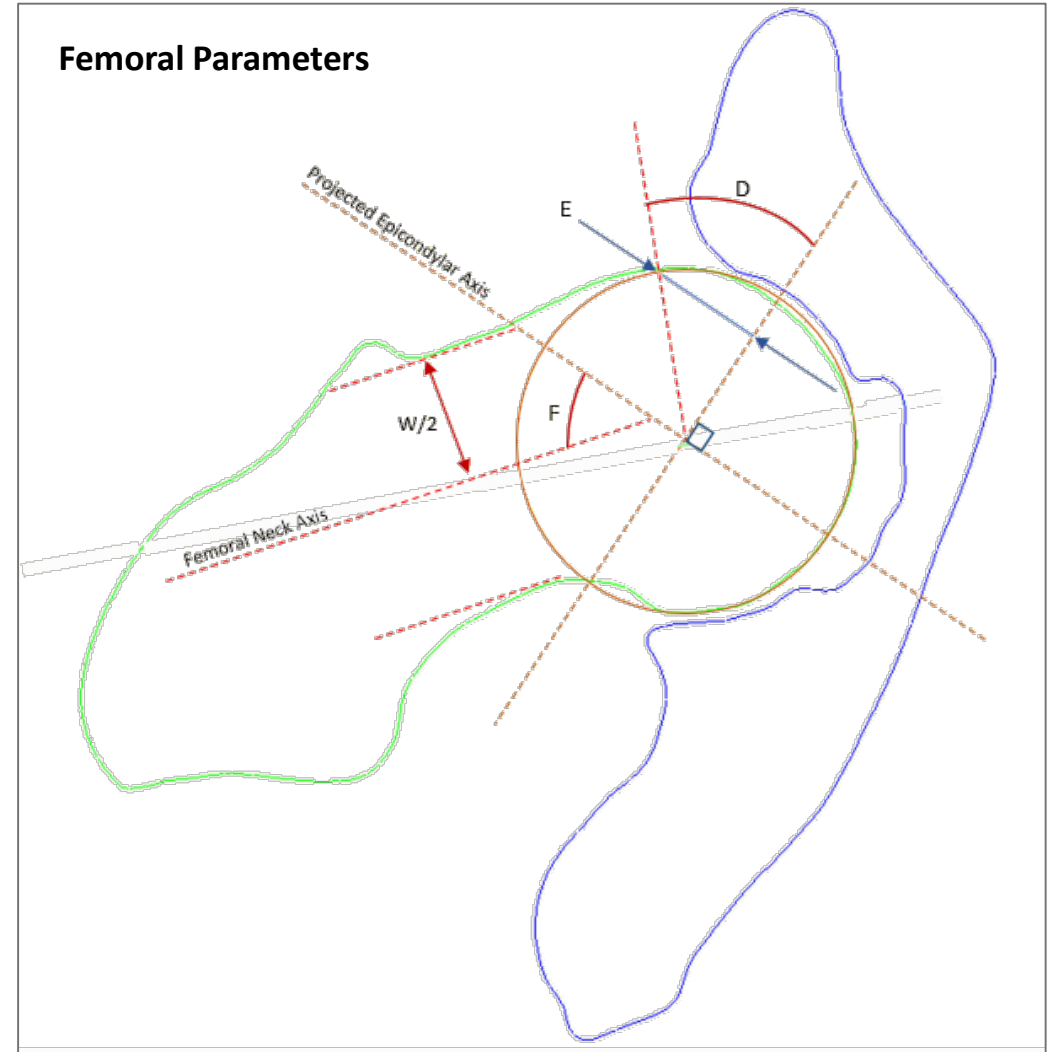
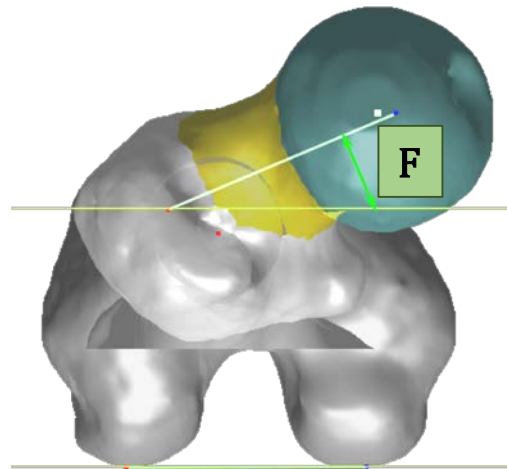
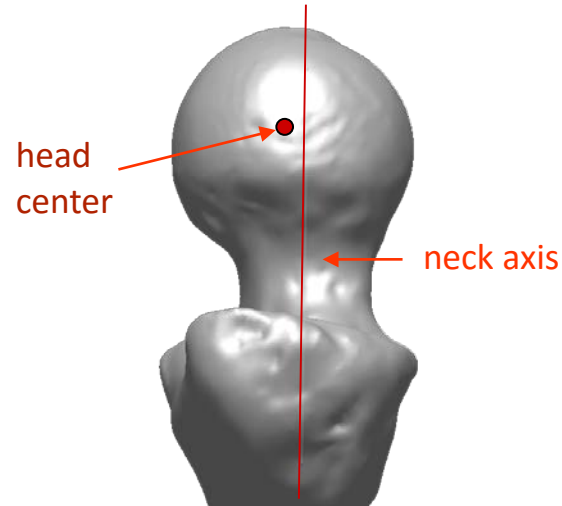
Parameters measured
A
B
C





# Femoral Parameters

Parameters Measured
D
E
F
Femoral anterior offset
AOS
2oC Alpha Angle
Neck width



# Results of the Statistical Analysis

- ❑ Stepwise logistic regression performed for cases impinging at  $<15^\circ$  and  $>15^\circ$  internal rotation
- ❑ Morphologic parameters – independent variable
- ❑ ROM of hip at  $90^\circ$  flexion,  $0^\circ$  adduction – dependent variable

Parameter	Mean	STDV	P - value
A	24.0°	7.30°	0.048
B	12.5mm	4.00mm	0.787
C	25.3mm	3.20mm	0.593
D	54.7°	16.3°	0.040
E	21.0mm	3.90mm	0.380
F	33.1°	11.3°	0.026
Neck Width	32.8mm	4.50mm	0.281
2oC Alpha Angle	73.6°	11.1°	0.308
Femoral Anterior Offset	7.20mm	2.70mm	0.904
AOS	0.15	0.06	1.000

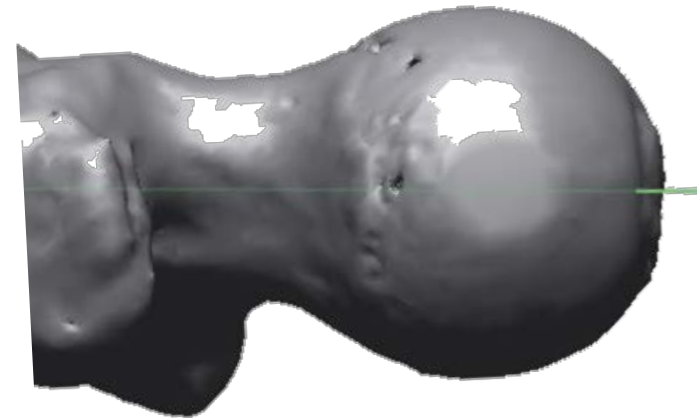
# Results of the Statistical Analysis

❑ Impingement Index (predicted ROM):

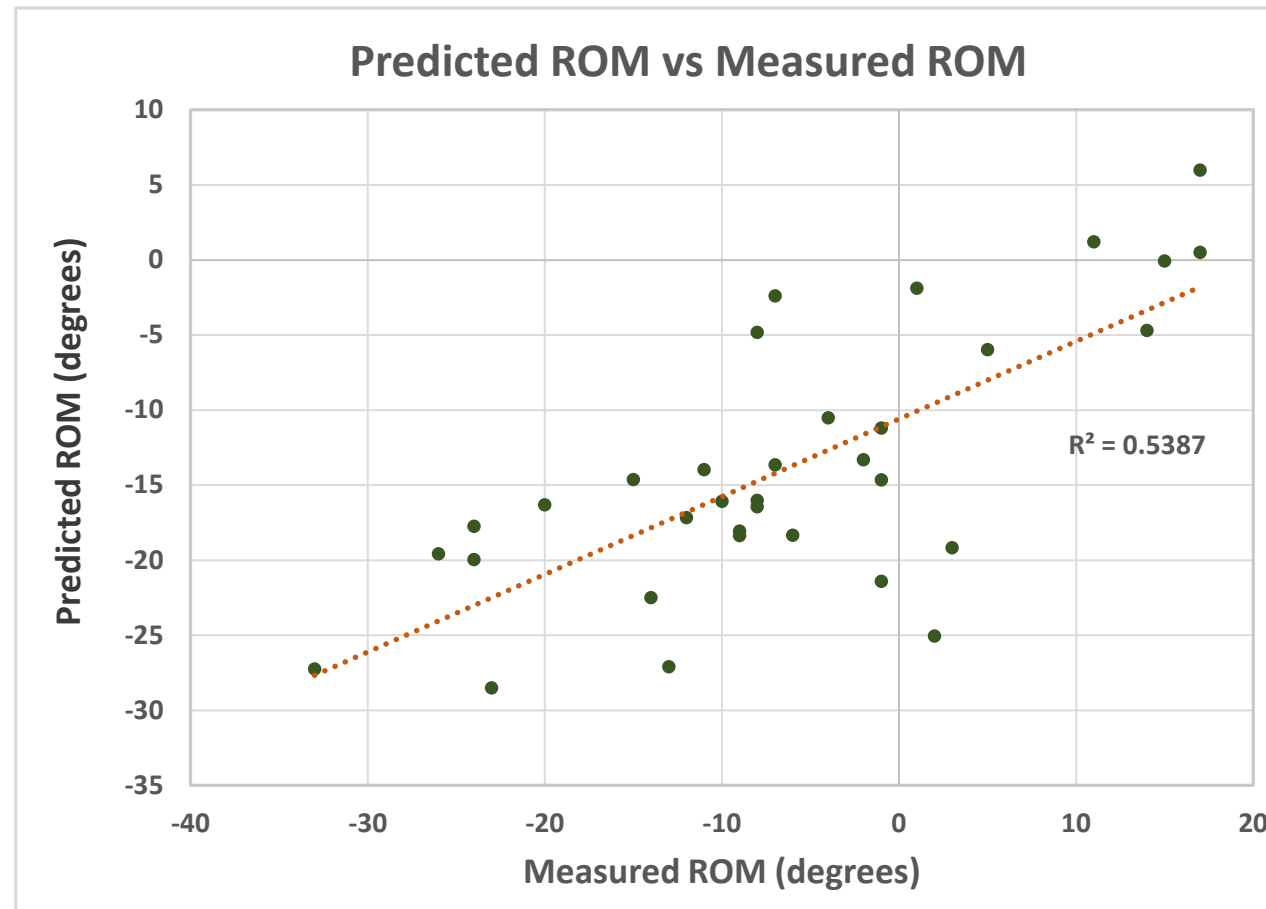
$$\text{ROM} = 0.16 * (F) + 0.11 * (D) - 0.17 * (A)$$

❑ Index correctly classified 82% of FAI cases

❑ None of the traditional parameters defining the risk of impingement were significantly correlated with ROM



# Results of the statistical analysis



Positive ROM indicates external rotation till impingement  
Negative ROM indicates internal rotation till impingement

# Significance of the Study Results

- ❑ The impingement index can estimate patient's individual risk of impingement
- ❑ Morphologic parameters deemed significant in this study can act as strong predictor of FAI in preoperative assessments
- ❑ Contributions from both the femur (D,F) and the acetabulum (A) contribute to ROM and so must be included.
- ❑ New morphologic parameters derived from MR/CT imaging should be explored for FAI identification

