Are Personalized and Sport-Specific Preoperative Plans Needed for Surgical Treatment of Femoro-acetabular Impingement?

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Introduction

- Common cause of recurrence of symptoms post FAI surgery is under-correction of the initial deformity. This commonly occurs when the hip is left with insufficient clearance between the femur and the acetabulum at the point of original impingement
- Conceivably, this location of impingement could vary with the kinematic demands of each sport and the bony anatomy of each individual patient

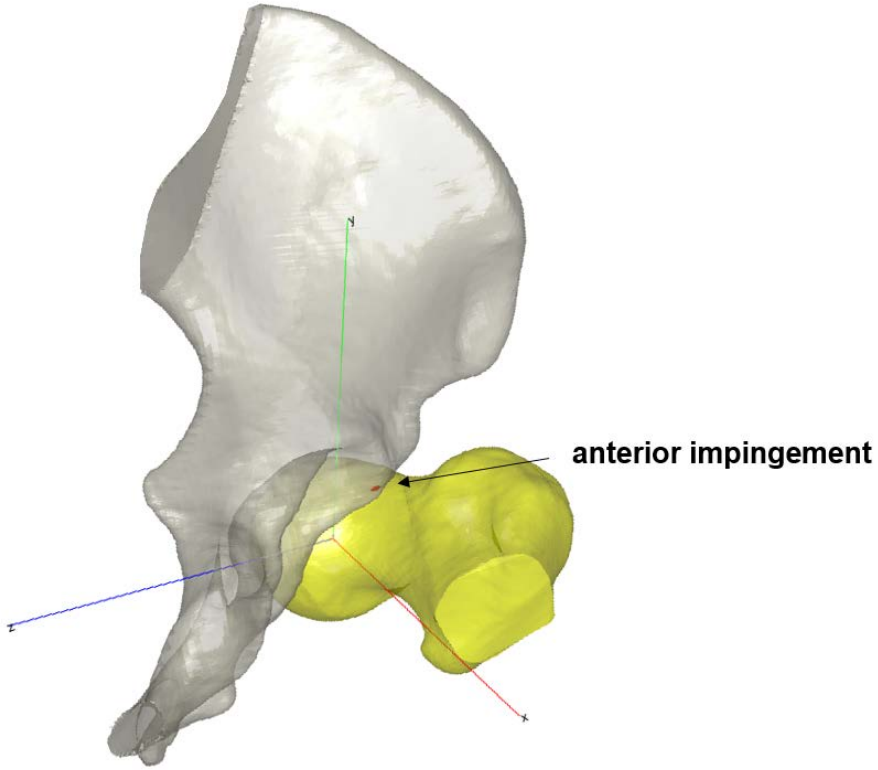
Research Questions

- Does the anatomic location of the site of impingement between the femur and the acetabulum vary with different sporting activities?

- Will one standardized plan for bony resection meet the needs of the majority of patients?

Methods

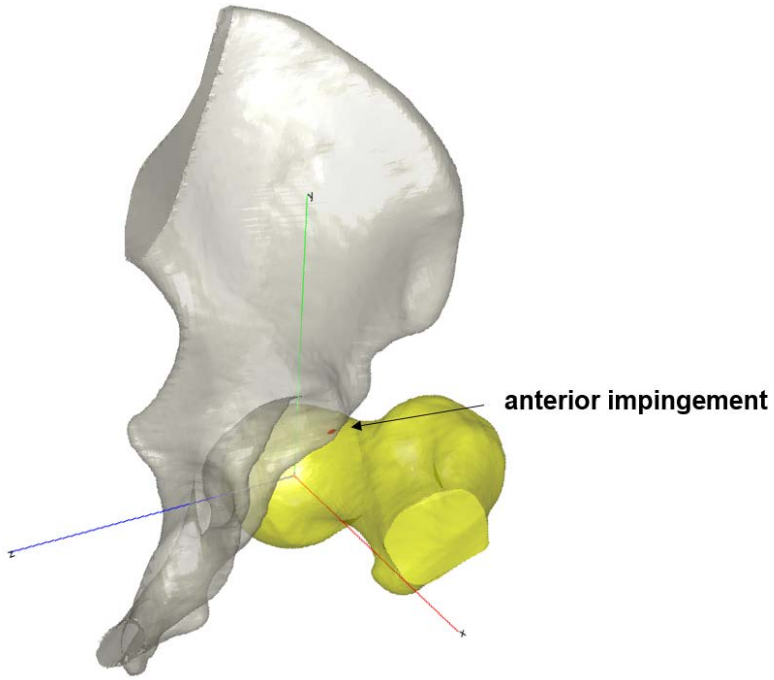
- Eight (8) male hips without degenerative arthrosis
- Chosen hips possessed clinical FAI morphology:
  - α angle: 56.2°± 4.2°
  - Lateral center edge (LCE) angle: 37.9°± 5.9°
- 3D computer models were reconstructed from CT scans



Methods

- Each hip was unable to achieve sufficient internal rotation to perform the following activities without impingement:

Activity	Flexion	Ab/Adduction	Internal Rotation
Flexion with internal rotation	90°	0° (neutral)	<25°
Pitching/stooping	100°	5° Adduction	10-30°
Hockey goalie ”butterfly slide”	75°	25° abduction	20-60°



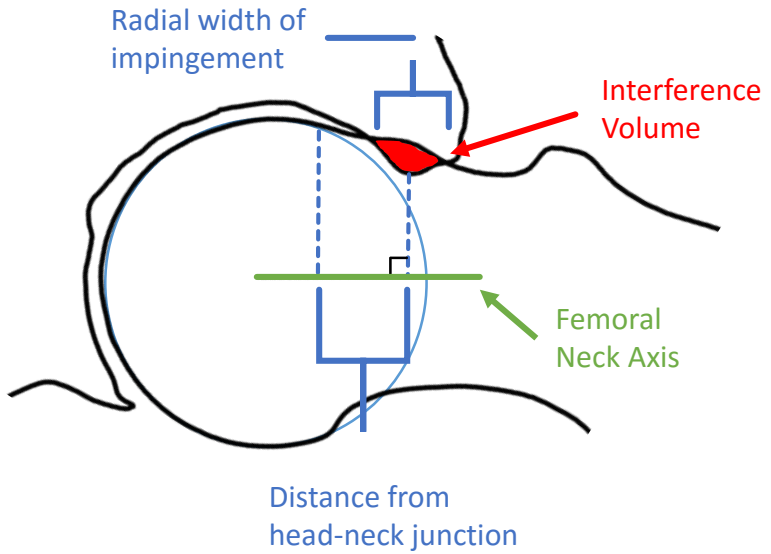
- Each 3D hip model positioned according conventions defined by International Society of Biomechanics
  - placed in flexion and abduction/adduction
  - internally rotated until impingement as detected by collision detection algorithm

- Each hip model was internally rotated an additional 10° to within the reported range of IR for the activity, simulating restoration of range of motion after surgical resection

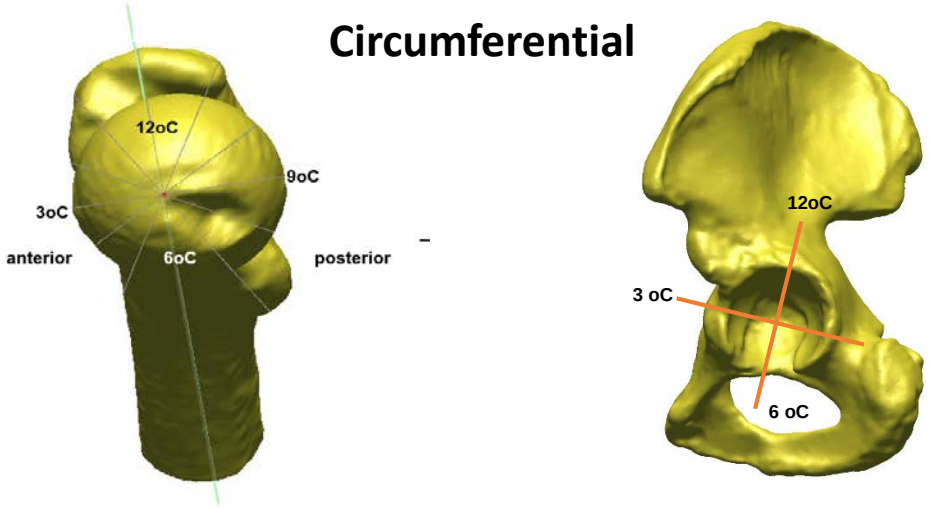
Methods

- The location of the initial **point of impingement** was defined in terms of its:
  - Circumferential position around the acetabular margin using the original clock-face convention (acetabular notch = 6:00)
  - The radial distance from the head/neck junction
- **The radial/circumferential boundaries of the bony interference volume** were recorded. This corresponds to the width of resection required to allow 10° of hip motion beyond the point of initial impingement
- **The radial/circumferential coordinates** recorded for each activity were compared using standard statistical methods

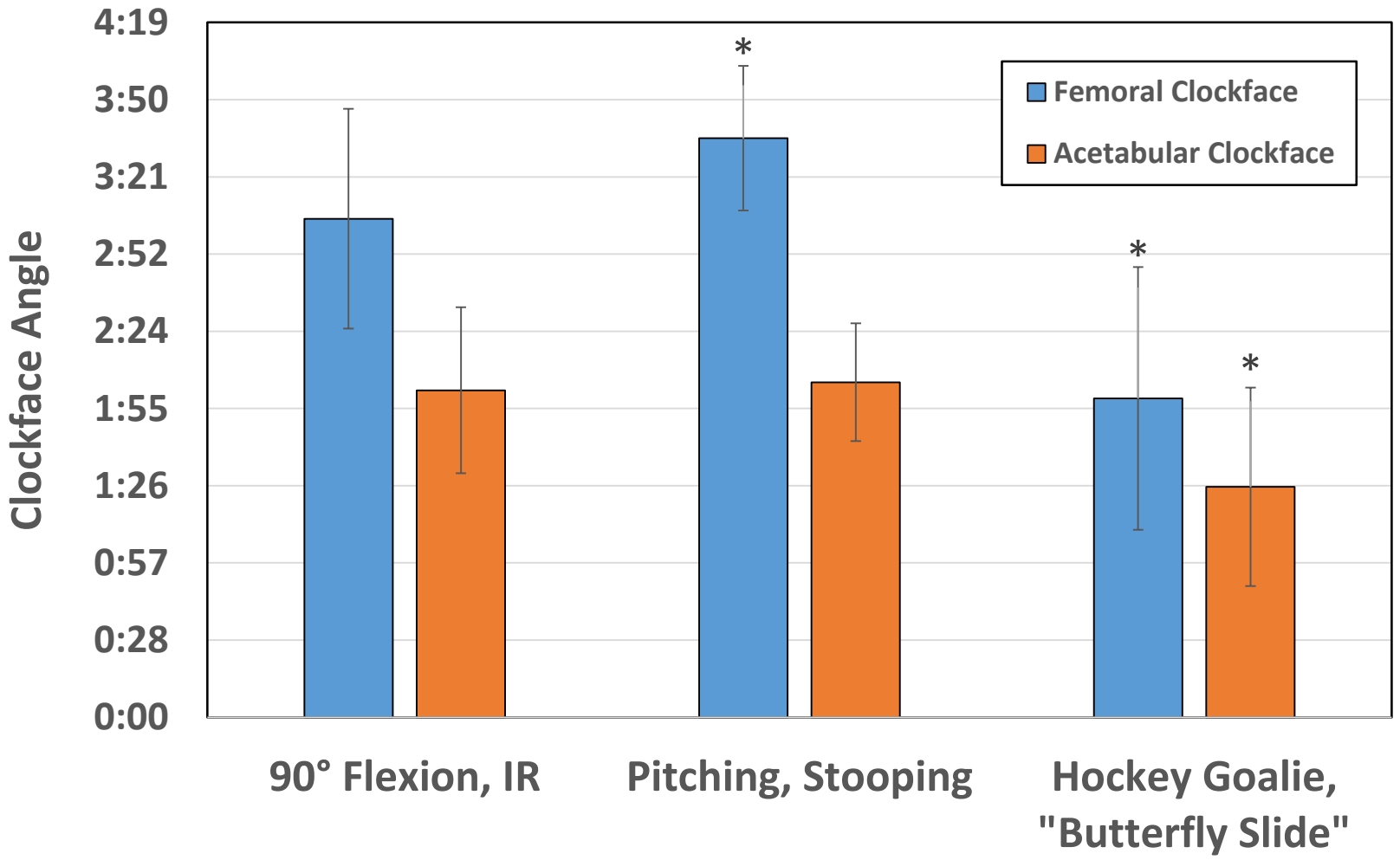
Radial

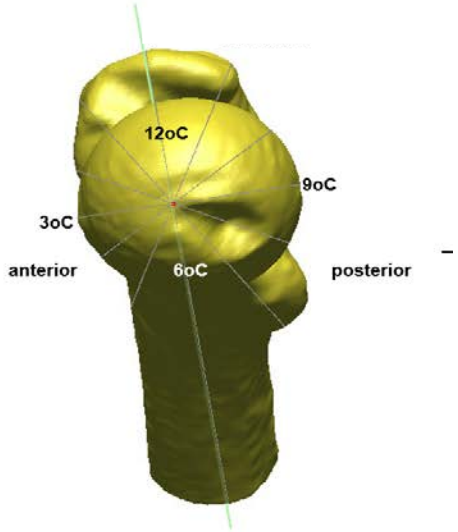


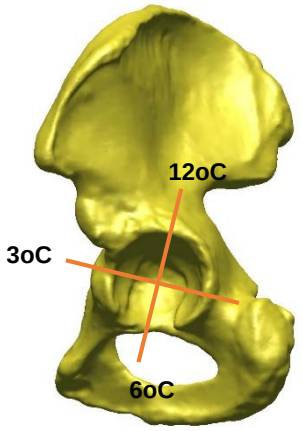
Circumferential



Results - Location of the Impingement Point

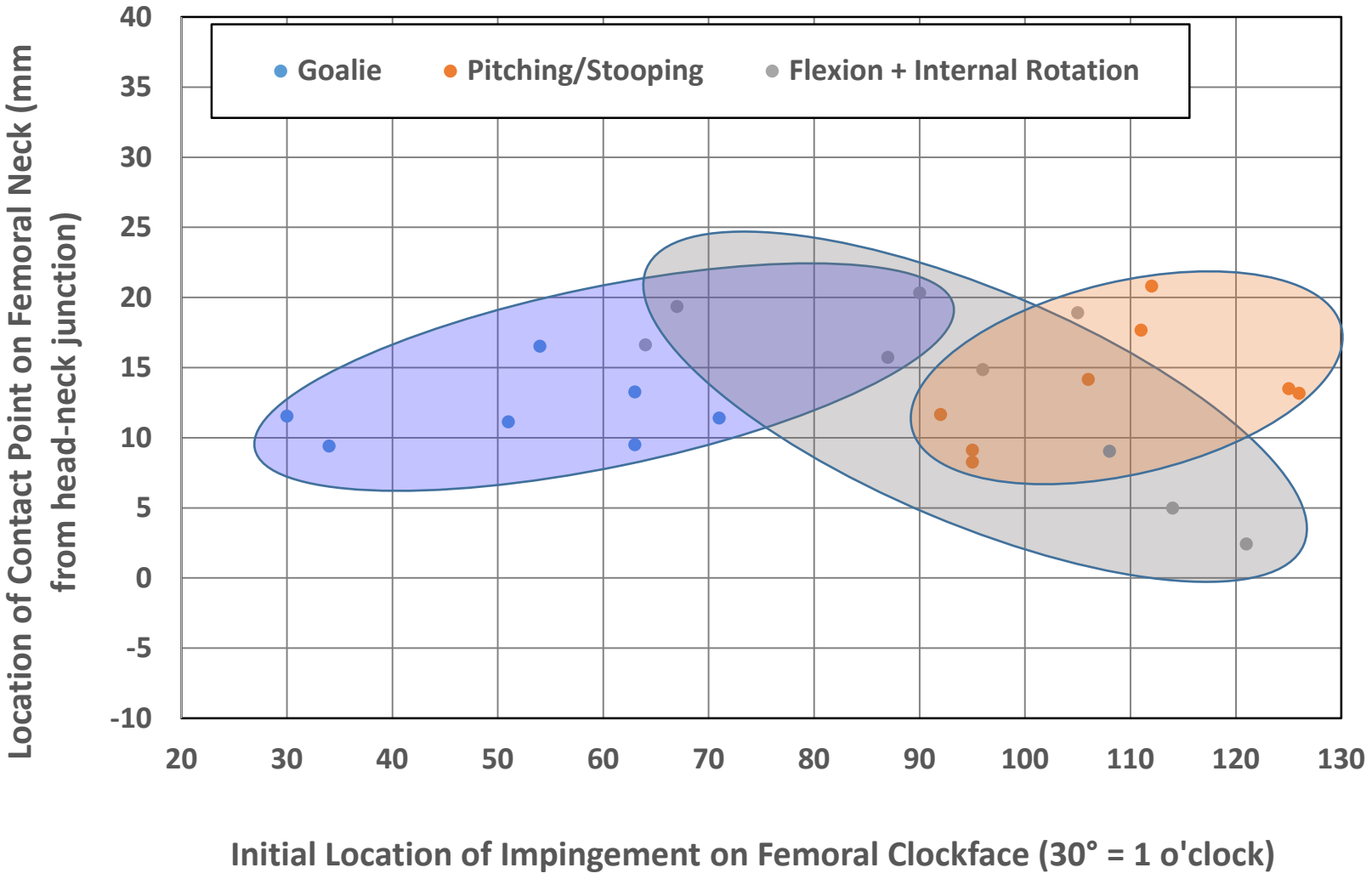




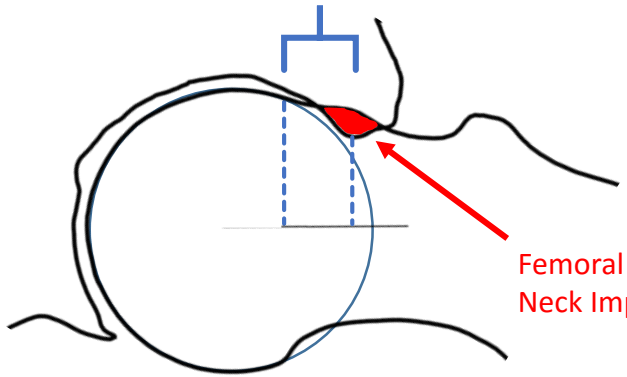


Asterisk (*) indicates statistically significant difference vs “90° Flexion, IR”

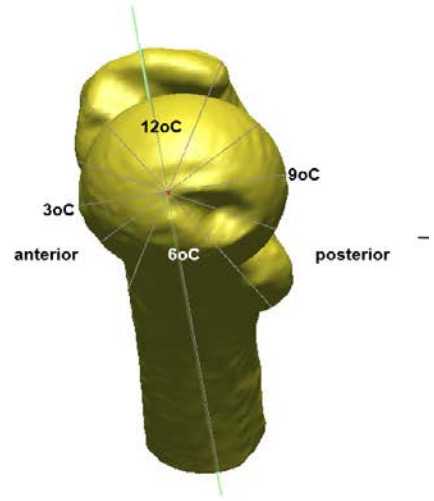
Results –Location of the Impingement Point: Femoral Neck



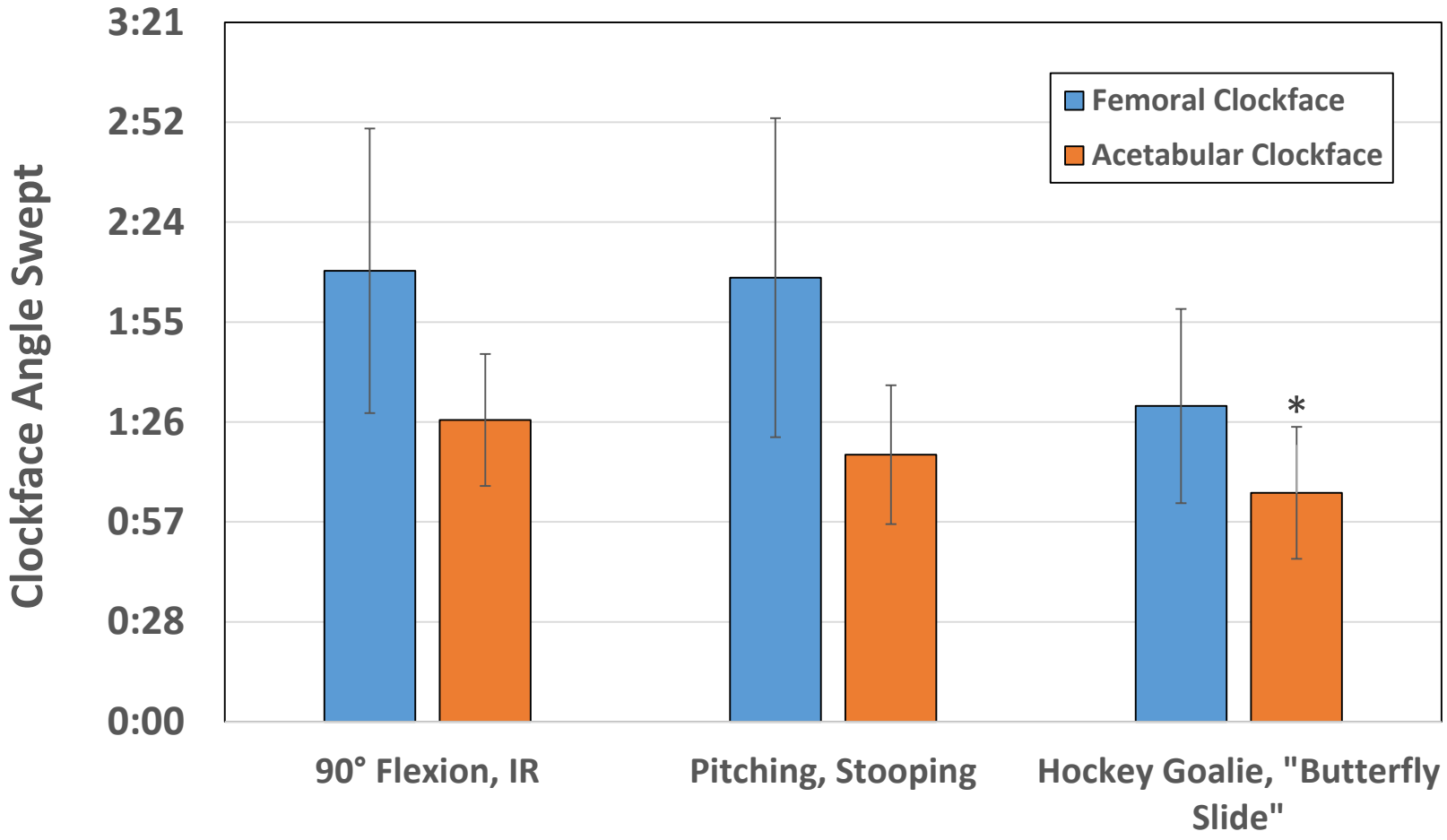
Distance of impingement from head-neck junction

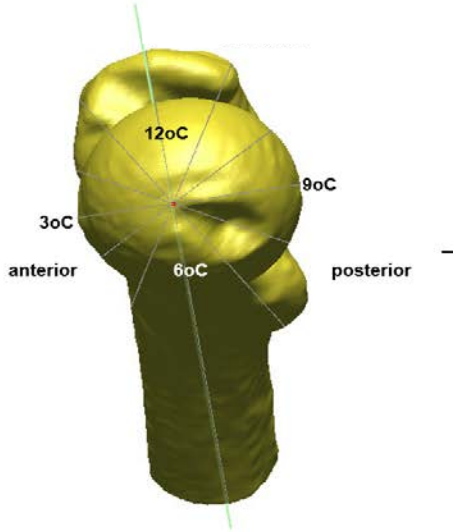


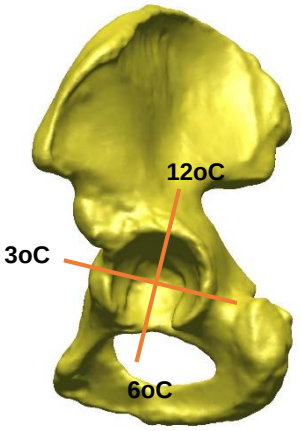
Femoral clockface



Results – Circumferential width of resection required

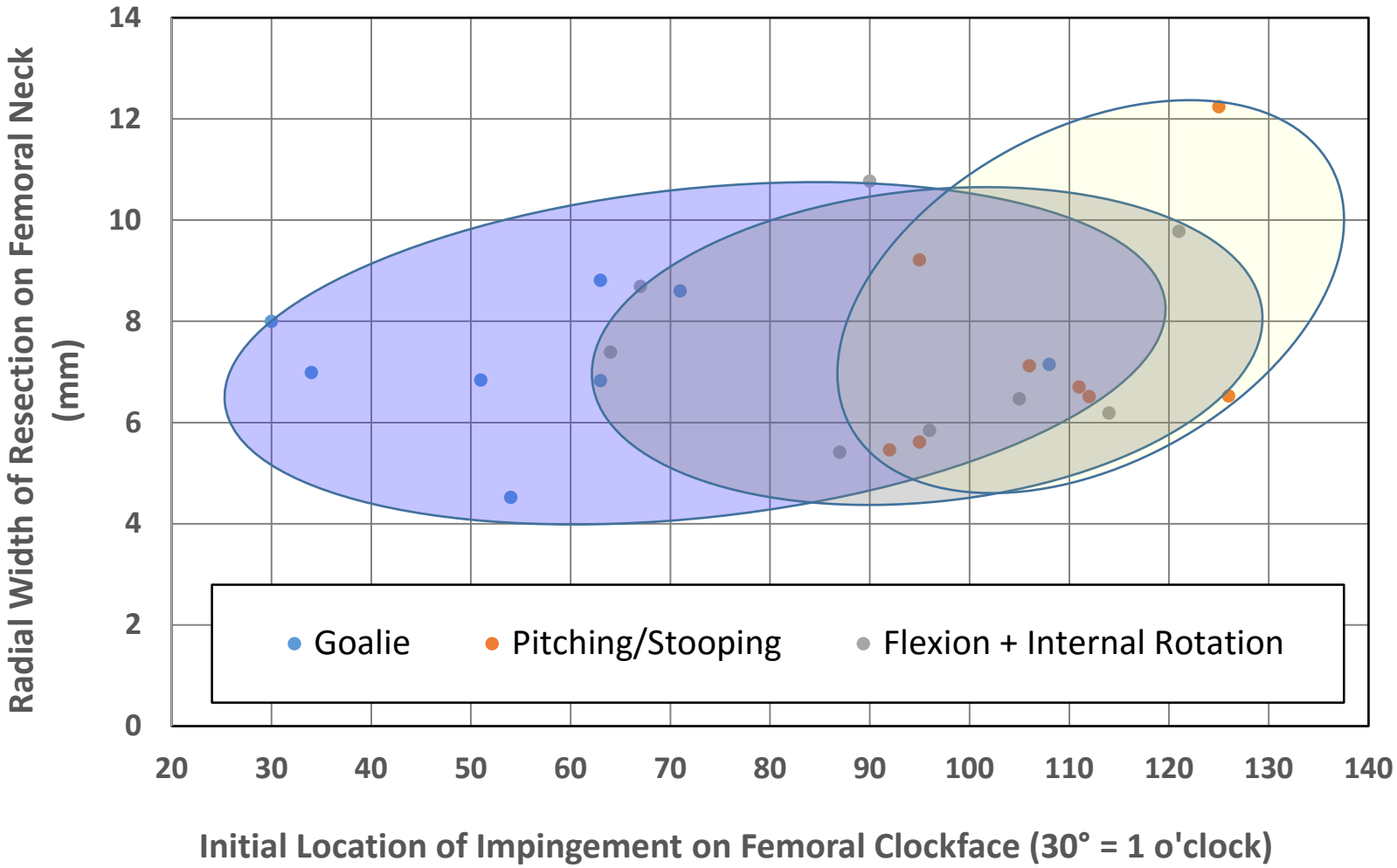


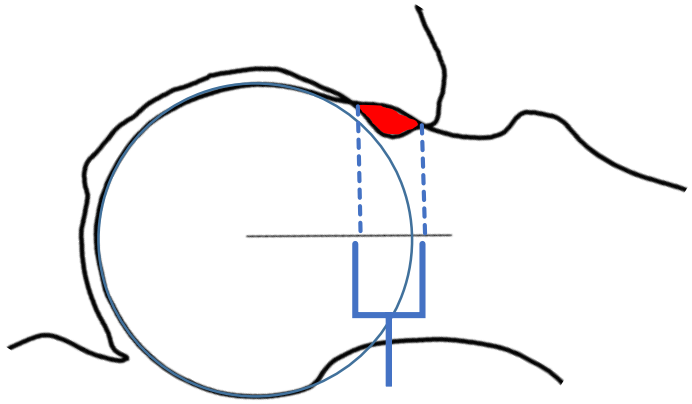




Asterisk (*) indicates statistically significant difference vs “90° Flexion, IR”

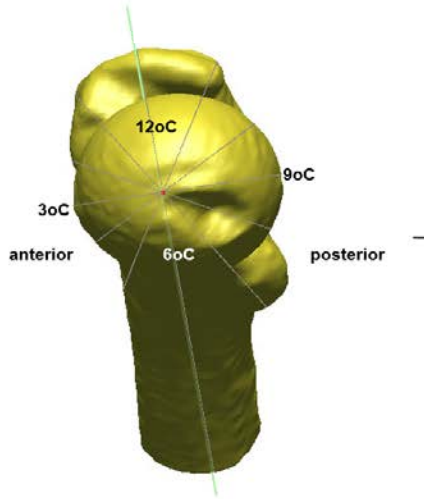
Results – Radial Width of Resection along the Femoral Neck





Width of resection to restore ROM for the activity

Femoral clockface



Conclusions

- The location of the femoro-acetabular impingement site varies with different athletic activities
- Even larger variations are observed between patients to the extent that a generic plan for osteochondroplasty would need to prescribe bone resection from 0:00 to 4:30hrs on the femur and 0:30 to 3:15 on the acetabulum to accommodate normal variation in hip anatomy
- In view of these findings we recommend use of individualized preoperative planning for FAI surgery