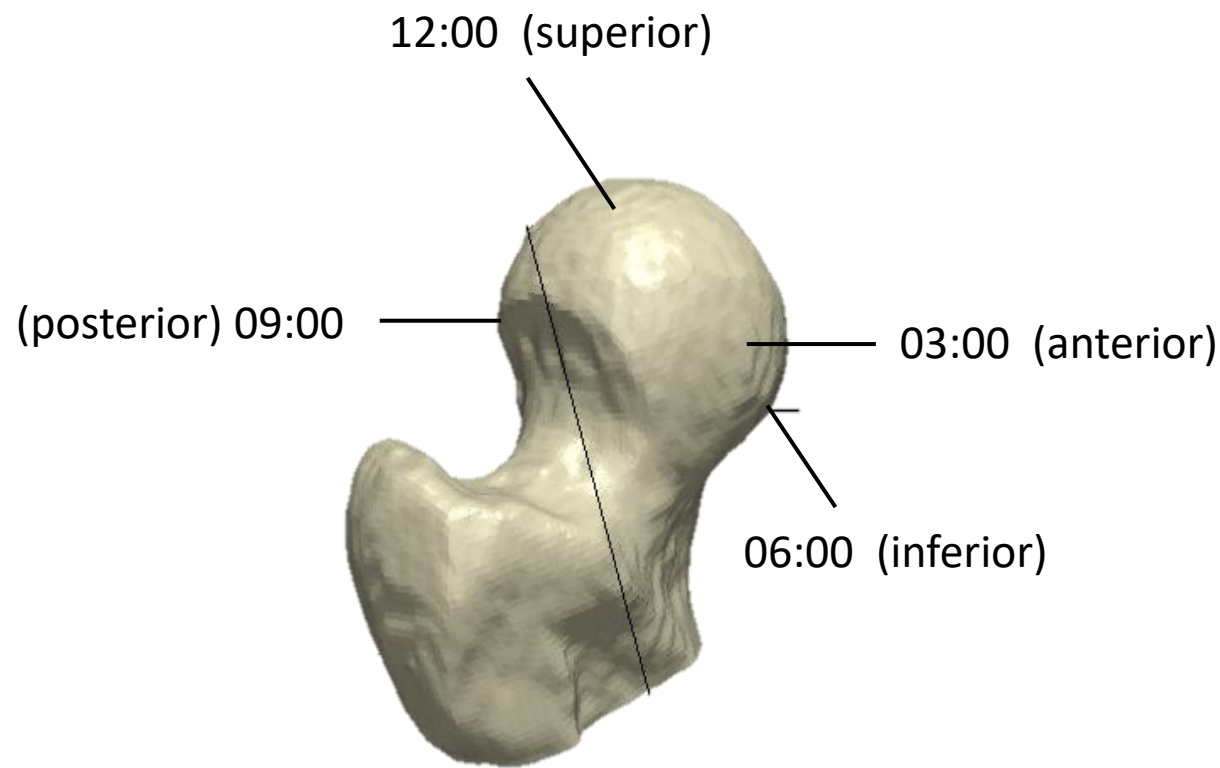
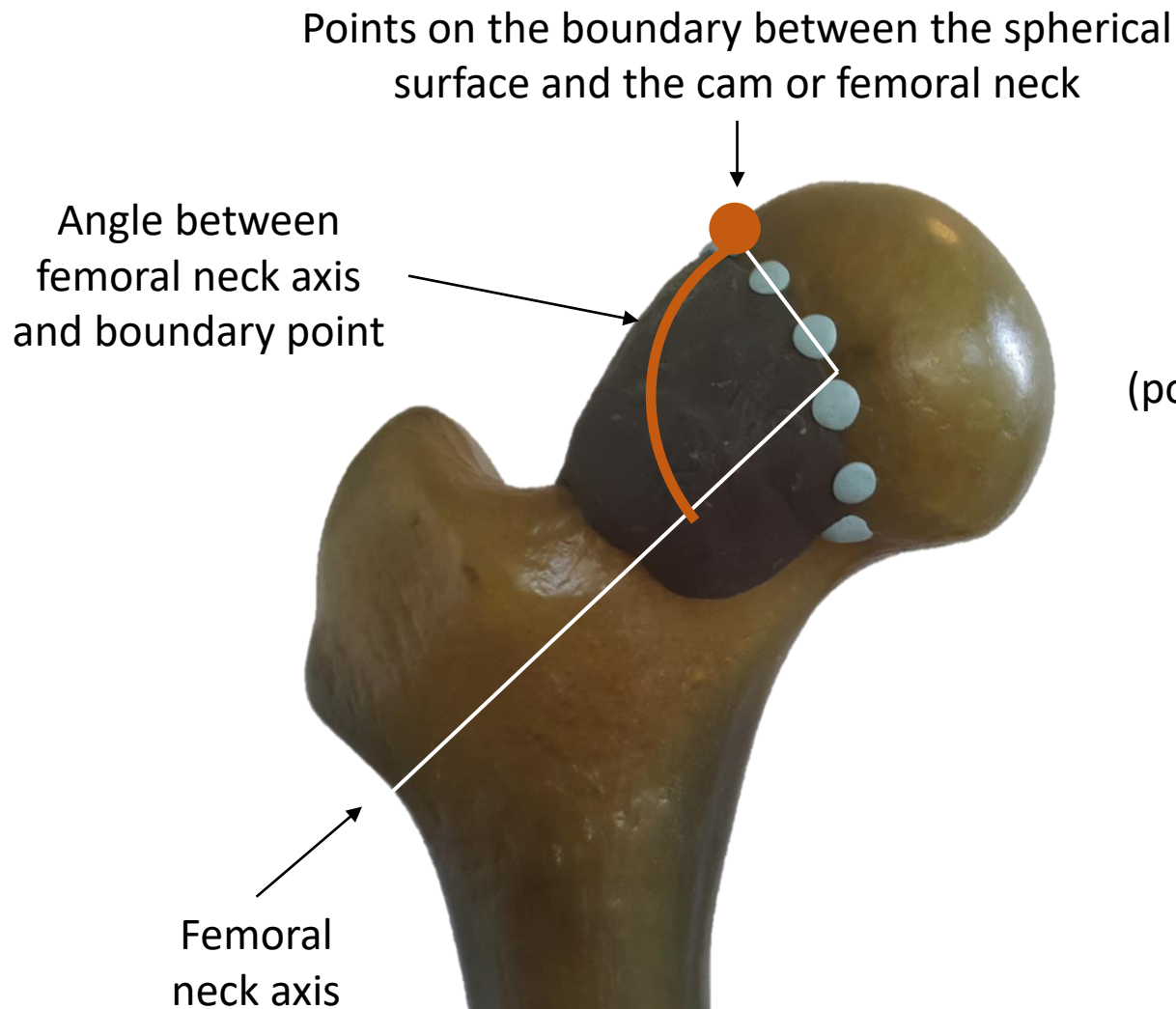


## **Femoral neck and cam edge points**

Definitions of angles used to define point locations

+ sources for the angle values used for this study

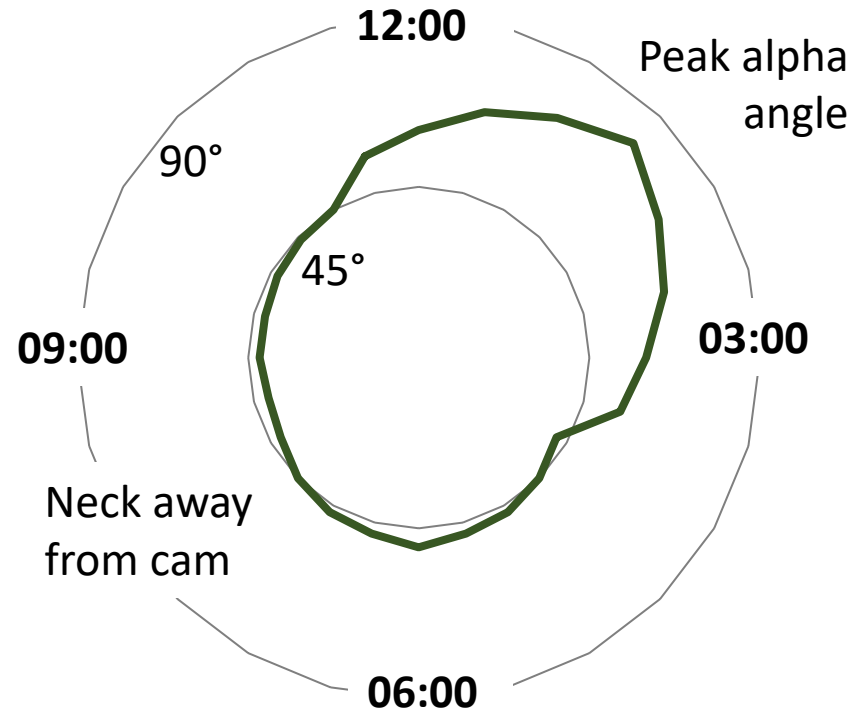
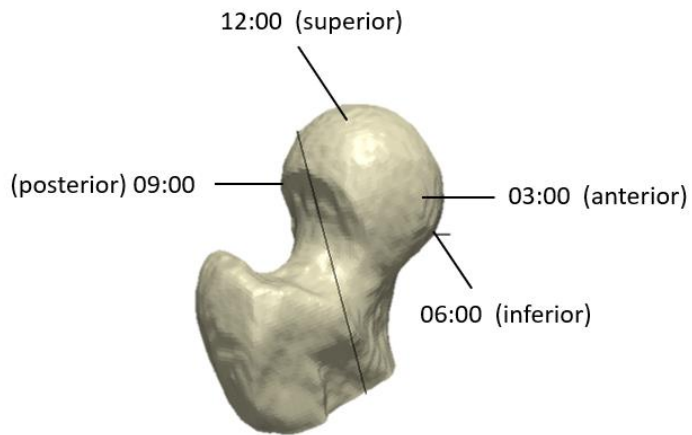
# Definition of femoral neck and cam edge angles



Clock face positions used to define the position of the points around the femoral neck axis

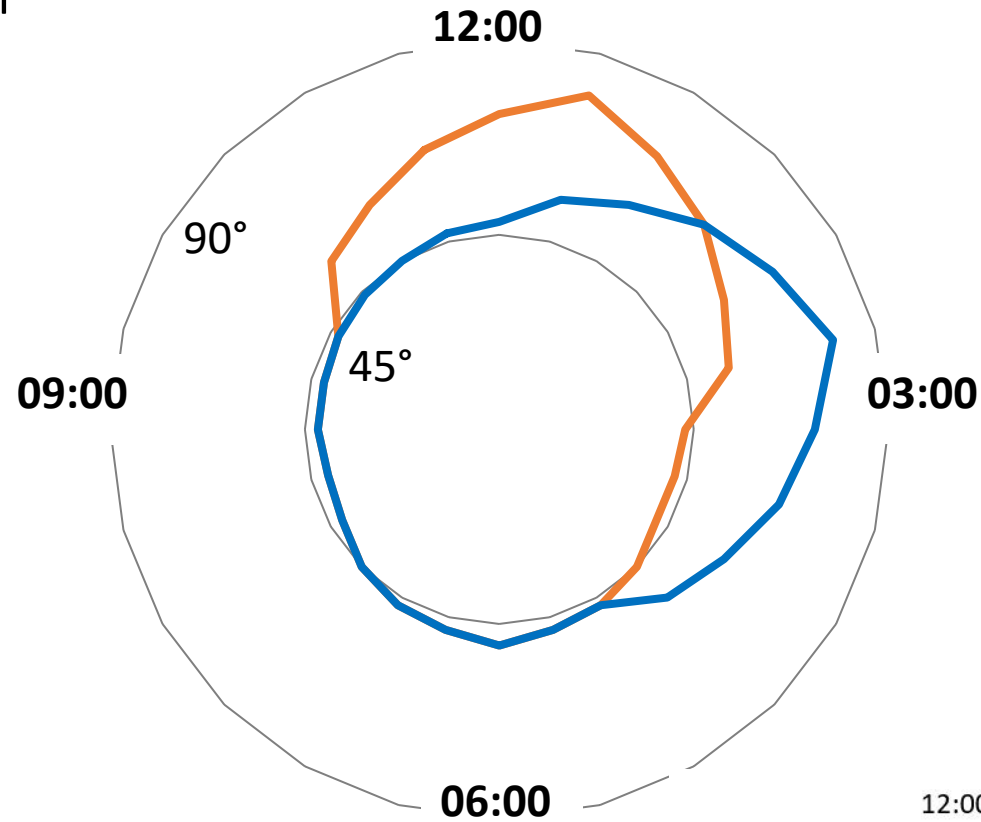
# Femoral neck and cam edge angles used for this study

In areas where there is no cam shape, the boundary of the neck is used, based on values from Nakahara et al (2011).



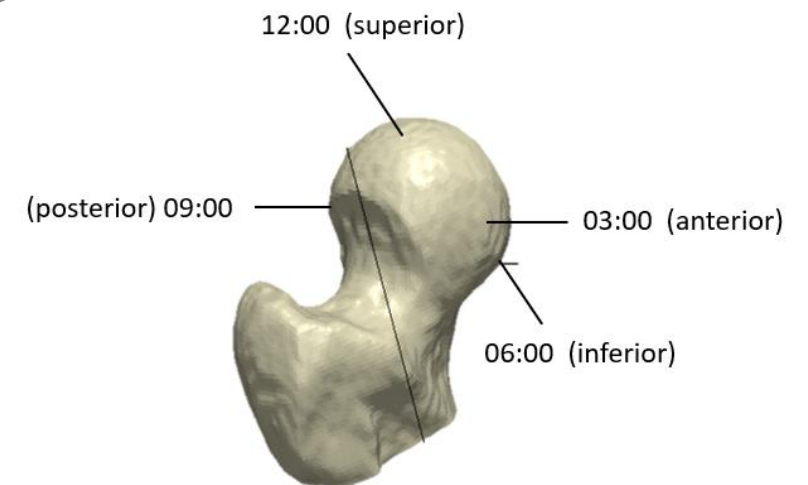
## Definition of the cases used in the paper

- **Cam size**
- Cam extent
- Cam location (2)



All cases in the study are representing large cam shapes, with a maximum alpha angle of 80°.

An alpha angle of 80° is close to the mean for a large cam group (Savage 2021), although alpha angles of 90+ have been recorded (Sutter 2012).



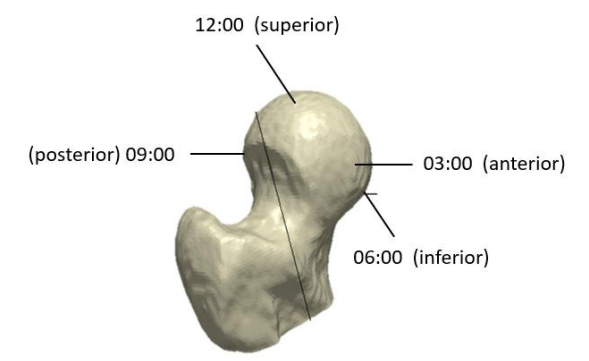
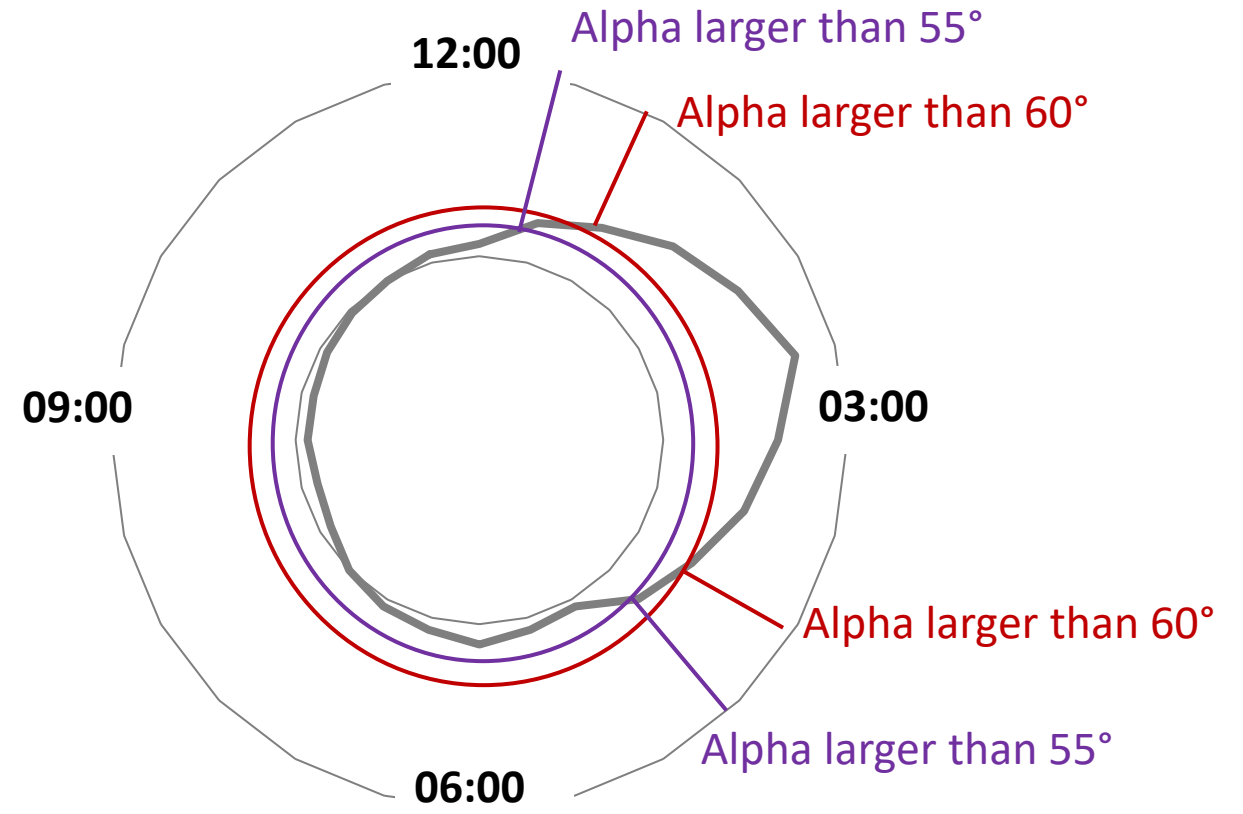
## Definition of the cases used in the paper

- Cam size
- **Cam extent**
- Cam location (2)

**Mascarenhas et al (2018)** analysed the extent of cam shape around the femoral head for a large asymptomatic population, looking at **extent with greater than 55 degrees alpha** and **greater than 60 degrees alpha**.

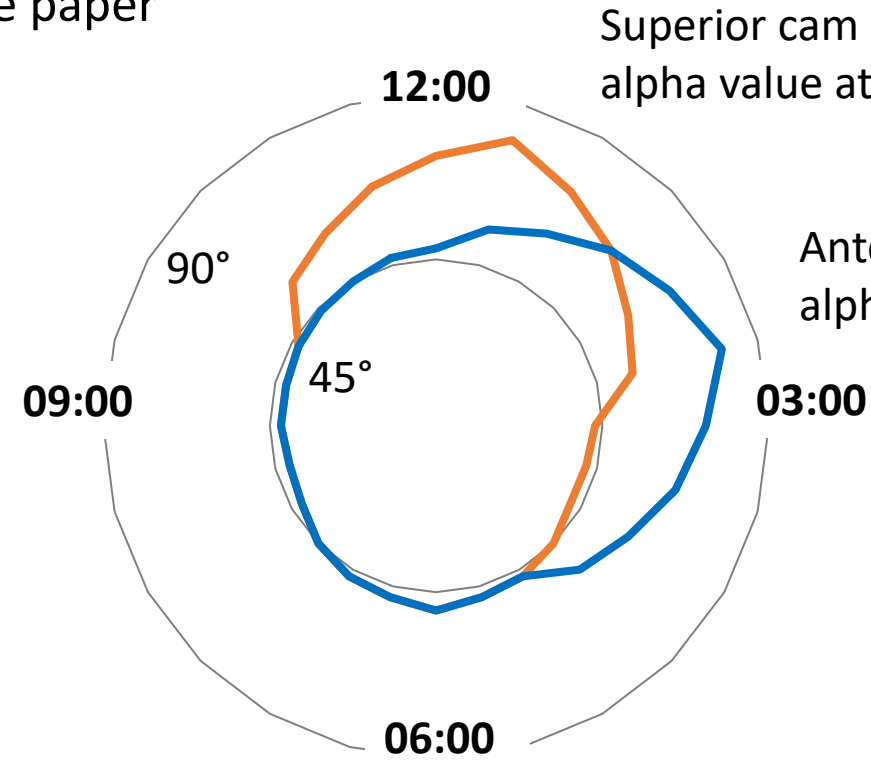
The change in alpha around the head in this model has been interpolated from that data. A larger cam (with a maximum alpha of greater than 60°) had an extent between 3 and 3.5 clock face positions (*omega 55 in the terms used in that work*).

Results from **Sutter et al (2012)** imply that a mean symptomatic cam has an extent around the femoral head (*omega 55*) closer to 3.5 clock face positions.



## Definition of the cases used in the paper

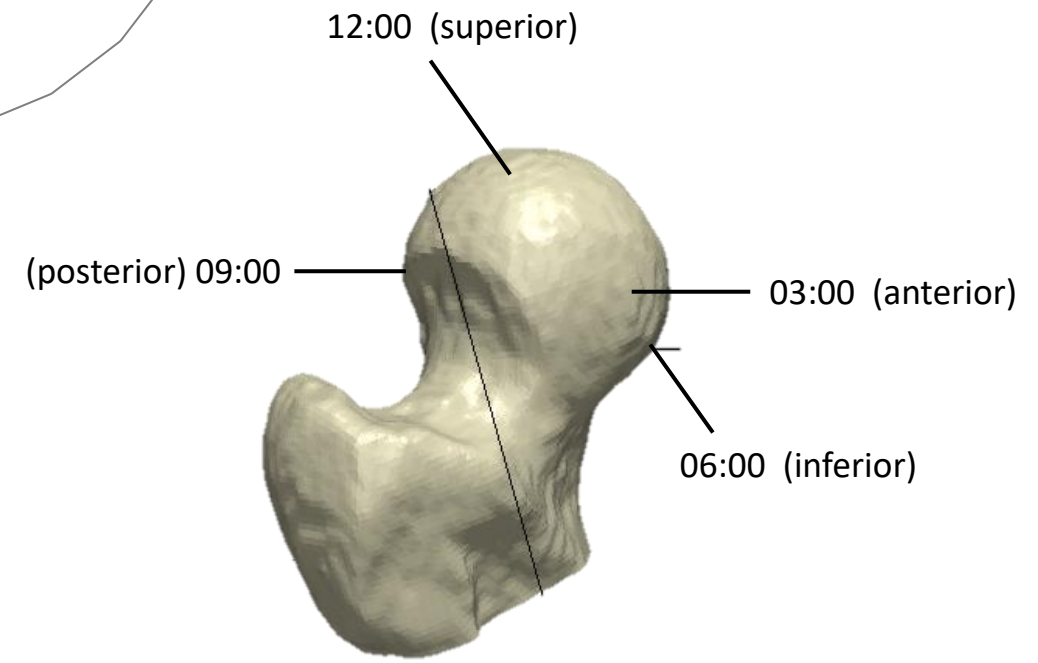
- Cam size
- Cam extent
- **Cam location (2)**



Superior cam with the maximum alpha value at the 12:30 position.

Anterior cam with the maximum alpha value at the 02:30 position.

The location of the highest alpha angle is consistently reported to be between 12 o'clock and 3 o'clock (Savage 2021), with Ellis et al (2020) reporting the majority of bone removal planned at the 1 and 2 o'clock positions.



## References

**Ellis et al.**, Total volume of cam deformity alone predicts outcome in arthroscopy for femoroacetabular impingement, *Knee Surgery, Sports Traumatology, Arthroscopy* 2020;28:1283–1289

**Mascarenhas et al.**, Hip shape is symmetric, non-dependent on limb dominance and gender-specific: implications for femoroacetabular impingement. A 3D CT analysis in asymptomatic subjects, *European Radiology* 2018;28:1609–1624

**Nakahara et al.**, Gender Differences in 3D Morphology and Bony Impingement of Human Hips, *Journal of Orthopaedic Research*, 2011 Mar;29(3):333-9

**Savage et al.**, Trunk, pelvis and lower limb walking biomechanics are similarly altered in those with femoroacetabular impingement syndrome regardless of cam morphology size, *Gait & Posture*, 2021;83:26–34

**Sutter et al.**, How Useful Is the Alpha Angle for Discriminating between Symptomatic Patients with Cam-type Femoroacetabular Impingement and Asymptomatic Volunteers? *Radiology*, 2012;264(2):514-521.