

^{1,2}J Pierrepont; ¹W Theodore; ³M Solomon; ⁴AJ Shimmin; ⁵E Marel

¹Optimized Ortho, NSW, Australia; ²University of Sydney, NSW, Australia; ³Sydney Orthopaedic Specialists, NSW, Australia; ⁴Melbourne Orthopaedic Group, VIC, Australia; ⁵Peninsula Orthopaedics, NSW, Australia

Introduction

Implantation of the acetabular component parallel to the transverse acetabular ligament (TAL) has been advocated as the target for patient-specific cup anteversion in total hip arthroplasty (THR) [1]. However, the pelvis is not a static structure and individual motion patterns affect the functional anteversion of the acetabular component during activity.

The aim of the study was to virtually implant 52 cups parallel to the TAL and measure the functional cup anteversion when standing.

Method

- Pre-operatively, 52 patients with unilateral arthritis received a low dose CT and standing lateral X-ray as part of their routine THR planning. Pelvic tilt was measured from the lateral X-ray, Fig 1a.
- The contralateral, non-arthritic acetabulum was segmented from CT to create 3D models of the acetabulum. In each 3D model, the TAL was defined by a line joining the posteroinferior and anteroinferior horns of the acetabular notch, Fig 1b.
- A cup was virtually positioned in each acetabulum, with the anteversion defined by an axis connecting the midpoint of the TAL line to the cup centre. Radiographic inclination was kept constant at 40° when standing in all patients, Fig 1c.
- The pelvis was moved to the functional position by reproducing the standing pelvic tilt from the lateral X-ray, Fig 1d.
- Finally, the functional cup anteversion was measured using the CAD software Solidworks (Dassault Systèmes, France), Fig 1e.



Fig 1a. Standing pelvic tilt

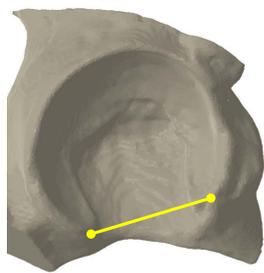


Fig 1b. Defining the TAL

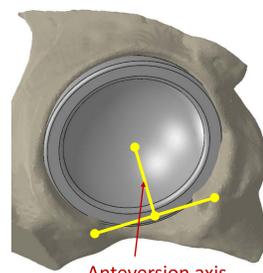


Fig 1c. Defining the cup anteversion

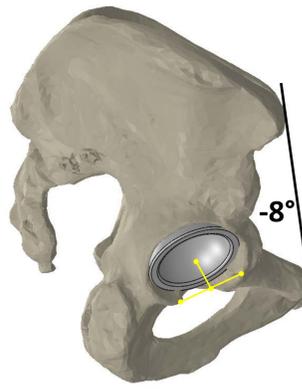


Fig 1d. Pelvis rotated to standing position



Fig 1e. Functional cup anteversion measured

Results

- Mean functional anteversion was 20.2° (SD = 7.5°), with a range of 0.6° to 39.7°
- 30% of cups were outside of the recommended 5° – 25° of radiographic anteversion [2]
- Our range of results support the findings of Griffin et al. [3]

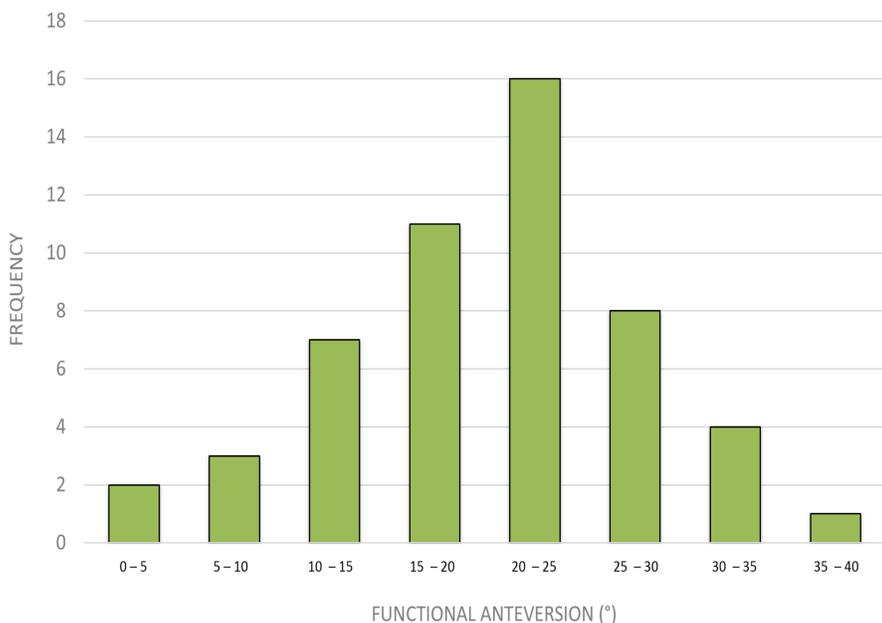


Fig 2. Variation in functional (standing) cup anteversion, using the TAL as the target reference

Conclusions

- The TAL is a reliable, patient-specific landmark
- However, due to the dynamic nature of the hip joint, should not be used as the target for cup anteversion
- The TAL should be used as an intra-operative reference from which the optimal cup anteversion can be defined

Outliers

Example 1

- Patient has functional standing anteversion of 40° when cup is parallel to TAL
- This individual required ~15° less anteversion than TAL to protect against anterior instability and edge-loading in extension

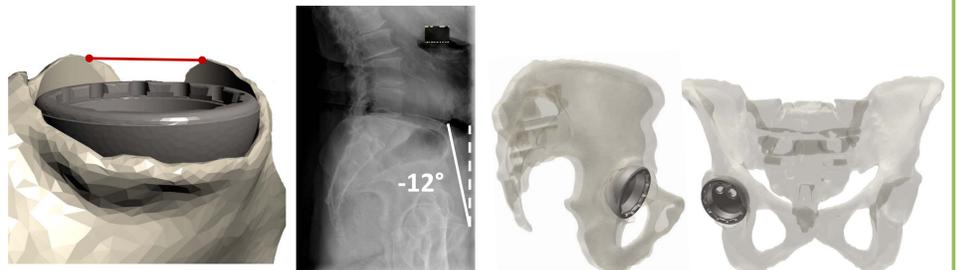


Fig 3. Cup positioned parallel to TAL leading to excessive anteversion in extension for this patient.

Example 2

- Patient has functional standing anteversion of 4° when cup is parallel to TAL
- This becomes 6° retroverted when in the flexed seated position, about to rise from a chair
- This individual required ~20° more anteversion than TAL to protect against posterior instability and edge-loading in flexion

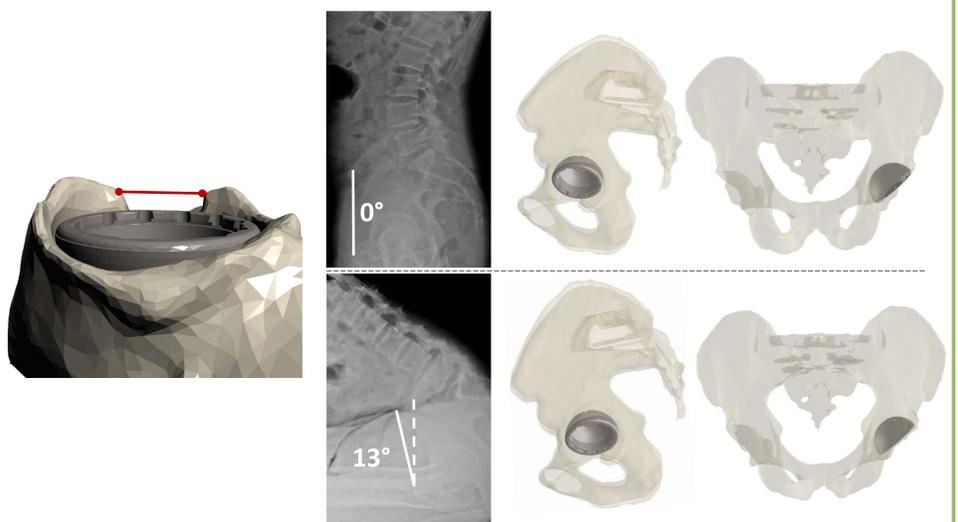


Fig 4. Cup positioned parallel to TAL leading to retroverted cup in flexion for this patient. Top row: standing position. Bottom row: flexed position.

References

1. Beverland DE, et al. (2016) *Placement of the acetabular component*. Bone Joint J; 98-B(1 Suppl A): 37-43.
2. Lewinnek GE, et al. (1978) *Dislocations after total hip-replacement arthroplasties*. J Bone Joint Surg Am; 60(2): 217-20.
3. Griffin AR, et al. (2014) *An in vivo comparison of the orientation of the transverse acetabular ligament and the acetabulum*. J Arthroplasty; 29(3): 574-9.

Disclosure One or more of the authors are paid consultants to Corin Group. One of the authors is a shareholder of Corin Group.