# Morphology of the deformed pelvis

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## INTRODUCTION:

Technical factors as positioning and sizing of the acetabular cup influence the risk of dislocation, impingement, wear of the components and overall function of total hip replacement (THR) [1]. In revision surgery or for displastic hips these aspects are even more important since morphological landmarks cannot easily be used. Consequently hip dislocation rates following hip revision rise up to 10% [2]. One method of determining the proper orientation and positioning of the new hip centre could be the use of – if available - the healthy contra lateral pelvis or an appropriately scaled pelvis model as reference.
The objective of this study was the comparison of acetabulum position, dimensions and orientation between the deformed and healthy side of unilateral affected human pelvises.

## MATERIALS AND METHODS:

CT scans of unilateral deformed pelvises were reconstructed (Avizo 5.1, Mercury Systems, n=9, Paprosky II-IV, Figure 1) and automatically aligned in the coordinate system of the pelvic anterior plane (right and left spina iliaca anterior superior and superior anterior symphis pubis).
The parameters determined were the abduction and anteversion angle, the largest *(a)* and the perpendicular diameter *(b)* of a best fit ellipse of the acetabular opening, and the centre of this ellipse.
The acetabular plane was determined by minimising the sum of square of the distances between the corresponding plane and 11 evenly manually placed landmarks on the acetabular rim excluding the fossa. Convergency of the plane orientation based on the number of landmarks used was assured.

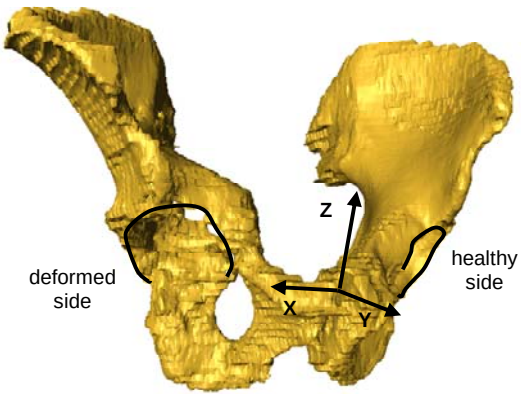


*Figure 1: Reconstructed pelvis*

## RESULTS:

The absolute difference of the centre of the ellipse of the deformed in comparison to the healthy side was in x-, y- and z-direction 7±6mm (-16 to 18), 12±11mm (-26 to 32) and 17±16mm (-47 to 39), respectively.
The anteversion angles were likely to vary less (-1±8°) than the abduction angle for both pelvis sides (13±12°) (Figure 2).

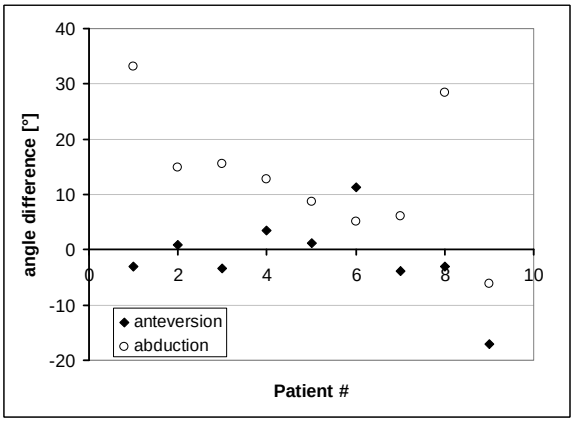


*Figure 2: Anteversion and abduction angle differences between the healthy and the deformed pelvis.*

The dimension of the acetabuli varied between the deformed and the healthy pelvis side 3.2±2.0mm in *(a)* and 1.0±0.8mm in *(b)*, whereas the ratio of these distances were 1.13 for the deformed and 1.06 for the healthy side.

## DISCUSSION:

Characterising the deformed acetabulum can help to choose an optimal implant size and be of value for the choice of implant fixation. Mirroring the geometry data from the healthy to the deformed side was shown to be a feasible method for the determination of orientation and position of the acetabular implant. If a biomechanically "improved" orientation is achieved by incorporating this method remains to be investigated and is presently outside the scope of this study.

The differences of the orientation of the acetabular plane and the centre of the acetabular opening between both pelvis sides were not consistent in the studied patient samples, indicating the individuality of the problem.

The abduction angles determined for the initial patient sample showed large differences (far above the safe zone angle of +/- 10° [3]) between the healthy and the deformed side, whereas the anteversion orientation was very similar. This implies that for the abduction orientation rather the contra lateral than the deformed side should be considered.

## REFERENCES:

[1] Kennedy et al. (1998) J.Arthropl 13:530-534; [2] Sah et al. (2008) J.Bone Joint Surg.Am. 90:506-516; [3] Lewinnek et al. (1978), J.Bone Joint Surg.Am. 60:217-220.

## ACKNOWLEDGEMENT:

This study was financially supported by DePuy US.