Quantifying Normative 3D Acetabular Orientation in Relation to Morphology and Functional Orientation of the Spinopelvic Unit in an Adult Population

Thom Snijders, Joost Van Erp, Harrie Weinans, F.C. Oner[1], Arthur De Gast[2], Tom Schlösser
[1]UMC Utrecht, [2]ADG Jointmobility Clinics BV

INTRODUCTION:

Functional mechanics of the acetabular component in total hip arthroplasty (THA) plays an important role in THA stability. The orientation of the prosthetic acetabular cup in THA is often based on the native acetabulum, as it is one of the few visual references during surgery. There is, however, wide variation in sagittal spino-pelvic morphology and pelvic tilt will change the functional 3D orientation of the acetabular component. The aim of this study is to quantify the link between normative 3D acetabular orientation to the sagittal morphology and functional orientation and position of the spino-pelvic unit in the normal adult population.

METHODS:

True-sagittal CT images of the pelvis were reconstructed from an existing database of 308 adults (18-87 years). Bilateral coronal inclination (CI), transverse version (TV) and sagittal ante-inclination (SAI) were measured with the pelvis in the supine, neutral, (pelvic tilt = 0˚), anterior pelvic plane and the functional position; the latter by applying (PTfunctional = -7+(0.37*PI)). These positions were related to the morphology parameters (pelvic incidence (PI), ischio-iliac angle (IIA), sacro-acetabular angle (SAA)), and the positional parameters (sacral slope (SS), pelvic tilt (PT)).

RESULTS:

Interindividual variation was largest for SAI (17˚±9˚, 0˚-41˚), compared to CI (40˚±4˚, 25˚-61˚) and TV (14˚±6˚, -2˚-32˚) in the neutral position, SAI was significantly larger in females, and there were no differences between the left and right hips. $SAI_{functional}$ is only weakly correlated with pelvic incidence ($r=0.231$, $p<0.001$), sacral slope ($r=0.296$, $p<0.001$), and pelvic tilt ($r=0.398$, $p<0.001$). IIA ($r=0.129$, $p<0.001$) was not correlated. Mean SAI changes from 17˚ in the neutral to 27˚ supine to 28˚ in the functional standing position.

DISCUSSION AND CONCLUSION:

Following the acetabular rim for positioning of the acetabular cup might lead to a wide variation in functional implant orientation. This might have consequences for THA stability. The SAI is the most variable acetabular orientation parameter, is not related to any palpable anterior landmark, but is correlated to functional pelvic morphology and mostly to pelvic tilt.