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The trigonometric algorithm defining the true three-dimensional acetabular cup orientation: Correlation between measured and calculated cup orientation angles

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Background: Acetabular cup orientation plays a key role in implant stability and success rate of total hip arthroplasty (THA). To date, the orientation is measured with different imaging modalities and definitions, leading to lack of consensus on optimal orientation. A three-dimensional (3-D) concept, which measures orientation in the three anatomical perpendicular planes and describes their mathematical relationship, enables universal definitions and quantifies cup orientation around the transverse axis in the sagittal plane. The latter is important, because high-risk movements for dislocation are mainly around the transverse axis in the sagittal plane. Purpose: To test the legitimacy and reliability of a 3-D concept to establish acetabular cup orientation.

Material & Methods: Twenty computed tomographic scans of patients with twenty-two primary THA in situ were systematically collected. On multiplanar reconstructions, three observers independently measured cup orientation in terms of coronal inclination, sagittal tilt and transverse version. The angles measured in two anatomical planes were used to calculate the angle in the third plane via a trigonometric algorithm. For correlation and reliability analyses, intra- and interobserver differences between measured and calculated angles were evaluated using the intra-class correlation coefficient (ICC).

Results: Measured and calculated angles had an ICC of 0.974 for coronal inclination, 0.993 for sagittal tilt and 0.993 for transverse version. Intra- and interobserver reliability had an ICC of 0.987 and 0.987 for coronal inclination, 0.979 and 0.981 for sagittal tilt and 0.992 and 0.978 for transverse version, respectively.

Conclusion: The 3-D concept with its trigonometric algorithm is a legitimate and reliable measurement tool. This 3-D concept can be used to determine the transverse version of acetabular cups from coronal inclination and sagittal tilt measurements. This offers the opportunity to have universal definitions whatever imaging modality is used and introduces the sagittal tilt, that comprehends the orientation of the cup around the transverse axis. Therefore, this straightforward 3-D concept can provide improved insight in optimal cup orientation.

Recent Publications

- 1. Snijders T, van Gaalen S M and de Gast A (2017) Precision and accuracy of imageless navigation versus freehand implantation of total hip arthroplasty: A systematic review and meta-analysis. International Journal of Medical Robotics and Computer Assisted Surgery doi: 10.1002/rcs.1843.
- 2. Alessandro Liberati et al., (2009) The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. PLoS Med6(7): e1000100

Biography

T E Snijders is a Researcher working in Department of Orthopedics at Clinical Orthopedic Research Center – (CORC-mN). He is a Professor in Diakonessenhuis Zeist in Netherlands. His research interests are Orthopedics and Trauma.

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