

Paper #47**COMPUTED 3D MOTION ANALYSIS OF THE HIP: COMPARISON OF CT- AND MRI-BASED DATA**

Jens Goronzy, Sophia Blum, Dirk Danowski, Verena Plodeck, Falk Thielemann, Albrecht Hartmann, Klaus-Peter Günther
University Clinic Carl Gustav Carus at the Technische Universität Dresden, Dresden, Saxony, Germany

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Summary: A software for 3D motion simulation is tested on MRIs of patients with FAI performing motion analysis and several angle measurements. These results are compared to CT-based analysis of the same patients.

Aim: Current 3D motion analysis concepts of the hip are mainly based on the acquisition of CT images. In order to avoid radiation exposure, a software has been developed which allows 3D motion simulation based on MRI scans. Due to different segmentation principles of both techniques it is unclear, however, if frequently measured parameters of acetabular and femoral morphology as well as simulated motion reports are identical. Aim of this prospective study is therefore to compare the results of CT- and MRI based measurement of acetabular coverage, femoral torsion and 3D motion simulation in patients with FAI.

Methods: After ethics approval 16 patients with symptomatic FAI (10 female, 6 male) and a mean age of 32,5 years (15 to 59 years) underwent CT- (Siemens Definition AS+, 0.6 mm slice thickness) as well as MRI-investigation (Siemens Verio, 3 Tesla, hip: VIBE sequence, 0.9 mm isotropic voxels, knees: HASTE, 6.5 mm slice thickness) of both hips together with a scan over the femoral condyles in order to measure femoral torsion. In 4 patients with motion artefacts the scan of one hip only could be processed. CT- and MRI-datasets of 28 hips were processed by a commercially available motion analysis software (Move forward TM, Clinical Graphics). Reports included acetabular version, lateral center edge (CE) angle, clockwise alpha-angles (15 o'clock = anterior, 12 o'clock = superior, 9 o'clock = posterior) and femoral version. In addition dynamic 3D motion simulation of maximum ROM in flexion, abduction and rotation at different flexion positions was performed. Results of CT-based data and MRI-based data processed by the software were compared.

Results: Obtained reports showed mean differences (\pm SD) of $1.7 \pm 1.2^\circ$ for acetabular version and $2.2 \pm 1.6^\circ$ for lateral CE angle. The mean differences for alpha-angles were $3.2 \pm 2.5^\circ$, $3.6 \pm 3.3^\circ$, and $3.4 \pm 2.8^\circ$ for measurement in 9, 12 and 15 o'clock position, respectively. The

difference between femoral torsion in both measurements was $2.3 \pm 1.8^\circ$. The largest discrepancies could be observed in the measurement of alpha angles. The reports of 3D motion analysis showed a mean difference of up to $1.2 \pm 2.1^\circ$ when simulating 10 different ROM directions. In 3 out of 280 simulated movements a significant discrepancy (21° , 15° , 10°) could be observed.

Discussion: MRI-based static and functional imaging of FAI hips provides similar values as CT based measurements. In addition MRI offers the possibility to assess soft tissue and ligaments. A potential disadvantage is the higher risk of knee motion during the MRI-scan and potentially resulting wrong femur torsional measurement when compared to CT due to longer acquisition times. This can be prevented by appropriate positioning tools and correct planning. In conclusion MRI is a possible alternative to CT for the assessment of 3D FAI pathology and simulated motion analysis without radiation exposure.