Dataset: Dynamic acetabular cup orientation in fast and slow walking total hip replacement patients: raw motion data, processed cup angles and statistical analyses.

Method document: Computational calculation of acetabular cup angles through gait

Computational simulation

- The acetabular cup was assumed to be implanted at 45^{o} inclination and 7^{o} version for every patient.
- In a neutral position, where pelvic tilt, obliquity and rotation were all zero, the pelvic coordinate system was set to be identical to the (global) laboratory coordinate system, and the anterior pelvic plane (APP) was parallel to the laboratory frontal plane.
- In this neutral pelvic orientation, the implanted cup orientation was the same in both systems.
- The inputs to the algorithm were the cup orientation in neutral pelvis position and the three pelvic angles for each of 101 points through the gait cycle.
- The outputs were the dynamic cup inclination angle (Figure 1a) and the dynamic cup version angle (Figure 1b), where term dynamic denotes measurement for every gait cycle point.
- The acetabular cup was represented by the outward facing normal vector of the acetabular cup rim plane, which was collinear with the vector between cup centre and cup pole.
- The cup was rotated by applying three pelvic movement components in Cardan sequence according to the pelvis segment joint angle calculation standard in Visual3D (C-Motion, Inc., US).
    - The internal-external rotation was applied first, followed by obliquity and finally tilt.

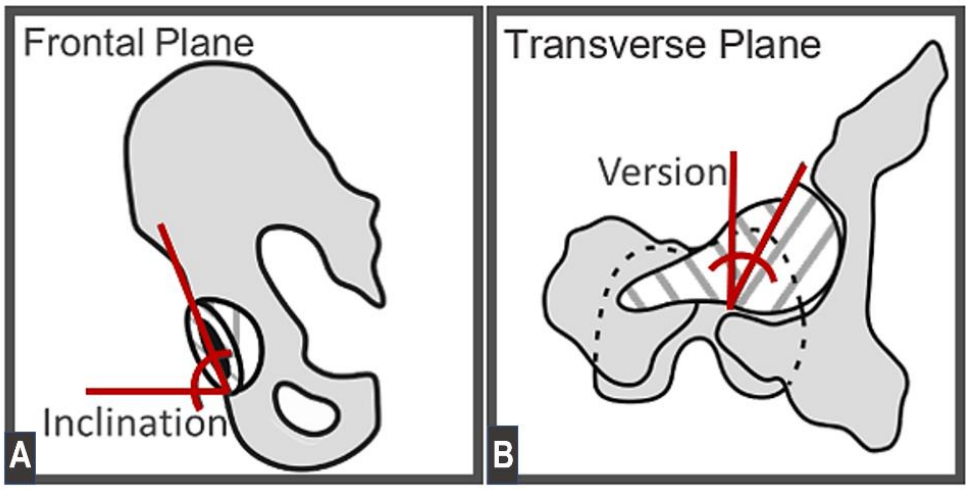

Figure 1: A) Pelvis with implanted acetabular cup in frontal plane. Inclination was defined as the angle between horizontal axis of the image and acetabular cup rim. B) Pelvis and femur with implanted total hip replacement in transverse plane. Version was defined as the angle between vertical axis of the image and acetabular cup rim.

Data processing

- For each patient and each trial, the inclination version angles were calculated from the acetabular cup rim plane normal vector.
- Those angles were then averaged over all three trials for each patient.
- The maximum, minimum, mean and range of the inclination and version angles, through the gait cycle, were calculated for each patient.
- The difference between the minimum, mean and maximum dynamic angles and the angle of implantation were calculated.

All simulation and calculations were performed using algorithms developed in Python (3.7).