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A NOVEL METHOD TO INVESTIGATE CROSS-SHEAR MOTION IN A HIP REPLACEMENT

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Summary: Introduction
Cross-shear forces between bearing surfaces at the hip have been identified as a key contributor to prosthesis wear. Previous analysis of this interaction has relied on computer-aided engineering software and MATLAB to simulate relative motion occurring between the femoral head and acetabular cup (MathWorks, Inc., Natick, MA, USA) (Budenberg et al., 2012; Saikko and Calonius et al., 2002; Ramamurti et al., 1996). Understanding and utilising these programmes is reliant on the users understanding of complex scripts. Additionally, without further programming, batch processing is not possible. Developing a user friendly program, with a simple yet flexible graphical user interface, would improve usability and cut analysis time.
Method
Visual 3D (Visual 3D standard, v5.01.18, C-Motion, Germantown, MD, USA) is an advanced research software package for the biomechanical analysis of 3D movement data. It is synonymous with all motion capture software, allowing for a smooth transition of data from its native software. The method put forward has manipulated the basic analytical capabilities of Visual 3D, allowing for the relative motion between surfaces at the hip to be estimated. Similar to previous work, 20 points were defined on the femoral head. The three dimensional displacement of each point can be calculated, therefore providing the hip motion paths occurring throughout an imported motion file. A number of pipelines calculate simple metrics to quantify the data, which can be graphed and exported easily for large data sets.
Results
The Visual 3D method will be validated against the computational script utilised by Budenberg et al. (2012). Initial comparisons indicate an average difference of < 0.00 mm across the twenty defined points. Following validation, potential improvements to the programme can be explored.
Conclusion
The developed method in Visual 3D allows the average user, with minimal computational experience, to easily process and analyse motions occurring between bearing surfaces at the hip. The method is applicable to any C3D motion file and will ultimately reduce analyse time when working with large sets of data. The method is likely to benefit those within the field of gait analysis who do not have a computational background.