

A new method of registration in navigated hip arthroplasty without the need to register the anterior pelvic plane

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The accuracy of standard instrumentation to positioning the acetabular component has been shown to be poor, with high volume arthroplasty surgeons only achieving an optimal acetabular component position in only 51% of cases. Computer navigation provides a possible solution to the issue of component malposition with studies demonstrating excellent accuracy. However, computer navigation has been slow to gain acceptance in the surgical community with only 1% of total hip replacements utilising this technology in England and Wales. One of the limitations to the implementation of this technology has been the need for the surgeon to register the anterior pelvic plane. This is inconvenient for surgeons operating on patients in the lateral decubitus position and in the supine position errors in anteversion measurements can occur, as the registration is done through soft tissue. We aim to demonstrate that it is possible to use a new registration methodology to accurately place the acetabular component without the need to reposition the patient and reduce the errors from registration through adipose tissue.

A prospective study of 50 patients undergoing total hip arthroplasty using imageless computer navigation was undertaken. During the surgery a standard APP registration was used as a reference. In parallel, a set of landmarks was acquired according to a new protocol for a true lateral registration method. All registration points, which were required for this approach, were taken with the patient draped and in the lateral decubitus position. The final component orientation was measured from post-operative CT scans to obtain the accuracy for the standard APP registration. The cup implant was then virtually re-positioned according to the new lateral registration technique. Both registration methods were compared to a gold standard APP defined directly on bone in the CT data set.

Following the recruitment of 41 patients. The results showed that the mean error in inclination was -1.4° (SD 2.8°) and 0.6° (SD 4.2°) for anteversion for the new registration. This compared favourably to the errors from the standard registering of the anterior pelvic plane in the traditional workflow, inclination mean error of -1.8° (SD 1.8°) and anteversion -5° (SD 2.6°). Statistically the percentage of acetabular component placed in the “safe zone” as described by Lewinnek was 99.9% for inclination and 98% for anteversion in the new method compared to 100% and 97.5% for the standard anterior pelvic plane registration.

Acetabular component orientation in total hip arthroplasty and hip resurfacing is now of paramount importance. Numerous studies have shown the detrimental effects of abnormal component orientation in metal on metal hip resurfacing and total hip replacement. However, all other bearings used in hip replacement have also been shown to be highly dependent on component orientation in their production of wear particles as well as the risk of dislocation. Traditional mechanical alignment guides have been shown to be highly variable in their ability to correctly orientate the acetabular component. In a review of total hip replacement and hip resurfacings, only 49% were found to be within the acceptable limit. More concerning is that this was only raised to 51% in the hands of high-volume arthroplasty surgeons. These figures are not inconsistent with other published studies. It is clear that there is a desperate need for technology to assist the surgeon in placing the components in the correct orientation. Unfortunately, computer navigated hip arthroplasty has been slow to gain acceptance. Reasons for this include the necessity to place fixation pins into the bone, line of sight issues related to optical tracking technology and the requirement to access the anterior pelvic plane. Access to the

anterior pelvic plane can be a major obstacle when performing hip arthroplasty in the lateral decubitus position as the patient often requires repositioning. There also exists concern that the anterior pelvic plane registration points are taken through adipose tissue, potentially introducing error, particularly in antiversion measurements.

The findings of this study appear to show that a new method of pelvic registration provides accurate component orientation without the need for patient repositioning, reduces operative time and reduces registration inaccuracies in obese patients. We hope that this new registration methodology will reduce some of the main obstacles limiting the use of imageless computer navigation in hip arthroplasty.