

A new registration method for imageless computer navigation in total hip arthroplasty: a cadaveric study

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The recent issues surrounding the problems of metal on metal bearing in hip arthroplasty have reinforced how crucial implant positioning is in hip arthroplasty. Optional acetabular component orientation has been shown to reduce the rate of dislocation and also reduce wear rates in hip arthroplasty. All bearing combinations appear to be sensitive to component orientation. However, the recent issues with metal on metal bearings have highlighted this. The literature shows that the use of mechanical alignment guides for the introduction of the acetabular component are imprecise. Even in expert hands conventional alignment guides can you to to suboptimal component orientation 49% of patients. One of the main barriers to the adoption of computer navigation is acquiring the anterior pelvic plane. Current registration methods require a repositioning of the patient to access the contra-lateral registration points. Concern has also been expressed when registering patients in the supine position due to the adipose tissue over the pubis area causing errors in final component orientation. We describe a new registration methodology which relies on known anatomical constants to enable the surgeon to register the pelvis using only points identifiable when the patient is fully draped the lateral position. The new method also eliminates the requirement of the pubis points reducing the error introduced by these points.

We utilised the new registration method on 25 cadaveric hips from 13 patients. The complete registration was performed in a lateral decubitus position. Registration points were taken from the ipsi-lateral anterior superior iliac spine (ASIS) and a mid-sagittal point at the lumbar spine (taken through the drapes). All other points were taken from the acetabular cavity and rim. Neither the contra-lateral ASIS nor points at the pubis symphysis had to be acquired. For evaluation purposes, the anterior pelvic plane was directly acquired on the bone as a gold standard.

In comparison to this gold standard, the average error for the new registration method was - 0.7° (SD 3.4) for inclination and 1.5° (SD 3.8) for anteversion. The results show that statistically within more than 95% of the cases the acetabular component would have been orientated within the “safe zone” as described by Lewinnek et al.

There is an urgent need to improve component orientation hip arthroplasty to reduce dislocation and wear. The use of computer navigation in hip arthroplasty has been slow to gain widespread popularity. Factors influencing the surgeon's decision may include increased operative time, line of sight issues, the requirement to place tracking pins and the requirement to register the anterior pelvic plane. Concern has also been expressed in the literature over the accuracy of computer navigation in hip arthroplasty due to the registration of bony landmarks through adipose tissue, particularly over the pubis. This study uses only landmarks that are easily identified within the lateral position enabling the surgeon to rapidly register the pelvis without the need to access the anterior pelvic plane. This study appears to demonstrates that it is possible to construct the anterior pelvic plane from registration points taken in the lateral position, with a fully draped patient. This advancement may reduce some of the barriers preventing patients from benefiting from the use of computer navigation and provide more accurate acetabular component placement.