

Accuracy and repeatability of axes for femoral component rotation in total knee arthroplasty: a cadaveric study

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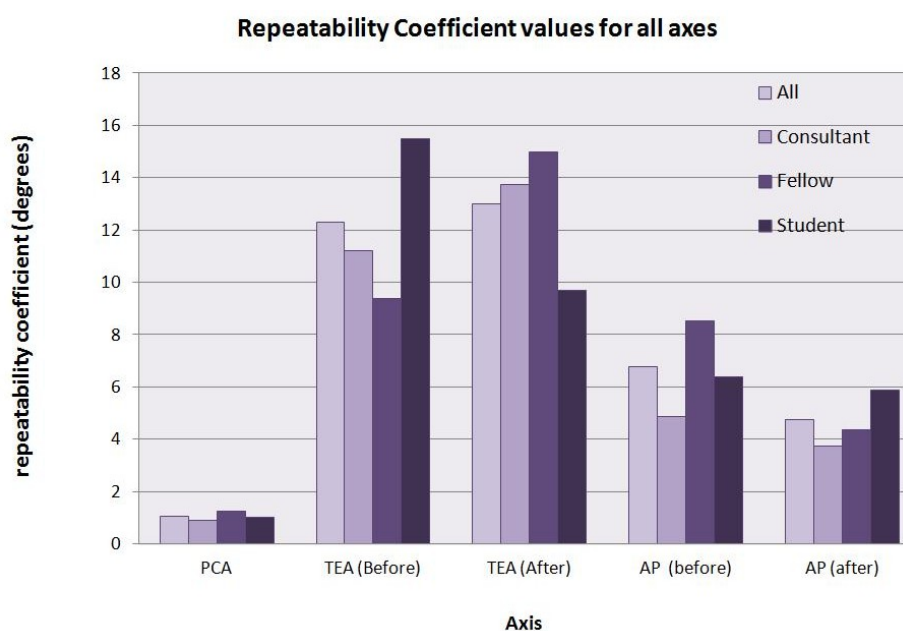
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Introduction: Optimising the rotational alignment of the femoral component is an important but challenging step in total knee arthroplasty (TKA). Previous studies have shown femoral rotational malalignment to be associated with a wide range of significant post-operative complications including limited and painful range of movement, patellofemoral joint instability, implant loosening and, ultimately, TKA failure leading to a need for revision arthroplasty. There continues to be disparity between surgeons as to which intra-operative technique, if any, results in optimal femoral component rotation thus minimising complications. The aim of this study was to measure the three bony axes usually used for femoral component rotation in TKA and compare the accuracy and repeatability of different routine and modified measurement techniques and effect of experience on measurement.

Materials & Methods: Six fresh frozen cadaveric limbs were used; four had signs of arthritic disease, two had none. The limbs were positioned and the knee joint exposed to simulate standard surgical procedure. Three observers (student, fellowship trainee and consultant) identified the posterior condylar (PCA), anteroposterior (AP) and the transepicondylar (TEA) axes. This was done using the standard workflow of a computer navigation system, which recorded the measurements. The AP axis was measured before and after being identified with an ink line drawn by each observer. Initially the TEA was measured by palpation of the epicondyles as per standard practice. Then an incision was made in the medial and lateral gutters at the level of the epicondyles, allowing the index finger to be passed behind the gutters. The TEA was then measured again by palpation using the same technique. In addition the true anatomical TEA was identified by the dissection of all the soft tissues surrounding the epicondyles and the direct palpation of the bony anatomy (the summit of the lateral and medial epicondyles). Each measurement with each technique was repeated three times. For all axes and each observer the repeatability coefficient was calculated.

Results: The identification of the PCA was the most reliable (repeatability coefficient: 1.1°) followed by the AP after drawing the ink line (4.5°) then the AP before (5.7°) and lastly the TEA (12.3°) which showed no improvement with the lateral gutter incisions (13.0°). In general the inter-observer variability for each axis was small (average 3.3°, range 0.4° to 6.1°), being best for the



consultant and worst for the student. In comparison to the true TEA, the measured TEA and AP axes distribution was evenly internally and externally rotated with a mean value within 1.5° , whilst the PCA was consistently 2.8° or more internally rotated with a mean of 5.7° . The PCA measured in the non-arthritic knees averaged 4.7° internally rotated from the true TEA compared to 6.7° in the knees with arthritic condylar erosion.

Discussion: The results of this study echoed previous work by demonstrating that palpation of the PCA was highly precise but prone to errors in representing the true TEA if there was asymmetrical condylar erosion. The palpation of the TEA was highly variable irrespective of observer ability and experience. The line perpendicular line to the AP axis most closely paralleled the true TEA when measured after being identified with an ink line. These results show that the femoral component rotation is variable with different axes. It is recommended that all axes should be considered before finalising component orientation, particularly to avoid malrotation in the presence of condylar erosion.