A Detailed Analysis of Patient Specific Instruments using Computer Assisted Surgery Tools.

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Computer-assisted surgery (CAS) is a tool developed to allow accurate limb and implant alignment in TKA. The strength of the technology is that it allows the surgeon to assess soft tissue balance and ligament laxity in flexion and extension. The accuracy of this ligament balancing technology depends upon an accurate determination of femoral component size. This size is established with intraoperative surface registration techniques. Customised instrumentation (CI) is a measured resection technique in which component size is established on preoperative 3D MRI reconstructions. The purpose of this study is to determine how these two computer-based technologies compare with regard to the accuracy with which femoral component size is established in TKA.

67 TKA were performed using CI and 30 TKA were performed using CAS by a single surgeon. CI-predicted and CAS-predicted femoral component size were compared to actual component selection. The process by which CI and CAS perform an anatomic registration was evaluated.

The CI and CAS systems accurately predicted surgeon-selected femoral component size in 89% and 43% of cases, respectively (p<0.001). The discrepancy between predicted and actual femoral component size with CI and CAS was 0.1 and 0.8 sizes, respectively (p<0.001). The maximum deviation between predicted and actual femoral component size was greater in CAS than in PMI (three sizes versus one size, respectively). The anterior cortex cut was flush in 92% of CI cases. The rotation profile was consistent with Whiteside’s line in 95% of CI cases.

The CI system was both more accurate and more precise than the CAS navigation system in predicting femoral component size in TKA. CI utilises preoperative MR imaging to generate femoral component sizing based on optimizing medial-lateral fit with a measured posterior femoral bone resection. CAS utilises surface registration techniques based on anatomic site registration that may be subject to intraoperative measurement error due to difficult visualization (femoral epicondyles), inherent subjectivity (Whiteside’s line) or anatomic variation (hypoplastic posterior condyles). CI bases implant sizing solely on reproducing an anatomical fit and a measured resection technique, whereas CAS attempts to balance an anatomic fit with optimal soft tissue balancing. In this study, the surgeon’s final component selection was more likely to be in accordance with the CI rather than the CAS sizing algorithm. The CI system was capable of accurate femoral component placement in TKA.

This study suggests that intraoperative surface registration may not be as accurate as preoperative 3D MRI reconstructions for establishing optimal femoral component sizing. Surgeons using intraoperative navigation based surface registration need to be aware of this when making femoral component size selection, establishing ligament balance, and determining femoral rotation.