Comparison of outcomes of robotic and manually implanted unicompartmental knee arthroplasty

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Introduction: Medial unicompartmental knee arthroplasty (UKA) for isolated medial knee arthritis is a highly successful and efficacious procedure. However, multiple published reports document that this procedure is technically more challenging than total knee arthroplasty (TKA) and also that surgical technical errors result in high early failure rates¹,². Haptic robotic systems have recently been developed under the premise that such technology can improve the surgical accuracy of medial UKA placement, reduce complications, and improve outcomes. However, very few reports have documented improvements in these parameters when comparing robotic UKA implantation to manually instrumented medial UKA². The goal of this study was to compare clinical and radiographic data for matched patient cohorts who received robotic-arm assisted UKA or standard instrumentation UKA.

Methods: This study was a retrospective review of 30 robotic-arm assisted UKA and 32 manual UKA performed by single fellowship-trained joint arthroplasty surgeon (SKK) from 6/2009-2/2012. Average follow-up was 10.1 months (range 5-36). Group selection was determined through non-randomized, surgeon-patient discussion. All procedures were completed through a medial parapatellar approach. All components were cemented. All tibial components were a metal-backed onlay design. Full hospital and clinic chart review of demographic, intra- and post-operative measures was performed. The two groups did not differ in any demographic measure. Radiographic analysis of pre-op and post-op images evaluating sagittal and coronal alignment, and component positioning performed by single observer (DCH), using OsiriX imaging system (Pixmeo; Geneva, Switzerland). Radiographs were available for analysis in 28 robotic-assisted and 30 manual patients. Independent samples t-tests were used to compare the two groups on the continuous variables. Chi-square (χ²) tests were used to categorical variables. Variables looking at accuracy were calculated as absolute values to avoid averaging across zero. Levene’s test of equality of variances was used to determine whether the dispersion of values within each group differed significantly. In the case of a significant Levene’s test, the separate variances t-test was used to compare equality of means. An alpha level of 0.05 was used as the decision point for statistical significance. All analyses were conducted using SPSS v. 20.

Results: Clinical data: Operative time was significantly longer in robotic-assisted UKA compared to the manual group. No difference seen in all other intraoperative measures. Length of the first post-op ambulation was significantly longer for the robotic group. Range of motion (ROM) on the day of surgery was significantly greater for the robotic group. Time to inpatient physical therapy clearance was significantly shorter in robotic group, but overall hospital stay was similar. Two weeks post-op, the manual group had significantly greater ROM. No difference seen in all other post-op measures. One patient (manual group) presented with a deep post-op infection requiring early debridement and revision to TKA at 6 months post-op. Two patients (one robotic, one manual) had post-op cellulitis requiring antibiotics. Continued medial-sided knee pain was reported more commonly in robotic group (6 patients) compared to manual group (1 patient).

Radiographic data: No difference seen between groups in pre-op measures of tibial axis, femoral axis and tibial slope. There was no significant difference in post-op tibial axis. The robotic group was significantly more accurate at recreating the pre-op femoral axis. The robotic group also had significantly less posterior
slope of the tibial component, but accuracy in recreation of slope was similar between groups. Accuracy in placement of the tibial component in the coronal plane was not significantly different between groups. The robotic group had significantly larger variance in coronal alignment of the tibial component. Medial overhang of tibial component was significantly greater and more variable in the manual group. Resection depth of medial tibial plateau was less in the robotic group but not statistically significant.

**Discussion:** This report provides detailed comparative clinical and radiographic analysis of robotic and manually implanted medial UKA in two matched groups of patients. The results demonstrate little to no clinical difference between groups. This cohort was the surgeon's first 30 procedures using the robotic-assisted system, so likely the surgical time difference will be diminished with more experience. Radiographic difference in outcomes between these two techniques was also minimal and unlikely clinically significant. The increased variance of coronal alignment in the robotic-assisted may be contributed to the ability to very precisely alter the alignment of the component to fit the patient's distinct anatomy. Overall, both techniques resulted in reproducible and excellent outcomes with low complication rates. The data suggests that the purported advantages of robotic UKA implantation may be obviated in the hands of a surgeon with experience and training in manual UKA implantation. More research, including randomized control trials would be beneficial to further evaluate this question further.

**References**
