Robotic-Assisted Total Knee Arthroplasty Improves Accuracy and Reproducibility Compared to Manual Instrumentation or Navigation

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Introduction:

Increased accuracy and lower rates of component positioning outliers have been associated with better long-term survival of implants and functional outcomes of total knee arthroplasty (TKA). This study investigates the accuracy of image-free robotic-assisted TKA compared to navigation-assisted and manual instrumentation techniques, using polyethylene tibial insert thickness as a surrogate.

Methods:

Consecutive primary TKA performed over 8-years by a single surgeon were retrospectively reviewed and divided in 3 groups: manual instrumentation (M-TKA), navigation-assisted (NA-TKA) and robotic-assisted (RA-TKA). Polyethylene insert thickness, deviation from planned thickness and rate of outliers were compared between the 3 groups. Logistic regression analysis was performed to identify predictors of greater polyethylene thickness.

Results:

There were 474 patients in the M-TKA, 257 in the NA-TKA and 225 in the RA-TKA groups, with median polyethylene thicknesses of 6.0 (IQR5.0–7.0), 6.0 (IQR 5.0–7.0) and 5.0 (IQR 5.0–6.0) millimeters respectively (p<0.001 for RA-TKA compared to both other groups individually). (Fig 1) Polyethylene inserts with a thickness of 10mm or more were used in 28 (5.9%) cases in the manual instrumentation, 13 (5.1%) cases in the NA-TKA and 1 (0.4%) in the RA-TKA group (p=0.004). Independent predictors for polyethylene thickness outliers (≥9 mm) included surgical technique, left side and male sex.
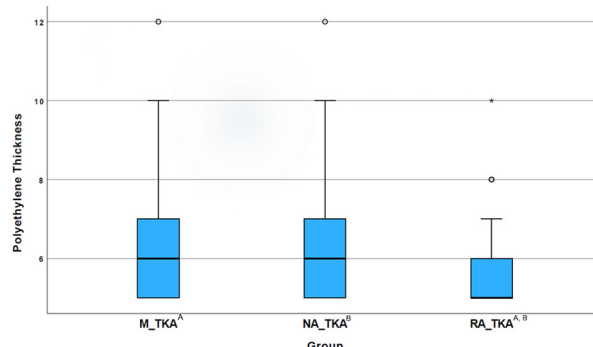
The box plot graph illustrated a learning curve of less than 30 cases before consistent polyethylene thickness was achieved in the robotic-assisted group. (Fig 2)
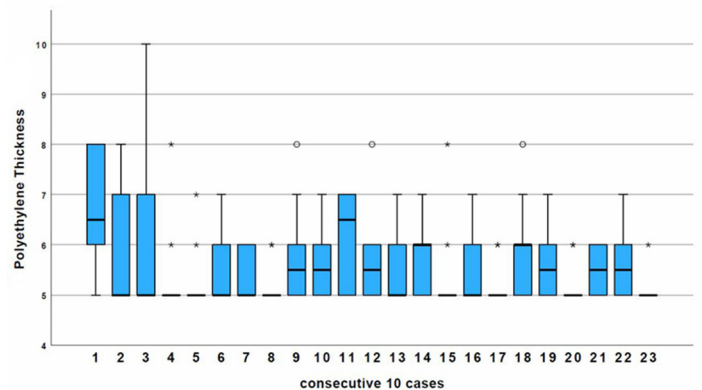
Conclusions:

This retrospective cohort study of 956 TKAs confirmed that the RA-TKA technique was more accurate than the M-TKA or NA-TKA techniques. This was shown by the 12-15 times lower odds of PE thickness outliers, as well as the lower deviation from planned thickness, when compared to the 2 other groups. However, contrarily to what was hypothesized, no difference was found between the NA-TKA and M-TKA techniques for polyethylene thickness or prevalence of PE thickness outliers.

Tibial polyethylene insert thickness, as a surrogate of surgical accuracy, is more reproducible in robotic-assisted than in navigation-assisted or manual instrumentation TKA. The learning curve to reach high levels of reproducibility with this technique is relatively short.

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