

Imageless computer assisted total knee arthroplasty: a meta-analysis of the current literature

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Introduction: Total knee arthroplasty (TKA) is the gold standard treatment for end-stage gonarthrosis. It is believed that increased accuracy in the alignment of TKA components is associated with improved functional outcomes. To that end, imageless computer assisted navigation (CAS) has been developed to improve accuracy of alignment. There have been numerous studies comparing TKA with and without CAS, with varying results. Furthermore, in instances where there is increased alignment accuracy, this improvement has not been shown to lead to improved functional outcomes. In the past, meta-analyses on the topic have included non-randomized and pseudo-randomized trials^{1,2} or focused only on radiographic outcomes, and have neglected functional outcomes³. This is the first meta-analysis on the topic that employs a strict selection criterion for Level 1 studies with true randomization and analyzes both radiographic and functional outcomes.

Methods: A literature search was performed using MEDLINE (via PUBMED), EMBASE (via OVID), SCOPUS, the Cochrane Database and bibliographies of identified papers. Included studies were restricted to English-language Level 1 randomized control trials in which patients underwent TKA performed with either imageless computer-assistance or conventional manual guides. The literature search and selection was performed independently by two researchers. Primary outcomes were radiographic measurement of mechanical axis and component alignment, functional outcomes as measured by the Knee Society Score (KSS) and Western Ontario and McMaster University Osteoarthritis Index (WOMAC), and operative time. All data published in an appropriate format with sufficient statistical information (e.g. standard deviation) was extracted and analyzed. Data in a format incongruous with other studies was excluded from analysis. A total of twenty-four papers, representing twenty-two separate randomized control trials, were included in analysis. A dedicated statistician utilized Cochrane Review Manager 5.1 to calculate effect size with the extracted data.

Results: The imageless computer-assisted groups demonstrated more accuracy in the alignment of the mechanical axis with 88.26% of knees within $\pm 3^\circ$ of the ideal target (180°), compared to 75.29% of the conventional knees. This is a statistically significant result with a $p < 0.00001$. Functional outcomes as measured by the total Knee Society Score were higher for the conventional groups in the first three to six post-operative months (mean 3.57 points higher, $p = 0.02$) and at one to two years post-op (mean 6.04 points higher, $p = 0.02$). Computer assistance extended the time spent in the OR by a mean of 18.4 minutes, statistically significant with a $p < 0.00001$.

Discussion: The results of our meta-analysis demonstrate that computer-assisted navigation leads to improved accuracy of the mechanical axis. However, the involvement of the computer-assistance increased the operative time of the procedure. Despite the improvement in accuracy, the computer-assisted group had statistically lower post-operative functional scores in the short and mid-term. This is a surprising result. Despite the improved radiographic results, the computer-assisted technique may result in worse functional outcomes in many circumstances. While longer term studies are needed to support this meta-analysis, the data does not support the rapid adoption of computer assisted surgery at this time for total knee arthroplasties.

References

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