The Journal of Arthroplasty 40 (2025) S65–S66

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

World Expert Meeting in Arthroplasty 2024

Does the Integration of Robotic Technology Improve Outcomes in Unicompartmental Knee Arthroplasty?

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ARTICLE INFO

Article history:
Received 18 September 2024
Received in revised form
16 October 2024
Accepted 18 October 2024
Available online 23 October 2024

Keywords:
robotic assisted
unicompartmental
uka
unicompartmental knee arthroplasty
conventional

Does the integration of robotic technology improve outcomes in unicompartmental knee arthroplasty?

Response/Recommendation:

*Robotic-assisted unicompartmental knee arthroplasty (R-UKA) is associated with better radiological outcomes (precision and accuracy).

**There is no difference between both techniques in terms of clinical outcomes.

Robotic-assisted unicompartmental knee arthroplasty offers several significant technological advantages, including precision and accuracy, repeatability, reliability, and real-time feedback. However, there are also studies in which conventional unicompartmental knee arthroplasty (C-UKA) was associated with shorter operative time and lower cost. Thus, the benefits of using robotics should be weighed against the added cost and longer operative time.

Level of Evidence: Moderate.

Expert Vote:

*78.6% Agree / 11.5% Disagree / 10.0% Abstain.

**70.8% Agree / 22.0% Disagree / 7.2% Abstain.

Rationale

Current studies have highlighted that the survivorship of unicompartmental knee arthroplasty (UKA) is closely linked to various intraoperative factors, such as lower-extremity mechanical alignment, component fixation and alignment, joint-line maintenance, and soft-tissue balancing [1–3]. To enhance surgical accuracy and precision and ultimately improve survivorship rates in UKA, several robotic-assisted arthroplasty surgery systems have been developed [4].

The studies in 14 meta-analyses have demonstrated that robotic assistance can significantly enhance the accuracy of surgery, particularly in the UKA. A key reasons for this improvement lies in the advanced three-dimensional visualization capabilities offered by robotic systems during the surgical procedure [5–7]. Alternatively, controversial issues such as surgery time and functional results exist. The studies did not find a statistically significant difference in Knee Society Score (KSS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (*P*-value 0.490, and 0.700 based on a *z*-test) between robotic-assisted UKA (R-UKA) and conventional UKA (C-UKA).

The low overall complication rates suggest that both R-UKA and C-UKA are generally safe procedures with a low risk of adverse

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to https://doi.org/10.1016/j.arth.2024.10.095.

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https://doi.org/10.1016/j.arth.2024.10.095

events. Superficial and deep infections were identified as the most prevalent complications, but the specific rates or comparative incidences between R-UKA and C-UKA were not detailed. The complication data demonstrated no significant differences in superficial and deep infection rates (odds ratio (OR) 2.8 (95% confidence interval (CI) 0.93 to 8.38); $P = 0.070$, z-test) or early re-intervention rates (OR 2.20 (95% CI 0.79 to 6.09); $P = 0.130$, z-test) in the C-UKA group compared to the R-UKA group in short-term follow-up.

Findings in the literature suggest that while both procedures are generally safe with low complication rates, R-UKA may offer advantages in terms of reducing complications and potentially lowering the need for revision surgeries compared to C-UKA (OR 2.18 (95% CI 1.06 to 4.49); $P = 0.040$, z-test). This is consistent with the data from national joint registries, which also indicate lower revision rates for R-UKA compared to C-UKA over similar timeframes [8,9].

There are three current financial studies comparing the cost of R-UKA and C-UKA. Of the studies, two using Markov decision analysis concluded that R-UKA is generally cost-effective compared to C-UKA, particularly in scenarios with higher case volumes and potential reductions in length of hospital stay [10–12].

In summary, while R-UKA offers technological advancements that enhance surgical precision and reduce revision rates compared to manual techniques, it does not significantly differ in functional outcomes. As the costs associated with R-UKA approach those of C-UKA in high-volume settings, the rationale for adopting robotic technology becomes increasingly compelling, potentially offering both clinical and economic benefits in the field of knee arthroplasty.

CRediT authorship contribution statement

Kayahan Karaytug: Writing – review & editing, Writing – original draft, Supervision, Investigation. **Emrah Caliskan:** Methodology, Formal analysis. **Mohammad K. Abdelnasser:** Writing – Review & Editing, Methodology, Formal analysis. **Rami Sorial:** Writing – Review & Editing, Methodology, Formal analysis. **Atul F. Kamath:** Supervision, Methodology, Formal analysis.

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