The Journal of Arthroplasty 40 (2025) S86–S87

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

World Expert Meeting in Arthroplasty 2024

Does the Use of Robotics Improve the Outcome of Primary Total Knee Arthroplasty?

Alisagib A. Dzhavadov, MD [a, b], Goksel Dikmen, MD [b, c, *], Jenna A. Bernstein, MD [d], Jose I. Fregeiro, MD [e], Xiang Li, MD [f], Ming Han Lincoln Liow, MD [g], David Liu, MD [h], Bharat S. Mody, MD [i], Javad Parvizi, MD [b, c, j], Jan Victor, MD [k]

[a] *Vreden National Medical Research Center of Traumatology and Orthopedics, Ministry of Health of Russian Federation, St. Petersburg, Russian Federation*
[b] *International Joint Centre (IJC), Acibadem Maslak Hospital, Istanbul, Turkiye*
[c] *Department of Orthopedics and Traumatology, Acibadem Mehmet Ali Aydınlar University, Istanbul, Turkiye*
[d] *Connecticut Orthopaedics, Hamden, Connecticut*
[e] *Department of Orthopedic and Traumatology, Hospital Asociación Española, Montevideo, Uruguay*
[f] *Department of Orthopaedics, Chinese PLA General Hospital (301 Hospital), Beijing, PR China*
[g] *Department of Orthopaedic Surgery, Singapore General Hospital, Singapore, Singapore*
[h] *The Gold Coast Centre for Bone and Joint Surgery, Palm Beach, Queensland, Australia*
[i] *Welcare Hospital, Vadoadara, India*
[j] *Rothman Orthopaedic Institute at Thomas Jefferson University, Philadelphia, Pennsylvania*
[k] *Department of Orthopedic Surgery, University Hospital Ghent, Gent, Belgium*

ARTICLE INFO

Article history:
Received 19 September 2024
Received in revised form
9 October 2024
Accepted 11 October 2024
Available online 18 October 2024

Keywords:
robotic surgery
knee
arthroplasty
outcome
complications
conventional

Does the use of robotics improve the outcome of primary total knee arthroplasty?

Recommendation: The use of robotics appears to improve radiographic alignment in the coronal plane for primary total knee arthroplasty, but there is no clear improvement in function or outcome measures, based on a number of meta-analyses of randomized controlled trials.

Level of Evidence: Moderate.

Delegate Vote: Agree: 85%, Disagree: 11%, Abstain: 4%.

Rationale

Total knee arthroplasty (TKA) is an effective surgical procedure that alleviates pain and restores function in patients who have arthritis of the knee [1,2]. However, the persistence of pain and patient dissatisfaction is not uncommon after primary TKA [3]. Various technological advancements have been developed over time with the intention of improving the results of primary TKA [4]. Robotic-assisted total knee arthroplasty (RA-TKA) is one such technology [5]. The purpose of this review is to summarize the results of systematic reviews and meta-analyses of randomized controlled trials comparing the results of RA-TKA and conventional total knee arthroplasty (CO-TKA).

The search strategy included the following Medical Subject Headings (MeSH) terms: Arthroplasty, Replacement, Knee AND Robotic Surgical Procedures AND Meta-Analysis as Topic. In our

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.2024.10.058.

* Address correspondence to: Goksel Dikmen, MD, MSc, Orthopedic Surgeon, Department of Orthopedics and Traumatology and International Joint Centre (IJC), Associate Prof. Dr. Acibadem Mehmet Ali Aydınlar University, Acibadem Maslak Hospital, Buyukdere Cad. No:40, Sariyer, Istanbul, Turkiye 34457.

https://doi.org/10.1016/j.arth.2024.10.058

initial literature review, 1,086 records were retrieved. After removing 502 duplicates, the titles and abstracts of 584 studies were screened for appropriateness. There were 78 studies that were then subjected to full-text review. Ultimately, three systematic reviews and meta-analyses of randomized controlled trial were included in the review [6–8]. A synopsis of relevant studies is presented here.

In one study, Bensa et al. [6] found improvement in patient-recorded outcome measurements in the RA-TKA group compared to the CO-TKA group, specifically the Western Ontario and McMaster Universities Osteoarthritis Index and Oxford Knee Score. The difference between the study group's outcomes did not reach the minimal clinically important difference.

In a meta-analysis by Alrajeb et al. [7], patients receiving RA-TKA had less mechanical axis deviation and tibio-femoral axis deviation in radiographic analysis but considerable heterogeneity. Similarly, the study by Ruangsomboon et al. [8] demonstrated increased radiographic accuracy in the RA-TKA group compared with the CO-TKA group in terms of mechanical axis deviation and mechanical axis outliers, but the minimally important difference was not achieved.

Ruangsomboon et al. [8] and Bensa et al. [6] both found that the CO-TKA group had shorter operative times compared with the RA-TKA group. However, one of the meta-analyses did not provide heterogeneity data, and another meta-analysis noted high heterogeneity of 99%.

There were no differences between the groups regarding complications, implant survival, blood loss, hospital length of stay, and range of motion [6–8].

There are scant high-level studies comparing RA-TKA with CO-TKA. However, based on the available data, RA-TKA does not show clear benefits in terms of clinical outcomes or function. At the same time, there seem to be some benefits in coronal plane radiographic precision. There is a need for future noncommercial studies of high methodological quality that can evaluate the role of robotics in joint arthroplasty. In the digital age, improved evaluation tools need to be developed to discern potential outcome differences, especially in highly functioning groups. Moreover, differing robotic systems need to be assessed on their own merits, as they differ in many utilities as well as in corresponding prosthesis designs. Future studies investigating RA-TKA will have to not only consider the effect of robotic delivery systems but also consider the effect of the alignment target and prosthesis design on differences in functional outcomes.

CRediT authorship contribution statement

Alisagib A. Dzhavadov: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation. **Goksel Dikmen:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jenna A. Bernstein:** Writing – review & editing, Resources, Data curation. **Jose I. Fregeiro:** Writing – review & editing. **Xiang Li:** Writing – review & editing, Visualization, Conceptualization. **Ming Han Lincoln Liow:** Writing – review & editing, Conceptualization. **David Liu:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis. **Bharat S. Mody:** Writing – review & editing, Writing – original draft. **Javad Parvizi:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jan Victor:** Writing – review & editing, Writing – original draft.

References

[1] Carr AJ, Robertsson O, Graves S, Price AJ, Arden NK, Judge A, et al. Knee replacement. Lancet 2012;379:1331–40. https://doi.org/10.1016/S0140-6736(11)60752-6.

[2] Preobrazhensky PM, Fil AS, Kornilov NN, Panteleev AN, Guatsaev MS, Kazemirsky AV, et al. Current state of knee arthroplasty in Russia: analysis of 36,350 cases from the register of the vreden national medical Research center of Traumatology and Orthopedics. Traumatol Orthop Russ 2023;29:73–85. https://doi.org/10.17816/2311-2905-9349.

[3] Gunaratne R, Pratt DN, Banda J, Fick DP, Khan RJK, Robertson BW. Patient dissatisfaction following total knee arthroplasty: a systematic review of the literature. J Arthroplasty 2017;32:3854–60. https://doi.org/10.1016/j.arth.2017.07.021.

[4] Hinloopen JH, Puijk R, Nolte PA, Schoones JW, de Ridder R, Pijls BG. The efficacy and safety of patient-specific instrumentation in primary total knee replacement: a systematic review and meta-analysis. Expert Rev Med Devices 2023;20:245–52. https://doi.org/10.1080/17434440.2023.2177152.

[5] Park SE, Lee CT. Comparison of robotic-assisted and conventional manual implantation of a primary total knee arthroplasty. J Arthroplasty 2007;22:1054–9. https://doi.org/10.1016/j.arth.2007.05.036.

[6] Bensa A, Sangiorgio A, Deabate L, Illuminati A, Pompa B, Filardo G. Robotic-assisted mechanically aligned total knee arthroplasty does not lead to better clinical and radiological outcomes when compared to conventional TKA: a systematic review and meta-analysis of randomized controlled trials. Knee Surg Sports Traumatol Arthrosc 2023;31:4680–91. https://doi.org/10.1007/s00167-023-07458-0.

[7] Alrajeb R, Zarti M, Shuia Z, Alzobi O, Ahmed G, Elmhiregh A. Robotic-assisted versus conventional total knee arthroplasty: a systematic review and meta-analysis of randomized controlled trials. Eur J Orthop Surg Traumatol 2024;34:1333–43. https://doi.org/10.1007/s00590-023-03798-2.

[8] Ruangsomboon P, Ruangsomboon O, Pornrattanamaneewong C, Narkbunnam R, Chareancholvanich K. Clinical and radiological outcomes of robotic-assisted versus conventional total knee arthroplasty: a systematic review and meta-analysis of randomized controlled trials. Acta Orthop 2023;94:60–79. https://doi.org/10.2340/17453674.2023.94.