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Does the Use of Robotic Technology Improve Outcomes in Primary Total Hip Arthroplasty?



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Does the use of robotic technology improve outcomes in primary total hip arthroplasty?

Recommendation: Based on available evidence, robotic-assisted total hip arthroplasty does not provide clear advantages over conventional total hip arthroplasty as far as clinical outcomes. Further studies are needed to confirm that improved radiographic outcome achieved with robotic surgery translates to better clinical outcome and survivorship.

Level of Evidence: Moderate.

Delegate Vote: Agree: 91%, Disagree: 8%, Abstain: 1%.

Rationale

Conventional total hip arthroplasty (CO-THA) has proven to be effective in the treatment of end-stage osteoarthritis of the hip

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[1]. Despite this, ongoing efforts are being made to improve the results of primary total hip arthroplasty (THA) through the development of various innovative technologies. Robotics have been introduced recently with the intention of improving the outcome of THA [2]. In recent years, several systematic reviews and meta-analyses have been published comparing the results of robotic-assisted total hip arthroplasty (RA-THA) and CO-THA. The purpose of this review is to summarize the results of systematic reviews and meta-analyses comparing the results of RA-THA and CO-THA.

PubMed, Ovid MEDLINE, Embase, and Web of Science were searched for potentially eligible studies from data inception to April 7, 2024. The search strategy included the following Medical Subject

Headings terms: Arthroplasty, Replacement, Hip AND Robotic Surgical Procedures AND Meta-Analysis as Topic. Using the search strategy, 192 records were found. After removing 54 duplicates, the titles and abstracts of 138 studies were screened. A full-text review of 27 studies was carried out. The full-text review resulted in the exclusion of 21 studies. Ultimately, nine systematic reviews and meta-analyses were included in the review [3–10]. A brief analysis of relevant studies is presented here.

Samuel et al. [3] and Ng et al. [6] in their meta-analyses reported better results in the RA-THA group compared with the CO-THA group using the Harris hip score and Western Ontario McMaster Universities Osteoarthritis Index, respectively. However, Ng et al. [6] emphasized that the minimal clinically important difference was not achieved. At the same time, Samuel et al. [3] conclude that, collectively, RA-THA and CO-THA demonstrate comparable functional results.

Emara et al. [7], Kumar et al. [4], and Wang et al. [5] found that postoperative limb length discrepancy after RA-THA was less compared with CO-THA, but there was high heterogeneity in the meta-analysis. For other radiographic parameters, RA-THA also showed better results in terms of component positioning (e.g., better cup placement, stem placement, global offset, etc.) [3–9].

A lower incidence of intraoperative and total complications was noted in the RA-THA group [5,8,9,11]. Most studies showed a similar or lower incidence of dislocations. In one large study of over 13,000 THA performed through a posterior approach, RA-THA had a 0.3 odds ratio (95% confidence interval 0.1 to 0.9, $P = 0.046$) compared to manual-THA for reoperation due to dislocation [12]. The remaining complication odds ratios, including those for infection, loosening, dehiscence, and “other,” were similar between the groups.

The current meta-analysis showed that the CO-THA group had a shorter operative time than the RA-THA. The longer operative time with RA-THA most likely relates to pin placement, stages of registration, as well as the learning curve [4,5,9].

In summary, RA-THA does not provide clear advantages over CO-THA as far as clinical outcomes. Some recent studies have shown improved radiological outcomes (e.g., acetabular component positioning), and some have shown reduced complications (e.g., dislocations). There is a clear need for future studies to see if the improved radiographic outcome achieved with robotic surgery translates to better clinical outcome and survivorship. Also, methodologically high-quality research should include comparative cost analyses to evaluate if the additional costs associated with robotics are justified.

CRediT authorship contribution statement

Alisagib A. Dzhavadov: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Goksel Dikmen:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Funding acquisition, Formal analysis, Data curation,

Conceptualization. **Michele R. D'Apuzzo:** Writing – review & editing. **Seng Jin Yeo:** Writing – review & editing. **Luigi Zagra:** Writing – review & editing. **Omer Faruk Bilgen:** Writing – review & editing. **Emrah Caliskan:** Writing – review & editing. **Micheal A. Mont:** Data curation, Formal analysis, Writing – review & editing. **Javad Parvizi:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Data curation, Conceptualization. **Ibrahim Tuncay:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Formal analysis, Data curation.

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