

Pros and cons of orthopaedic robots

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Abstract :

The use of robotic technology in orthopaedic surgery has grown substantially over the past decade, driven by the promise of enhanced surgical precision. Orthopaedic robots are assistive devices that guide surgeons in positioning implants with high accuracy. They differ fundamentally from autonomous surgical robots used in fields such as urology or gynaecology, which execute surgical manoeuvres based on surgeon commands. In orthopaedics, the surgeon remains in full control throughout the procedure, with the robot serving as a precision-enhancing tool.

Accurate implant positioning is widely recognised as a critical factor for achieving optimal long-term outcomes in joint replacement. This rationale has driven the adoption of robotic assistance, particularly in total knee arthroplasty, where robots are most commonly deployed. Clinical studies with follow-up periods exceeding ten years have consistently demonstrated that robotic-assisted procedures achieve significantly improved implant alignment compared to conventional techniques. However, a striking paradox has emerged: despite measurably superior positioning accuracy, clinical outcomes - including patient-reported satisfaction, functional scores, and revision rates - remain globally comparable between robotic-assisted and manually performed procedures.

One plausible explanation for this paradox lies in the ongoing debate regarding optimal implant alignment in total knee arthroplasty. At least six distinct alignment philosophies are currently in clinical use, including mechanical, kinematic, and restricted kinematic approaches, yet consensus among experts remains elusive. Robots execute whichever alignment strategy the surgeon selects with high fidelity - but if the chosen strategy is suboptimal for a given patient, precision alone cannot guarantee superior outcomes. The systematic collection of intraoperative positioning data now possible with robotic systems presents a unique opportunity. By correlating these detailed alignment parameters with long-term clinical outcomes across different philosophies, we may finally identify which alignment strategy delivers the best results, thereby unlocking the full potential of robotic assistance in orthopaedic surgery.