

Abstract

Background: Digital-assisted technologies (DATs), including robotic-assisted surgery, computer navigation, and 3D printing, are transforming joint arthroplasty by enhancing precision and personalization. Understanding their current adoption in China is crucial for guiding future development and training.

Methods: A cross-sectional survey was conducted from 2019 to 2023. Valid questionnaires were collected from 133 surgeons (senior/mid/junior: 82/36/15) across 30 high-volume Chinese hospitals. Data encompassed basic clinical data, DAT application (robotics, navigation, 3D printing, PSI, Sensor, digital planning), surgeon attitudes, and future outlook.

Results: Among 164,550 joint arthroplasties performed, 11,940 (7.26%) utilized DATs. DAT adoption grew significantly: primary THA increased from 4.39% (2019) to 12.78% (2023), and primary TKA from 4.65% to 6.88%. Surgical robotics was the most prevalent DAT (implemented in most hospitals), followed by 3D printing and navigation. Robotic-assisted procedures showed parallel growth (THA: 2.9% to 5.15%; TKA: 2.02% to 5.08%). Surgeons perceived DATs positively, with 82.0% believing robotics aids young surgeon development. However, prolonged operative time (average +15-30 min), citing setup, registration, and robotic movement were reported. Most surgeons (75.2%) preferred using robotics when available, primarily for improved accuracy, while cost and complexity were key deterrents. The ideal proportion of DAT-assisted surgery was deemed 25-50% by 48.1% of respondents. Concerns existed regarding potential specific complications (e.g., registration failure, unintended arm movement).

Conclusion: This national cross-sectional study demonstrates rapid growth (20.3% annual increase) in DAT adoption within Chinese joint surgery, driven predominantly by robotics and navigation. Despite high surgeon interest due to perceived accuracy benefits, overall utilization (7.26%) remains low compared to developed nations, hindered by cost, prolonged operative time, technical complexity, and learning curve challenges. Addressing these barriers through structured training, cost-benefit optimization, and standardized protocols is essential for broader implementation.