

Laser-Guided Surgery for Thumb Joint Arthroplasty

Total Joint Arthroplasty (TJA) of the thumb base is an advancing surgical treatment for osteoarthritis (OA) in the carpometacarpal (CMC-1) joint. While TJA offers improved mobility and faster recovery compared to traditional treatments such as trapeziectomy, the procedure presents challenges in accuracy and precision. Current semi-freehand surgical techniques lack standardized landmarking, leading to complications such as prosthesis misalignment, cup loosening, and ultimately revision surgeries.

This thesis explores the use of laser guidance during surgery as an innovative approach to enhance the precision of prosthesis placement in thumb joint arthroplasty. Through a collaborative design process with surgeons at Reinier Haga Orthopedisch Centrum, a concept for laser-guided surgery was developed. This concept aids surgeons in accurate k-wire placement by improving alignment and reducing intraoperative variability. The final design focuses on integration into the surgical workflow and ease of use during surgery.

Evaluation through interviews, feasibility testing and validation testing demonstrated the potential of the concept to improve accuracy while maintaining surgical efficiency. Future recommendations include further embodiment of the design, cadaver studies for validation, and exploration of additional technologies such as surface mapping. The proposed solution offers a promising step towards reducing complications and improving outcomes in thumb joint arthroplasty.

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