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Singapore's Alexandra Hospital develops world's first A.I. algorithm for robotic knee replacements

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As the world's first computational algorithm for robotic total knee replacement (rTKR), the new AI algorithm has been granted an international Patent Cooperation Treaty (PCT) patent.



Caption: Novel AI-based algorithm for robotic TKR which enhances accuracy and efficiency

(Left to Right): Dr Glen Liau (Consultant, Division of Adult Reconstruction and Joint Replacement Surgery, Department of Orthopaedic Surgery, Alexandra Hospital) with his team of medical practioners Ryan Loke and Dr Matthew Ng

Singapore's Alexandra Hospital (AH) Orthopaedic Surgery department has developed the world's first computational algorithm designed to improve the accuracy and efficiency of robotic total knee replacements (rTKR). The invention has been granted the international Patent Cooperation Treaty (PCT) by the World Intellectual Property Organization. Dr Glen Liau Zi Qiang, an orthopaedic surgery consultant at Alexandra Hospital, developed this algorithm with Dr Matthew Ng Song Peng and Mr Ryan Loke Wai Keong.

AI-powered innovation optimises personalised implant positioning during rTKR surgeries by creating personalised implant positioning accuracy for each patient's unique knee anatomy. Through this innovative approach, surgeons can achieve precise alignment of the knee components, which could result in better postoperative outcomes and implant longevity, as well as reduce surgical duration and increase productivity, making this a game changer in this field. Approximately 200 patients have undergone surgery using this new method since August 2023.

Overcoming the challenges of current rTKR methods:

Total Knee Replacement (TKR) surgeries are among the most common orthopaedic procedures, which have become more prevalent, rising from 187 patients for every 100,000 people aged 65 and above in 1999 to 499 patients in 2019. Over the time, the prevalence rate has increased 2.7 times till date. TKR surgeries allow patients with severe knee pain caused by degenerative conditions, such as osteoarthritis, to regain pain-free mobility, and improve their quality of life. In light of their precision and potential for better patient outcomes, robotic total knee replacement surgery (rTKR) has gained popularity in the

past five years.

Since every person has their own bone and ligament structures, finding the optimal solution in a robotic knee replacement can be challenging. Positioning the implants correctly is critical to post-operative biomechanical function, patient comfort, and operation success. Hence, itegrating this novel A.I. algorithm approach into the software interface of the cutting robot improves surgical planning accuracy and reduces surgical duration, which eventually translates into lower blood loss and shorter anaesthesia duration.

This innovation is being explored further in long-term studies to see whether it may improve patient outcomes and safety by decreasing the incidence of suboptimal implant positions, unnecessary operative time, blood loss, and infections. In the near future, it may also result in shorter wait times for elective procedures and lower treatment costs.

Dr Glen Liau who practices and operates at both AH and NUH added, "With ongoing studies to validate its long-term impact, this AI-driven approach has the potential to set new standards in robotic-assisted orthopaedic surgery, ultimately benefiting both patients and surgeons worldwide."

Hithaishi Bhaskar