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Telesurgery 2.0

As practice re-emerges, patient engagement and standardisation of evaluation are crucial

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Interest in telesurgery has been renewed around 20 years after it first came into use. With telesurgery, a remote surgeon is able to operate with a tool on a patient over a distance between two hospitals. The tool in question is usually a surgical robot, and the connection between the remote surgeon and the patient is through a secure telecommunication link. The challenge is to keep the time delay short as the distance between the surgeon and the patient increases.

The first clinical telesurgery was a robotic cholecystectomy in 2001 between New York and Strasbourg,[1] using a robot called Zeus (Computer Motion, USA) with the connection provided by French Telecom at considerable expense. This was followed by the first randomised controlled trial of telesurgery between Guy's Hospital, UK, and Johns Hopkins Hospital, USA, using a percutaneous access to the kidney robot,[2] showing that although the robot was slower than a human hand it was more accurate at inserting a needle into the kidney. Robotic surgery was also reported from a teaching hospital to remote community hospitals in Northern Canada.[3] Thereafter the da Vinci robotic system (Intuitive Surgical, USA) became the main surgical robot in the market for 20 years. Although it revolutionised surgery, it was not built with telesurgery in mind. As a result, the concept of telesurgery gradually faded and traditional robotic surgery with the surgeon and patient in the same room has been the norm, until recently.

In 2018 we demonstrated 5G ultra-low latency telesurgery with a headset for vision and a haptic glove to control a 3D printed robotic tool, with minimal time lag.[4] Colleagues from China performed 5G telerobotic procedures soon after, and since then China has largely dominated the re-emergence of telesurgery.[5 6] Several reasons for this exist. The new robotic systems are telesurgery compatible. This means improved 3D computer vision and a reduced time delay within the robots themselves. The telecommunication links have vastly improved with fibreoptic lines, 5G/6G cloud architecture, high speed internet, and satellite. The connections are now an astonishing 99.9999% secure. And as China has a single law across the nation, overcoming the legal obstacles is easier than in other countries such as the US, where the laws are different across different states.

Multiple reports of telesurgery within nations, as well as transcontinentally, have been published.[7-10] The national reports have come from China, Japan, India, and Belgium, with transcontinental telesurgery between North and South America, Europe/UK and China, China and Africa, and the first US Food and Drug Administration approved procedure from the US to Africa.[11] This last one was of humanitarian benefit as the expertise for robotic surgery was provided by a highly experienced team from Florida to Angola. Angola had in 2025 been hit with a substantial cholera outbreak making the delivery of care even more challenging.

Around 300 telesurgery procedures have been reported with no technical failures. What was lacking in these reports was the scientific rigour needed to show that telesurgery was safe and here to stay. In a linked paper (doi:10.1136/bmj-2024-083588), a multicentre randomised controlled trial compared telesurgery in China with local robotic surgery for two urological procedures—robotic assisted radical prostatectomy and robotic partial nephrectomy for small renal masses.[12] The authors accept that deciding on the numbers needed to treat to show non-inferiority of telesurgery was difficult, as no such previous trials had been conducted. A large number of patients were invited; some agreed to be randomised, but many decided against participation. The main reason for patients not joining the trial or withdrawing after randomisation was the desire to have traditional robotic surgery with the da Vinci system, which already has an established track record in China. The robot used in the trial was the MP1000 (Edge Medical Co, China), which is telesurgery compatible. The telecommunication links were an optical transport network and a dedicated cloud connect network.

The trial showed telesurgery to be non-inferior to local robotic surgery with minimal time delay (latency 20.1-47.5 ms) from 1000-2800 km and no cybersecurity problems. The only failure of the robot happened on a single occasion in the local robotic surgery arm. Although having had patients randomised to either prostate or kidney surgery in the two arms would have been preferable, this would have led to a longer time being needed to complete recruitment. The positive margin rates for robotic assisted radical prostatectomy were significantly lower in the telesurgery arm, and one possible explanation for this may be that the most experienced surgeon was in the telesurgery arm. Secondary outcomes such as complications, early recovery, and medical team workload, did not differ between the two groups.

In 2024 the Society for Robotic Surgery began consensus meetings of telesurgery involving surgeons, ethicists, patients' groups, device manufacturers, telecommunication experts, policy makers, regulators, legal experts, and hospital administrators. This led to a Delphi consensus and 10 guiding principles for telesurgery.[13 14] These are informed consent, patient autonomy, surgeon-patient relationship, surgeon's discretion, clear roles and

responsibilities, comprehensive data review, guaranteed system safety, reliable communication network, approved equipment, and emergency protocols. The European Association of Urology has followed with its policy document.[15]

The return of telesurgery has wider considerations. Newer robots will reduce the cost, connectivity across nations will improve, and artificial intelligence (AI) will personalise surgery while making it more efficient.[16] Standardisation of evaluation with frameworks such as IDEAL (stages 1-4) for investigating surgical innovations will be vital.[17] This trial would be an example of IDEAL stage 3, which focuses on rigorously testing new technologies and treatments, ideally through randomised controlled trials, while also considering matters such as recruitment challenges and high quality data. Sceptics argue that if a team capable of performing surgery locally was essential in case the telecommunications link should go down, then why have a remote surgeon in the first place? Does it make financial sense? Or perhaps we accept that this is purely about bringing the best surgeon to a remote location without the surgeon, the patient, or their family having to travel long distances.

Most crucially, the authors of this trial accept that patient and public involvement was not an important part of the trial design. Most grant funding bodies now insist on this. Although robotic surgery may eventually become more automated, when asked recently at the Royal Academy for Engineering People's AI Stewardship Summit the public were willing to be part of trials but said "not yet" to fully autonomous surgery.[18] Initiatives such as the Responsible AI UK ecosystem will ensure that public trust remains the highest priority as surgery becomes more digital and the role of telesurgery becomes more established across health systems and nations and even in space.[19]

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