Editorial

# Robot-Assisted in Hip and Knee Surgery: Are we ready?

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The word 'robot' is derived from the Polish word "robota," which means forced labor. It describes a machine that carries out various tasks either automatically or with minimal external input, especially one that is programmable. There are two main types of robotic surgery systems: haptic and autonomous. Haptic or tactile systems allow the surgeon to use or drive the robot to perform a surgical procedure. This technology requires constant input by the surgeon for the procedure to proceed. In contrast, autonomous robotic systems require the surgeon to perform the approach and set up the machine, but once engaged, the robot completes the surgery without the surgeon's help. The use of robotic technology has, in some cases, facilitated minimally invasive surgery, which has gained popularity with some patients. In spinal surgery, robotic technology has been successfully used to increase the accuracy of implant placement. Furthermore, robotic technology can improve the radiological alignment of implants following the pre-operative plan.[1,2]

The use of robots in surgery dates back to the mid-1980s with the development of a system for performing stereotactic neurosurgery. Similar systems for this application were under development throughout the world at about the same time. The first active robotic system for orthopaedic procedures was ROBODOC (Integrated Surgical Systems, Davis, CA), developed at the University of California, Davis, from 1986 to 1992. Researchers at Northwestern University designed a robotic device to perform hip and followed by knee arthroplasty. A robotic arm was developed to provide a highly accurate, portable coordinate measurement device for the surgery (FARO Technologies, Lake Mary, FL). These systems were never commercialized. [1,2]

The technology evolves, and new robot systems are introduced, mainly for hip and knee arthroplasty. In the past five years, there were many publications on robotic-assisted arthroplasty. For instance, robotic-TKA (Ra-TKA) compared to conventional TKA with mostly short to mid-term follow-up. Some papers showed the advantages of robotics: reduced bone and periarticular injury, accuracy in implant positioning and limb alignment, decreased total expenses, shorter length of hospital stay. The others showed no significant difference in functional outcomes despite an increased accuracy in implant placement and limb mechanical axis alignment. Unfortunately, although improved implant alignment might be associated with implant survivorship, it does not



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correlate to patient satisfaction, as shown by Parratte and Abdel.[3,4,5]

Apart from joint arthroplasty, robotic surgery in orthopaedic has marked another new beginning with the introduction of robotic assistive anterior cruciate ligament reconstruction (ACLR). This technology aims to improve the positioning accuracy of tunnels in ACLR. The system includes a pre-operative path planning system, an intraoperative path planning system, and a navigation and positioning system. The studies are still limited, but the results show superior accuracy in both femoral and tibial tunnels placement. Active robotic technology seems to be accurate and feasible with promising initial results from Europe. However, robotics can only be as precise as the surgeon who plans the procedure. Therefore, future studies must focus on integrating arthroscopy, 3D image-enhanced computer navigation, and surgical robotics to increase precision in surgical techniques[6].

**Where do we stand?**

The question of whether robots and computers will eventually replace doctors is a growing debate among physicians. Regardless of the mixed result of the novel robotic surgery, the public's unawareness of the dubious outcome superiority can lead to misinformation and incorrect decision-making by patients. The three main concerns regarding Robotic technology included lack of surgeon experience with robotic surgery, robot malfunction causing harm, and increased cost. Regardless of the findings, the public perception is still "The Latest is The Greatest"; hence they prefer to be operated by robotic technology compared to the conventional method. It is important to understand and weigh the benefits and limitations of robotic surgery.

Although robotic surgery is still relatively new for many applications, recent clinical data has demonstrated several benefits, including improvement of accuracy of joint alignment or implant placements, reduction of the length of hospital stay due to the minimally invasive nature of surgeries, cutting off operating time, minimalizing intraoperative infection risk, and lower readmission and revision surgeries[7,8].

Some limitations might result in robotic surgery being less appealing. There are constant worries that robotic surgery may result in adverse events such as iatrogenic patient injuries (burns, cuts, or damaged organs), charring of instruments, or intraoperative malfunction. There are also financial barriers limiting the widespread use of robotics in orthopaedic surgery. The start-up cost for owning or obtaining a robotic system is often prohibitive for many institutions. Furthermore, these systems require continuous calibration of hardware and software upgrades, resulting in additional costs. The use of the autonomous robotic system was also thought to increase the incidence of both nerve damage and infection[7,8].

**The future prospect in Indonesia**

There might be some skepticism or even resistance to welcome new technology as with other new things. Nowadays, in the era of 4.0, the traffic of digital information is highly and widely accessible to our patients, making them aware of anything popular in other parts of the world. Robotic surgery that might appear to be new and unfamiliar in Indonesia might be hype in the future. We will eventually be forced to adapt to this technology to satisfy patient's expectations. Huge scale investment will be needed to start and invite this robotic service. With the market prediction for the global growth of orthopedic surgical robots at a 13% annual growth rate and reaching $4.1 billion in 2029, robotic surgery is still an appealing hot pie for the industry to penetrate the Indonesian market[9]. Then, in the end, the question will remain the same: are we willing to keep up with the new technology?



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