

# Robotics in Arthroplasty



AAHKS Digital Health Committee

The concept of a mechanical device to take over human tasks has been written about since Homer described mechanical servants in the the Iliad. Leonardo DaVinci sketched designs of a mechanical knight, and Isaac Asimov defined the three laws of robotics intended to keep humans safe from robots. The term “robot,” meaning forced labor, was first used in a Czechoslovakian play in 1920 describing the creation of artificial humans without souls.

The robots used in medicine; however, do not resemble humans. These are mechanical arms which perform very specific tasks. The first robotic procedure was a CT guided neurosurgical biopsy in 1985. This robot arm was later used for prostate surgery. The first FDA-approved surgical robot was used primarily to broach the femur for total hip replacements. Research into the feasibility of tele-robotics eventually led to development of a complete surgical system with robotic arms controlled by a surgeon outside of the sterile field. This system can be used for a wide variety of minimally invasive procedures in obstetrics and gynecology, urology, cardiology, and general surgery.

## Robotics in Orthopaedics

Early adaptation of robotics was limited in orthopaedics because of the high cost and cumbersome, time consuming and unreliable systems. Renewed interest has been driven by patient and surgeon desire for new technology with improved outcomes and possible cost savings through increased OR efficiency. Improved preoperative planning, precise bone cuts, and optimized placement of implants are all achievable with robotics. It is yet undetermined if improved alignment equates with improvements in patient satisfaction, soft tissue balance and decreased revision rates. Downsides of robotic assisted surgery include patient exposure to radiation when preoperative CT scans are required, initial capital expenses, and potential for complications at the pin sites.

The first orthopedic robotic system was completely autonomous. The surgeon would perform the approach, but once the robotic guidance began, it could not be modified. This led to problems with soft tissue damage; although, implant position was improved. This system is no longer in use. Current systems in orthopaedics are robotic assisted - the surgeon can modify the plan and physically controls the robot during the procedure.

Robotics in orthopaedics are tools which provides information to the surgeon and aid in performing precise bone cuts. Used correctly, they may provide improved outcomes and operating room efficiency. The use of a robot in arthroplasty still requires skill in balancing soft tissues, protecting ligaments against damage, and remembering that the surgical plan is only as good as the data that is provided. The technology is improving rapidly, and it is likely that future robotic designs will increase accuracy, precision and ease of use while decreasing costs.

## References

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