

# Robotics in Orthopedic Surgery: 6 Points on the Present and Future

Written by Laura Miller | June 13, 2011

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Robotic and computer-assisted technology is now available for use during orthopedic and spine procedures. There are many concerns associated with the efficacy and efficiency of this technology, especially since it costs hospitals a great deal of money to acquire. Here, orthopedic and spine surgeon leaders discuss six points on where the technology is now and where it will likely head in the future.

**1. What robotic and computer-assisted technology is capable of now.** Currently, there are only a few orthopedic procedures, such as partial knee and hip replacements that have robotic or computer-assisted technology to help facilitate the surgeries. As the technology advances, companies have gone from developing facilitating technology to enabling technology. "Up until now, a lot of the advanced techniques using computer assistance have been facilitating, which means they made the surgery more precise," says [Andrew Pearle, MD](#), an orthopedic surgeon at the Hospital for Special Surgery in New York City. "Now, we are starting to see more programs that are enabling, which means making it possible to do surgeries that surgeons couldn't do before."

Robotic systems for orthopedic and spine surgery are surrounded by misconceptions, most notably that the robot performs the procedure. However, the robot is only able to follow the surgeons' preoperative plans and guide them perioperatively. "Some surgeons think that a robot will make a bad surgeon good," says [Isador Lieberman, MD](#), a spine surgeon with Texas Back Institute in Plano and co-inventor of SpineAssist from Mazor Robotics. "If you don't understand the indications, biomechanics and musculoskeletal anatomy, it doesn't matter what tools you have in your hand, you won't do a good job."

Surgeons often use advanced technology in their every day lives, such as computers or Ipad, but many are skeptical about bringing the robotic technology into the OR. Some surgeons might feel threatened by the idea of using the technology to enhance a procedure they already perform well while others fear the technology is industry-driven instead of evidence-based. "The argument about needing long-term data supporting better outcomes with robotic technology is good, but everything has to start somewhere," says [James Ballard, MD](#), an orthopedic surgeon with Legacy Meridian Park Medical Center in Tualatin, Ore. "If a new idea comes out that you understand and like, you just might have to use it."

**2. Applying evidence-based research to robotic technology.** Strong, evidence-based studies showing that robotic technology produces better outcomes are lacking, and many orthopedic surgeons are unsure of spending the extra time and money to train on the systems. "We have to show using the robot is better than conventional techniques, and it's got a long way to go," says Dr. Pearle. "Up until now, robotics has been promoted and expanded mainly because of marketing successes of the robotic companies."

Strong evidence-based studies are rare in orthopedics because sorting patients and physicians into randomized, double-blind groups is problematic, and patients often want to use the latest and greatest technology if it's available. Dr. Pearle is participating in research at the Hospital for Special Surgery using the technology on cadavers, but the best studies using humans take several years to complete.

The short-term studies show that using the robot has very little impact on a patient's immediate outcome.

"A lot of computer surgery or robotics improves implant positioning, and the improved effects of implant positioning sometimes aren't seen for 10-20 years," he says. "A well-positioned implant may not mean the patient feels better in the first five years, but it could mean that the implant is more durable over the second five years. It's pretty clear, at least with total knee replacement, that implant positioning may not be as important in the short term as fixation strategies, surgical techniques and patient selection."

Additionally, measuring the success of precise incisions for joint replacement using robotic technology is difficult because surgeons don't have the outcome tools to define the precision. The kinematics aren't sensitive enough for patient performance outcomes to help depict improvements for implants that are placed within a millimeter of where surgeons want them.

**3. Marketing the technology.** While the technology doesn't have hard clinical evidence to support its use, device companies have been able to sell their systems to hospitals across the country. Much of the success of these sales can be attributed to marketing by the company, but the sustained use of the technology could be a sign that hospitals and surgeons are seeing good results.

"Marketing can only take you so far, and now we have to show that the technology is better," says Dr. Pearle. "These systems cost so much that hospitals tend to create a marketing effort when they buy one of these products. That is a bad thing because it limits the substantive research that needs to be done for robotics."

Orthopedic and spine device companies are also seeing the marketing power of robotic technology and many may add robotics to their proprietary portfolio. "The companies will link implantable devices to robotic systems," says Dr. Lieberman. "I see a big market growing there and I think it's going to be subject to the typical supply and demand rules that we see in other emerging technology."

Before learning the MAKOpasty procedure, Dr. Ballard didn't perform partial knee replacements because he felt the instrumentation and technology was too finicky. "I had dealt with a lot of patients who had failed partial knee replacements, and that scared me away from performing it," he says. "When I used the robotic system, I have a reproducible way to place implants. I don't think the robotic technology makes the procedure any worse, and it stands the chance to create better outcomes."

**4. Patient demand for robotic surgery.** In some communities, patients are driving the trend toward robotic- and computer-assisted procedures by demanding them from their physicians. "Patients see advertisements and hear a lot about robotic surgery, so there are a fair number of them who come into the office asking for it," says [Scott Heithoff, DO](#), an orthopedic surgeon with Orthopedic Associates of Port Huron (Mich.). Healthcare is one of the last fields switching over to electronic technology and patients are often well-accustomed with the potential advantages robotics can bring to their every day lives before the need for surgery arises.

"Patients realize what the computer has done in their personal life, and if they are going to have an operation, they want the best thing going for them," says [Lawrence D. Dorr, MD](#), medical director of the Dorr Arthritis Institute at Good Samaritan Hospital in Los Angeles. "Patients can find the information on the Internet and they know who in their community uses robotic technology. Then, when the physician down the street does robotic surgeries and has great results, you feel pressure to use the technology too."

Dr. Lieberman has already witnessed patient demand for robot-assisted spine surgery. "There's a perception out there that the robot is more accurate and efficient, which could translate to better outcomes," he says. "If the patient wants robotic surgery, the hardest thing to tell them is that they don't need surgery or that the robot won't help them with their particular procedure. It's recognizable and appreciated, and patients want to use it."

**5. Dealing with the technology expense.** Purchasing the equipment and software for performing robotic or computer-assisted surgery places a great burden on the hospital or healthcare provider. Some surgeons are partnering with hospitals that purchase the equipment, but even taking the time out of daily practice to train and become proficient on the technology can be difficult, despite the potential benefits of using the systems. "Right now, I think cost is a limiting factor," says Dr. Heithoff. "For example, a robotic knee system can come close to costing a million dollars. But, as with any technology, the cost will come down with time."

For now, the initial staggering costs place pressure on hospitals to market their new equipment to patients, which can be problematic since the technology hasn't been proven at the strong evidence-based level yet. "Some of the issues with current research on the effectiveness of the robots comes because it's not independent, non-biased research," says Dr. Heithoff. "This might be difficult to achieve because the robot cost so much. Many surgeons need the company backing to complete the research."

However, once the hospital goes beyond the initial cost for the equipment, a more precise surgery could save money in the long run. "The fact of the matter is, if you get a good result with every surgery you do, you save time with the complications associated with failed surgery," says Dr. Dorr. "People look at it as a short-term expense, but you have to look at it in the long run. It could prevent revision surgeries and long hospital stays. I think if it's going to make the patients better, it's worthwhile."

**6. Will robotic technology still be around in 10 years?** With increased pressure to reduce the cost of healthcare and emphasis on evidence-based medicine, robotic technology must prove its efficacy to continue its increased use. The systems will need to come down in price, which will happen if more products come into the market. "Ten years from now, I think robotic technology will be pervasive among operations, including trauma, joint and spine," says Dr. Dorr. "There isn't much more that can be done with implants, fixation and articulation. The only thing we can do is improve our human performance."

While robotic technology for orthopedics may expand in the future, there will most likely be limitations to how far it will go. "I don't think we'll ever see completely active robots in orthopedic surgery because there is too much variation in the human anatomy and too many instances that need immediate human judgments," says Dr. Ballard. "I think you're going to see refinements to the preoperative planning software and limited robotic technology so you can see what you want to change and go through simulations until the surgery is perfect."

Dr. Lieberman predicts that robotics will become more of the standard of care for spine surgery as well. "Much like none of us would want to be without GPS in our cars today, in the future we'll want to have the robotic technology in the OR," he says. "We can still perform surgery without it, but we'll want the robot there because it's more efficient and will be the standard of care."

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