New spine robot to serve as backbone for orthopedic innovations

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As personalized medicine continues to garner more importance in the field of health care, orthopedic surgeons use advances in imaging technology coupled with the latest robotics capabilities to improve the

likelihood of achieving successful outcomes for patients undergoing spinal surgery. The Mazor X Stealth Edition, a new surgical robot from Medtronic, is coming to the Yale New Haven Hospital, Saint Raphael Campus, and the first surgeries using this technology will be performed in May of 2022.

Peter Whang, MD, associate professor of orthopedics and rehabilitation, works extensively with this technology to perform robotic-assisted spinal fusions. "I like to think of it as a co-bot rather than a robot," Whang says. "Robots like this, while not autonomous, function more as an extension of a skilled surgeon. They create more opportunities for increasing the safety, reproducibility, and efficiency of these procedures, and also fully leverage the benefits of preoperative planning."

With this type of novel technology, orthopedic surgeons such as Whang are able to upload preoperative CT scans of patients into the robotic platform to plan out the procedure in advance and calculate trajectories of implants for spinal operations like fusions, which allows for the placement of screws more safely and accurately.

By utilizing robotic systems and other advanced technologies, many spine surgeries may be performed in a minimally invasive fashion, which is associated with numerous advantages including: less damage to muscles, reduced blood loss and operative time, decreased complication rates, quicker recoveries, and ultimately better clinical outcomes.

"Currently, the new robot will be used primarily for spinal fusions, which involve stabilizing two or more levels of the spine using implants such as screws and cages to alleviate back pain address symptoms of nerve compression," Whang says. "However, we will also be able to use the robot to address patients with a wide range of conditions such as degenerative arthritis, spinal deformities, and traumatic injuries."

In fact, at a time when medical technology is advancing at an increasingly rapid pace, robots like the one at Yale enable orthopedic surgeons to perform even more complex cases. For instance, their technological capabilities can also be integrated with artificial intelligence and offer a range of patient-specific treatment options necessary to provide personalized care.

Daniel Rubio, MD, assistant professor of orthopedics & rehabilitation, focuses many of his surgical efforts on scoliosis and other spinal deformity cases. Scoliosis refers to a sideways curvature of the spine which can require surgery to correct the patient's alignment.

To illustrate how imaging technology and surgical navigation used in conjunction with this new robot will further advance personalized medicine, Rubio discusses a case where a patient may require surgical intervention.

"When I see the patient and review their X-rays, I can manipulate renderings of their spine using our 3D imaging technology," Rubio says. "This allows me to show a representation or a model of what their optimal surgery would involve in real time with extremely precise detail."

"Before patients even commit to surgery, I can clearly show them where the incisions will be, the cages and rods that will be designed specifically for their operation, and the improvements in their alignment with a high degree of accuracy," he says as he manipulates a 3D rendering of a patient's spinal column.

If a patient chooses surgery, the innovations in personalized medicine and preoperative planning are where this new robot and other cutting-edge technology truly shine.

"In many cases, surgery is a very personal decision for patients," Rubio said. "As their health care provider, it is my responsibility to steward the trust they place in me to explain all the risks and benefits associated with these procedures. If a patient decides to move forward, I will then use their imaging to have custom implants designed specifically for them."

Cages, screws, and rods are essential for an orthopedic surgeon treating conditions such as scoliosis. With rods, the material becomes much less stable as more bends and adjustments are made manually during surgery. With the use of this imaging technology that produces components that are designed precisely for each patient's anatomy, the need to reshape the rods is vastly reduced or even eliminated and these custom-shaped rods are on hand before Rubio makes the first incision.

When these personalized implants are coupled with the new robotic system, it results in shortened recovery times, enhanced precision, and greater consistency while also offering valuable real-time feedback in the operating room so surgeons like Whang and Rubio can implement this data in a manner that is most beneficial for each individual patient.

"As a research institution, Yale is often on the cutting edge when it comes to surgical innovations and advanced technologies," Whang concludes. "We understand that there is a considerable capital cost to incorporate these novel platforms to our spine service line. Nevertheless, we believe that they will afford us wide-ranging opportunities to not only provide better care to our patients but also perform studies that investigate the diverse benefits of robotics and other innovations in spine surgery. As a result, we are much better positioned to help our patients today while simultaneously preparing to integrate the technologies of tomorrow into our own practices."

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