Navigation and Robotics in Scoliosis Surgery

Navigation and robotics are two closely connected technologies. They are becoming more common in scoliosis surgery. Navigation allows a spine surgeon the precisely identify parts of a patient's anatomy relative to a computer model. Robotics builds on this by helping a surgeon perform a surgery planned out on a computer model.

A critical step in spine surgery is the insertion of implants. Navigation can help with that step. To straighten a scoliosis, the surgeon places screws in the spine. These are then attached to corrective rods. They are placed within a narrow column of bone in the spine and must be placed very precisely to prevent complications. Most surgeons place these by understanding the anatomy and experience. The placement is then confirmed with x-rays. No surgeon is 100 percent successful at placing these screws. Navigation offers the potential to make surgeons more exact.

Navigation for the spine works in a similar way to the navigation app on your phone. Your phone (computer) understands where you are relative to a computer map. Spine navigation uses three-dimensional imaging such as a CAT scan to model the spine. An image guidance system is then used with the scan to help the surgeon. This allows the surgeon to see on a computer screen how the intended plan fits the spine. The result is improved precision. Most studies confirm better accuracy when navigating screws. The down side includes increased cost, the added radiation of a CAT scan, and longer operative times[1].

Robots bring up memories of Arnold Schwarzenegger in the Terminator. The idea of using robots in spine surgery may seem like science fiction. On more careful thought, we realize that our world is filled with robots. They are designed to make our lives easier or better in some way. Some simple robots have jobs like vacuuming the floor. Others can be very complex, performing tasks like helping to build a car. Others handle shipping products from mega-warehouses. Since the 1980s, scientists have been developing ways to use robotics in surgery.

Robots have been very successful in manufacturing. They have more precision, improved endurance, better speed, greater consistency, and reduced cost. Can these advantages carry over to the area of surgery? Robotic surgery has shown promise in several areas. They are commonly used in heart surgery, bladder surgery, and general surgery. They allow these surgeries to be done with a minimally invasive approach. This means a very small cut is used. Robots have also been used in joint replacement surgery and shown improved precision.

Many patients worry that a robot will be performing their surgery. This is not the case. The surgeon is doing the surgery using the robot as an aide. The robot is an extension of the surgeon's hands. Current systems use a robot in different ways:

- **Supervisory** – The surgeon plans the surgery and the robot performs certain parts of the surgery under control of the surgeon.
- **Tele-surgical** – The surgeon performs the surgery at a computer console. The robot mimics the movements of the surgeon's hands. The console is typically in the operating room. This is a little like a video game.

There are currently several robots approved for spine surgery. They have mostly been used in adults for fusion of the spine. Studies done so far show that robots probably are slightly more precise than humans. Robots add to the cost, slow down surgery and have equal long term patient results[2]. At this point, efforts to use robotics in adolescent scoliosis have been few.

Robotic systems for surgery have come a long way over the last thirty years. They show promise for the more precise insertion of pedicle screws. There are still questions about increased cost, long term patient outcomes, x-ray exposure, and total surgical time. Once these are resolved, robotic scoliosis surgery may become more common.

References

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