Within 0.5 millimeter for spinal column operations

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With less than a 0.5 mm margin of error, Neuroglide, the robot developed by researchers in the robotics lab, allows for the placement of screws in small vertebrae with unequaled precision. KB Medical is the start-up being founded to get this product on the market.

Imagine placing a screw 4 mm in diameter into a bone that measures, on average, 6 mm in width, with cerebral arteries on one side and the spinal cord on the other. It's a risky operation for even the best surgeons. The robot, developed by Szymon Kostrzewki, Philippe Bérard and other researchers from the group "Virtual Reality and Active Interfaces" (VRAI) led by Charles Baur at the Robotic Systems Laboratory (LSRO2) at EPFL, has demonstrated a precision of 0.5 mm for this operation. Right now, trials are being done on bodies donated to science at the CHUV, and a start-up, KB medical, is being created.

A Guide to Penetrate the Vertebrae

The robot is compact, in the form of a small box, and is maintained by a passive structure on top of the operating field. The secret: a design that combines high precision mechanics and automatic control, giving the robot irreproachable accuracy. This level of reliability is not possible without the most discerning vision. An optical tracking camera, developed by Atracsys, another spin-off of VRAI at LSRO2, allows for following the trajectory of this medical drill precisely and in real-time. The information gathered is then transmitted to software that allows the

robot to constantly reposition itself according to the trajectory pre-established by the surgeon.

Even the Vibration of the Drilling is Corrected

As with all operations on the spine, a preliminary x-ray is required. With this image, the surgeon sets about virtually simulating the best placement for the screw and the appropriate positioning of the robot. Once the patient is properly placed for the surgery, the practitioner aligns on the real robot and its virtual image on the screen. Neuroglide, the drill's guide, maintains the desired position to one-tenth of a millimeter during the drilling, compensating for even the slight displacement linked to the vibration of the drill. "In the end, the operation does not last but one or two minutes longer than the current manual methods that are already computer-assisted," says Szymon Kostrzewski, "due to the time necessary for placing the robot." In the future, the operating time will be considerably reduced thanks to a percutaneous procedure.

Optimal Placement is Evaluated at 68%

After an accident, a herniated disc or osteoporosis, placing a screw to bind together cervical vertebrae may become necessary to spare the patient excess and uncomfortable pain. About 400,000 screw placements in the spinal column are performed every year in Europe. According to the *International Journal on Medical Robotics and Computer-Assisted Surgery*, around 4% of manual operations on the second cervical vertebra present neurological complications. The occurrence of arterial injury hovers between 4% and 8% and the optimal placement of screws is marginally above 68%. Philippe Bérard highlights the fact that, "The world market for spinal fusion equipment is worth many billions of dollars."

Clinical trials in Autumn 2013

KB Medical, the start-up being created by Szymon Kostrzewski and Philippe Bérard to commercialize the system, hopes to finish a second prototype in a year and proceed to clinical trials in Autumn 2013. Other applications for this system are already on the horizon. For example, the device shows promise for surgeries in otolaryngology, which are becoming more and more mechanized, such as in procedures to remove tumors that present a different resistance to cartilage and other neighboring tissues.

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