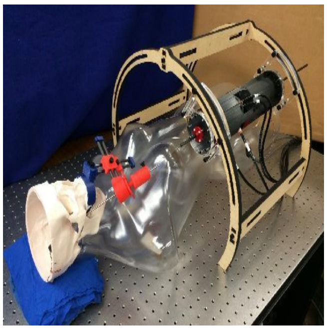
Robot Performs Epilepsy Surgery Through the Cheek



A robotic device that can be used to perform minimally invasive epilepsy surgery has been developed by a team of engineers from Vanderbilt University (Nashville, TN, USA). A working prototype was unveiled in a live demonstration at the Fluid Power Innovation and Research Conference 2014 (FPIRC14) held in Nashville between 13 and 16 October.

For severe cases of epilepsy, treatment often requires drilling through the skull deep into the brain to destroy the small area where the seizures originate. This method, aside from being invasive and dangerous, requires a long recovery period.

Five years ago, the Vanderbilt team thought it was possible to address epileptic seizures in a less invasive way. They noted that the area of the brain involved with seizure activity is the hippocampus, which is located at the bottom of the brain. Thus, they aimed to develop a robotic device that pokes through the cheek and enters the brain from underneath which avoids having to drill through the skull and is much closer to the target area.

To do so, it was necessary for the team to have a shape-memory alloy needle that could be precisely steered along a curving path and a robotic platform that could operate inside the powerful magnetic field created by a magnetic resonance imaging (MRI) scanner.

The business end of the device is a 1.14 mm nickel-titanium needle (unlike many common metals, nickel-titanium is compatible with MRIs). This needle works like a mechanical pencil and has concentric tubes, some of which are curved, that allow the tip to follow a curved path into the brain, explained David Comber, the graduate student in mechanical engineering who did much of the design work. A robotic platform uses compressed air to guide and push the needle segments a millimetre at a time.

The research team has measured the accuracy of the system in the lab and found that it is better than 1.18 mm, which is considered sufficient for such an operation, Comber pointed out. In addition, the surgeon can track the movement of the nickel-titanium needle by taking successive MRI scans.

The next stage in the surgical robot's development is testing it with cadavers, said Eric Barth, associate professor of mechanical engineering and head of the project. The robotic device could be in the market within the next decade, according to the professor.

Prof. Barth's team identified epilepsy surgery as an ideal, high-impact application through discussions with Associate Professor of Neurological Surgery Joseph Neimat. Currently, neurosurgeons use the through-the-cheek approach to implant electrodes in the brain to track brain activity and identify the location where the epileptic attacks originate. However, the straight needles they use cannot reach the target area. The surgeons therefore must drill through the skull and insert the needle used to destroy the misbehaving neurons through the top of the head.

Comber and Barth then shadowed Neimat through brain surgeries to see how their device would work in practice. "The systems we have now that let us introduce probes into the brain – they deal with straight lines and are only manually guided," Prof. Neimat explained. "To have a system with a curved needle and unlimited access would make surgeries minimally invasive. We could do a dramatic surgery with nothing more than a needle stick to the cheek."

The Vanderbilt team has designed the system so that much of it can be made using 3D printing in order to keep the price low. This was achieved by collaborating with Vito Gervasi and Jonathon Slightam at the Milwaukee School of Engineering who specialise in novel applications for additive manufacturing, Prof. Barth said.

Source: EurekAlert.org
Image Credit: David Comber, Vanderbilt University

Published on : Mon, 20 Oct 2014