Smart surgical robot makes light work of ear implants

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Credit: Brunel Institute of Bioengineering

Patients having ear implants could have safer surgery with a hand-held robotic drill so sensitive it can drill through an eggshell and stop before reaching the membrane.

Every year about 700 people in the UK have cochlear implants to help them hear when hearing aids can't help.

Surgeons have to train for 10 years to do the intricate procedure, where they drill through bone, into the middle ear and into the cochlea. And if bone dust enters the cochlea, it can damage balance.

Bioengineers at Brunel have tested a new robotic hand drill with a smart sensor that stops automatically before it reaches the delicate endosteal membrane in the inner ear.

"It reduces the risk of people suffering balance damage," said Dr. Xinli Du at Brunel Institute of Bioengineering.

"It drills at a much slower pace, which reduces the impact and amount of contact, which means less vibrating, which can damage the cochlea."

Right now, surgeons routinely use a robotic drill attached to a mechanical arm for cochleostomies. But hand-held robotic drills leave a smaller footprint and use more of the surgeon's dexterity. Plus they are quicker to set up and learn to use, so cut training costs for surgeons.

While standard robotic drills are guided along a pre-planned drill path calculated from a CT image of the patient's inner ear, the new lightweight tool runs on a unique smart sensing algorithm. With micron-level accuracy, its smart sensing system uses feedback about the force and torque between the drill and body part to automatically decide when to stop. "With different people, the tensions will be different and the drilling time will be different," explains Dr. Xinli. "But the force and the torque will be similar."

For the first time, Dr. Xinli's team successfully used the new smart-sensing device to perform the cochleostomy on humans. In a study published in Robotic Surgery: Research and Reviews, the team practised on an egg and then carried out the operation three times on humans, keeping the delicate endosteal membrane intact.

"The hand-guided robotic drill produces consistent outcomes and augments surgeon control and skill," the study says. Its advantage is its flexibility to alter the drill's trajectory, which is crucial to avoid slipping. "There is anticipated benefit in the reduction of trauma tissue as a result," said Dr. Xinli. "Potentially it could be developed for NHS use."

More information: Xinli Du et al. A hand-guided robotic drill for cochleostomy on human cadavers, *Robotic Surgery: Research and Reviews* (2018). DOI: 10.2147/RSRR.S142562

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