Optical guide aims to keep orthopedic procedures right on target

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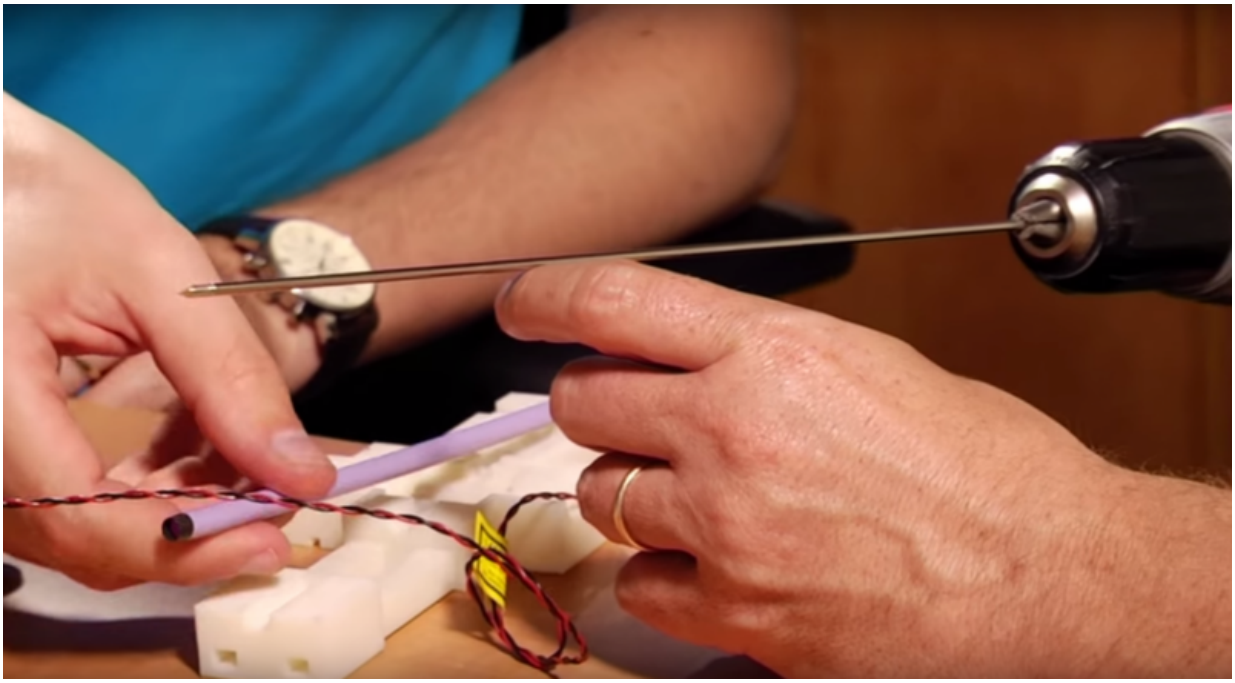

Students at the Hebrew University's BioDesign program developed an opto-electronic drilling system that detects minute changes in guide-wire trajectory during surgery. Credit: The Hebrew University of Jerusalem

In the United States alone, hip fracture fixation is performed on 258,000 patients; spinal fusion accounts for 350,000 persons every year. As the population ages, the number of these surgical procedures will continue to grow.

Common orthopedic procedures, such as hip and pelvic fracture surgery as well as spinal fusion, require the accurate positioning of a thin metallic wire to guide the positioning of a fixating screw. However, the surgical procedure is often hampered by deflection, bending and even breakage of the guide-wire, which then requires repair while complicating and prolonging the recovery of patients.

"This is a significant challenge", said Prof. Meir Liebergall, head of the Department of Orthopedic Surgery at Hadassah Medical Center, "as complications in guide-wire positioning could lead to revision surgeries and increase hospitalization time and cost."

To address this challenge, Prof. Liebergall partnered with a multidisciplinary team of medical doctors, along with engineering and business students, from The Hebrew University's BioDesign: Medical Innovation program.

They identified a solution: by creating a system that provides real-time indication of deflection or bending of the guide-wire, the surgeon will be able to adjust the procedure before damage occurs.

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The team developed BendGuide, an opto-electronic drilling system that monitors and detects minute changes in guide-wire trajectory during surgery. It allows surgeons to correct drilling trajectories during the procedure itself. The system eliminates guide-wire bending or breakage and significantly reduces operation time and safety.

"This is an elegant technological solution to a complex problem," said Prof. Yaakov Nahmias, director of The Hebrew University's Alexander Grass Center for Bioengineering and the BioDesign program. "The group model and proof-of-concept experiments showed they could detect even miniscule changes in guide-wire trajectory."

BendGuide uses a fiber bundle with a reflecting laser beam that enables detection of small deflections in wire trajectory. At a fully-aligned state, the beam power hits the center of the detector array. When deflected, mirror misalignment causes the power to spread differentially across the fiber bundle.

The market for computer-aided navigation systems for surgery is growing fast. The potential market is estimated at $500 million annually in the United States alone. BendGuide aims to become an integral part of this market, which is expected to grow further with the aging population.

Provided by Hebrew University of Jerusalem