

Holding It Together: How A Smarter Mesh Is Reinventing Hernia Surgery

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More than 1.5 million abdominal hernia surgeries are performed across the globe each year to repair a weakened area in the muscle or connective tissue, where an internal organ or other body part protrudes through an abnormal opening. Often caused by strain, aging, or prior surgeries, hernias can lead to discomfort, pain, and complications if left untreated. Even after surgical repair, patients face the difficult reality that internal sutures could tear free from the repaired tissue at any moment, causing significant pain and potential long-term health issues.

North Carolina State University (NC State) professor of textile engineering Dr. Jon Rust and former Duke University associate professor of surgery Dr. Howard Levinson recognized an opportunity to dramatically improve the comfort and safety of hernia patients and began working together in 2015 to create a novel mesh that would withstand tension and avoid surgical or device failure. The doctors created a prototype that was initially tested on the carcass of a pig by weaving the mesh extensions throughout the connective tissue and pulling to create tension. This testing yielded exciting results: the mesh never tore, even when the tissue did. The inventive process was extensive and required several adjustments, including modifying the meeting point of the extensions to the body of the mesh, transitioning from a sharp "V" shape to a flat connection to improve mesh durability and usability.

The technology transfer offices at both NC State and Duke helped to accelerate the innovation into the hands of surgeons who treat hernia patients. Both offices worked to facilitate connections with medical device companies to help Dr. Rust fully understand the market need and modify the technology accordingly. The doctors continued developing the technology and Dr. Levinson went on to found the company Deep Blue Medical Advances (Deep Blue) to bring the device to market. He remains the Chief Medical Officer at the company.

The technology was licensed to Deep Blue in 2017 and integrated into a product, the T-Line Hernia Mesh, a novel ravelresistant, warp-knitted mesh used to combat problems in tissue repair surgery. To continue development, Deep Blue secured more than \$4M in translational funds through Duke, the North Carolina Biotechnology Center, and the National Institutes of Health.

The company also received support from NC State's Wolfpack Investor Network and Duke Capital Partners (DCP), member-based investment groups comprised of accredited NC State and Duke alumni investors. Their investment in Deep Blue helped to accelerate its path to market. Both groups of investors have supported Deep Blue in multiple fundraising rounds and a DCP member sits on the company's Board of Directors.

The T-Line Hernia Mesh received regulatory approval from the FDA in 2020 and is now actively being used in clinical sites in the United States. With the success of this product, Deep Blue now plans to extend the technology to other clinical areas such as breast reconstruction.

While the commercial impact of his innovation continues to grow, Dr. Rust is proud to have contributed so positively to the well-being of hernia patients who can now benefit from a more permanent solution to an agonizing problem.

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