Revolutionizing pediatric heart surgery through 3D computational modeling, patch design, and the use of laser projections

An update for the Graeme McDaniel Foundation
November 2023

In an era of increasingly complex pediatric cardiovascular surgery, patients with uniquely intricate congenital anomalies require precise interventions. **David Hoganson, MD**, and his visionary team have embarked on a groundbreaking mission to transform how we approach and prepare for these life-saving procedures. Generous support from the Graeme McDaniel Foundation has helped fuel their pioneering work to improve patch design and implementation for complex ventricular septal defects within the heart.
Using cutting-edge technology borrowed from the aerospace and automotive industries, as well as incredibly detailed 3D computational models of patient's hearts, the team continues to innovate and improve surgeries.

Since we last spoke, Dr. Hoganson and his team have made significant strides in their efforts, thanks to your generous philanthropic investment:

- The team has onboarded a **PhD-level expert in computational fluid dynamics** to unlock realistic flow analysis of blood through the heart and into the lungs. This breakthrough allows surgeons to account for blood-flow dynamics while planning for surgery. It lets them craft repairs that create optimal post-surgical blood flow and pressure—a crucial factor in long-term patient outcomes.

- The team has been focused on refining the process for **VSD patch planning** to improve efficiency. Just this past week, they used the laser projector in the operating room for the first time on a complex VSD patient. The laser projected the exact design onto the sterile patch material. The surgery was a big success, and the child is doing well. The use of the laser projection made the surgery more precise and faster. The team is planning to use the laser for VSD patches in several other cases.

- In early November, the engineering team **presented at an international engineering conference** on the aorta patch planning process. Their presentation was met with great excitement from the brightest minds in the engineering space. The team will continue to present on this topic at upcoming conferences, including at the annual American Association for Thoracic Surgery meeting next Spring in Toronto.

The future of clinical innovation

The growth of this program has been extraordinary. When Dr. Hoganson began this project six years ago with a handful of carefully recruited engineers, developing a single patient model took eight weeks or more. Less than 10 patients benefited in that first year. Now, with an engineering team of 12, models can be built in less than two weeks and more than 800 patients have had their surgery planned this way. But there's still much work to be done. Workflow improvements, faster computational modeling, and broader integration across surgical disciplines are needed to respond quickly to urgent cases including newborn children (which require model development in hours, not days) and extend this technology across Boston Children's and beyond.

Your support continues to catalyze these transformative improvements in pediatric cardiovascular surgery. Your investments will enable faster, more precise surgeries, reduce the burden on young patients and their families, and accelerate the development of critical medical devices. Together, we will reshape the future of pediatric surgery and bring hope to countless children and their families. **We cannot thank you enough for your partnership in this groundbreaking journey to save young lives and revolutionize pediatric health care.**