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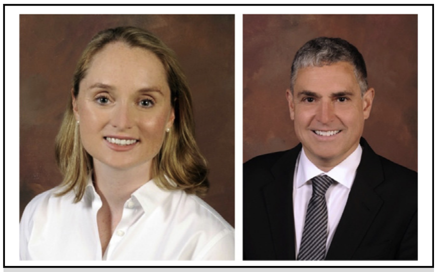
Commentary: Print another heart, practice makes perfect

Alison F. Ward, MD, and Richard Lee, MD, MBA



Alison F. Ward, MD, and Richard Lee, MD, MBA

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CENTRAL MESSAGE

Hands-on surgical training quantitatively improves surgeons' techniques; continued demonstration of improved performance will be needed for widespread adoption in congenital heart surgery training.

In this edition of the *Journal*, Hussein and colleagues[1] describe a hands-on surgical training congenital heart surgery tool for the arterial switch procedure using a 3-dimensional (3D) printed model of transposition of the great arteries. They sought to objectively demonstrate an improvement in technical performance and speed with repeated practice using their model. The objective performance assessments included a procedure-based assessment, a holistic assessment, and a time-based assessment. Eighty percent of the 30 surgeons improved after their first attempt, and surgical experience did not affect performance scores. There were statistically significant improvements across all the holistic scores: fluency, knowledge, and respect for tissue. All surgeons' speed increased from their first to second attempt, with a mean improvement of 25%.

The benefits of a 3D printed model are clear: a unique, anatomically precise model created to help understand the anatomic relationships of lesions and practice operations. This model is not without drawbacks, which include high printing costs and materials that do not accurately simulate human tissue, especially valve tissue.[2-4] Cost and equipment requirements for 3D printing limit its widespread applicability, but as the authors point out, collaboration among hospitals, training programs, and even insurers could ensure widespread adoption of this training modality. Using quantitative data to demonstrate improved performance and even potentially improved outcomes will be key to continue funding simulation. In this study, although 80% of surgeons improved between attempts 1 and 2, the authors fail to provide a realistic answer for why 20% of participants performances did not improve—citing that the surgeons potentially adopted an alternative technique on the second. With further simulation development, the goal will need to be a higher success rate to justify widespread adoption.

The learning curve for congenital heart surgery training is steep given the technical demands of complex operations, relative rarity of individual lesions, and a small operative field, all within the time constraints of fellowship. In an era when outcomes are monitored closer than ever before, there needs to be innovation in how we train young surgeons to be proficient. Use of models on which trainees can practice and master the technical aspects of operations in a low-risk environment before the operating room, as demonstrated here, can quantitatively improve performance. The authors support the notion of increased hands-on surgical training in congenital heart surgery and take it a step further suggesting shifting the training paradigm away from number of operations toward operative competency, a thought-provoking idea that they believe could decrease the training time—an unrealistic idea.

3D printed models provide a hands-on simulation tool for congenital heart surgeons and trainees. More studies, like this one, will need to demonstrate quantitatively improved performance to promote widespread adoption within the congenital heart surgery training paradigm.

From the Division of Cardiothoracic Surgery, Department of Surgery, Medical College of Georgia, Augusta University, Augusta, Ga.

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Address for reprints: Richard Lee, MD, MBA, Department of Surgery, Medical College of Georgia, 1120 15th St, BA-4300, Augusta, GA 30912 (E-mail: RICKLEE@augusta.edu).

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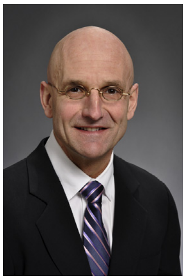
Check for updates

Commentary: Operate on my printed model—absolutely; my newborn grandchild?

Ronald K. Woods, MD, PhD



Ronald K. Woods, MD, PhD

CENTRAL MESSAGE

Procedural training on 3D-printed models may enhance knowledge and technical performance of selected congenital cardiac surgical procedures.

Training of pediatric cardiac surgeons and mentoring junior surgeons—mission vital, yet not easy to do. The difficulty is inherent to the low- (or no) error margin in many of the procedures we do. Let's suppose you are an experienced surgeon with a newborn grandchild with transposition of the great arteries (TGA) and ventricular septal defect (VSD). You are to advise your son or daughter to choose between surgeon A, who trained at a reputable program, met all certification criteria (remarkably did 10 mentored TGA/VSD procedures during training), and is in year 1 in practice. As faculty, surgeon A has done 2 mentored repairs with excellent results. Surgeon A will now operate independently with a senior mentor readily available. Your other option is surgeon B, who has done 70 repairs with excellent results. Your advice? And that is the essence of our challenge. In part, this highlights the importance of the work by the group in Toronto, who has invested considerably in expertise and infrastructure to enable the incorporation of 3-dimensional (3D) training models into their curriculum. They now provide an assessment tool and demonstrate that practicing the arterial switch on a 3D TGA model can result in performance improvement.[1] Despite numerous challenges, I suspect most, if not all accredited training programs will incorporate this type of training as part of their curriculum at some point in the future, even if simply by sending trainees to specialized "boot camps." Although possibly limited to a handful of common anomalies, it couldn't hurt (except maybe some money), and it may well help.

But does the number of 3D model procedures or scores influence your choice of surgeon?

Suppose you are the surgical director of a 150 pump case/year program and do 2 to 4 TGA/VSD procedures per year. Your denominator is low—one little mishap could impact your percentage for the next several reporting cycles. At what point do you allow your junior partner to be the primary surgeon? At what point do you step away from mentoring every detail of the case? What feedback are you getting from your cardiologists? These are incredibly important questions, and the answers have incredibly important implications for Surgeon A maturing to Surgeon B. The solution may not be easy, but it isn't magic—it requires available, willing, competent mentors who will stand

From the Division of Pediatric Cardiothoracic Surgery, Department of Surgery, Medical College of Wisconsin, and Herma Heart Institute, Children's Wisconsin, Milwaukee, Wis.
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Address for reprints: Ronald K. Woods, MD, PhD, Division of Pediatric Cardiothoracic Surgery, Department of Surgery Medical College of Wisconsin, Children's Wisconsin, 9000 W Wisconsin Ave, MS B 730, Milwaukee, WI 53226 (E-mail: rwoods@chw.org).
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