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Editorial Comment
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Is a Three-Dimensional Printed Cardiac Model Better Than a Traditional Cardiac Model for Medical Education?

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Three-dimensional (3D) printing is a new technology that could be used to study congenital heart disease, coronary artery disease, and surgical and catheter-based structural disease.[1,2] In addition to clinical practice, there have been only a few studies about its role in medical teaching.

On this issue, Wang et al.[3] reported their randomized controlled trial about using 3D printing in cardiac model teaching of valvular heart disease. Thirty-four medical students were randomized to either the 3D printing group taught with the aid of a 3D-printed cardiac model or the traditional model group with a commonly used plastic cardiac model. A ventricular septal defect (VSD) model was 3D printed from a 64-slice multi-detector computed tomography (CT) image of a 47-year-old male patient. After a 120-minute teaching session, both groups of medical students were required to complete a questionnaire with 10 medical questions and 3 evaluative questions. However, the authors found no difference in the overall performance and satisfaction of the students in the 2 groups. They only found that more students in the 3D printing group believed that they had understood at least 90% of the contents of the session.

Interestingly, another recent study compared the impacts of two-dimensional (2D) and 3D cardiac models on how pediatric residents understand and learn about tetralogy of Fallot (TOF) following a teaching session.[4] Thirty-five pediatric residents were enrolled in the study, including 17 residents in the 2D image group and 18 residents in the 3D model group. The 3D models included a cardiac CT of a normal infant heart, a cardiac magnetic resonance imaging (MRI) of an adult patient with repaired TOF, and a 3D echocardiogram of an infant with unrepaired TOF. All the participants had to complete 9 multiple-choice questions before and after the teaching session. The study found that both groups demonstrated similar knowledge acquisition in post-test scores. However, residents in the 3D image group gave a higher composite learner satisfaction score than the 2D image group. The author concluded that 3D cardiac models enhance resident education about TOF by improving learner satisfaction.

Simulations are now in widespread use in medical education. With advancements in technology, we have more and more tools for medical simulation, such as high-fidelity simulations.[5,6] However, there is still debate over whether advanced technology will always be helpful in improving learning outcomes. One systematic review was conducted to find the features and uses of high-fidelity medical simulations that lead to most effective learning between 1969 and 2003.[5] A total of 670 journal articles were reviewed initially and from these, 109 journal articles were selected. Among these 109 journal articles, the features and uses of high-fidelity medical simulations included providing feedback in 51 (47%) of them, repetitive practice in 43 (39%), curriculum integration in 27 (25%), range of difficulty level in 15 (14%), multiple learning strategies in 11 (10%), capture clinical variation in 11 (10%), controlled environment in 10 (9%), individualized learning in 10 (9%), defined outcomes in seven (6%), and simulator validity in four (3%).

3D cardiac modeling is a new technology in medical simulation. In these two studies,[3,4] 3D printing techno-

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logy did not show superiority in knowledge acquisition when compared to other groups (2D image[4] or plastic cardiac model[3]). However, these findings suggest that more effects are still needed to improve medical teaching in addition to new technology, such as feedback, repetitive practice, curriculum integration, and so on.[7,8]

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