

The utility of 3-dimensional printing in structural heart interventions: experience from Split

 **Andrija Matetić^{2*}**
 **Frane Runjić¹**,
 **Ivica Kristić¹**,
 **Darija Baković Kramarić¹**

¹University Hospital of Split, Split, Croatia

²University of Split School of Medicine, Split, Croatia

KEYWORDS: 3-dimensional printing, structural heart interventions, planning.

CITATION: *Cardiol Croat.* 2025;20(1-2):30-1. | <https://doi.org/10.15836/ccar2025.30>

***ADDRESS FOR CORRESPONDENCE:** Andrija Matetić, Klinički bolnički centar Split, Spinčiceva 1, HR-21000 Split, Croatia. / Phone: +385-98-9546-455 / E-mail: andrija.matetic@gmail.com

ORCID: Andrija Matetić, <https://orcid.org/0000-0001-9272-6906> • Frane Runjić, <https://orcid.org/0000-0001-6639-5971>
Ivica Kristić, <https://orcid.org/0000-0002-9882-9145> • Darija Baković Kramarić, <https://orcid.org/0000-0001-6751-5242>

Introduction: Structural heart interventions rely on meticulous planning with multimodal imaging¹. Technological advancements now enable digital 3-dimensional (3D) reconstructions from CT, MRI, and echocardiography¹. The next level of preprocedural planning for complex structural heart interventions includes in silico 3D printed models^{2,3}.

Methods and Results: The utilization of 3-dimensional printing for structural heart interventions at the University Hospital of Split has allowed us to anticipate potential challenges and tailor our approach to each patient's unique anatomy. Importantly, this methodology is exclusively designed for ex vivo planning purposes to simulate and plan complex structural heart interventions before the actual procedure^{2,3}. The protocol includes advanced computation of the 3-dimensional digital reconstructions from different imaging modalities (computed tomography, magnetic resonance imaging, or echocardiography), followed by the model optimization and translation to appropriate digital files, as well as the final 3-dimensional printing. Based on the structural intervention, this protocol may include a priori integration of predefined therapeutic devices into the model (e.g. heart valves; clips; occluders; etc.), or a posteriori integration of these devices as a separate in silico model. Finally, the 3-dimensional models need to undergo post-processing phase to achieve its final form. This approach has facilitated planning for complex transcatheter aortic valve interventions (**Figure 1**), percutaneous paravalvular leak and intracardiac fistula closures (**Figure 2**), mitral valve interventions, and more.

RECEIVED:
February 5, 2025
ACCEPTED:
February 14, 2025

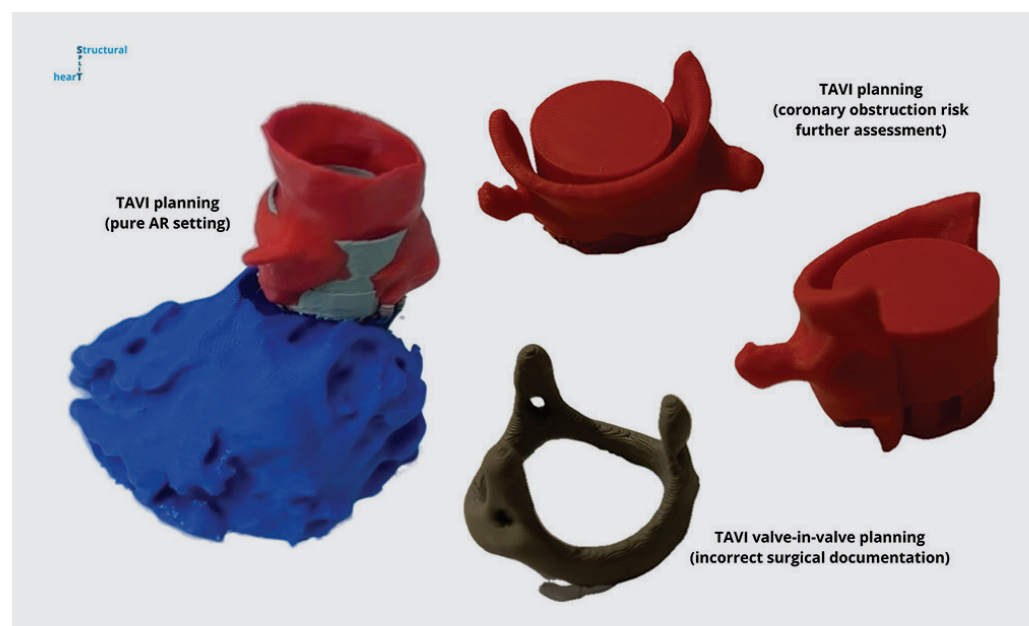
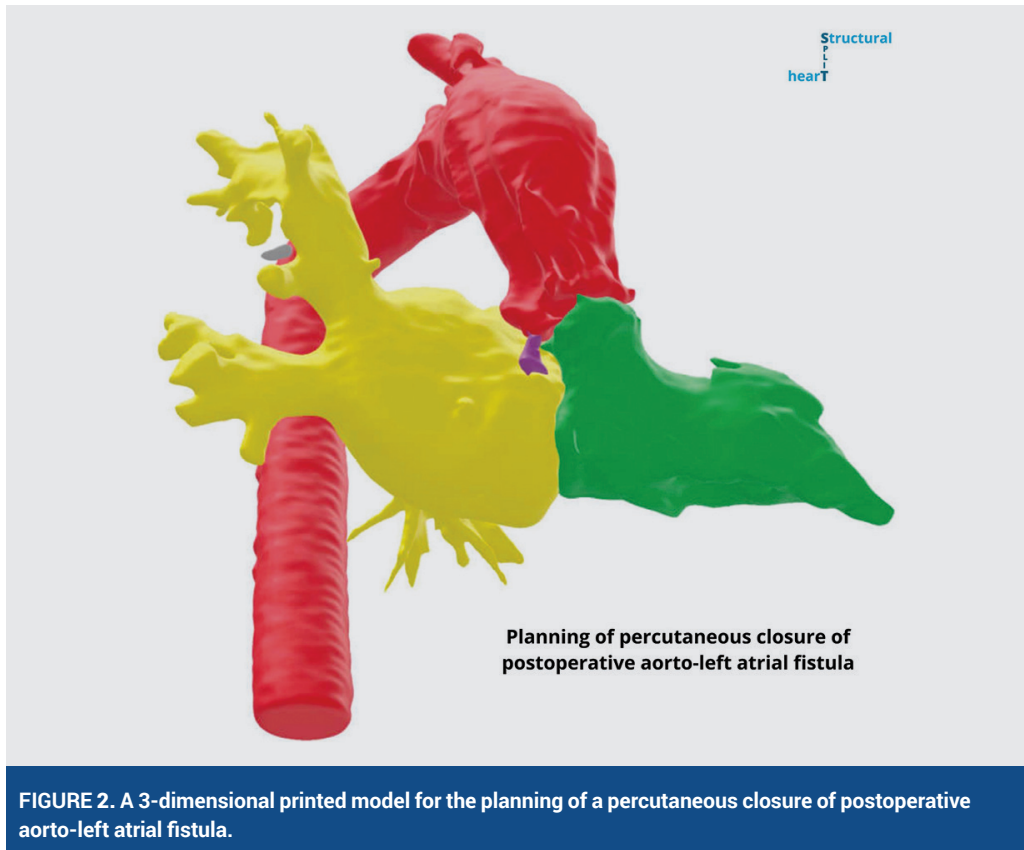


FIGURE 1. Exemplary 3-dimensional printed models for various structural heart interventions from the University Hospital of Split.



Aligned with existing literature, 3D printing optimizes workflow, improves procedural efficiency, and enhances communication within multidisciplinary teams by offering tangible, detailed visualizations of cardiac anatomy^{2,3}.

Conclusions: The integration of 3D printing with the planning of structural heart interventions at the University Hospital of Split has multiple favourable effects, overall improving the procedural efficiency. Given its well-documented benefits in experienced centres worldwide, broader adoption of this methodology is warranted.

LITERATURE

1. Telmesani A, Chang SM, Faza N, Little SH, Shah DJ. Role of Multimodality Imaging in Transcatheter Structural Interventions. *Methodist DeBakey Cardiovasc J.* 2023 May 16;19(3):91-104. <https://doi.org/10.14797/mdcvj.1209>
2. Harb SC, Rodriguez LL, Vukicevic M, Kapadia SR, Little SH. Three-Dimensional Printing Applications in Percutaneous Structural Heart Interventions. *Circ Cardiovasc Imaging.* 2019 Oct;12(10):e009014. <https://doi.org/10.1161/CIRCIMAGING.119.009014>
3. Fan Y, Wong RHL, Lee AP. Three-dimensional printing in structural heart disease and intervention. *Ann Transl Med.* 2019 Oct;7(20):579. <https://doi.org/10.21037/atm.2019.09.73>