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Coronary access techniques following ACURATE neo2 implantation in surgical bioprosthesis

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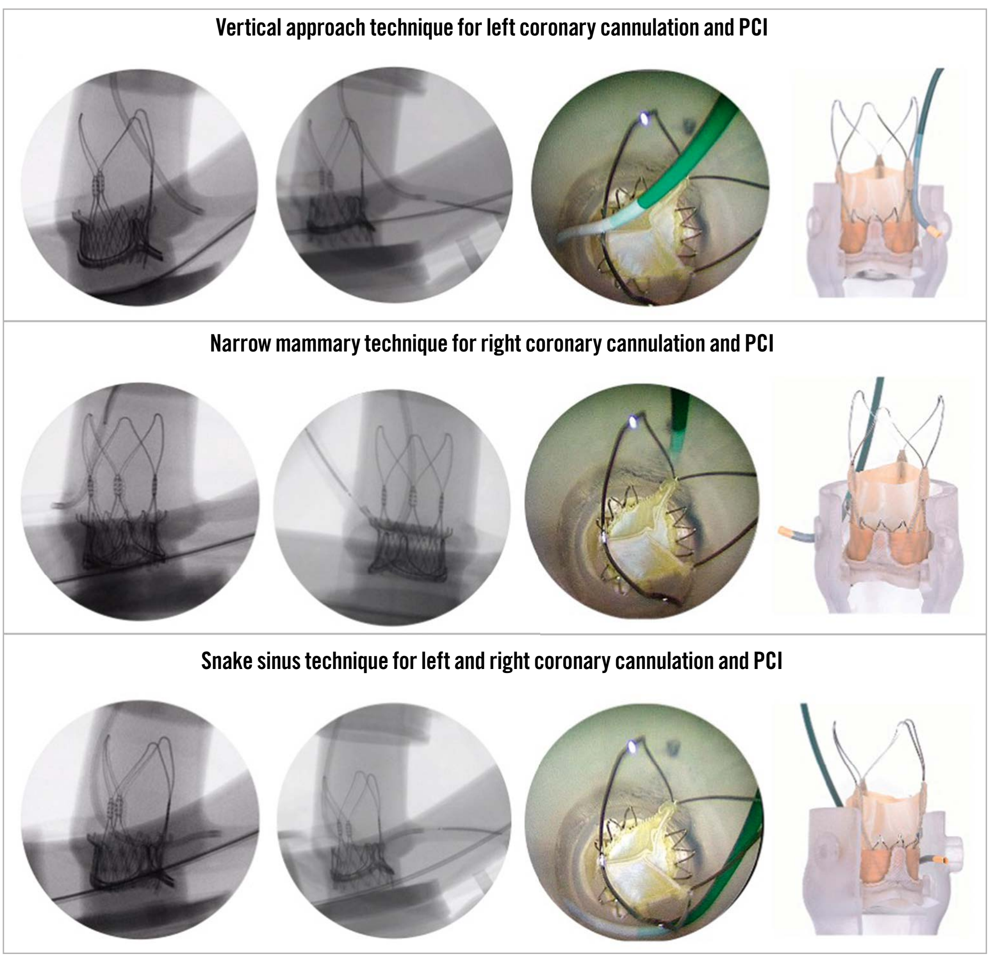

Figure 1. *Novel coronary access techniques to bypass the ACURATE neo2 valve frame following ViV-TAVI. The vertical approach, narrow mammary and snake sinus techniques are presented with (from left to right): fluoroscopic images of diagnostic cannulation, percutaneous coronary intervention, internally mounted borescope view and ex vivo modelling. PCI: percutaneous coronary intervention; ViV-TAVI: valve-in-valve transcatheter aortic valve implantation*

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Coronary access after transcatheter aortic valve implantation (TAVI) procedures can be challenging due to anatomical, procedural or valve-related factors[1,2]. This challenge is further augmented during valve-in-valve (ViV) procedures due to the additional presence of transcatheter or surgical valve frames and leaflets[3]. Dedicated valve-specific cannulation techniques are required for operators to achieve coronary access, particularly in challenging scenarios[2,4]. To date, specific coronary cannulation techniques have only been described for the CoreValve/Evolut (Medtronic) and SAPIEN (Edwards Lifesciences) valve platforms following native aortic valve TAVI[2,4].

Therefore, we performed *ex vivo* simulations of coronary access in a computed tomography-derived patient-specific pulsatile flow ViV-TAVI model consisting of an ACURATE *neo2* (Boston Scientific) valve implanted inside a Carpentier-Edwards Perimount 25 mm surgical bioprosthesis (Edwards Lifesciences).

A challenging cannulation was simulated by selecting a patient with low coronary heights and narrow aortic sinus dimensions. An ACURATE *neo2* valve was positioned at a high implantation depth and with severe commissural misalignment between the transcatheter and surgical valve posts **(Supplementary Figure 1)**. Expert operators attempted to cannulate the left and right coronary arteries under fluoroscopic guidance using a wide range of differently sized and shaped catheters. The different cannulation approaches were visualised using an internally mounted borescope camera.

We describe three novel cannulation techniques, the vertical approach, narrow mammary and snake sinus, which all allow the obstructive elements of the ACURATE *neo2* valve frame to be bypassed by a catheter **(Figure 1, Supplementary Figure 2, Moving image 1- Moving image 3)**. These techniques are preferable in the setting of severe commissural misalignment and/or if the coronary ostia arise below the level of the upper crown adjacent to the pericardially covered stent frame. The vertical approach and internal mammary techniques are used for left and right coronary cannulation respectively, whilst the snake sinus technique can be used for cannulation of either ostium.

The reported techniques were reproduced by different operators using both 6 Fr diagnostic and guiding catheters. Adequate guiding catheter support was assessed for by simulating a percutaneous coronary intervention procedure. Delivery of an intracoronary wire, 3.0 non-compliant balloon and a 4.0×24 mm drug-eluting stent was feasible with all three techniques.

These techniques were specific to the ACURATE *neo2* valve because of its unique split-level design with a short lower-stent frame and large open upper stabilisation arches. These techniques could not be replicated with the Evolut valve, due to the larger outflow portion of the valve, which leaves less room for a catheter to bypass the valve frame. All cannulations were performed from the femoral access route. Whilst the left radial access route may achieve similar results, we cannot comment on the feasibility of these cannulation techniques using the right radial approach, particularly in the presence of tortuous brachiocephalic anatomy. The safety and efficacy of these novel cannulation techniques has to be determined in different anatomical settings before further *in vivo* validation.

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Conflict of interest statement
D. Dudek is on the advisory board for Boston Scientific. The other authors have no conflicts of interest to declare.

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Supplementary data
Supplementary Figure 1. Challenging configuration of ACURATE *neo2* implantation inside Carpentier-Edwards surgical aortic bioprosthesis.

Supplementary Figure 2. Three-dimensional digital reconstructions of the proposed novel techniques demonstrating how the catheters bypass the obstructive elements of the ACURATE *neo2* valve frame (Boston Scientific).

Moving image 1. *Ex vivo* simulation of the vertical approach cannulation technique.

Moving image 2. *Ex vivo* simulation of the snake sinus cannulation technique.

Moving image 3. *Ex vivo* simulation of the narrow mammary cannulation technique.

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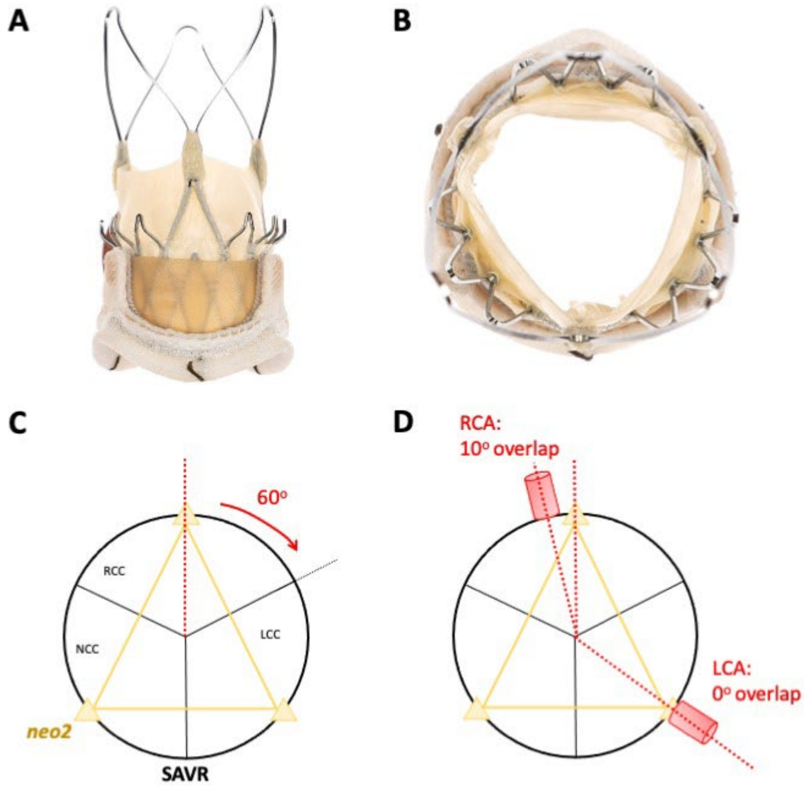
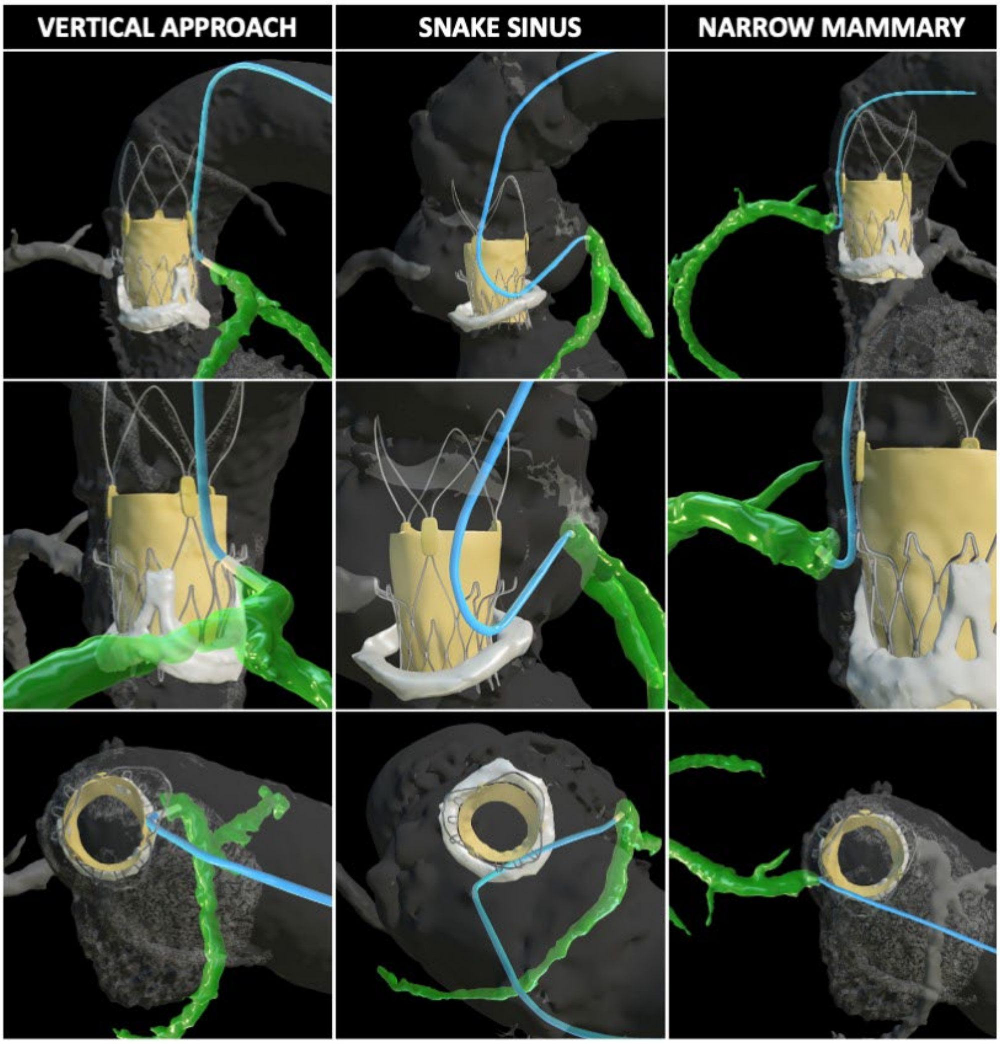
Supplementary data



Supplementary Figure 1. Challenging configuration of ACURATE *neo2* implantation inside Carpentier-Edwards surgical aortic bioprosthesis. (A-B) An ACURATE *neo*2 transcatheter valve was implanted high in a Carpentier-Edwards 25 mm prosthesis resulting in (C) severe commissural misalignment between both the valves and (D) severe overlap between the ACURATE *neo*2 commissural posts and both coronary ostia. LCA: left coronary artery; RCA: right coronary artery; SAVR: surgical aortic valve replacement



Supplementary Figure 2. Three-dimensional digital reconstructions of the proposed novel techniques demonstrating how the catheters bypass the obstructive elements of the ACURATE n*eo*2 valve frame.

In the vertical approach a Judkins left catheter is directed along the inner curve of the aorta to approach the gap between the valve frame and aortic wall from above. The short distal tip of the catheter is used to enter this gap and the catheter advanced to achieve selective cannulation.

For the narrow mammary approach an internal mammary catheter is used to enter the narrow gap available between valve frame and aortic wall. The short tip and therefore smaller turning radius of the catheter allows the catheter to be rotated within the narrow sinus space to achieve ostial cannulation.

For the snake sinus technique an Amplatz left catheter is guided between the open stabilising arches to enter the sinus space adjacent to the target ostium. The 0.035” guidewire is then used to direct the catheter around the outside of the valve frame towards the left or right coronary sinus. The target ostium is then approached laterally.