

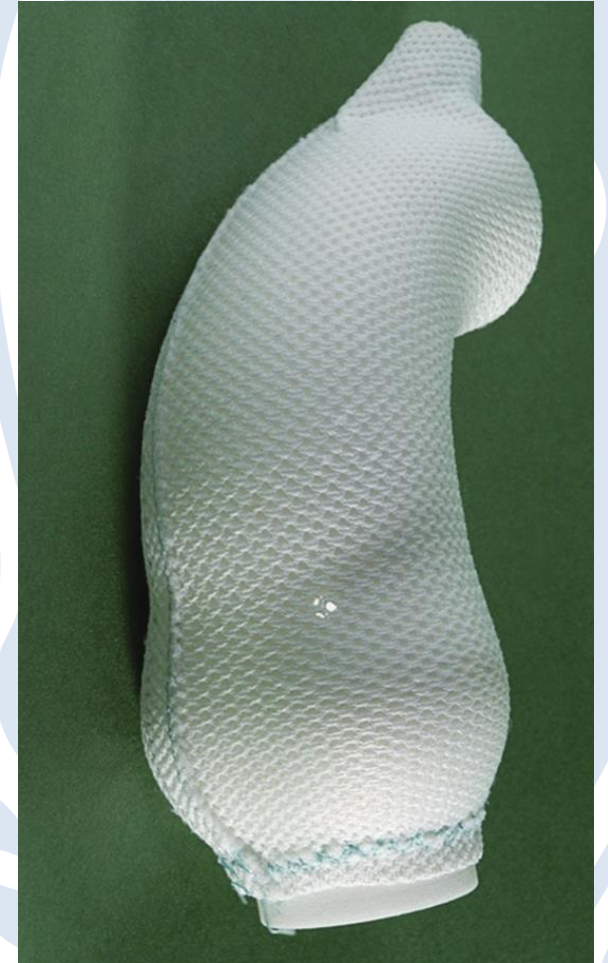
Can 3D Printed Models of Coronary Anatomy Reduce the Risk of Major Complications During Personalised External Aortic Root Support (PEARS) Surgery?

A Pilot Study

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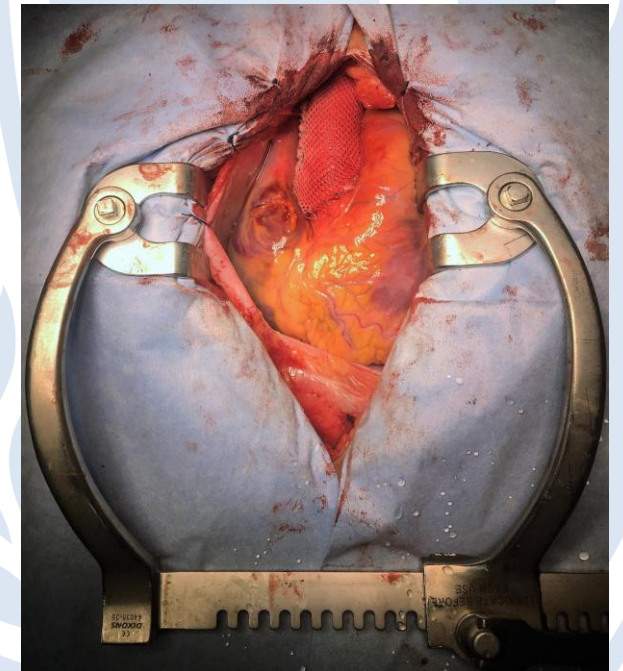
Personalised External Aortic Root Support (PEARS)

- **Contrast enhanced CT aorta of patient**
 - Computer Aided Design (CAD)
 - 3D printed former
 - Poly-Ethylene Teraphthalate woven mesh
 - Bespoke 80% to 100% actual size of aorta
- **Aorta dissected to Annulus**
 - Controlled hypotension
- **Exovasc placed around aortic root**
 - Keyholes cut for coronary ostia
 - Reconstituted with 4/0 Ethibond
 - Seam closed laterally
- **Clink on link below to view a 1 minute operative video**
 - <https://youtu.be/zqKRaj-ETuE>



PEARS for Aortic Root Aneurysm

- **PEARS first performed for aortic root aneurysm 24th May 2004**
 - To date 843 performed worldwide plus 155 Ross-PEARS operations
- **Advantages**
 - shorter operation time
 - usually cardiopulmonary bypass not required
 - retention of the normal aortic valve leaflets and function
 - potentially reduced cumulative re-intervention rate
 - no prosthetic material in contact with the bloodstream
 - almost certainly reduced lifetime risk of endocarditis
- **Disadvantages**
 - Risk of emergency coronary intervention in 5.5%
 - Van Hoof et al. Heart 2021;107:1790



Study Aims and Methods

- **To document the incidence of complications related to coronary artery dissection during PEARS to the aortic root.**
 - Retrospective study carried out on the first 14 patients in our PEARS programme. Major complications and long-term follow-up were recorded.
- **To assess feasibility of using 3D models of aortic root and coronary artery anatomy intraoperatively to guide surgeon during dissection.**
 - Prospective pilot study performed using 3D-printed models of the coronary artery anatomy used to guide dissection in the next 6 consecutive patients.

Study Results

- **Combined total of 20 patients in the two parts of the studies.**
- **Mean age was 37 years (range 17 to 62) and 4 were female.**
 - Marfan syndrome (MS) in 10,
 - Loeys-Dietz in 3,
 - Autosomal dominant connective tissue disorder in 3,
 - Idiopathic in 4.
- **All completed without CPB bar two who had concomitant MVRepair.**
- **All survived surgery and there was 1 late death at 41 months post-op in an alcoholic, cocaine addict with schizophrenia.**
- **No dissection or rupture occurred at median follow-up of 48 months.**

Results: Incidence of complications during PEARS

- Three patients in the retrospective study had perioperative complications.
- Patient 7 with Marfan Syndrome had VF on closure of sternum, after defibrillation, the integrity of the origins of the coronary arteries was confirmed and the chest re-closed without incident.
- Patient 9 with Loeys-Dietz syndrome developed an asymptomatic but enlarging pseudoaneurysm of the right coronary artery detected on routine CT scan which was successfully repaired.
- Patient 6 with Marfan Syndrome undergoing concomitant mitral valve repair had a cardiac arrest on closure of the sternum. This did not respond to defibrillation and following emergency re-institution of CPB, CABG was performed to the circumflex artery and she remains well 52 months later.

Results: Patient 6 PEARS and MV Repair

- Initial concern that circumflex artery might have been injured during mitral annuloplasty suture placement
 - Subsequent angio showed ostial occlusion so likely to be due to PEARS



- Anatomy of LMS later studied using 3D printed model of coronary anatomy

Coronary Anatomy Modelling

- **Virtual CAD model**
 - Helpful for preoperative planning
 - Click on link below
 - [P03028 - 3D model by Axial3D \(@axial3d\) \[67a0caf\] \(sketchfab.com\)](#)
- **3D printed actual size**
 - Helpful for operative dissection



Results: Pilot Study of Coronary Anatomy Modelling

- **In the pilot study, similar 3D models were created for 6 PEARS patients and used to guide operative dissection of coronary ostia.**
- **All operations were completed with no perioperative complications and feedback from surgeon confirmed the utility of the model.**
- **One further PEARS with 3D model guide completed since abstract submission, also uncomplicated.**

Conclusions

- **PEARS is a safe and effective operation for Aortic Root Aneurysm.**
 - Long term follow-up data is required
- **Potential for coronary artery complications in approx 1 in 7 cases.**
- **This pilot study confirms the feasibility of using 3D models of coronary anatomy as a guide during PEARs surgery which may reduce coronary complication rate and warrants further study.**
- **As some complications such as coronary artery pseudoaneurysm may be asymptomatic, we recommend routine CT angiograms be performed with 48 hours of PEARs.**