3D Specific Hologram Virtual Reality Evaluation in Cardiovascular Surgery

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Background:

- Anatomical evaluation under physiologic status would be quite important to achieve various kinds of cardiac surgical procedures especially in the aortic root surgery and possibly in any structural heart diseases and aortic diseases by endovascular or catheter approach.
- We introduced novel workstations which create 3D Hologram Virtual Reality (3D-VR) Images in the field of cardiovascular surgery. We present 3D-VR evaluation in the aortic root surgery including valve sparing aortic root surgery (VSARS) and aortic valve leaflet reconstruction (AVLRS).

Method:

- Enrolled patients for the aortic root surgery underwent enhanced ECG-triggered cardiac CT. Axial images using a 264-row CT with slice thickness of 0.625mm were obtained during mid-to-end. Patients for the aortic disease also underwent enhanced thoracic, abdominal, and pelvic CT.
- Axial images using a 264-row CT with slice thickness of 0.625mm were obtained early and late phase of enhanced images. Digital imaging and communications in medicine or DICOM data of these CT images were installed a novel workstation, EchoPixel Ture3D.

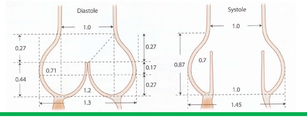
3D Holographic VR Evaluation : True3D / EchoPixel



Operators can control images in 3D space, zooming, pulling any parts of organs out, rotating, measuring and so on.

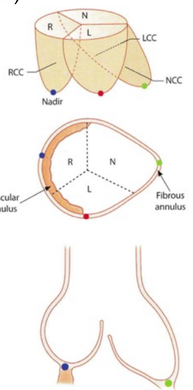
Our aortic valve leaflet reconstruction (AVLR) using same-sized three leaflet **A**ortic **T**ri-**L**eaflet **A**natomical reconstruction **S**urgery (**ATLAS**)

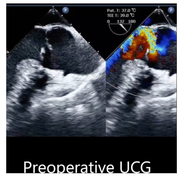
- ✓Three same-sized autologous pericardial leaflets
- ✓Leaflet shape and size were designed from the physiologic anatomical data
- ✓Leaflet size is determined from STJ diameter
- ✓Anatomical reconstruction with excellent hemodynamics without any fluttering of leaflets



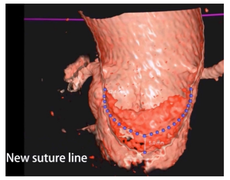
Pitfall of this procedure!

Some cases of severe AR had characteristic aortic root that non-coronary nadir is shifted to LV, in whom we have to plicate Valsalva sinus in order to create balanced new aortic valves.



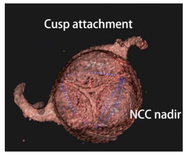


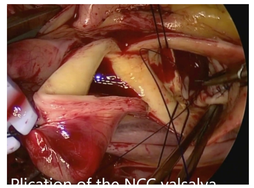
Preop UCG: Type 1 BAV
Severe ASR

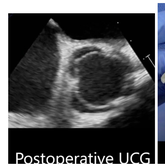


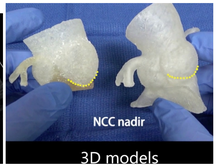
Design for additional procedure by 3D-VR imaging

Adjustment of the aortic annulus

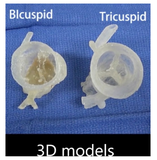






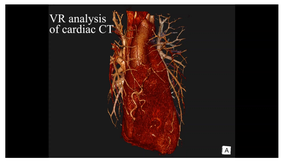




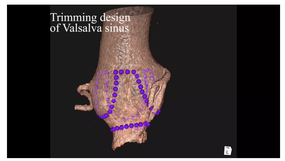


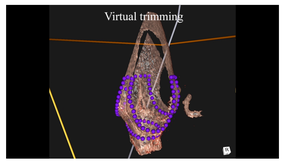
- ✓ 3D-VR analysis revealed the precise configuration of the aortic root in 3D spacidic view
- ✓ The measurements in the VR image simulated the actual surgical procedure.
- ✓ The measurements in the VR image were evaluated to be as reliable as the actual measurements.
- ✓ The graft sizes and respective commissure heights selected from the VR image measurements were satisfactory for actual surgery.

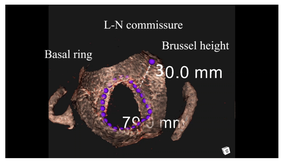
Valve Sparing Aortic Root Surgery : Standard Case

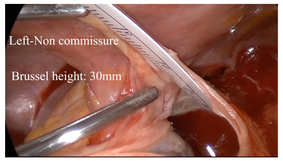


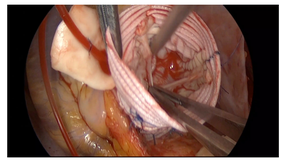


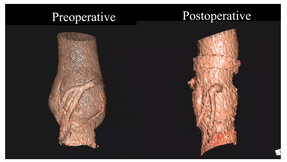




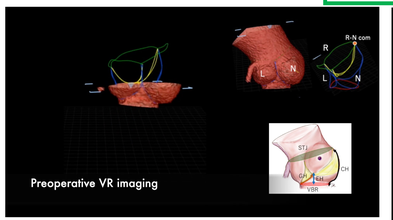


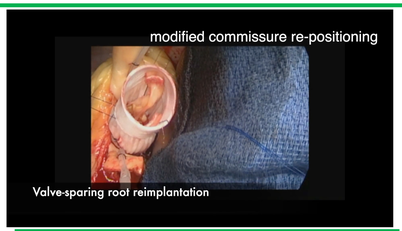


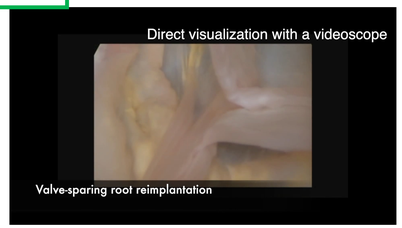


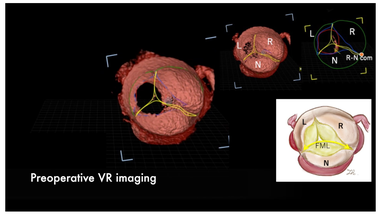


Preoperative evaluation of a distorted aortic root case

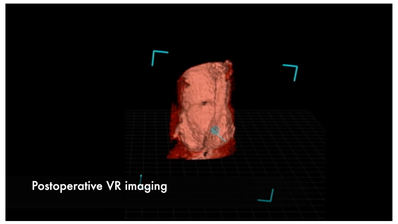








- ✓ Confirmation that the commissure position is maintained at 120 degrees.
- ✓ Estimation of the proper position of re-positioning where sufficient cusp coaptation is obtained from the measured value of Non-Left commissure height.
- ✓ Graft size and re-positioning position are determined in the actual surgery based on the preoperative evaluation.



Conclusion 3D-VR image analysis had notably provided valuable information for understanding of precise anatomy under physiological condition in the field of cardiovascular surgery. Further growth would be promising.