1

Aortic Root Enlargement: A new surgical technique to avoid PPM

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Current Topics

The Problem of Valve Prosthesis-Patient Mismatch

SHAHBUDIN H. RAHIMTOOLA, M.D.

broadened.[37] Mismatch can be considered to be present when the effective prosthetic valve area, after insertion into the patient, is less than that of a normal human valve. The reduced prosthetic valve area is

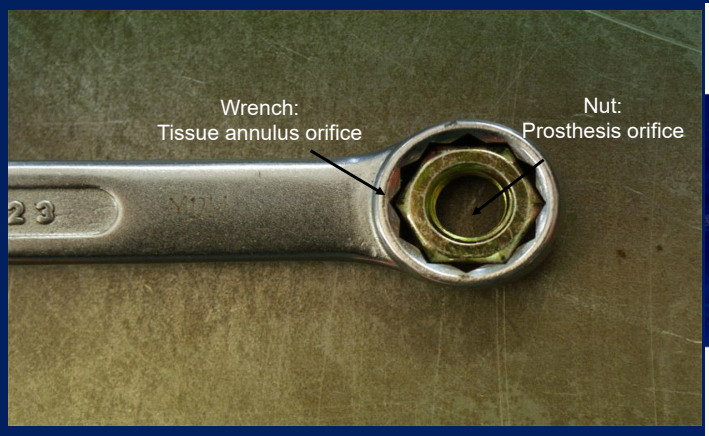
of the pig aortic valve. All prostheses (mechanical and bioprostheses) have an in vitro effective orifice area that is smaller than that of the normal human valve.

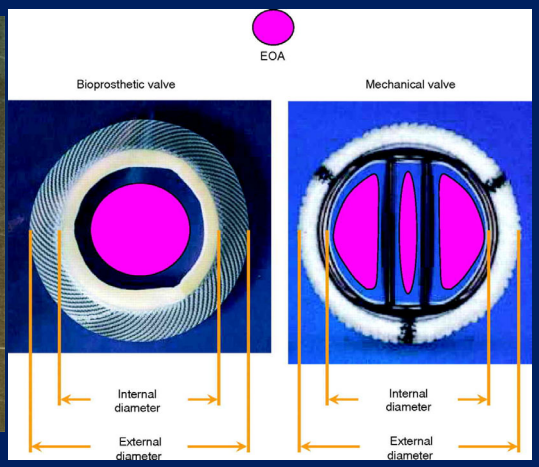
Circulation, 1978

3

Bill Northrup

Do Prostheses Compromise the Annulus Area?





SAVR and TAVR devices have sutures and/or hardware supporting leaflets that take up space ***inside*** and/or ***above*** the annulus

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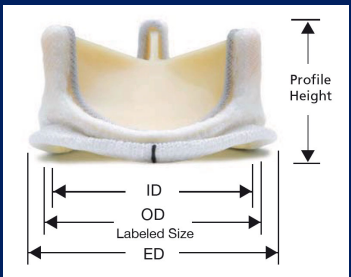
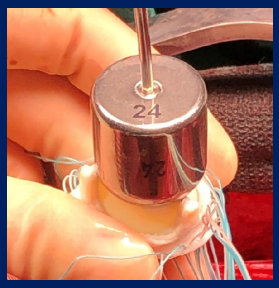
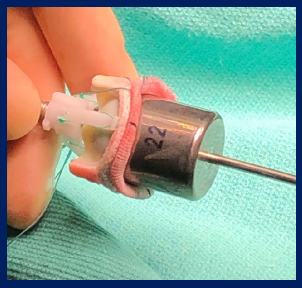
The true size of the prosthetic valves







Size (mm)	19	21	23	25	27	29
A. Tissue Annulus Diameter (Stent Diameter, mm)	19	21	23	25	27	29
B. Internal Diameter (Stent ID, mm)	18	20	22	24	26	28

Size 25

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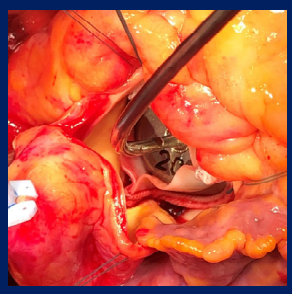
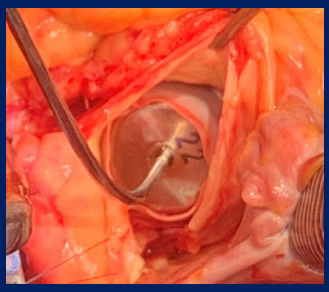
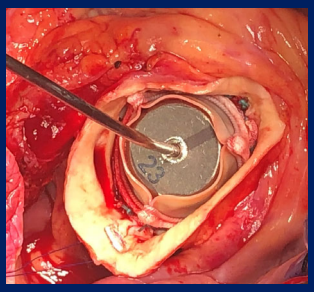
The inner diameter of the prosthetic valve is ~5 mm smaller than the label



25 Valve – 20 mm



27 Valve – 22 mm



29 Valve – 23 mm

23 Valve – 16mm

21 Valve – 14mm

19 Valve – 14mm

6

Most common SAVR valve used: size 21-23

- **PARTNER 1, 2, 3,**
- **Pivotal trial, Evolut low risk trial**
- **SURTAVI trial**
- **NOTION trial**
- **Large series of AVR in STS database**

Rate of Aortic Annular Enlargement : 1-4%

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How to prevent PPM?

8

Annular enlargement at the time of SAVR will alleviate the bottleneck effect of the prosthetic and allow for better hemodynamics and avoidance of PPM

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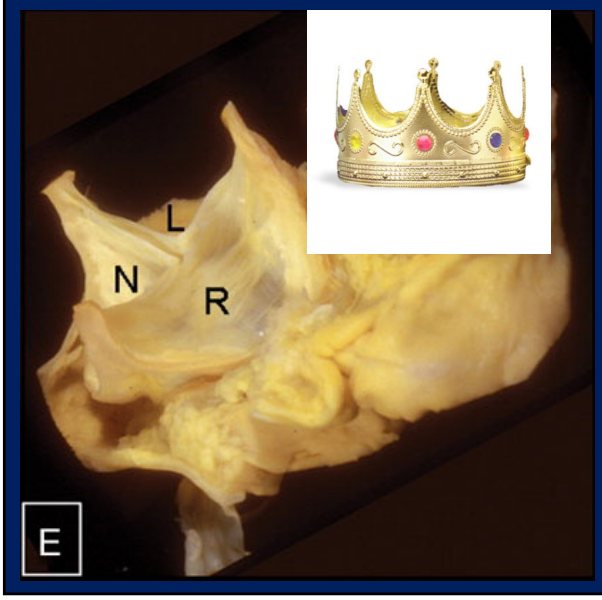

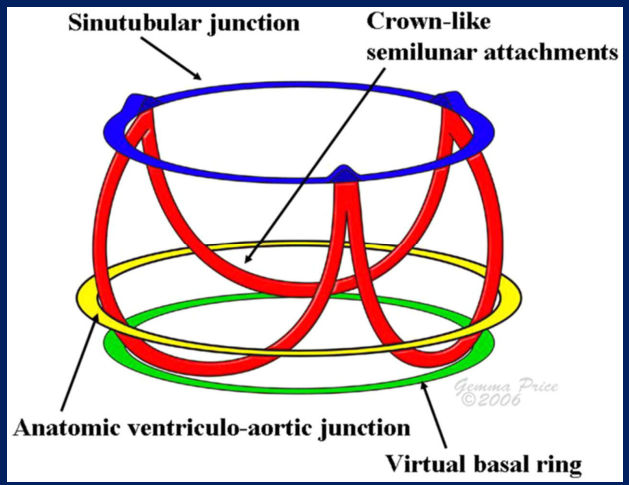

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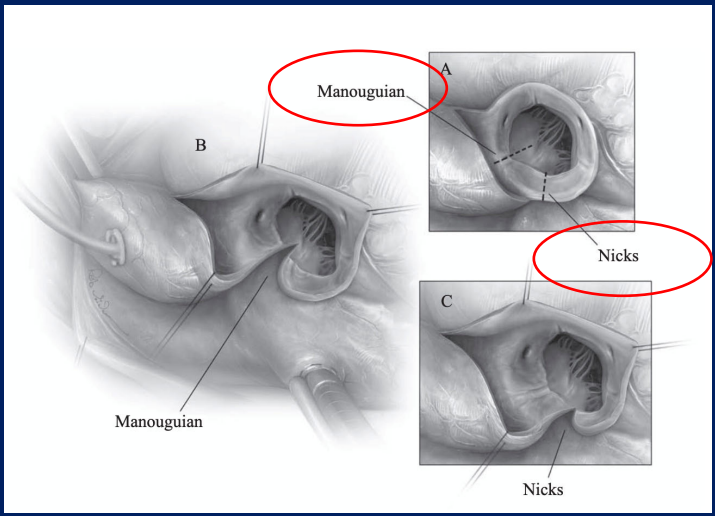
Established Root Enlargement Techniques:



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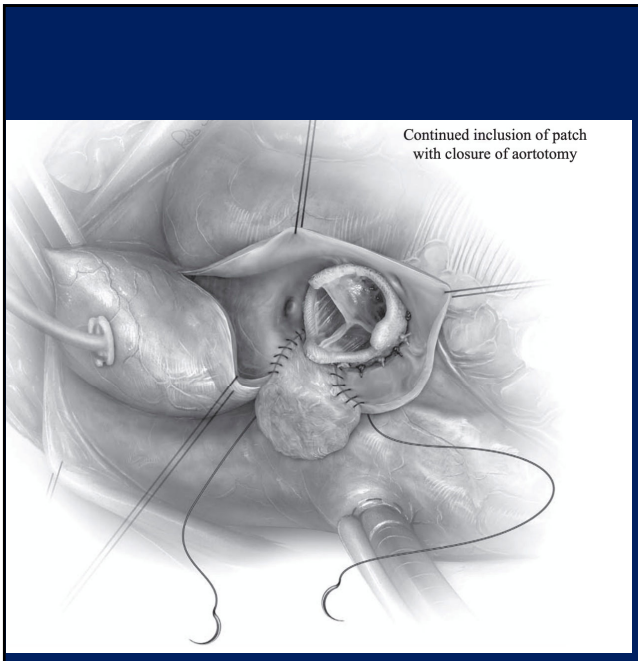

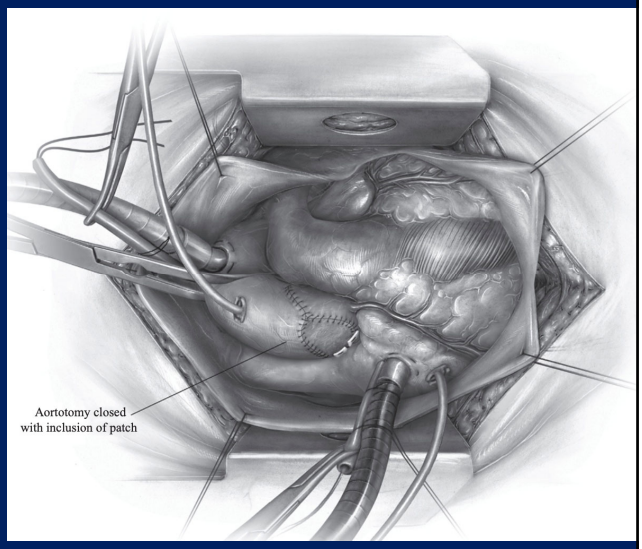

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Nick's and Manouguian only allows for upsizing by 1 or 2 valve sizes

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Novel "Y" incision root enlargement technique

can reliably upsize by 3-5 valve sizes
29 Valve (ID =23 mm) vs. 23 Valve (ID=16 mm)

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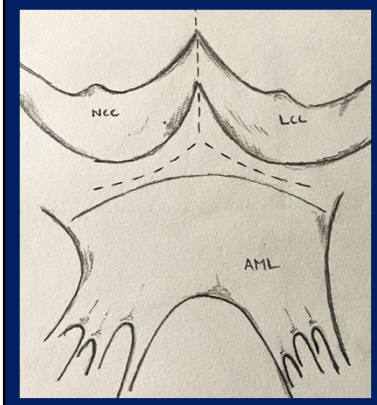
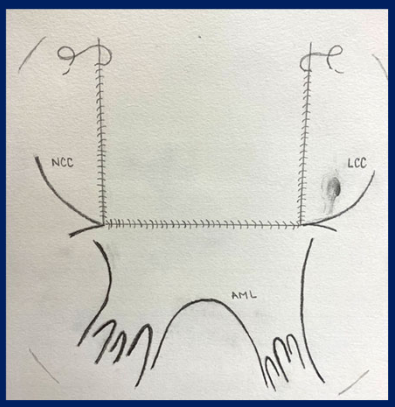
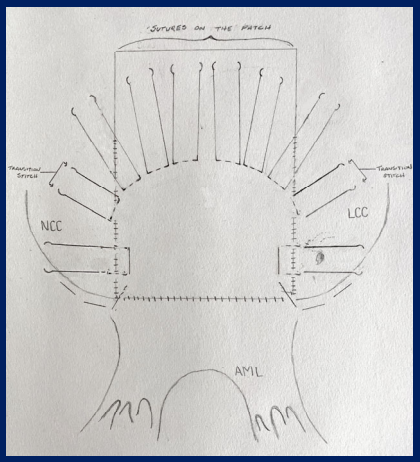
A "Y" Incision/Rectangular Patch to Enlarge the Aortic Annulus 3-5 Valve Sizes







Yang B, JTCVS Tech, 2021; Yang B, Ann Thora Surg, 2021; Yang B CTSNet 2021; Yang B, JTCVS Tech 2022

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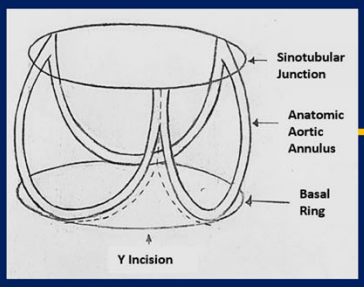
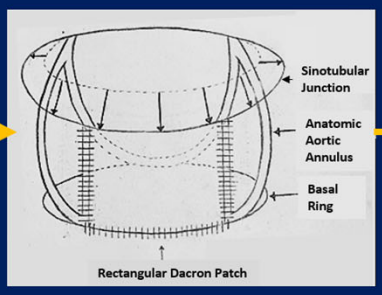
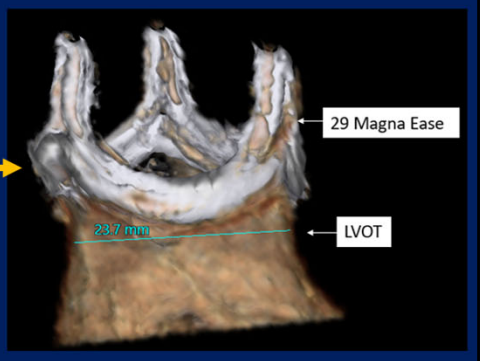
A "Y" Incision/Rectangular Patch to Enlarge the Aortic Annulus 3-5 Valve Sizes







Yang B, JTCVS Tech, in press 2022

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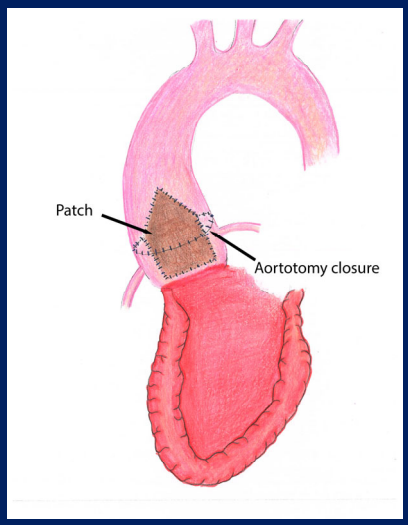

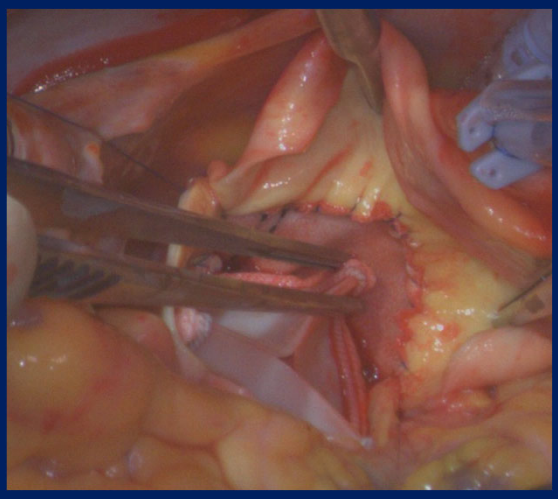

Complete Aortotomy with Roof Technique

Yang, Ann Thora Surg, 2022

Yang, JTCVS Tech, Feb. 2022

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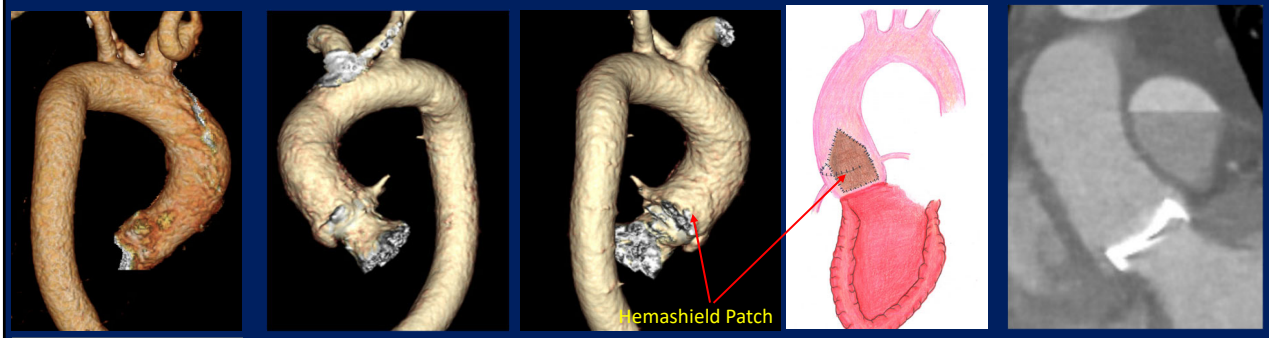
19 mm annulus upsized to Size 27 mechanical valve (female, BMI 53 Kg/m^2)



Pre-operative CTA

Post-operative CTA

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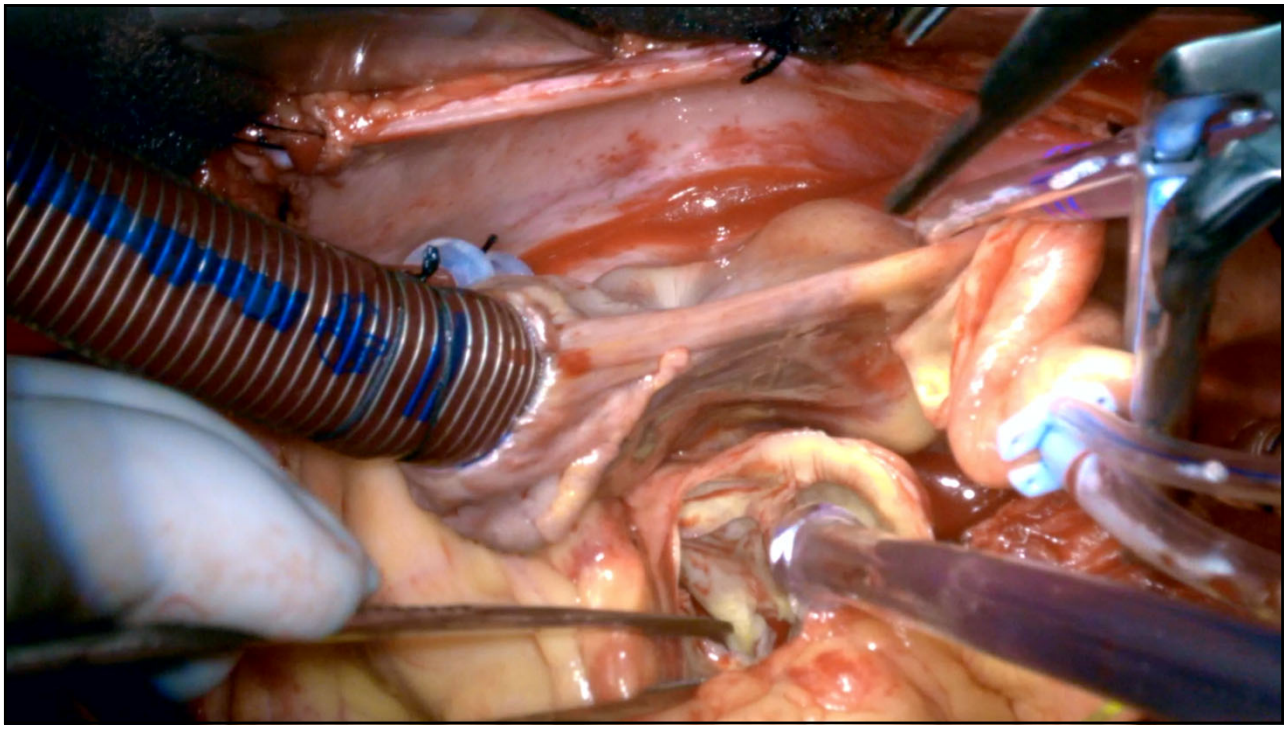
Video presentation

- 70 yo, Female. s/p mastectomy and radiation
- Symptomatic severe AI
- Basal ring 21 mm
- Y-incision AAE, AVR 27 Avalus
- Post op TEE:
  - AV Gradient: 11/5 mmHg
  - LVOT Gradient: 3/1.5 mmHg

19



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Early outcomes of the Y-incision technique to enlarge the aortic annulus 3 to 4 valve sizes

Bo Yang, MD, PhD, Corina Ghita, BS, Alexander Makkinejad, BS, China Green, BS, and Xiaoting Wu, PhD

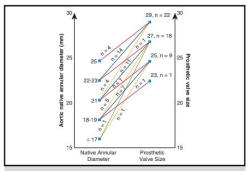
ABSTRACT

Objective: To evaluate the safety and efficacy of a novel aortic annular enlargement technique.

Methods: From August 2020 to February 2022, 50 consecutive cases of aortic valve replacement with Y-incision aortic annular enlargement and other combined cardiac procedures were performed primarily for severe aortic stenosis. Data were obtained through medical record review, The Society of Thoracic Surgeons database, and National Death Index data.

Results: The median age was 65 (59, 71) years, 70% of patients were female, and 26% had previous cardiac surgery. Sixty-six percent patients had isolated aortic valve replacement. The preoperative mean gradient was 40 (30, 47) mm Hg, and the native aortic annular size was 21 (19, 23) mm. After aortic annular enlargement, the median prosthesis size was 27 (27, 29) with 54% of patients having a size 29 or the largest sized valve. The median increment of annulus enlargement was 3 (3, 4) valve sizes. 88% of patients received no blood transfusion. There were no major postoperative complications, including operative mortality, renal failure requiring permanent dialysis, mediastinitis, or reoperation for bleeding, except for 1 stroke. Three-month postoperative computed tomography aortogram showed the aortic root was enlarged from 27 (24, 30) to 40 (36, 41) mm without aortic pseudoaneurysm. The postoperative mean gradient was 7 (5, 8) mm Hg and valve area was 1.9 (1.7, 2.3) cm^2 at 3 to 12 months. Mitral and tricuspid valve functions were significantly improved. Survival was 100% at 18 months.

Conclusions: Y-incision aortic annular enlargement was safe and effective for upsizing the aortic annulus by 3 to 4 valve sizes. (J Thorac Cardiovasc Surg 2022;■:1-10)



Native aortic annulus diameter versus prosthesis size after Y-incision annular enlargement.

CENTRAL MESSAGE

Y-incision aortic annular enlargement is safe, effective, and can be used routinely in aortic valve replacement to implant a large prosthetic valve with an inner diameter matching the native annulus.

PERSPECTIVE

Y-incision aortic annular enlargement was found to safely and effectively upsize the aortic annulus by 3 to 4 valve sizes to match the prosthesis inner

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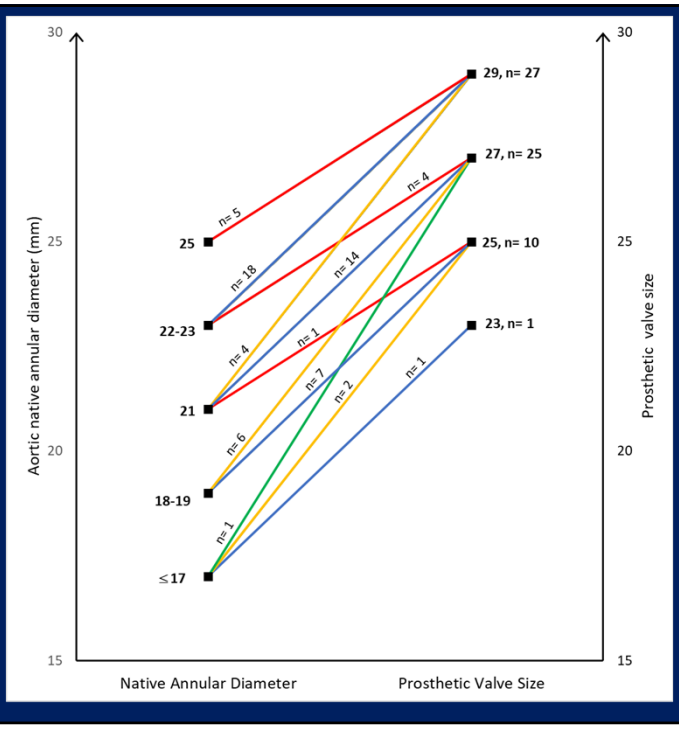

Yang B, JTCVS 2022

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Preoperative and Intraoperative data

Variable	Y Incision Patients (n=64)
Age (years)	63 (58, 70)
Female Sex	44 (69)
BSA (m^2)	2.0 (1.7, 2.2)
BMI (kg/m^2)	29.5 (25.2, 34.3)
Previous Cardiac Surgery	22 (34)
Previous Aortic Valve Surgery	13 (20)
Severe Aortic stenosis	52 (81)
Isolated AVR	40 (63)
Native aortic annulus size (mm)	21 (19, 23)
Annular size enlarged (valve size)	3 (3, 4)
Implanted prosthesis size	27 (27, 29)

Postoperative Outcomes

Reoperation for Bleeding	0 (0)
Stroke exacerbation	1 (2)
Permanent Dialysis	0 (0)
Complete heart block	0 (0)
Pacemaker implantation	0 (0)
Deep Sternal Infection	0 (0)
Hours intubated	3.9 (2.9, 9.0)
Operative mortality	0 (0)

Yang B, JTCVS , 2022

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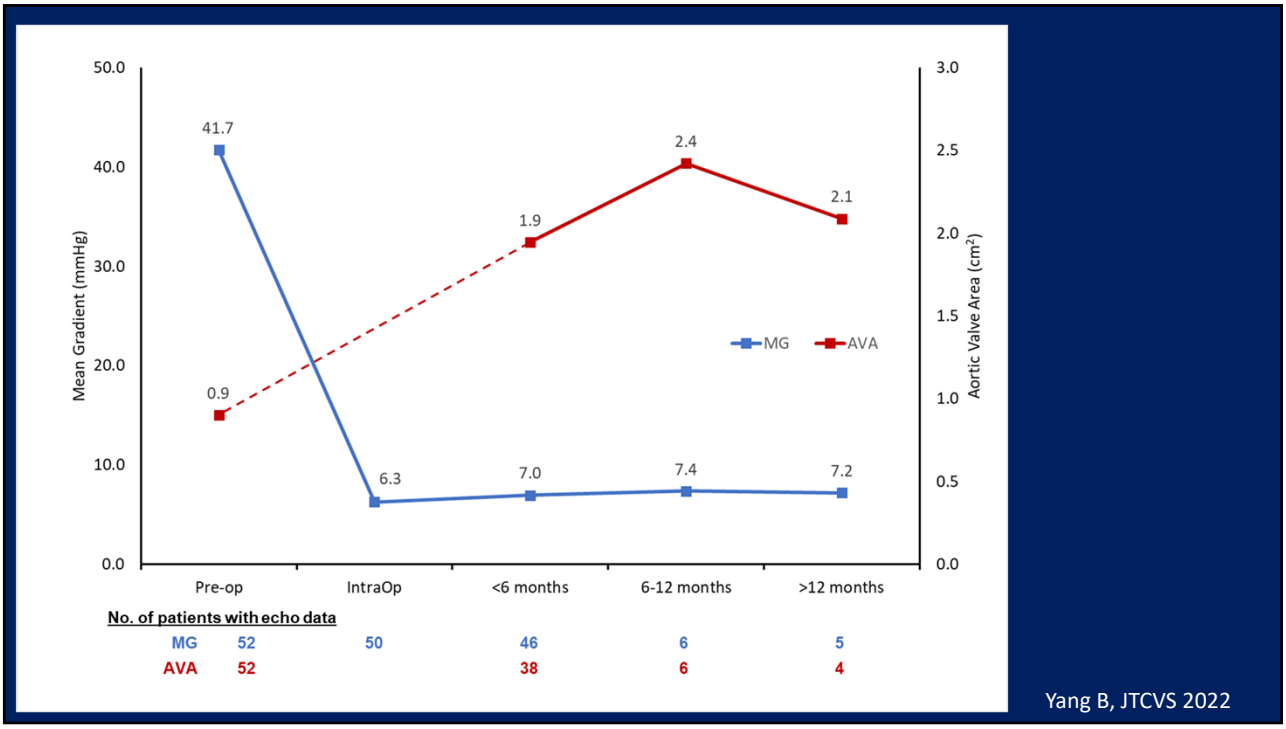

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Implementation of new surgical technique

- Within U of M
- Statewide
- Nationwide

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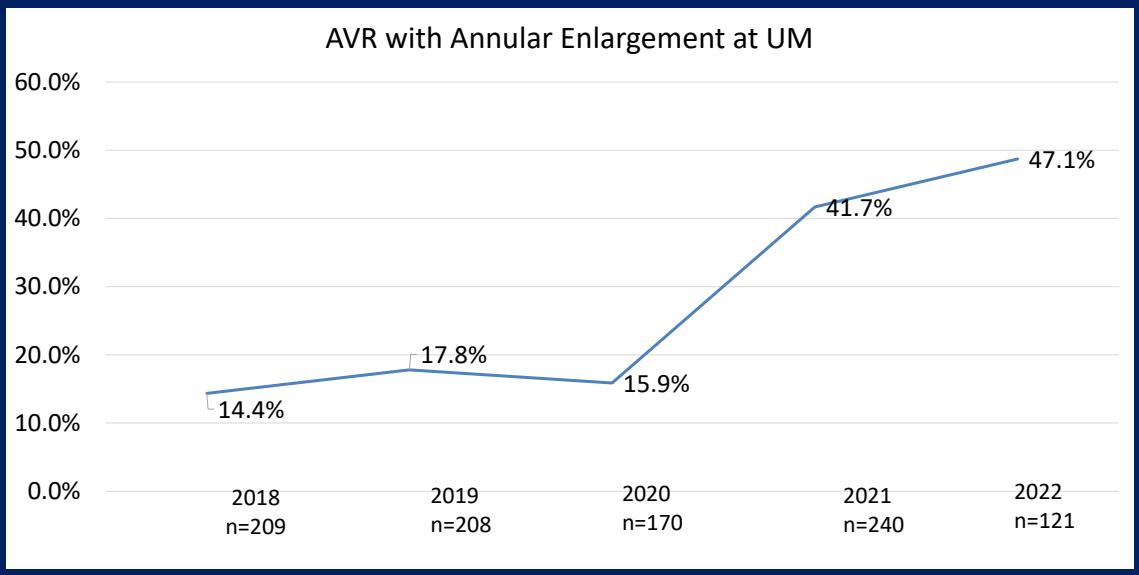
Trend of aortic annular enlargement at U of Michigan



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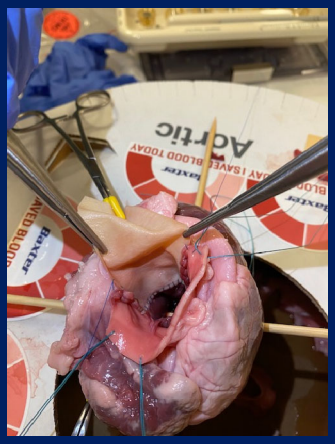
Statewide implementation of new surgical technique



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Hands-on Wet Lab

Saturday, September 11, 2021

Hosted by the Department of Cardiac Surgery, University of Michigan

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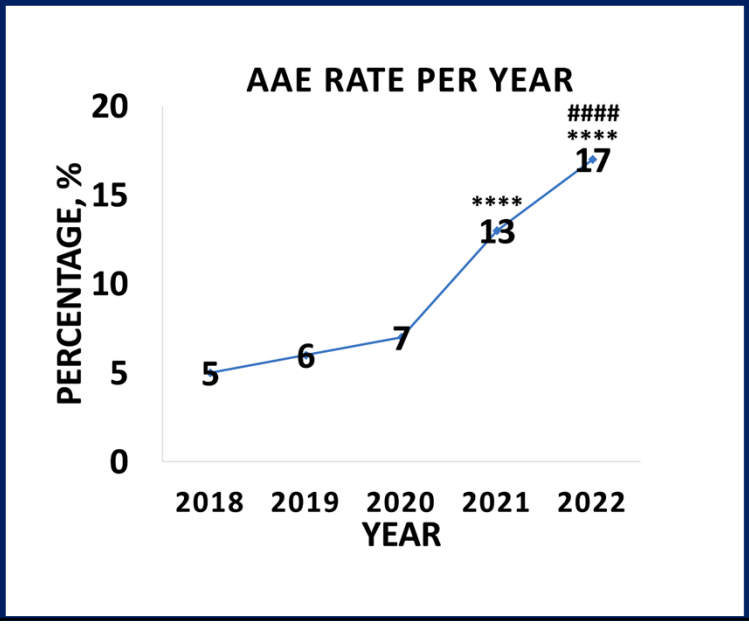
Data of State of Michigan



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Nationwide implementation

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Case 1

- 70M
- BMI 50, BSA 2.6
- Prior 21 Magna Ease 2017 (attempted 23)
- MG intraop 15, up to 32 by 2018

- Redo SAVR with root enlargement → 29mm INSPIRIS

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Case 2

- 66F
- 64kg, BSA 1.5
- L upper lobectomy, PFTs 30%ile
- Prior 19mm Trifecta (2016) – true ID 17mm
- VTC 4mm on the left

- Redo SAVR w/ root enlargement → 23mm INSPIRIS

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Case 3

- 47F h/o IVDU
- 19mm Trifecta (2015) for endocarditis

- Redo SAVR w/ root enlargement → 25mm INSPIRIS

33

Case 4

- 65F h/o BAV, AS
- 21mm Trifecta (2019)
- Presented with severe AI

- Redo SAVR w/ root enlargement → 25mm INSPIRIS

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Conclusion

- Every patient with normal aortic annulus (19-25 mm) should have aortic annular enlargement to place a prosthetic valve with inner diameter matching the diameter of patients' annuli to avoid PPM
- Y-incision/rectangular patch aortic annular enlargement could safely and effectively enlarge the aortic annulus by 3-4 valve sizes to achieve this goal.

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