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# Redo-TAV therapy: Rationale, Feasibility, and Optimization

Miho Fukui, MD, PhD



The slide has a purple-to-blue gradient background. It features the title "Redo-TAV therapy: Rationale, Feasibility, and Optimization" in white, followed by the speaker's name "Miho Fukui, MD, PhD". A diagram of a redo transcatheter aortic valve (TAV) is shown, with a green line indicating the valve's position and red dots at the aortic root. The HOPE logo and the Minneapolis Heart Institute Foundation logo are at the bottom right.

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## What is Redo-TAV, transcatheter aortic valve, (TAV-in-TAV) therapy?



- All TAVR devices are bioprosthetic valves
- All bioprosthetic valves degenerate
- When degenerated, re-intervention is required
- Redo-TAVR: Implant new device in old device

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## Rationale:

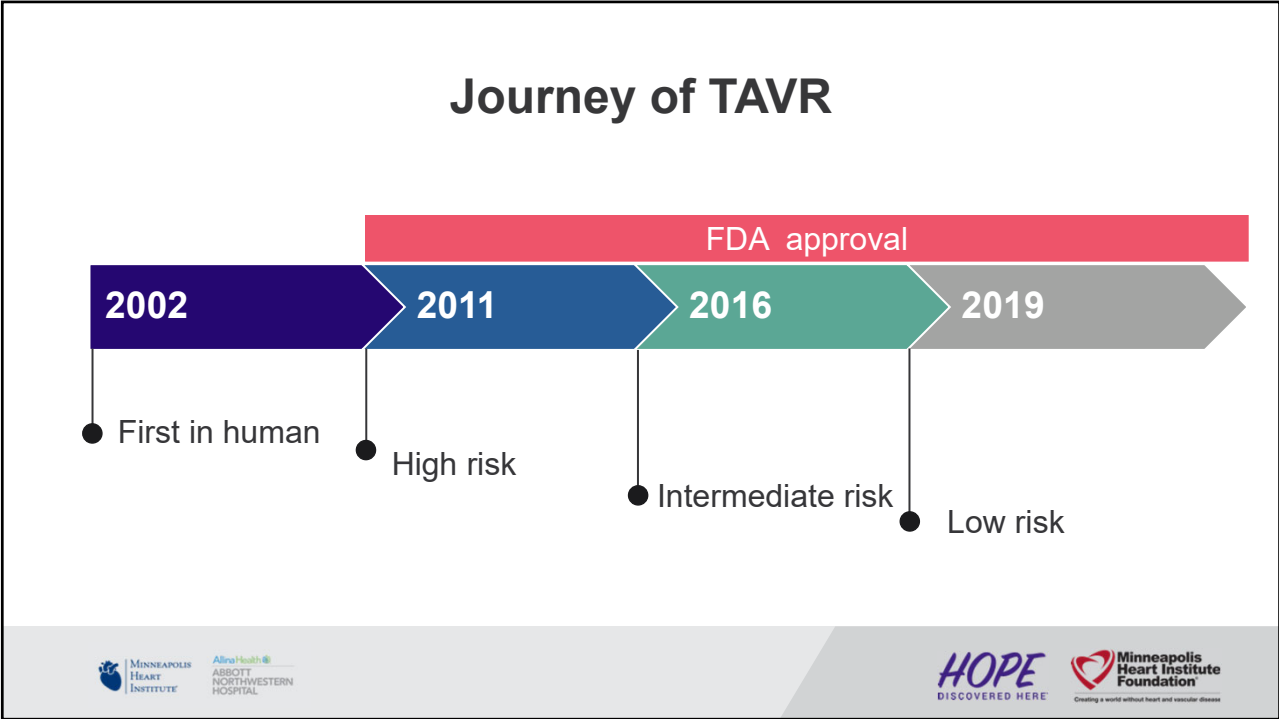
**Why is this topic important to discuss?**

**MINNEAPOLIS  
HEART  
INSTITUTE**  
Alina Health  
ABBOTT  
NORTHWESTERN  
HOSPITAL

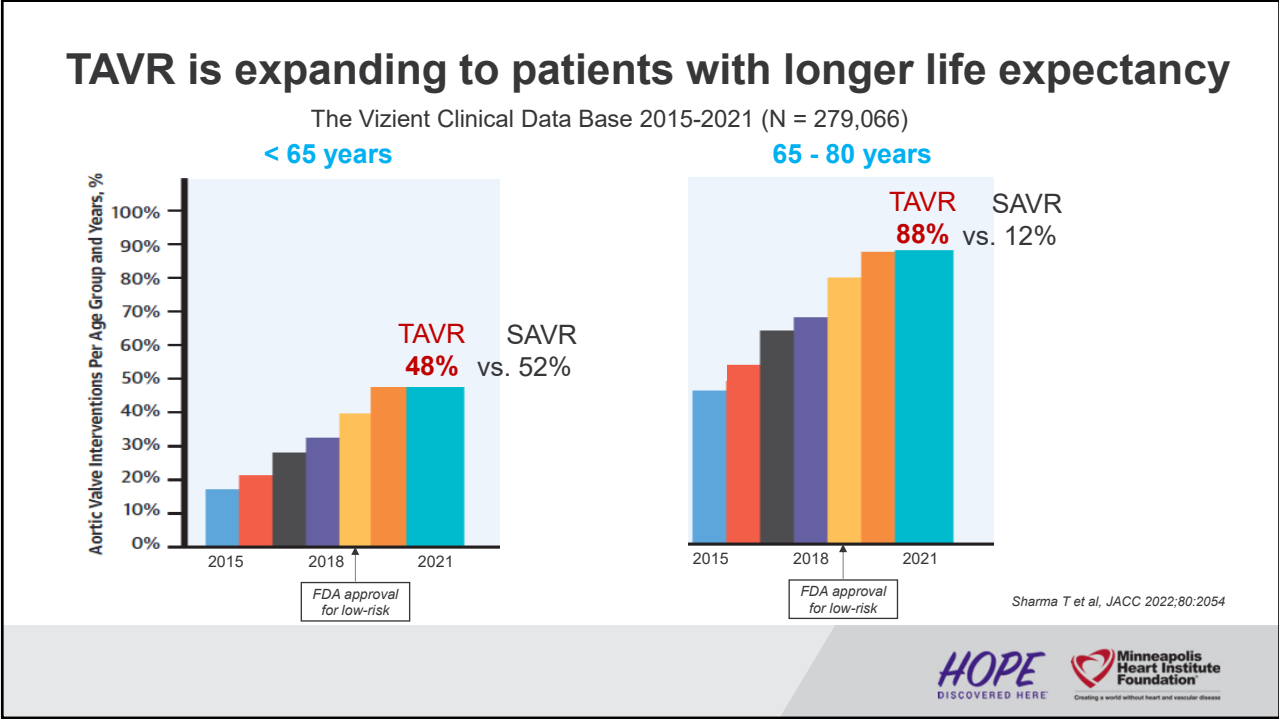
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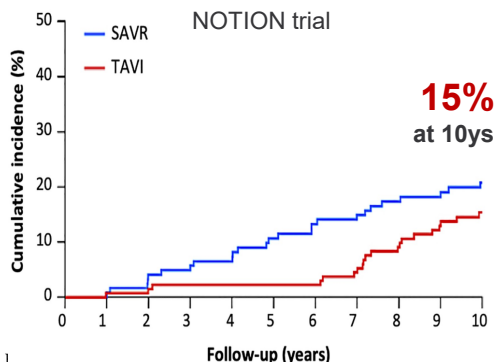
5



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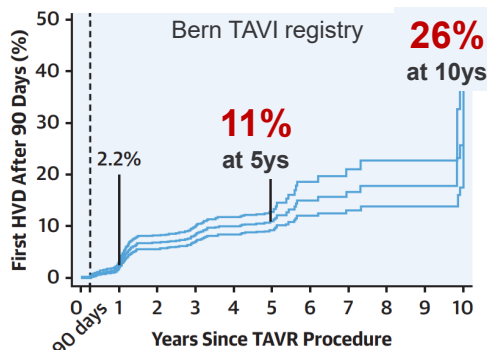
## Bioprosthetic valve degenerates 5-10 years after implantation

### Cumulative incidence of $\geq$ moderate structure valve deterioration



TAVI	134	131	128	117	109	96	82	71	56	44	30
SAVR	123	122	116	107	96	84	69	61	48	41	32

Thyregod et al, EHJ 2024;45:1116



No. at Risk:

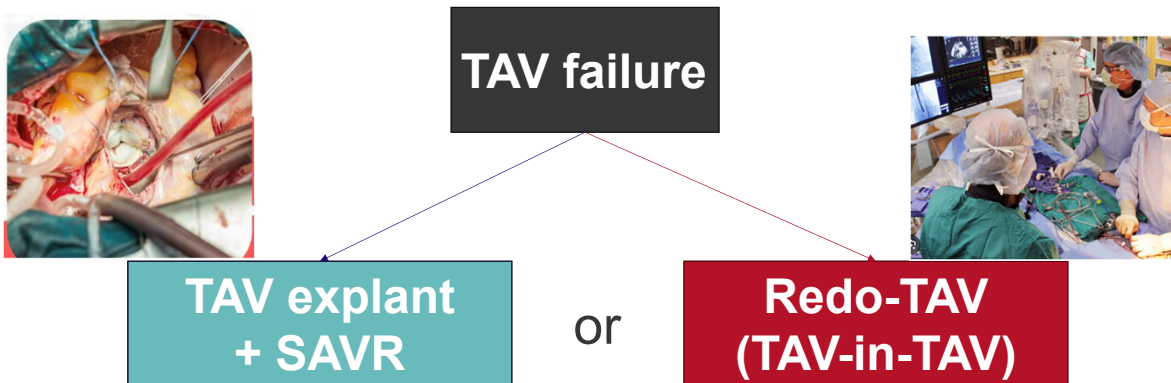
— 2,403 1,829 1,050 895 735 520 129 88 61 41 23

Alaour B et al, JACC CV Interv 2025;18:72



7

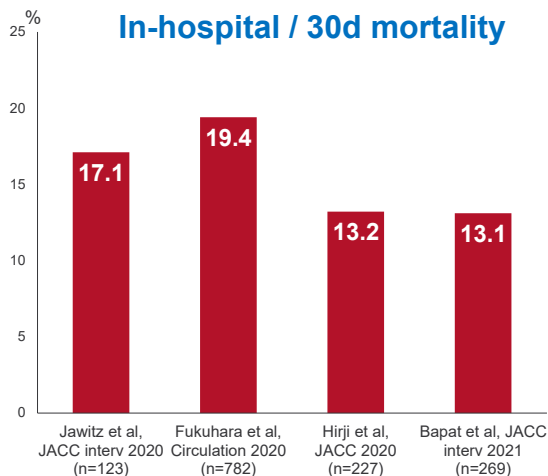
## Surgery or Re-Transcatheter therapy after TAV failure



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## TAV explant + SAVR had higher mortality due to...

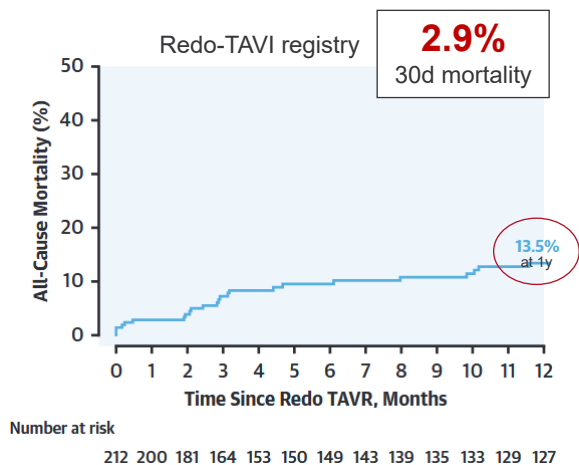


- Higher mortality reflects:
  - Early experience from 2015-2020
  - Urgent indications
  - Endocarditis
  - Higher STS/Euroscore at explant
  -
- No difference between:
  - BEV & SEV
  - AVR & Root replacement

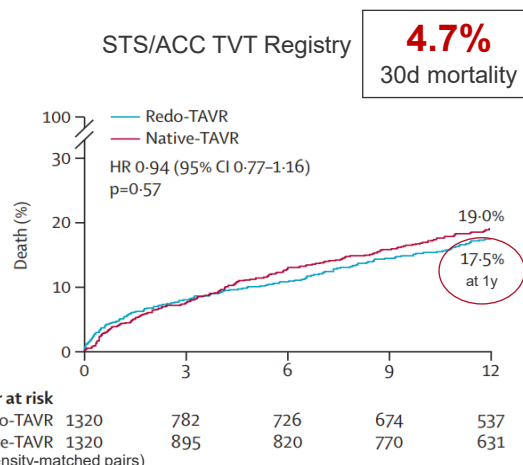


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## Lower mortality with Redo-TAV when Redo-TAV is feasible



Landes et al, JACC 2022;15:1543



Makkar et al, Lancet 2023;402:1529



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## Redo-TAV has lower 30d but similar 1y mortality to TAV explant

Report From Centers for Medicare and Medicaid Services 2012-2017

N=133,250

**TAV explant + SAVR**



**Redo-TAV**



Matched analysis

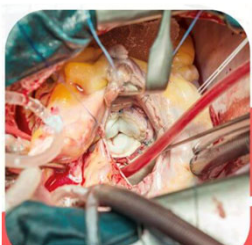
30-day Mortality	<b>12%</b>	vs.	<b>6%</b>
30-day MACE	<b>66%</b>	vs.	<b>40%</b>
1-year Mortality	<b>21%</b>	vs.	<b>21%</b>

Percy et al, JACC Interv 2021;14:1717



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## Which would you choose?



**TAV failure**

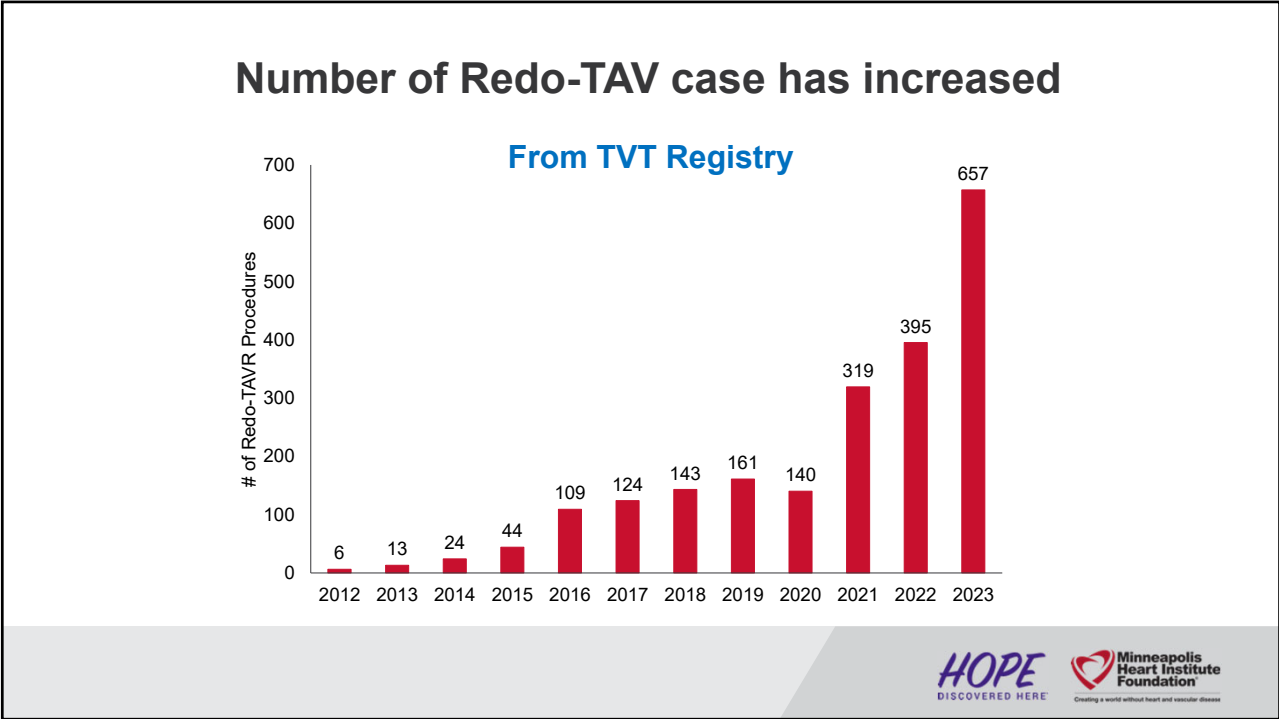
**TAV explant + SAVR**

or

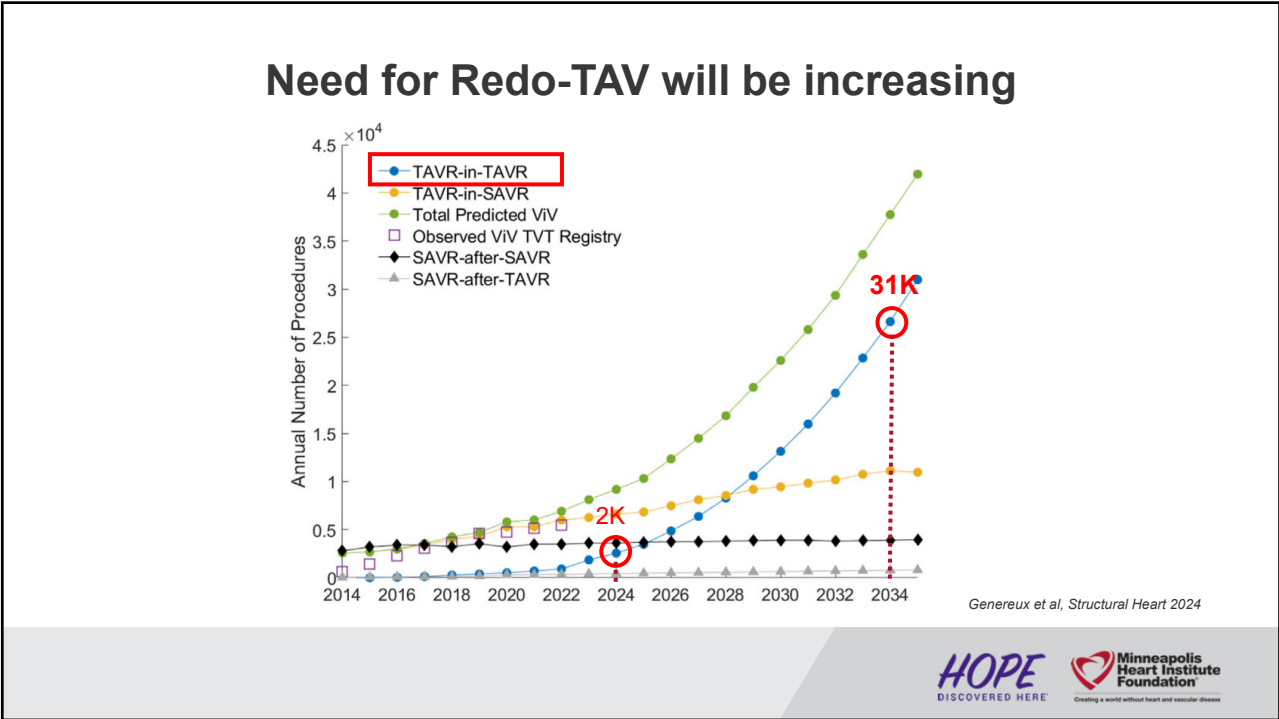
**Redo-TAV (TAV-in-TAV)**



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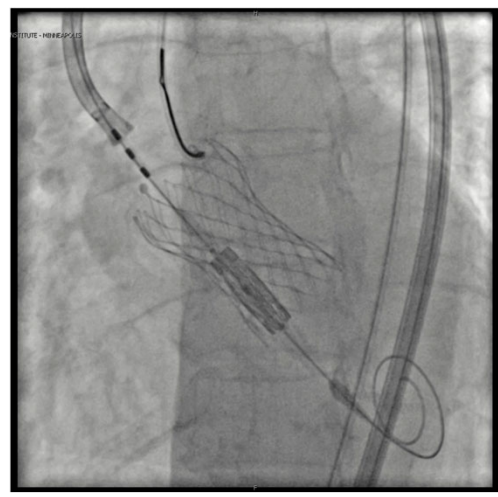
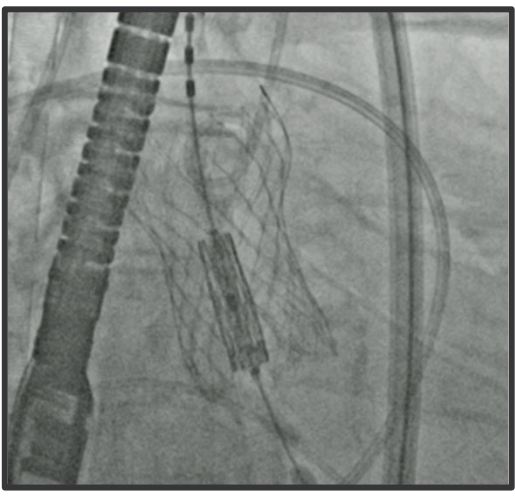
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### BIG WAVE of Redo-TAV is coming



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### Appeared simple! But is it?



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## Similar with TAV-in-SAV?

### TAV-in-SAV

- Valve dimensions maintained
- Valves are implanted at annulus
- Valves have similar heights

Sizing

Implant position

Coronary Risk



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## TAV in TAV is Not as simple as TAV in SAV

### TAV in SAV

- Valve dimensions maintained
- Valves are implanted at annulus
- Valves have similar heights

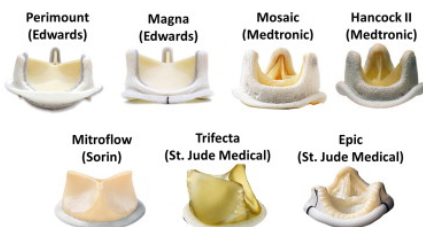
### TAV in TAV

Sizing

Implant position

Coronary Risk

- In-vivo shape and size varies
- Depth of implant varies
- Valves have different structures



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## Need to consider native anatomy, index TAV and second TAV

### 1. CT Evaluation of THV and Root Anatomy

Aortic Root Anatomy	THV #1 Failure Mode
THV #1 Design	THV #1 Characteristics
Stenosis / Regurgitation	
Commissural (Mis)alignment	

### 3. THV #2 Sizing

THV #1	THV #2
BEV	• BEV: Same size • MEV: Size to ID*
BEV/MEV	True size / Oversize to THV #1**
SEV	Oversize to THV #1 by SEV type using CT**
SEV	SEV=THV#1 → Same Size as THV #1
SEV	SEV=THV#1 → Oversize to THV #1

### 4. THV #2 Positioning

Neo-Skirt Height	Increase in Radius of Index Evolut
S3 Outflow at Node 4	S3 Outflow at Node 6
	Evolut in Evolut
	S3 Outflow at Node 5

Tarantini et al, JACC interv 2022

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## Feasibility:

### Can we perform Redo-TAV therapy for our patients safely?

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## Many considerations to take into account...

### Different implant position

THREE DIFFERENT IMPLANT POSITIONS

TECHNICAL IMPLICATIONS OF DIFFERENT SAPIEN 3 IMPLANT POSITIONS IN AN EVOLUT VALVE

NEO-SKIRT HEIGHT

INCREASE IN RADIUS OF INDEX EVOLUT

Lower S3 implantation associated with greater leaflet overhang. Leaflet overhang can vary between 0%-84% with different implant positions. Alkhalaf, M. et al. J Am Coll Cardiol Intv. 2022;15(4):368-377.

### Coronary obstruction

### Coronary access

Coronary obstruction

Coronary access

Valves (5 Designs)

Aligned retro TAVR

Misaligned retro TAVR

Variable skirt height of transcatheter TAVR, some combinations have a neoskirt twice higher than other combinations.

Variable dimension of the lowest accessible cell after retro TAVR.

Cell skirt misalignment can reduce dimension of accessible cell by up to 22% and might result in difficult catheterization.

Meier B, et al. J Am Coll Cardiol Intv. 2022;15(10):1019-1031.

### Sinus sequestration

CENTRAL ILLUSTRATION CT-identified risk of Coronary Obstruction Due to Sinus Sequestration

Sinus Sequestration

Evolut R/Evolut PRO in Evolut R/Evolut PRO

SAPIEN 3 in SAPIEN 3

Evolut R/Evolut PRO in Evolut R/Evolut PRO

SAPIEN 3 in Evolut R/Evolut PRO

Evolut R/Evolut PRO in SAPIEN 3

Evolut R/Evolut PRO in SAPIEN 3

First TAV Commissure Level

First TAV Leaflets

Evolut R/Evolut PRO Commissural Posts

SAPIEN 3 Commissural Posts

TAV Skirt

Second TAV Leaflets

Sinus Sequestration

### Leaflet overhang

Leaflet overhang

### Expansion of TAVs

Expansion of TAVs

Without post-dilatation

With post-dilatation

23 mm S3 in 23 mm SXT

### Pinwheeling

Pinwheeling

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I know the problems,  
rather than discuss them,  
Let's find out solutions!!!

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## Key considerations for Redo-TAV feasibility

- 1) **2<sup>nd</sup> TAV compatibility**
- 2) **Implant Position**
- 3) **2<sup>nd</sup> TAV sizing**
- 4) **Coronary Risk**

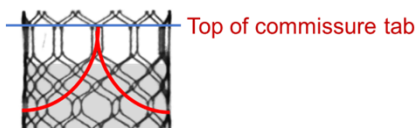
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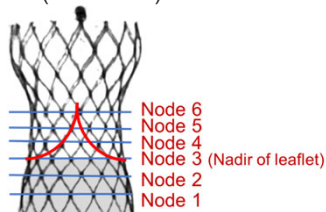
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## Landmarks on TAV devices

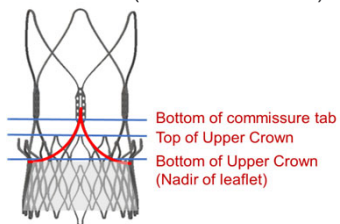
Sapien 3 (Edwards Lifescience)



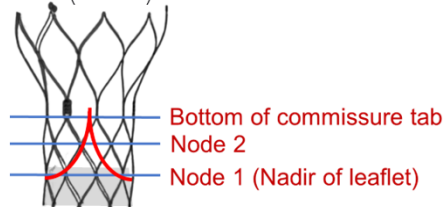
Evolut (Medtronic)



ACURATE neo2 (Boston Scientific)



Navitor (Abbott)



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### 1) TAV compatibility: Four combinations

**Index TAV: Short**                      **Index TAV: Tall**




\*Index TAV = first implanted TAV  
Second TAV = new TAV inside index TAV

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### 1) TAV compatibility: Four combinations

**Short in Short**      **Tall in Short**      **Tall in Tall**      **Short in Tall**



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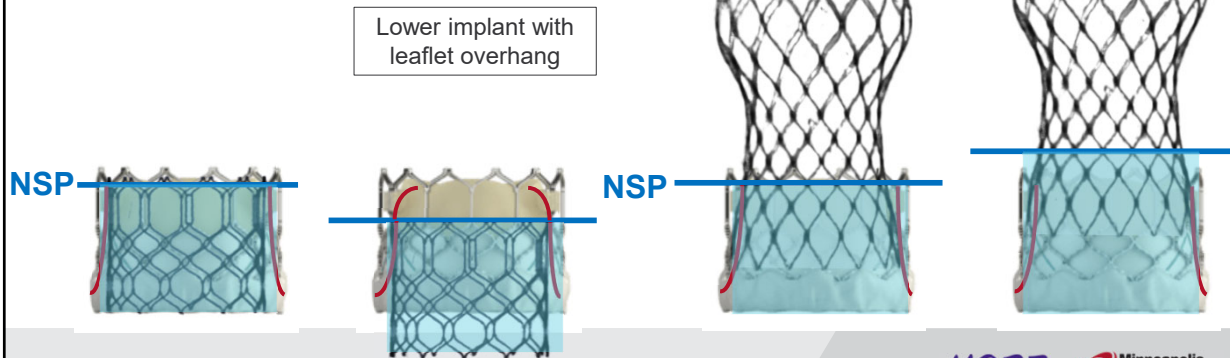
## 2) Implant position: Neoskirt and Neoskirt Plane (NSP)

Combination of : Index TAV **Pinned** leaflets + Inner Skirt of Second TAV

**Short in Short**

**Tall in Short**

Higher implant than node 3 results in higher NSP



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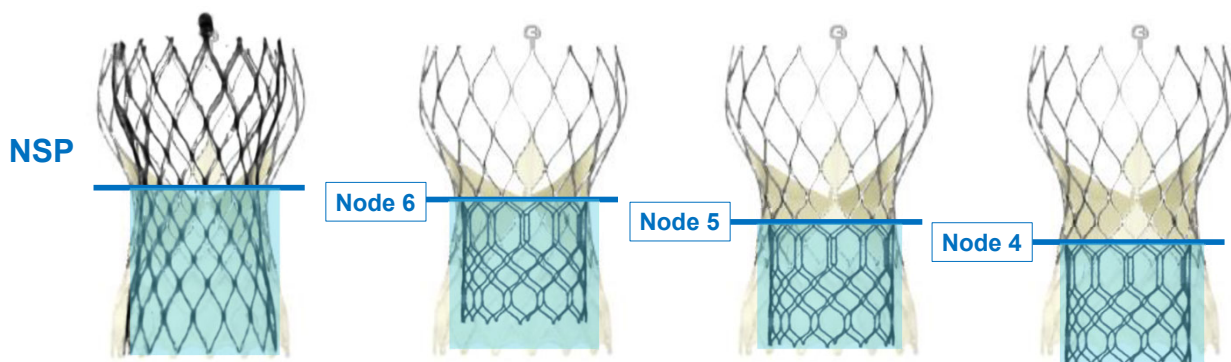
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## 2) Implant position: Neoskirt and Neoskirt Plane (NSP)

**Tall in Tall**

**Short in Tall**

**NSP level can be adjusted**

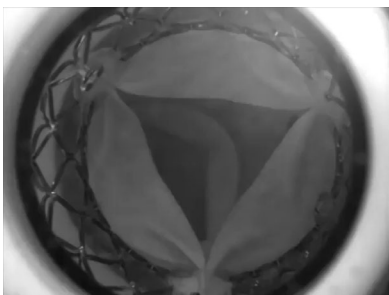


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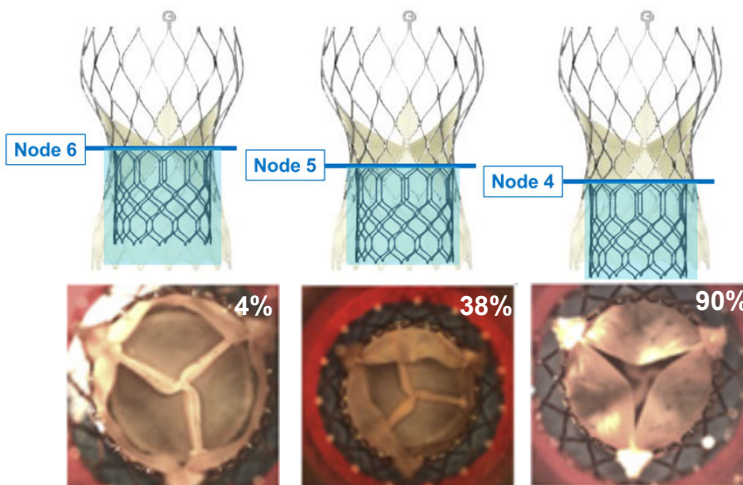
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## Leaflet Overhang & Neoskirt Plane (NSP)



Sathanathan...J et al, *Eurointervention* 2021;21:17:856  
Akodad. M et al, *JACC interv* 2022;15:368



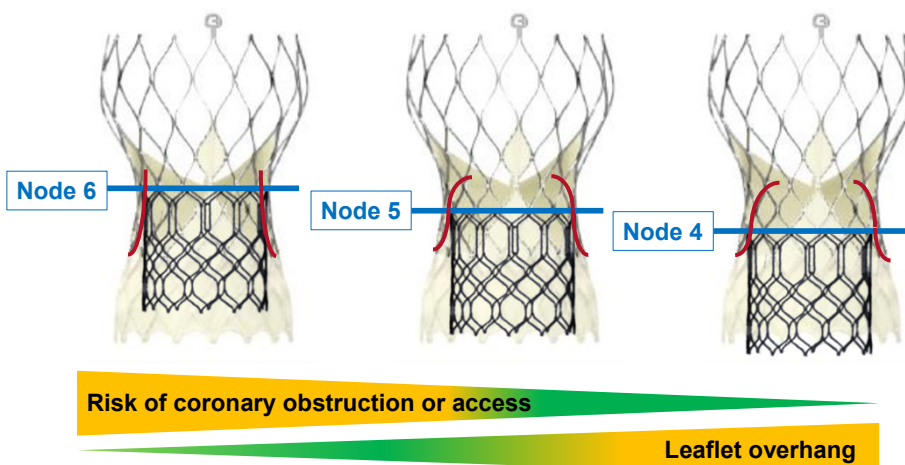
Acceptable hemodynamics (mean gradient & regurgitant fraction)

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## How to choose implant position?



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### 3) 2<sup>nd</sup> TAV Sizing: In-vivo sizing may be better

Strategies: In-vivo / In-vitro / pre-index native annulus

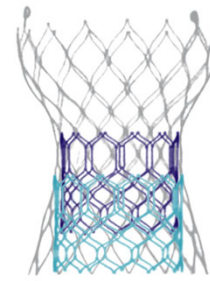
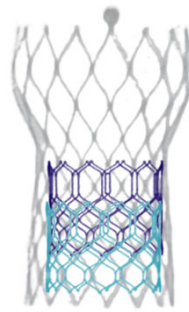
1. Under- & Uneven expansion is common



2. Size may change by TAV size and position

Evolut 26

Evolut 34



Node 6

Node 4

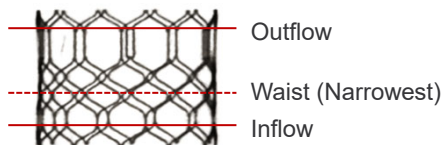
S3 size may not change

S3 size may change



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### 3) 2<sup>nd</sup> TAV Sizing: Each TAV has unique sizing strategy



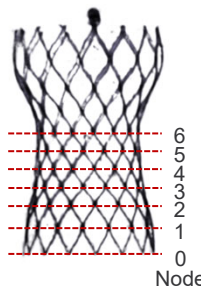
Outflow

Waist (Narrowest)

Inflow

**Short & Tall 2<sup>nd</sup> TAV**

Average of areas at the 3 levels



Node

**Short:** Average of areas at NSP and 3 nodes below

**Tall:** Same or one size smaller size of Evolut



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### 4) Coronary Risk

**Direct Coronary Obstruction**      **Sinus Sequestration**

Post Redo-TAV      Post Redo-TAV

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### 4) Coronary Risk Analysis: Coronary Risk Plane (CRP)

**CRP: Plane below the LOWEST coronary ostia**

CRP: Below top of commissure tab      CRP: Above top of commissure tab

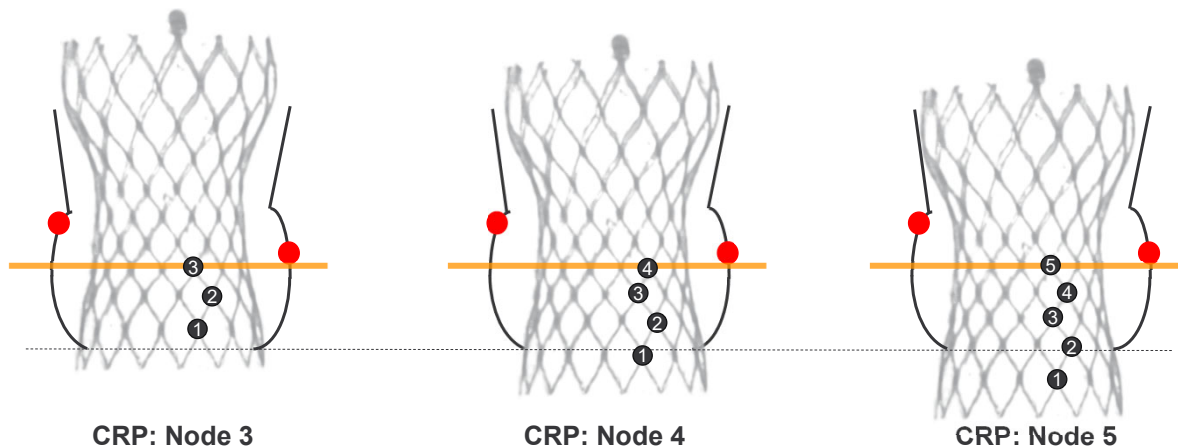
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## 4) Coronary Risk Analysis: Coronary Risk Plane (CRP)

CRP: Plane below the **LOWEST** coronary ostia



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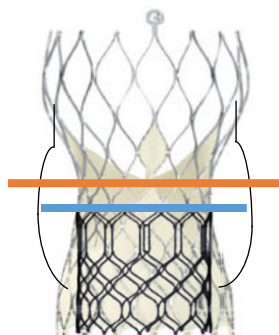
## 4) Coronary Risk Analysis: When?

**CRP**

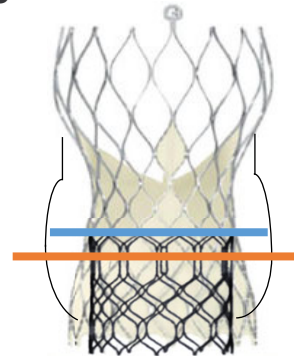
Coronary risk plane

**NSP**

Neoskirt plane



Low risk of coronary  
Skip VTA measurement



**NSP**

**CRP**

Need coronary assessment  
After second TAV sizing

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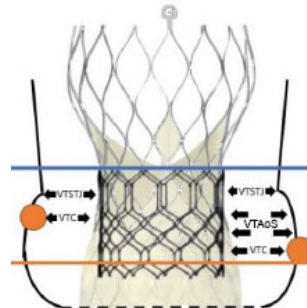
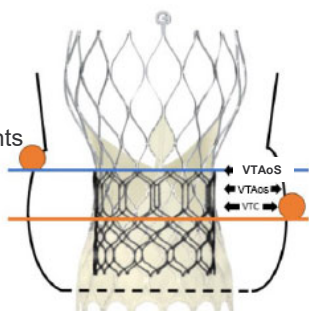
## 4) Coronary Risk Analysis: How?

**VTA (valve to aorta) = VTC, VTAoS and VTSTJ\***

**NSP below STJ: VTAoS and VTC**

**NSP above STJ: VTSTJ, VTAoS and VTC**

Multiple Measurements  
Take smallest



\*VTC = Valve to coronary  
VTAoS = Valve to Aortic sinus  
VTSTJ = Valve to ST junction

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## 4) Coronary Risk Analysis: How?

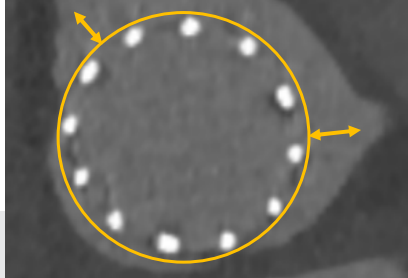
**BEV could expand index TAV and increase coronary risk**

→ Use virtual circle of second TAV size chosen

When virtual circle of second TAV is

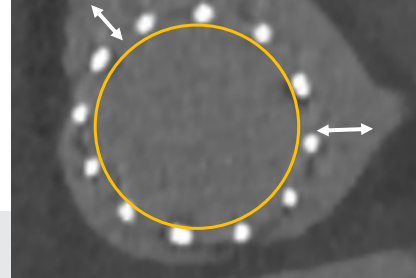
Outside of index TAV

VTA = From virtual circle of second TAV size to ostium



On / Inside of index TAV

VTA = From index TAV to ostium



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## 4) Coronary Risk Analysis: Risk classification

VTA > 4 mm

Minimal Risk of Coronary obstruction & good coronary access

VTA 2-4 mm

Possible Risk of Coronary obstruction & difficult coronary access

VTA < 2 mm

Very high risk of Coronary obstruction & Difficult coronary access

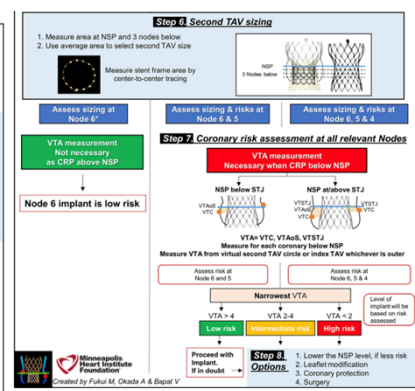
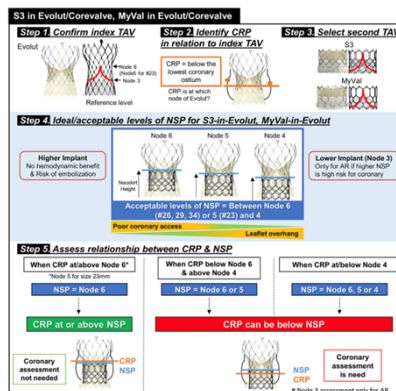


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## We need systematic algorithm for patient safety

### A Guide to Transcatheter Aortic Valve Design and Systematic Planning for a Redo-TAV (TAV-in-TAV) Procedure

Vinayak N. Bapat, MBBS, MCh,<sup>1,2</sup> Miho Fukui, MD, PhD,<sup>3</sup> Syed Zaid, MD,<sup>4</sup> Atsushi Okada, MD, PhD,<sup>5</sup>




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## App is practical tool for everyday practice can support your planning and procedure

Download on the App Store



GET IT ON Google Play






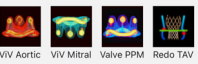
**Redo TAV APP**

**REDO TAV**

Supported by




**Joseph F. and Mary M. Fleischacker Family Foundation**





Developed by  
Dr. Miho Fukui  
Dr. Vinayak (Vinnie) Bapat

Contributions by  
Dr. Atsushi Okada



[mplsheart.org/apps](https://mplsheart.org/apps)

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## Simulation studies of Redo-TAV feasibility with App algorithm

Circulation: Cardiovascular Interventions

**ORIGINAL ARTICLE**

Feasibility of Redo-Transcatheter Aortic Valve Replacement in Sapien Valves Based on In Vivo Computed Tomography Assessment

Miho Fukui MD, PhD, Atsushi Okada MD, PhD, Kishore R. Thori, BA, Marcus R. Burns DNP, Hideo Kikita MD, PhD, Cheng Wang MD, Aya Phichapho MD, John R. Lesser MD, Paul Soraja MD, Judo L. Cavalcanti MD, Vinayak N. Bapat MD

Circulation: Cardiovascular Interventions

**ORIGINAL ARTICLE**

In Vivo Computed Tomography Sizing for Redo-Transcatheter Aortic Valve Replacement in Evolut Valves: Impact on Sizing, Feasibility, and Prosthesis-Patient Mismatch

Atsushi Okada MD, PhD, Miho Fukui MD, PhD, Syed Zaidi MD, Kishore R. Thori, BA, Evan Walker-Kurtz MS, Larissa I. Starbuck MD, Marcus R. Burns DNP, Hideo Kikita MD, PhD, Cheng Wang MD, Aya Phichapho MD, John R. Lesser MD, Judo L. Cavalcanti MD, Paul Soraja MD, Vinayak N. Bapat MD

**Feasibility of redo-TAVI in the self-expanding ACURATE neo2 valve: a computed tomography study**

Gintautas Biedankas MD, Yusuke Kohari MD, PhD, Arif A. Khokhar MD, BM, BCh, MA, Mohamed Abdel-Wahab MD, PhD, Ahmed Abdelhakeem MD, Miho Fukui MD, PhD, Klaus Fuglestad MD, PhD, Darin Dadek MD, PhD, Andreas Fuchs MD, PhD, Joao Cavalcanti MD, Kenaro Hayashida MD, PhD, Gilbert H.L. Tang MD, MSc, MBA, Darren Mylonis MD, PhD, Vinayak N. Bapat MD, Ole De Backer MD, PhD

**60-80% after TAVR is expected to be feasible of Redo-TAV**

**S3 in S3 simulation**

**In-Vivo CT Sizing**

One size smaller than in-vitro sizing: 13%

Same size with in-vitro sizing: 87%

One size smaller than in-vitro sizing: 4%

Same size with in-vitro sizing: 96%

**Estimated Coronary Risk**

High: 25% (S3), 23% (Evol)

Intermediate: 37% (S3), 17% (Evol)

Low: 57% (S3), 60% (Evol)

**S3 in Evolut**

Node	Neosart plane level	P-value	Low risk	Intermediate risk	High risk
Node 6	82%	P<.001	18%	26%	+8%
Node 5	81%		44%	54%	+10%
Node 4	84%		77%	83%	+4%
Overall (All sizes)					

**S3 in Evolut**

Node	Neosart plane level	P-value	Low risk	Intermediate risk	High risk
Node 6	18%	P<.001	26%	+8%	
Node 5	44%		54%	+10%	
Node 4	77%		83%	+4%	
Overall (All sizes)					

**Node 4 vs Node 5 vs Node 6**

Node	Neosart plane level	P-value	Low risk	Intermediate risk	High risk
Node 6	18%	P<.001	26%	+8%	
Node 5	44%		54%	+10%	
Node 4	77%		83%	+4%	
Overall (All sizes)					

**Overall (All sizes)**

Node	Neosart plane level	P-value	Low risk	Intermediate risk	High risk
Node 6	82%	P<.001	18%	26%	+8%
Node 5	81%		44%	54%	+10%
Node 4	84%		77%	83%	+4%
Overall (All sizes)					



**ACURATE neo2 valves: a CT analysis.**

High S3 implant in ACURATE neo2: 92%

Independent predictors of a high risk of redo-TAV feasibility with a high S3 implant: 40%

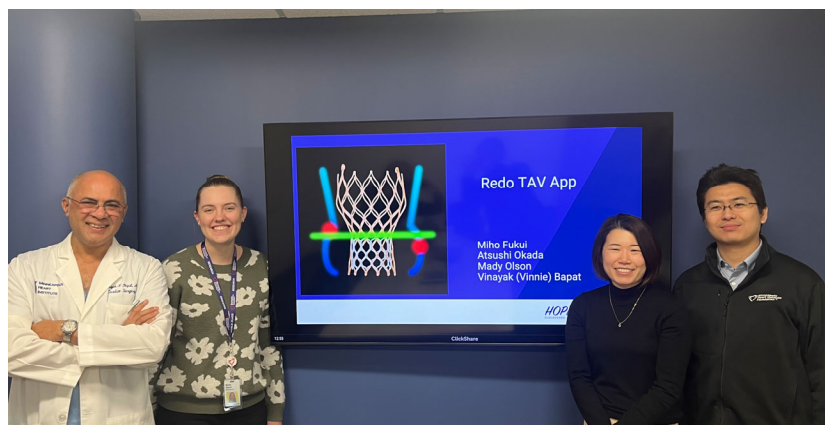
STJ/aortic annus mean  $\beta$  ratio <1.15

Multivariate model	Odds ratio (95% CI)	P-value
Female	2.75 (1.24-6.10)	0.01
Aortic annus perimeter, cm	0.95 (0.93-0.98)	<.05
STJ/aortic annus mean $\beta$ ratio <1.15	3.98 (1.94-8.08)	<.01

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# Development of APP is collaboration work

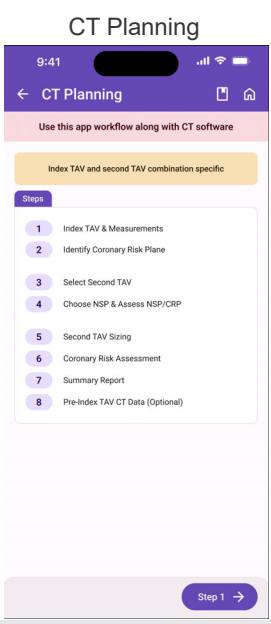
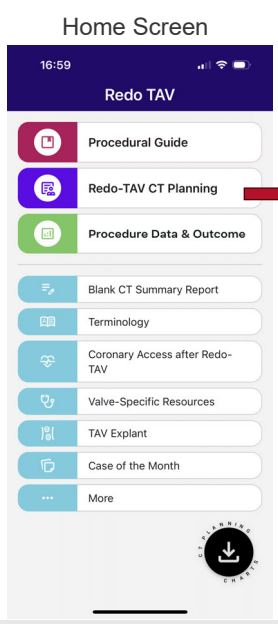


With  
 -KOLs  
 -Industry partners  
 -App developer

Under the support of  
 Fleischacker Family



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- Steps**
- 1 Index TAV & Measurements
  - 2 Identify Coronary Risk Plane
  - 3 Select Second TAV
  - 4 Choose NSP & Assess NSP/CRP
  - 5 Second TAV Sizing
  - 6 Coronary Risk Assessment
  - 7 Summary Report
  - 8 Pre-Index TAV CT Data (Optional)



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# Optimization:

**How can we achieve better outcomes?**



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## Case: Index Evolut R #29



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## Step 1. Index TAV & Measurements

**Steps**

- 1 Index TAV & Measurements
- 2 Identify Coronary Risk Plane (CRP)
- 3 Select Second TAV
- 4 Choose NSP & Assess NSP/CRP
- 5 Second TAV Sizing
- 6 Coronary Risk Assessment
- 7 Summary Report
- 8 Pre-Index TAV CT Data (Optional)

In-vitro shape

CT image of this case

**CT Planning**  
Step 1: Index TAV & Measurements  
Medtronic Evolut R 29

Height:	45
Diameter:	29
Inner Skirt Height:	14
Native Annulus Perimeter:	72.3-81.7

	Area	Perimeter
Node 6:	388	mm <sup>2</sup>
Node 5:	376	mm <sup>2</sup>
Node 4:	374	mm <sup>2</sup>
Node 3:	368	mm <sup>2</sup>
Node 2:	396	mm <sup>2</sup>
Node 1:	425	mm <sup>2</sup>

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## Step 2. Identify Coronary Risk Plane (CRP)

**Steps**

- 1 Index TAV & Measurements
- 2 Identify Coronary Risk Plane (CRP)
- 3 Select Second TAV
- 4 Choose NSP & Assess NSP/CRP
- 5 Second TAV Sizing
- 6 Coronary Risk Assessment
- 7 Summary Report
- 8 Pre-Index TAV CT Data (Optional)

**CT Planning**  
Step 2: Identify Coronary Risk Plane

Mark bottom of both coronaries in relation to the reference levels

**Reference Levels for Redo-TAV**

**Bottom of RCA & LCA Ostiums**

RCA: Node 4

LCA: Node 5

**Coronary Risk Plane (Lowest Level of Coronaries)**

CRP Level: Node 4

**RCA**

**LCA**

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## Step 3. Select Second TAV & levels of implant

**Steps**

- 1 Index TAV & Measurements
- 2 Identify Coronary Risk Plane (CRP)
- 3 Select Second TAV
- 4 Choose NSP & Assess NSP/CRP
- 5 Second TAV Sizing
- 6 Coronary Risk Assessment
- 7 Summary Report
- 8 Pre-Index TAV CT Data (Optional)

**CT Planning**

Step 3: Select Second TAV

Choose Second TAV Device

ACURATE neo2

Allegra

Evolut FX  
USE WITH CAUTION

Evolut PRO+  
USE WITH CAUTION

MyVal

Navigator

SAPIEN 3

SAPIEN 3 Ultra

Use With Caution ⓘ

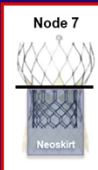
Next

S3 - in- Evolut

Neoskirt plane (NSP) = plane at the top of the Neoskirt

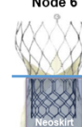
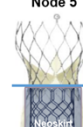
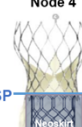
Not recommended

Node 7



No hemodynamic benefit  
Risk of migration

Acceptable levels of NSP  
Node 6 to Node 4

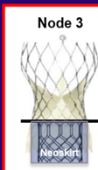




Poor coronary access

Leaflet overhang

Only for pure AR  
with coronary risk

Node 3



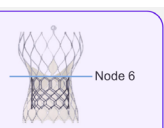
49

## Step 4. Choose NSP & Assess NSP/CRP relation

**Steps**

- 1 Index TAV & Measurements
- 2 Identify Coronary Risk Plane (CRP)
- 3 Select Second TAV
- 4 Choose NSP & Assess NSP/CRP
- 5 Second TAV Sizing
- 6 Coronary Risk Assessment
- 7 Summary Report
- 8 Pre-Index TAV CT Data (Optional)


CRP=Node 4



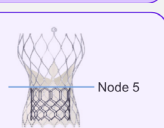
Node 6

⇒

NSP above CRP




Need coronary assessment



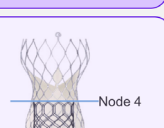
Node 5

⇒

NSP above CRP




Need coronary assessment



Node 4

⇒

NSP at CRP



Low risk of coronary

NSP = Neoskirt Plane  
Plane at Top of Neoskirt

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## Step 5. Second TAV Sizing

**Steps**

- 1 Index TAV & Measurements
- 2 Identify Coronary Risk Plane (CRP)
- 3 Select Second TAV
- 4 Choose NSP & Assess NSP/CRP
- 5 Second TAV Sizing
- 6 Coronary Risk Assessment
- 7 Summary Report
- 8 Pre-Index TAV CT Data (Optional)

CT Planning

Step 5: Second TAV Sizing

Choose Second TAV Size

Selected Second TAV Device: SAPIEN 3 U...

Average Area: 376.5 mm<sup>2</sup>

Valve size (mm)	Area (mm <sup>2</sup> )
20	273-345
23	338-430
26	430-546
29	540-683

Node 6

376.5 mm<sup>2</sup>

→ **S3 #23**

Node 5

378.5 mm<sup>2</sup>

→ **S3 #23**

Node 4

390.8 mm<sup>2</sup>

→ **S3 #23**

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## Step 6. Coronary Risk Assessment

**Steps**

- 1 Index TAV & Measurements
- 2 Identify Coronary Risk Plane (CRP)
- 3 Select Second TAV
- 4 Choose NSP & Assess NSP/CRP
- 5 Second TAV Sizing
- 6 Coronary Risk Assessment
- 7 Summary Report
- 8 Pre-Index TAV CT Data (Optional)

Node 6

Summary - Not to Scale

Narrowest VTA Values

RCA: 3.1 mm

LCA: 4.1 mm

Caution  
Consider coronary protection if in

Node 5

Summary - Not to Scale

Narrowest VTA Values

RCA: 4.4 mm

LCA: N/A

Caution  
Consider coronary protection if in

Node 4

Summary - Not to Scale

Narrowest VTA Values

RCA: N/A

LCA: N/A

Caution  
Consider coronary protection if in

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# Step 7. Summary Report

- Steps**
- 1 Index TAV & Measurements
  - 2 Identify Coronary Risk Plane (CRP)
  - 3 Select Second TAV
  - 4 Choose NSP & Assess NSP/CRP
  - 5 Second TAV Sizing
  - 6 Coronary Risk Assessment
  - 7 Summary Report**
  - 8 Pre-Index TAV CT Data (Optional)

### NSP = N6

**Index TAV**  
TAV: Evolut R  
Size: 29

**Second TAV**  
TAV: SAPIEN 3 Ultra  
Size: 23

**Area & Perimeter According to In-Vivo Sizing Algorithm**  
Area: 376.5 mm<sup>2</sup> Perim: 69 mm

Index TAV Failure Mechanism: AR  
CRP: Node 4  
NSP: Node 6

**Summary - Not to Scale**  
RCA: 3.1 mm  
LCA: 4.1 mm

**Narrowest VTA Values**  
RCA: 4.4 mm  
LCA: 4.1 mm

**Caution**  
Consider coronary protection if in doubt

Intermediate risk to coronaries

### NSP = N5

**Index TAV**  
TAV: Evolut R  
Size: 29

**Second TAV**  
TAV: SAPIEN 3 Ultra  
Size: 23

**Area & Perimeter According to In-Vivo Sizing Algorithm**  
Area: 378.5 mm<sup>2</sup> Perim: 69.3 mm

Index TAV Failure Mechanism: AR  
CRP: Node 4  
NSP: Node 5

**Summary - Not to Scale**  
RCA: 4.4 mm  
LCA: N/A

**Narrowest VTA Values**  
RCA: 4.4 mm  
LCA: N/A

**Caution**  
Consider coronary protection if in doubt

Low risk to coronaries  
Consider coronary protection when leaflets are calcified, independent of NSP/CRP relationship

### NSP = N4

**Index TAV**  
TAV: Evolut R  
Size: 29

**Second TAV**  
TAV: SAPIEN 3 Ultra  
Size: 23

**Area & Perimeter According to In-Vivo Sizing Algorithm**  
Area: 390.8 mm<sup>2</sup> Perim: N/A

Index TAV Failure Mechanism: AR  
CRP: Node 4  
NSP: Node 4

**Summary - Not to Scale**  
RCA: N/A  
LCA: N/A

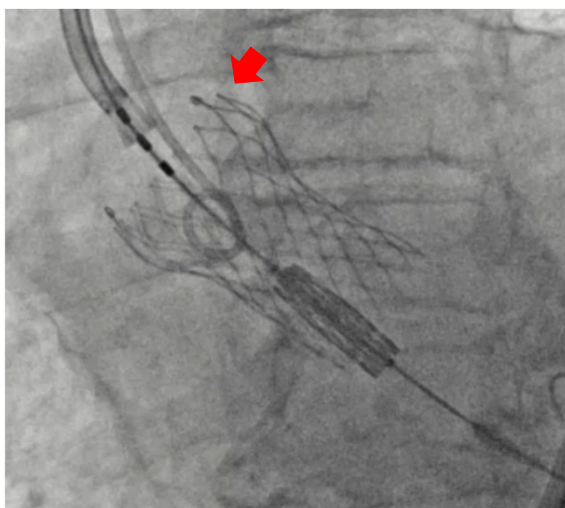
**Narrowest VTA Values**  
RCA: N/A  
LCA: N/A

**Caution**  
Consider coronary protection if in doubt

Low risk to coronaries  
Consider coronary protection when leaflets are calcified, independent of NSP/CRP relationship

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# Redo-TAV procedure: Successful implantation

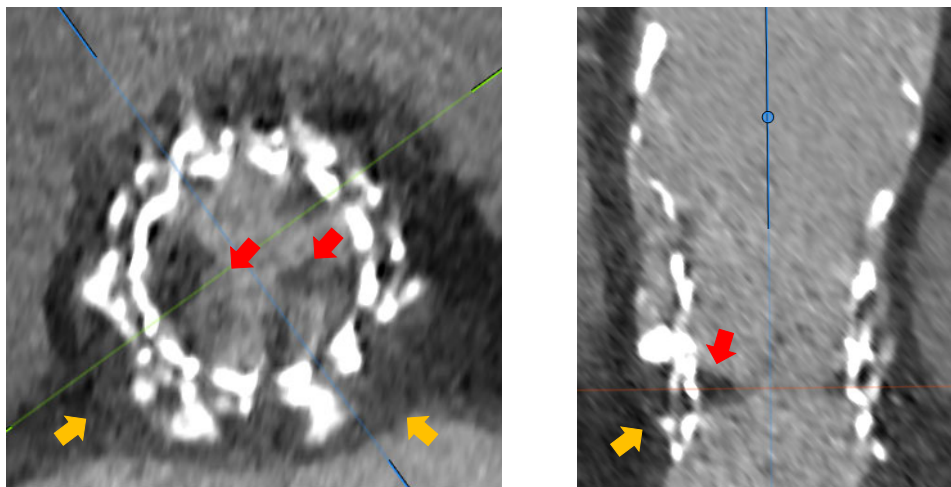


Post-TTE: No transvalvular or paravalvular AR, Mean gradient 8 mmHg

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Next day after procedure, patient experienced stroke...

**Thrombosis on second TAV leaflets and native-sinus**

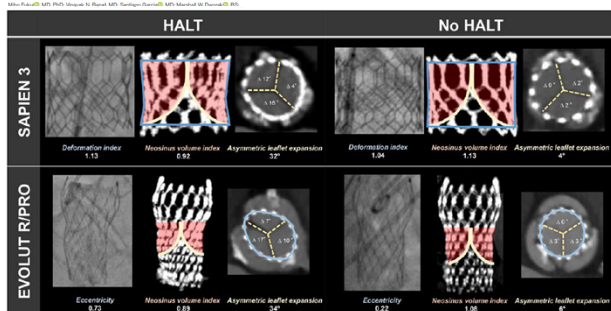


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## Why did this happen?

Circulation  
ORIGINAL RESEARCH ARTICLE

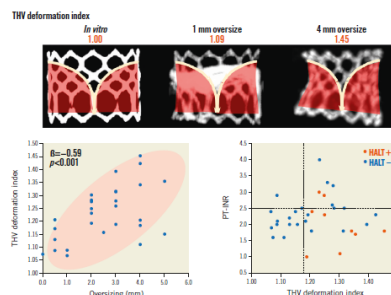
Deformation of Transcatheter Aortic Valve Prostheses: Implications for Hypoattenuating Leaflet Thickening and Clinical Outcomes



Fukui M, Sorajja P, et al. Circulation 2022

EuroIntervention

CENTRAL ILLUSTRATION Stent frame deformation of transcatheter heart valves (THV), i.e., underexpansion and an hourglass shape, is common and is influenced by the degree of oversizing.



Fukui M, Bapat V et al. EuroIntervention 2023

**TAV deformation could cause HALT/Thrombus**

HOPE  
DISCOVERED HERE

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## This is also supported by bench testing

### Underexpansion & Flow Stagnation

Blood residence time (i.e. stasis) on transcatheter aortic valve leaflets after 100%, 90%, and 80% stent expansion.

*Khodae F. et al. Interact Cardiovasc Thorac Surg 2020*

### Under-/Eccentric expansion & Leaflet Stress

*Qiu D. et al. Int J Numer Method Biomed Eng 2022*

### Underexpansion & Pinwheeling

*Sathananathan J. et al. JACC intv 2019;12:65*

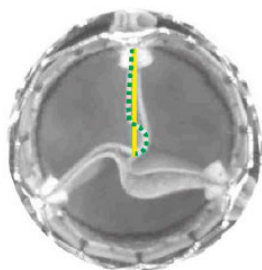
57

## How could the procedure have been optimized?

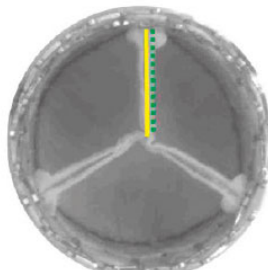
		<b>% S3 expansion</b>
		<b>Outflow</b>
		<b>86%</b>
		<b>Waist</b>
		<b>80%</b>
		<b>Inflow</b>
		<b>87%</b>

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## Pre/Post dilatation could be option



Without  
Pre/Post dilatation



With  
Pre/Post dilatation

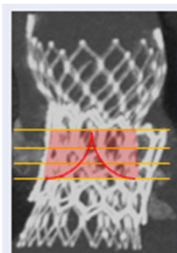
Meier D, et al. *Eurointervention*. 2023;19:757



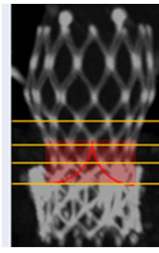
59

## In-vivo sizing & pre/post dilatation are crucial for optimal second TAV expansion & function

Index TAV	SAPIEN #23
Second TAV	S3 #23
Sizing	In-Vitro
Index TAV Expansion	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">Pre </div> <div style="text-align: center;">Post </div> </div>
Pre-Dilatation	-
Inflation volume during Redo-TAV	-1 cc
Post-Dilatation	+ (delivery system, -1cc)
Second TAV Expansion (Area, mm <sup>2</sup> )	79% (324)
Outflow	51% (210)
Waist	82% (337)
Inflow	82% (337)



69%  
66%  
64%  
62%



81%  
80%  
86%  
82%



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## 4 prospective studies of Redo-TAV are ongoing

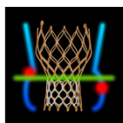
### ReTAVI study

- Europe, Canada, Israel
- Redo-TAV with Sapien family
- Target n=150

### REVALVE study

- Europe
- Any combinations of index and second TAVs
- Target n=300-500

### REFINE study



- Across all continents
- Focus on Pre/Post CT
- Target n=225

### RESTORE study

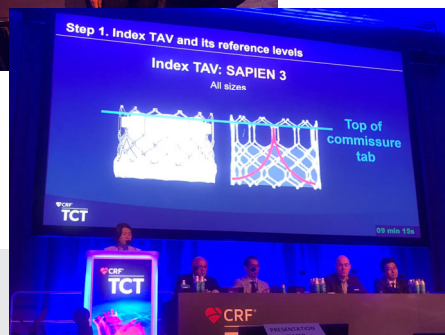
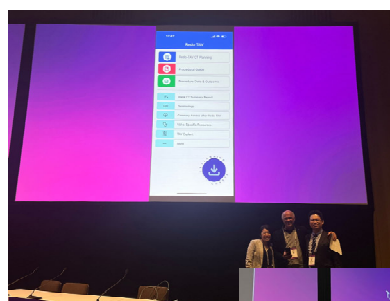
- U.S.
- Redo-TAV with Evolut or Sapien family
- Target n=250

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## Dedicated session across countries



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## First Workshop for Redo-TAV CT planning in Brazil



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## Second Workshop at NY valves 2024



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# Virtual Redo-TAV Workshop is coming!

Minneapolis Heart Institute Foundation | PIE MEDICAL IMAGING

## Redo-TAV: CT Planning Workshop

Saturday, April 12, 2025

Global Virtual Workshop

Redo-Tav App

CT Planning

Step 3: Select Second TAV

Headset Plane (NPP) for S3 in Evolut

Assess the size of PVP

Headset Plane (NPP) for S3 in Evolut

Implant Top of S3 between Neck 4 & 5  
In Pops A6, lower implant may be considered

More Info



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# Dedicated CT software module by 3Mensio is coming soon

3mensio

Aortic Valve ED

Aortic Valve ED

Value in Value

Femoral

Subcutaneous

Carotids

Direct Access

2D

3D

Save

Close

Series: 23  
Images: 541-724  
Slice Spacing: 1.0 mm

Perpendicular (VR)

Distance: 0.0 mm

Place the Virtual Valve

Double Oblique (VR)

Caution: displayed leaflets are a schematic representation.

Top of Commissure Tab

CRP

Wrist (narrowest)

Head

Orientation

Measurements

Report

Workflow Assistant

1. Define Centerline
2. Index Valve alignment
3. Preparation
4. Valve placement
5. Risk Assessment

Value Placement

Back

Confirm

Index Valve Diameters

- Top of Commissure Tab
- Wrist (narrowest)
- Head

Derived Diameters

Virtual Valve

Sapien 3/Ultra

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- Show 3D model
- Edit Orientation

Custom



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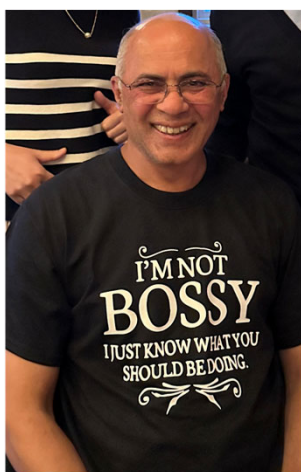
## Key takeaways

- The number of Redo-TAV is increasing
- Feasibility should be assessed step-by-step on pre-CT with four key considerations:
  - 2<sup>nd</sup> TAV compatibility
  - Optimal implant position
  - 2<sup>nd</sup> TAV sizing
  - Coronary Risk
- Strategize the optimization of the procedure



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## My personal takeaways



***Rather than discuss the problems***

***Let's find out solutions!!!***



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