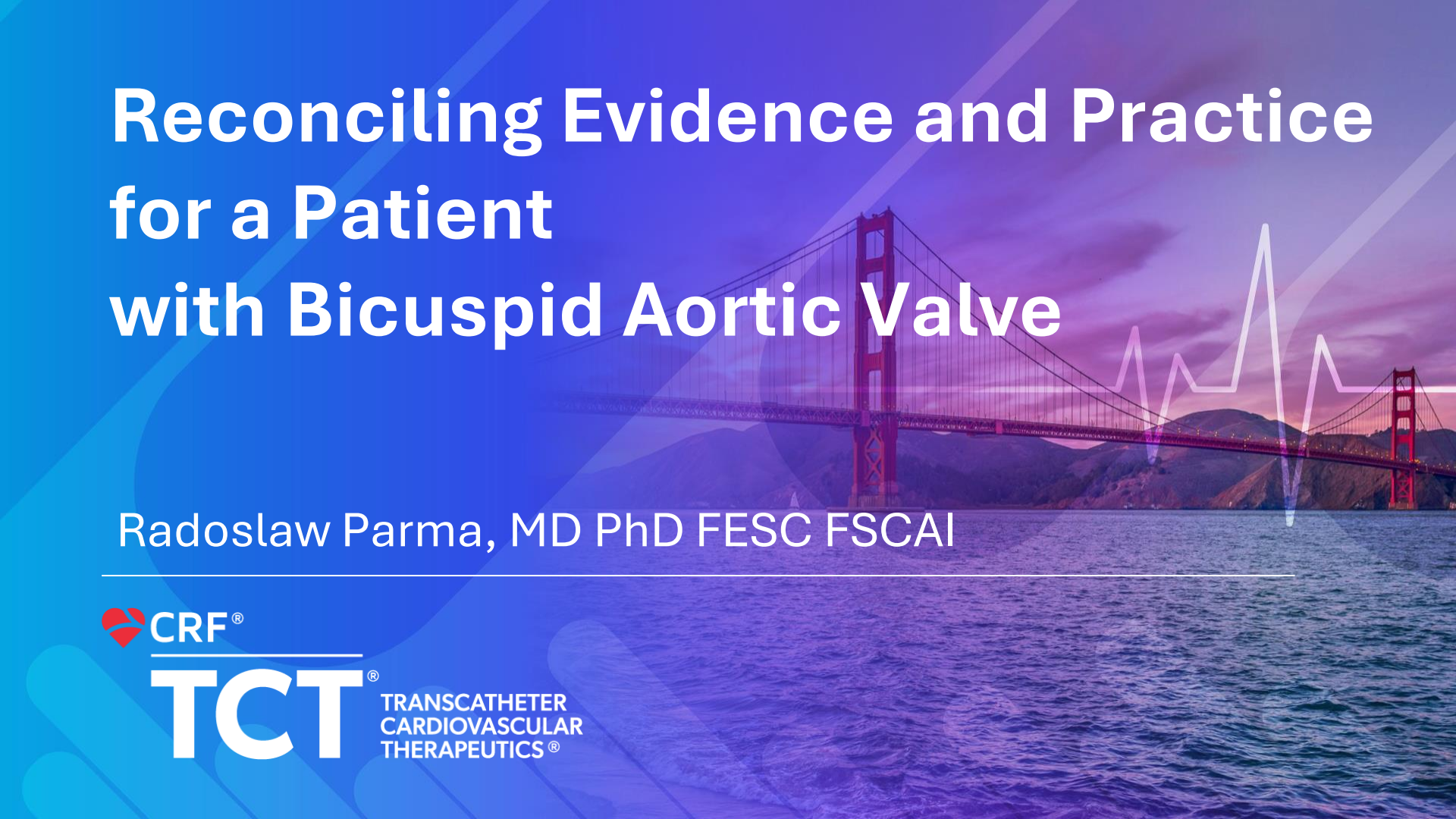
Reconciling Evidence and Practice for a Patient with Bicuspid Aortic Valve



Radoslaw Parma, MD PhD FESC FSCAI

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Disclosure of Relevant Financial Relationships

Within the prior 24 months, I have had a financial relationship with a company producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients:

Nature of Financial Relationship	Ineligible Company
Other Financial Benefit	Edwards Lifesciences

All relevant financial relationships have been mitigated.
Faculty disclosure information can be found on the app

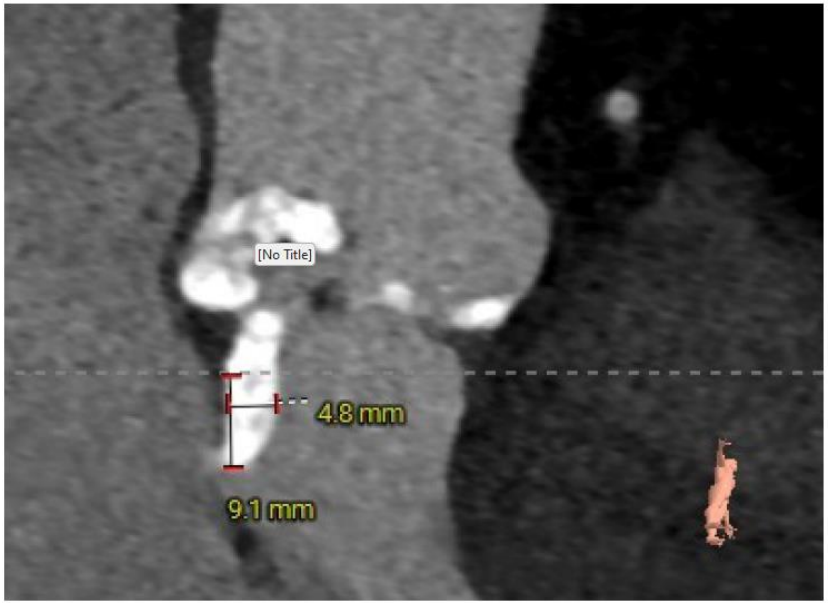
Bicuspid Aortic Valve type 1 LR in a 75 y.o. patient with low risk for SAVR

Bicuspid Aortic Valve type 1 LR with a calcified raphe

Aortic Valve Annulus

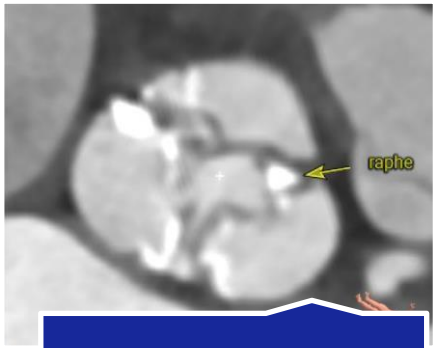
LVOT & LM CT

LVOT calcification

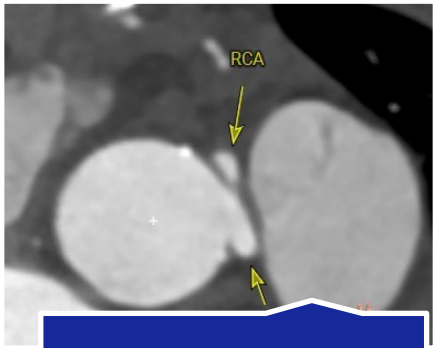


LCA Height

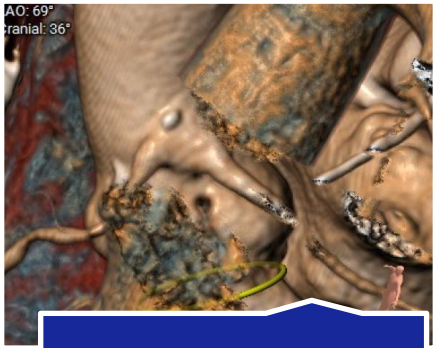
Coronary anomalies: Common trunc



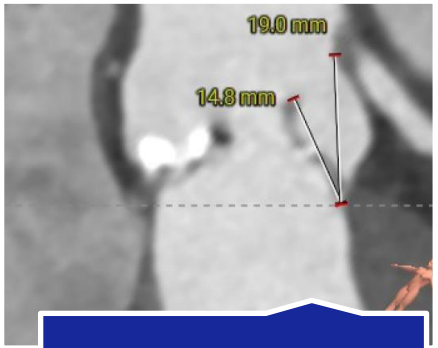
BAV type 1LR



Common trunc

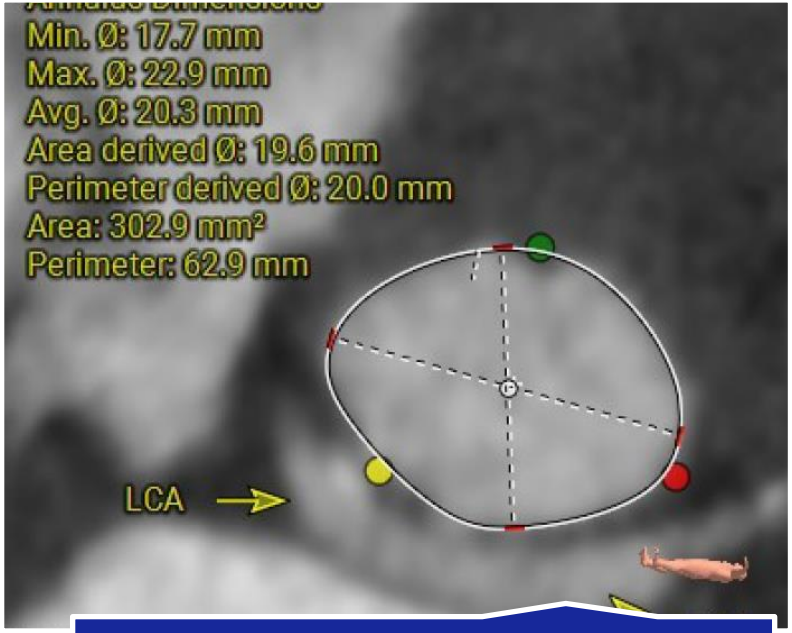


Common trunc

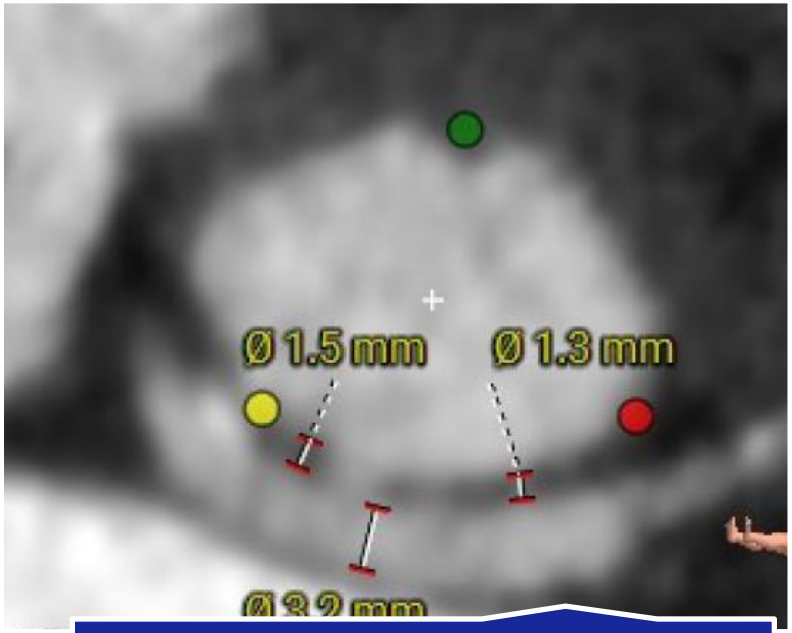


Leaflet lenght

Coronary anomalies: RCA - CX



Cx



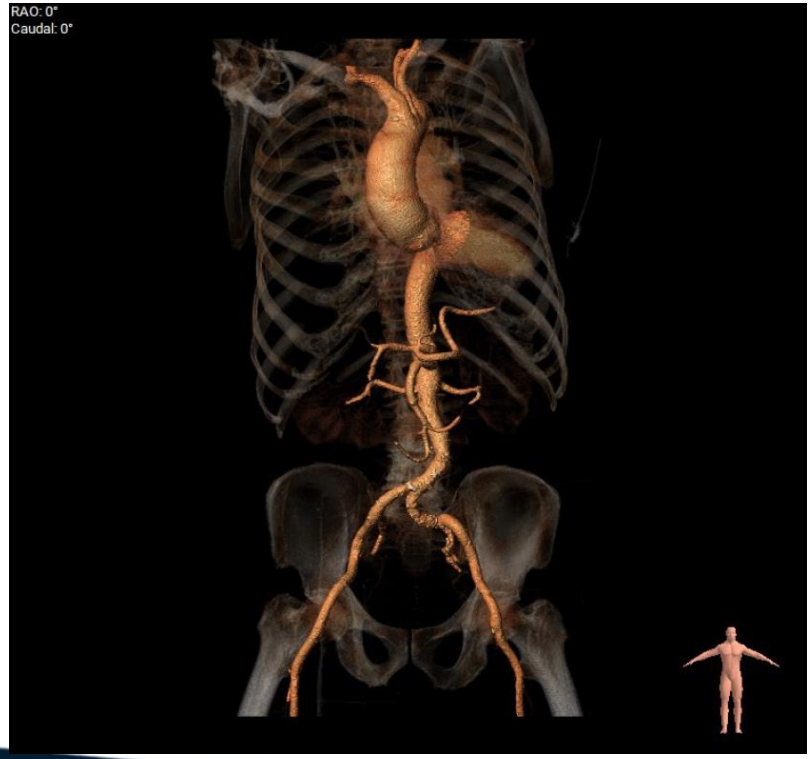
Cx

Coronary anomalies: RCA - CX

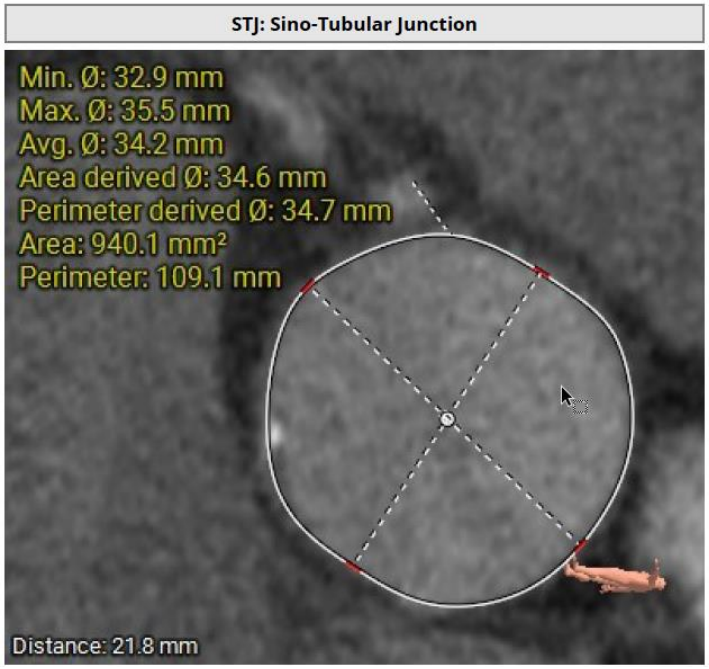
Cx

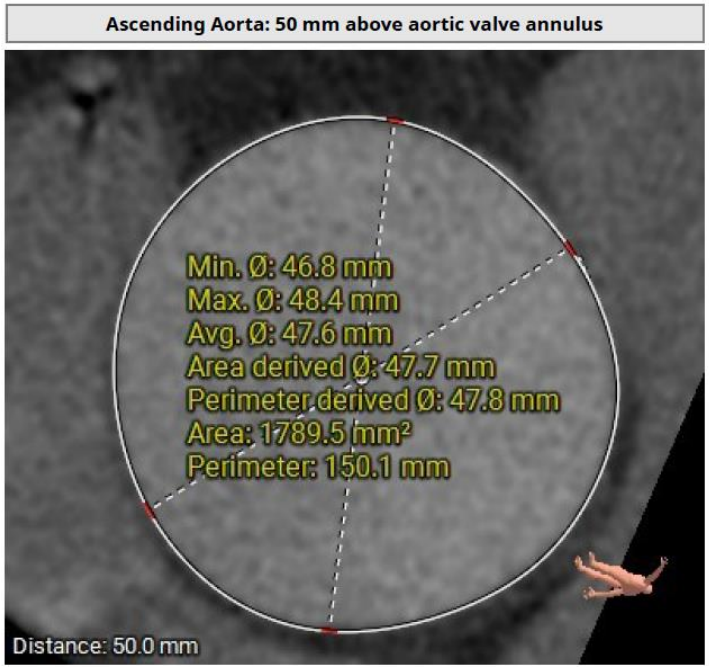
Cx

Arterial System Overview

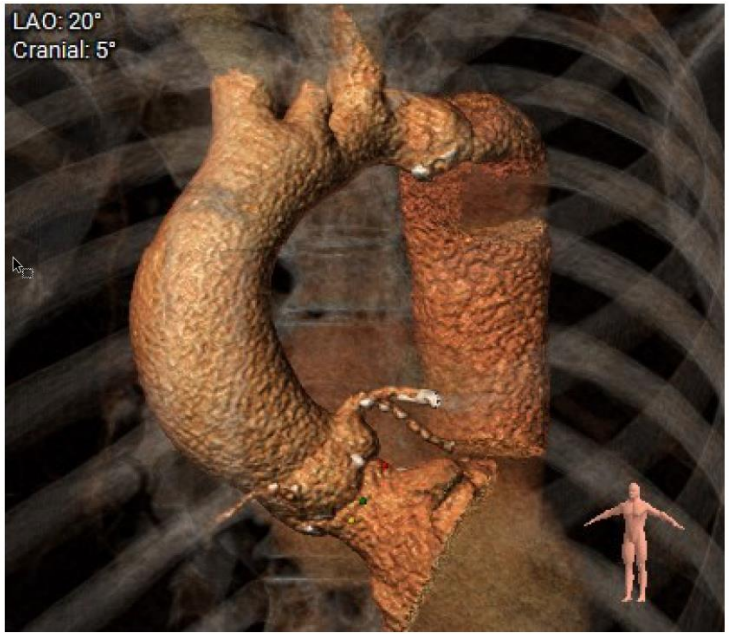


Ascending Aorta Aneurysm





Aortic Arch



Bicuspid Aortic Valve challenges

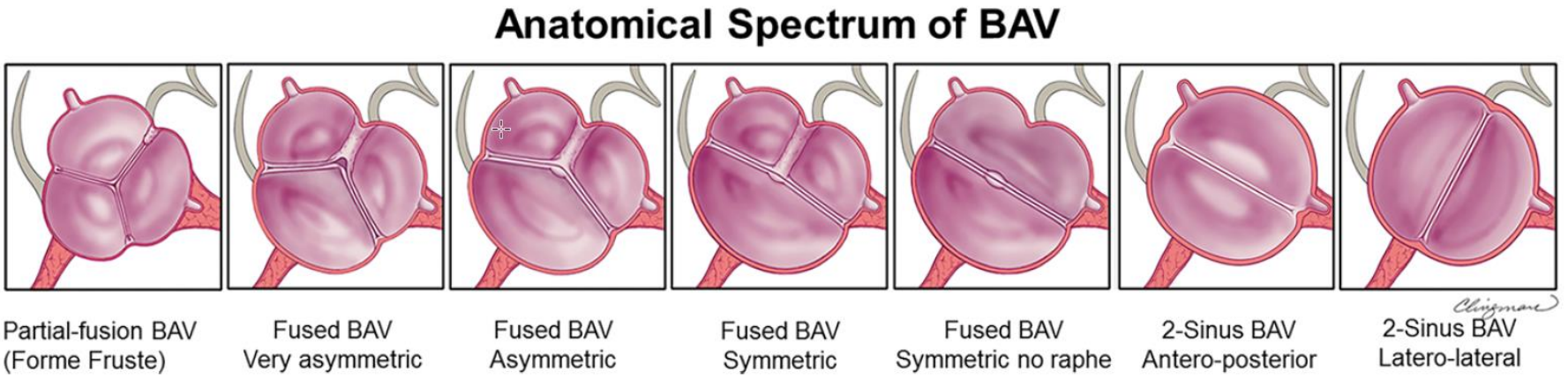
Clinical factors

- younger age
- concomitant aortopathy
- predominant aortic regurgitation or mixed aortic valve
- insufficient calcification for device anchoring

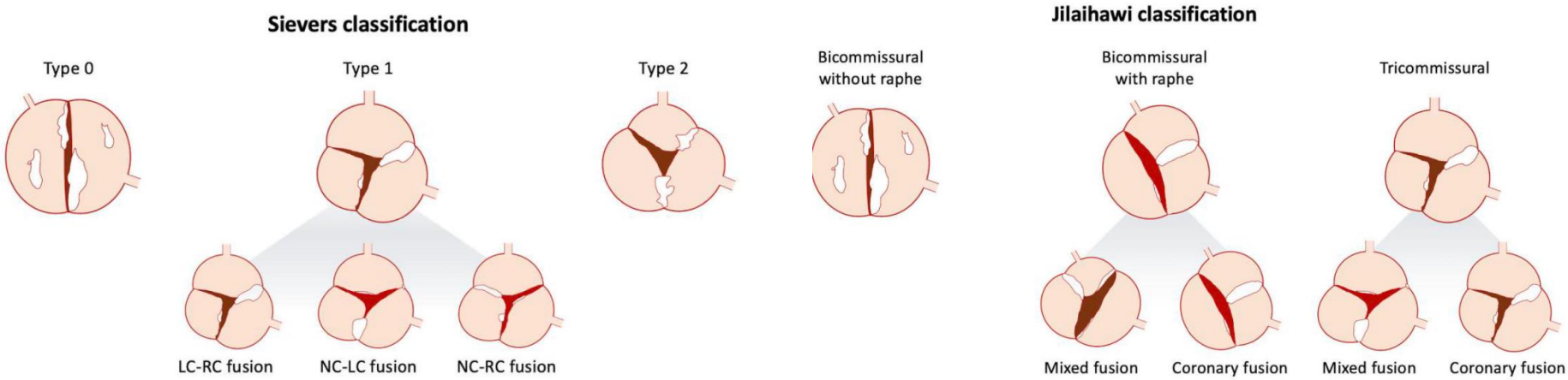
Anatomic factors

- Larger annuli
- Increased cusp calcification
- Eccentric, nontubular shape of aortic valve complex
- Presence of calcified raphe(s)
- Increased frequency of coronary anomalies
- Longer leaflets with increased frequency of calcified leaflets)
- horizontal aorta
- Aortic root and ascending aorta dilation

BAV: Wide Anatomical Spectrum

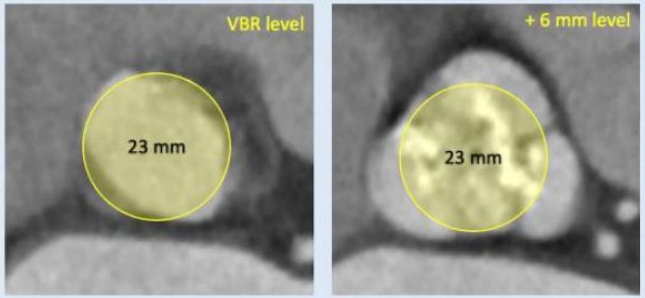


Classification Approaches



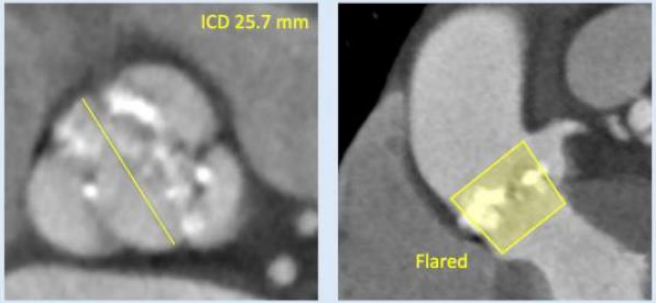
BAV Sizing Methods
BEV THV

CIRCLE METHOD



- Valve area projections from VBR to STJ every 3 mm
- Only for BE THVs
- Suitable for type 0 BAV

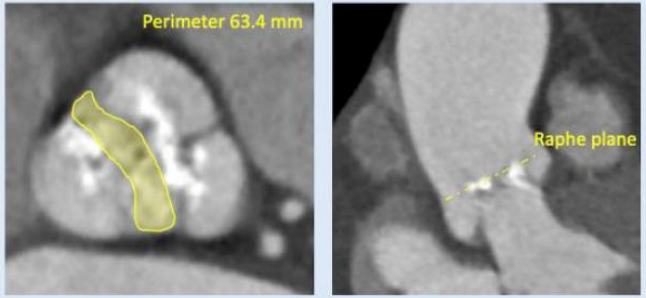
BAVARD



- Annular/intercommissural diameter ratio
- Tubular, flared and tapered configurations
- Validated for both SE and BE THVs
- Suitable for type 0 BAV

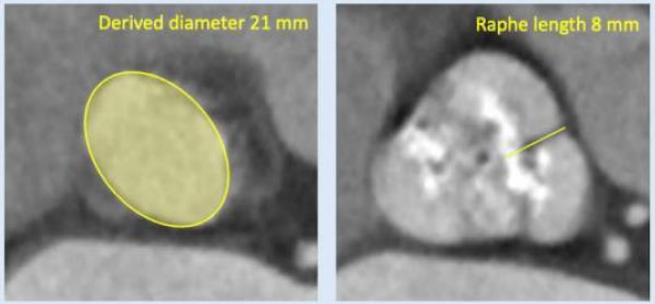
BAV Sizing Methods
SEV THVs

LIRA



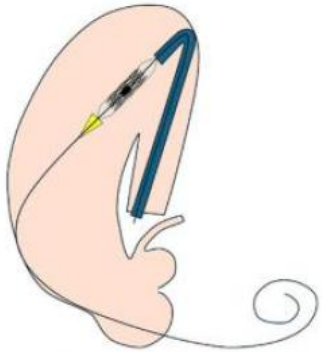
- Perimeter measurement at the level of maximum raphe length
- Only for SE THVs
- Only for type 1 BAV

CASPER



- Perimeter/area derived diameter corrected by calcium amount and raphe length
- Not validated for BE THVs
- Only for type 1 BAV

Procedural Challenges
Angulation

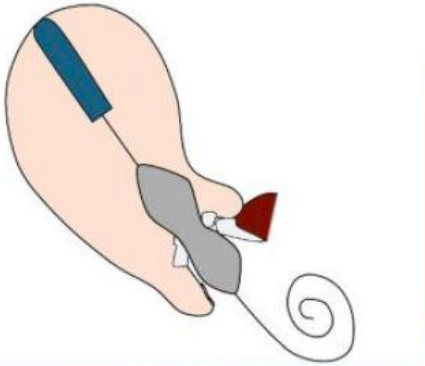


Extreme aortic plane/arch angulations

- Difficulties in valve crossing
- Difficulties in THV delivering
- Aortic wall injury
- Stroke

- Use of stiffer guidewires/ buddy wire or balloon
- Use of THV with active flexible DS
- Ad-hoc DS snaring

Procedural Challenges
Calcium Burden

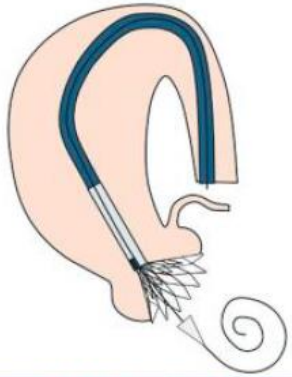


Erratic leaflet/LVOT calcium burden

- Annular injury
- Stroke
- Significant PVL
- THV underexpansion

- Pre-dilatation (non-aggressive in LVOT calcification)
- SE THV preferred if annular injury>PVL risk
- BE THV preferred if PVL>annular injury risk
- CEPD use
- Post-dilatation if underexpanded THV

Procedural Challenges
Parallax

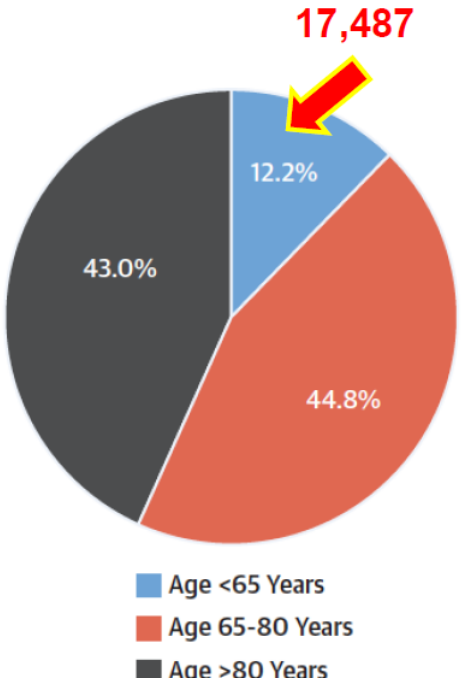


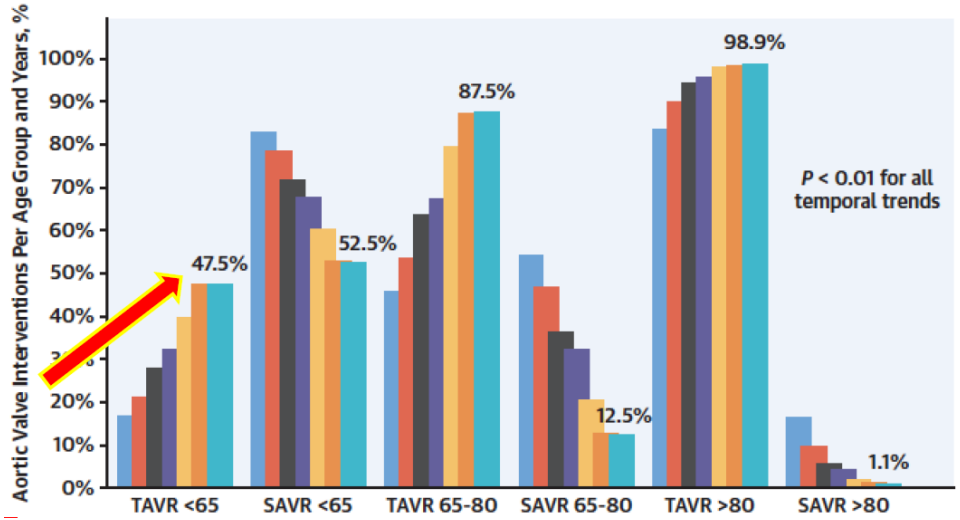
Device parallax/lack of working projections

- Valve embolization
- Less predictable implantation depth (type 0 BAV)

- Use of recapturable THV
- Minimize THV parallax
- BE THV positioning on top of annular plane

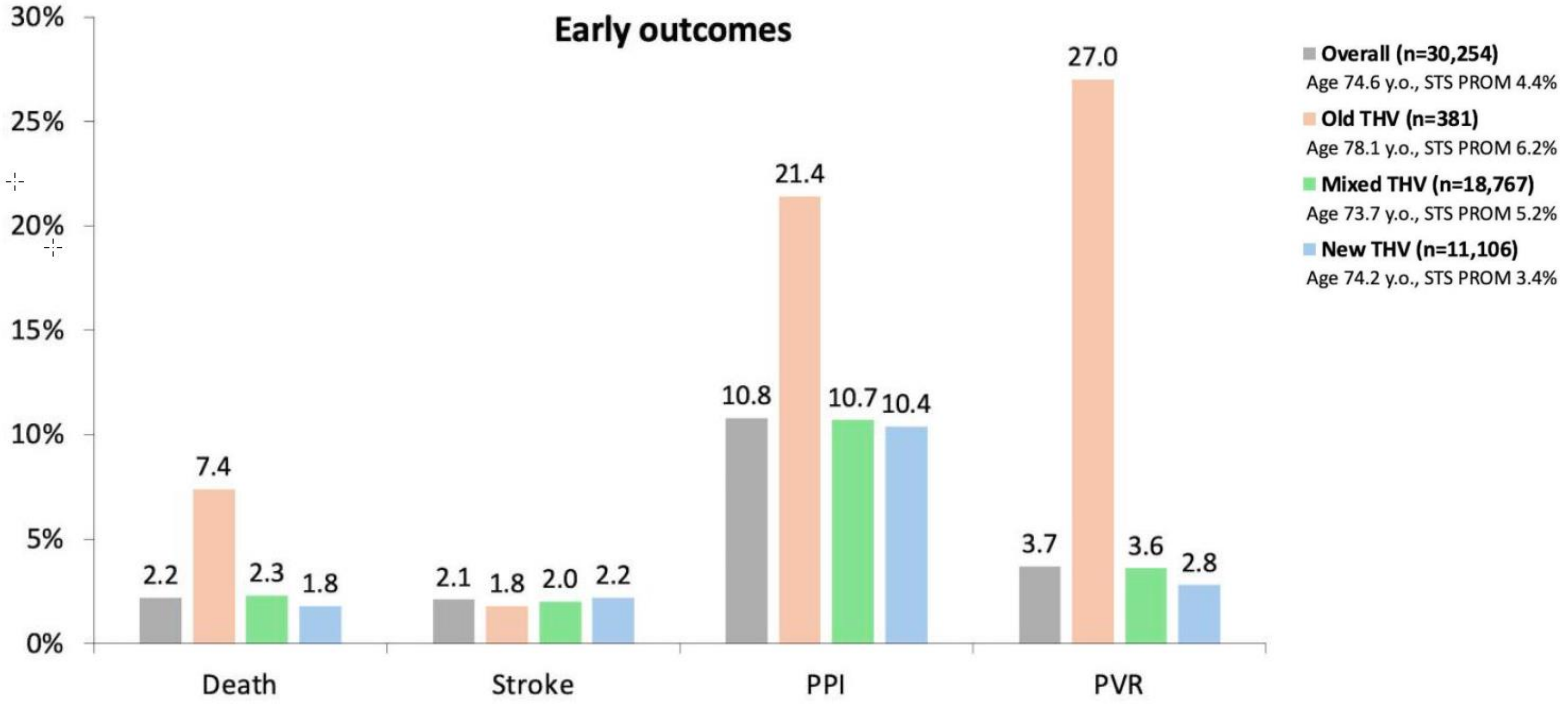
Lowering Age of TAVI Patient Population





Sharma et al, JACC 2022 .Nov 22;80(21):2054 2056.

Outcomes of TAVR in BAV by THV Generations



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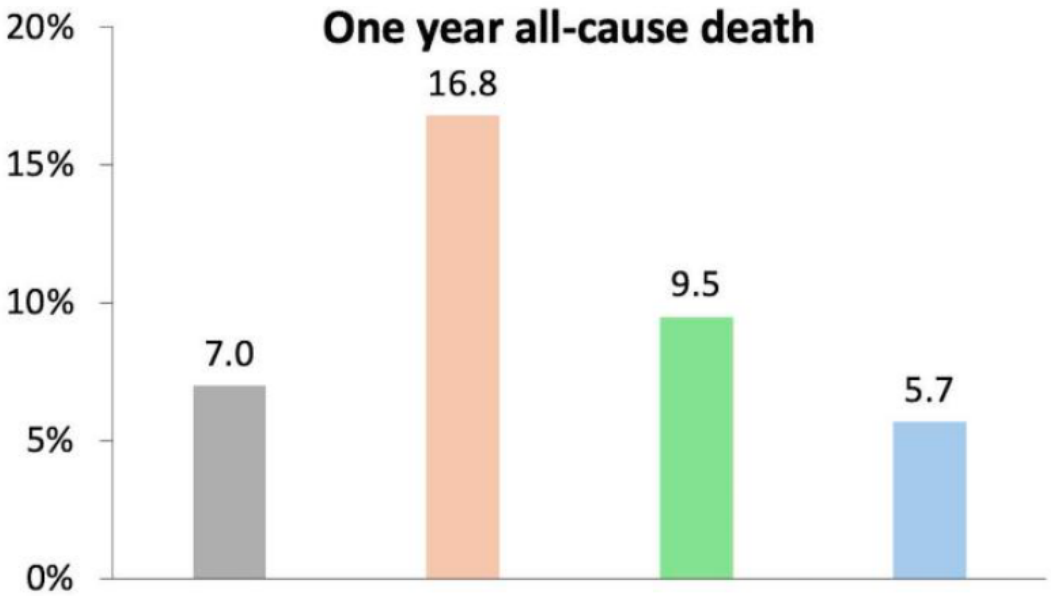
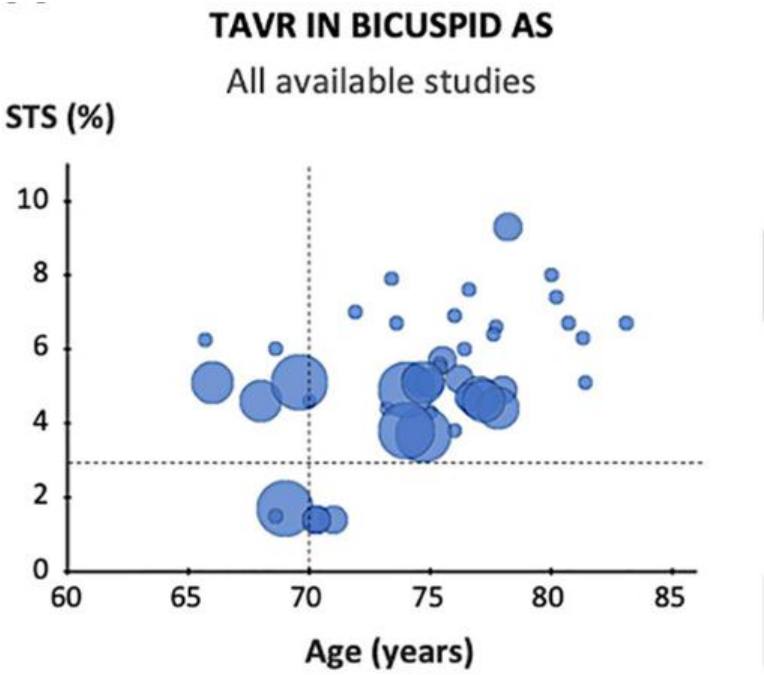
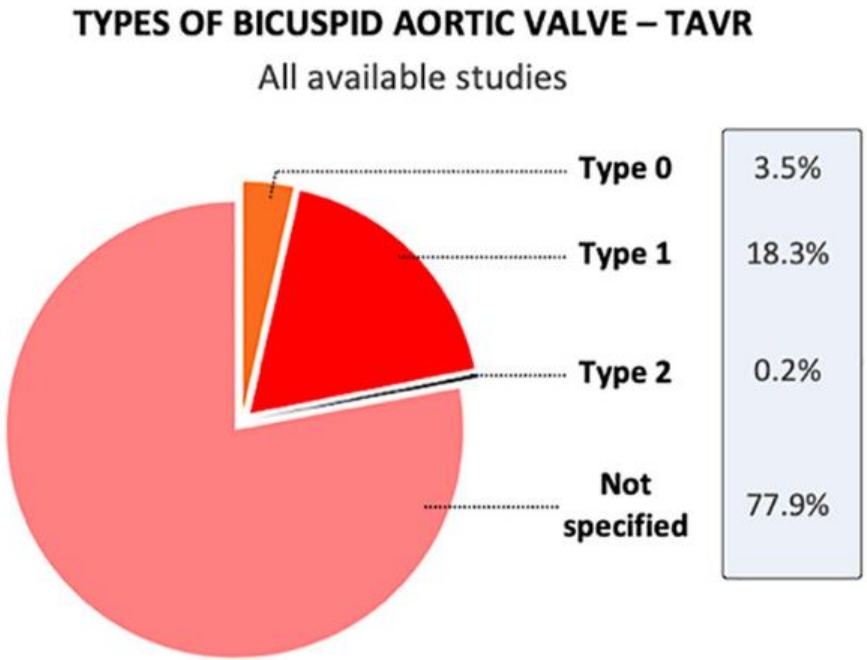


Current studies on SAVR vs TAVI: review





Kang, J. JH. et al. Surgical vs transcatheter aortic valve replacement in bicuspid aortic valve stenosis: A systematic review and meta-analysis. Trends in Cardiovascular Medicine (2023)

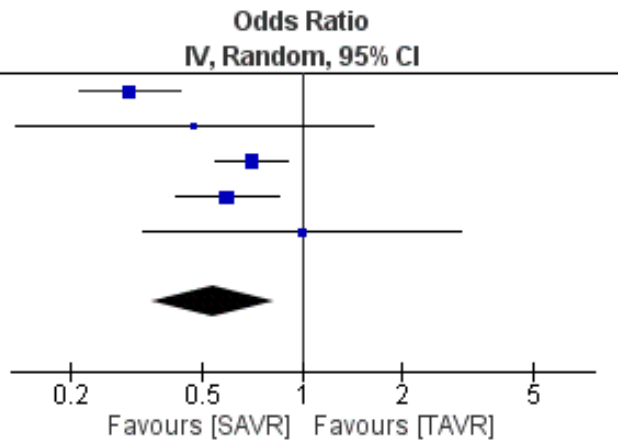
Current studies on SAVR vs TAVI

PPI

Study or Subgroup	SAVR Events	SAVR Total	TAVR Events	TAVR Total	Weight	Odds Ratio IV, Random, 95% CI
Elbadawi 2019	45	975	135	975	26.4%	0.30 [0.21, 0.43]
Husso 2021	4	75	8	75	8.6%	0.47 [0.14, 1.64]
Majmunder 2022	113	1393	155	1393	28.7%	0.71 [0.55, 0.91]
Mentias 2020	53	699	85	699	26.1%	0.59 [0.41, 0.85]
Soud 2020	7	68	7	68	10.2%	1.00 [0.33, 3.02]
Total (95% CI)		**3210**		**3210**	**100.0%**	**0.54 [0.35, 0.83]**
Total events	222		390			

Heterogeneity: $Tau^2 = 0.15$; $Chi^2 = 16.38$, $df = 4$ ($P = 0.003$); $I^2 = 76\%$

Test for overall effect: $Z = 2.83$ ($P = 0.005$)



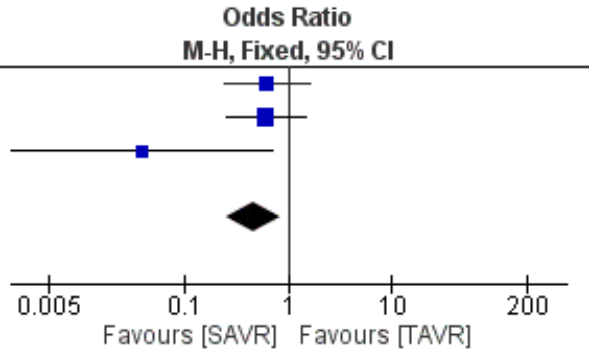
Kang, J. JH. et al. Surgical vs transcatheter aortic valve replacement in bicuspid aortic valve stenosis: A systematic review and meta-analysis. Trends in Cardiovascular Medicine (2023)

Current studies on SAVR vs TAVI

PVL

Study or Subgroup	SAVR Events	SAVR Total	TAVR Events	TAVR Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Husso 2021	8	75	12	75	33.7%	0.63 [0.24, 1.63]
Majmunder 2022	8	1393	13	1393	40.7%	0.61 [0.25, 1.48]
Tsai 2021	0	82	6	48	25.6%	0.04 [0.00, 0.72]
Total (95% CI)		**1550**		**1516**	**100.0%**	**0.47 [0.26, 0.86]**
Total events	16		31			

Heterogeneity: Chi² = 3.48, df = 2 (P = 0.18); I² = 43%
Test for overall effect: Z = 2.43 (P = 0.02)



Kang, J. JH. et al. Surgical vs transcatheter aortic valve replacement in bicuspid aortic valve stenosis: A systematic review and meta-analysis. Trends in Cardiovascular Medicine (2023)

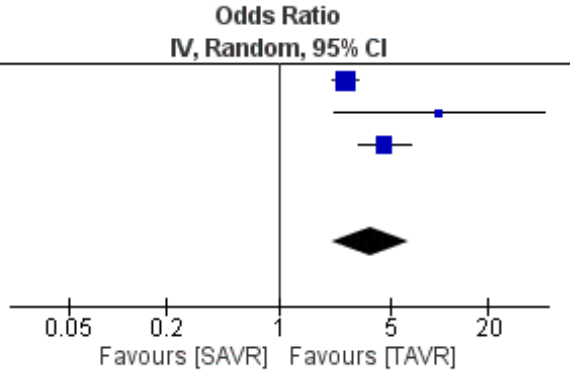
Current studies on SAVR vs TAVI

Bleeding

Study or Subgroup	SAVR Events	SAVR Total	TAVR Events	TAVR Total	Weight	Odds Ratio IV, Random, 95% CI
Elbadawi 2019	435	975	230	975	48.3%	2.61 [2.15, 3.17]
Husso 2021	16	75	2	75	10.4%	9.90 [2.19, 44.78]
Majmunder 2022	145	1393	35	1393	41.3%	4.51 [3.09, 6.57]
Tsai 2021	0	82	0	48		Not estimable
Total (95% CI)		**2525**		**2491**	**100.0%**	**3.76 [2.18, 6.49]**
Total events	596		267			

Heterogeneity: Tau² = 0.15; Chi² = 8.85, df = 2 (P = 0.01); I² = 77%

Test for overall effect: Z = 4.75 (P < 0.00001)



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ESC SHD Guidelines 2025

Mode of intervention		
It is recommended that AV interventions are performed in Heart Valve Centres that report their local expertise and outcome data, have on-site interventional cardiology and cardiac surgical programmes, and a structured collaborative Heart Team.	I	C
It is recommended that the mode of intervention is based on Heart Team assessment of individual clinical, anatomical, and procedural characteristics, incorporating lifetime management considerations and estimated life expectancy.	I	C
TAVI is recommended in patients ≥70 years of age with tricuspid AV stenosis, if the anatomy is suitable.[d] [1–4,389–397,465,485,486]	I	A
SAVR is recommended in patients <70 years of age, if the surgical risk is low.[e] [413,429,487]	I	B
SAVR or TAVI are recommended for all remaining candidates for an aortic BHV according to Heart Team assessment.[2,4,396,397,429,488–490]	I	B
Non-transfemoral TAVI should be considered in patients who are unsuitable for surgery and transfemoral access.[417–423,491–498]	IIa	B
TAVI may be considered for the treatment of severe BAV stenosis in patients at increased surgical risk, if the anatomy is suitable.[430–432,434,499–502]	IIb	B
Balloon aortic valvotomy may be considered as a bridge to SAVR or TAVI in haemodynamically unstable patients, and (if feasible) in those with severe AS who require urgent high-risk NCS.	IIb	C

ESC European Society of Cardiology
European Heart Journal (2025) **00**, 1–102
https://doi.org/10.1093/eurheartj/ehaf194
ESC GUIDELINES

2025 ESC/EACTS Guidelines for the management of valvular heart disease

RCT proposal

TAVR in Bicuspid Aortic Stenosis

Current Evidence and Proposal for a Randomized Controlled Trial Design

Philippe Nuyens, MD,[a] Ole De Backer, MD, PhD,[a] Janarthanan Sathananthan, MBChB, MPH,[b,c] Troels Højsgaard Jørgensen, MD, PhD,[a] Hendrik Treede, MD, PhD,[d] Jonathon A. Leipsic, MD, PhD,[b] Jeroen J. Bax, MD, PhD,[e] John G. Webb, MD,[b,c] Roxana Mehran, MD,[f] Mao Chen, MD, PhD,[g] Michael Reardon, MD,[h] Martin B. Leon, MD,[i,j] Lars Søndergaard, MD, DMSc[a]

Patients with severe symptomatic AS and bicuspid aortic valve

- Heart Team decision for replacement with a bioprosthetic aortic valve
- Low risk for SAVR or TAVR, as assessed by the local Heart Team
- Patient's age ≤ 75 years and an estimated remaining life expectancy of more than 5 years
- No need for aortic root replacement (ascending aorta diameter < 50 mm)

	Safety outcome analysis	Effectiveness outcome analysis
	Intermediate analysis	**Non-inferiority RCT**
Significance level (α)	-	5%
Power (1-β)	-	80%
Non-inferiority limit	-	4%
Sample size per group	-	426
Drop out	-	10%
Total sample size required		**N = 940**

	A priori expected rates of clinical endpoints			
	At 2 years		At 5 years	
	TAVR	SAVR	TAVR	SAVR
Mortality	2%-3%	2%-3%	4%-6%	4%-6%
Stroke	3%-4%	3%-4%	6%-8%	6%-8%
Valve-related hospitalization	-	-	6%-10%	8%-14%
Composite endpoint	**6%** (5%-7%)	**6%** (5%-7%)	**20%** (16%-24%)	**23%** (18%-28%)

Nuyens, P. et al. TAVR in Bicuspid Aortic Stenosis: Current Evidence and Proposal for a Randomized Controlled Trial Design. JACC: Cardiovascular Interventions 16, 1682–1687 (2023).

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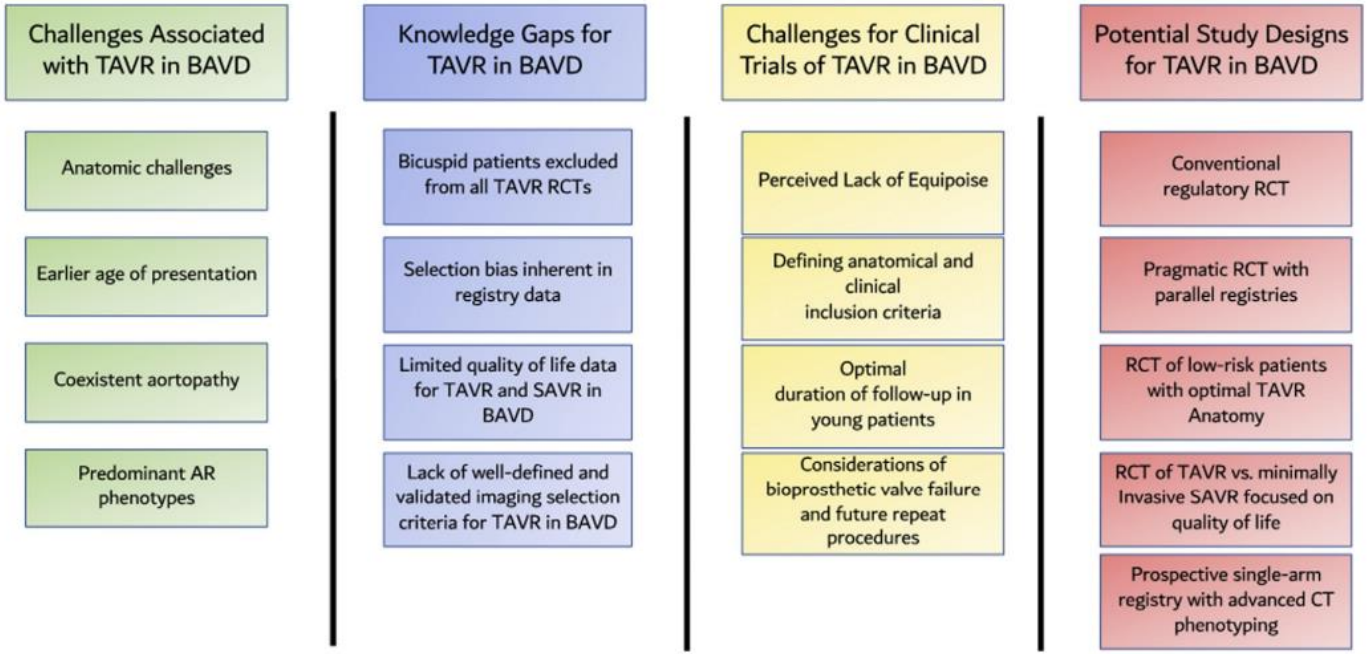
Study Design Proposal



Ahmad, Y. et al. Clinical Research on Transcatheter Aortic Valve Replacement for Bicuspid Aortic Valve Disease: Principles, Challenges, and an Agenda for the Future. Struct Heart 7, 100102 (2023).