

2016 ASE State of the Art Echocardiography Course | Tucson, AZ

Echo Evaluation of a Mitral Valve Prostheses

Sunday, February 14, 2016 | 1:50 – 2:10 PM | 20 min

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NYU
SCHOOL OF
MEDICINE



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Director of Echocardiography Lab
Director of Operations, Noninvasive Cardiology
Associate Professor of Medicine
New York University Langone Medical Center

Disclosures

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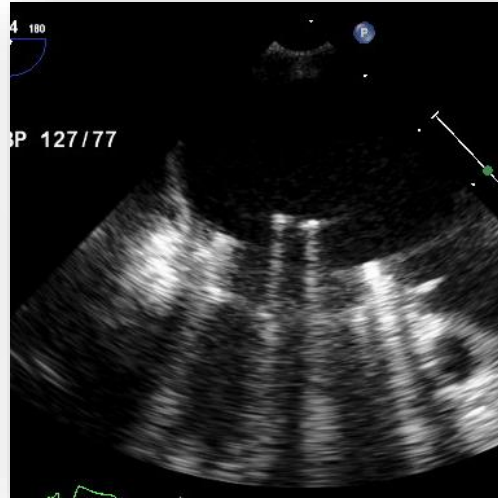
Speakers Bureau
Philips, Medtronic

IMAGING OF PROSTHETIC VALVES



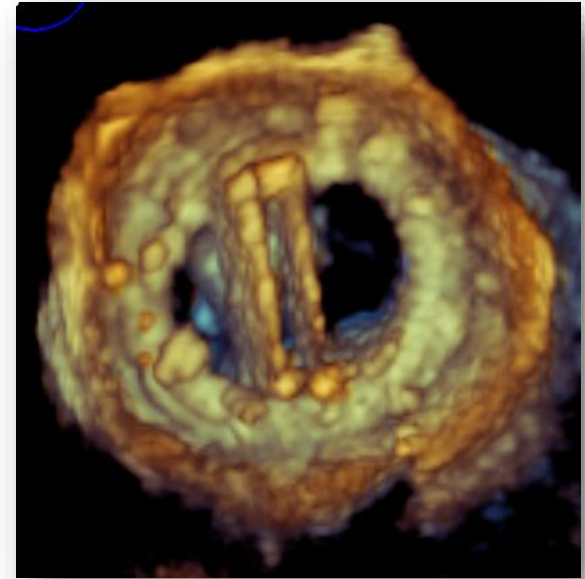
Prosthetic valves have been in clinical use for about **50 years.**

1960's



Until recently, **cross-sectional 2D imaging** was practically the only way to visualize them.

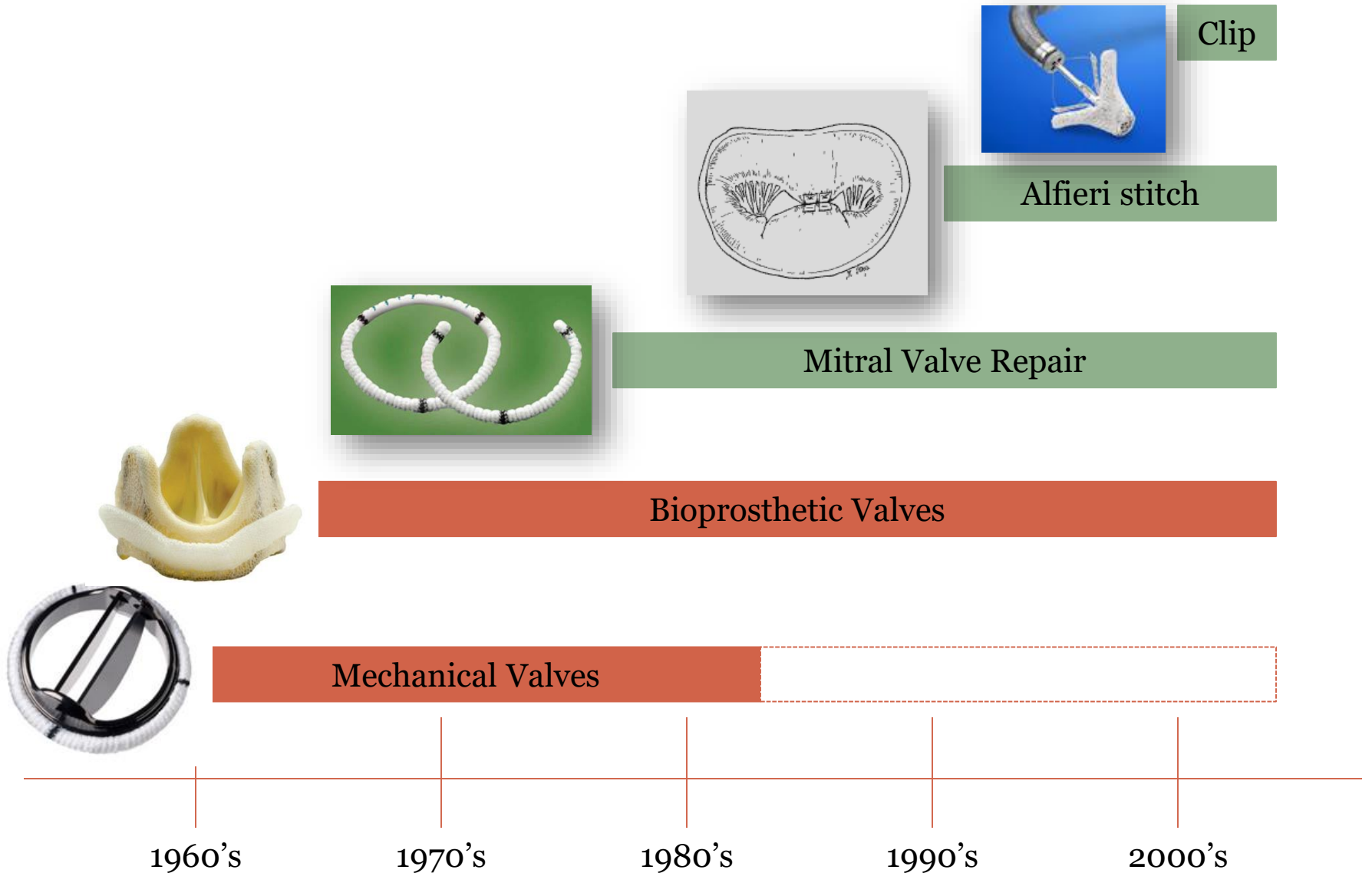
St. Jude mitral valve in 'anti-anatomic' position.



With **3D echocardiography** images start to match the appearance of actual valves.

2000's

HISTORICAL DEVELOPMENT OF PROSTHETIC VALVES



Valve Prosthesis

Mechanical

Bioprosthetic

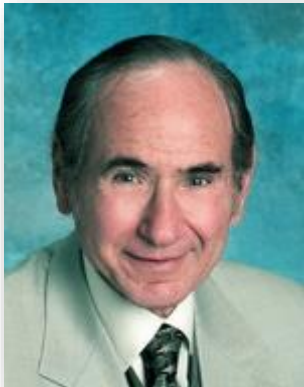
First implantation

First implantation

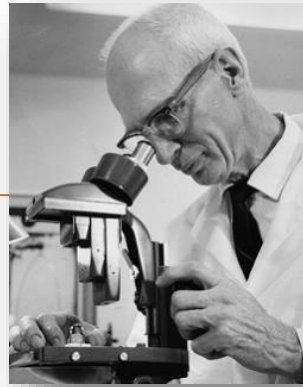
1960

1965

Trained at Bellevue Hospital,
now part of NYU Medical Center



Starr-Edwards
mechanical valve



Carpentier-Edwards
bioprosthetic valve



Albert Starr
(b. 1926 in New York)

Miles Lowell Edwards
(1898-1982)

Alain Carpentier
(b. 1933 in Toulouse)

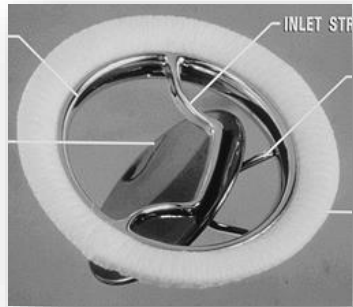
MECHANICAL VALVES

(Year of First Introduction)



Starr-Edwards
(1960)

BALL-IN-CAGE

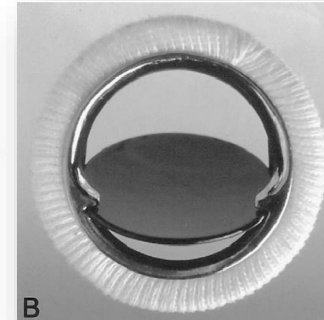


Björk-Shiley
(1969)
>> Discontinued
1986



Hall-Kaster
(1977)
>> **Medtronic Hall**

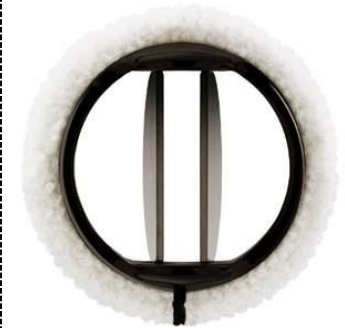
SINGLE LEAFLET



Omniscience
(1978)



Omnicarbon
(1984)



Nicoloff-Posis
(1977)
>> **St Jude**

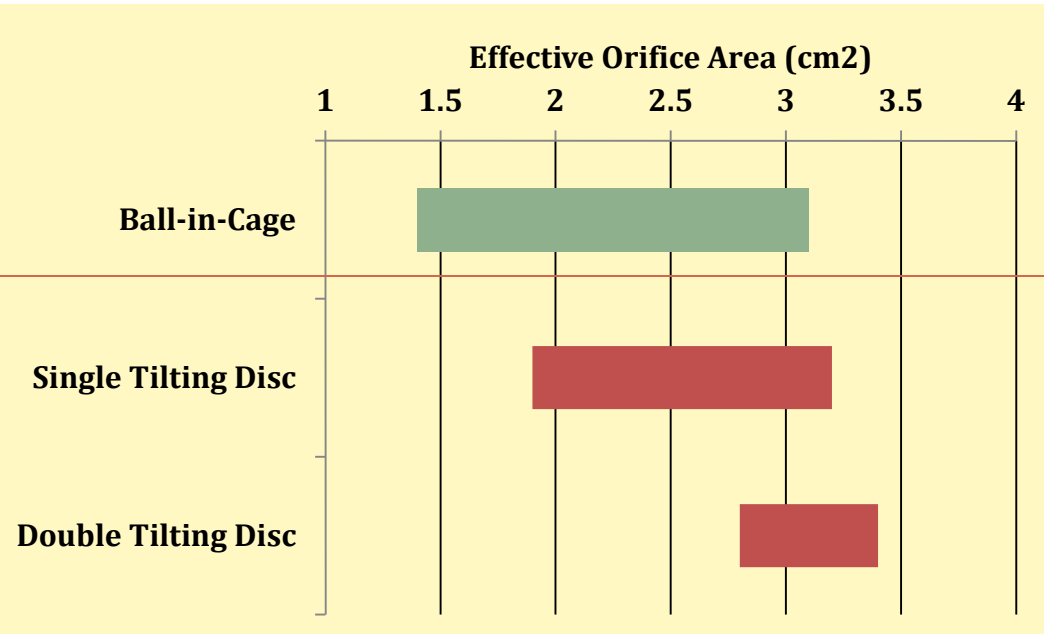


Carbomedics
(1980's)

BILEAFLET

Mechanical Mitral Valve Prosthesis

7



Metal cage
+ silastic ball

Partly or fully made of **pyrolytic carbon**
(originally used in nuclear reactors)



Jack Bokros

(b. 1935)

Inventor of pyrolytic carbon

Based on data from *N Eng J Med* 1996;335(6):407-416

Increase in Valve
Orifice Area

QUESTION #1:

How many prosthetic valves are implanted in the United States annually?

- A. 1,000
- B. 10,000
- C. 100,000
- D. 1,000,000

QUESTION #2:

What percentage of implanted valves are mechanical?

- A. 10%
- B. 30%
- C. 50%
- D. 70%

Annually, approximately 100,000 prosthetic valves are implanted in the United States, approximately 50% of which are mechanical.

United States represents approximately 1/3 of the world valve prosthesis market.

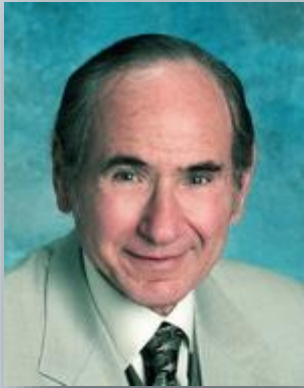
Mechanical Prostheses

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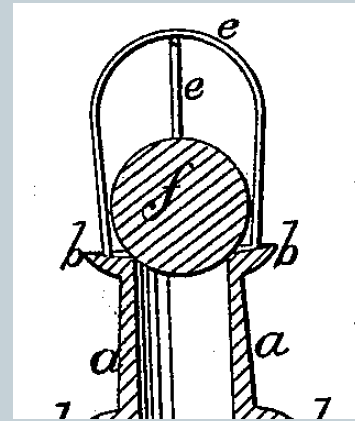
BALL-IN-CAGE

Starr-Edwards Ball-in-Cage Valve

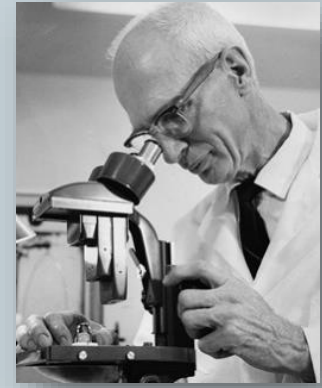
10



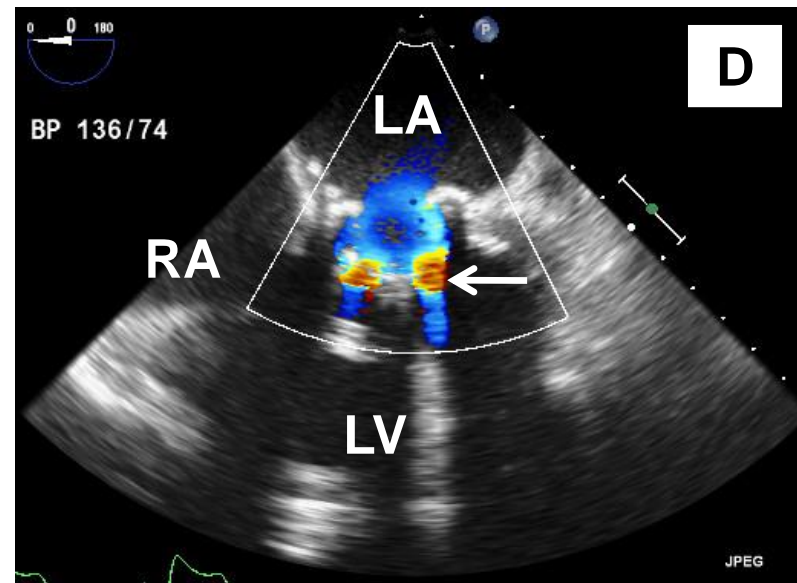
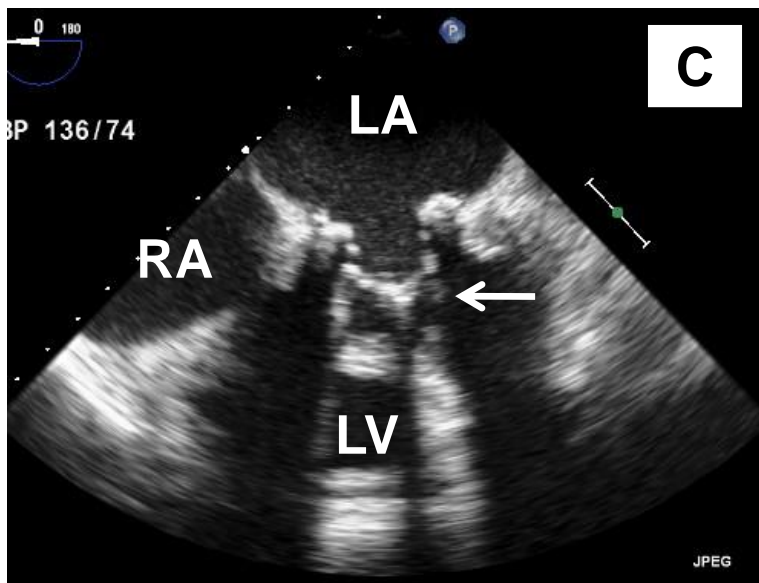
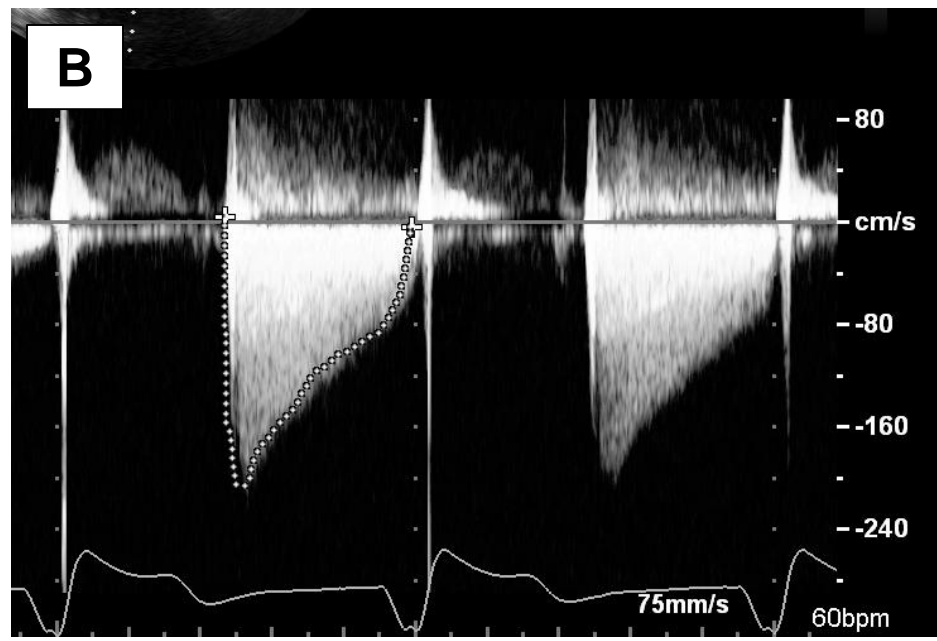
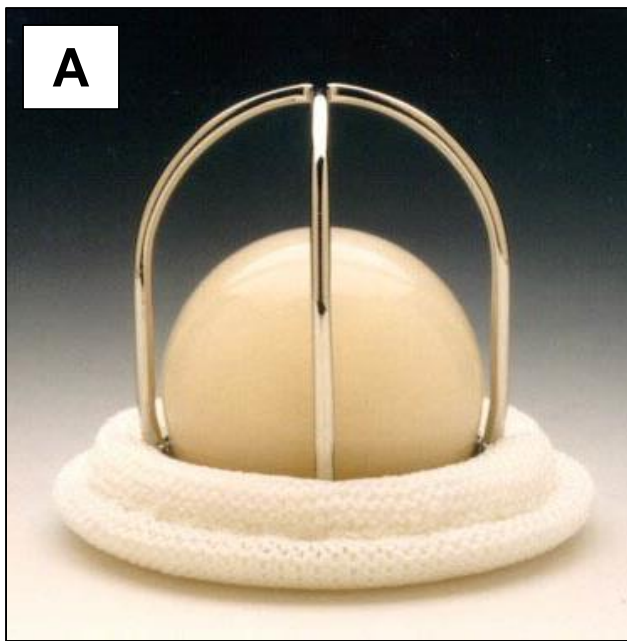
Albert Starr
(b. 1926 in New York)
American Surgeon
Trained at Bellevue Hospital,
now part of NYU



Bottle Stopper
1858 patent to JB
Williams from
New York



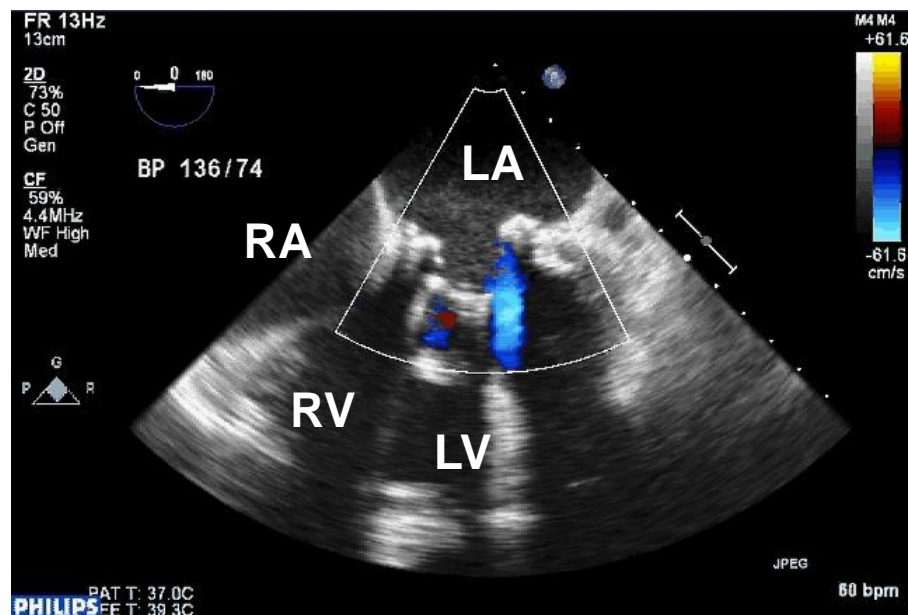
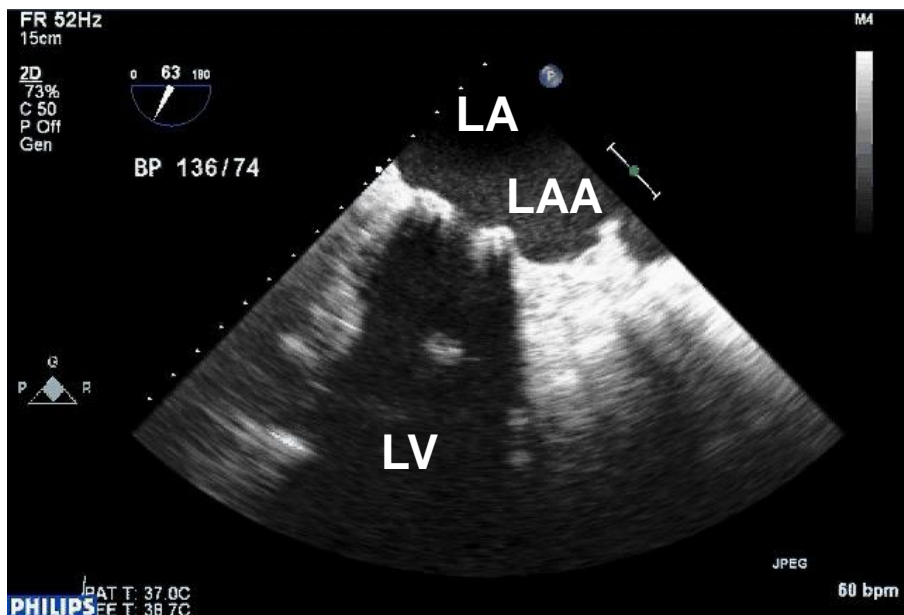
Miles Lowell Edwards
(1898-1982)
American Engineer



2D TEE: Starr-Edwards Mitral Valve

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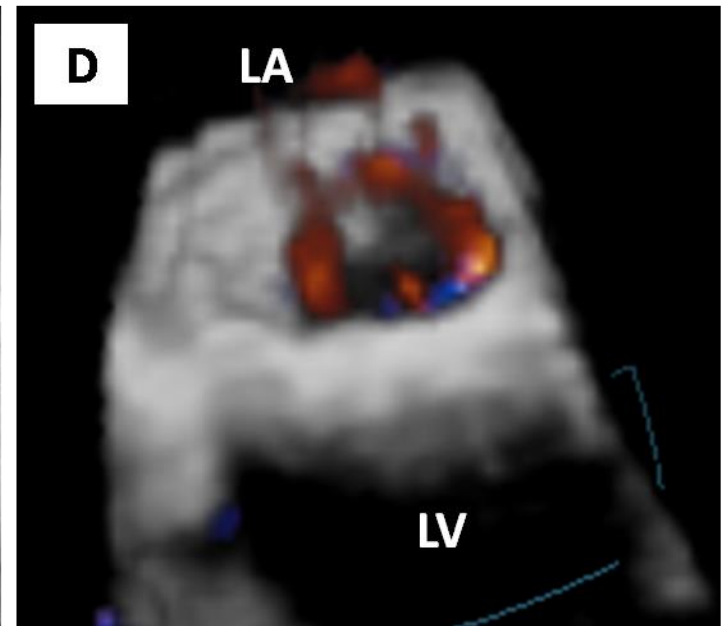
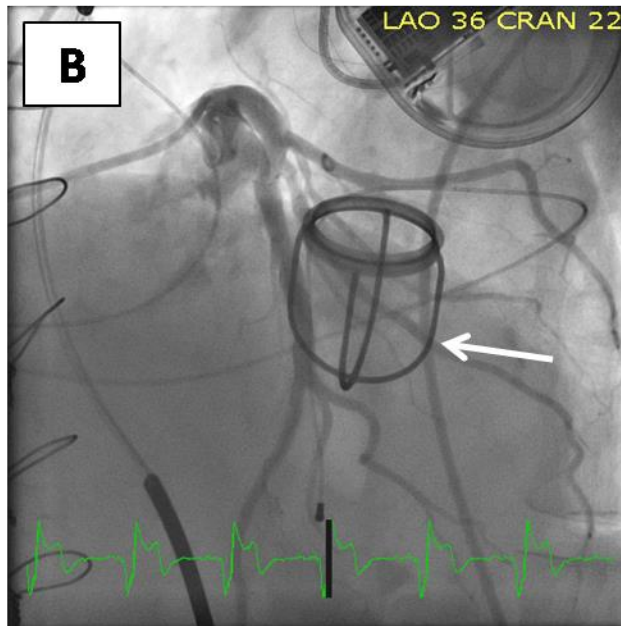
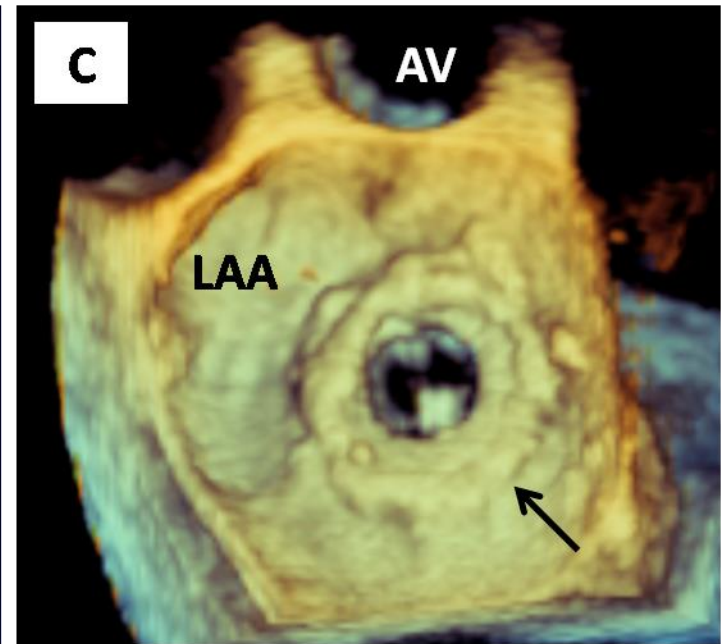
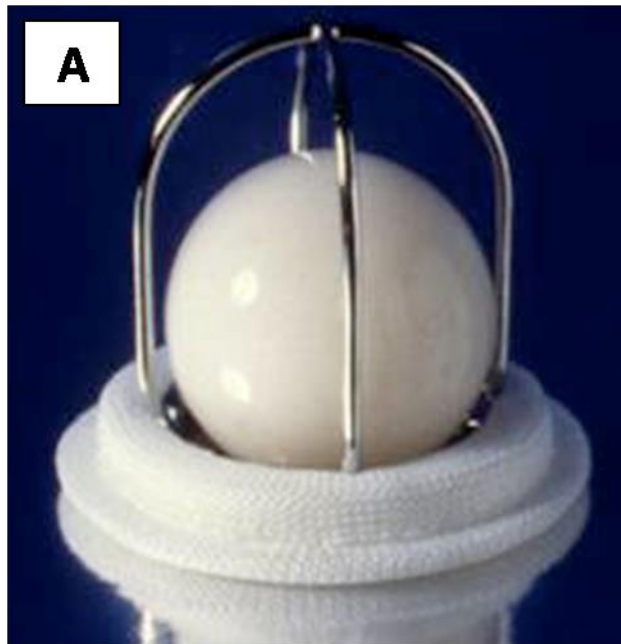
77-year-old woman; s/p Starr-Edwards MVR (Model 6120; size 2M = 28 mm)
35 years earlier in Rochester, NY



**Starr-Edwards
Mechanical Valve
(Model 6120)**

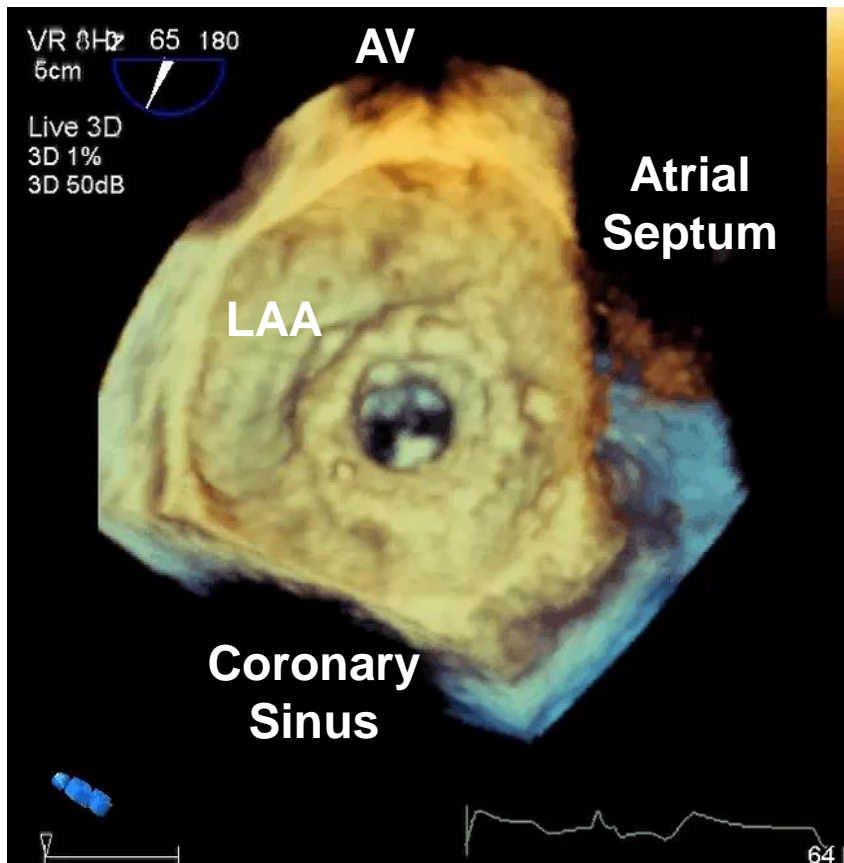
Used since 1960's

Still in production and
implanted mostly in
developing countries
due to its reasonable
cost.

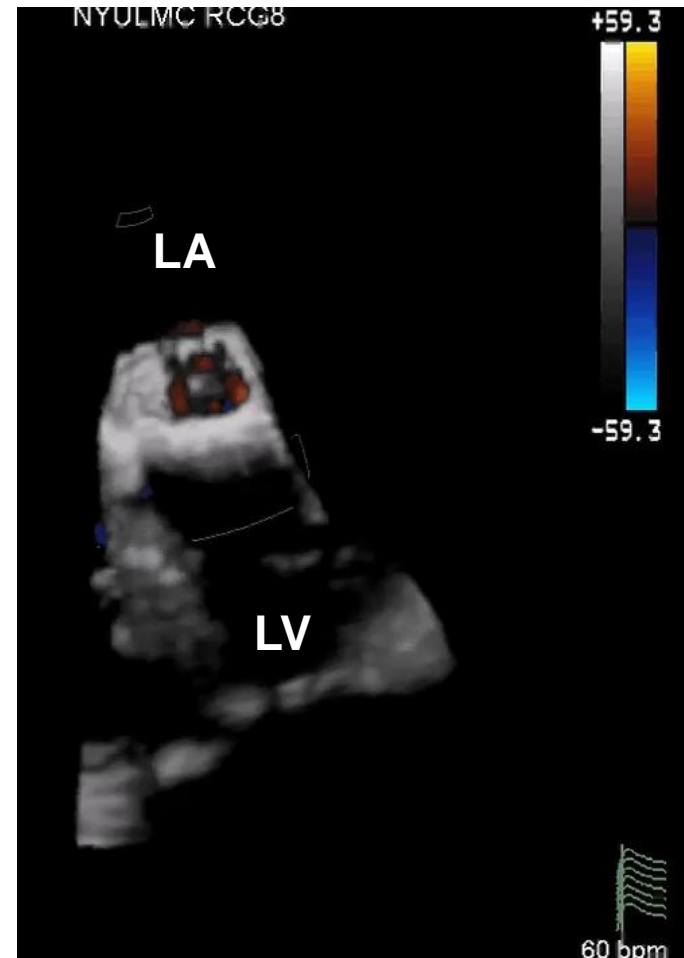


3D TEE: Starr-Edwards Valve

14



LA Side



Starr-Edwards Valve on Fluoroscopy

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Fluoroscopy
Starr-Edwards Mitral Valve

Video 1

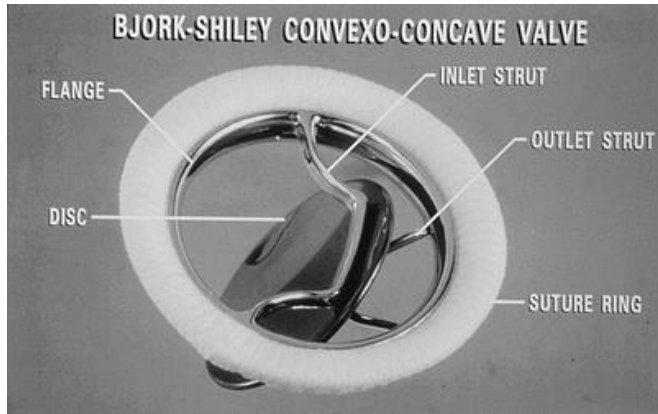
N Engl J Med. 2008;358(21):e24

Mechanical Prostheses

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SINGLE TILTING DISC

SUMMARY: SINGLE TILTING DISC MECHANICAL PROSTHESES



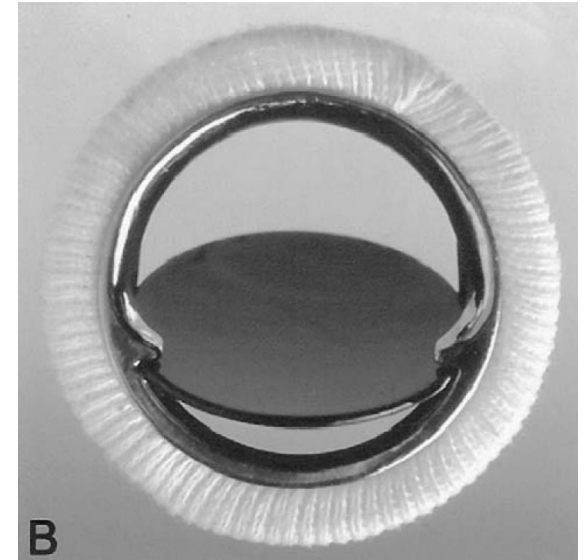
Björk-Shiley

2 central struts



Medtronic Hall

1 central strut



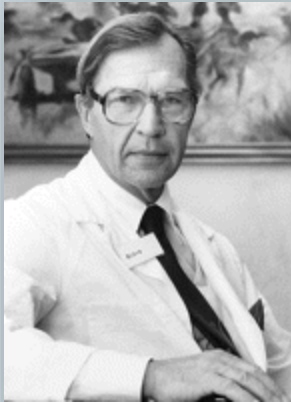
Omniscience

No central struts



Björk-Shiley Single Tilting Disc Valve

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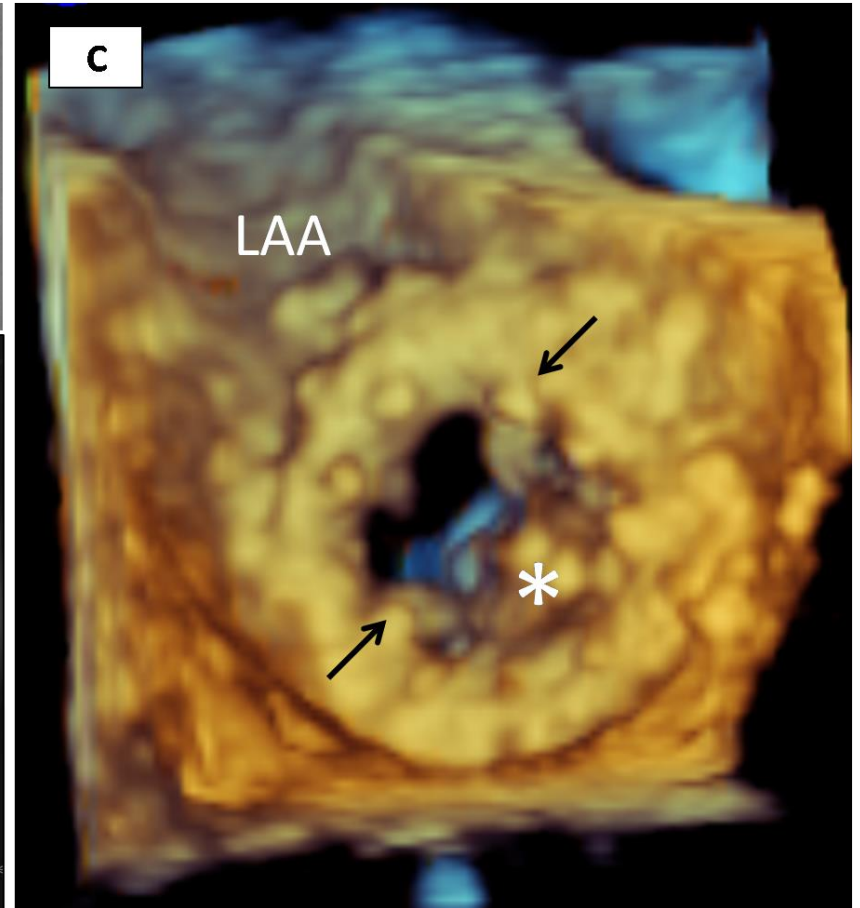
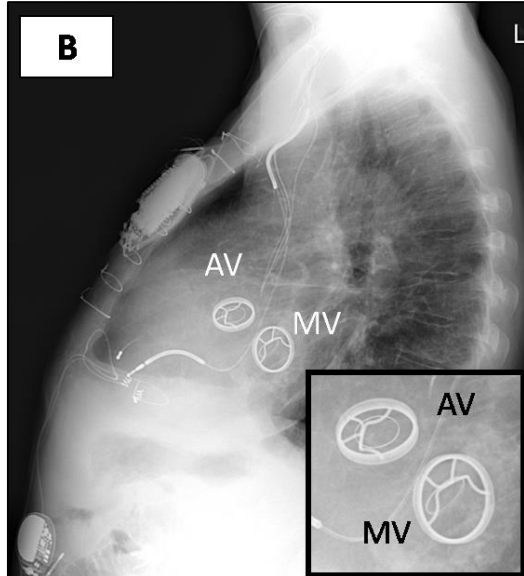
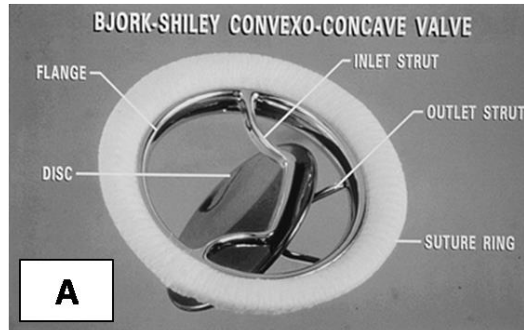
Viking Björk
(1918-2009)
Swedish Cardiac Surgeon



Donald Shiley
(1920-2010)
American Engineer

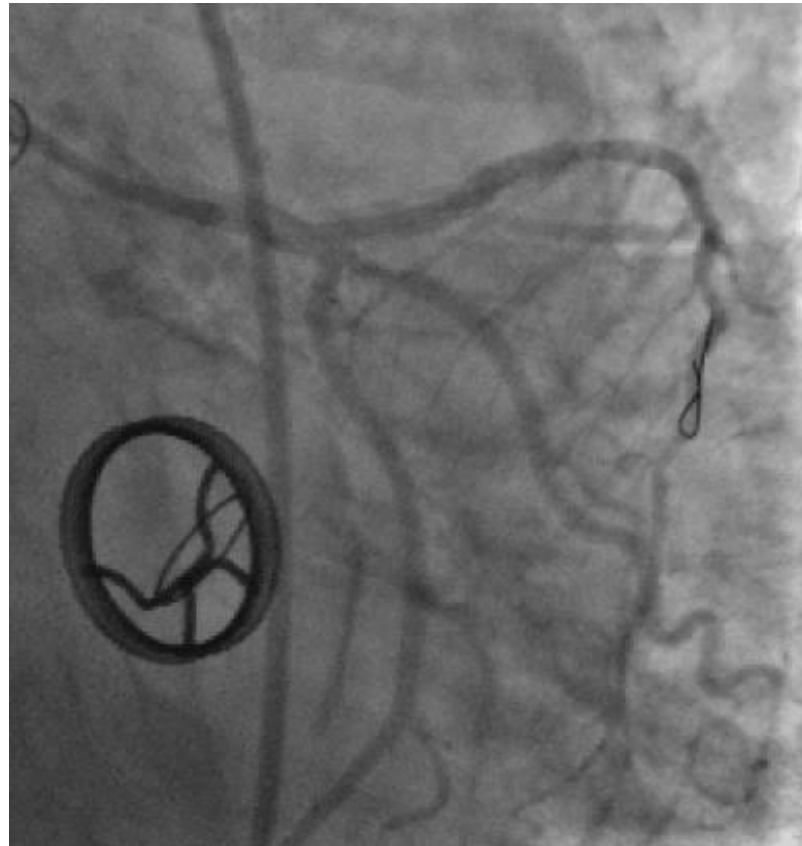
Björk-Shiley Single Tilting Disc Valve

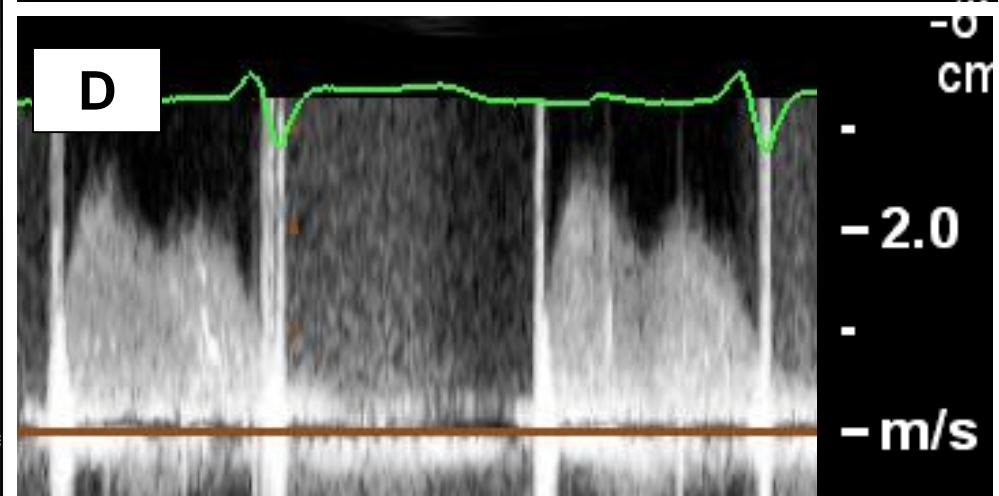
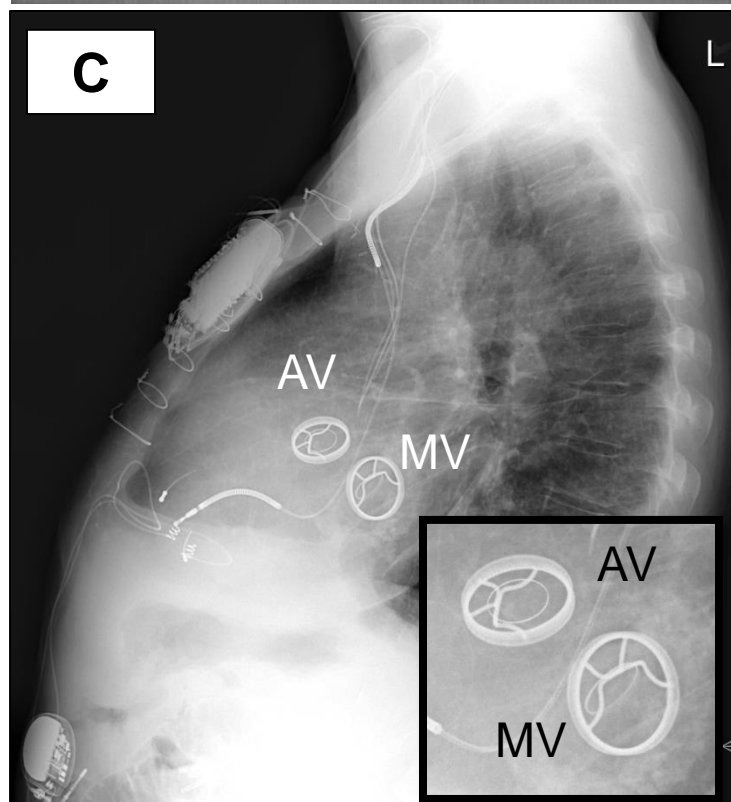
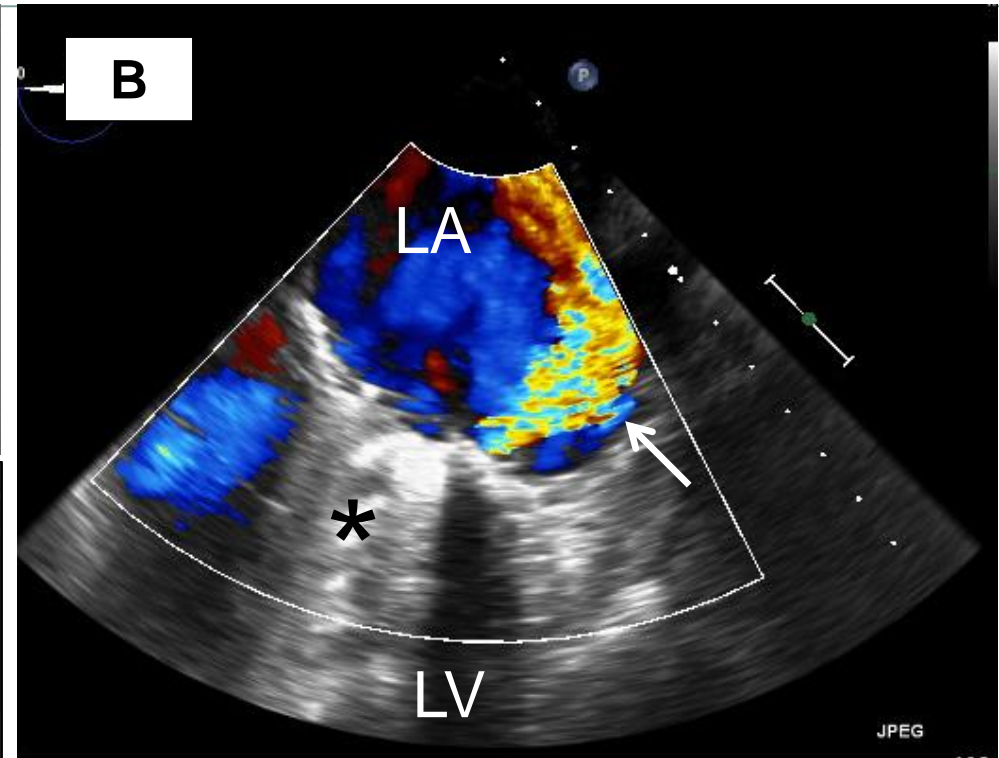
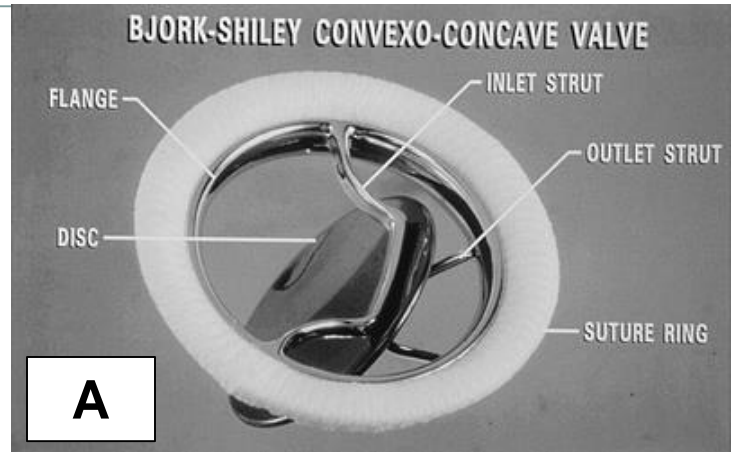
Used 1971-1986,
discontinued after a
series of strut fractures.



Fluoroscopy: Björk-Shiley MVR

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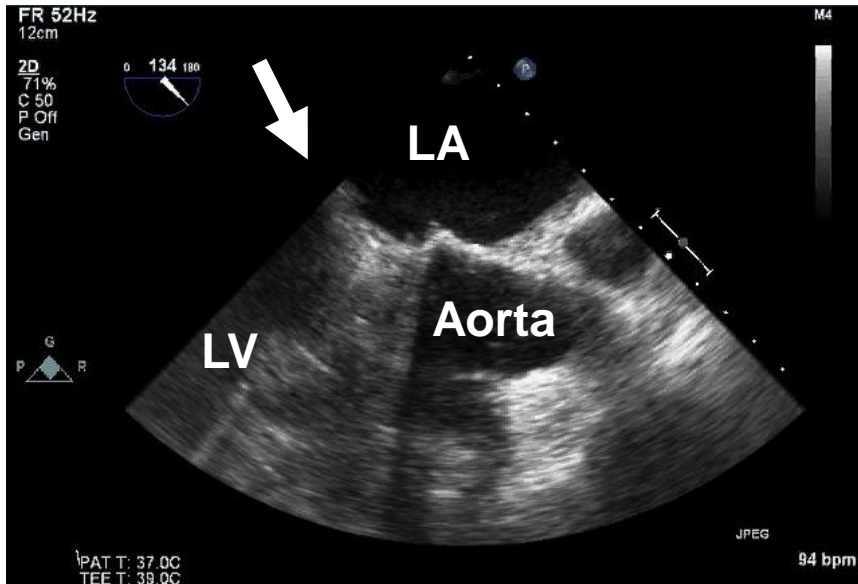


Figure

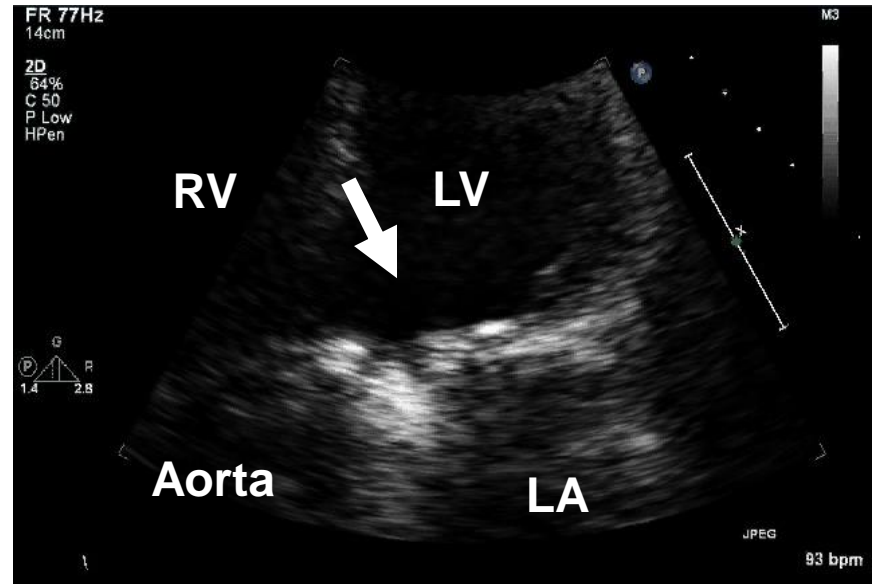
2D Echo: Björk-Shiley Mitral Prosthesis

22

40-year-old woman; s/p Björk-Shiley MVR in 1980's
Now presents with progressive dyspnea



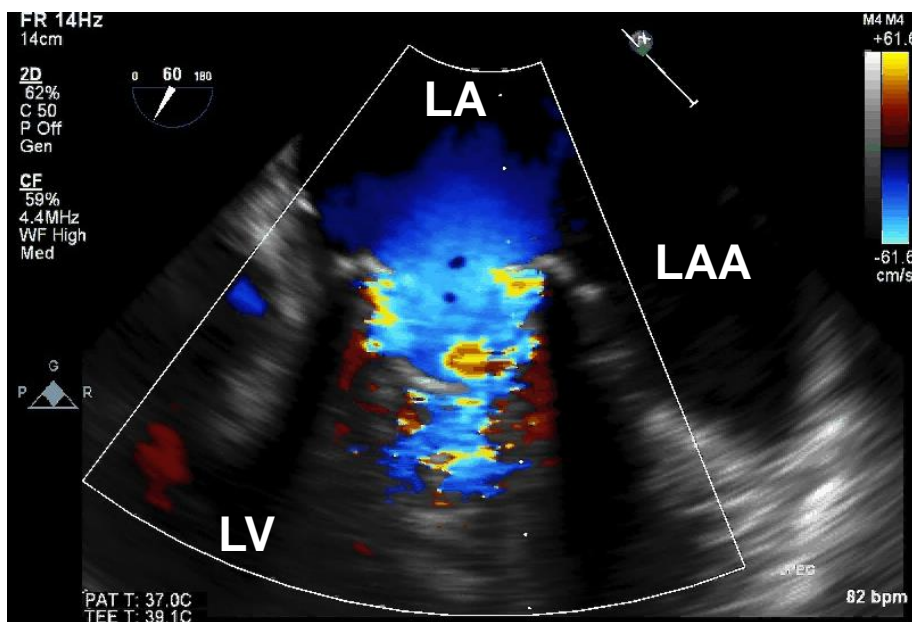
2D TEE



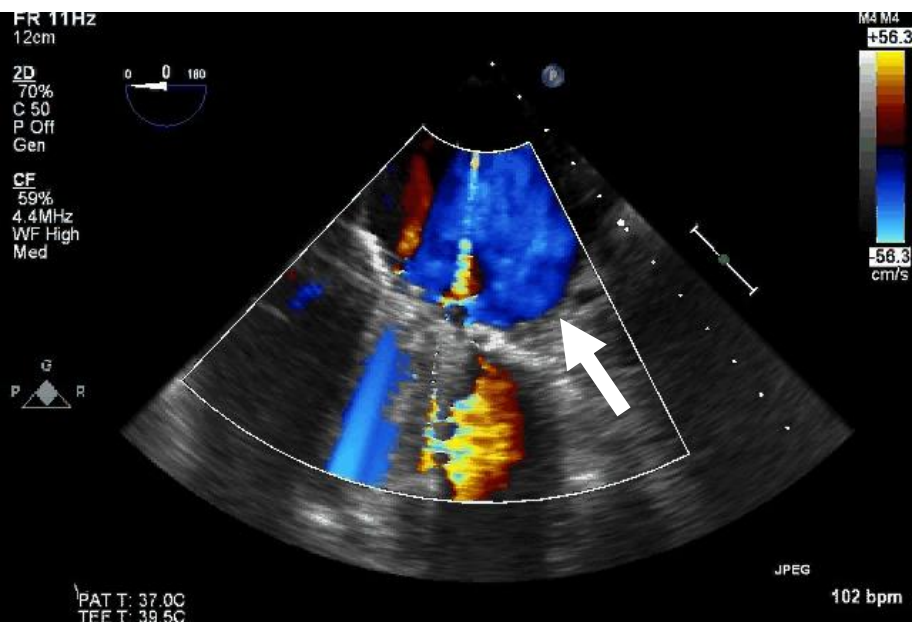
2D TTE

2D TEE: Björk-Shiley MVR

23

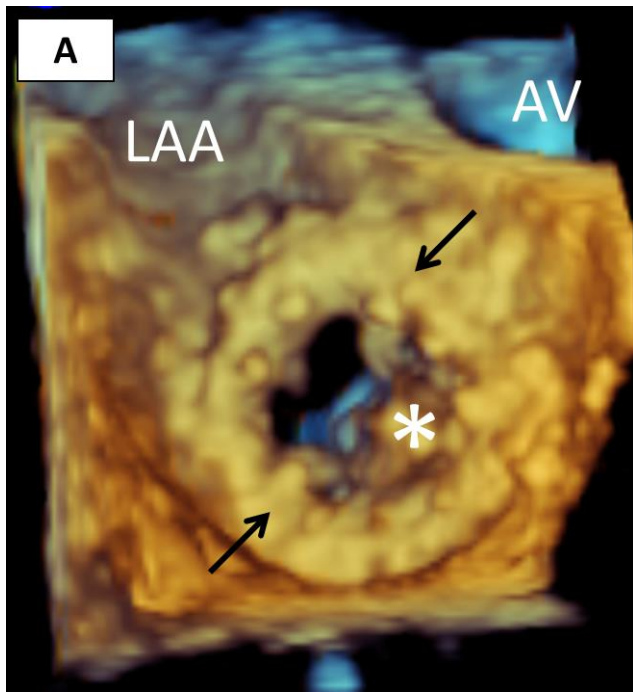


NORMAL
Mild Mitral Regurgitation
(Washing Jets)

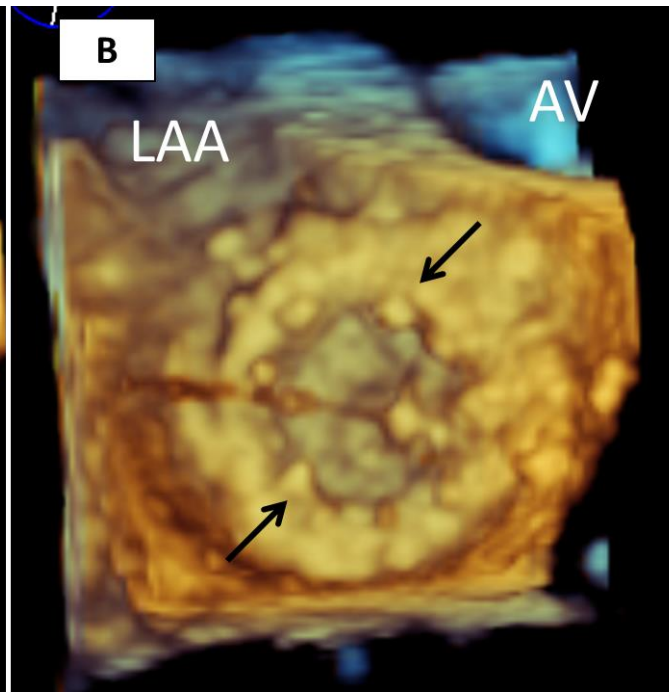


ABNORMAL
Paravalvular Mitral Regurgitation

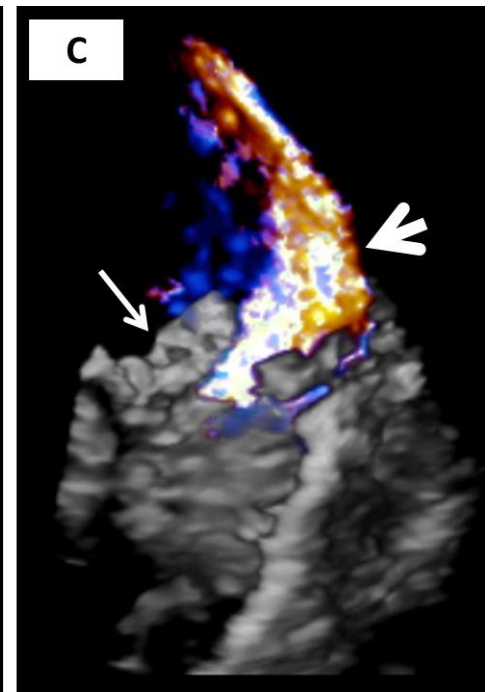
3D TEE: Björk-Shiley Mitral Prosthesis



DIASTOLE: Valve Open

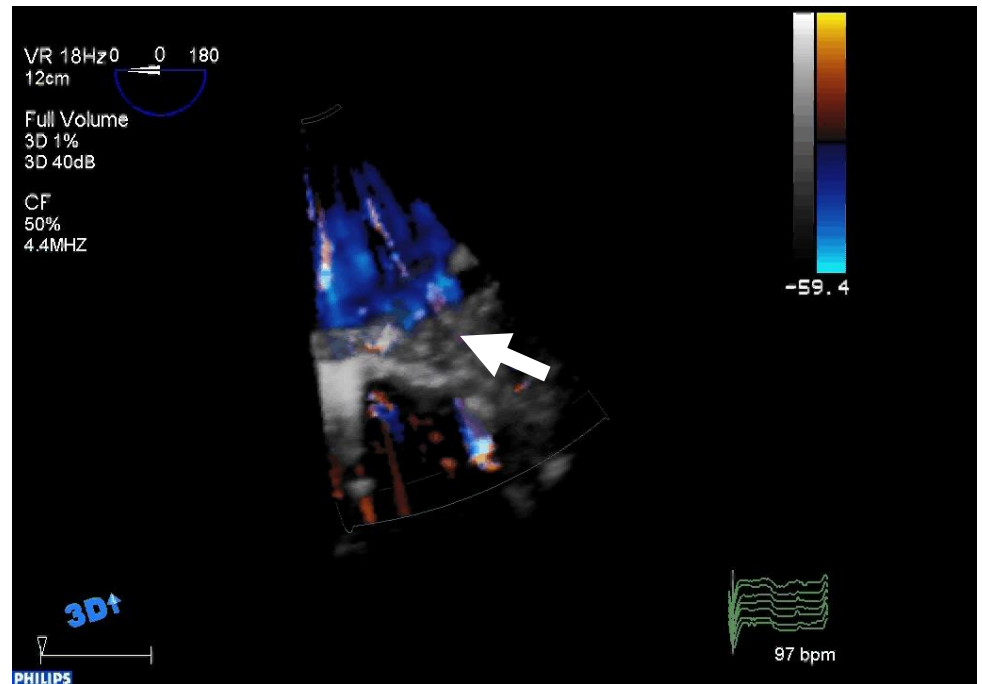
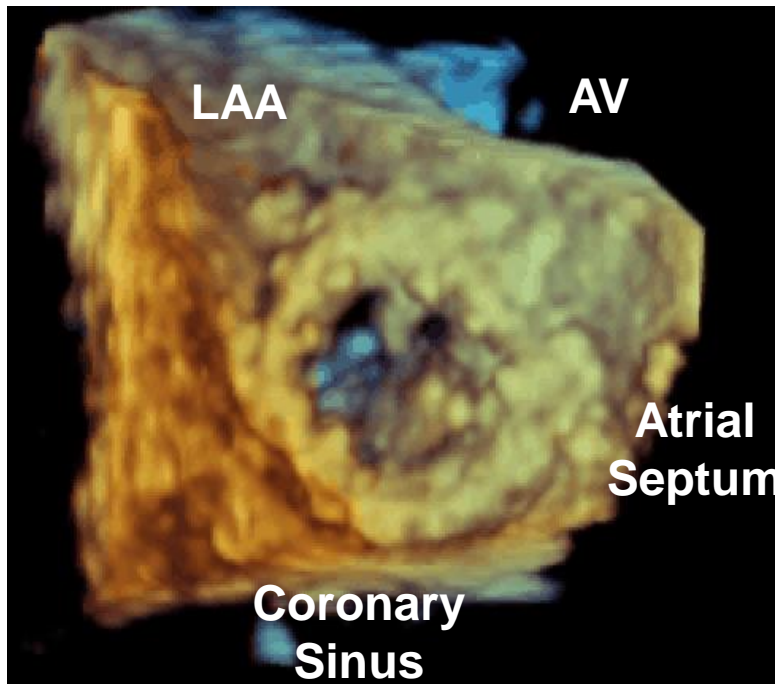


SYSTOLE: Valve Closed



SYSTOLE: Paravalvular Leak

3D TEE: Björk-Shiley Mitral Prosthesis

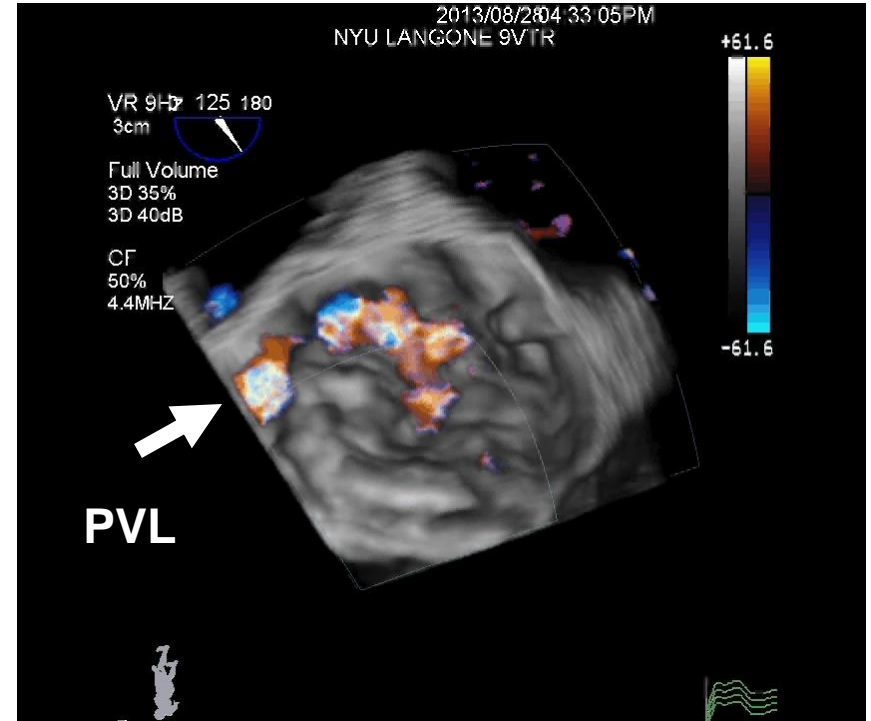
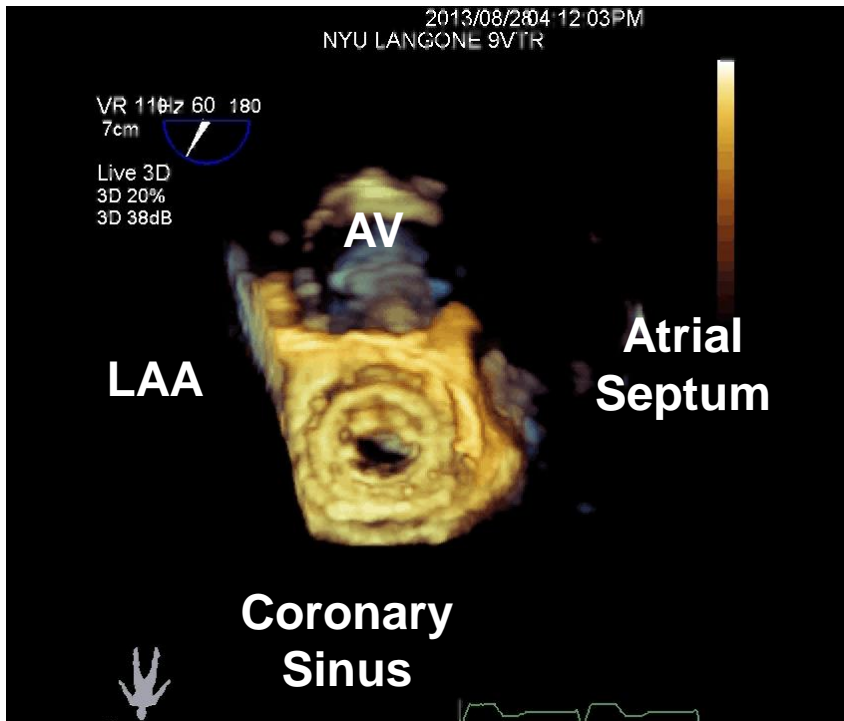


Severe paravalvular mitral regurgitation

3D TEE: Björk-Shiley Valve

26

77-year-old woman; s/p Björk-Shiley MVR in 1980's
Now presents with hemolytic anemia



Hall-Kaster (Medtronic Hall) Single Tilting Disc Valve

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Karl Victor Hall
(b. 1917)
Norwegian Surgeon



Robert Kaster
(b. 1933)
American Engineer

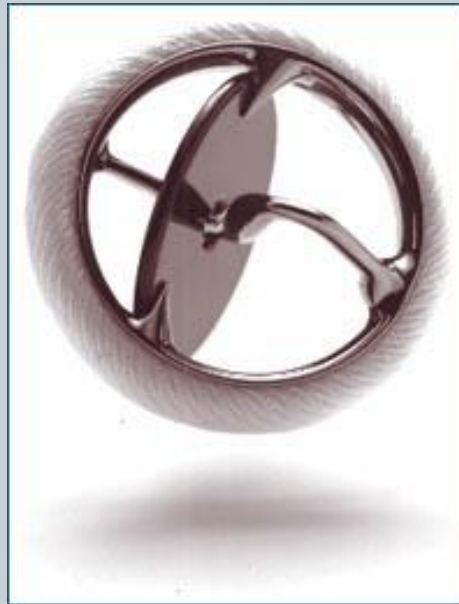


Medtronic Hall (Hall-Kaster) Single Tilting Disc Valve

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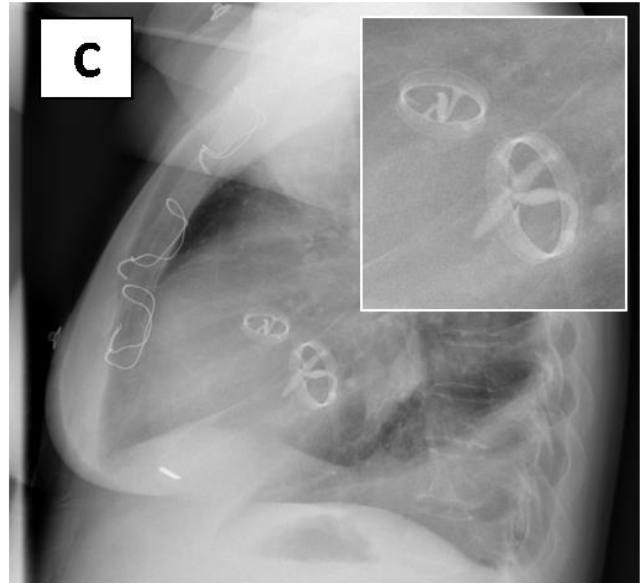
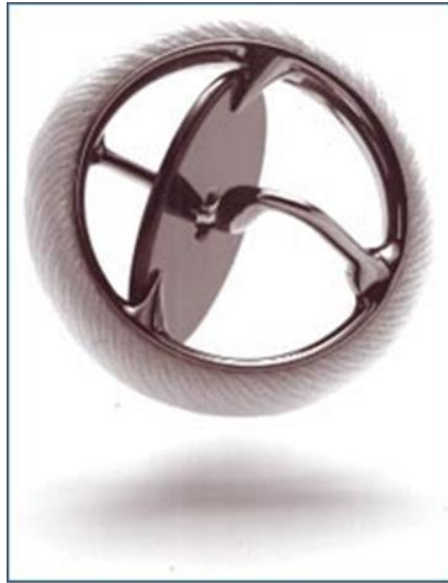


Karl Victor Hall
(1917-2001)
Norwegian Surgeon



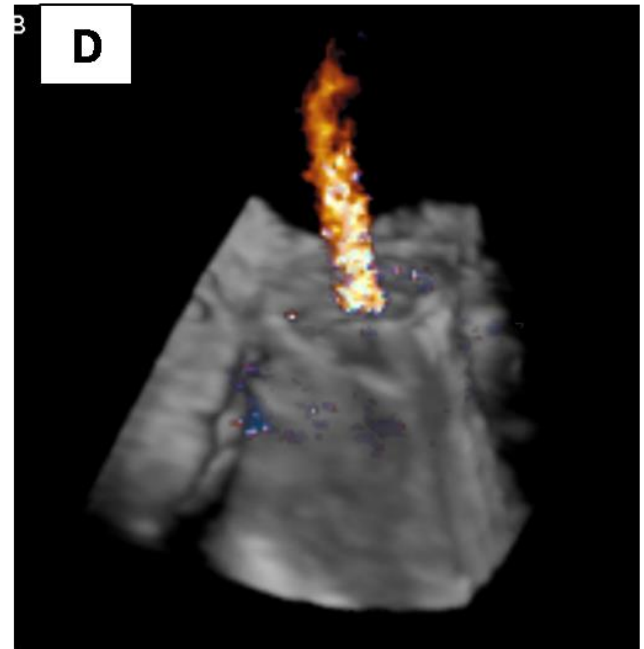
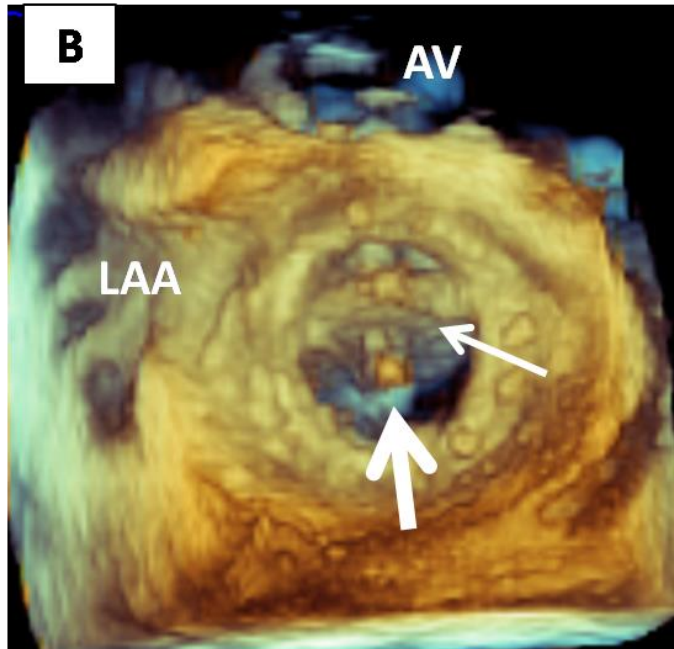
Robert Kaster
(b. 1933)
American Engineer

A



**Medtronic Hall
Single Tilting Disc
Valve**

Used since 1977;
still in production



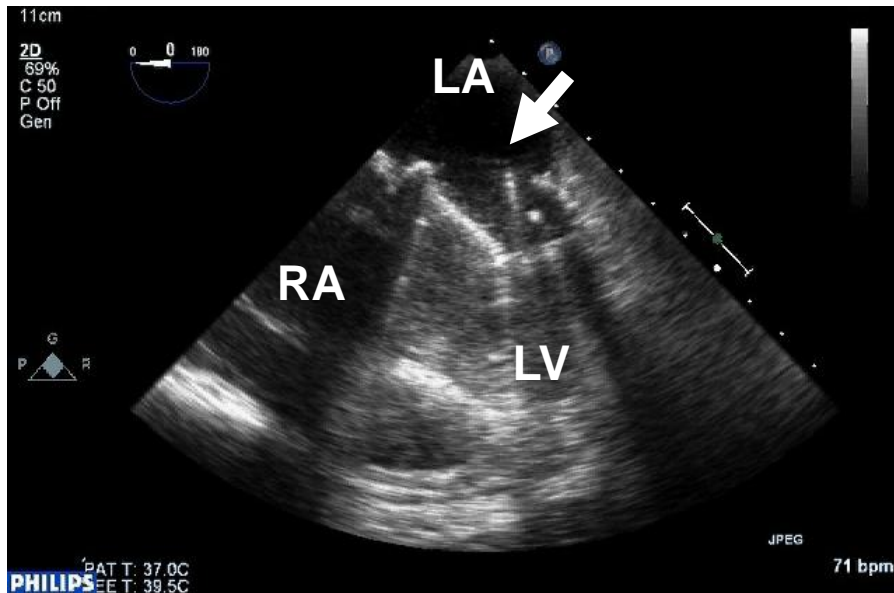
Fluoroscopy: Medtronic Hall MVR + AVR

30

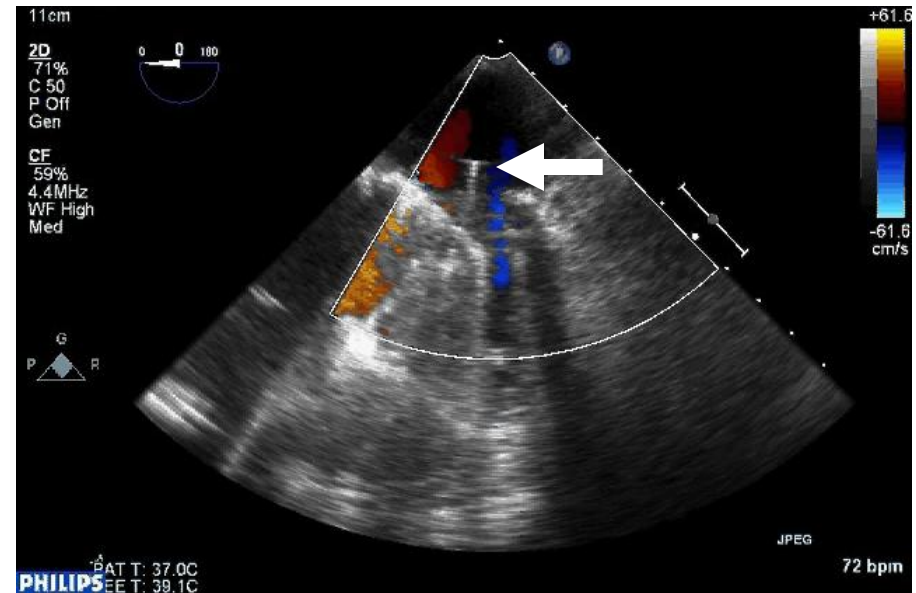
Fluoroscopy
Hall-Medtronic Mechanical
Mitral & Aortic Prostheses

2D TEE: Medtronic Hall MVR

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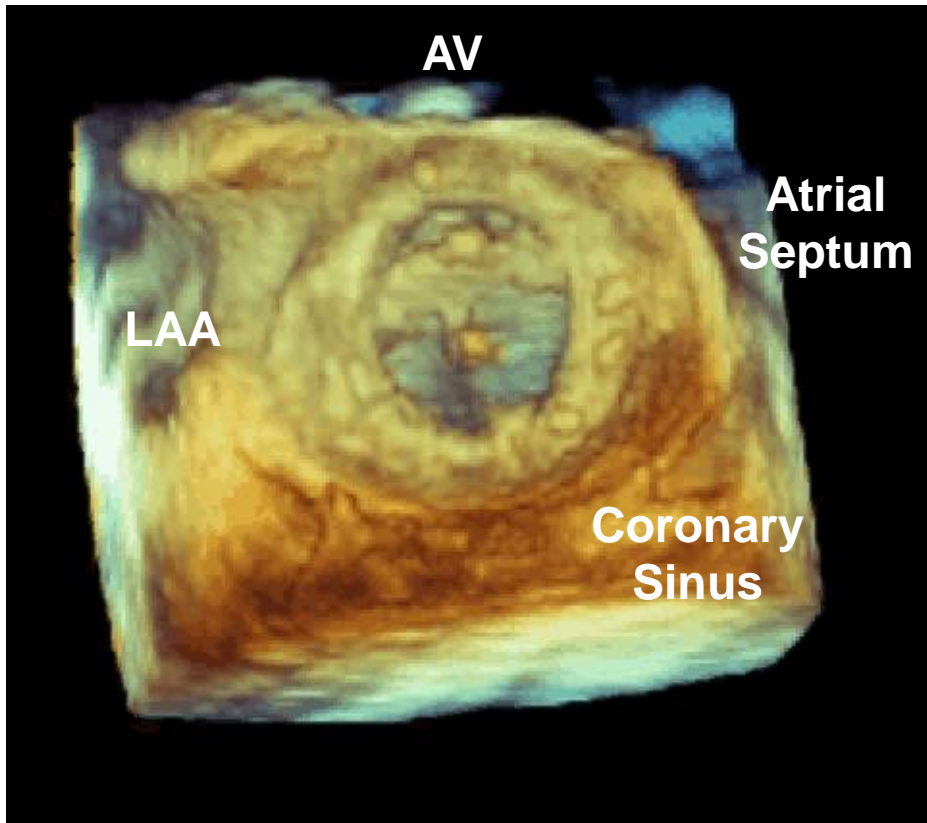
Single-disc mechanical prosthesis
with a centrally protruding shaft



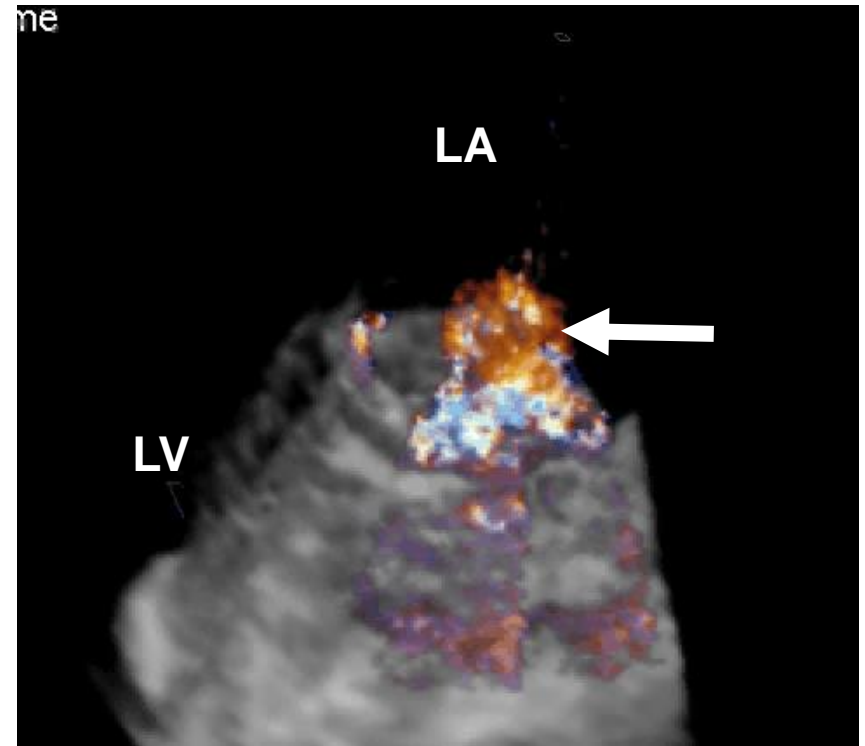
Physiologic central mitral regurgitation
(‘donut hole regurgitation’)

Medtronic Hall Valve

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Single-disc mechanical prosthesis with a centrally protruding shaft



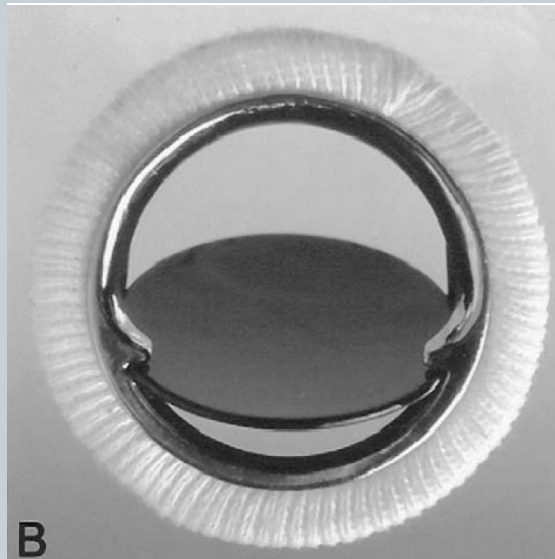
Physiologic central mitral regurgitation ('donut hole regurgitation')

Omniscience Single Tilting Disc (Derived from Lillehei-Kaster Valve)

33



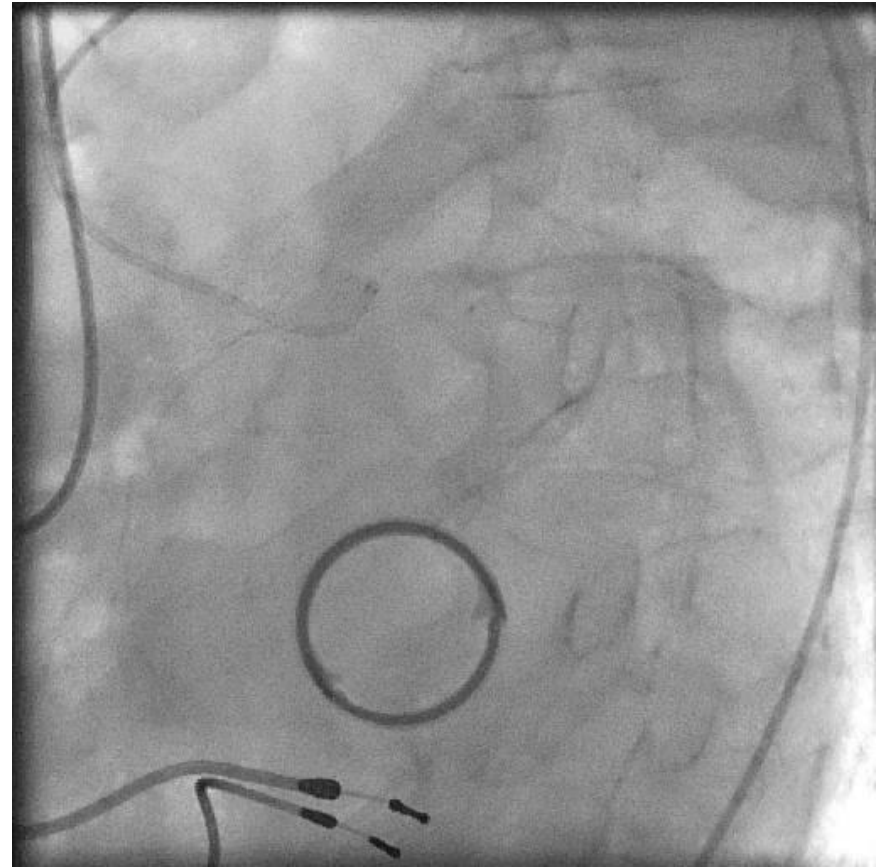
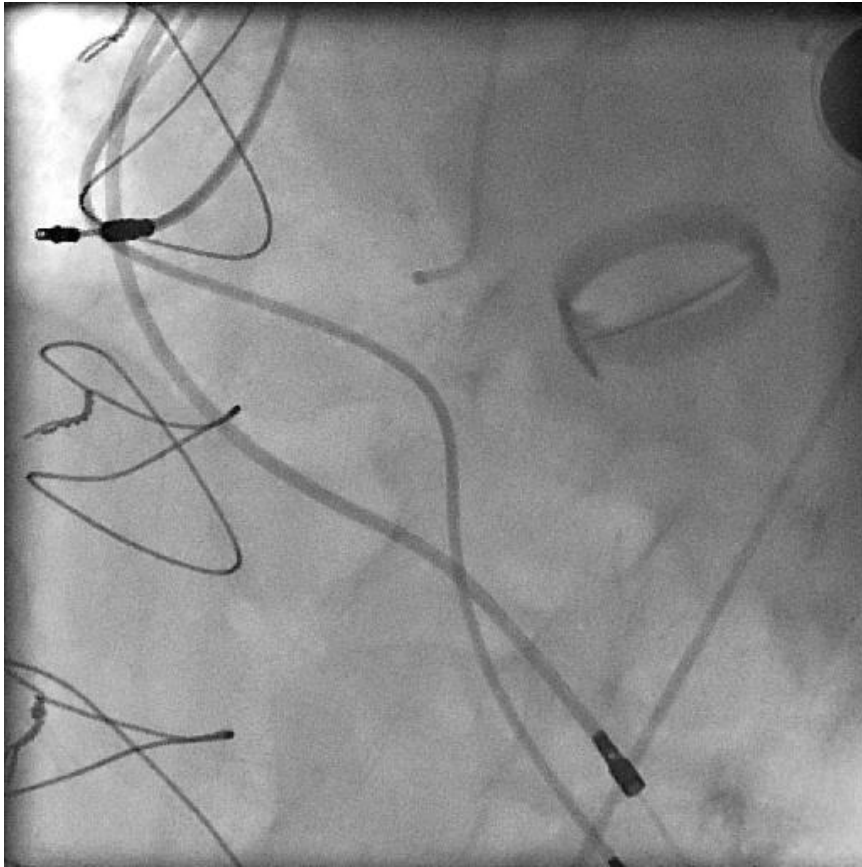
C. Walton Lillehei
(1918-1999)
American Surgeon



Robert Kaster
(b. 1933)
American Engineer

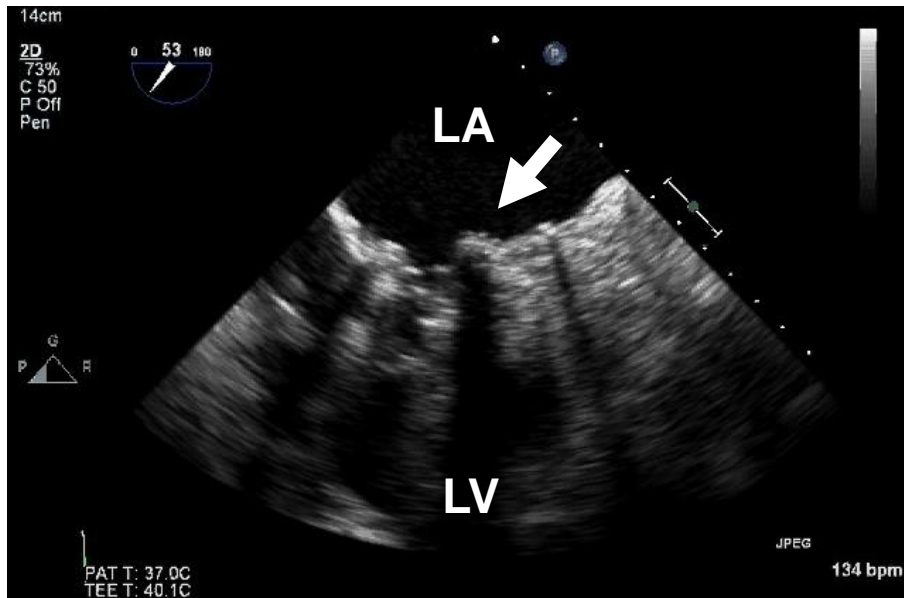
Fluoroscopy: Omniscience MVR

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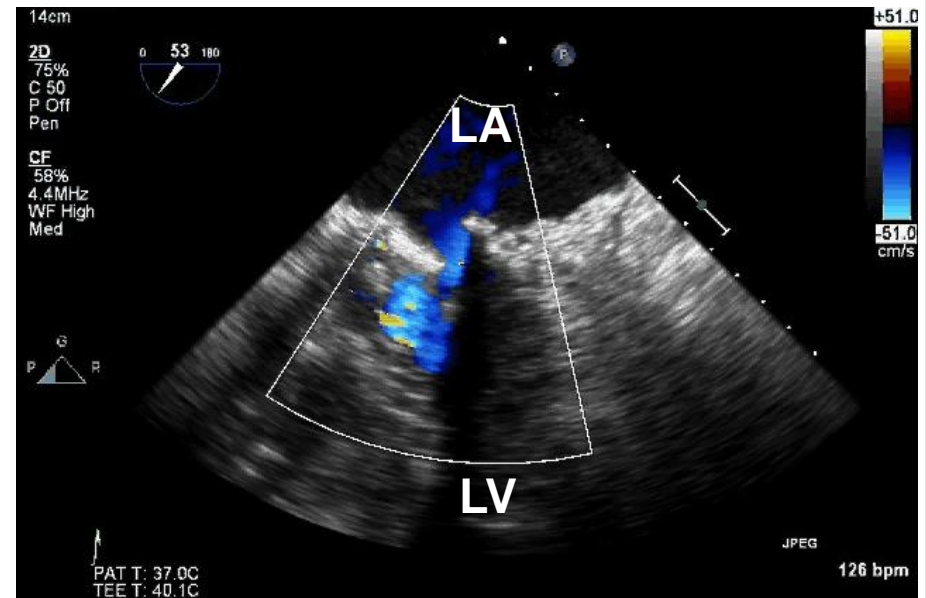


2D TEE: Omniscience Mitral Valve Prosthesis

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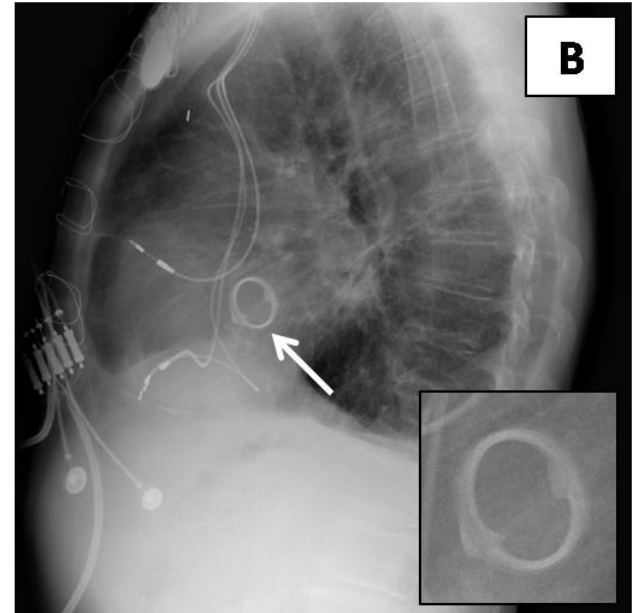
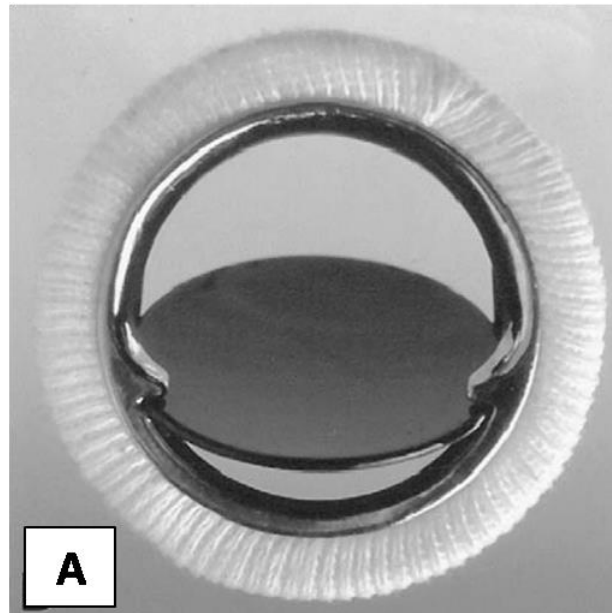
Single-disc mechanical prosthesis
with no protruding shaft



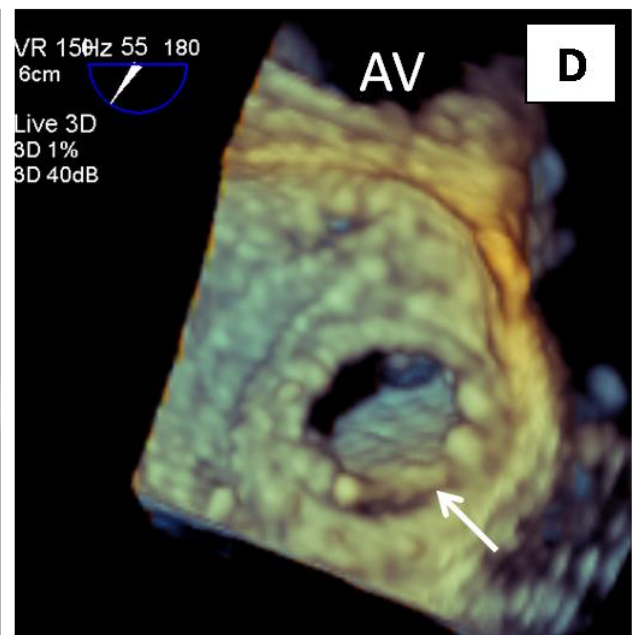
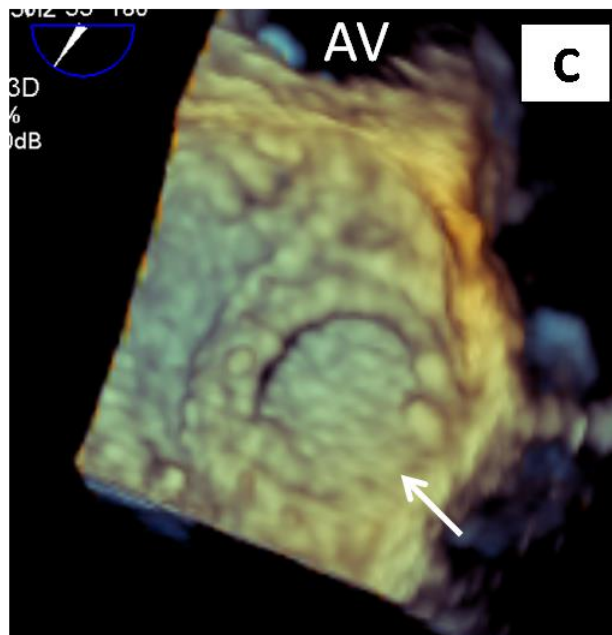
Minimal physiologic regurgitation

OMNISCIENCE
Single Tilting Disc
Mechanical Valve

Used since 1978;
still in production.

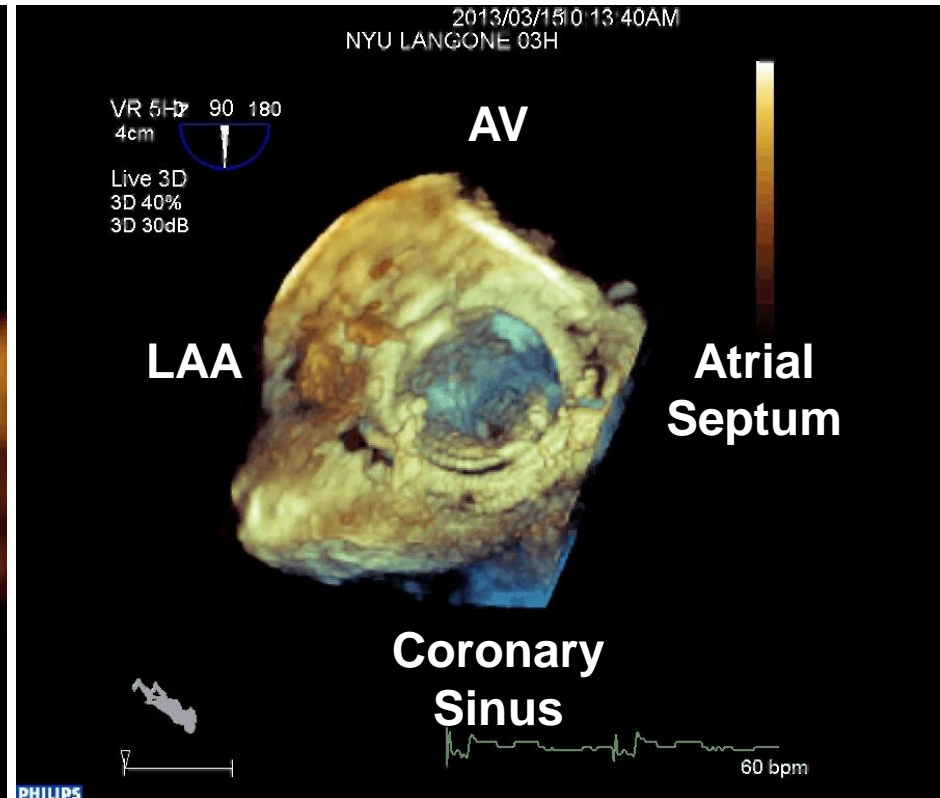
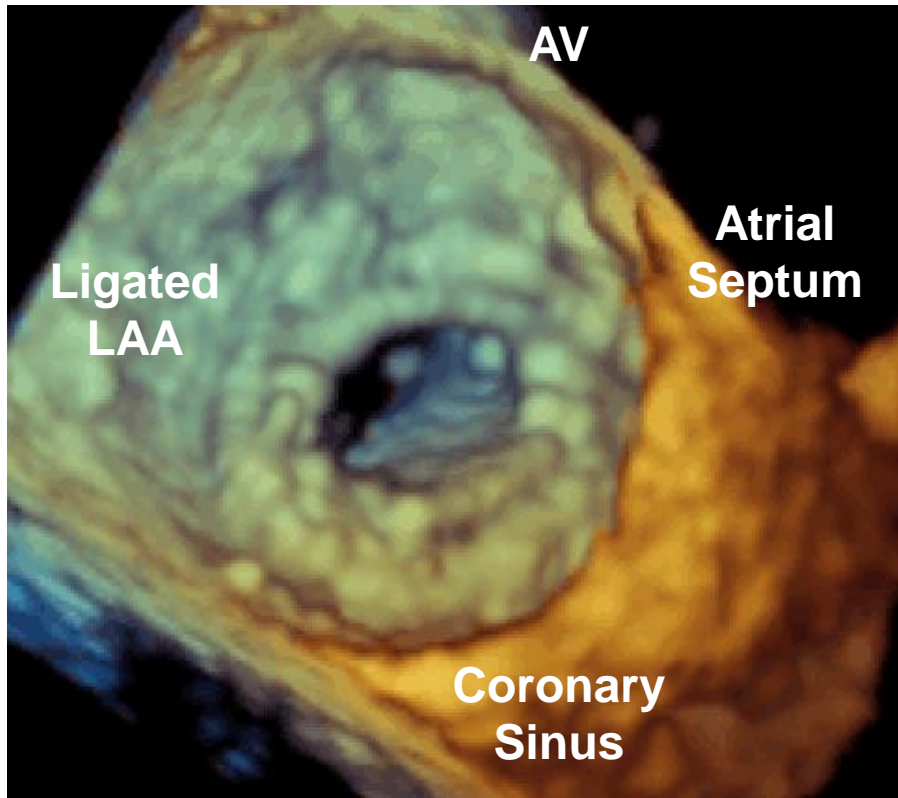


OMNICARBON
Variant of
Omniscience, made
purely of pyrolytic
carbon; in production
since 1984

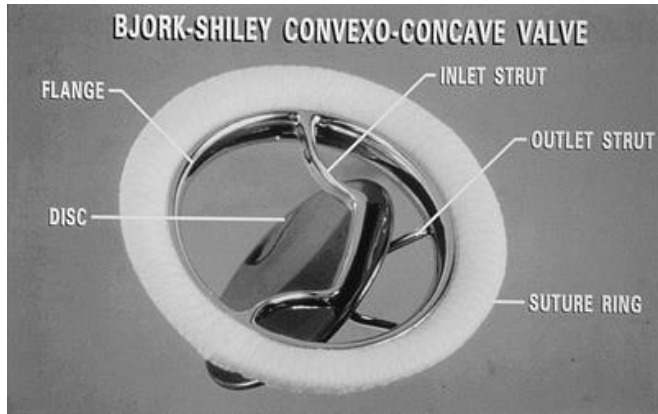


3D TEE: Omniscience Valve

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SUMMARY: SINGLE TILTING DISC MECHANICAL PROSTHESES



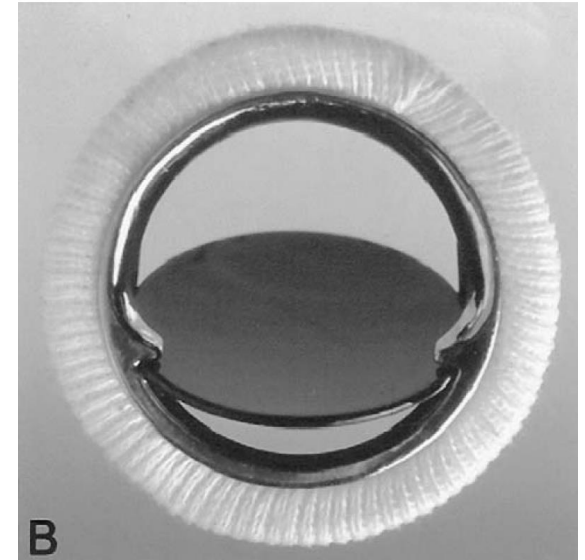
Björk-Shiley

2 central struts



Medtronic Hall

1 central strut



Omniscience

0 central struts



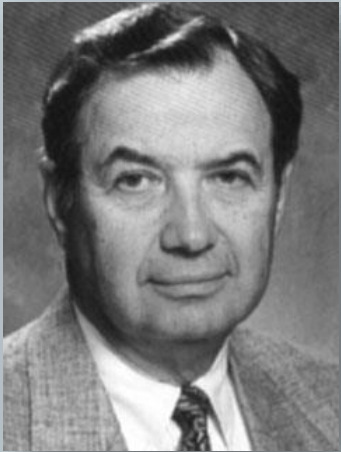
Mechanical Prostheses

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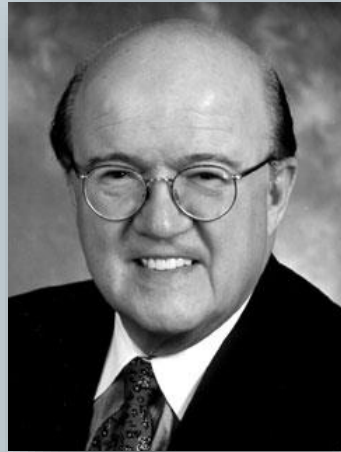
DOUBLE TILTING DISC

St. Jude Bileaflet Tilting Disc Valve (Nicoloff-Posis-Villafaña Valve)

40

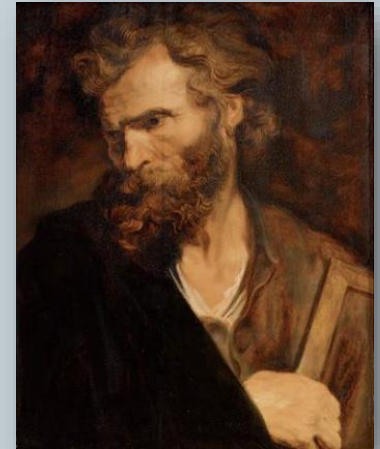


Demetre Nicoloff
(1934-2003)
American Surgeon



Manuel Villafaña
(b. 1940 in New York)
American Entrepreneur

Named after
St. Jude Thaddeus,
patron saint of difficult
cases by Manuel Villafaña
whose son was recovering
from serious disease at the
time.



Apostle Jude Thaddeus
by Anthony van Dyck
c. 1619

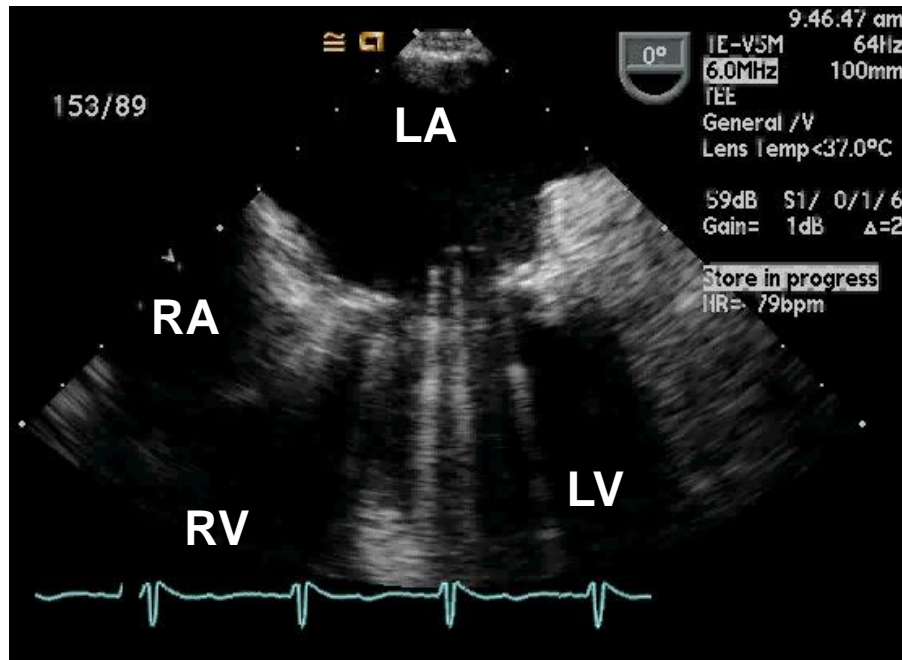
Fluoroscopy: St. Jude MVR

41

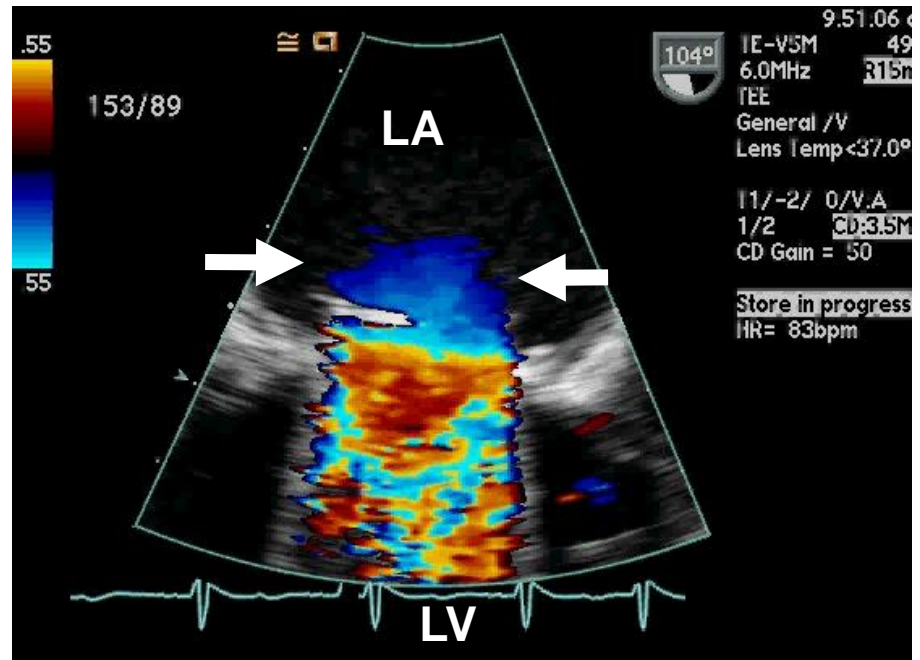
Fluoroscopy
St. Jude Mitral Valve

2D TEE: Normal St. Jude MVR

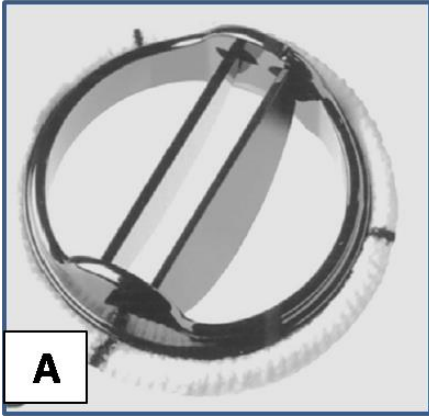
42



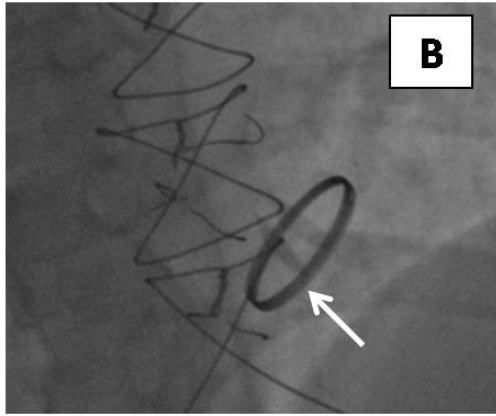
Double-disc mechanical prosthesis



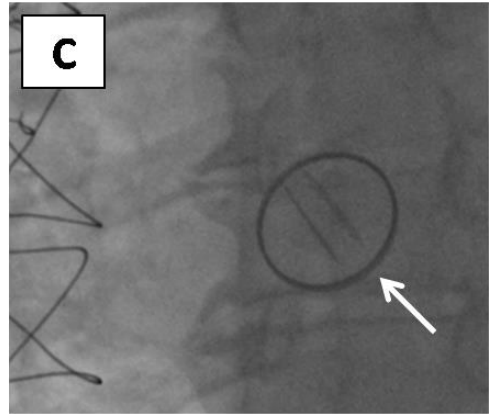
2 out of 6 jets of physiologic regurgitation seen



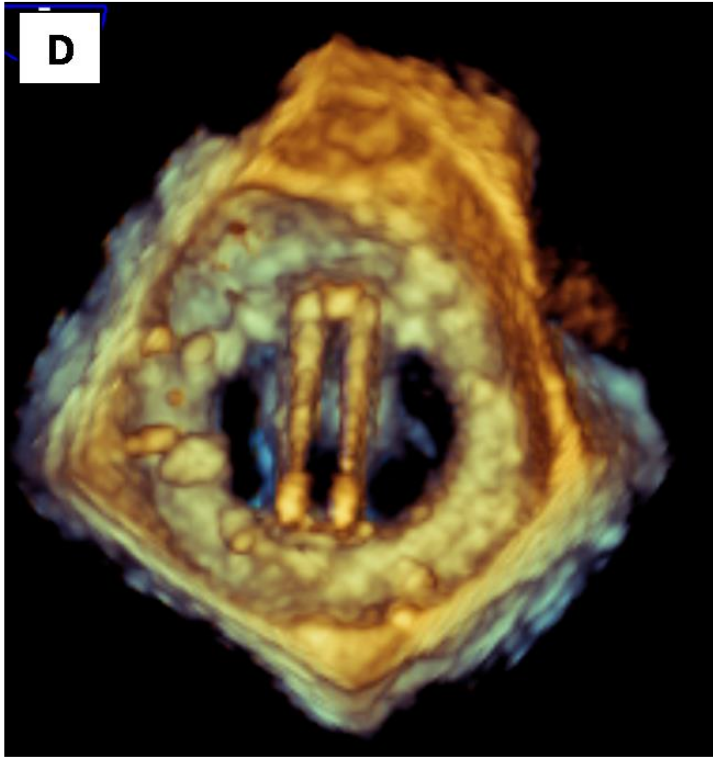
A



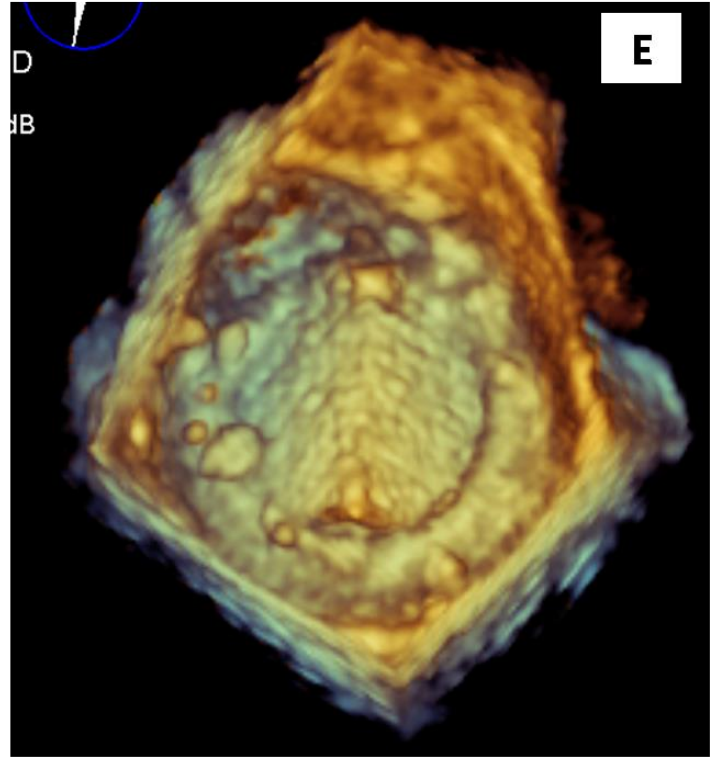
B



C



D



E

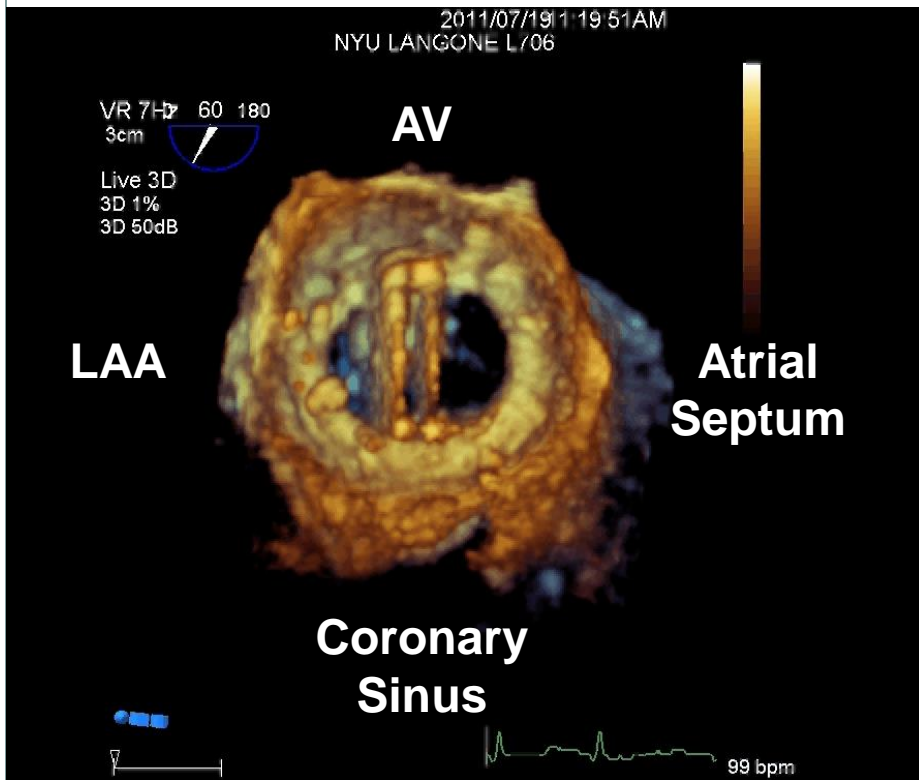
**ST. JUDE
Bileaflet
Tilting Disc
Mechanical Valve**

Used since 1977;
still in production

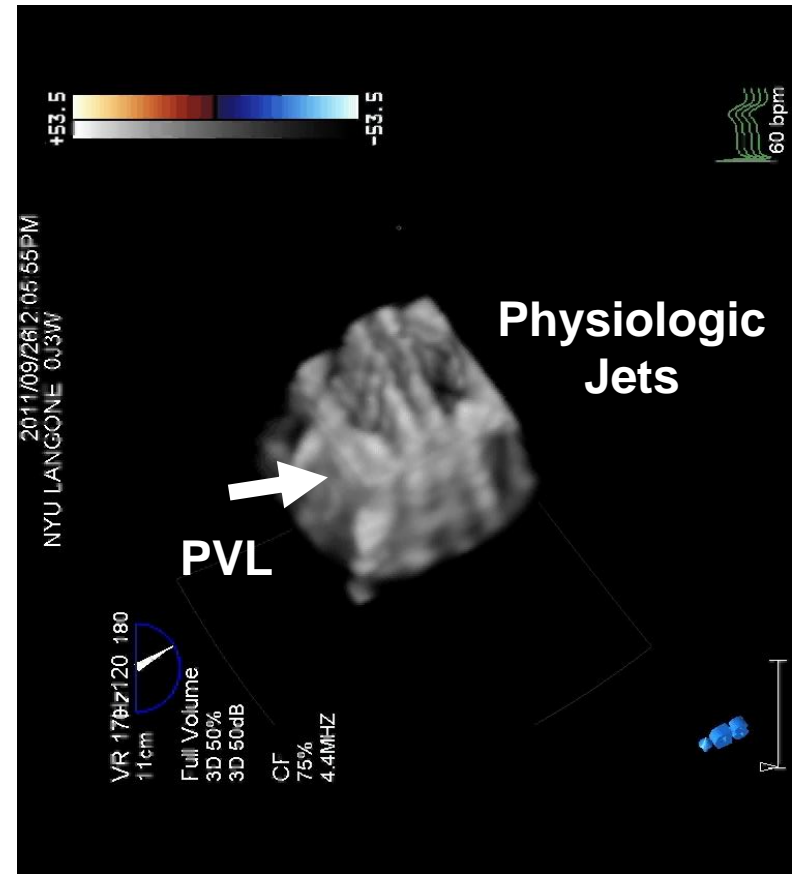
CARBOMEDICS
Very similar to St.
Jude valve

3D TEE: St Jude MVR

44



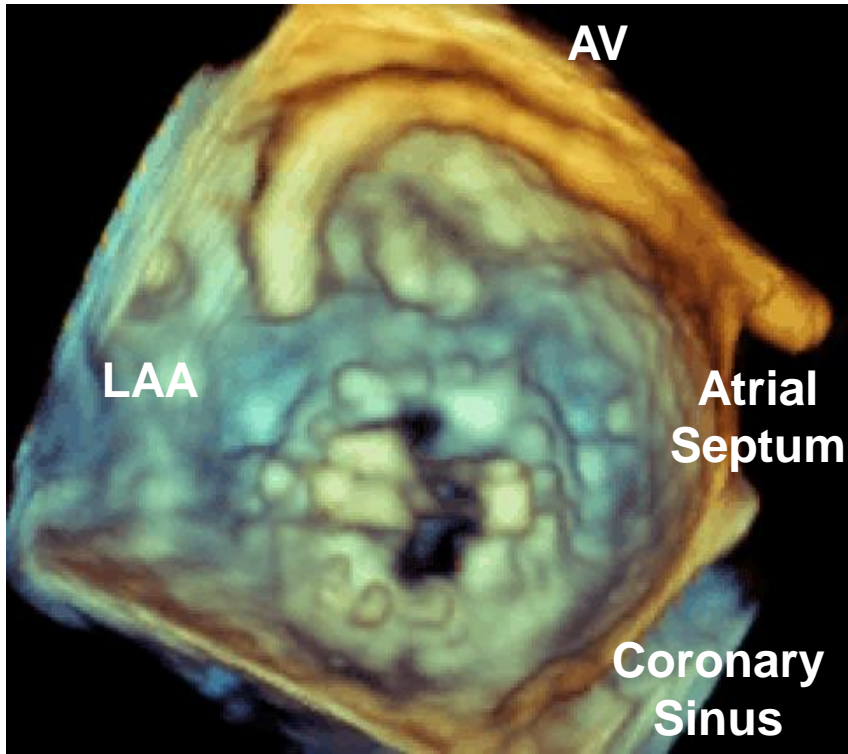
St. Jude mitral valve in
'anti-anatomic' position.



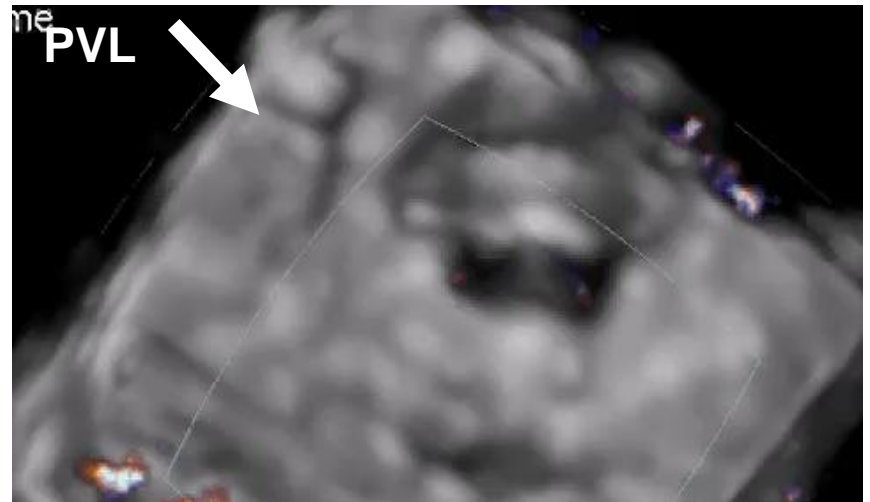
Multiple jets of physiologic regurgitation
+ Paravalvular leak At 7 o'clock

St. Jude Prosthesis

45



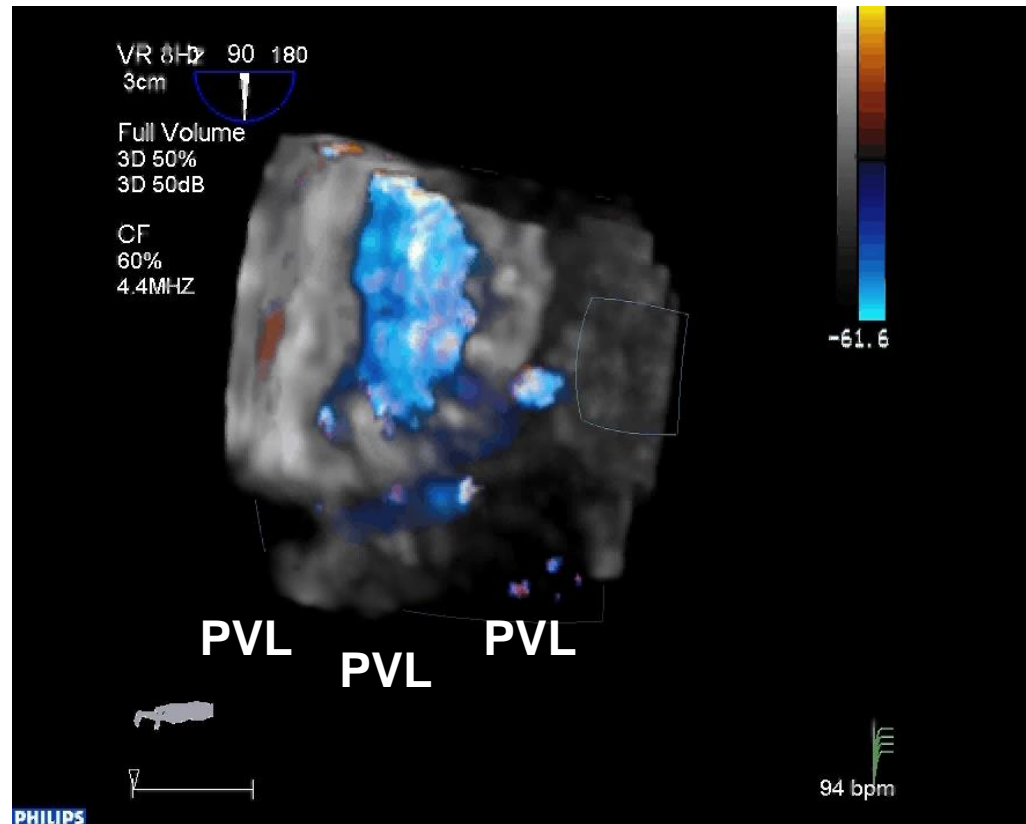
St. Jude mitral valve in
'**anatomic**' position.



Paravalvular Leak (PVL)
At 10 o'clock

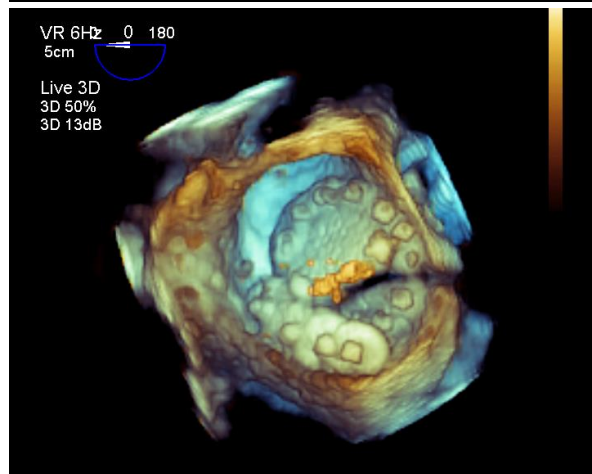
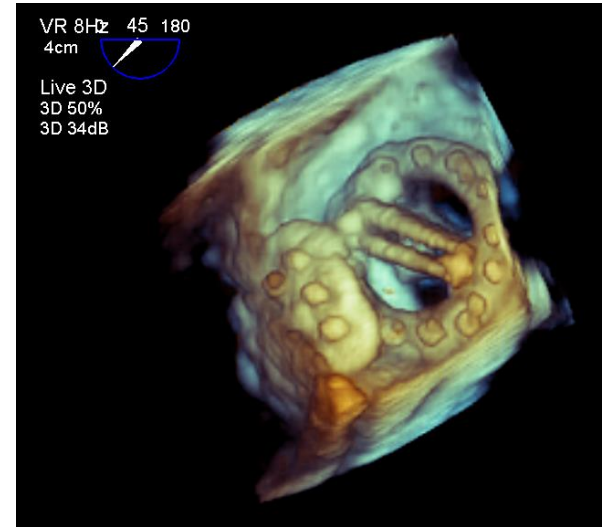
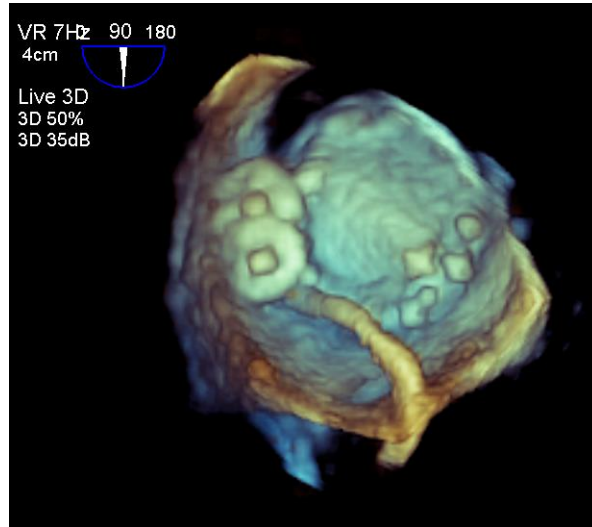
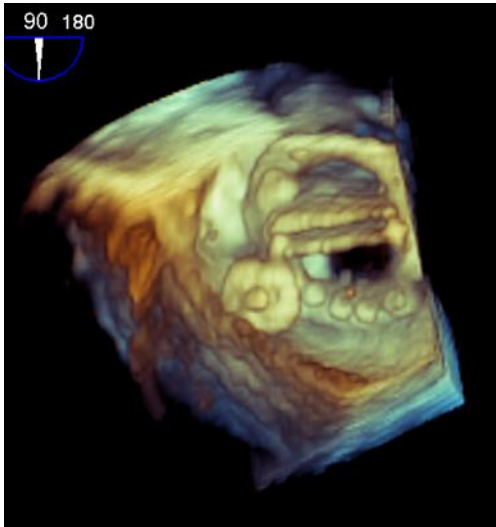
3D TEE: St Jude MVR with Multiple Paravalvular Leaks

46



3D TEE: St Jude MVR – Closure of PVLs

47



Bioprostheses

48

Bioprostheses

49



Alain Carpentier
(b. 1933 in Toulouse)
French Surgeon

He developed the concept
and coined the term
bioprosthesis.

Bio-prostheses

Autograft

- Ross procedure

Homograft

- Cadaveric aortic valve

Xenograft (Heterograft)

- Porcine
- Bovine

The only type used in mitral position



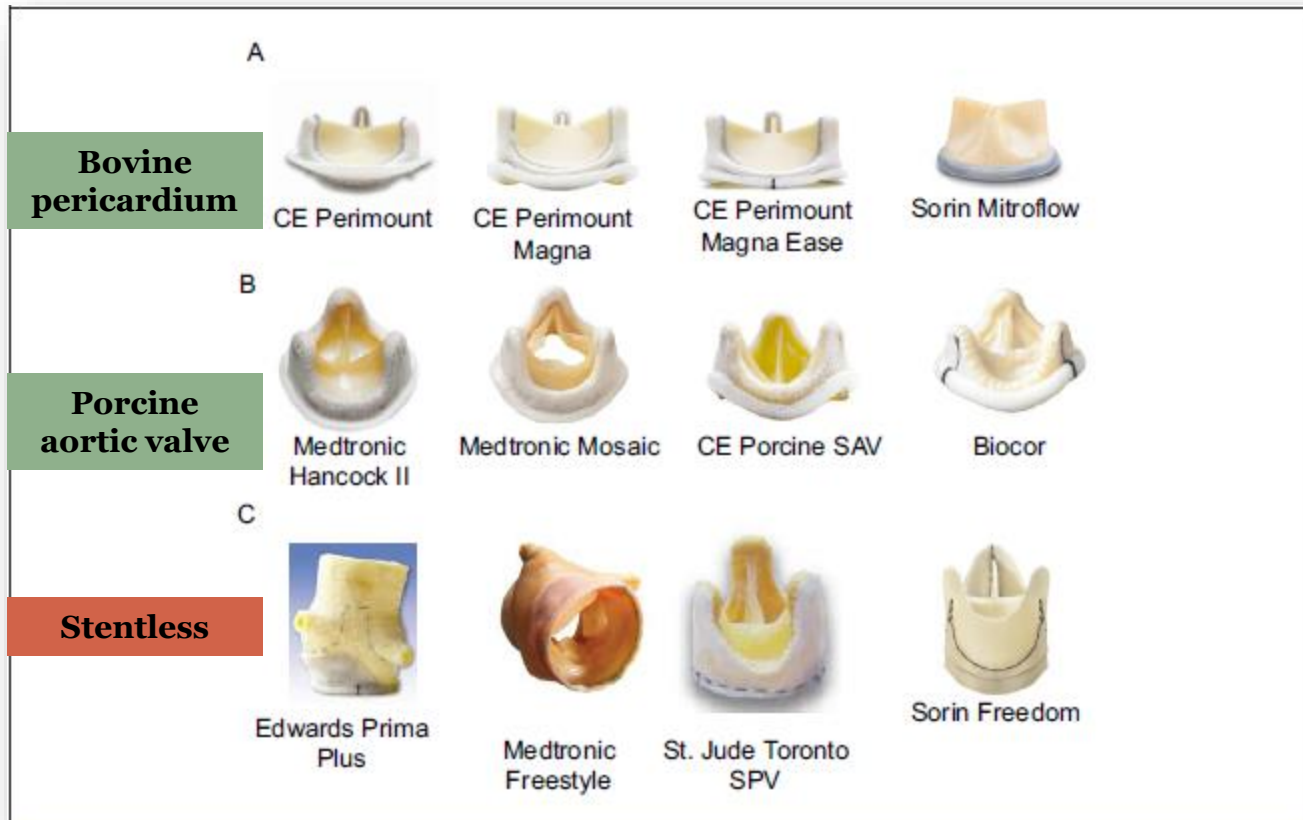
Alain Carpentier
(b. 1933 in Toulouse)

CARPENTIER'S CONTRIBUTIONS

- Glutaraldehyde preservation
- Use of pig aortic valve in human mitral position
- Prosthetic stent
- Coined the term 'bioprosthesis' ('bioprothèse' in French)

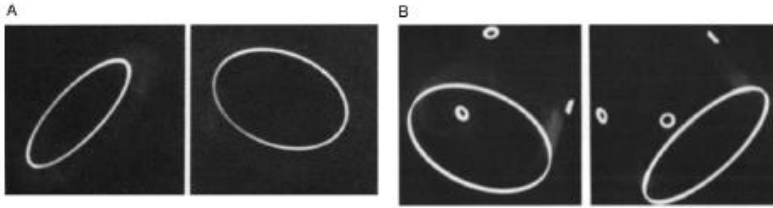
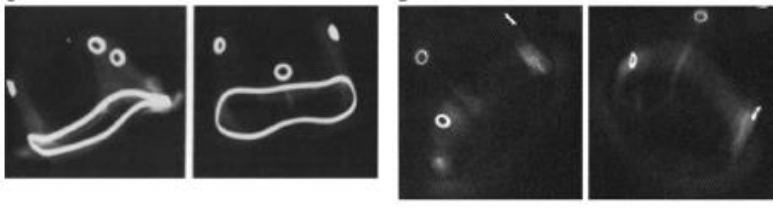
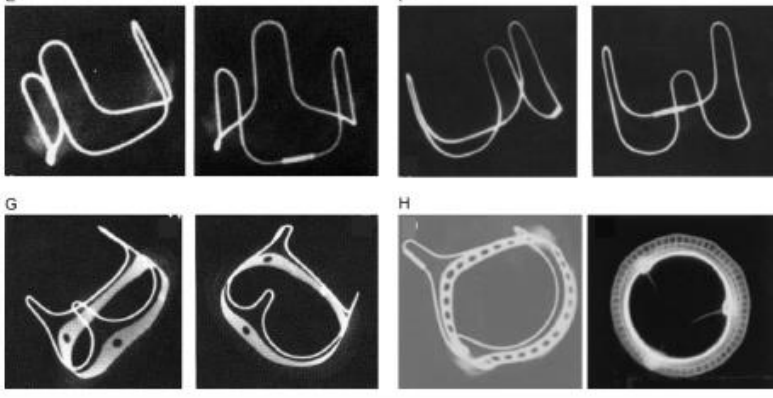
Bioprosthetic Valves

51



Source: *J Am Coll Cardiol Interv* 2011;4:721-32

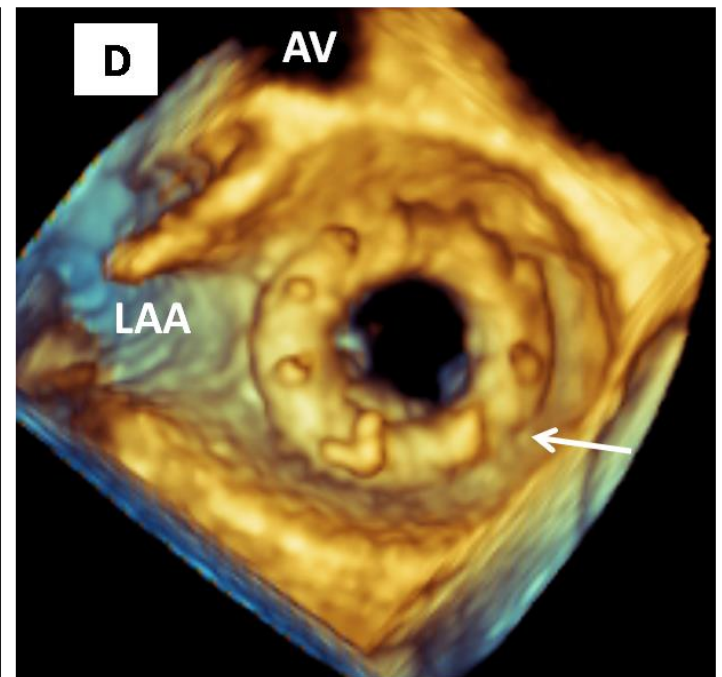
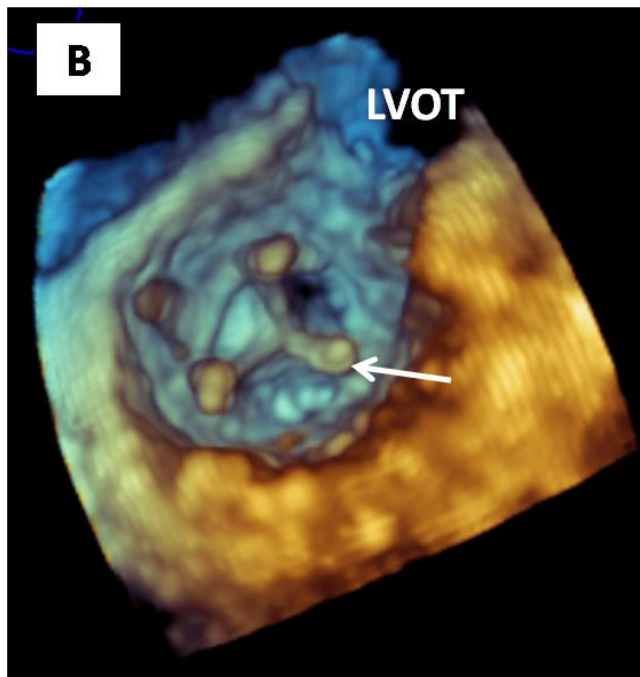
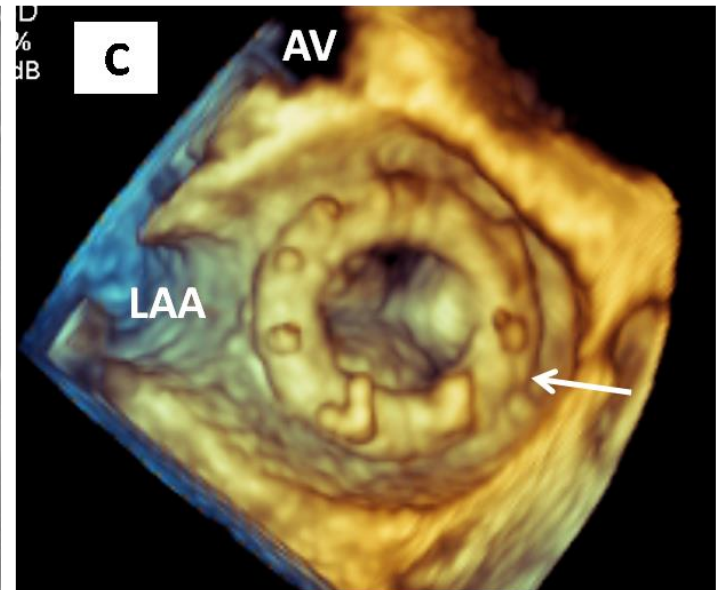
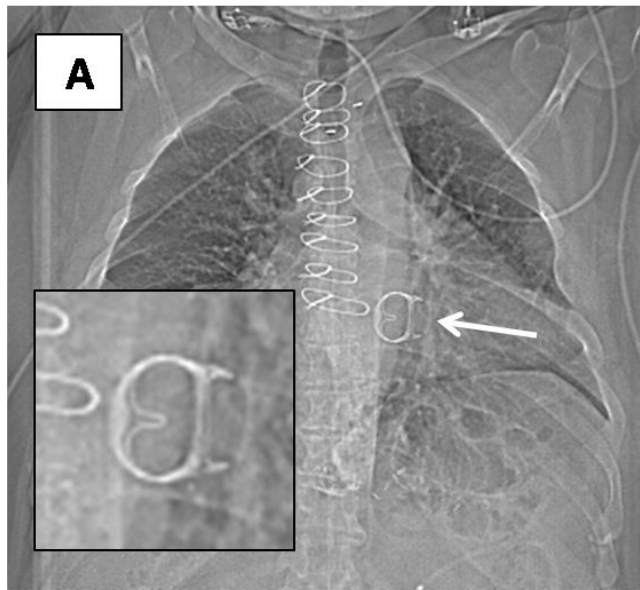
BIOPROSTHETIC VALVES: X-RAY IMAGING

<p>HANCOCK standard</p>		<p>Hancock modified</p>
<p>MEDTRONIC Hancock II</p>		<p>Medtronic Mosaic</p>
<p>CARPENTIER-EDWARDS (CE)</p> <p>CE, pericardial</p>		<p>CE, supra-annular</p> <p>CE, Perimount (Magna)</p>

Source: *J Am Coll Cardiol Intv* 2011;4:721-32

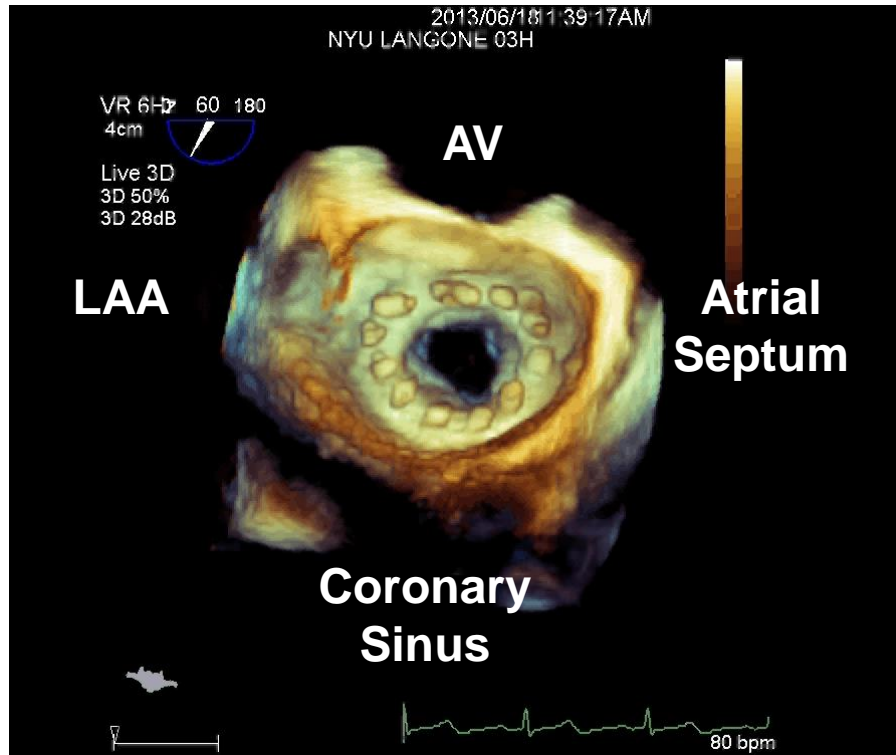
**Carpentier-Edwards
PERIMOUNT
Stented Bovine
Pericardial Valve**

One of many types of
bioprosthetic valve.

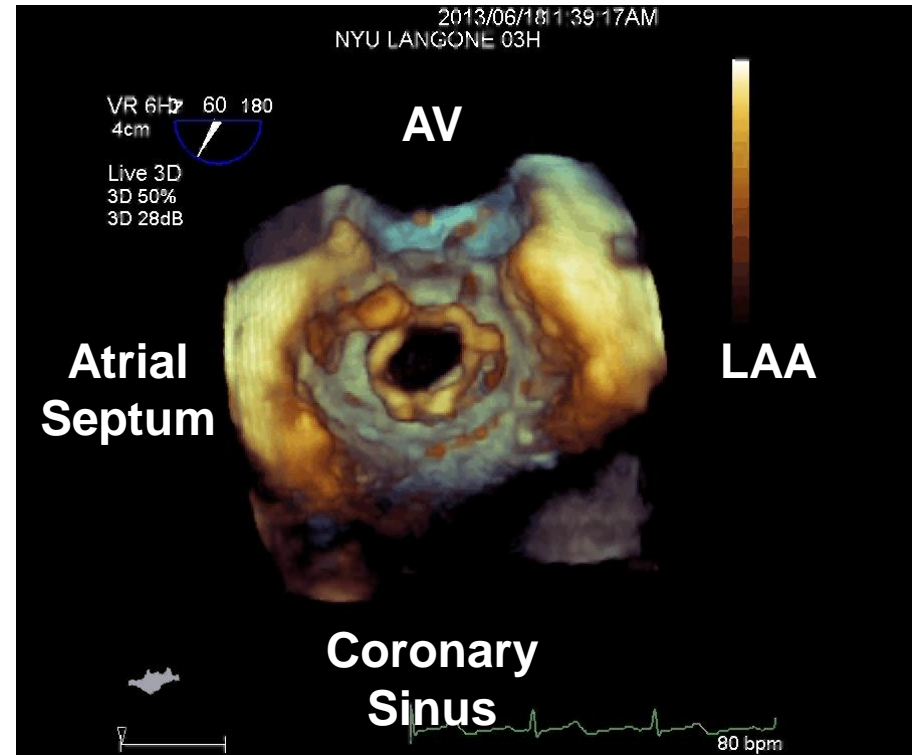


3D TEE: Normal Carpentier-Edwards MVR

54



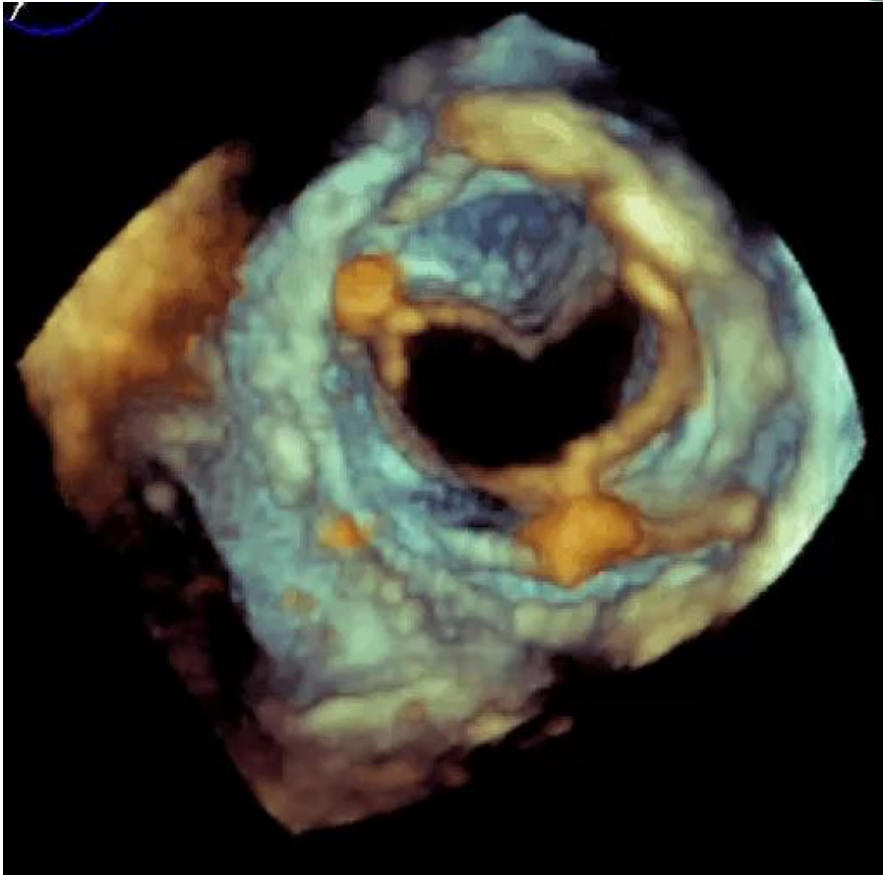
LA Side



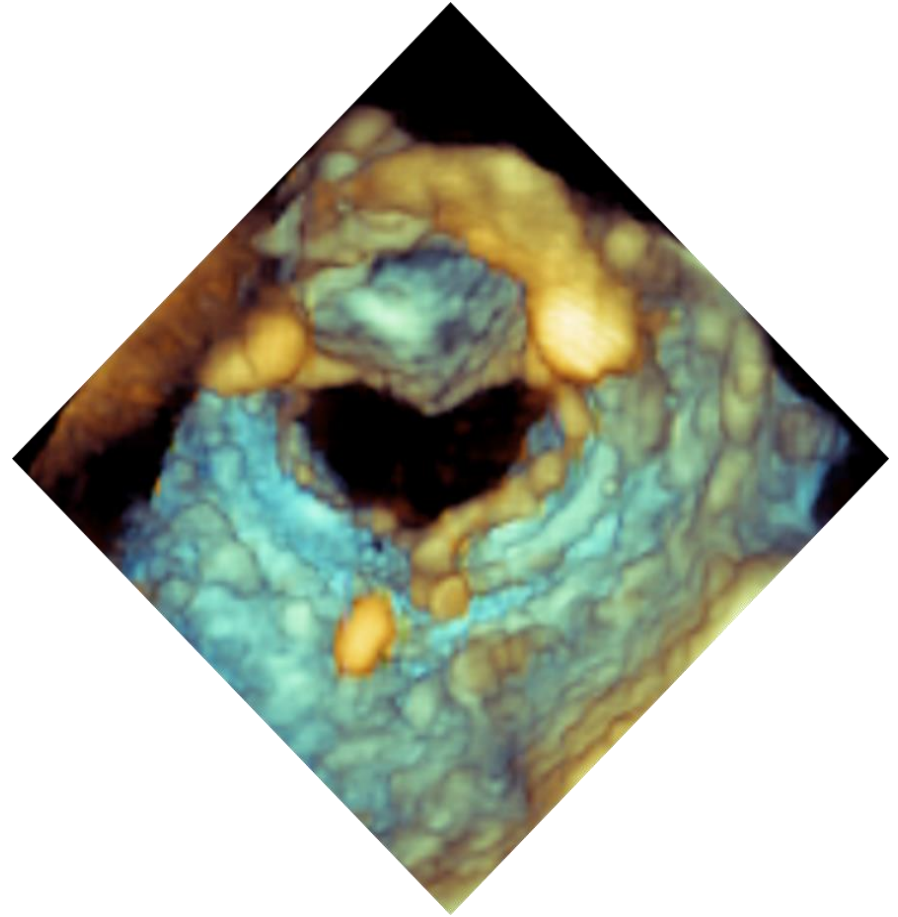
LV Side

3D TEE: Edward Magna Bio-MVR

55



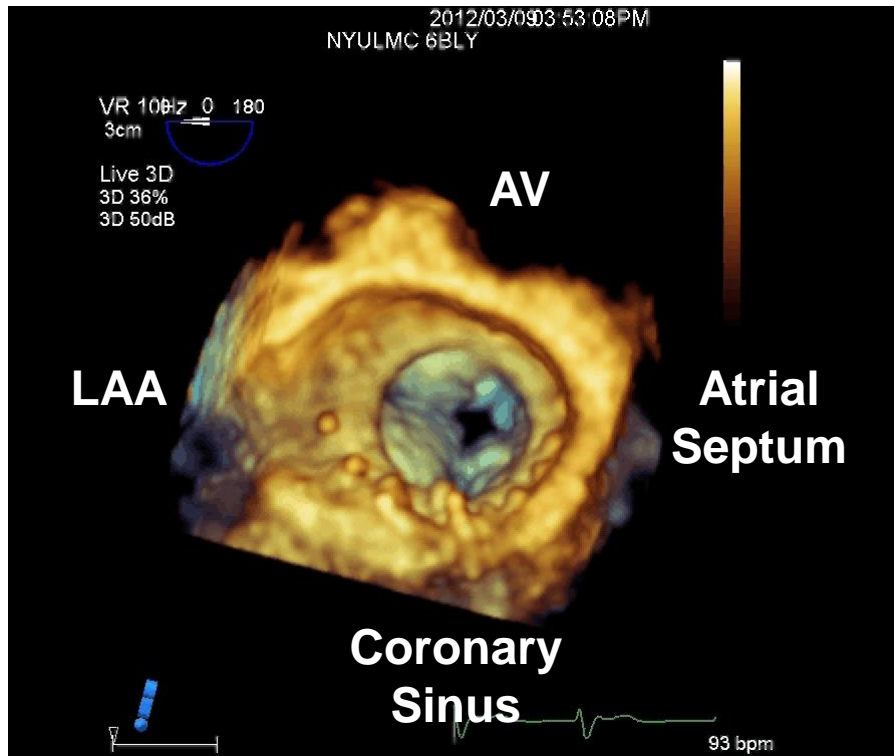
LV Side



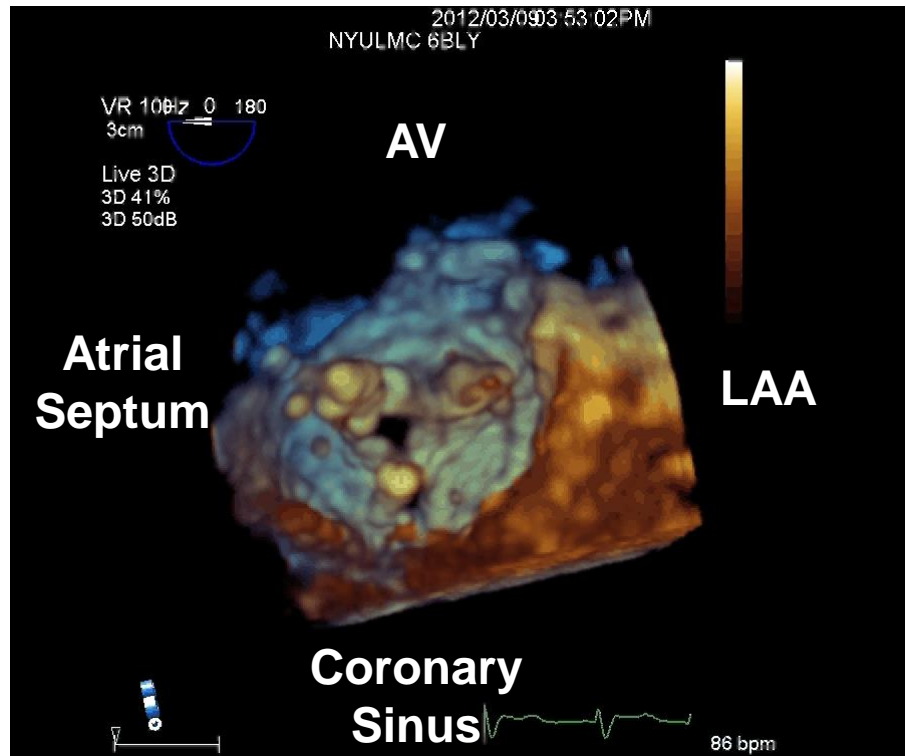
LV Side

3D TEE: Stenosed Mitral Bioprosthesis

56



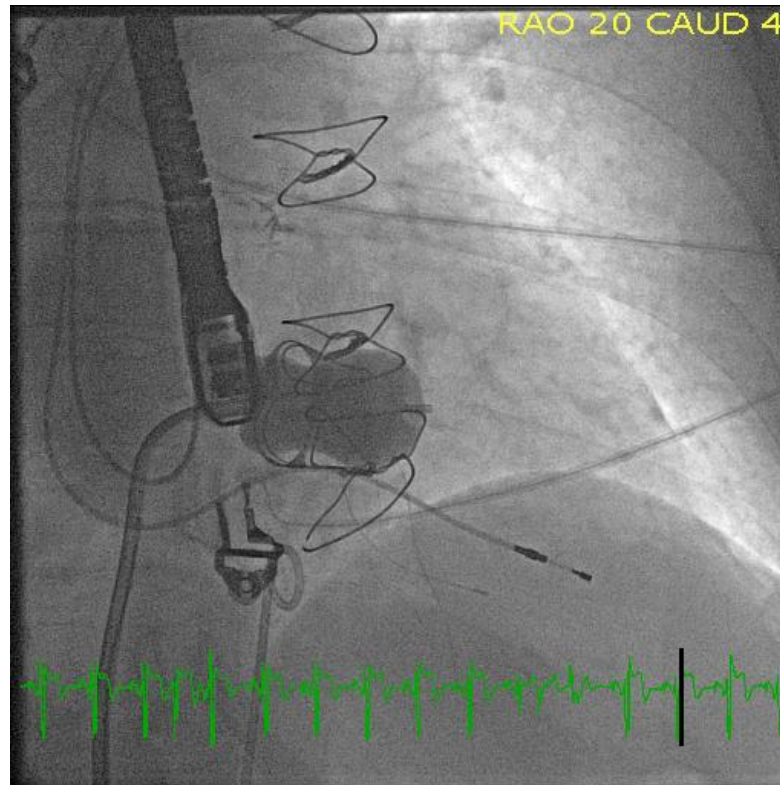
Stenosed mitral bioprosthesis
(LA side)



Stenosed mitral bioprosthesis
(LV side)

Balloon Valvuloplasty of Stenosed Mitral Bioprosthesis

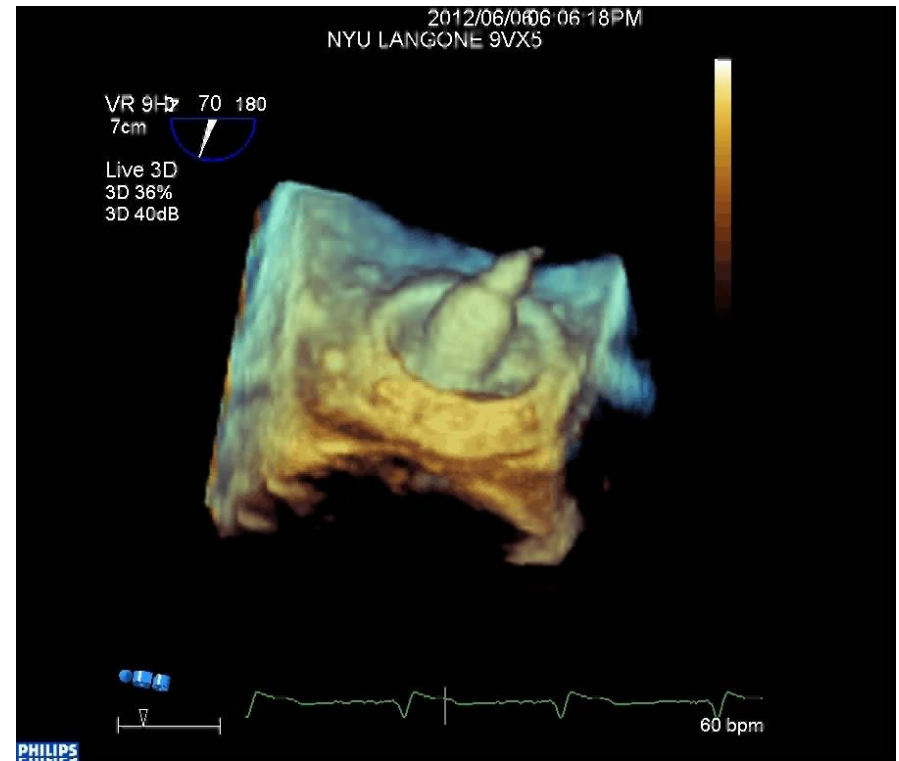
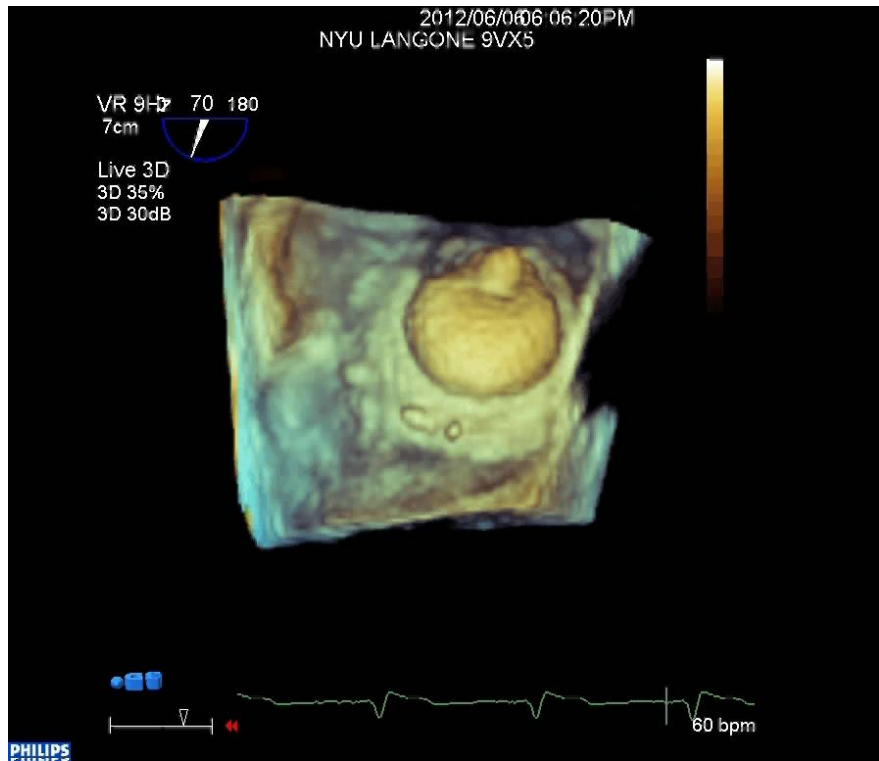
57



Fluoroscopic Guidance
of Balloon Valvuloplasty

Bioprosthetic Mitral Balloon Valvuloplasty

58



Mitral Valve Repairs

59

MV Repairs

Ringless

Ring
(Full circle)

Band
(Partial circle)



Alain Carpentier
(b. 1933 in Toulouse)
‘Father of MV repair’

CARPENTIER’S CONTRIBUTIONS

- Use of prosthetic ring
- Techniques of mitral repair

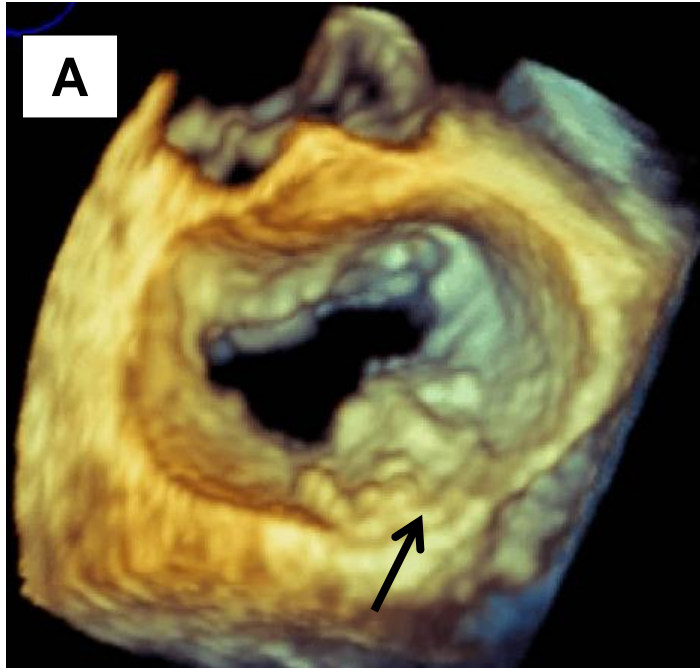
Mitral Valve Repairs

61

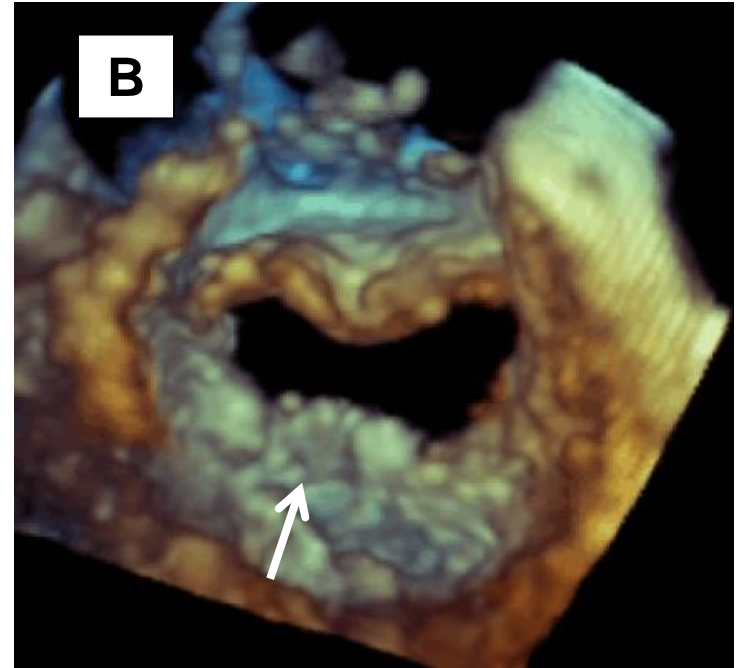
RINGLESS REPAIR

**'Ringless'
Mitral Valve
Annuloplasty**

Not commonly
performed.



LA Side



LV Side

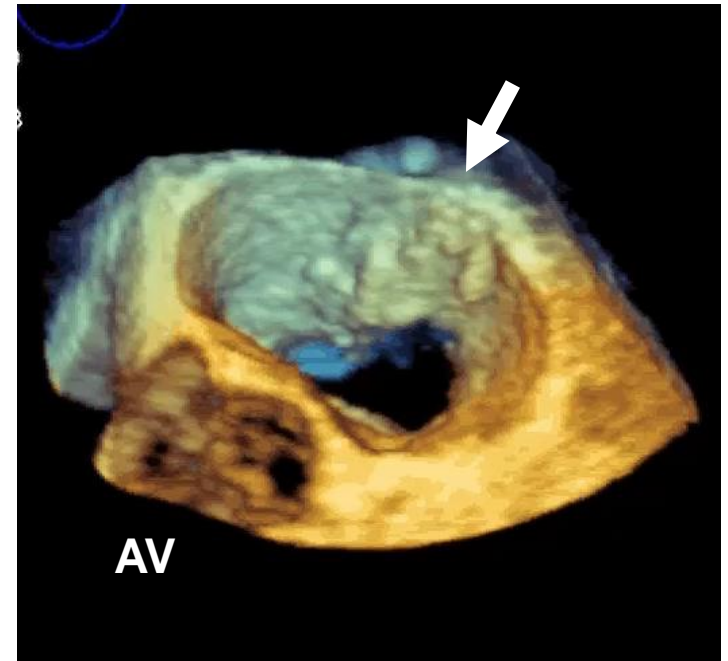
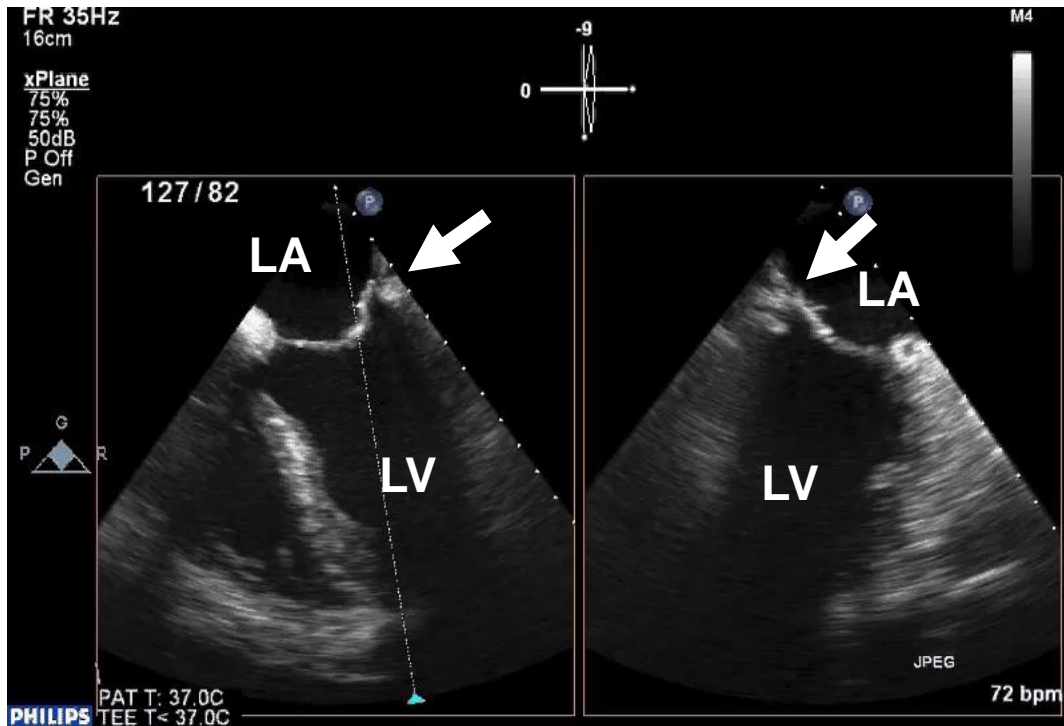
Ringless Mitral Valve Repair

63

3D TEE
Ringless MV Repair

Ringless Mitral Valve Repair

64



Mitral Valve Repairs

65

RING AND BAND ANNULOPLASTIES

Annuloplasty Rings & Bands

66



Full annuloplasty **ring**



Partial annuloplasty ring (**band**)

Mitral Valve Repair With Annuloplasty Band

67



Stephen Colvin
(1943-2008)

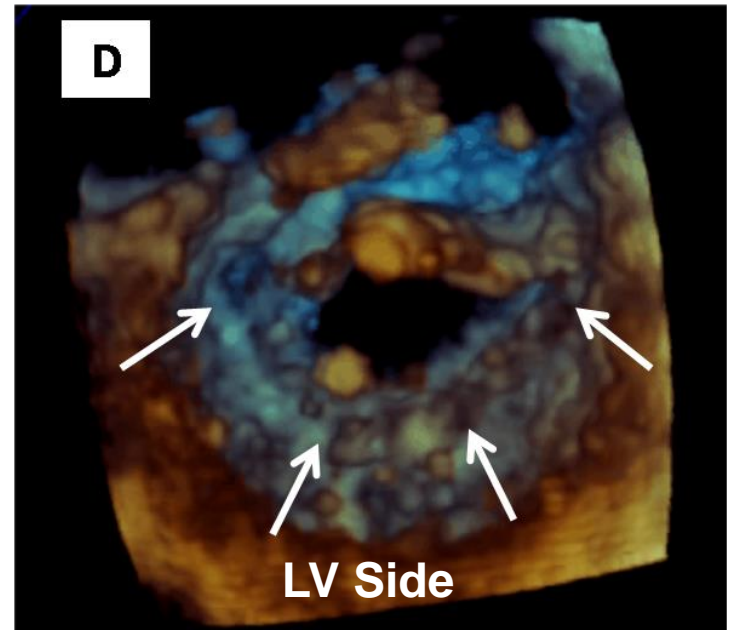
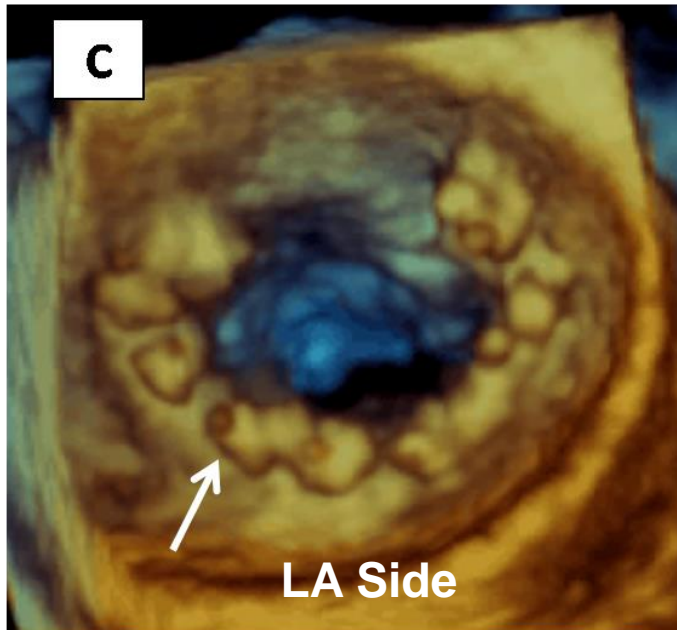
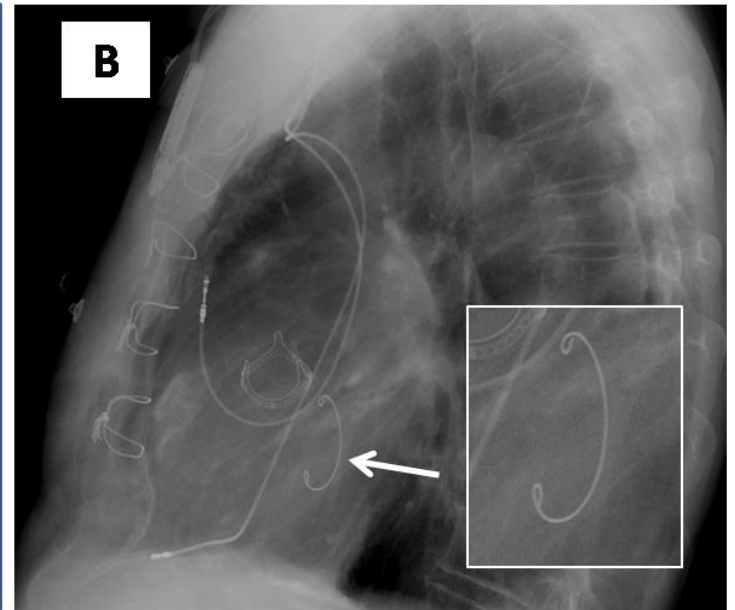
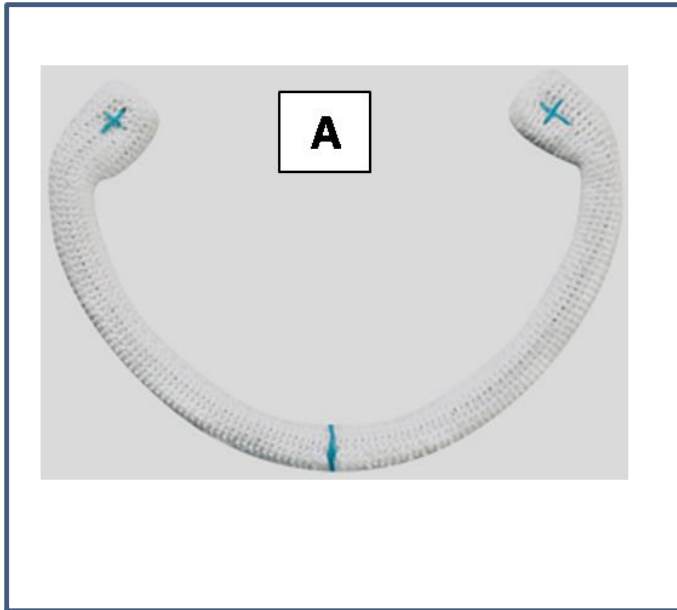


Aubrey Galloway
Head, NYU CT Surgery

Colvin-Galloway Future Band,
a semi-rigid annuloplasty band (2001)

**Colvin-Galloway
Future Band
Mitral Valve
Repair**

One of several types
of annuloplasty
bands



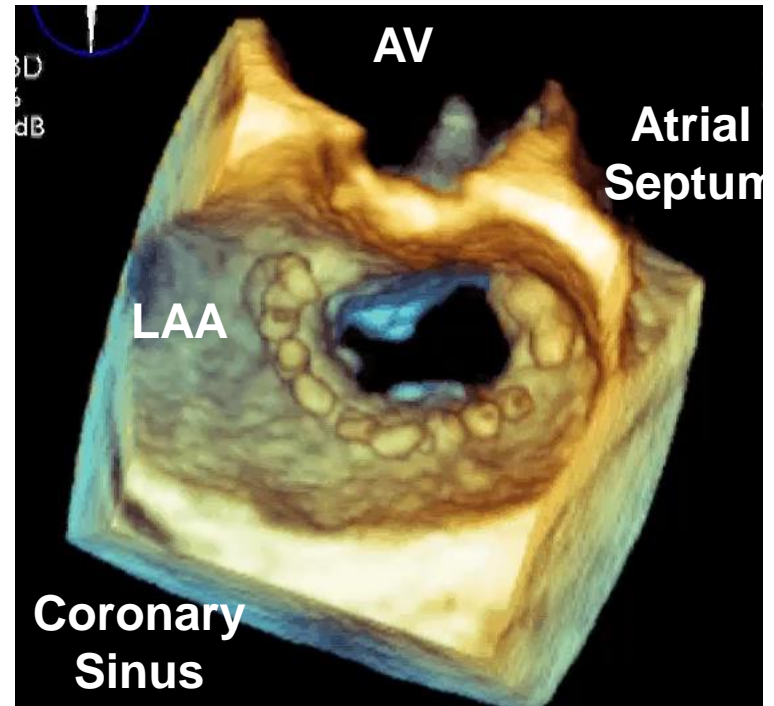
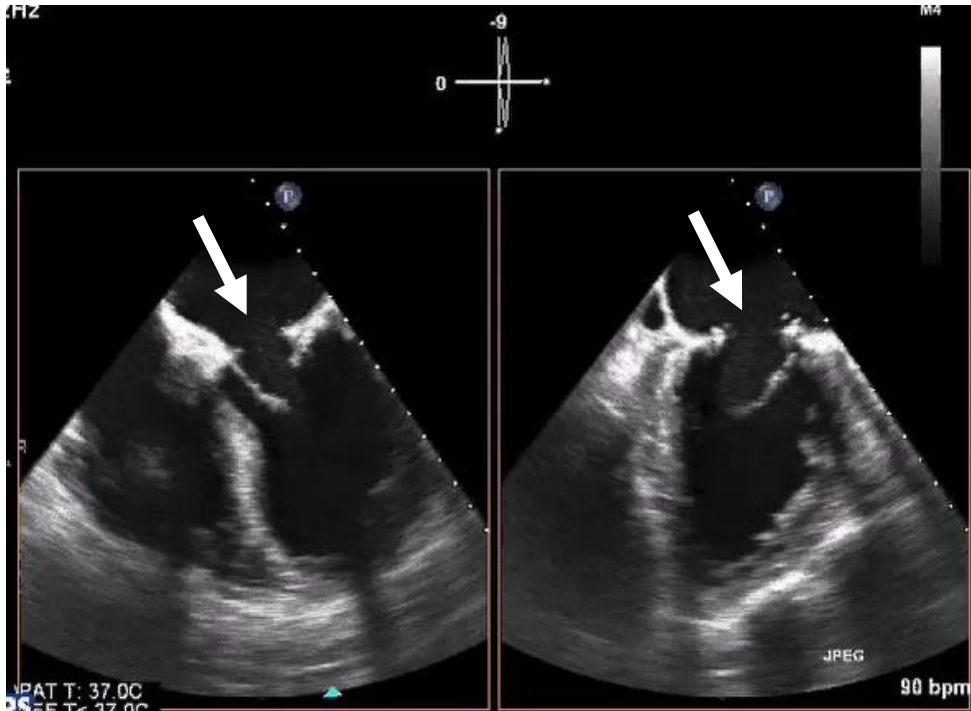
Mitral Band Annuloplasty

69

3D TEE
Mitral Annuloplasty Band

Mitral Annuloplasty: Partial Ring (Band)

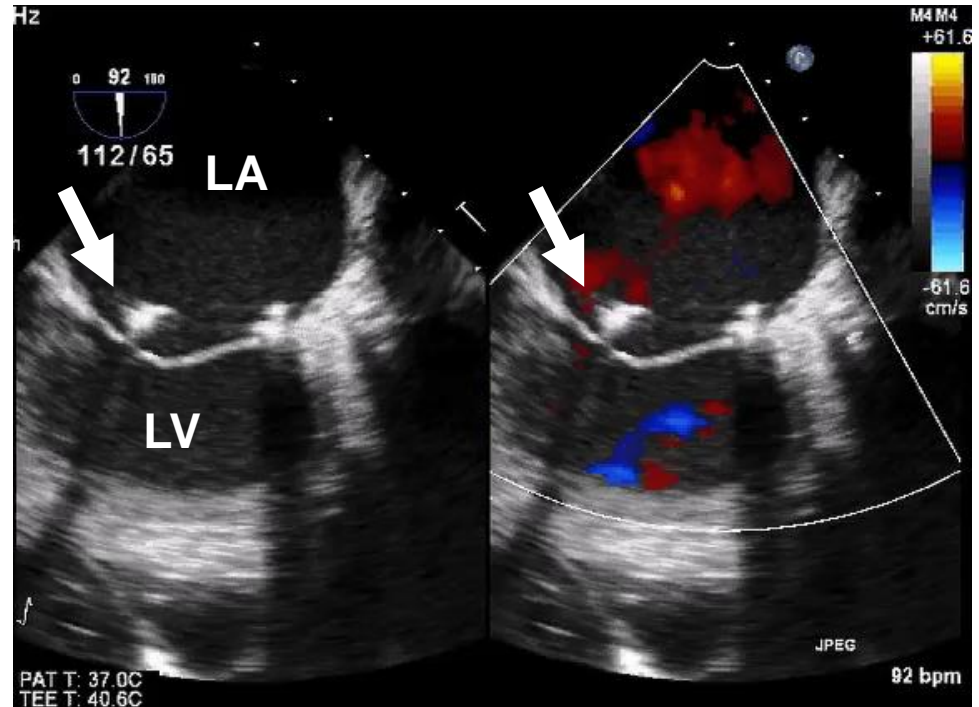
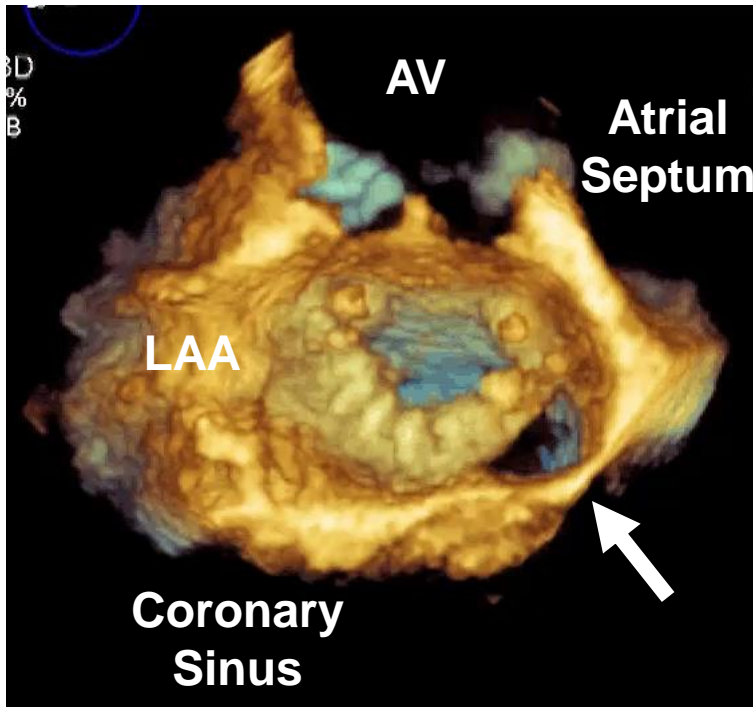
70



Normal Annuloplasty Band

Mitral Annuloplasty: Partial Ring (Band)

71

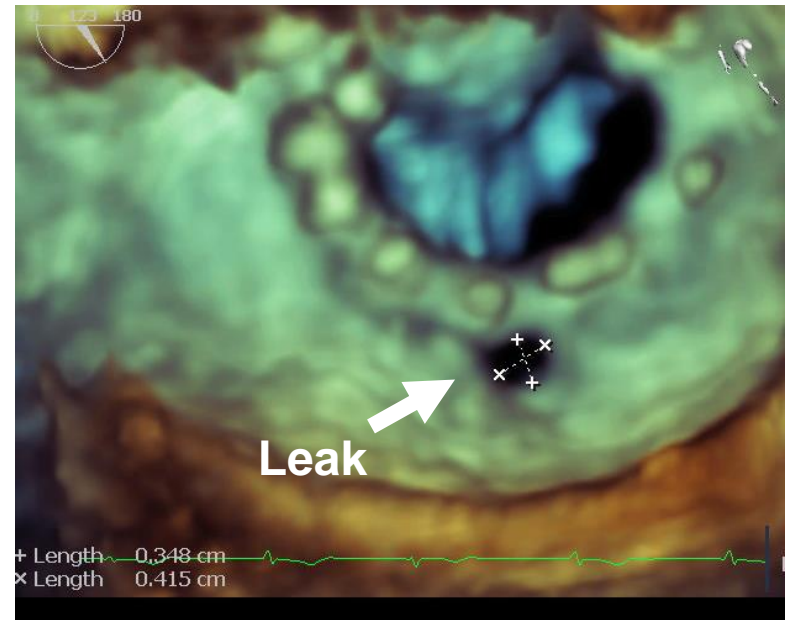
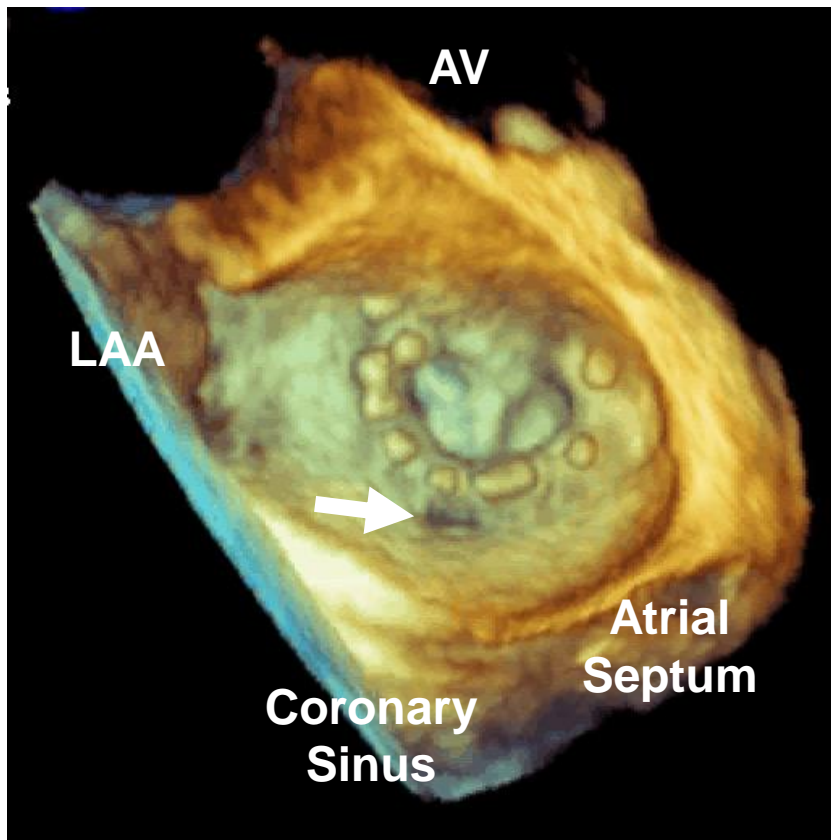


Dehisced Annuloplasty Band

3D TEE: Mitral Annuloplasty Band

72

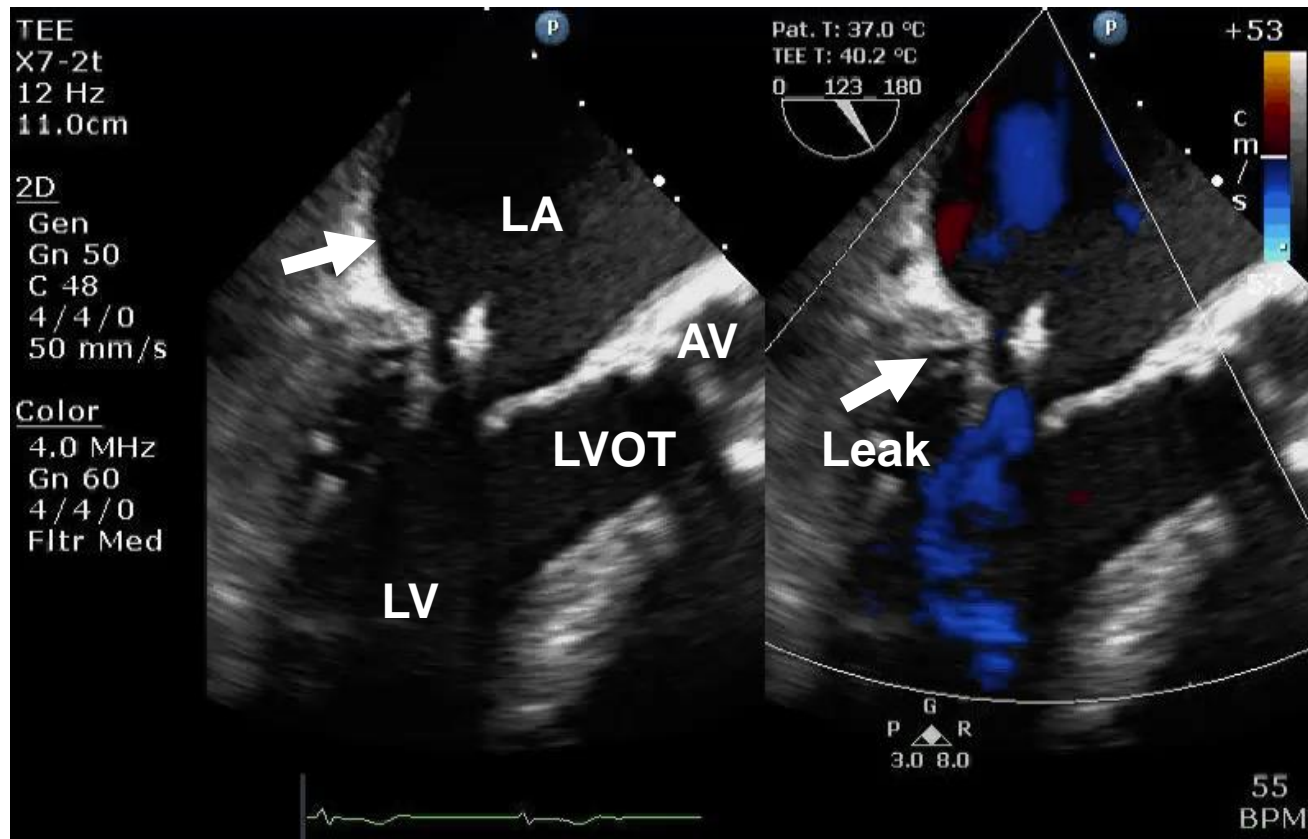
85-year-old man; s/p mitral band annuloplasty a year earlier
Now presents with *Staph aureus* bacteremia



2D TEE: Mitral Annuloplasty Band

73

85-year-old man; s/p mitral band annuloplasty a year earlier
Now presents with *Staph aureus* bacteremia

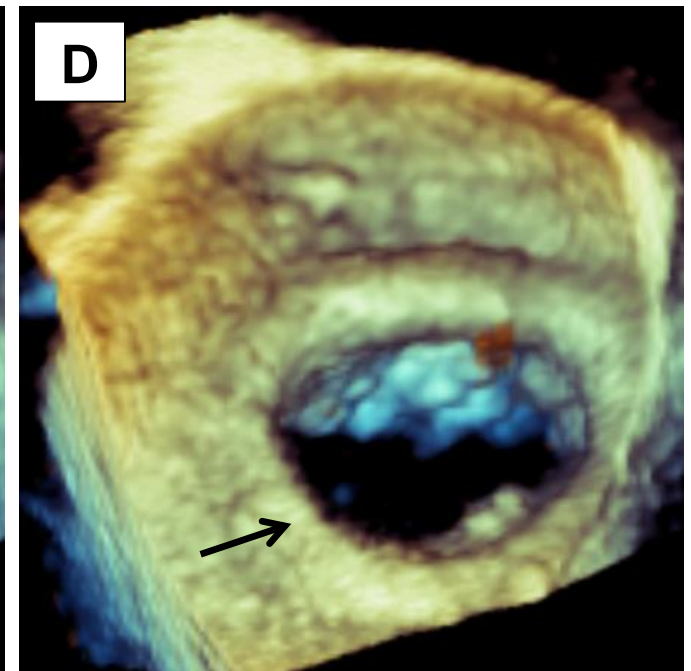
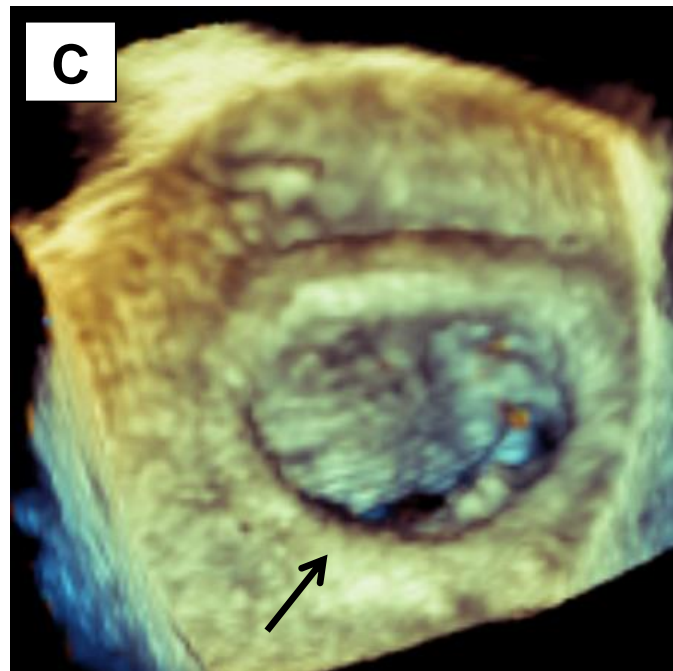
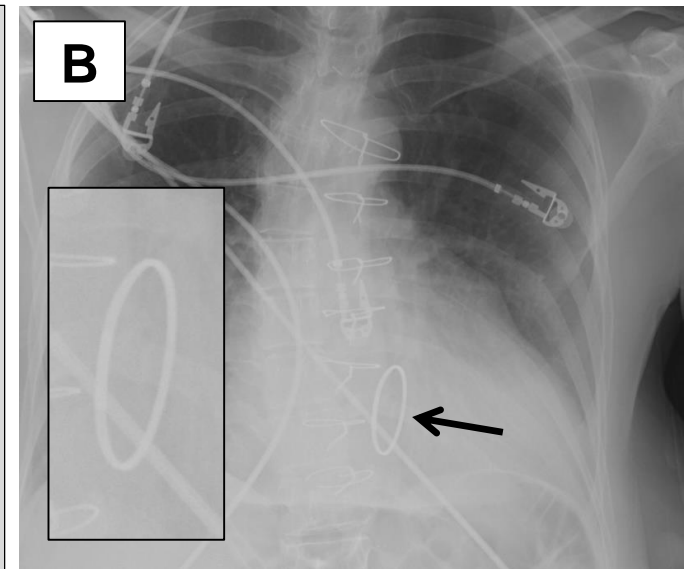
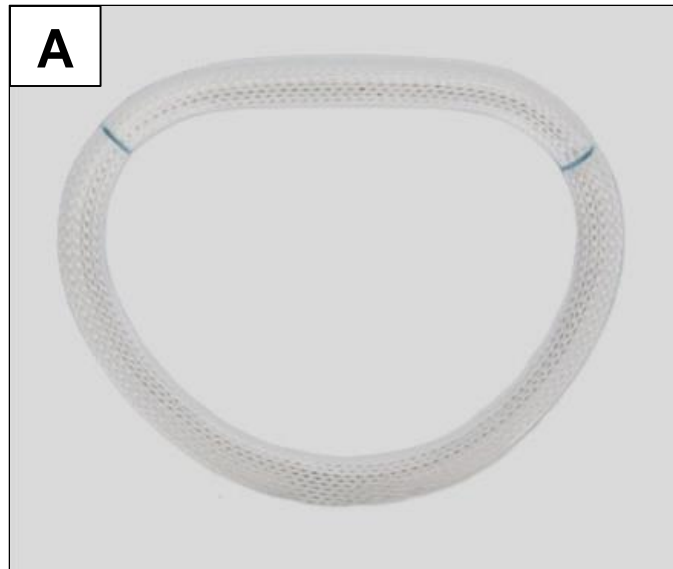


Mitral Valve Repair With Annuloplasty Ring

74

**Carpentier
Physio
Mitral Valve
Ring**

One of many types
of annuloplasty
rings



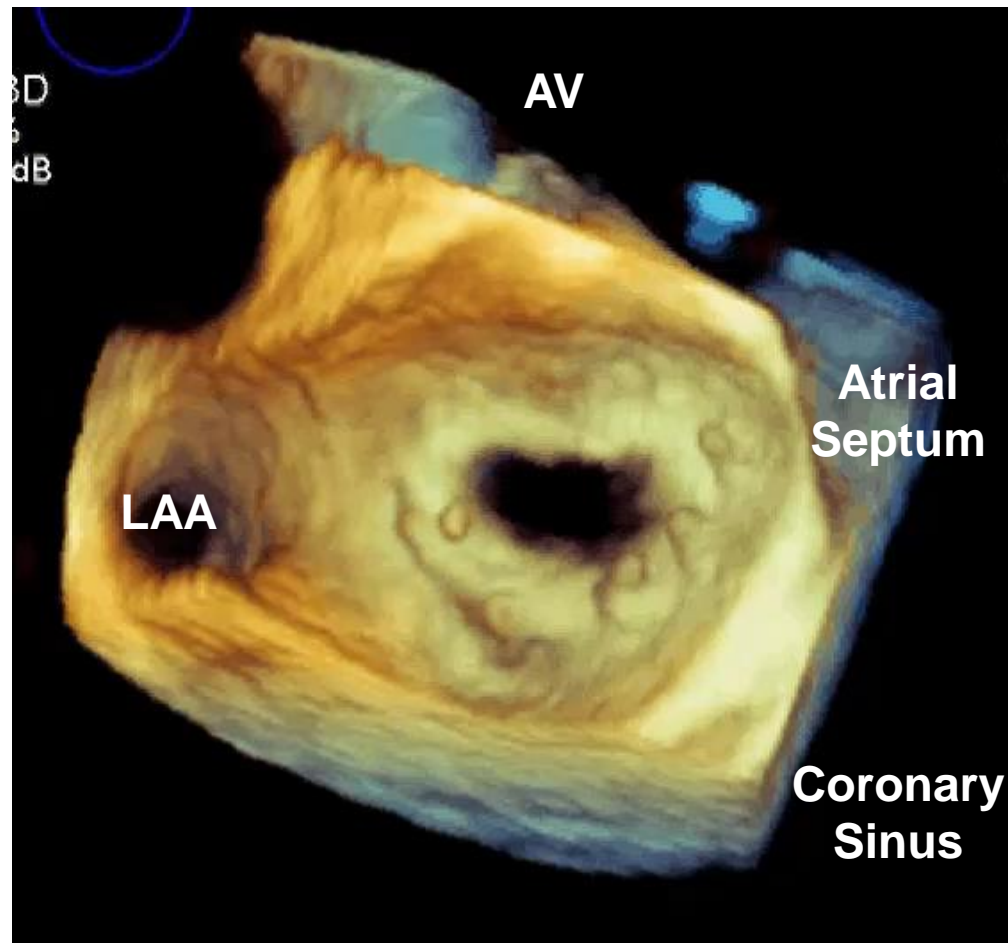
Mitral Ring Annuloplasty

76

3D TEE
Mitral Annuloplasty Ring

Mitral Annuloplasty: Full Ring

77



Percutaneous MV Repair (Mitral Valve Clipping)

78



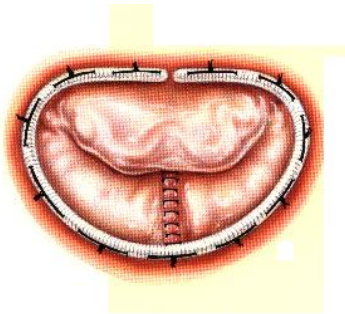
MitraClip
4-mm wide Cobalt Chromium
V-shaped clip covered with
polyester cloth

History of Mitral Valve Repair

79



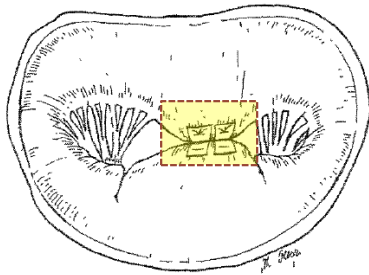
Alain
Carpentier



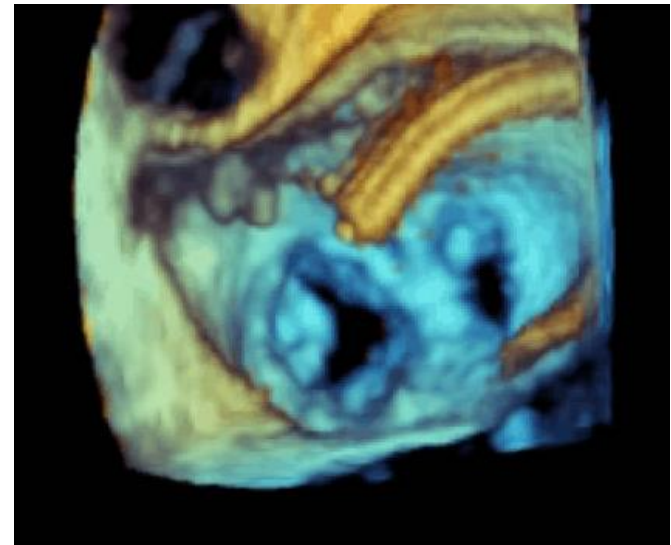
1970's
MV Repair with
Annuloplasty Ring



Ottavio Alfieri



June 1991
Surgical Edge-to-Edge Repair
(Alfieri stitch)



2000's
Percutaneous Edge-to-Edge Repair
(Evalve; MitraClip)

Mitral Valve Repairs

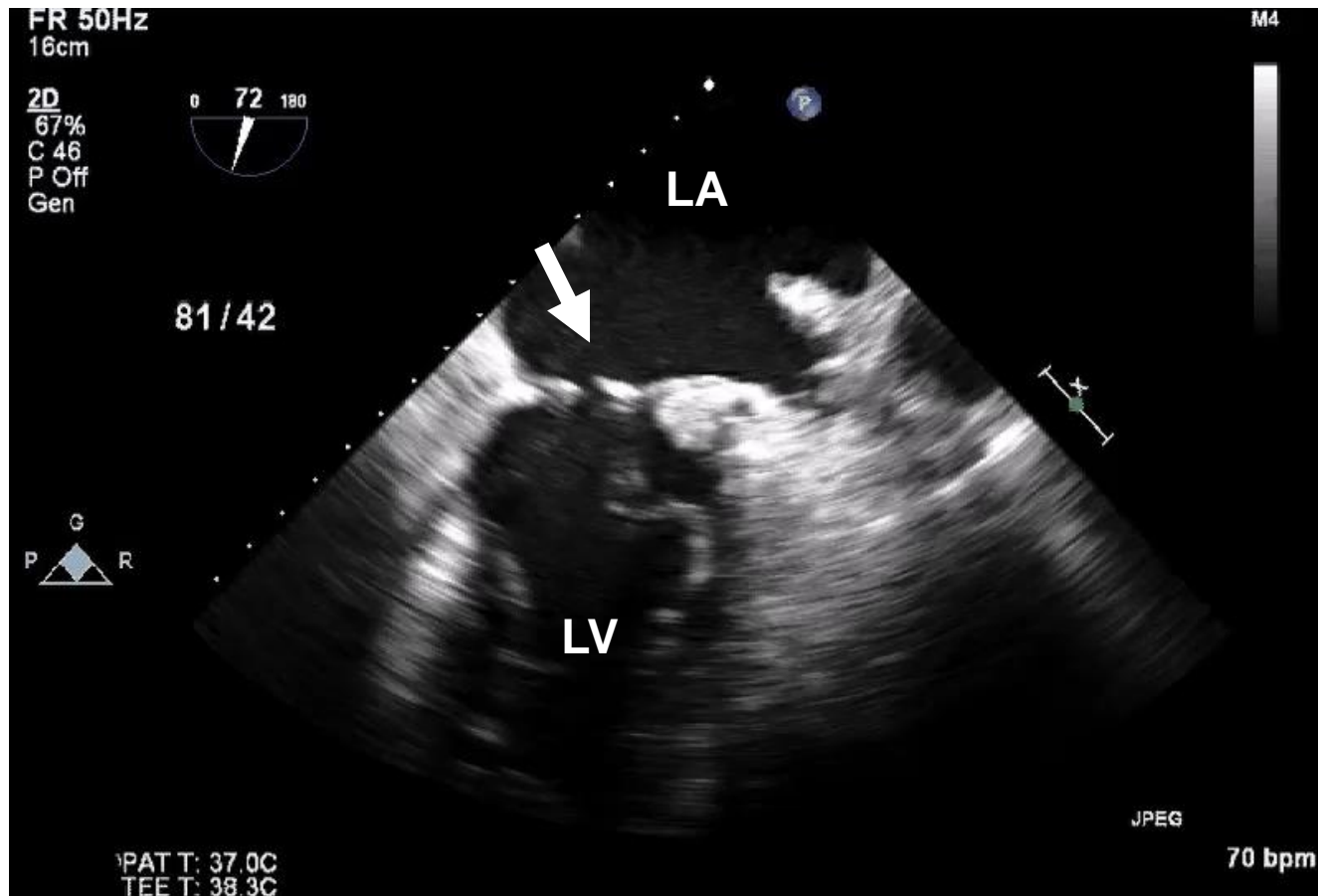
80

SURGICAL EDGE-TO-EDGE REPAIR (ALFIERI STITCH)

Surgical Alfieri Stitch: 2D TEE

81

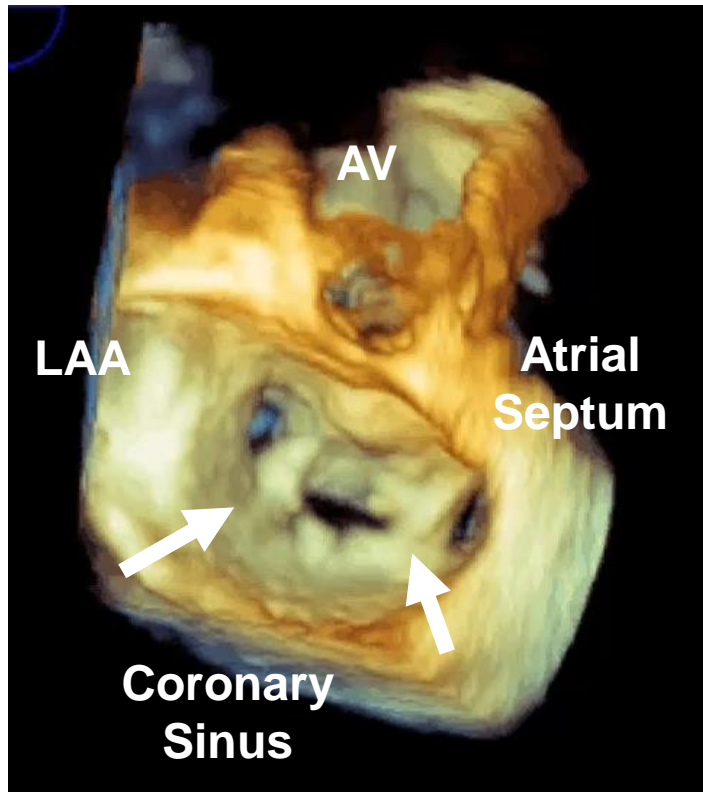
83-year-old man; s/p surgical Alfieri stitch 9 years earlier



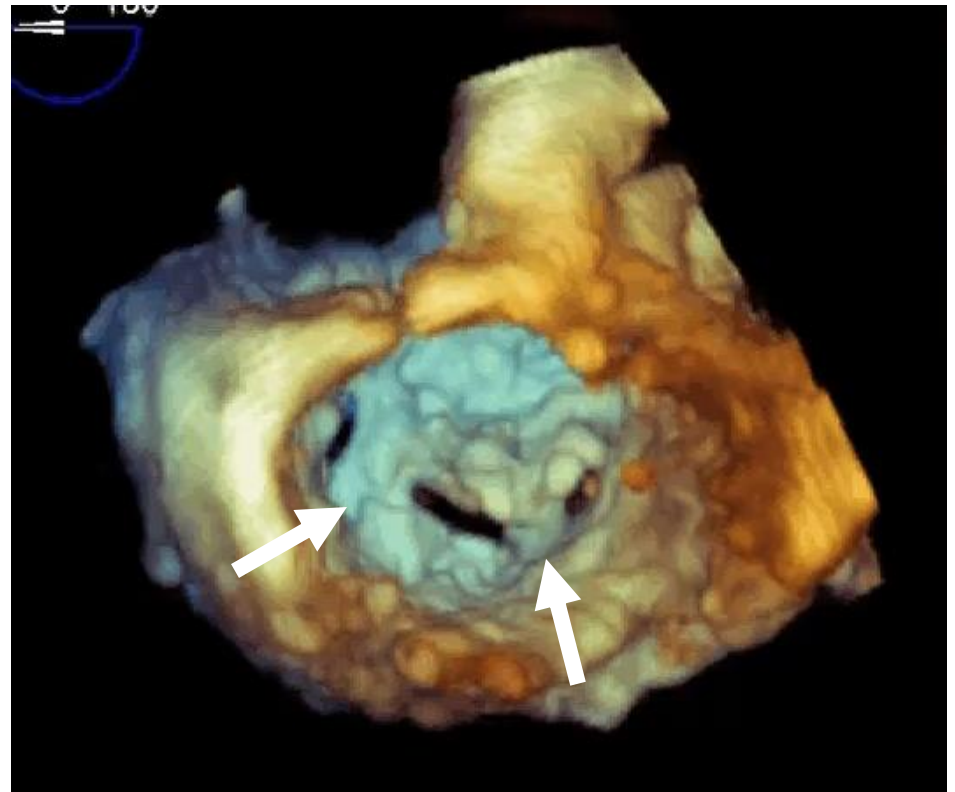
Surgical Alfieri Stitch: 3D TEE

82

83-year-old man; s/p surgical Alfieri stitch 9 years earlier



LA Side



LV Side

Mitral Valve Repairs

84

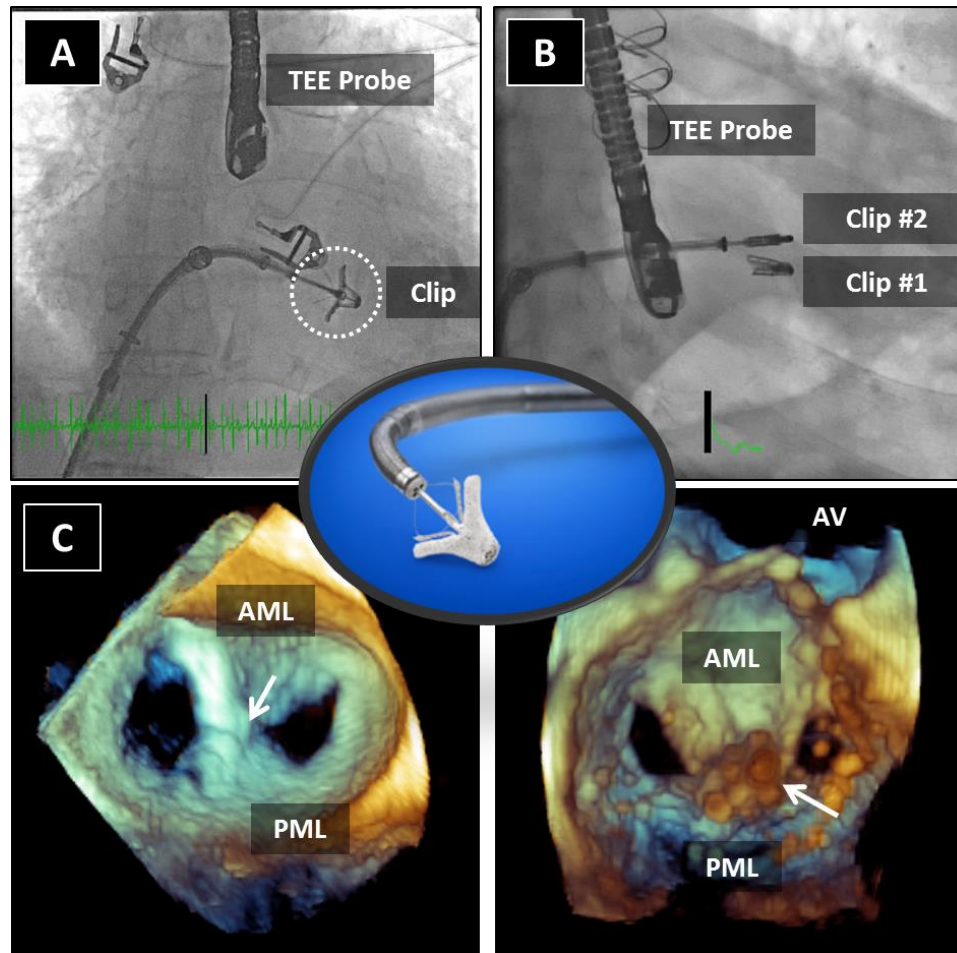
PERCUTANEOUS EDGE-TO-EDGE REPAIR (MITRAL CLIP)

**PERCUTANEOUS MITRAL CLIPPING IS APPROVED
IN THE UNITED STATES
FOR THE FOLLOWING INDICATION**

Significant symptomatic **degenerative** mitral valve disease
with **mitral regurgitation $\geq 3+$**
who have **too high a risk for surgery**.

Mitral Clipping: Clip Deployed

86

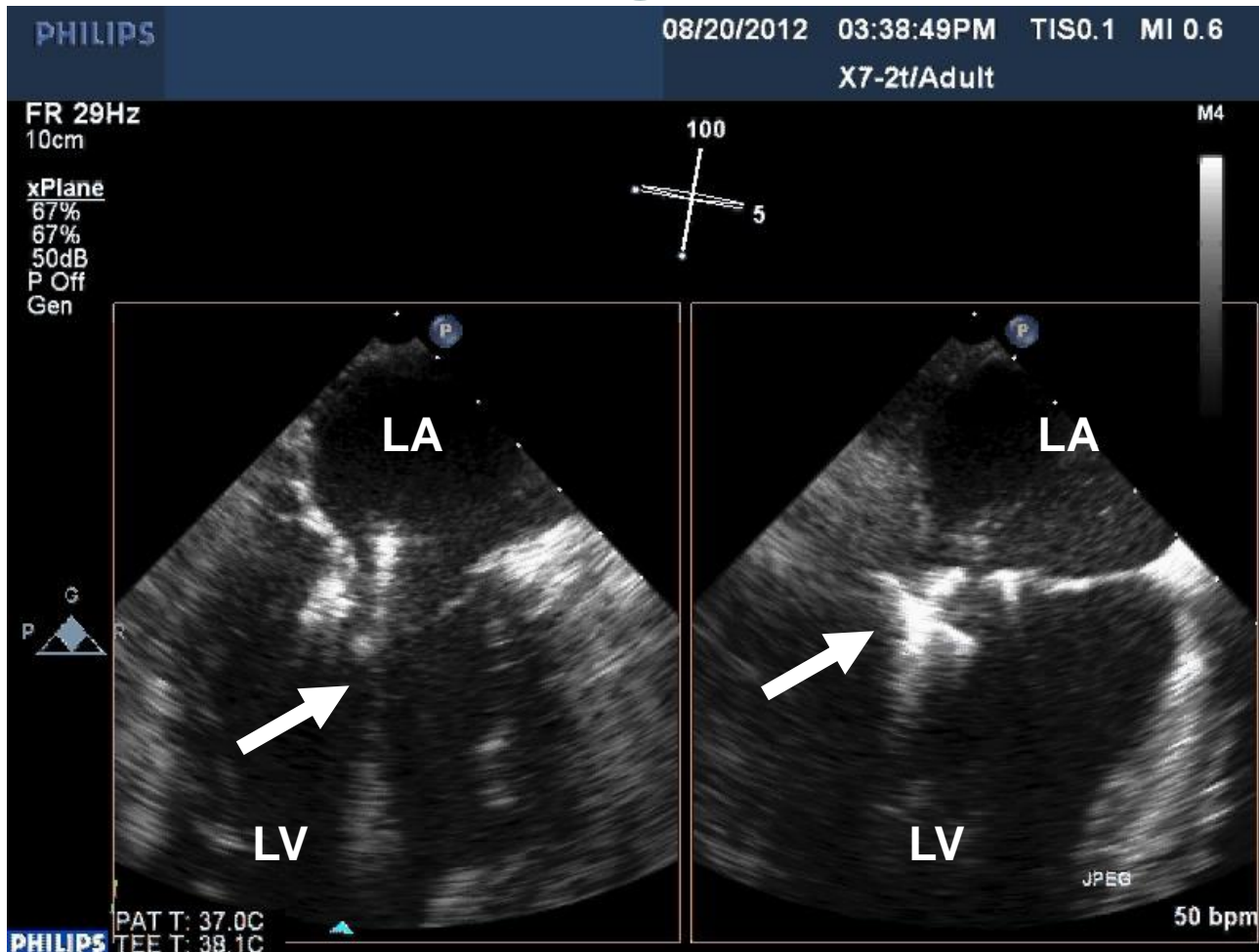


Left **atrial** side

Left **ventricular** side

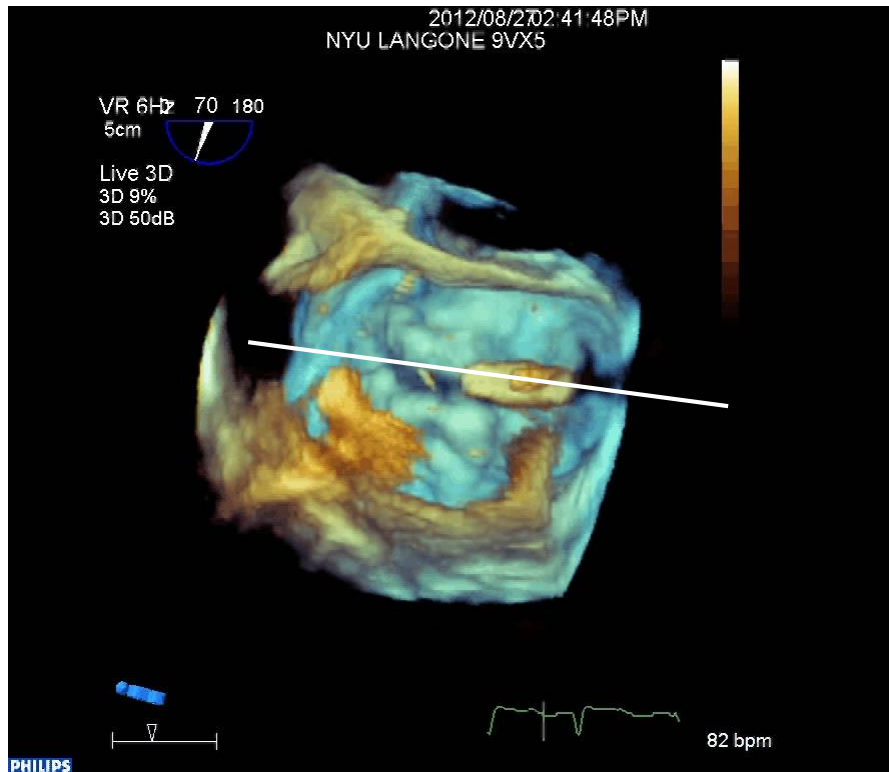
Percutaneous Mitral Clipping: Clip Being Deployed

87

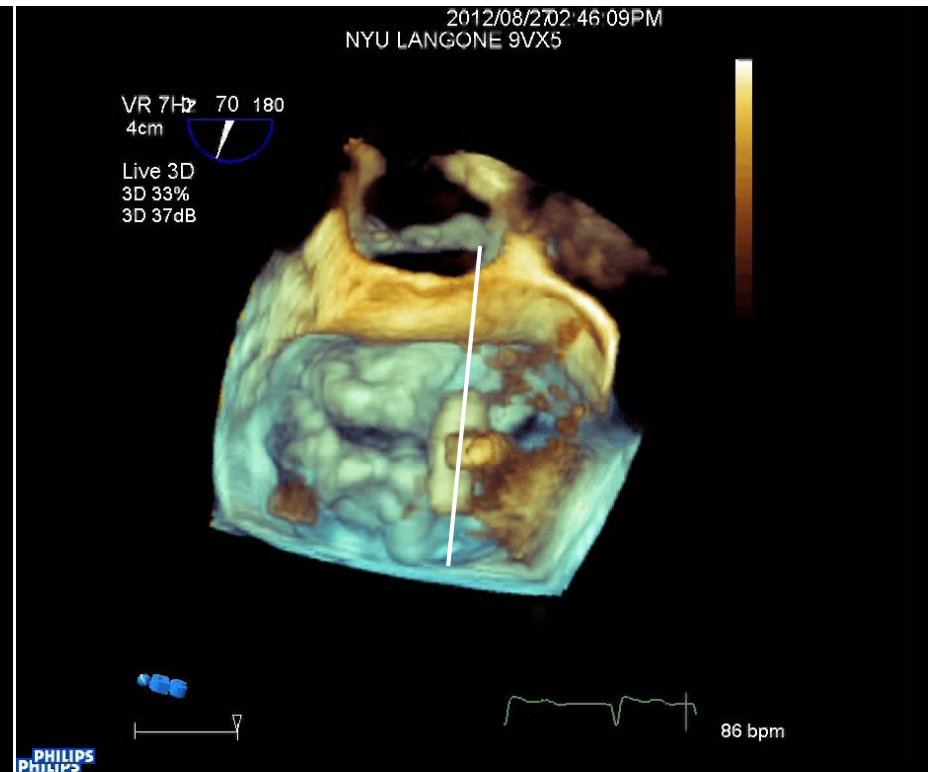


Percutaneous Mitral Clipping: Clip Positioning

88



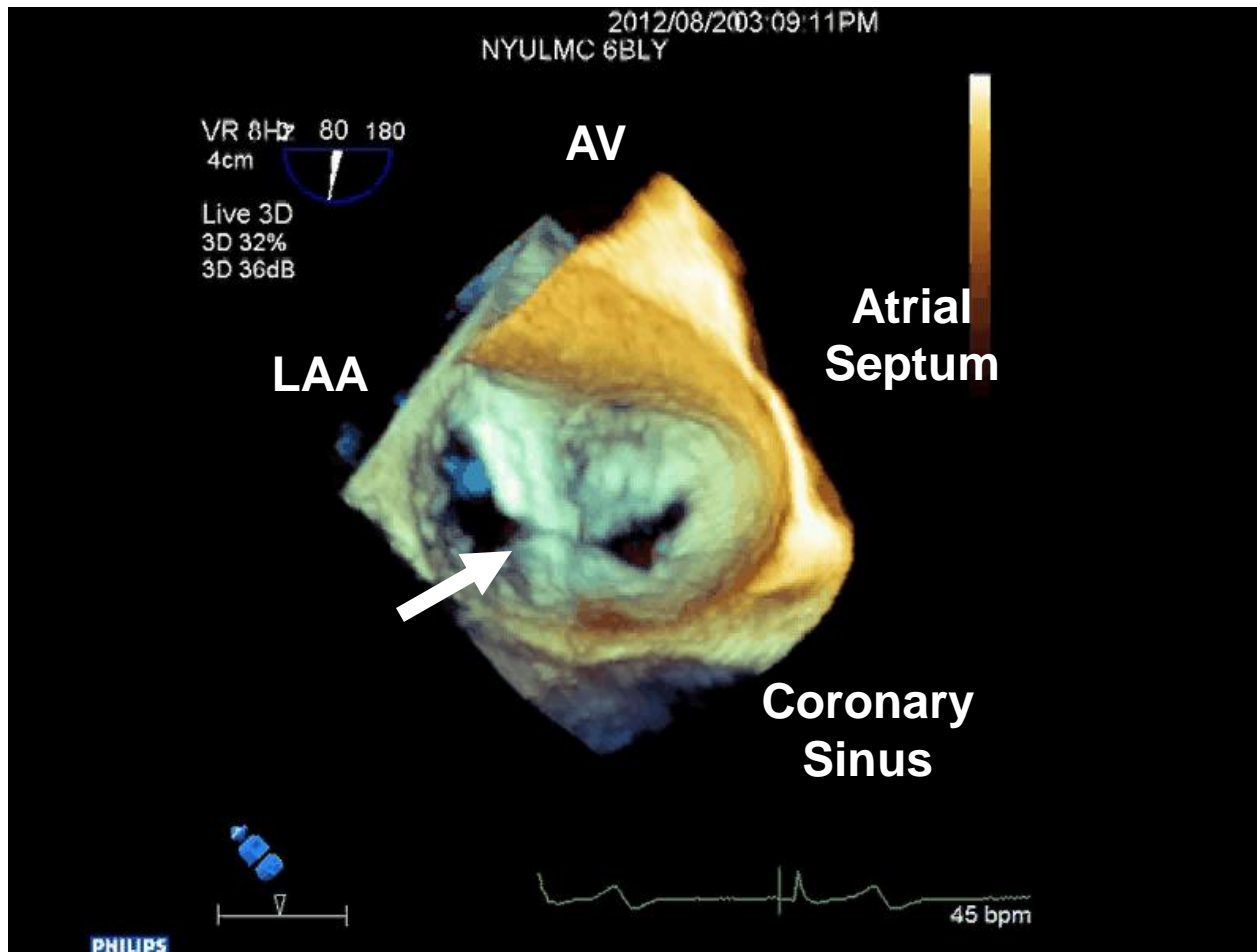
Improper
Clip Orientation



Proper
Clip Orientation

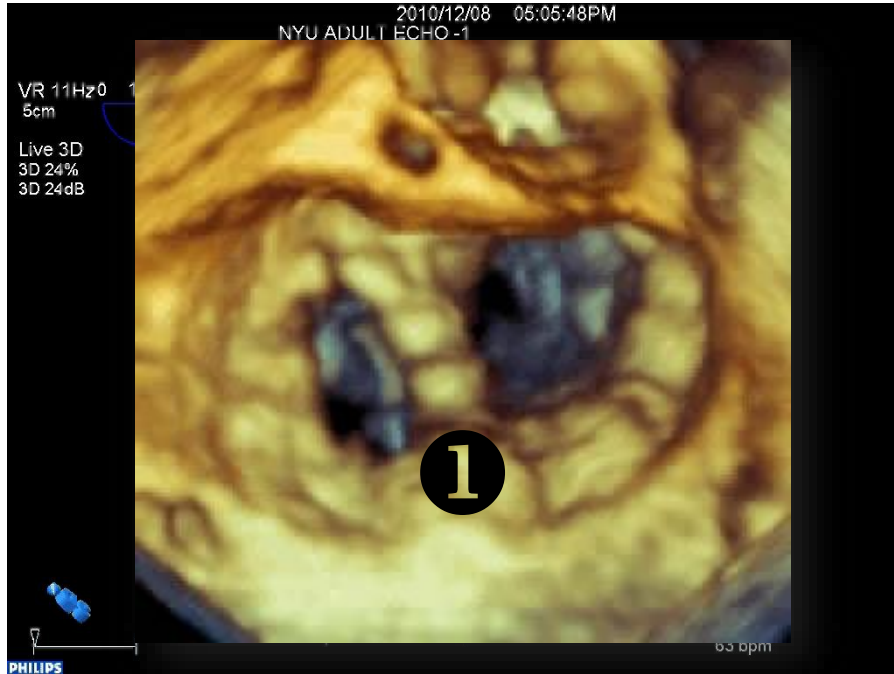
Percutaneous Mitral Clipping: Clip Deployed

89

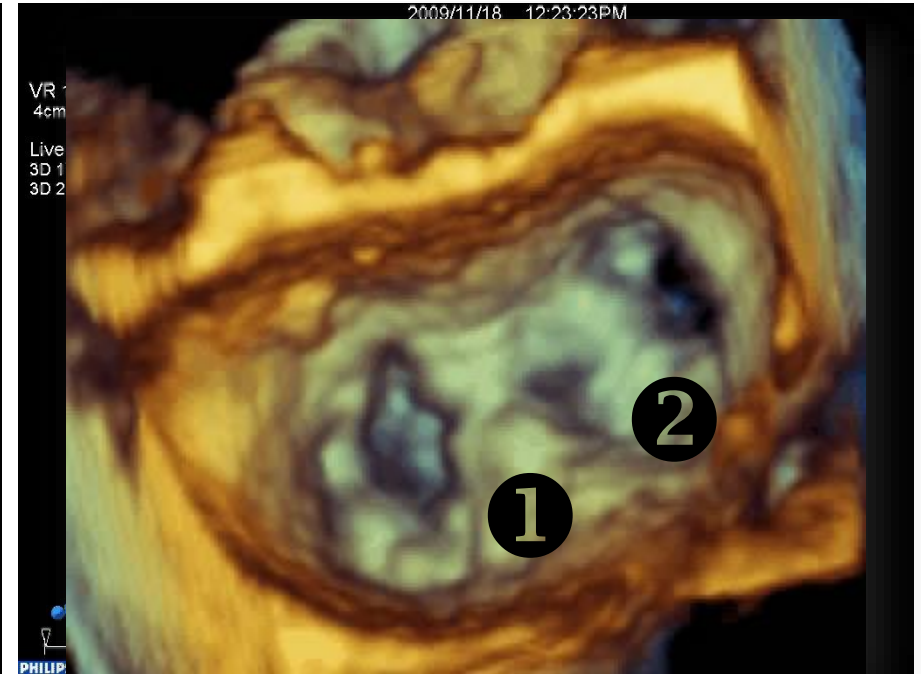


Percutaneous Mitral Valve Clipping

90



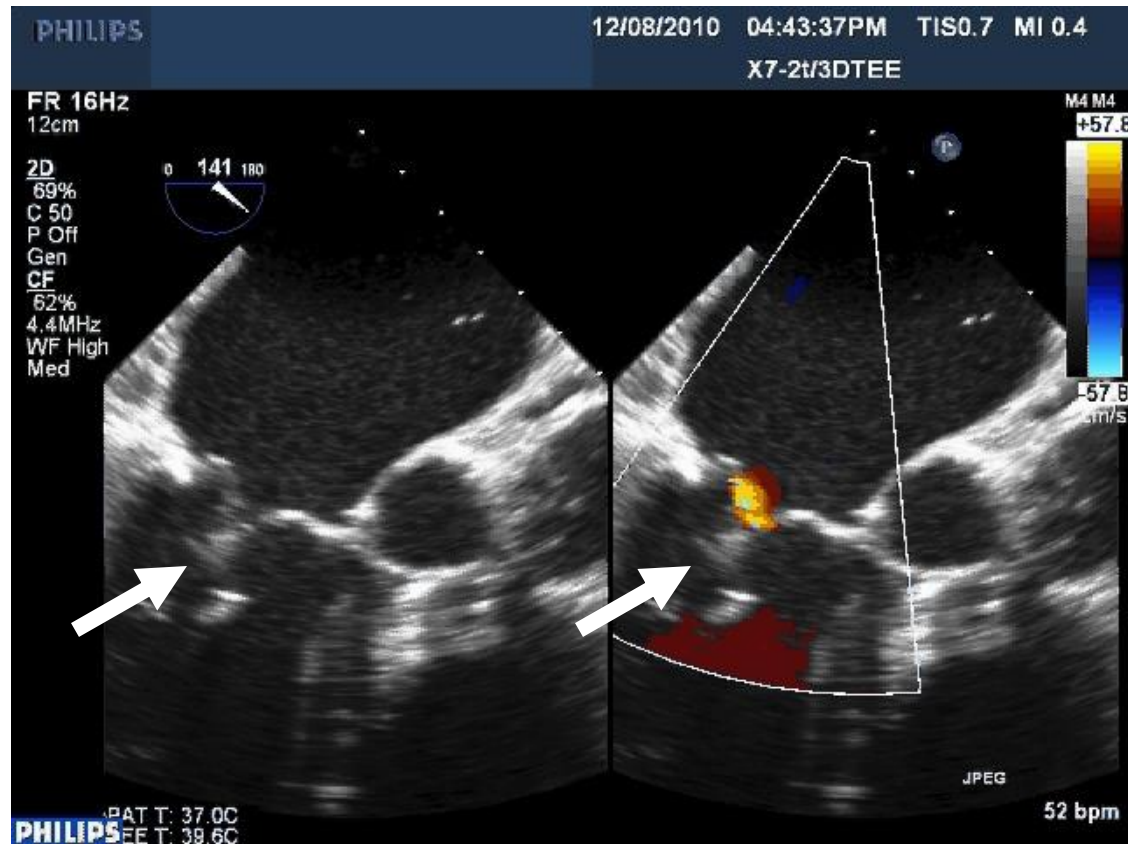
Single Clip



Two Clips

Percutaneous Mitral Clipping: Final Result

91



Post clipping: Only mild mitral regurgitation

Bonus Feature

92

Valve In Valve

[View More By This Developer](#)

By UBQO Limited

Open iTunes to buy and download apps.



[View In iTunes](#)

This app is designed for both iPhone and iPad

Free

Category: Medical
Updated: Oct 03, 2013
Version: 2.1
Size: 39.1 MB
Language: English
Seller: UBQO Limited
© UBQO Limited
Rated 4+

Compatibility: Requires iOS 6.0 or later. Compatible with iPhone, iPad, and iPod touch. This app is optimized for iPhone 5.

Customer Ratings

We have not received enough ratings to display an average for the current version of this application.

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[Cardio Z](#)
[View In iTunes](#)

Description

An instant guide to Valve in Valve procedures for clinicians

Quick, clear and concise information about heart valves and Valve in Valve therapy. A guide you wish you always had

[UBQO Limited Web Site](#) [Valve In Valve Support](#)

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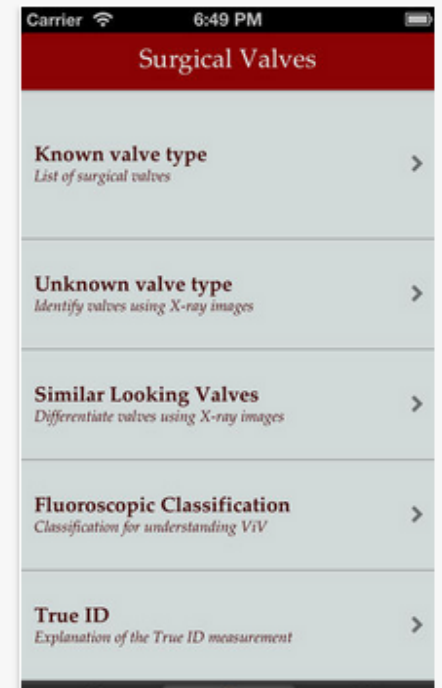
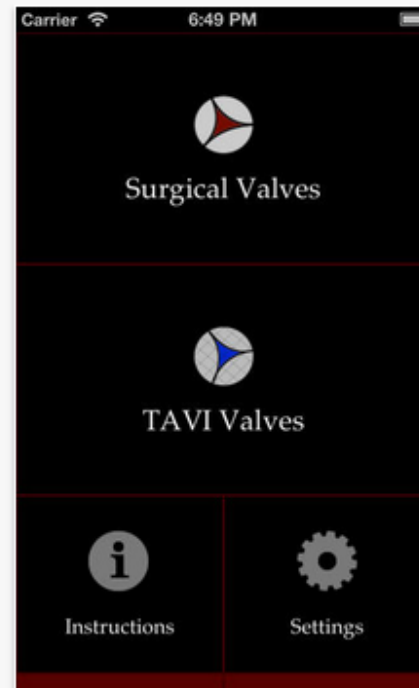
What's New in Version 2.1

Compatibility with iOS 7

Valve-in-Valve App
Available for iOS;
android version pending

Screenshots

iPhone | iPad



Thank You!

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New York University Medical Center

This presentation is a result of a collaborative effort of many members of the NYU medical community including Echo Lab, Cath Lab, EP Lab, Clinical Cardiology, Cardiac Surgery & Pediatrics.

**American Heart Association
(AHA) Meeting , Los Angeles**
November 3, 2012

Christian Hall

The son of Karl Victor Hall, the inventor of the Medtronic Hall valve



Christian Hall
Professor Dr Med
Spesialist i Hjertesykdommer

