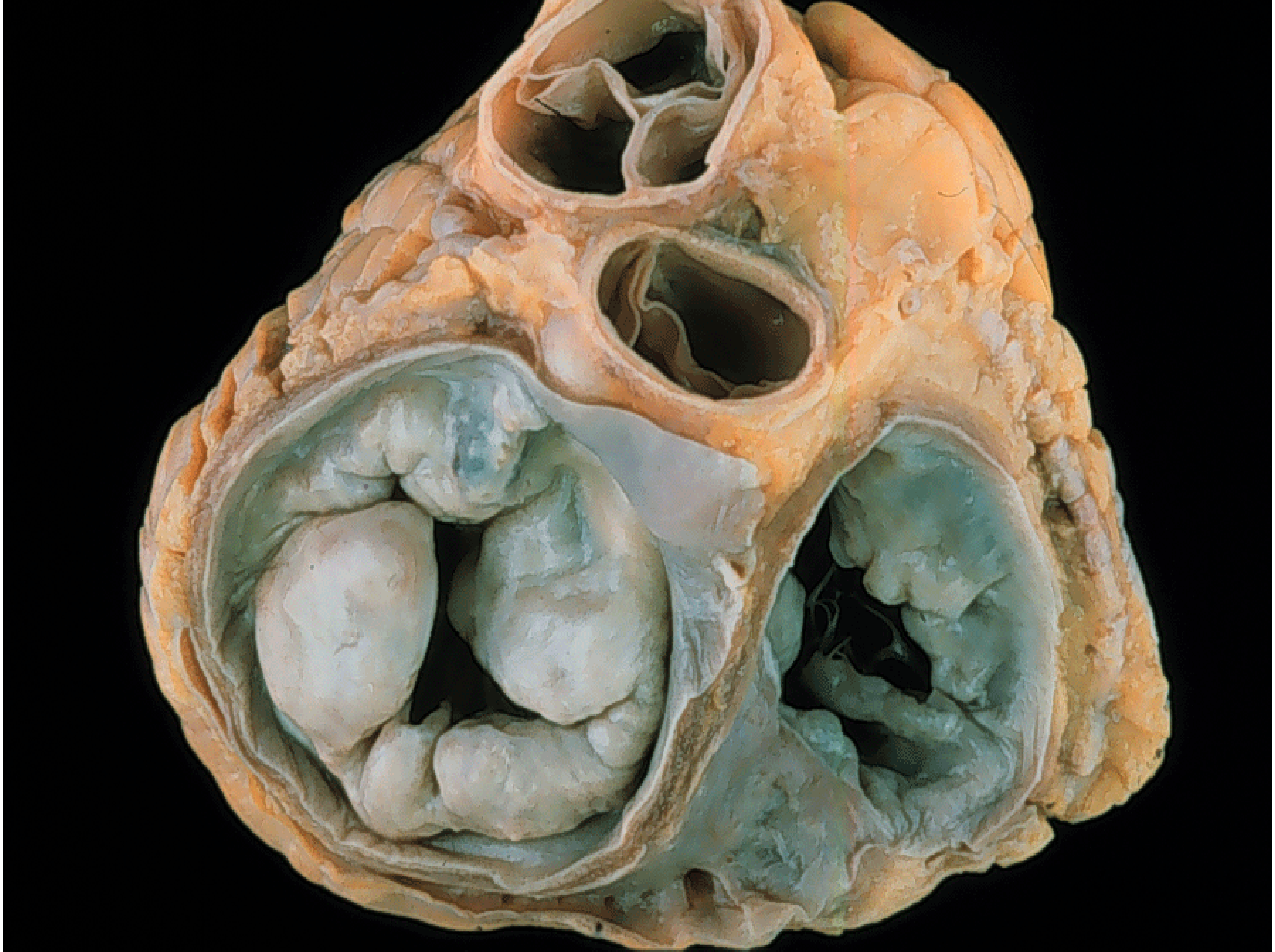
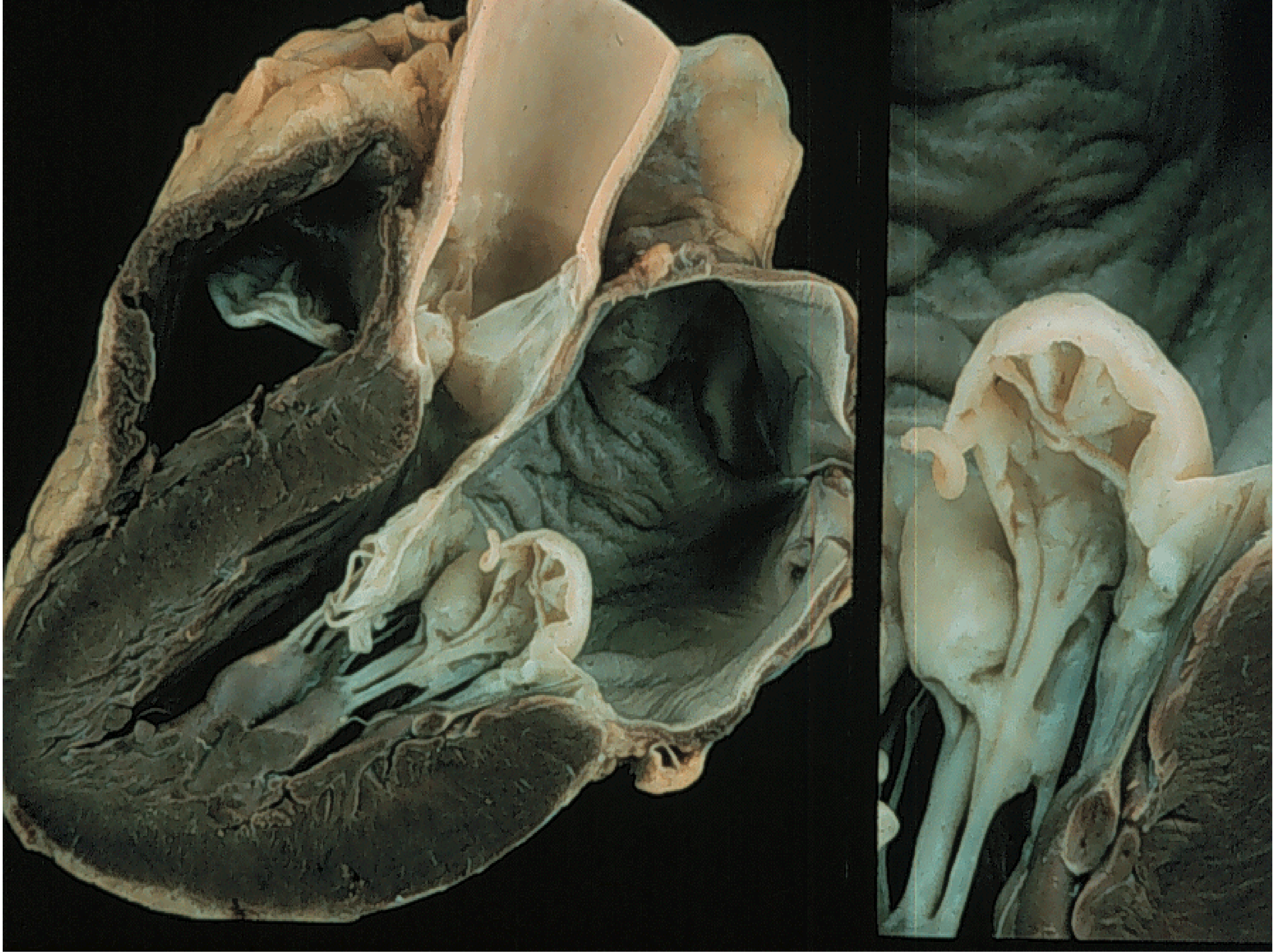
MVP
Mechanism-Outcome

Torino **2010**

Maurice E. Sarano, MD, FACC
Mayo Clinic, Rochester, MN





Burden of valvular heart diseases: a population-based study

Vuyisile T Nkomo, Julius M Gardin, Thomas N Skelton, John S Gottdiener, Christopher G Scott, Maurice Enriquez-Sarano

Background Valvular heart diseases are not usually regarded as a major public-health problem. Our aim was to assess their prevalence and effect on overall survival in the general population.

Methods We pooled population-based studies to obtain data for 11 911 randomly selected adults from the general population who had been assessed prospectively with echocardiography. We also analysed data from a community study of 16 501 adults who had been assessed by clinically indicated echocardiography.

Findings In the general population group, moderate or severe valve disease was identified in 615 adults. There was no difference in the frequency of such diseases between men and women (p=0·90). Prevalence increased with age, from 0·7% (95% CI 0·5–1·0) in 18–44 year olds to 13·3% (11·7–15·0) in the 75 years and older group (p<0·0001). The national prevalence of valve disease, corrected for age and sex distribution from the US 2000 population, is 2·5% (2·2–2·7). In the community group, valve disease was diagnosed in 1505 (1·8% adjusted) adults and frequency increased considerably with age, from 0·3% (0·2–0·3) of the 18–44 year olds to 11·7% (11·0–12·5) of those aged 75 years and older, but was diagnosed less often in women than in men (odds ratio 0·90, 0·81–1·01; p=0·07). The adjusted mortality risk ratio associated with valve disease was 1·36 (1·15–1·62; p=0·0005) in the population and 1·75 (1·61–1·90; p<0·0001) in the community.

Interpretation Moderate or severe valvular diseases are notably common in this population and increase with age. In the community, women are less often diagnosed than are men, which could indicate an important imbalance in view of the associated lower survival. Valve diseases thus represent an important public-health problem.

Lancet 2006; 368: 1005–11

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See Comment page 969

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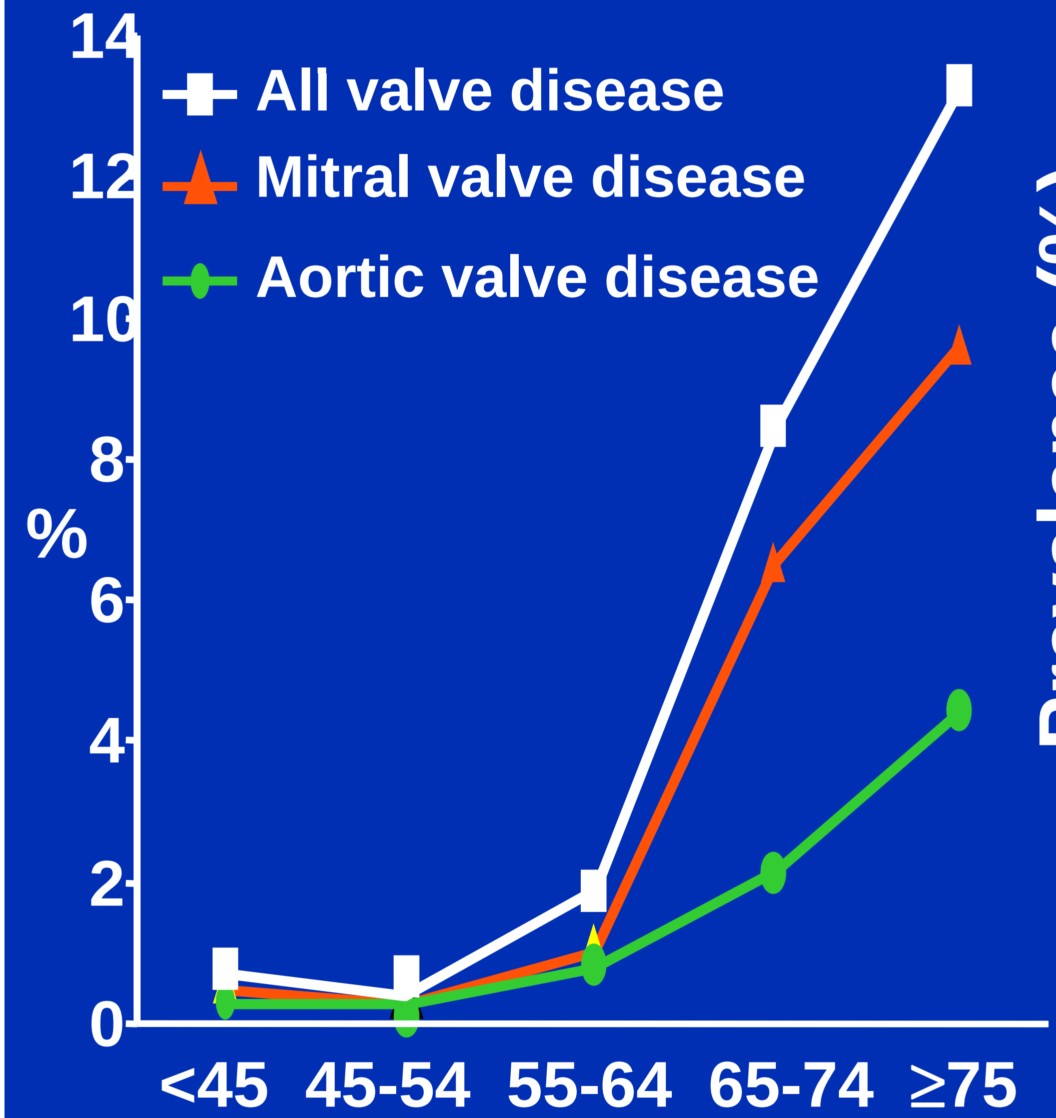
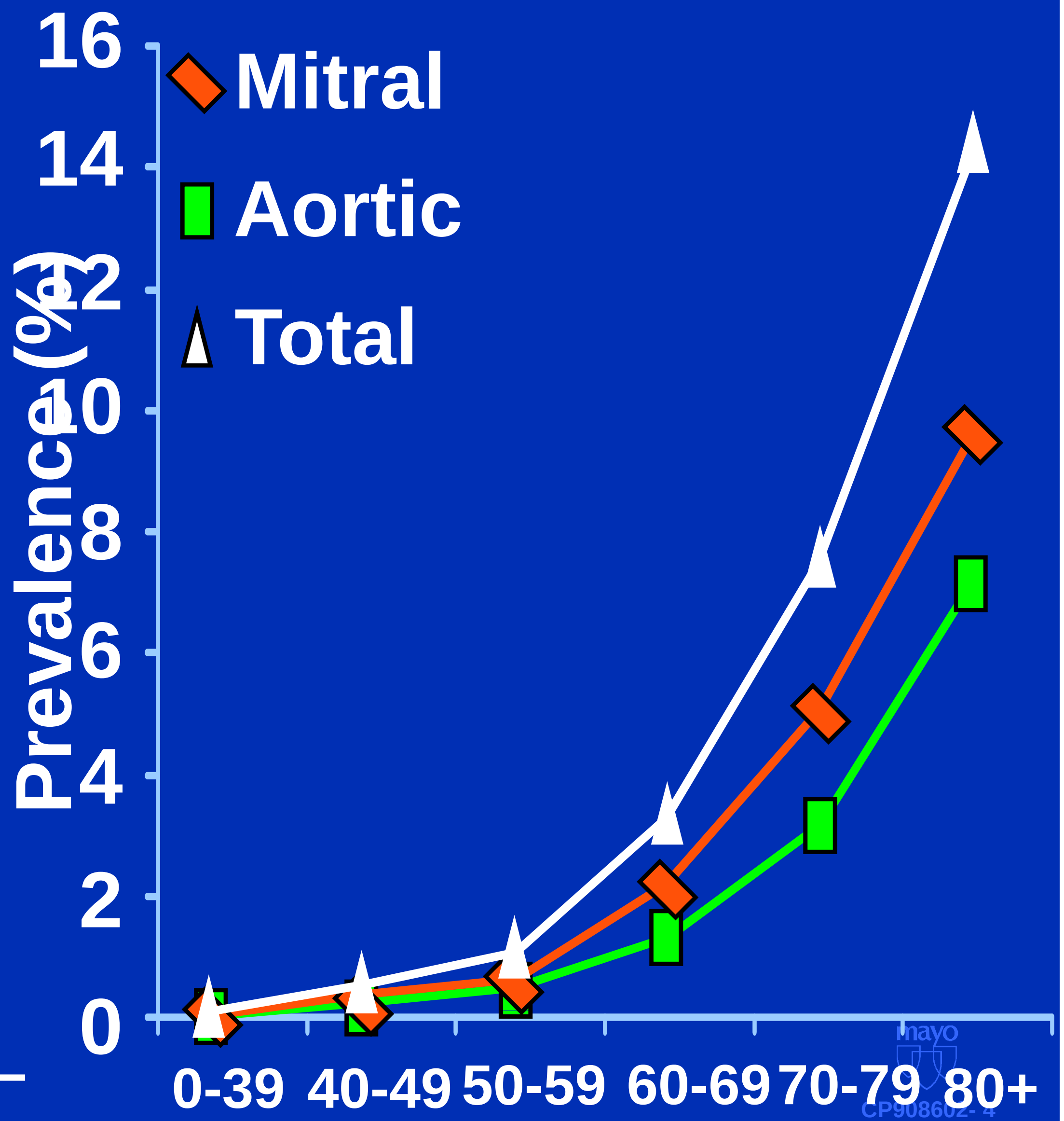
Correspondence to:
Prof Maurice Enriquez-Sarano, Division of Cardiovascular Diseases and Internal Medicine, Mayo Clinic, Rochester,

Prevalence of Valve Diseases

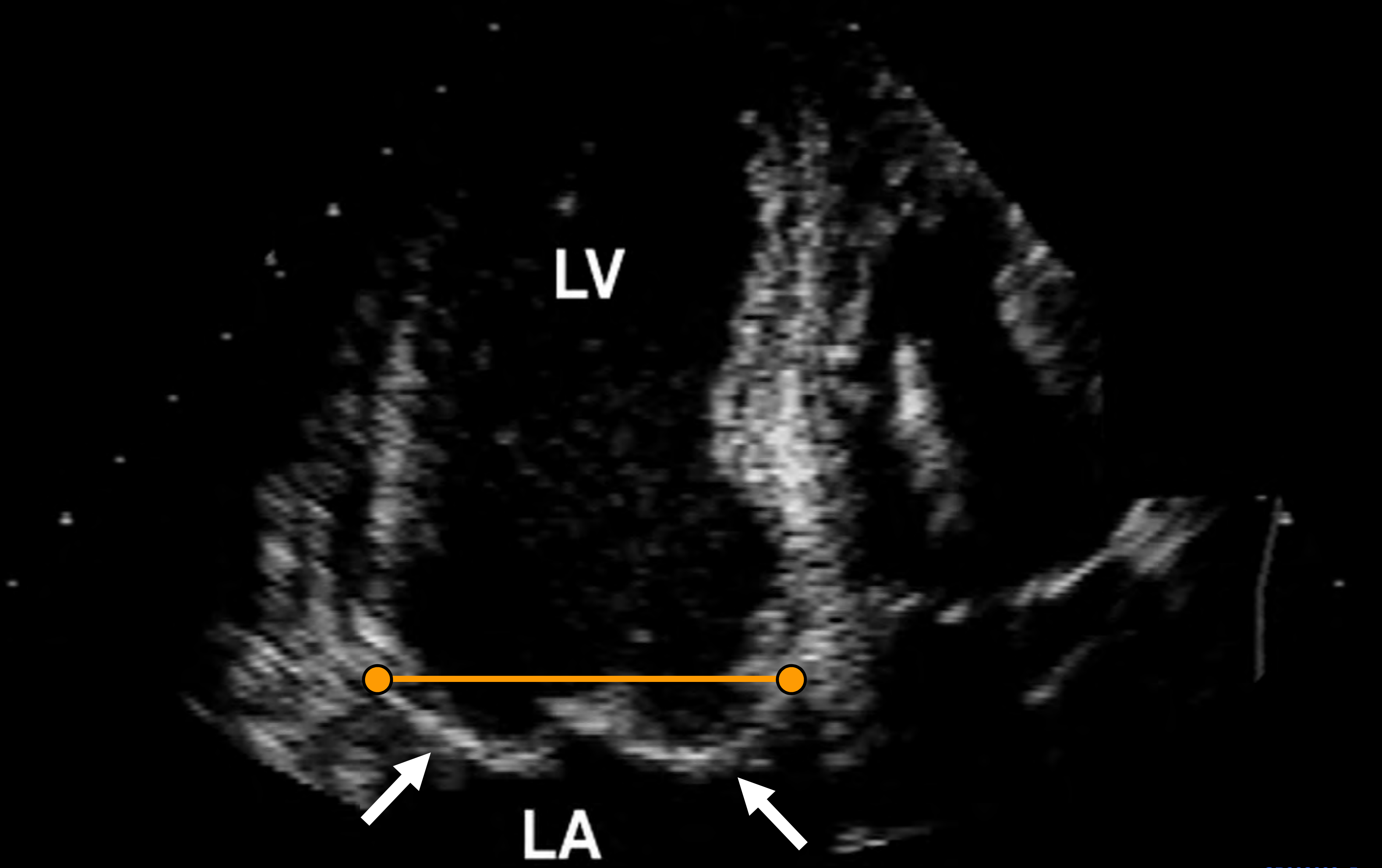
Population-NIH series



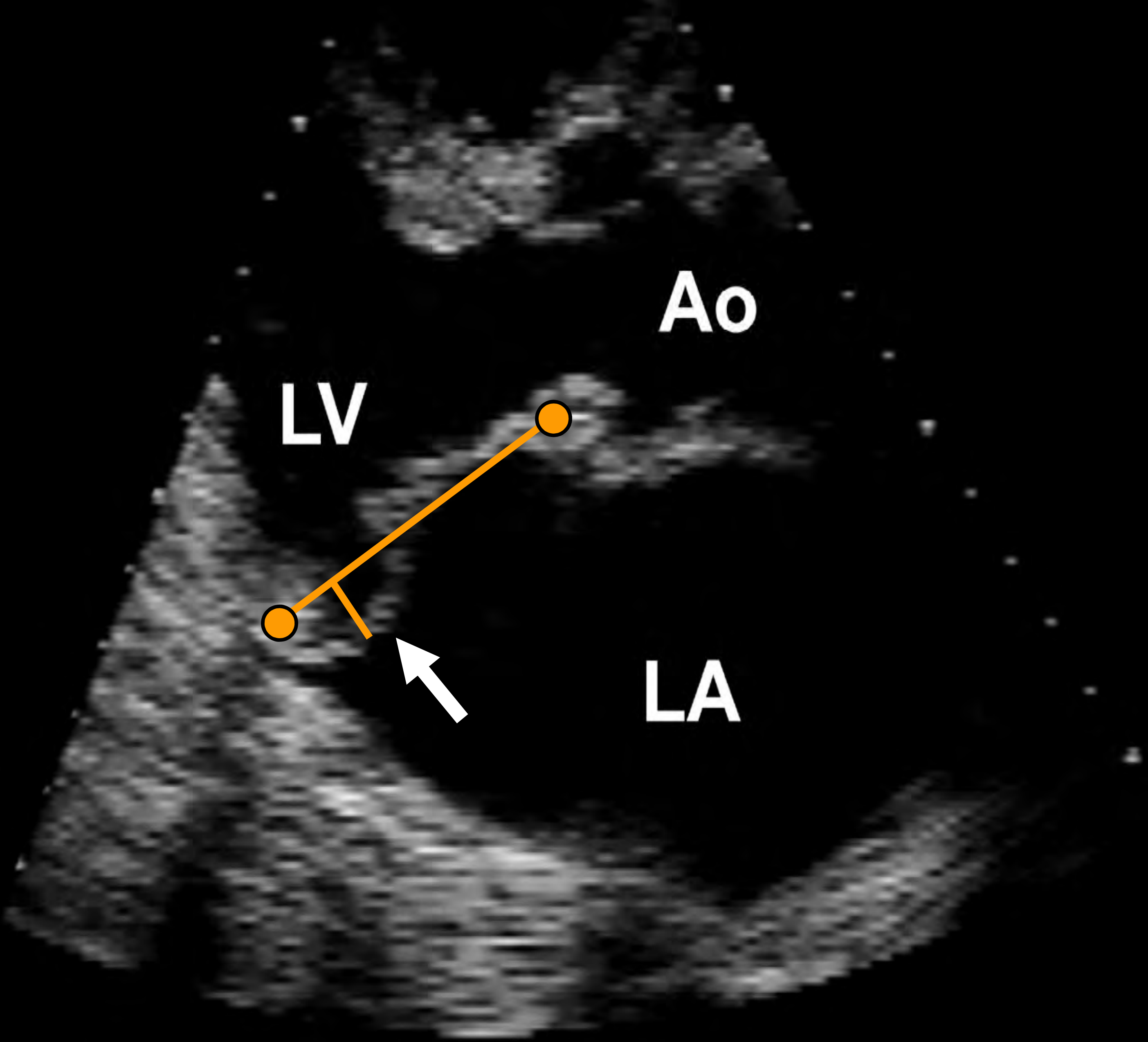
Olmsted County



Mitral Valve Prolapse?



Mitral Valve Prolapse



Prevalence of MVP

Previously overestimated	**5-17%**
With current criteria	**0.6-2.4%**

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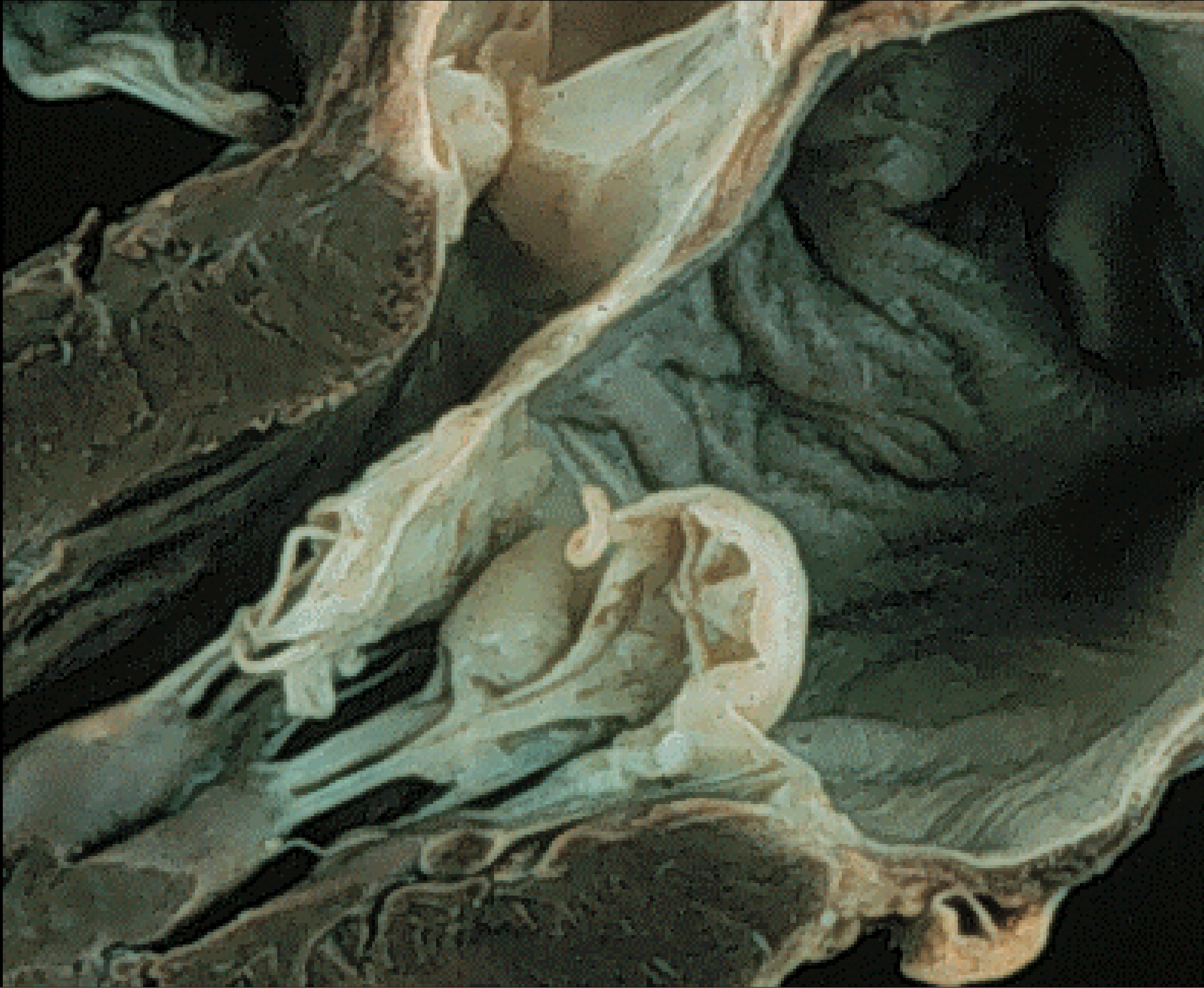
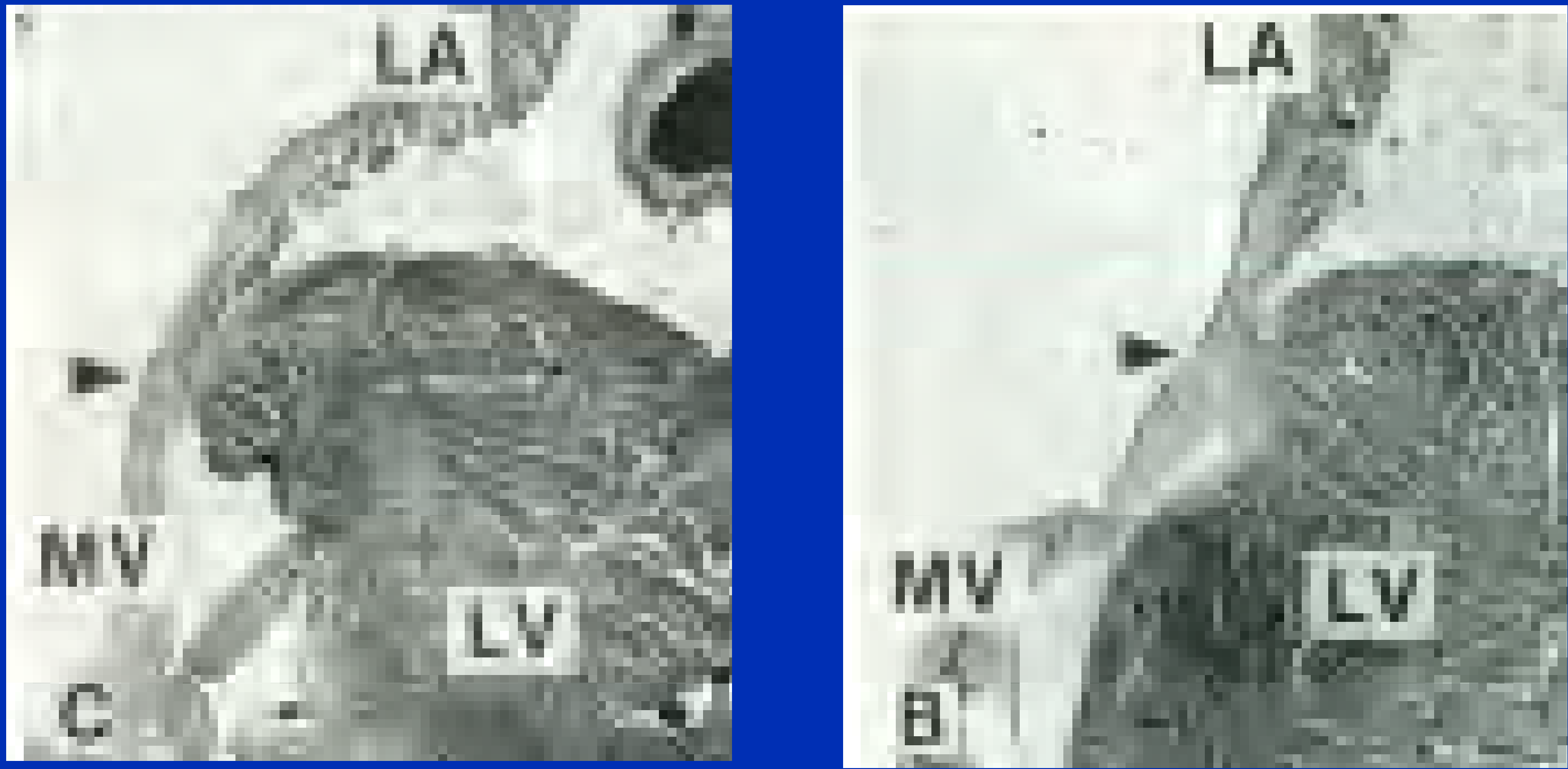
CP908602- 7

MVP

All these misconceptions stem from our lack of understanding of the interaction between Mitral valve and annulus



Mitral Annulus



Normal atrio-valve and ventricle junction

Thin leaflets

Hutchins GM, NEJMed 1986; 314: 535-40

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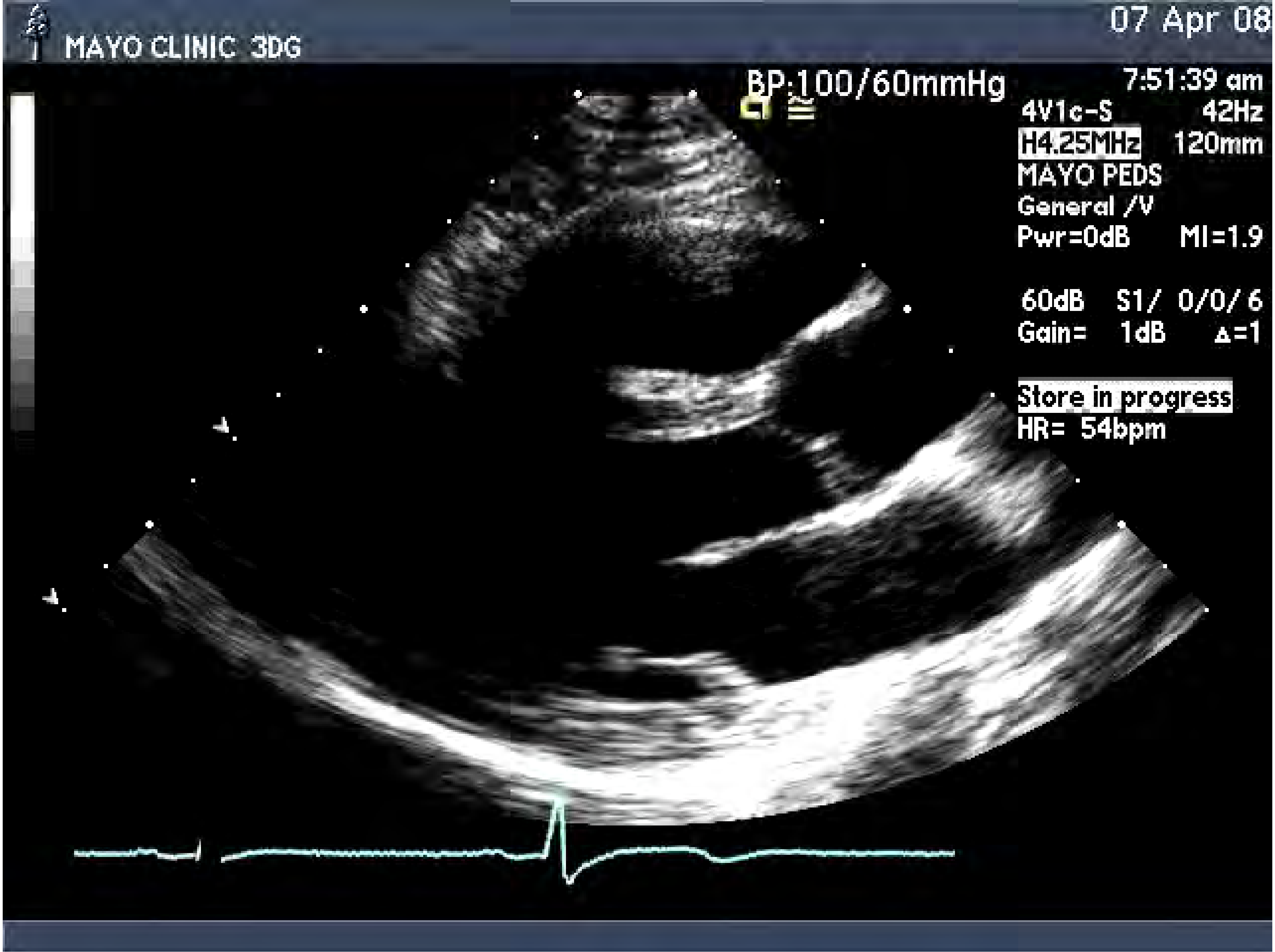
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Pwr=0dB MI=1.9
60dB S1/ 0/0/ 6
Gain= 1dB Δ=1
Store in progress
HR= 54bpm

Mitral Annulus

The Mitral annulus has always been frustrating to study

JOURNAL OF APPLIED PHYSIOLOGY
Vol. 30, No. 5, May 1971. Printed in U.S.A

Size and motion of the mitral valve annulus in anesthetized intact dogs

ANASTASIOS G. TSAKIRIS, GOETZ VON BERNUTH, G. C. RASTELLI, MAURICE J. BOURGEOIS, JACK L. TITUS, AND EARL H. WOOD
Mayo Graduate School of Medicine (University of Minnesota), and
Mayo Clinic and Mayo Foundation, Rochester, Minnesota 55901

TSAKIRIS, ANASTASIOS G., GOETZ VON BERNUTH, G. C. RASTELLI, MAURICE J. BOURGEOIS, JACK L. TITUS, AND EARL H. WOOD. *Size and motion of the mitral valve annulus in anesthetized intact dogs.* J. Appl. Physiol. 30(5): 611–618. 1971.—Phasic variations in the size, shape, and position of the annulus of the mitral valve during the cardiac cycle were studied in five normal anesthetized dogs 8–16 weeks after suturing seven to nine lead beads on the endocardial surface of the valve ring during cardiopulmonary bypass. Field-by-field measurements from biplane video angiograms were used to study changes of the valve ring, sizes of the left atrium and ventricle, and efficacy of closure of the mitral valve during different hemodynamic conditions. Eccentric narrowing of the annulus (mainly dorsal and lateral portions) during atrial and ventricular contractions reduced its area by 10–36% of the maximal value during diastole. The relative contribution of atrial and ventricular contractions to the phasic decrease in the area of the annulus varied in the same animal during different experimental hemodynamic conditions. The findings suggest that the presystolic narrowing associated with atrial systole may be particularly important in the prevention of mitral regurgitation during decreased cardiac contractility evidenced by a low ejection fraction and an increased end-diastolic volume.

METHODS

Operative procedure. In five dogs ranging in weight from 12 to 19 kg, the thorax was opened at the fourth interspace (pentobarbital anesthesia, endotracheal intubation, and intermittent positive-pressure ventilation). After institution of normothermic cardiopulmonary bypass (disk oxygenator and roller pumps) at flow rates of 70 ml/kg of body weight and after electric fibrillation of the heart, the mitral valve was exposed through a left atriotomy. Perforated lead beads, approximately 1.5–2.0 mm in diameter were threaded on 5-0 silk and sutured to the apparent annulus of the mitral valve. The beads were placed directly on the base of the mitral valve at its visible juncture with the cardiac wall; in the region of the aortic valve, the plane of the anterior mitral leaflet was followed. Seven to nine beads were used in each dog. During the operation, care was taken to avoid injury to the mitral valve leaflets, the chordae tendineae, and the papillary muscles. After evacuation of all air and after defibrillation of the heart, the left atrium was closed. Benzathine penicillin G (1,200,000 units) and streptomycin

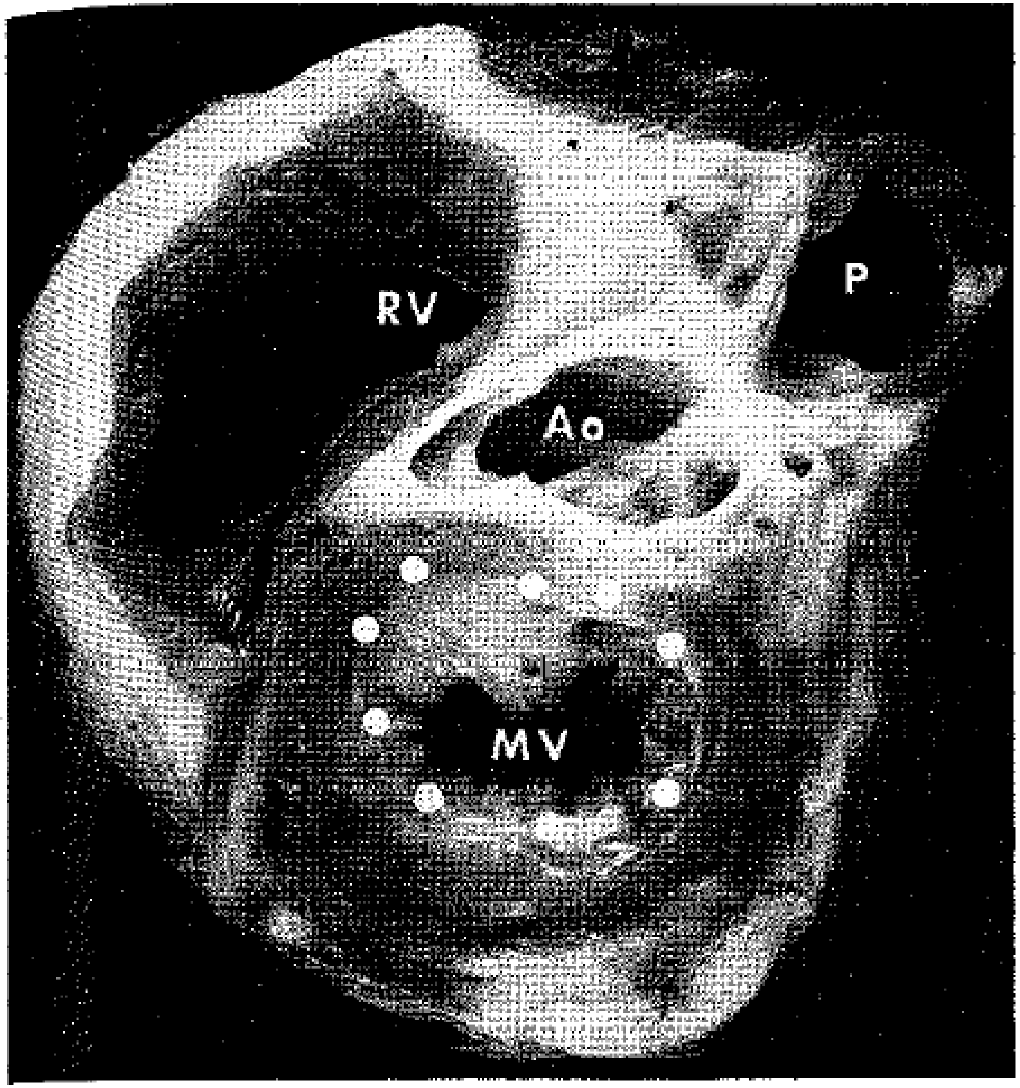


FIG. 2. Cephalad-to-caudad view of mitral orifice of a dog heart, with left atrium removed, demonstrating approximate position

the suture of each bead were made in order to determine its exact location relative to the mitral ring and the presence and extent of fibrosis or other alteration.

RESULTS

Anatomic findings. In all dogs the beads were properly positioned in the region of the mitral annulus (Fig. 3). The beads on the anterior mitral leaflet were situated at approximately the midpoint of the sheet of fibrous tissue that extends continuously from anterior leaflet into the base of the aortic cusps. In the commissural regions and the posterior leaflet, the beads were almost exactly at the point of junction of the left atrial endocardium and the mitral valvular tissue, or within 1 mm of this poorly definable point.

Reaction to the beads and their anchoring sutures was minimal (Fig. 3) and consisted of modest amounts of granulation and fibrous tissue with foreign body giant cells. The tissue reaction was confined to the immediate area of the bead and in no instance was deformity or fibrosis of the leaflet tissue apparent. Fibrosis or fibrocartilaginous deformation was present near the left atrial incisions which were some distance from the valve ring.

Motions of valve ring. The hemodynamic parameters measured during control conditions and the responses to different interventions were normal in all dogs (10). During ventricular systole the mitral ring moved toward the ven-

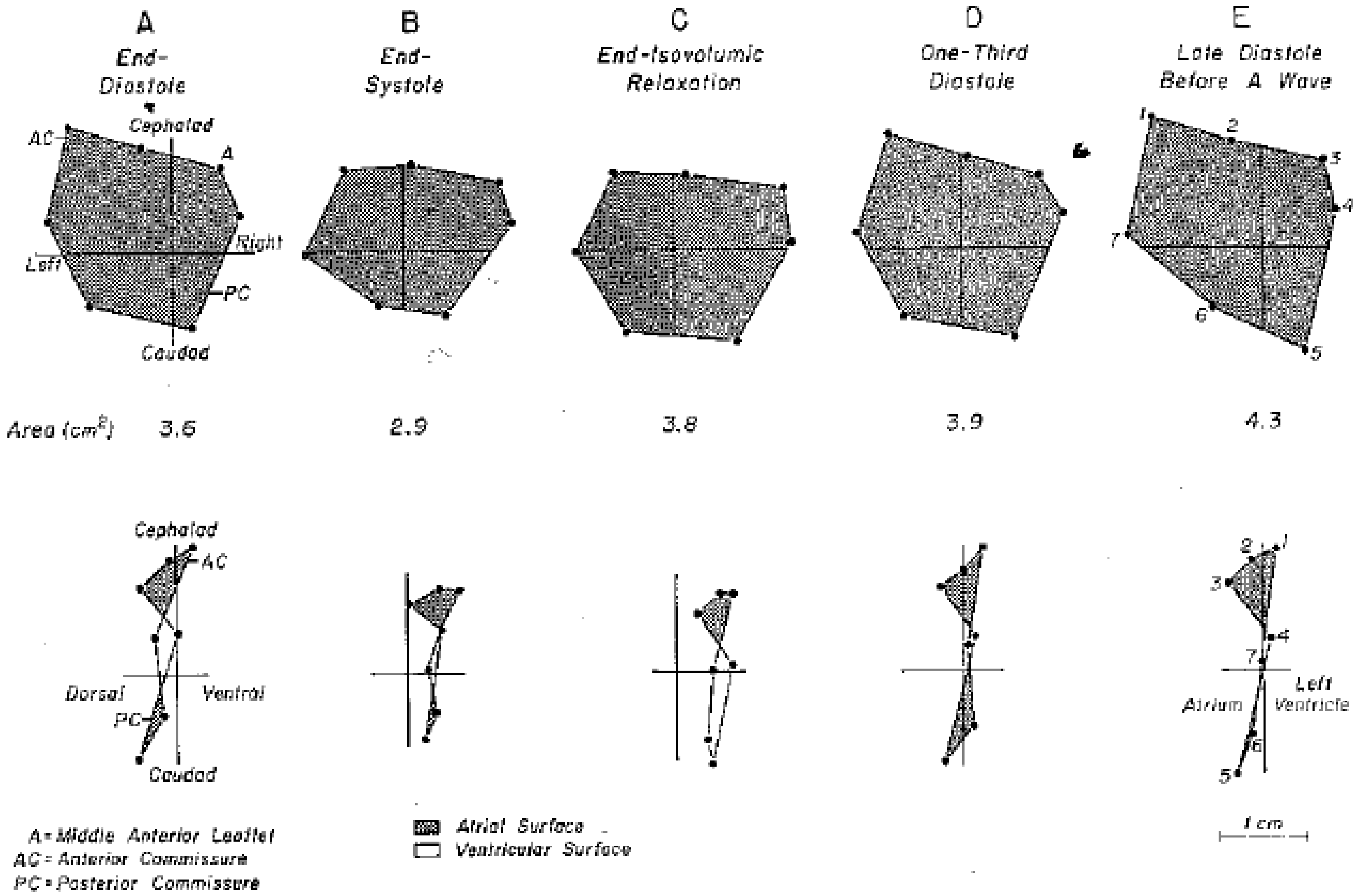
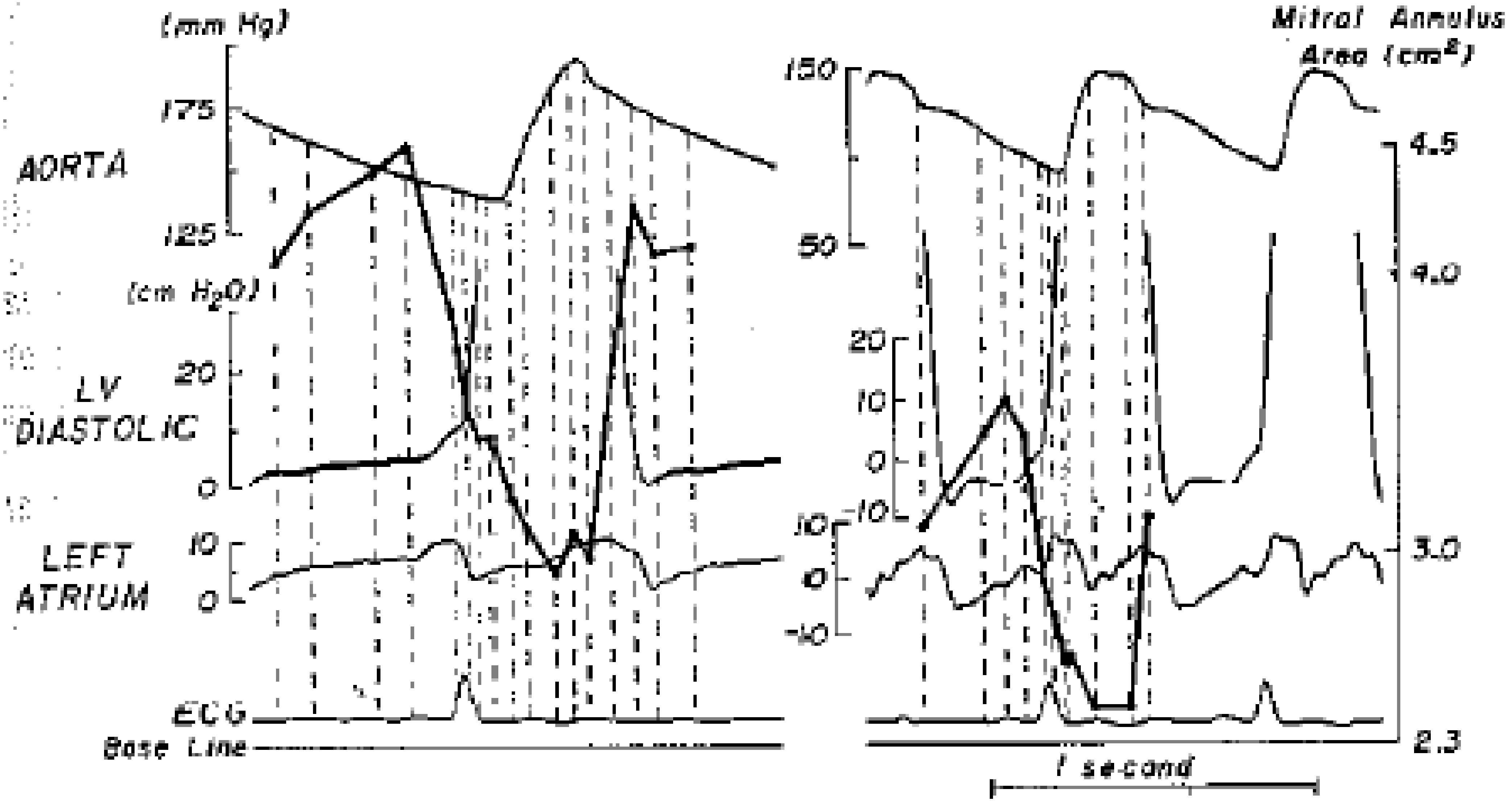


FIG. 4. Change in size and position of annulus of mitral valve during one cardiac cycle (17-kg dog, morphine-pentobarbital anes- at points of intersection of cross hairs in upper panels. P these cross hairs is nearly identical to plane of mitral



NARROWING (%):	34	31
HEART RATE (beats/minute):	67	115
STROKE VOL (ml):	20	25

Mitral Annulus

The Mitral annulus in normal animals is dynamic

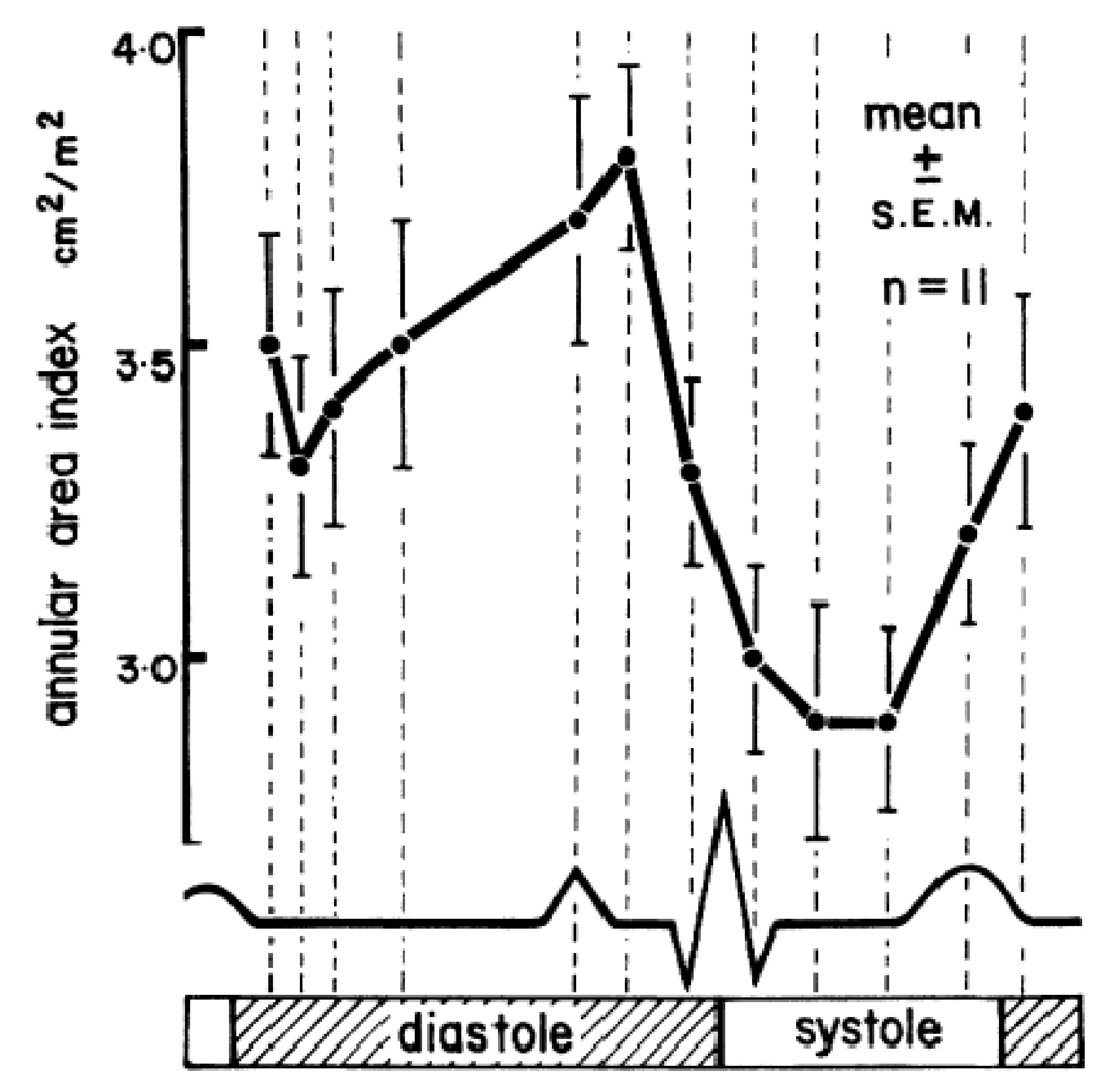
What about humans ?

Size and Motion of the Mitral Valve Annulus in Man

I. A Two-dimensional Echocardiographic Method and Findings in Normal Subjects

JOHN A. ORMISTON, M.B., CH.B., PRAVIN M. SHAH, M.D., CHUWA TEI, M.D., AND MAYLENE WONG, M.D.

SUMMARY Using wide-angle, phased-array, two-dimensional echocardiography, mitral leaflets and their annular attachments were recorded from a view close to the standard apical four-chamber view. The transducer was rotated and recordings were made at 30° rotational intervals around the circumference of the mitral valve annulus. To reconstruct the annulus, diameters (or chords) from each rotational interval were arranged around a reference point. This was done for 12 times during the cardiac cycle. Annular areas were planimetered and circumferences measured. Correlation was good for areas reconstructed and measured by the same observer on separate occasions ($r = 0.963$) and by two different observers ($r = 0.987$). In 11 normal subjects the annular area index (area divided by body surface area) increased during diastole to a maximum of 3.8 ± 0.7 cm²/m² (mean ± SD) in late diastole. There was presystolic followed by systolic narrowing to a minimum in mid-systole. The mean reduction in area was 26 ± 3%. The maximal annular circumference was 9.3 ± 0.9 cm and the mean reduction in circumference was 13 ± 3%. The overall motion pattern was similar to that reported in experimental studies in the dog. Mitral annular reconstruction may provide new information about normal and abnormal function of the mitral valve apparatus.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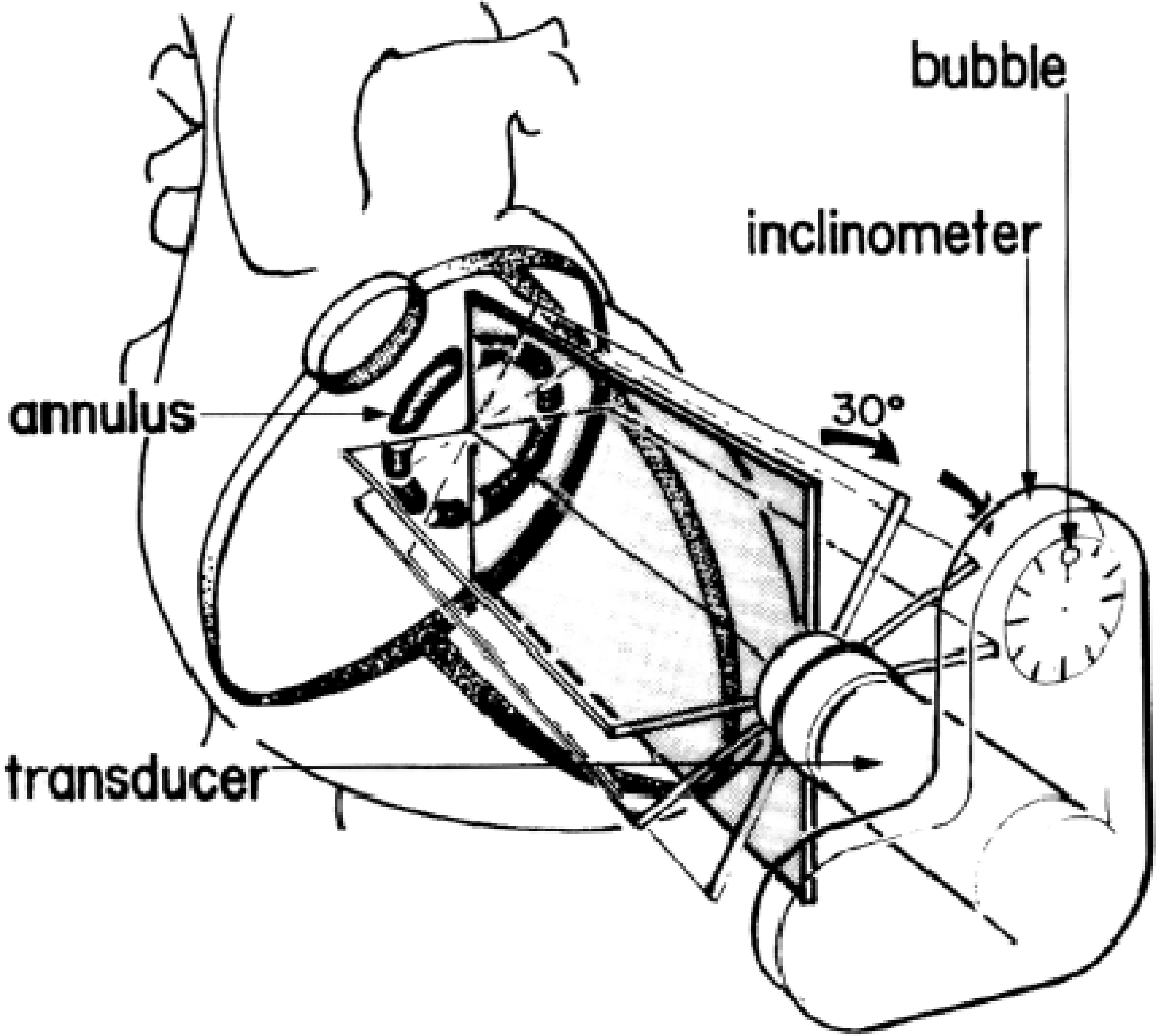
3·5
3·0
mean
±
S.E.M.
n = 11
diastole
systole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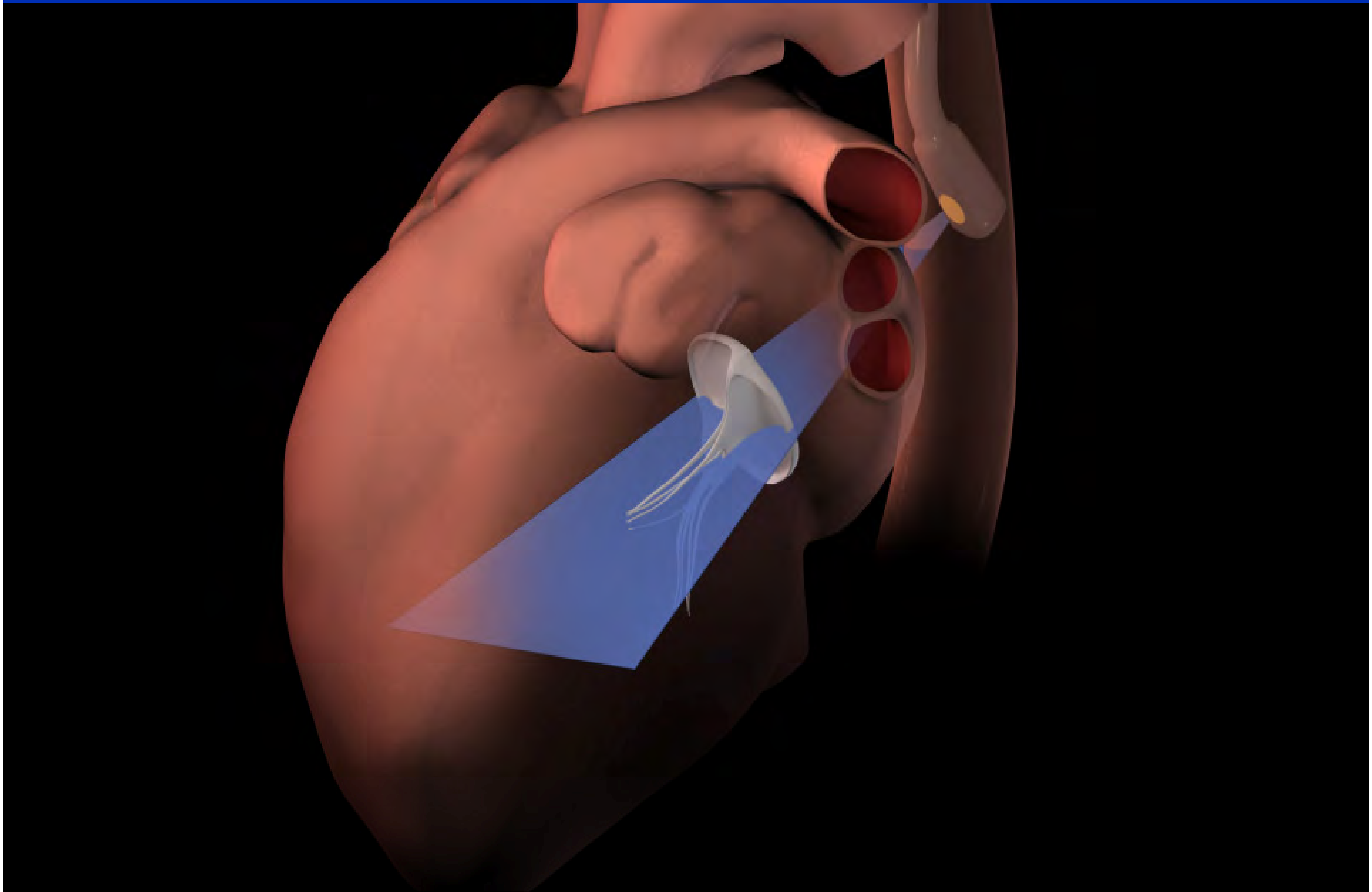
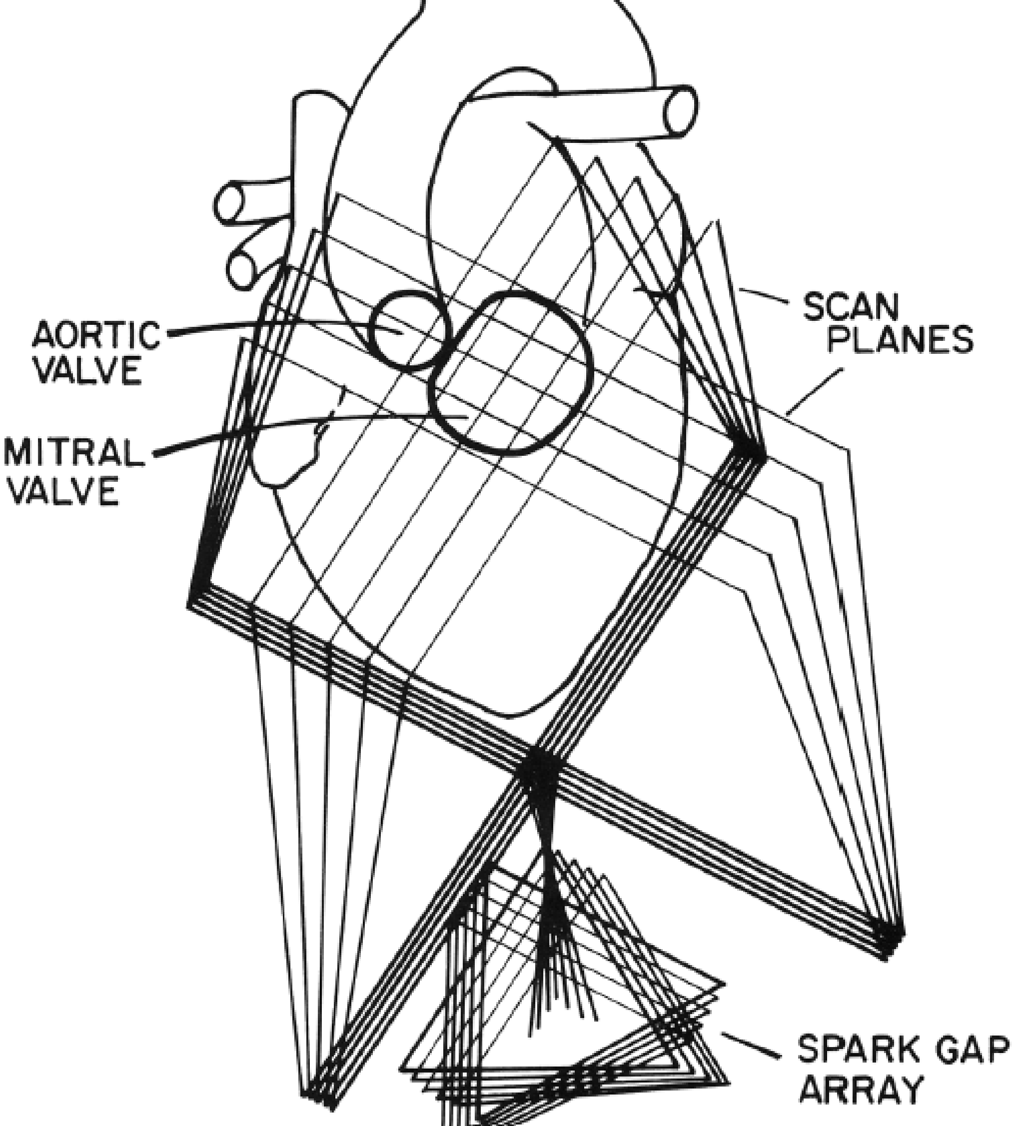
annulus
30°
transducer

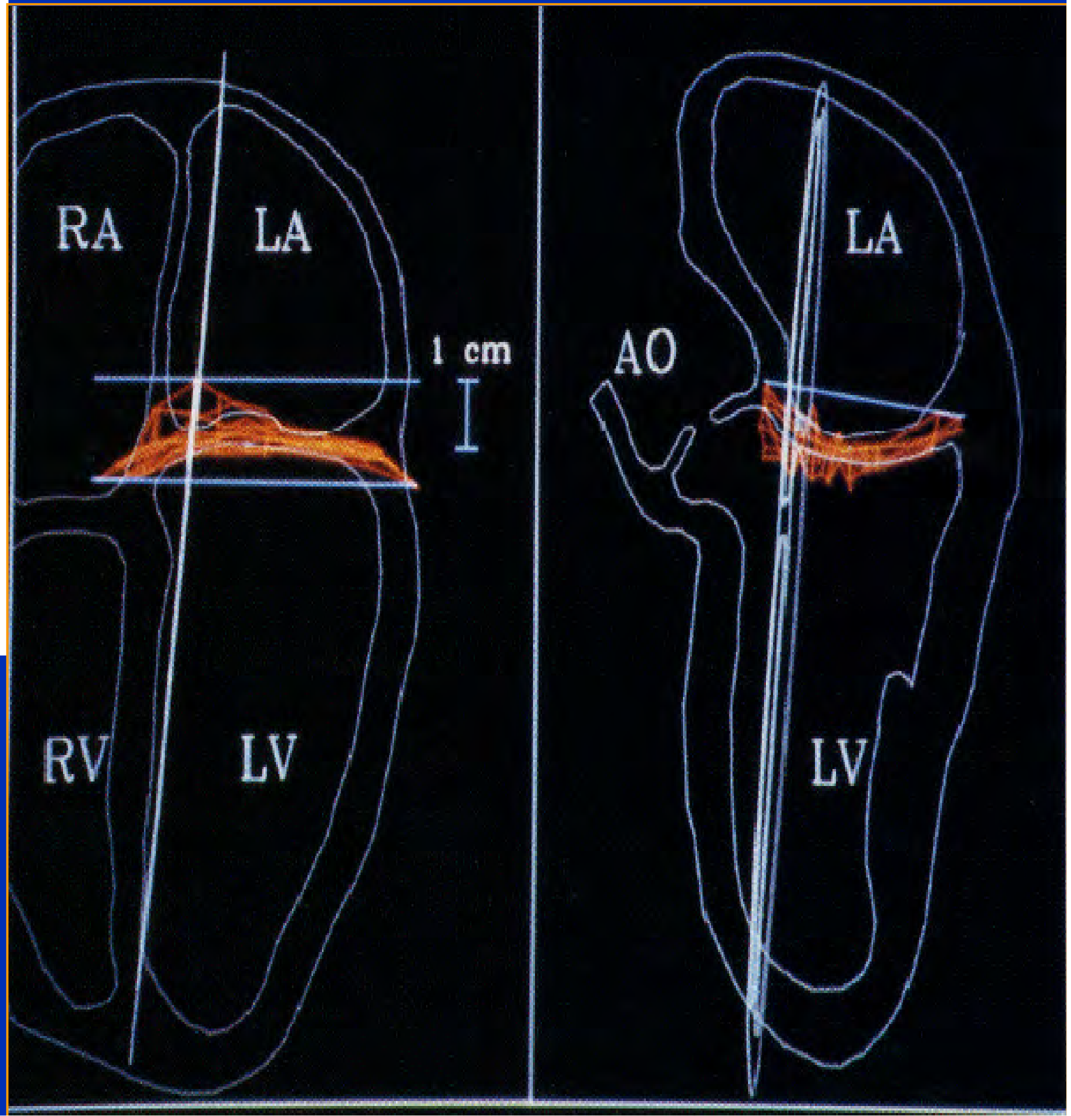


Three-Dimensional Echocardiographic Reconstruction of the Mitral Valve, With Implications for the Diagnosis of Mitral Valve Prolapse

Robert A. Levine, MD, Mark D. Handschumacher, BS,
Anthony J. Sanfilippo, MD, Albert A. Hagege, MD, Pamela Harrigan, RDMS,
Jane E. Marshall, BS, and Arthur E. Weyman, MD

Mitral valve prolapse has been diagnosed by two-dimensional echocardiographic criteria with surprising frequency in the general population, even when preselected normal subjects are examined. In most of these individuals, however, prolapse appears in the apical four-chamber view and is absent in roughly orthogonal long-axis views. Previous studies of in vitro models with nonplanar rings have shown that systolic mitral annular nonplanarity can *potentially* produce this discrepancy. However, to prove *directly* that apparent leaflet displacement in a two-dimensional view does not constitute true displacement above the three-dimensional annulus requires reconstruction of the entire mitral valve, including leaflets and annulus. Such reconstruction would also be necessary to explore the complex geometry of the valve and to derive volumetric measures of superior leaflet displacement. A technique was therefore developed and validated in vitro for three-dimensional reconstruction of the entire mitral valve. In this technique, simultaneous real-time acquisition of images and their spatial locations permits reconstruction of a localized structure by minimizing the effects of patient motion and respiration. By applying this method to 15 normal subjects, a coherent mitral valve surface could be reconstructed from intersecting scans. The results confirm mitral annular nonplanarity in systole, with a maximum deviation of 1.4±0.3 cm from planarity. They directly show that leaflets can appear to ascend above the mitral annulus in the apical four-chamber view, as they did in at least one view in all subjects, without actual leaflet displacement above the entire mitral valve in three dimensions, thereby challenging the diagnosis of prolapse by isolated four-chamber view displacement in otherwise normal individuals. This technique allows us to address a uniquely three-dimensional problem with high resolution and provide new information previously unavailable from the two-dimensional images. This new appreciation should enhance our ability to ask appropriate clinical questions relating mitral valve shape and leaflet displacement to clinical and pathologic consequences. (*Circulation* 1989;80:589–598)


AORTIC
VALVE
MITRAL
VALVE
SCAN
PLANES
SPARK GAP
ARRAY


RA
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1 cm
RV
LV
AO
LA
LV


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MMC ADULT
NTHI General
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65dB S1/ 0/0/ 6
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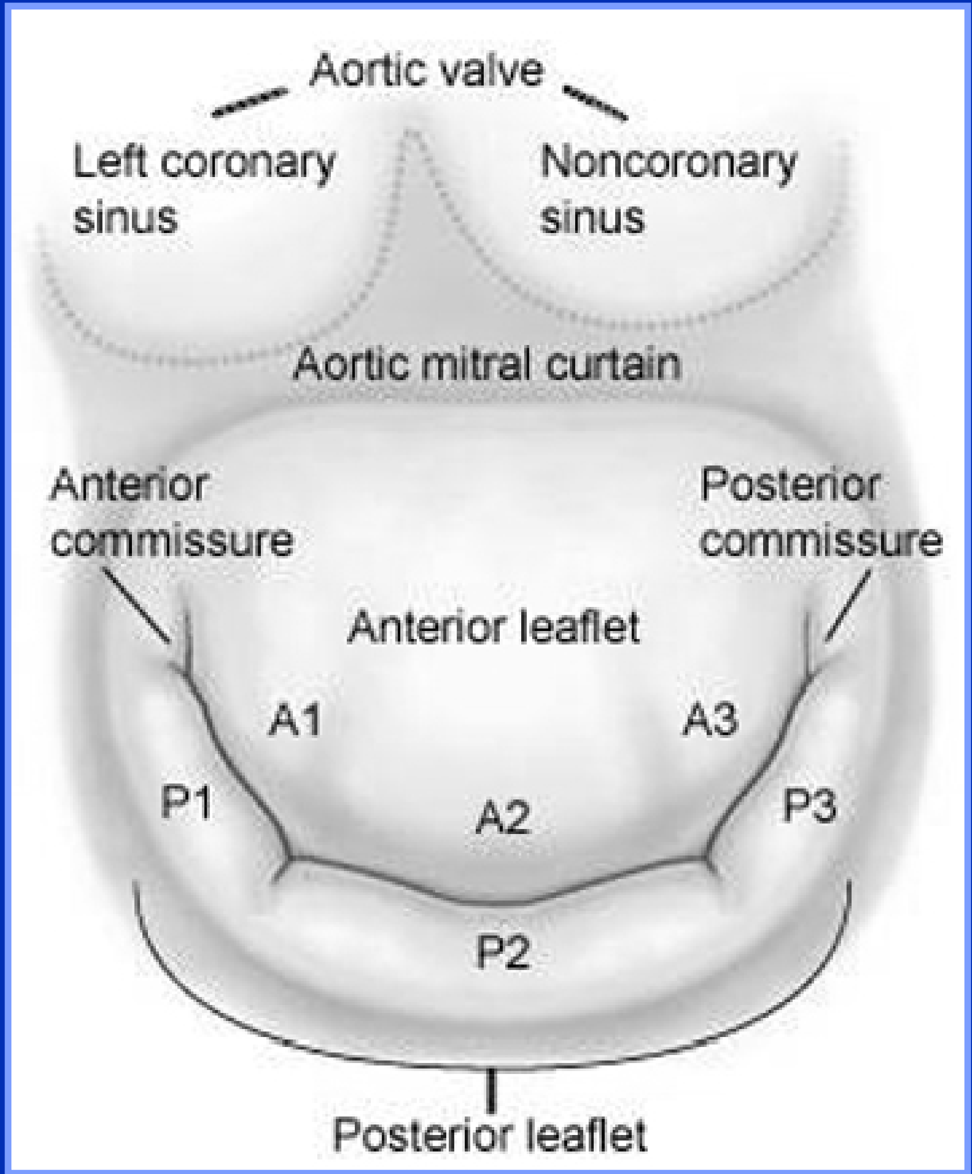
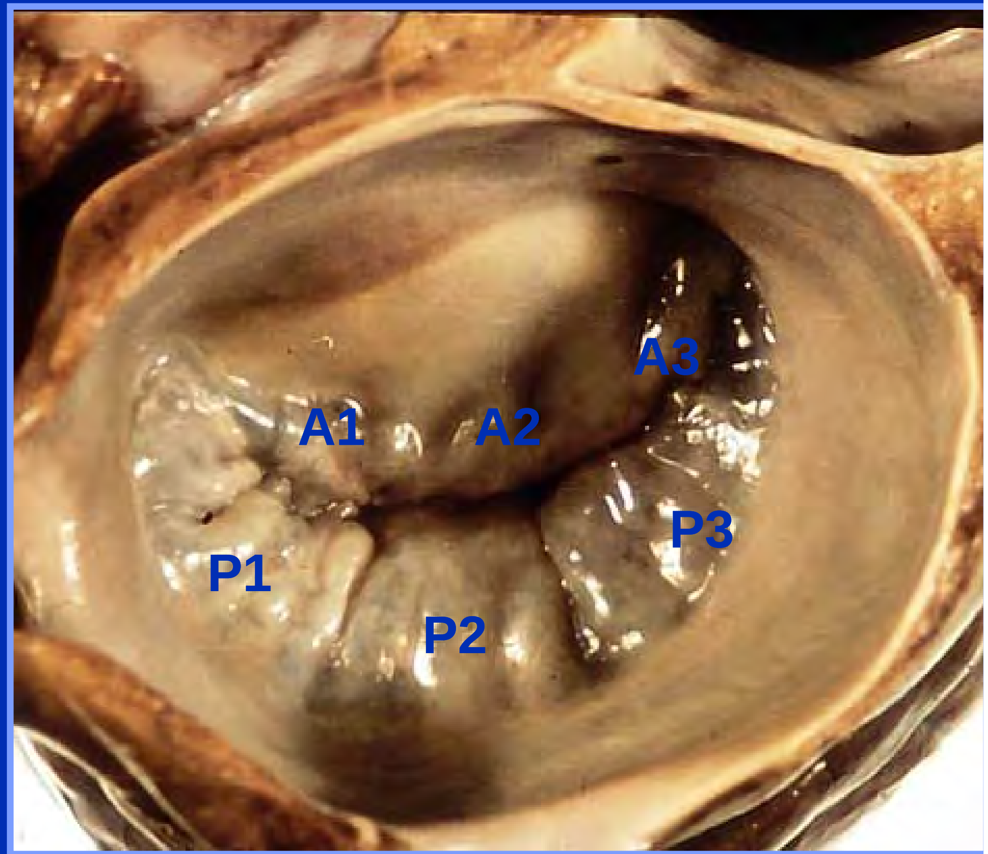
Mitral Valve Anatomy: View from the Left Atrium






A
LA
LV
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FR 38Hz
5.8cm
2D
69%
C 50
P Off
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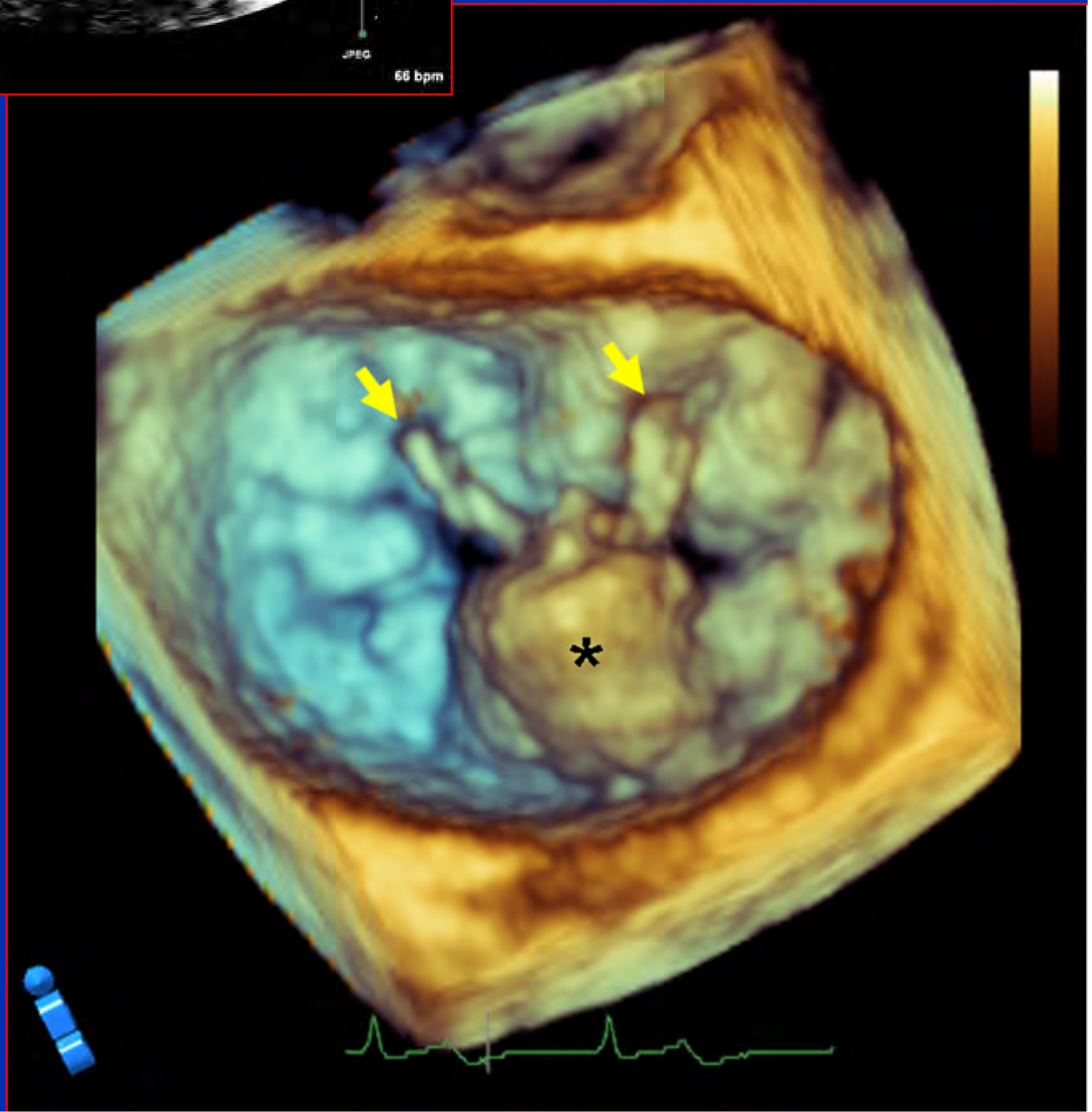
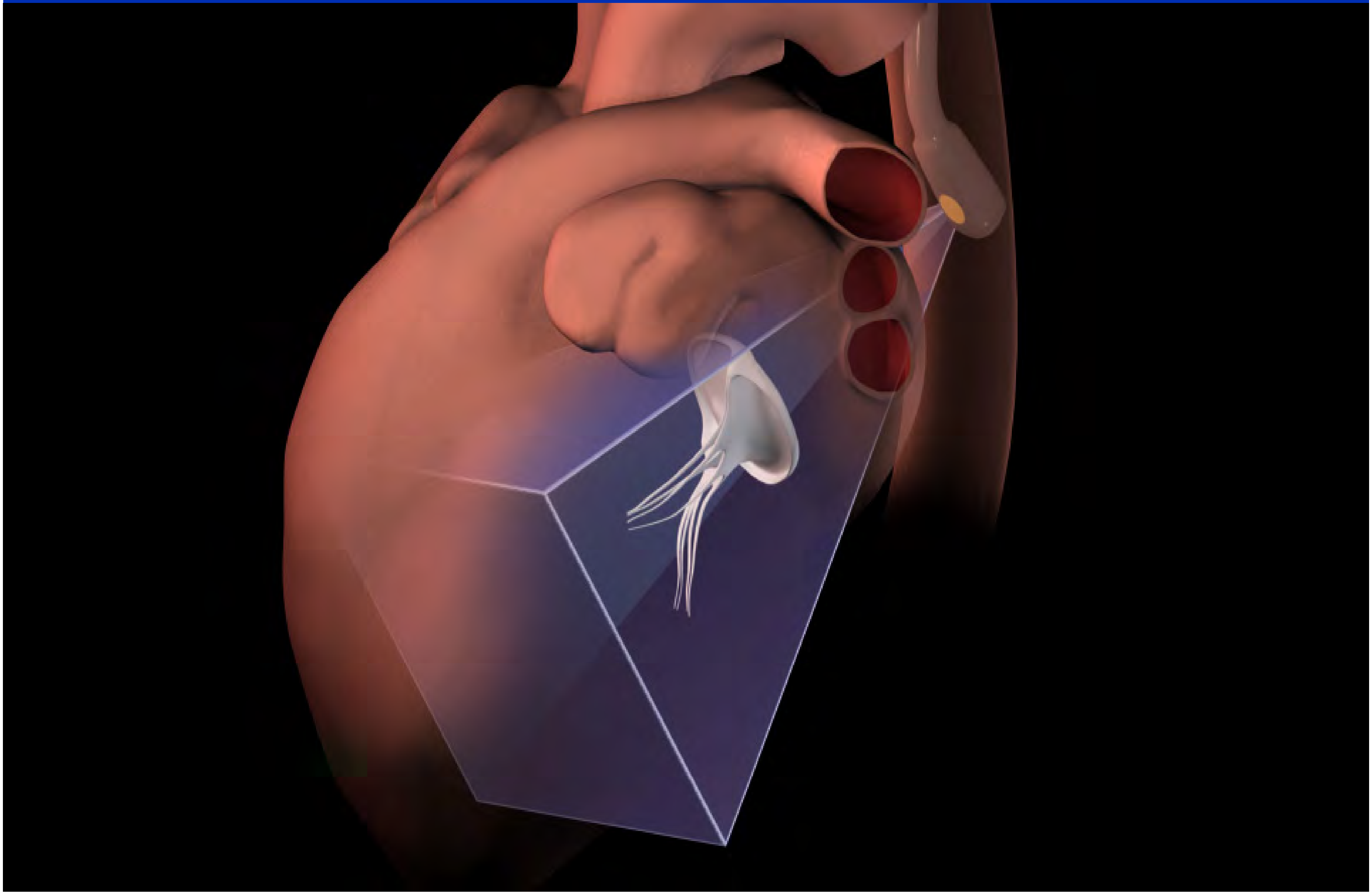
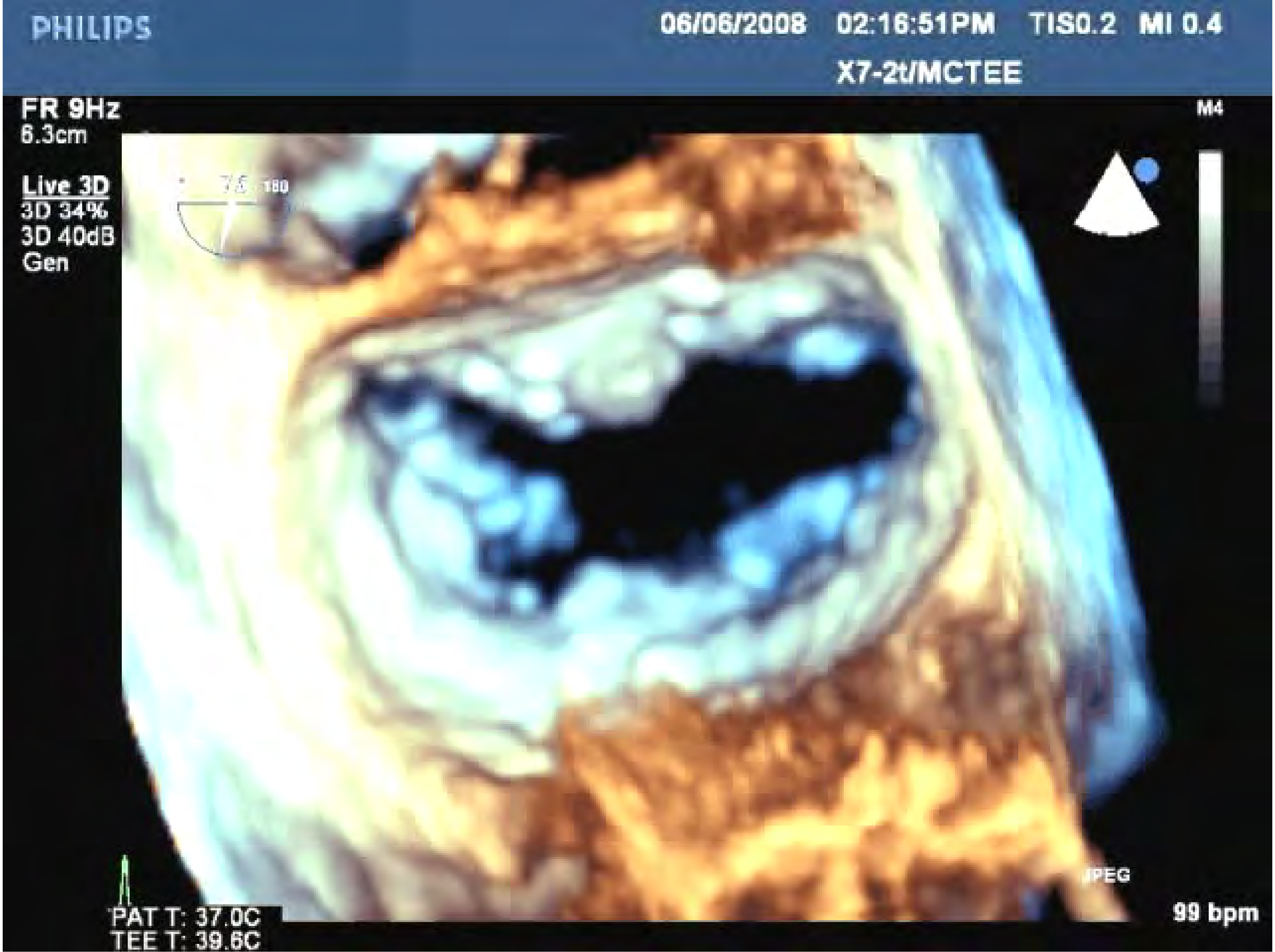
JPEG
66 bpm

↑2D TEE↑

↓3D TEE↓



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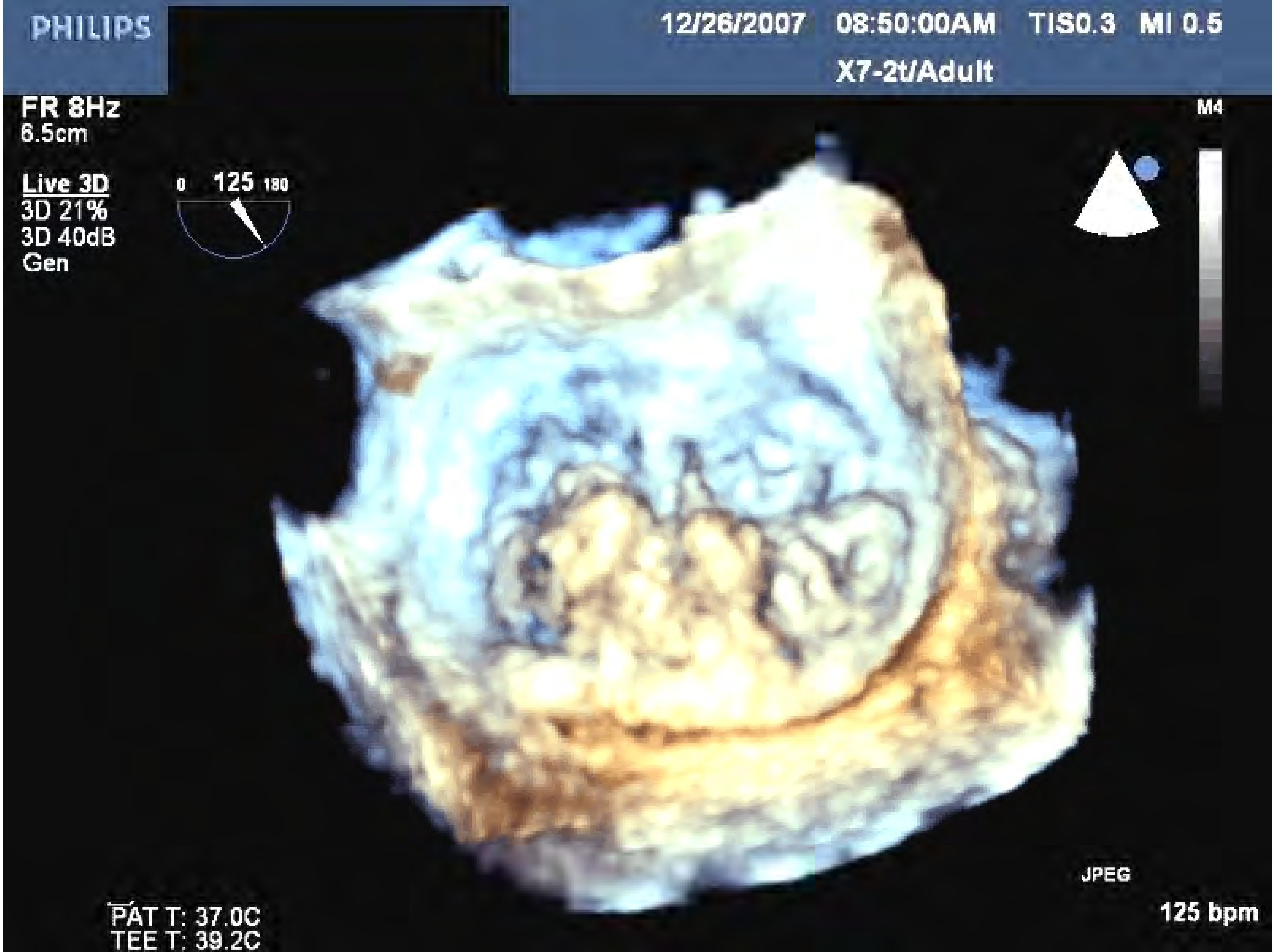
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TEE T: 39.2C

Is the Anterior Intertrigonal Distance Increased in Patients With Mitral Regurgitation Due to Leaflet Prolapse?

Rakesh M. Suri, MD, DPhil,* Jasmine Grewal, MD,* Sunil Mankad, MD, Maurice Enriquez-Sarano, MD, Fletcher A. Miller, Jr, MD, and Hartzell V. Schaff, MD

Divisions of Cardiovascular Surgery and Cardiovascular Diseases, Mayo Clinic, Rochester, Minnesota

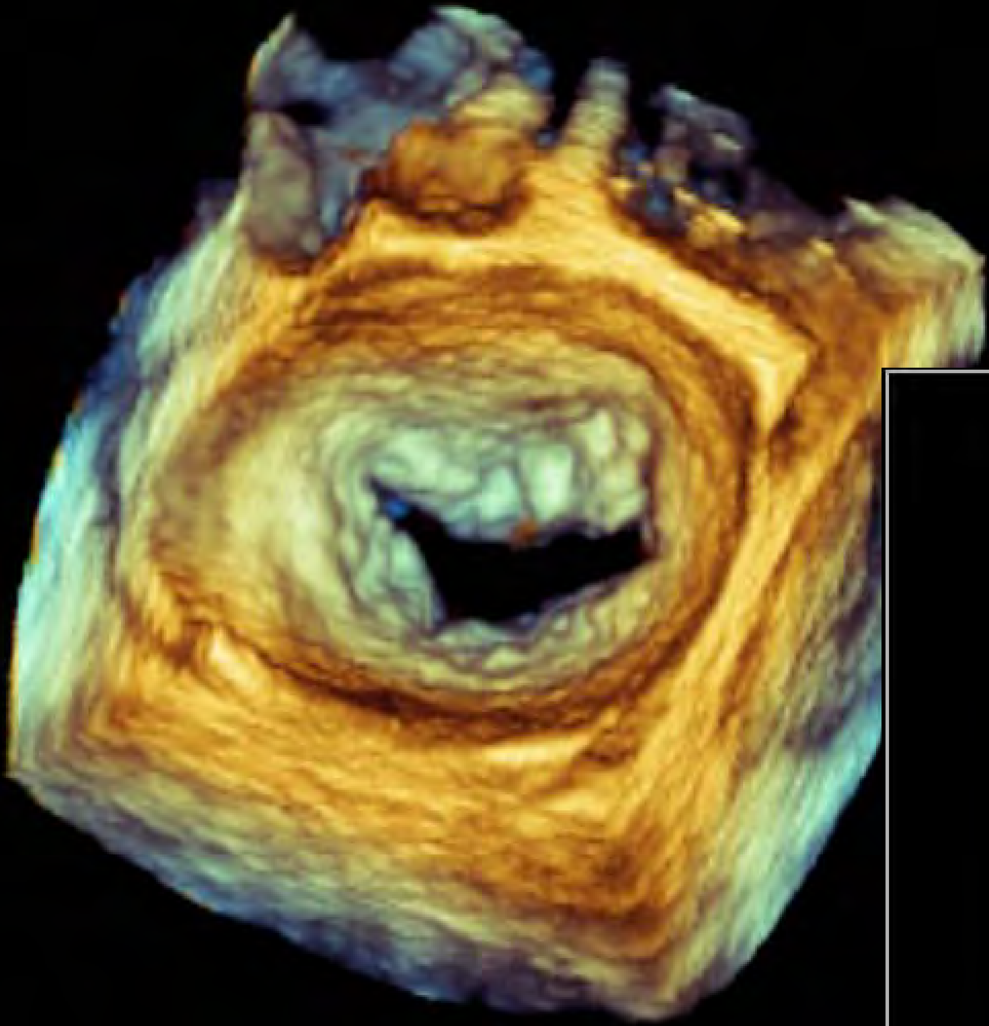
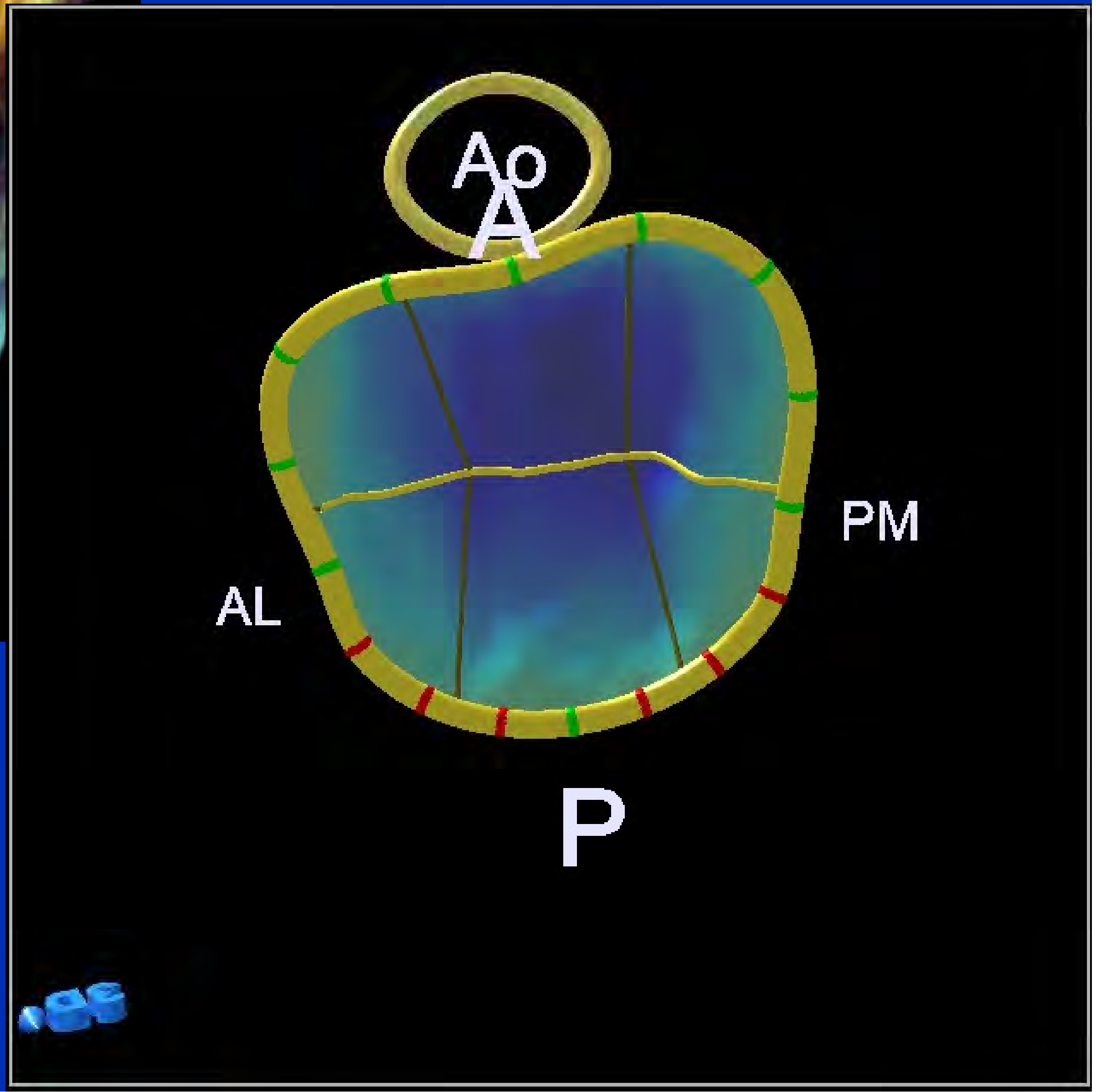
Background. Severe mitral regurgitation (MR) leads to progressive enlargement of left ventricular dimensions and, consequently, the mitral valve (MV) annulus. Data from animal and cadaver studies suggest that the mitral annulus may dilate asymmetrically in certain conditions, which may influence the choice of valve repair technique. Although it is generally accepted that the posterior mitral annulus dilates in patients with severe MR due to leaflet prolapse, the stability of the anterior intertrigonal distance has not yet been demonstrated in humans.

Methods. We obtained real-time, three-dimensional (3D) transesophageal echocardiographic images of the MV in 44 patients: 29 patients scheduled to undergo MV repair for severe MR due to leaflet prolapse (MV disease group) and 15 normal outpatients undergoing evaluation for various reasons (control group). Mitral valve repair was performed by median sternotomy or minimally invasively using thoracoscopic or robotic assistance. All patients underwent implantation of a standard-length flexible 63-mm posterior annuloplasty band at the time of mitral repair and we obtained postoperative 3D images for 11 patients after separation from bypass. Mitral annular dimensions were measured throughout the cardiac cycle using reconstructive analysis software (QLAB MVQ Version 6.0; Phillips, Bothell, WA).

Results. The mean patient age was 60 years; 30 were men. The mean ejection fraction was 0.61 and was similar between the two groups ($p = 0.16$). In patients with MR due to leaflet prolapse, posterior annular length and total annular circumference were significantly larger than in control patients ($p < 0.001$). In contrast, there was no detectable difference in the anterior intertrigonal distance between patients with MR and normal controls. After mitral valve leaflet repair and posterior annuloplasty there was a significant decrease in both the total annular circumference and posterior annular length ($p < 0.0001$) while cyclic annular contraction was preserved.

Conclusions. Although the posterior mitral annulus is enlarged in patients with significant MR due to degenerative leaflet prolapse, there is no evidence that the intertrigonal distance is abnormal in these patients. Our data support the conclusion that posterior annular reduction with a flexible device at the time of mitral valve repair is important, and that altering the anterior intertrigonal portion of the mitral annulus is unnecessary.

(Ann Thorac Surg 2009;88:1202–8)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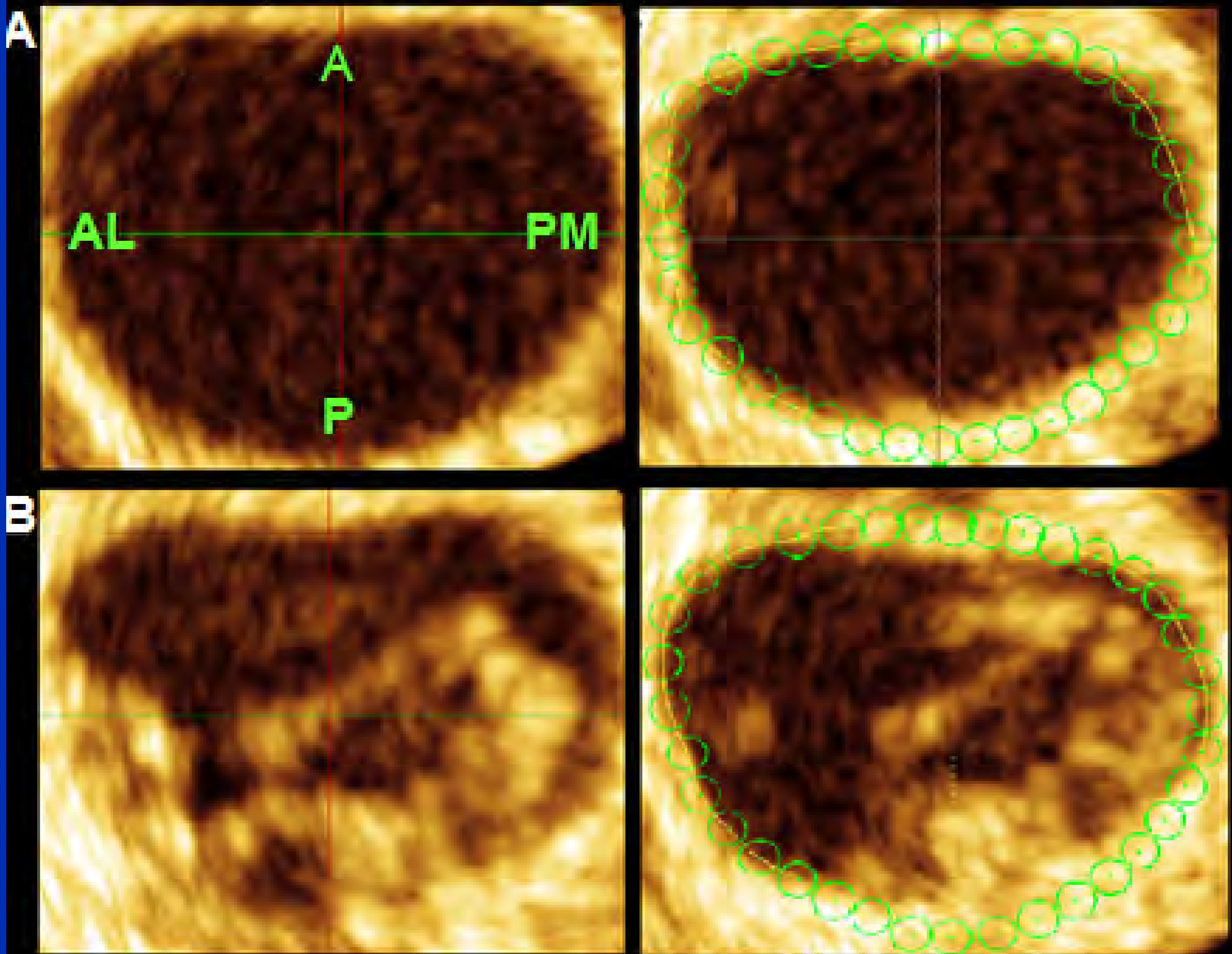
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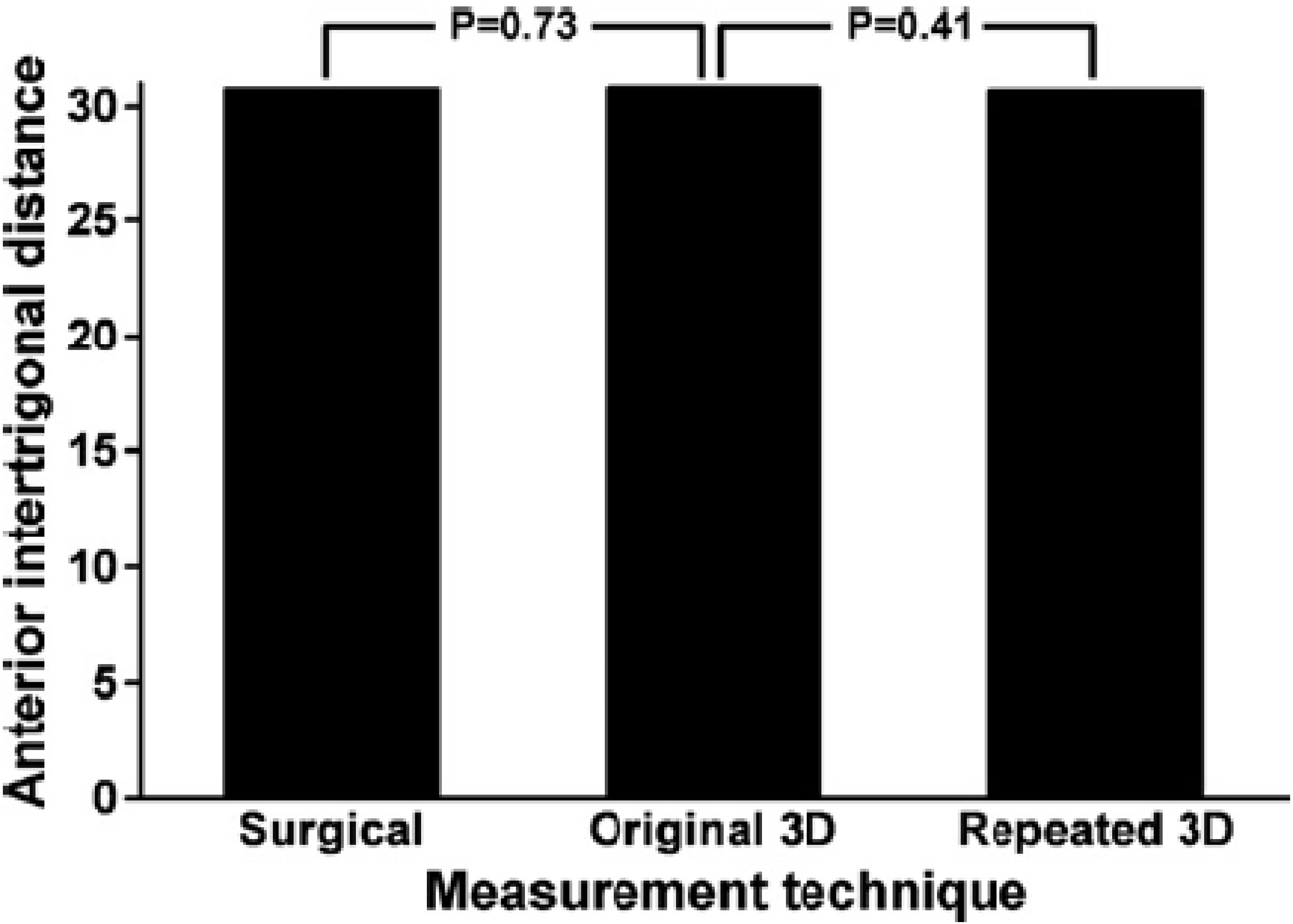
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P=0.41
Anterior intertrigonal distance
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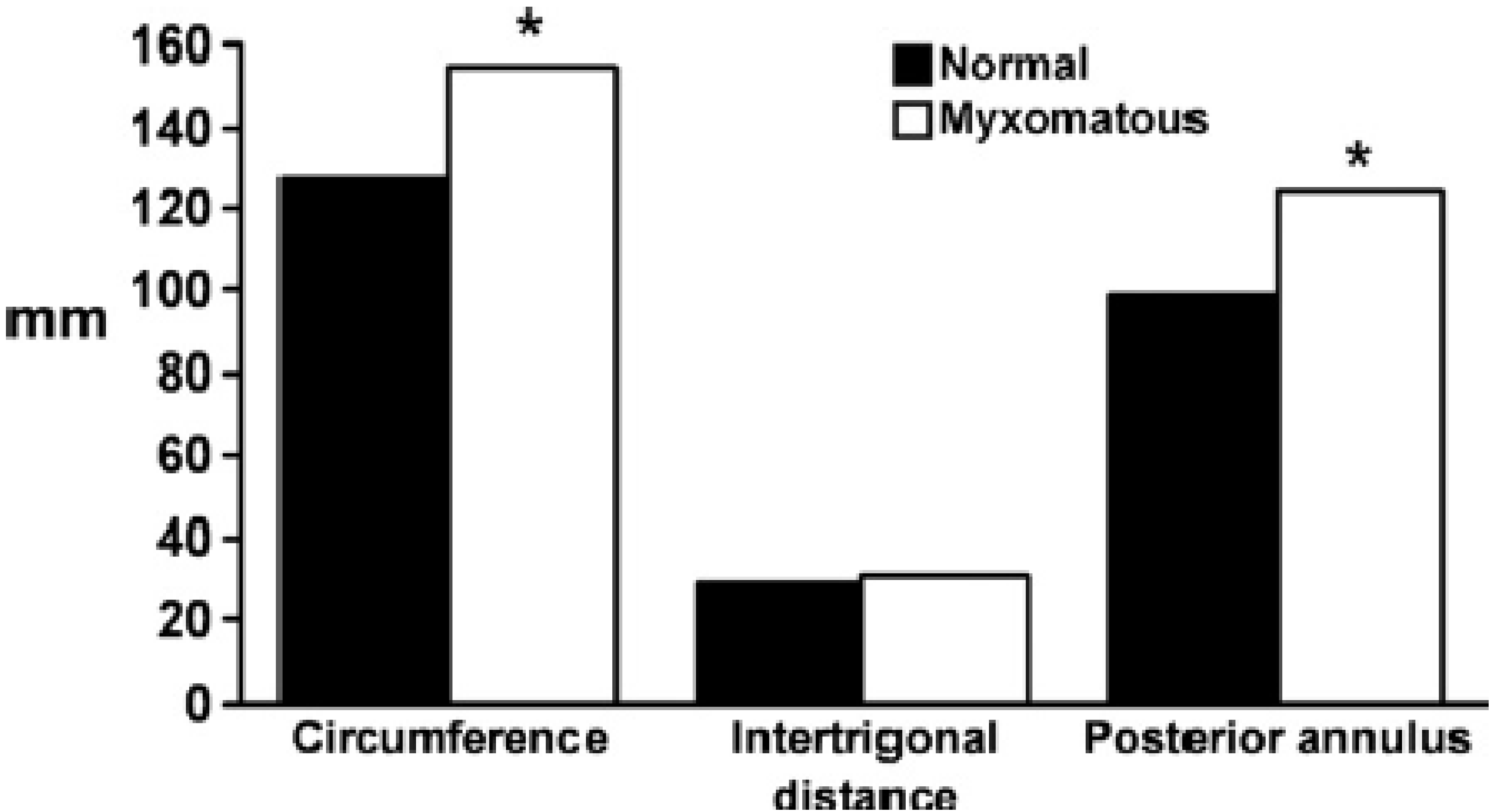
25
20
15
10
5
0
Surgical
Original 3D
Repeated 3D
Measurement technique



160
140
120
100
80
60
40
20
0
mm
*
*
Normal
Myxomatous
Circumference
Intertrigonal distance
Posterior annulus

Mitral Annular Dynamics in Myxomatous Valve Disease

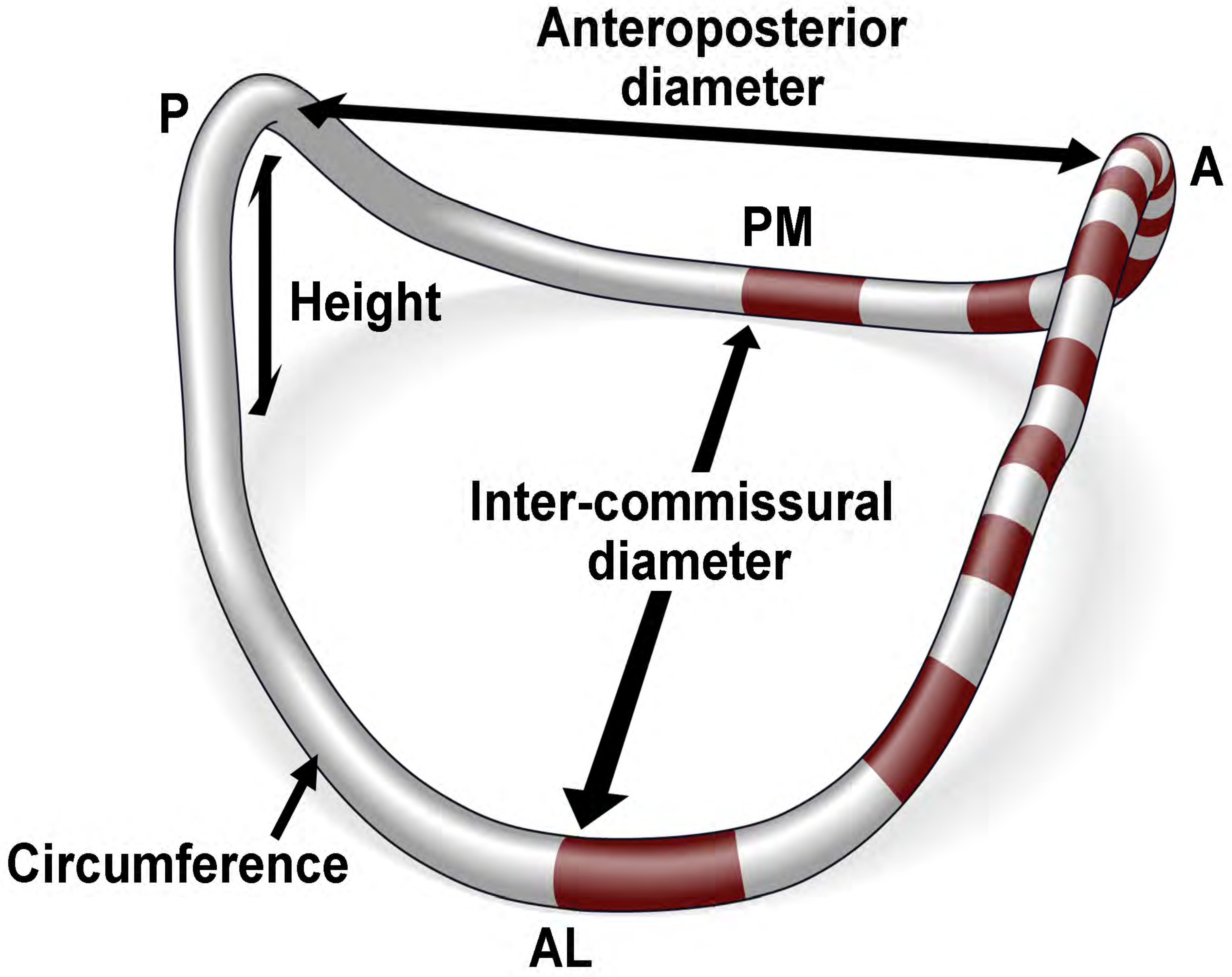
New Insights With Real-Time 3-Dimensional Echocardiography

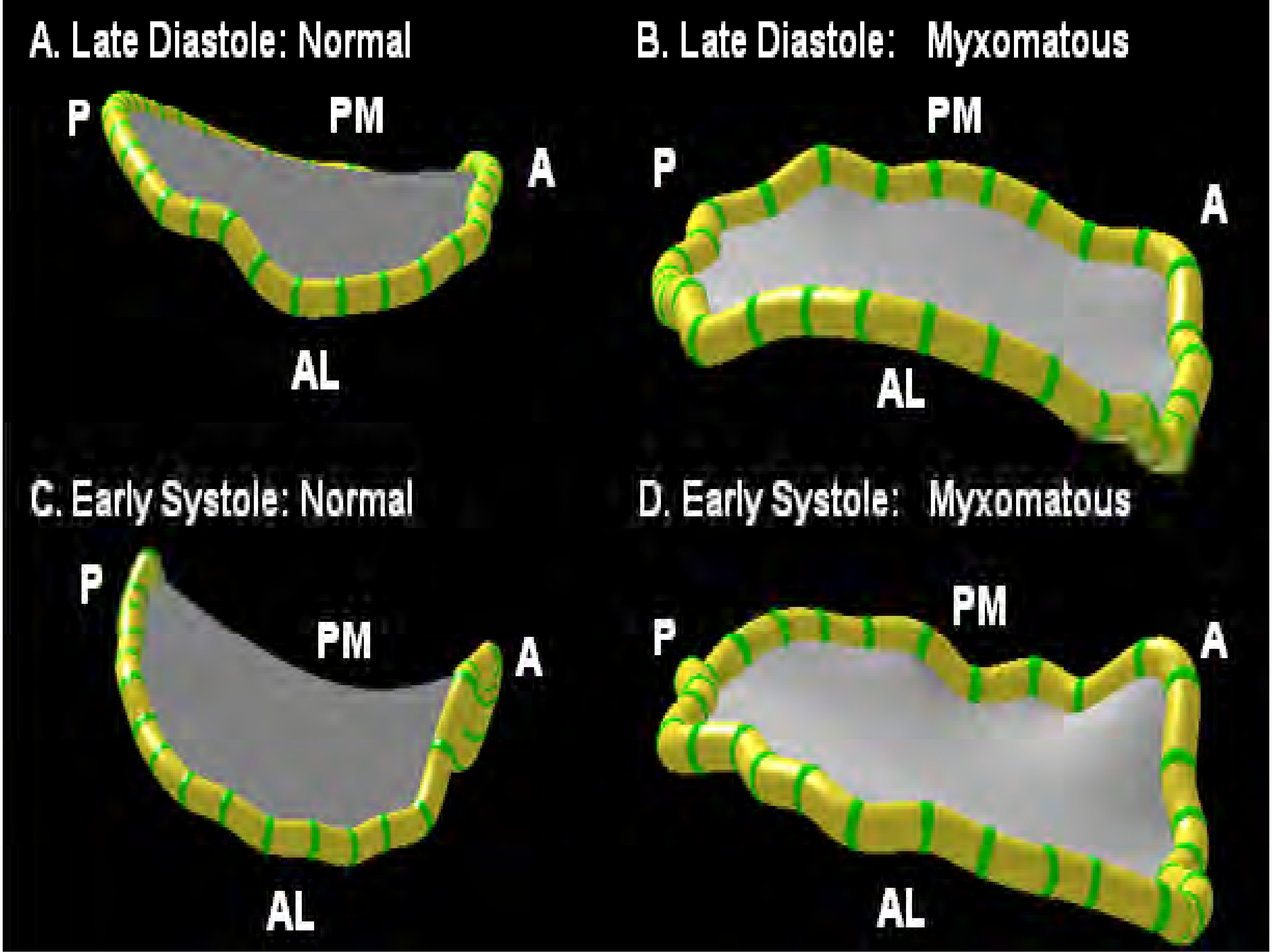
Jasmine Grewal, MD; Rakesh Suri, MD, DPhil; Sunil Mankad, MD;
Akiko Tanaka, MD; Douglas W. Mahoney, MS; Hartzell V. Schaff, MD;
Fletcher A. Miller, MD; Maurice Enriquez-Sarano, MD

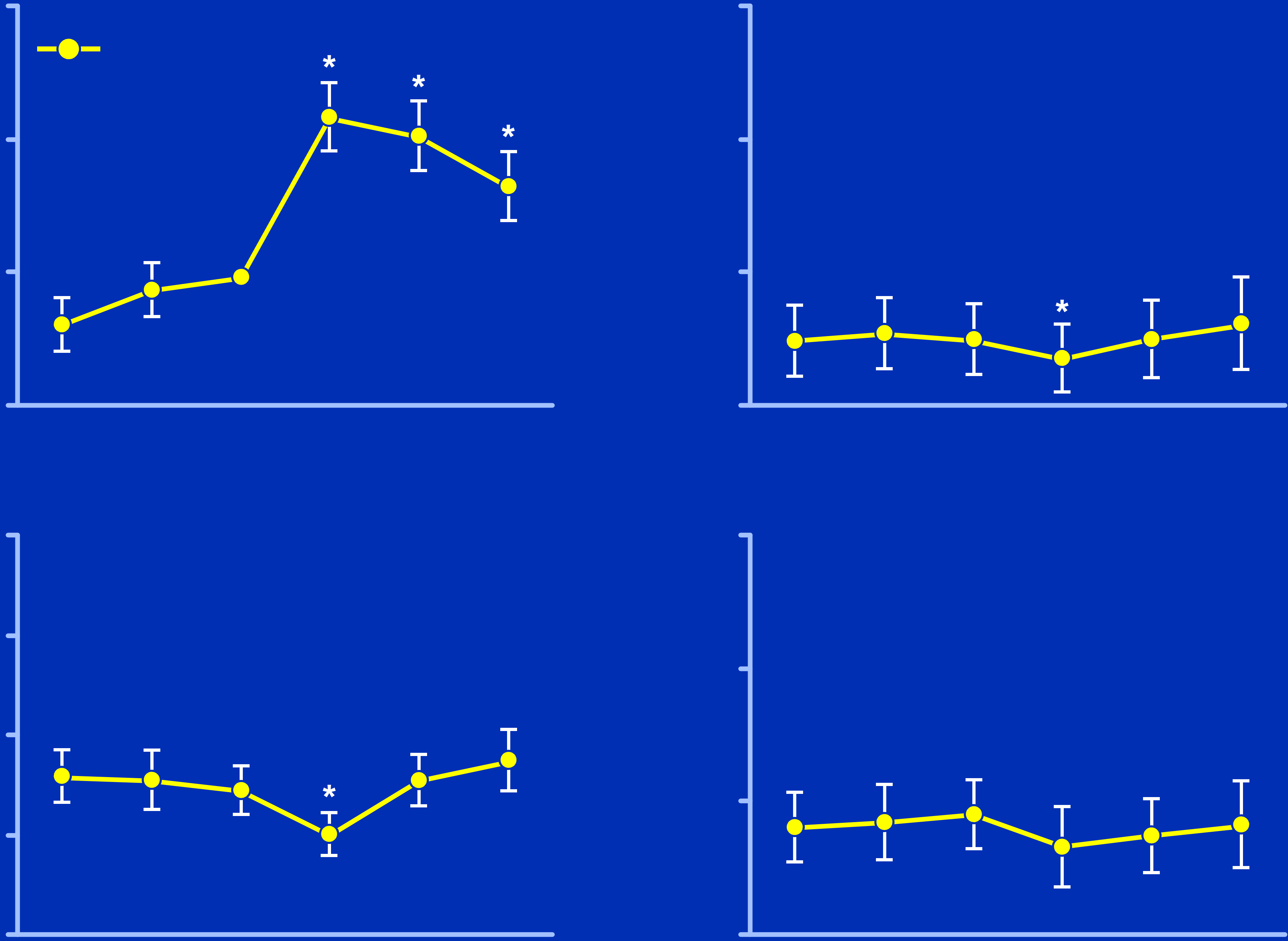
Background—Mitral annulus is a complex structure of poorly understood physiology. Full-volume real-time 3-dimensional transesophageal echocardiography offers a unique opportunity to completely image and quantify mitral annulus size and motion.

Methods and Results—Real-time 3-dimensional transesophageal echocardiography of the mitral valve was acquired in 32 patients with myxomatous valve disease (MVD) and moderate to severe regurgitation, 15 normal control subjects, and 10 patients with ischemic mitral regurgitation of identical body surface area. Mitral annular dimensions (circumference, area, anteroposterior and intercommissural diameters, height, and ratio of height to intercommissural diameter ratio, which appraises annular saddle-shape depth) were measured throughout the cardiac cycle with dedicated quantification software. Compared with direct surgical measurement, 3-dimensional anterior annular dimension provided reliable measurements (mean difference, 0.1 ± 0.1 mm; $P=0.73$; 95% confidence interval, ±4.4 mm). Annular dimensions were larger in MVD patients compared with control subjects in diastole (all $P<0.05$). Normal annulus displayed early-systolic anteroposterior ($P<0.001$) and area ($P=0.04$) contraction, increased height ($P<0.001$), and deeper saddle shape (ratio of height to intercommissural diameter, $15\pm1\%$ to $21\pm1\%$; $P<0.001$), whereas intercommissural diameter was unchanged ($P=0.30$). In contrast, MVD showed early-systolic intercommissural dilatation ($P=0.02$) and no area contraction ($P=0.99$), height increase ($P=0.11$), or saddle-shape deepening ($P=0.35$). Late-systolic MVD annular saddle shape deepened but annular area excessively enlarged ($P<0.04$) as a result of persistent intercommissural widening ($P<0.02$). MVD annulus also contrasts with ischemic mitral regurgitation annulus, which, despite similar anteroposterior enlargement, is narrower and essentially adynamic. After MVD repair, the annulus remained dynamic without systolic saddle-shape accentuation ($P=0.30$).

Conclusions—Real-time 3-dimensional transesophageal echocardiography provides insights into normal, dynamic mitral annulus function with early-systolic area contraction and saddle-shape deepening contributing to mitral competency. MVD annulus is also dynamic but considerably different with loss of early-systolic area contraction and saddle-shape deepening despite similar magnitude of ventricular contraction, suggestive of ventricular-annular decoupling. Subsequent area enlargement may contribute to mitral incompetence. After mitral repair, MVD annulus remains dynamic without systolic saddle-shape accentuation. Thus, real-time 3-dimensional transesophageal echocardiography provides new insights that allow the refining of mitral pathophysiology concepts and repair strategies. (*Circulation*. **2010;121:1423-1431.**)


Anteroposterior
diameter
P
A
PM
Height
Inter-commissural
diameter
Circumference
AL


A. Late Diastole: Normal
P
PM
A
AL
B. Late Diastole: Myxomatous
PM
P
A
AL
C. Early Systole: Normal
P
PM
A
AL
D. Early Systole: Myxomatous
PM
P
A
AL



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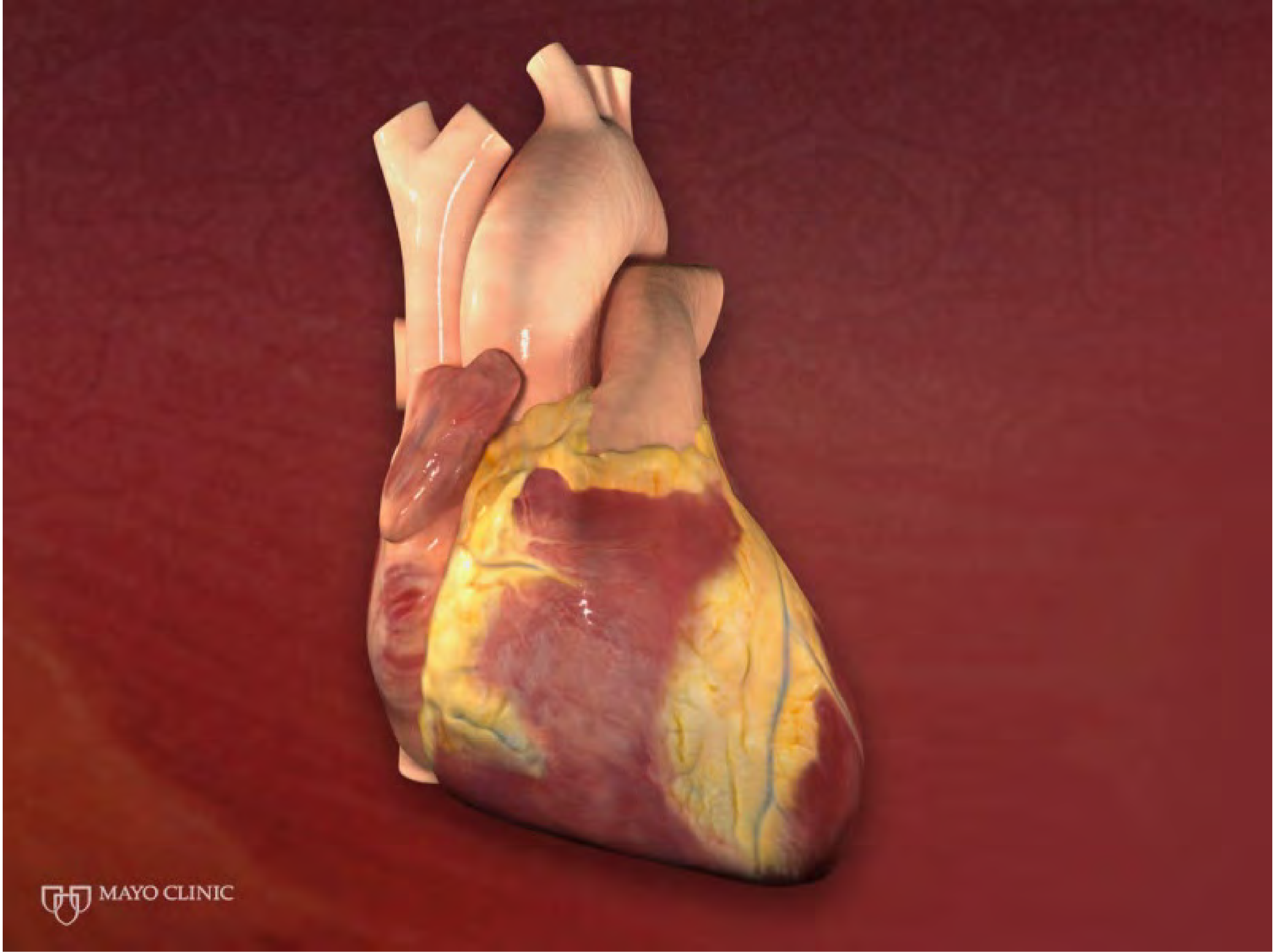

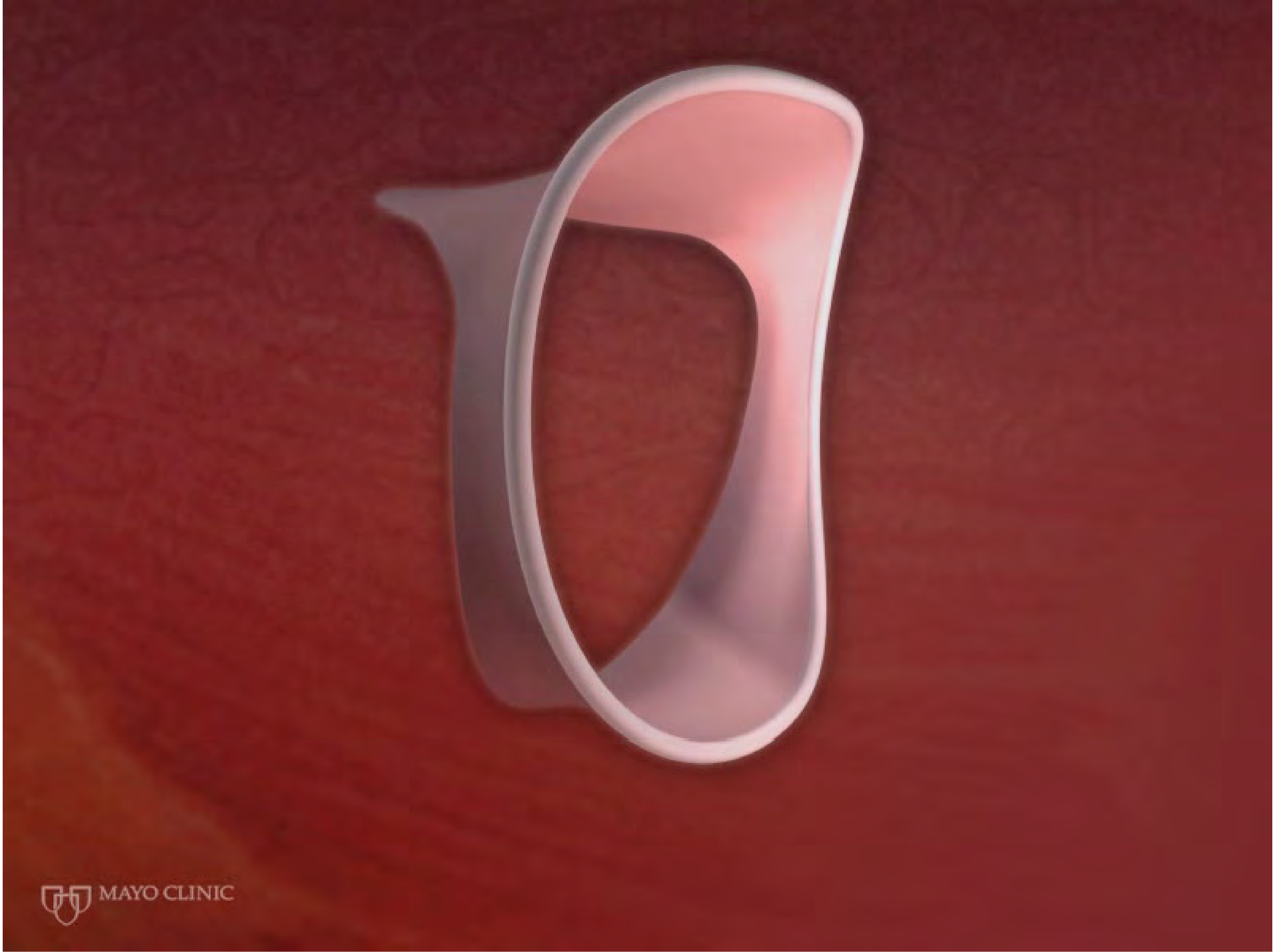

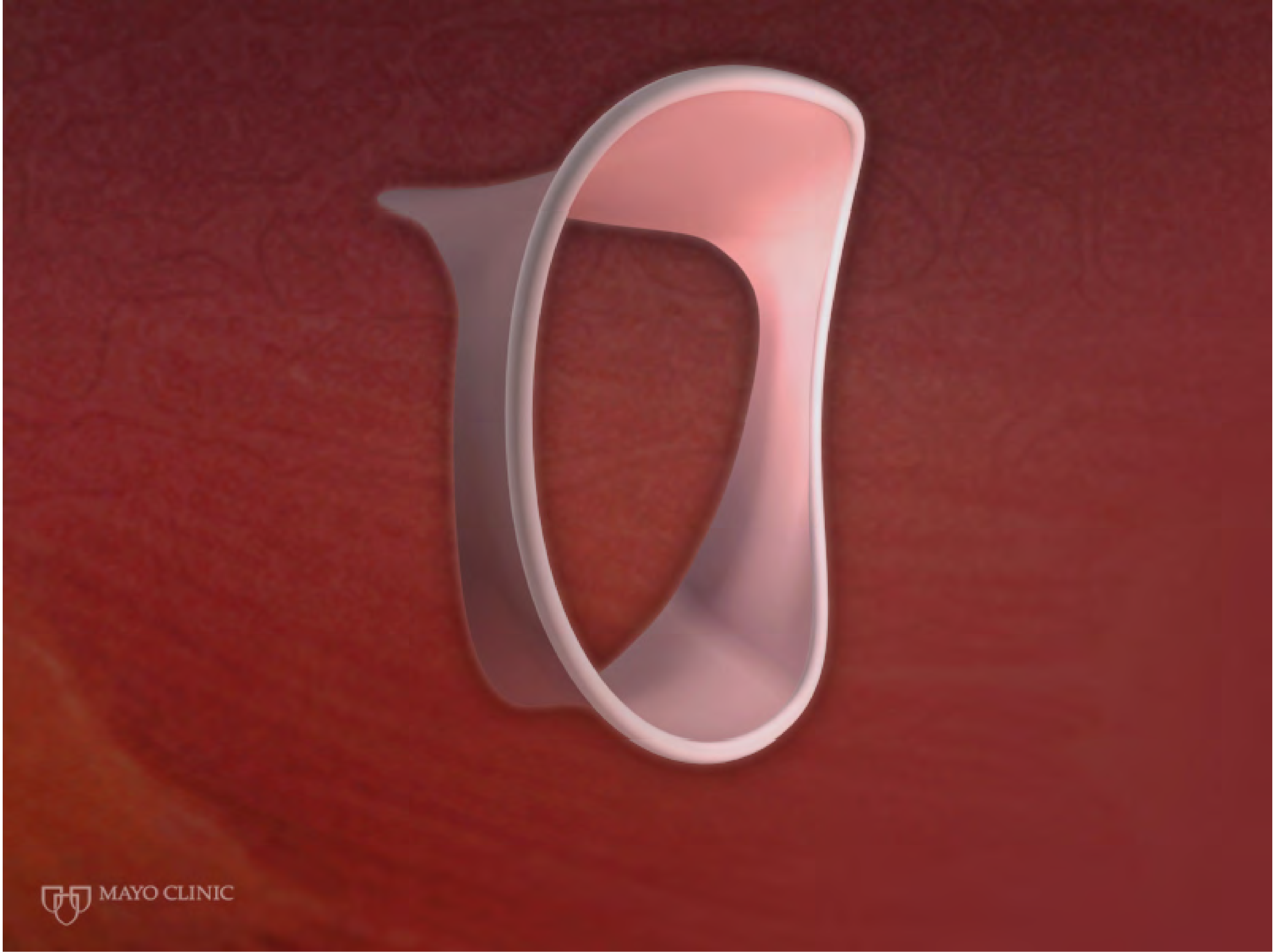

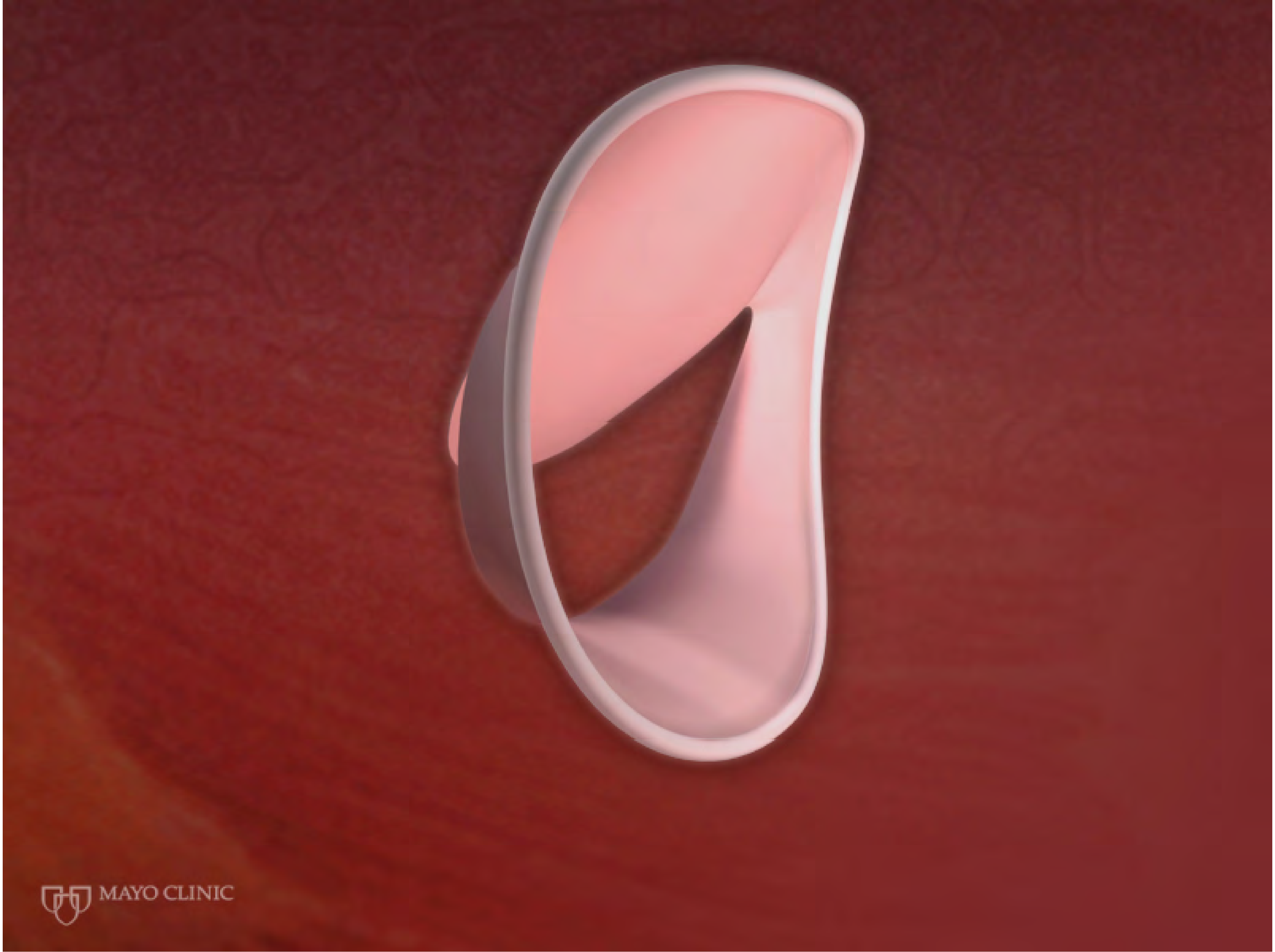
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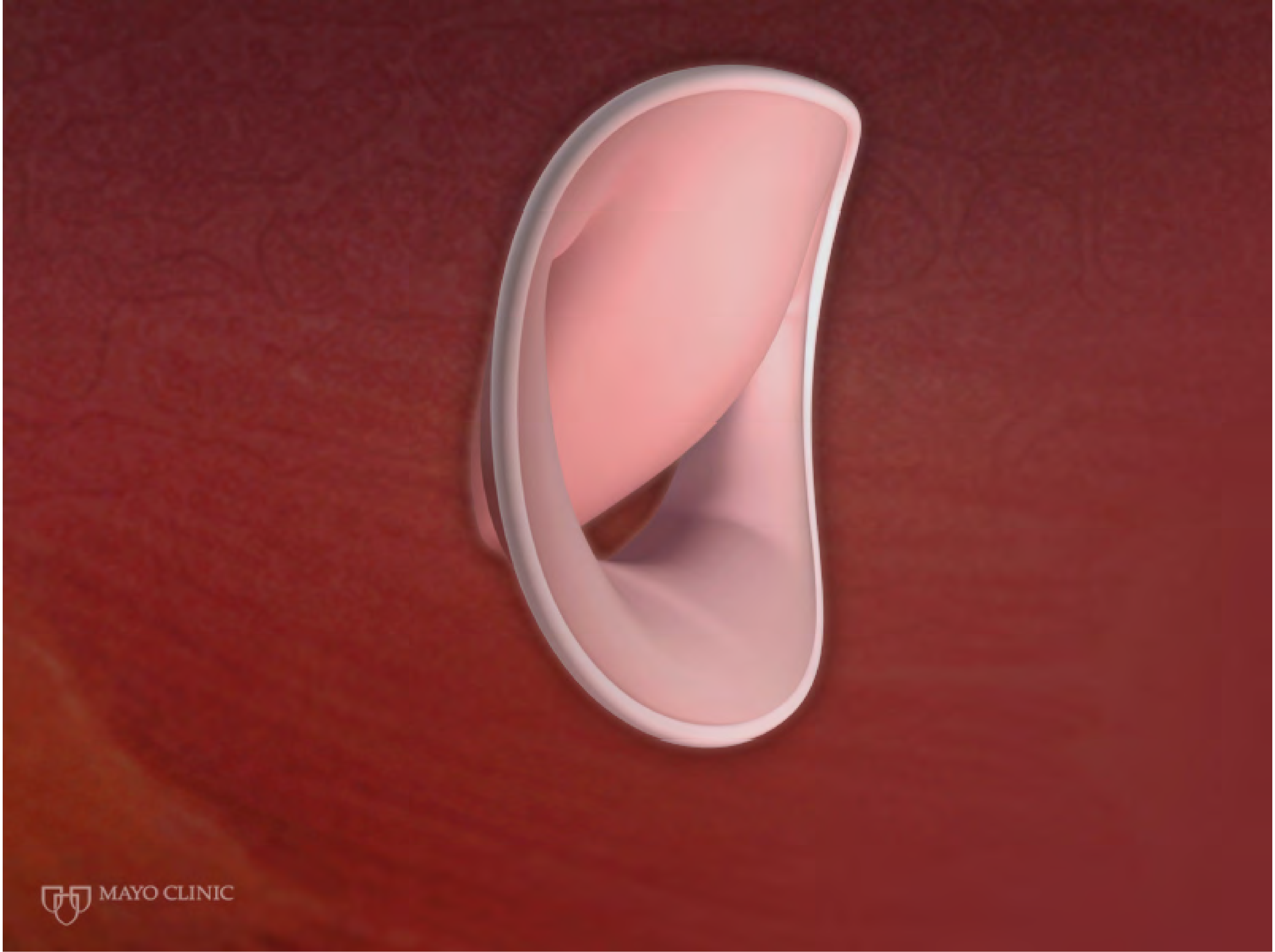

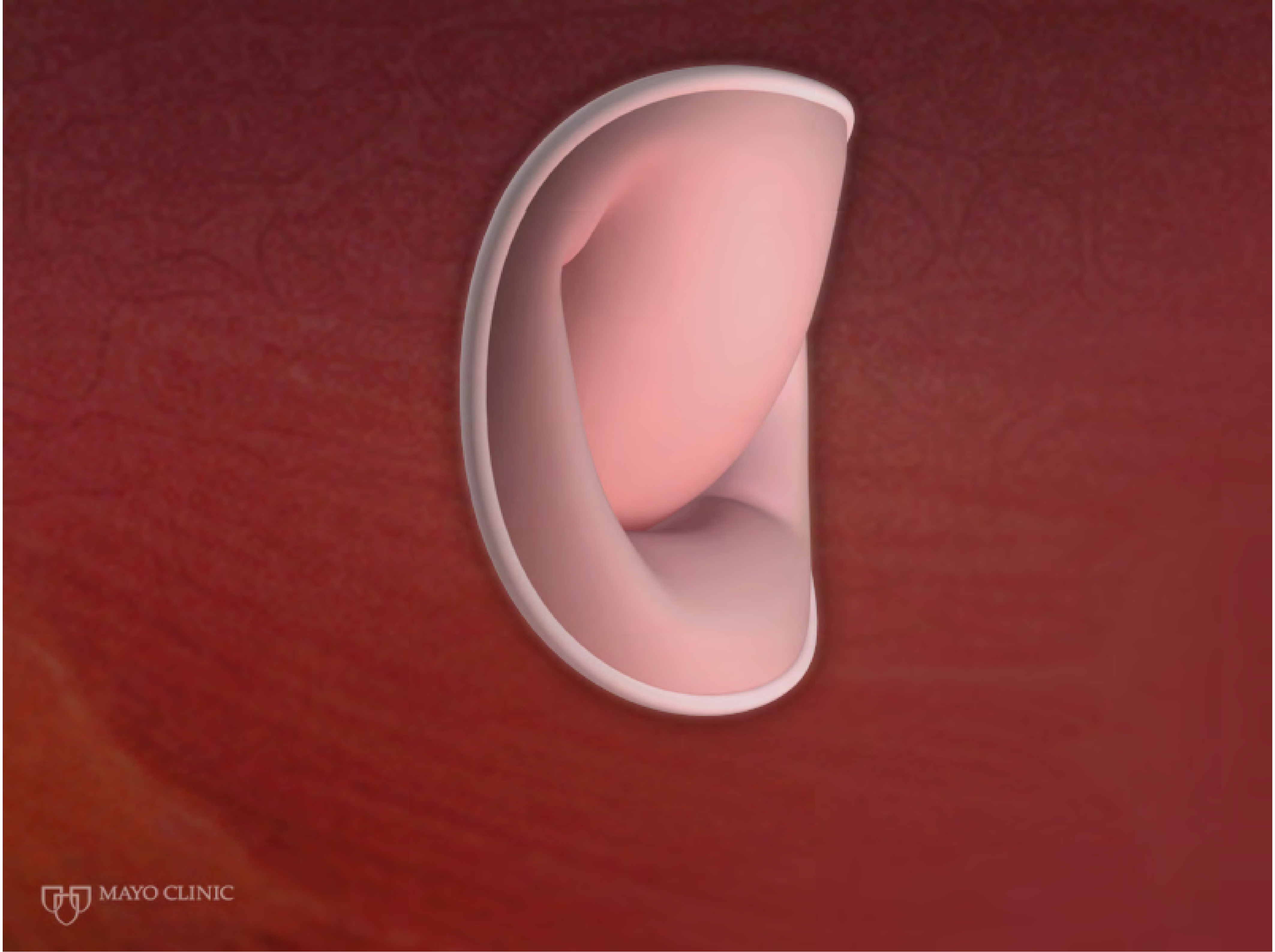
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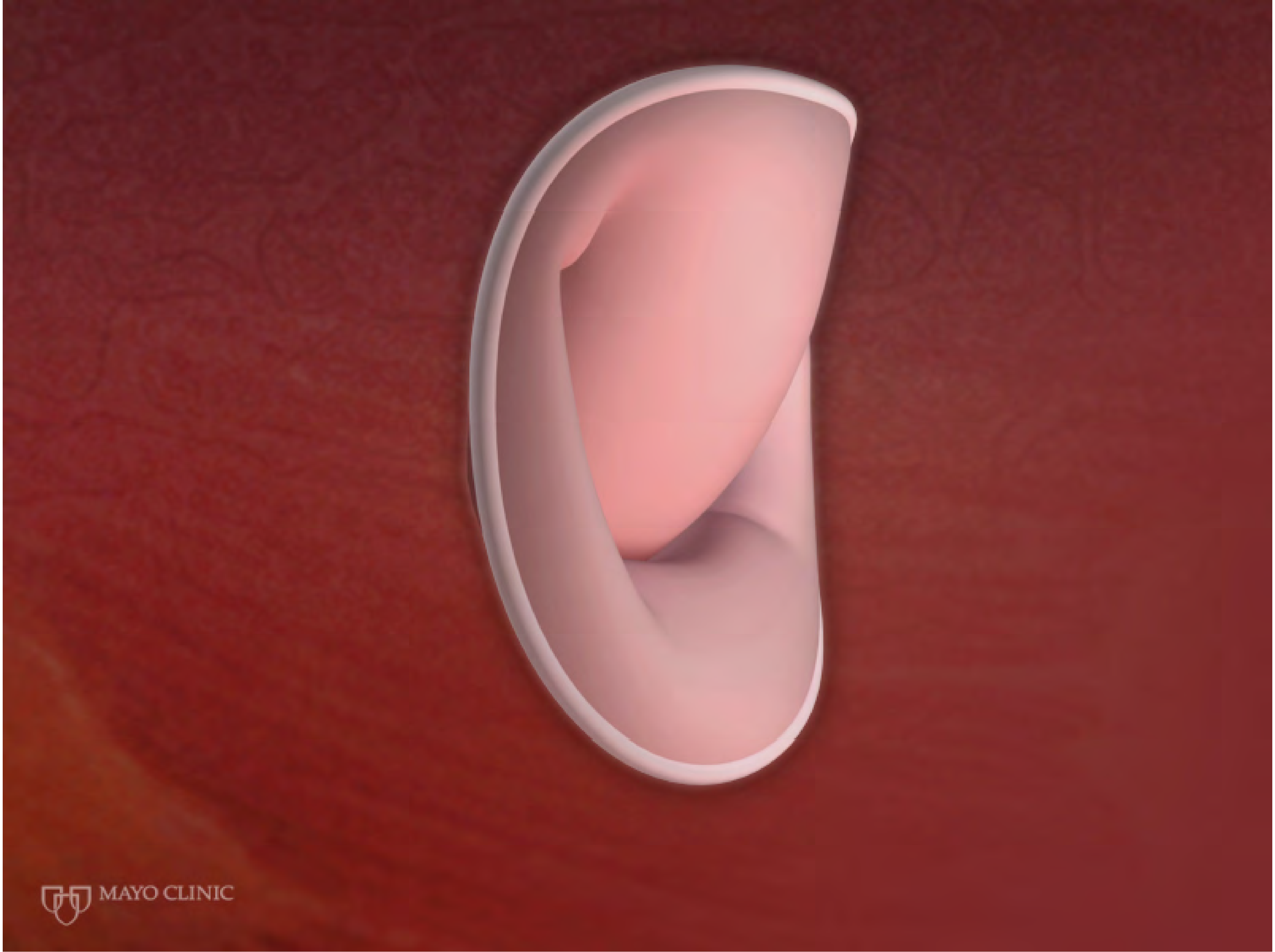
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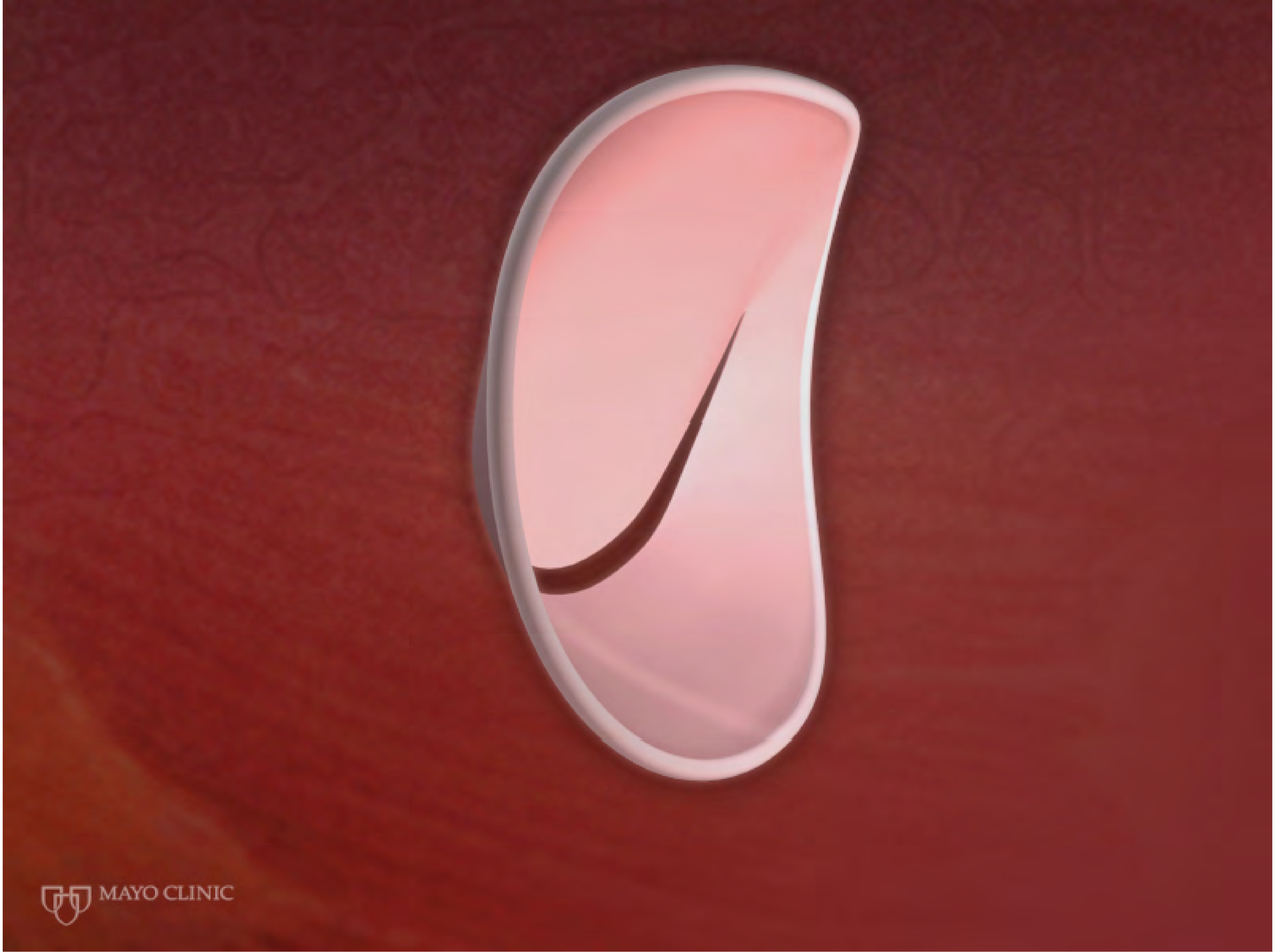
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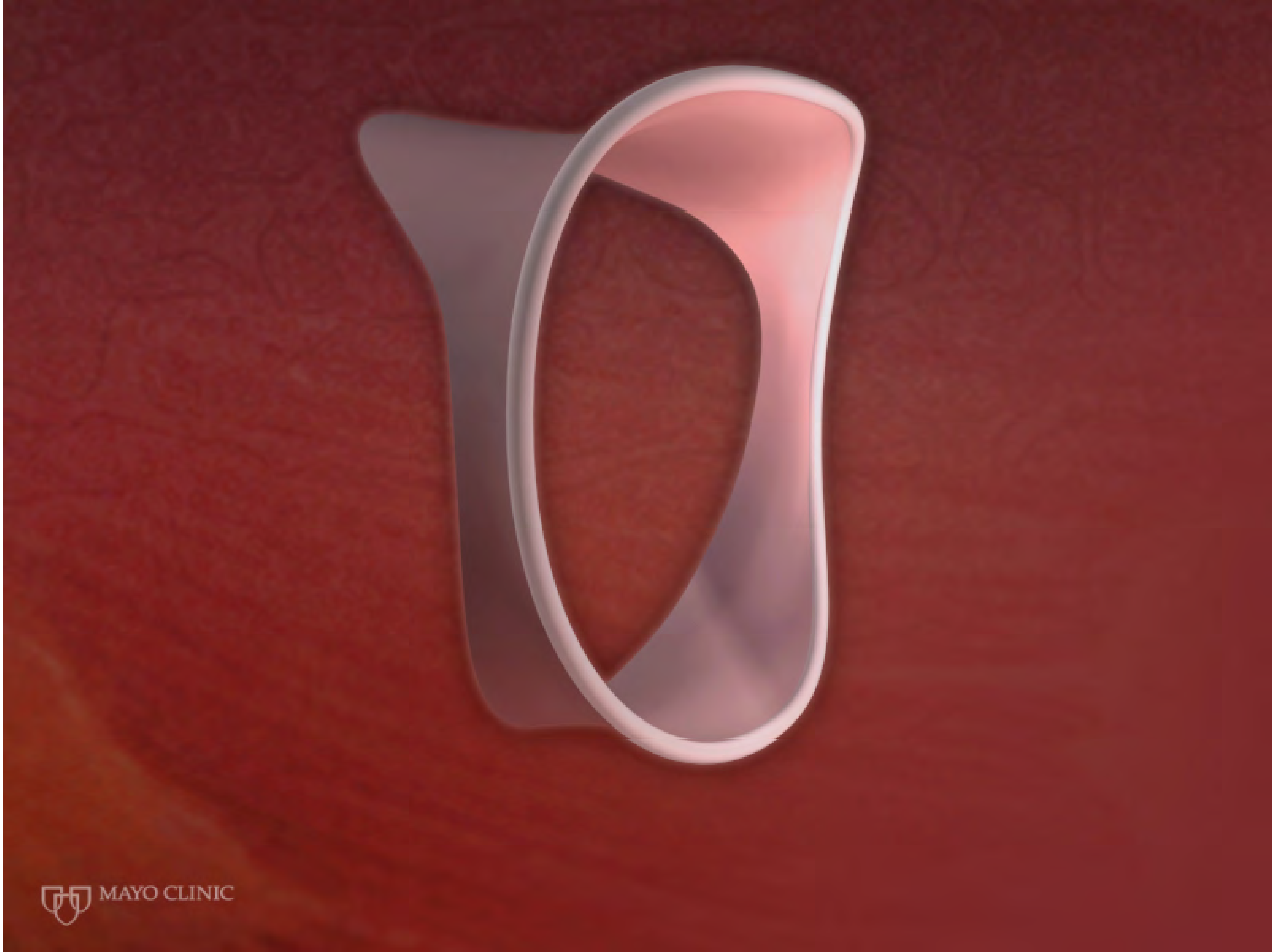

MAYO CLINIC

Normal Mitral Annulus

- Stable in Diastole
- In early systole:

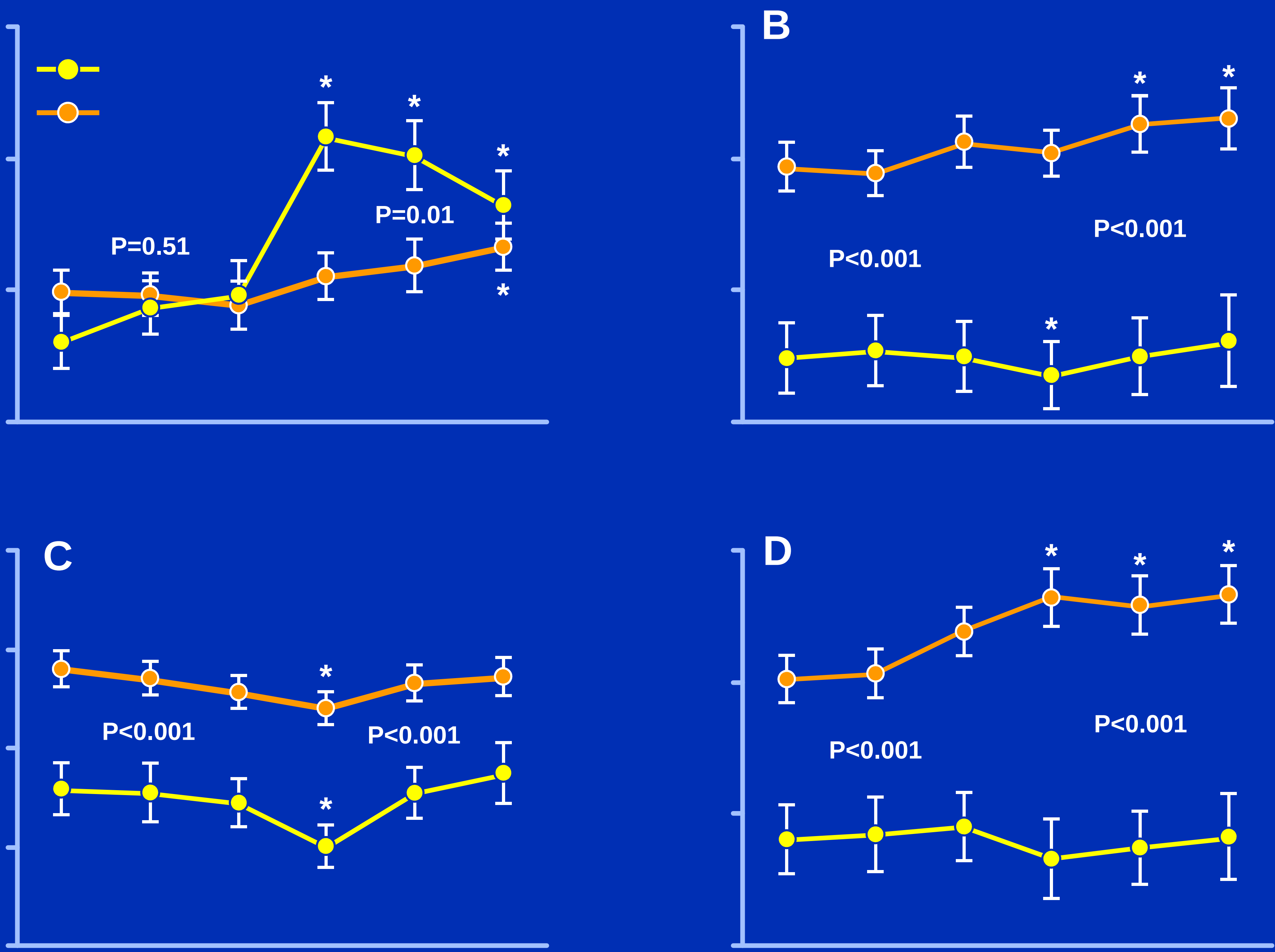
  AP contraction with Area contraction and without Inter-commissural change

  Saddle shape accentuation
- In late systole:

  AP and Area relaxation back to baseline

  Saddle shape remaining accentuated

  Circumference stretching
- Early Diastole: Return to baseline



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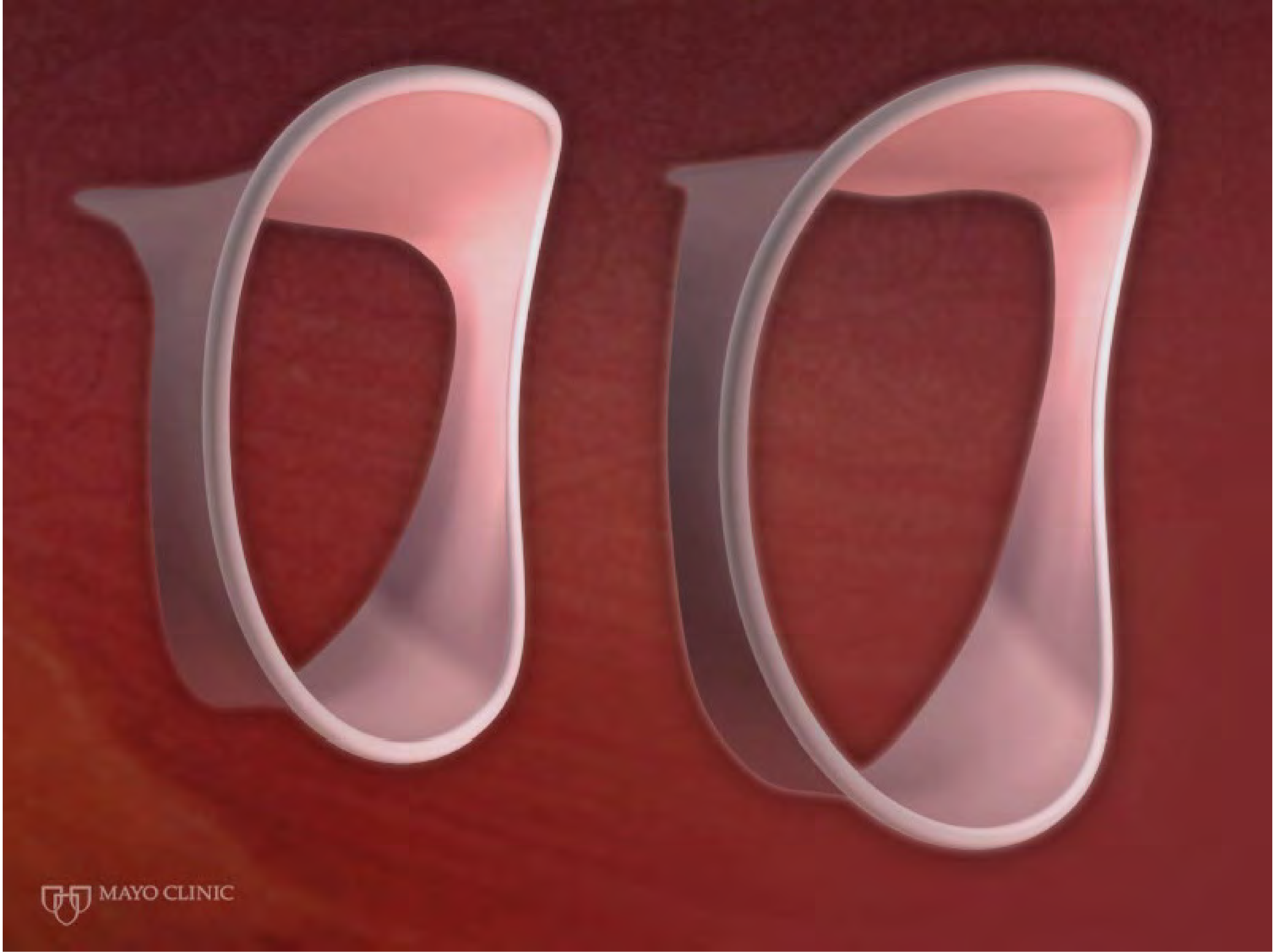


Myxomatous Mitral Annulus

- **Stable in Diastole**
- **In early systole:**

  AP weak contraction without Area contraction due to Inter-commissural dilatation

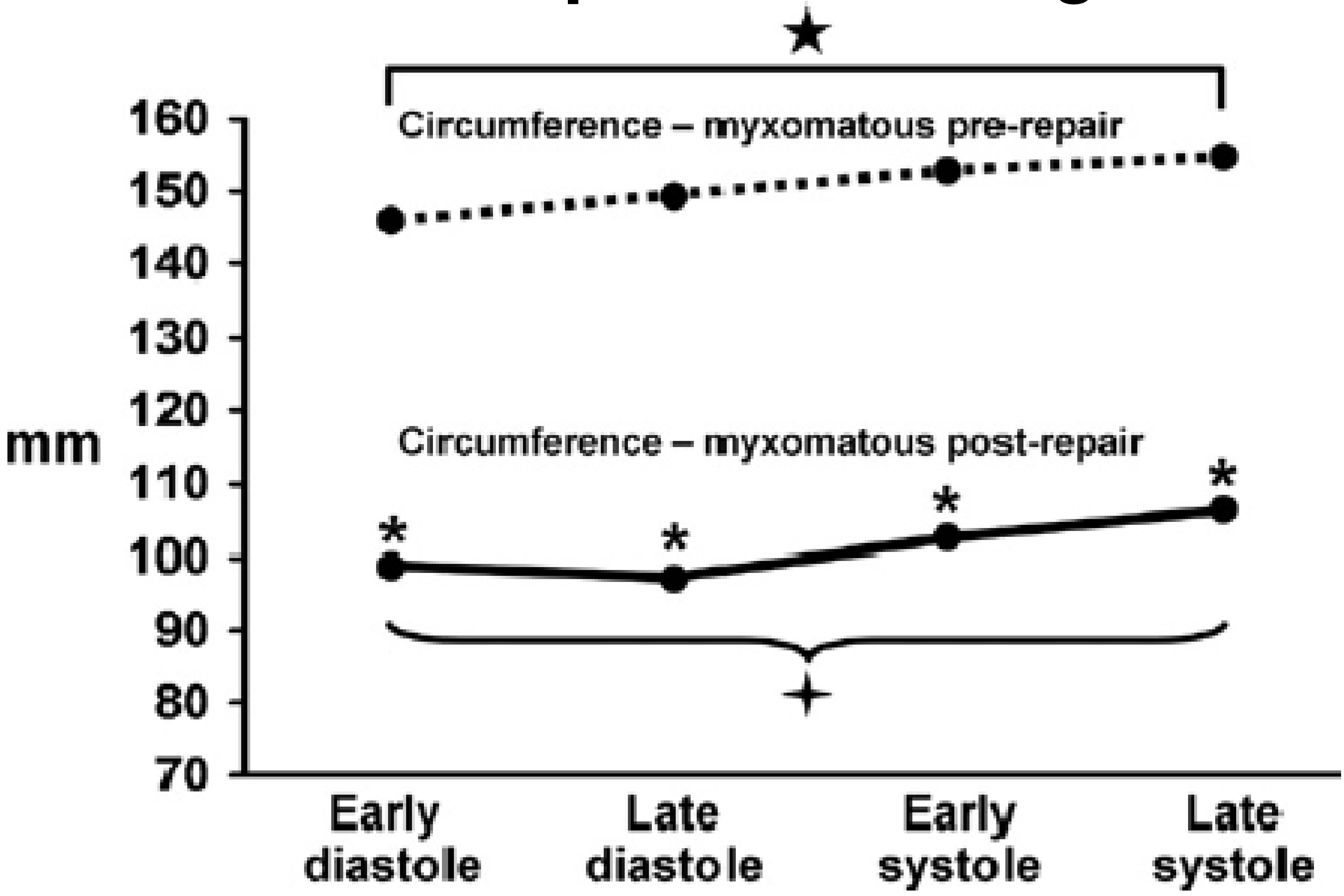
  No saddle shape accentuation
- **In late systole:**

  AP relaxation back to baseline

  Saddle shape slowly accentuated

  Area marked enlargement due to progressive inter-commissural enlargement
- **Early Diastole: Return to baseline**

Post-operative changes



3D Echo analysis of Mitral Annular Physiology

What have we learned:

3D Echo provides accurate and reproducible measurements of mitral annular dimensions

3D Echo provides unique physiologic insights into mechanisms protecting from MR in normal subjects

MVP myxomatous alterations involve profound annular alterations all tending to enhance MR occurrence

MVP

OUTCOME

Prevalence and **Clinical Outcome** of **Mitral Valve Prolapse**

The New England Journal of Medicine July 1st, 1999

TABLE 2. PREVALENCE OF VARIOUS FINDINGS ACCORDING TO TH… ABSENCE OF MITRAL …

		… (%)
	…	25 (0.7)
	1 (1.2)	58 (1.7)
…isease*	1 (1.2)	52 (1.5)
	3 (3.6)	103 (3.0)

*Cerebrovascular disease refers to stroke or transient ischemic attack.

Is MVP Uniformly Benign ?

Freed, LA et al. *N Engl J Med*. 1999;341:1-7.

Natural History of Asymptomatic Mitral Valve Prolapse in the Community

Jean-François Avierinos, MD; Bernard J. Gersh, MB, ChB, DPhil; L. Joseph Melton III, MD; Kent R. Bailey, PhD; Clarence Shub, MD; Rick A. Nishimura, MD; A. Jamil Tajik, MD; Maurice Enriquez-Sarano, MD

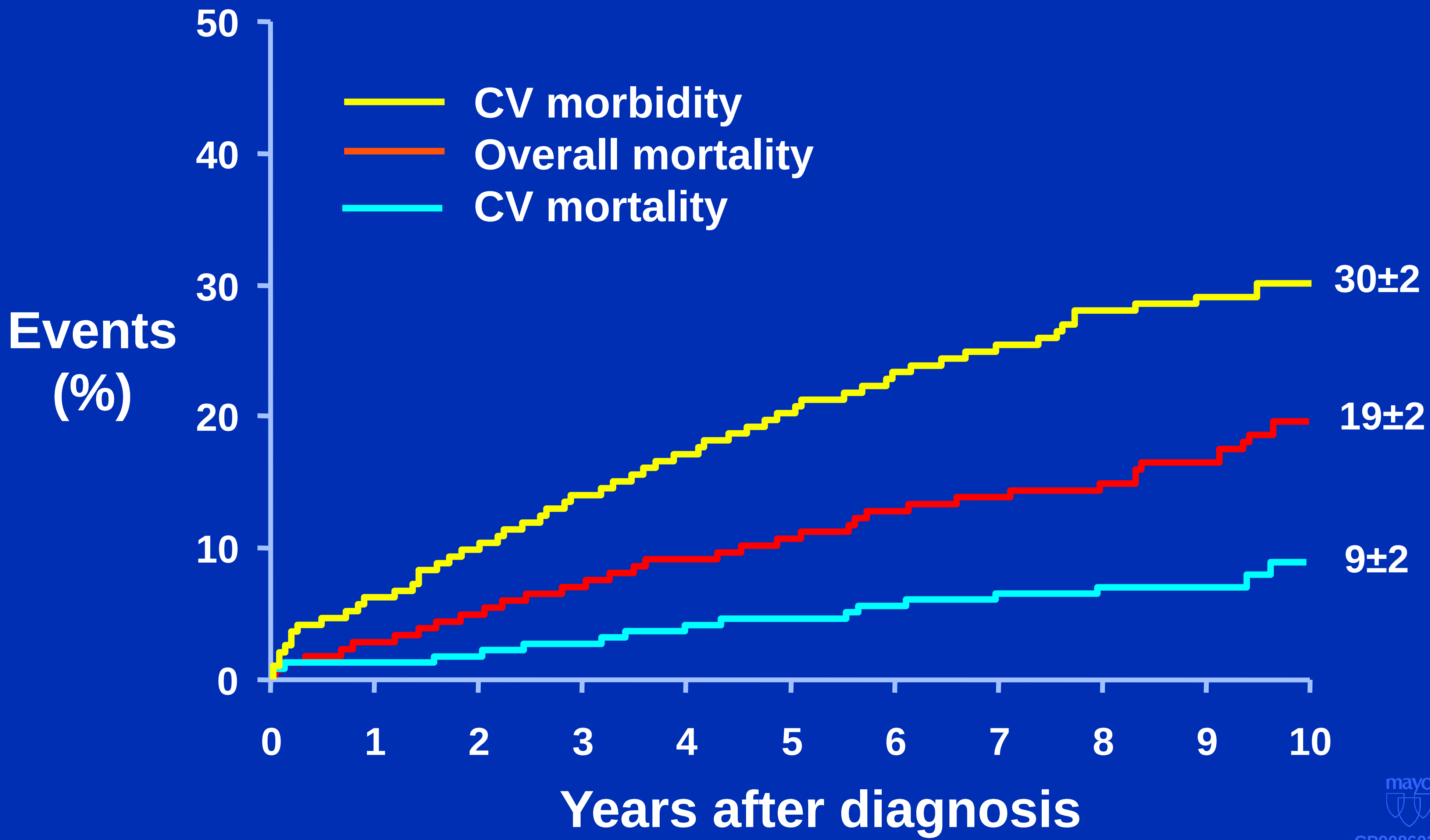
Background—The outcome of mitral valve prolapse (MVP) is controversial, with marked discrepancies in reported complication rates.

Methods and Results—We conducted a community study of all Olmsted County, Minn, residents first diagnosed with asymptomatic MVP between 1989 and 1998 (N=833). Diagnosis, motivated by auscultatory findings (n=557) or incidental (n=276), was always confirmed by echocardiography with the use of current criteria. End points analyzed during 4581 person-years of follow-up were mortality (n=96, 19±2% at 10 years), cardiovascular morbidity (n=171), and MVP-related events (n=109, 20±2% at 10 years). The most frequent primary risk factors for cardiovascular mortality were mitral regurgitation from moderate to severe (P=0.002, n=131) and, less frequently, ejection fraction <50% (P=0.003, n=31). Secondary risk factors independently predictive of cardiovascular morbidity were slight mitral regurgitation, left atrium ≥40 mm, flail leaflet, atrial fibrillation, and age ≥50 years (all P<0.01). Patients with only 0 or 1 secondary risk factor (n=430) had excellent outcome, with 10-year mortality of 5±2% (P=0.17 versus expected), cardiovascular morbidity of 0.5%/y, and MVP-related events of 0.2%/y. Patients with ≥2 secondary risk factors (n=250) had mortality similar to expected (P=0.20) but high cardiovascular morbidity (6.2%/y, P<0.01) and notable MVP-related events (1.7%/y, P<0.01). Patients with primary risk factors (n=153) showed excess 10-year mortality (45±9%, P=0.01 versus expected), high morbidity (18.5%/y, P<0.01), and high MVP-related events (15%/y, P<0.01).

Conclusions—Natural history of asymptomatic MVP in the community is widely heterogeneous and may be severe. Clinical and echocardiographic characteristics allow separation of the majority of patients with excellent prognosis from subsets of patients displaying, during follow-up, high morbidity or even excess mortality as direct a consequence of MVP. (***Circulation*. 2002;106:1355-1361.**)

Asymptomatic MVP in the Population

Mortality and Morbidity



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Asymptomatic MVP
Risk Stratification

Primary Risk Factors (mort)

- EF<50%
- MR ≥ moderate

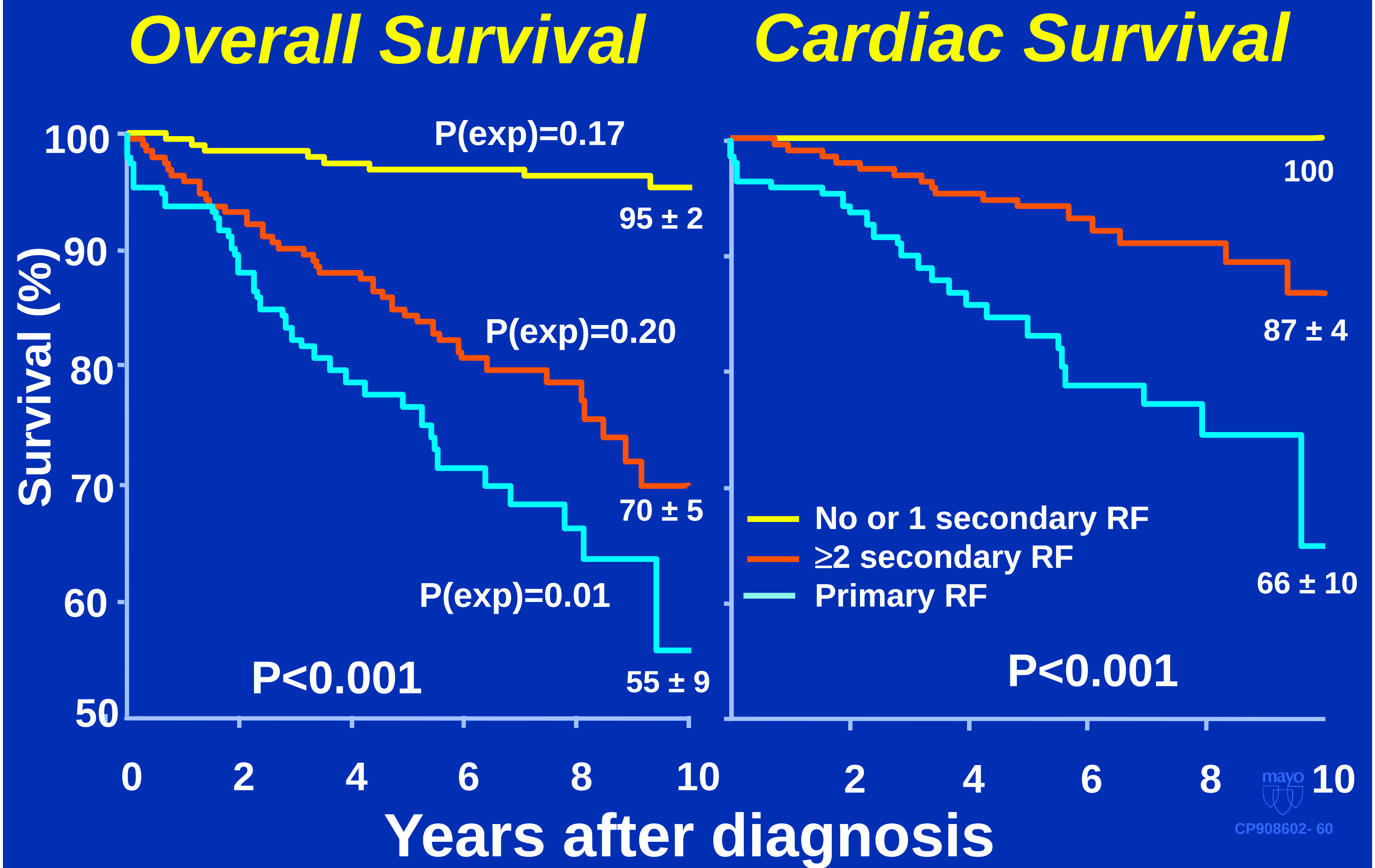
Secondary Risk Factors (morb)

- Age ≥ 50 years
- A Fib
- Slight MR
- Flail leaflet
- LA ≥ 40 mm

Outcome of MVP – Risk Stratification

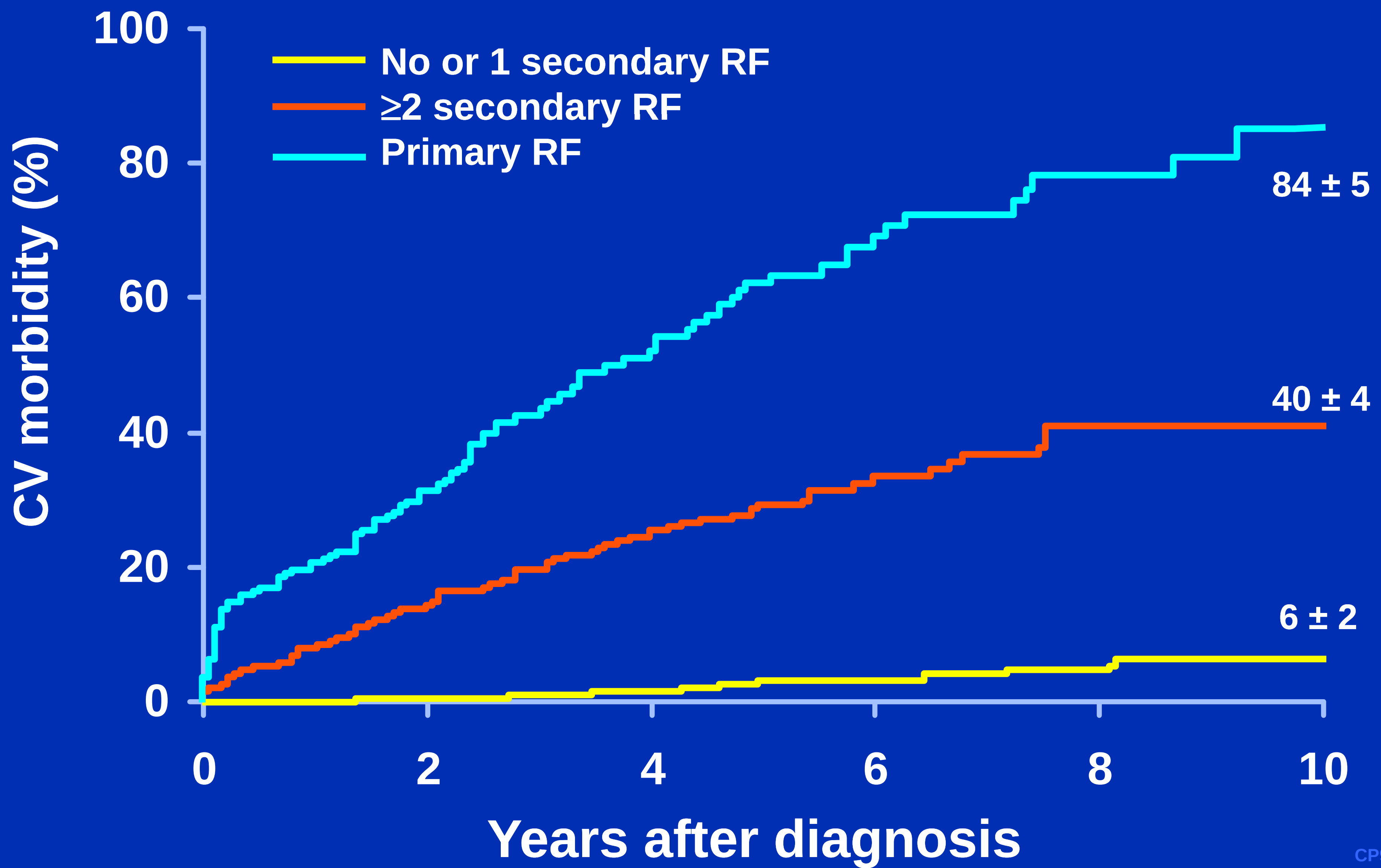
3 groups	No.	%
No or 1 secondary RF	430	52
≥2 secondary RF	250	30
Primary RF	153	18
• MR ≥ moderate	131	
• EF <50%	31	

Outcome of Asymptomatic MVP



Outcome of Asymptomatic MVP

Cardiovascular Morbidity



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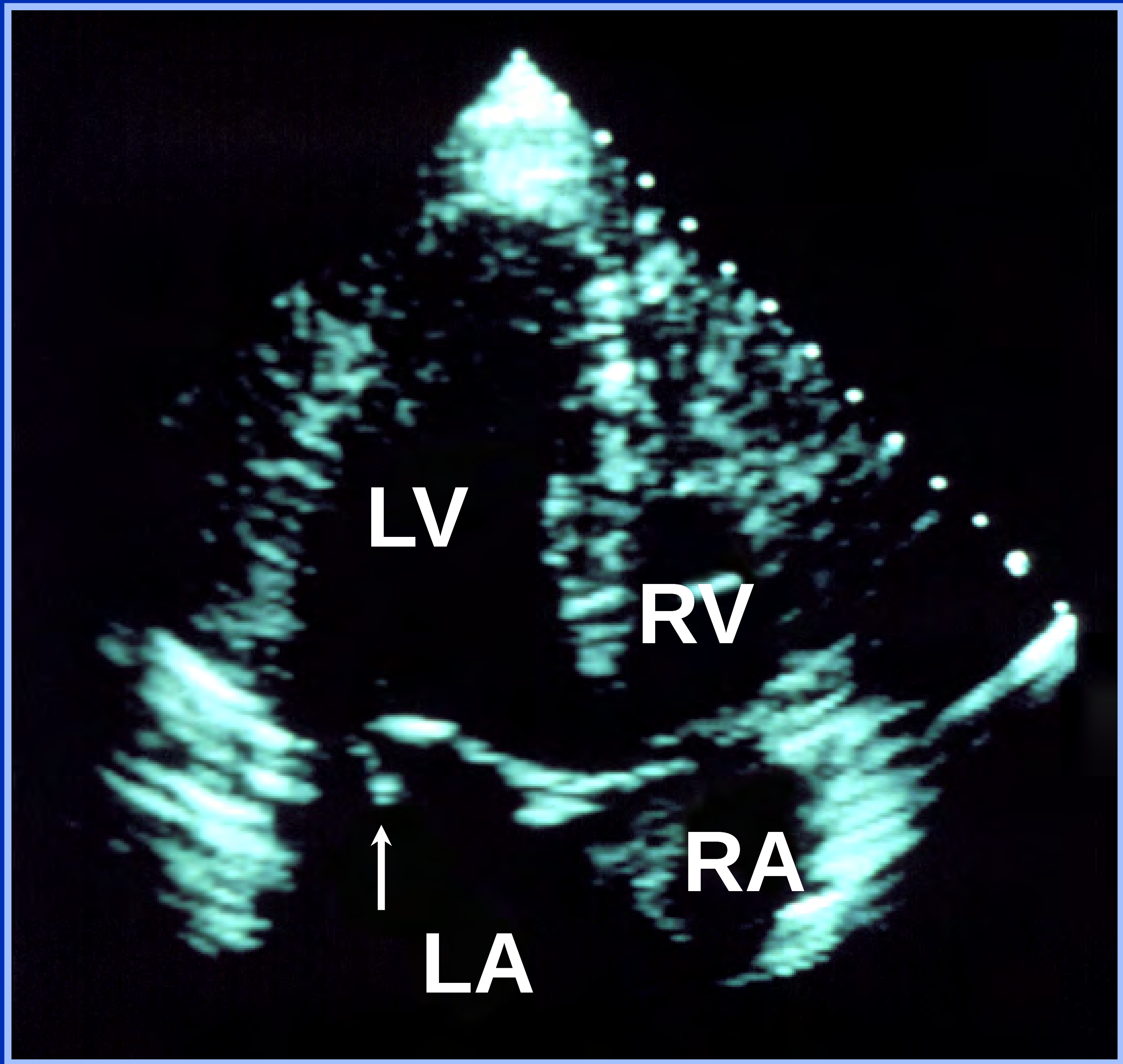

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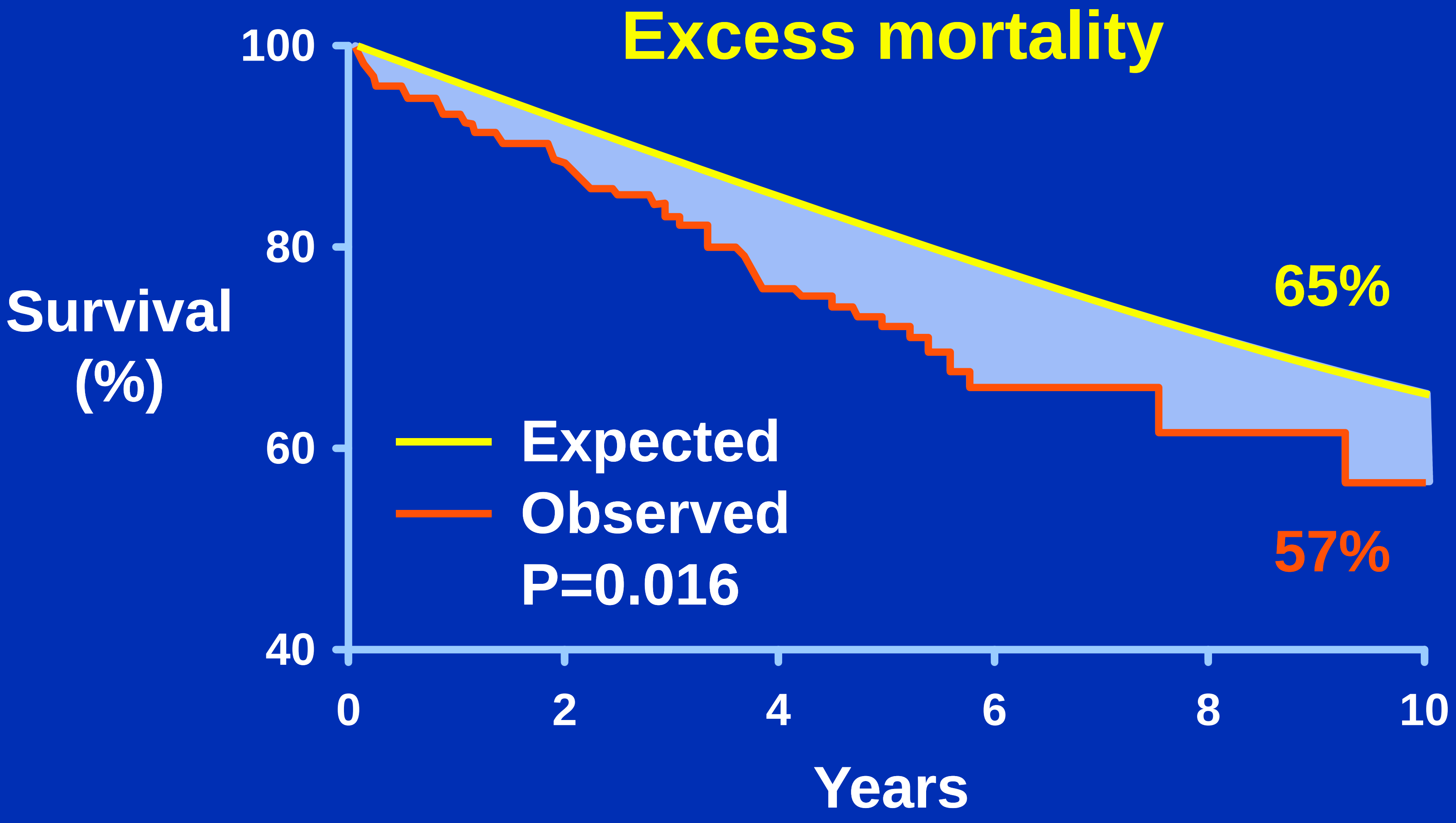
MR due to Flail Leaflets Natural History



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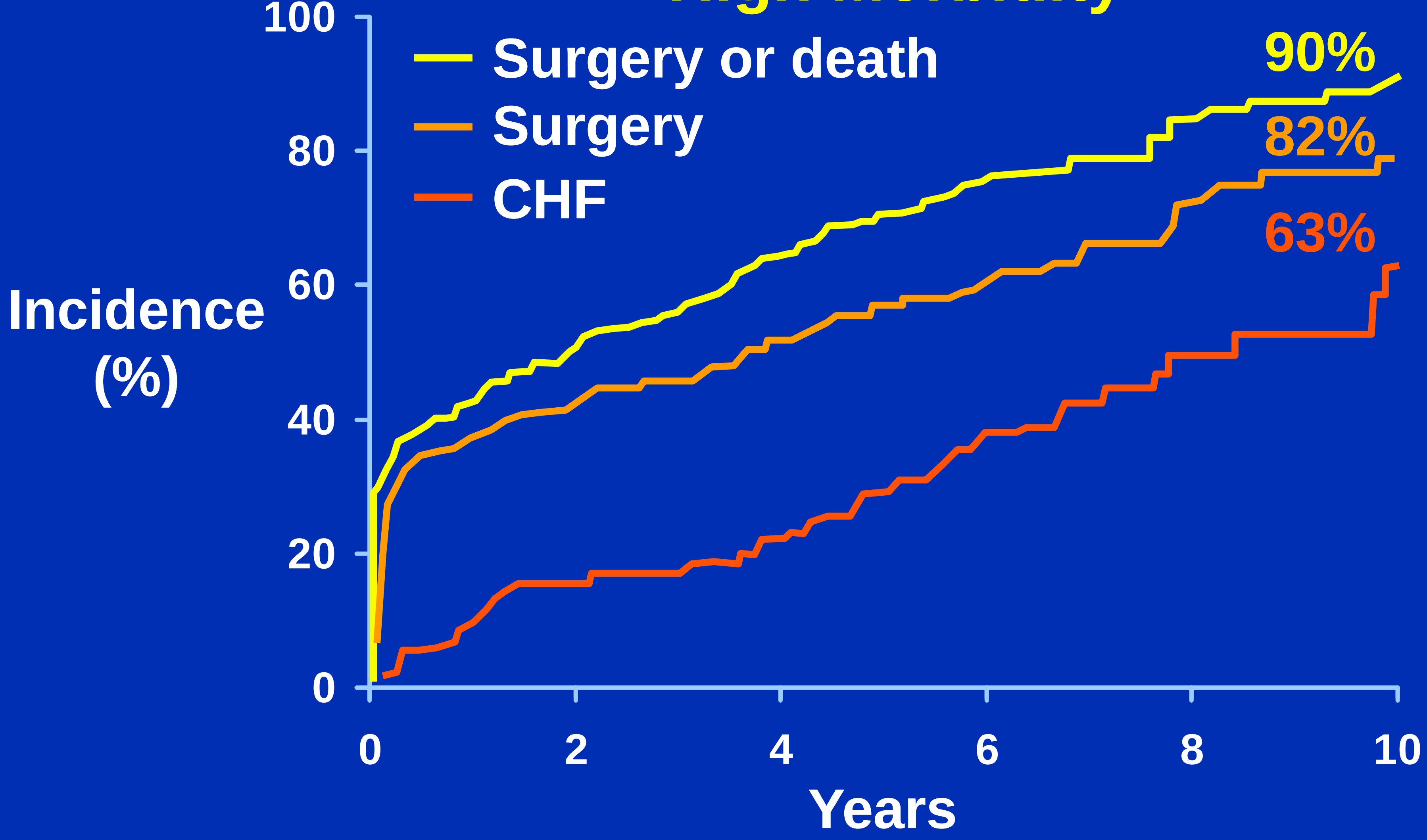
Mitral Regurgitation

Natural History

High Morbidity



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MVP and MR

MVP and MR are *not* uniformly benign conditions

MVP and MR are heterogeneous conditions with prognosis highly dependent on the MR and its consequences

MVP and MR

Can LV size

reflect MR severity, and

guide surgical indications

Annals of Internal Medicine | Article

Sex Differences in Morphology and Outcomes of Mitral Valve Prolapse

Jean-François Avierinos, MD; Jocelyn Inamo, MD; Francesco Grigioni, MD; Bernard Gersh, MD; Clarence Shub, MD; and Maurice Enriquez-Sarano, MD

Background: Mitral valve prolapse is more common in women than in men, but men more often have surgery for severe regurgitation.

Objective: To compare morphology and outcomes of mitral valve prolapse in men and women.

Design: Retrospective cohort study.

Setting: The Mayo Clinic, Rochester, Minnesota.

Patients: 4461 women and 3768 men who received a diagnosis of mitral valve prolapse by echocardiography from 1989 to 1998 (896 Olmsted County residents and 7333 referred patients).

Measurements: Mitral prolapse characteristics (localization, leaflet thickening or flail, regurgitation), ventricular and atrial characteristics, cardiac surgery, and mortality.

Results: Compared with men, women had less posterior prolapse (22% vs. 31%), less flail (2% vs. 8%), more leaflet thickening (32% vs. 28%), and less frequent severe regurgitation (10% vs. 23%) ($P < 0.001$ for all comparisons). Regardless of the severity of regurgitation, left ventricular and atrial diameters were smaller in women than in men but were larger in women after normalization to body surface area. Among patients with severe regurgitation, women were less likely than men to undergo cardiac valve surgery (52% vs. 60%; adjusted risk ratio, 0.79 [95% CI, 0.74 to 0.84]). At 15 years, women with no or mild mitral regurgitation had better odds of survival than men (87% vs. 77%; adjusted risk ratio, 0.82 [CI, 0.76 to 0.89]), but those with severe regurgitation had worse survival than men (60% vs. 68%; adjusted risk ratio, 1.13 [CI, 1.01 to 1.26]). The survival rate 10 years after surgery was similar in women and men (77% vs. 79%; $P = 0.14$). Observations in Olmsted County patients and referred patients were similar.

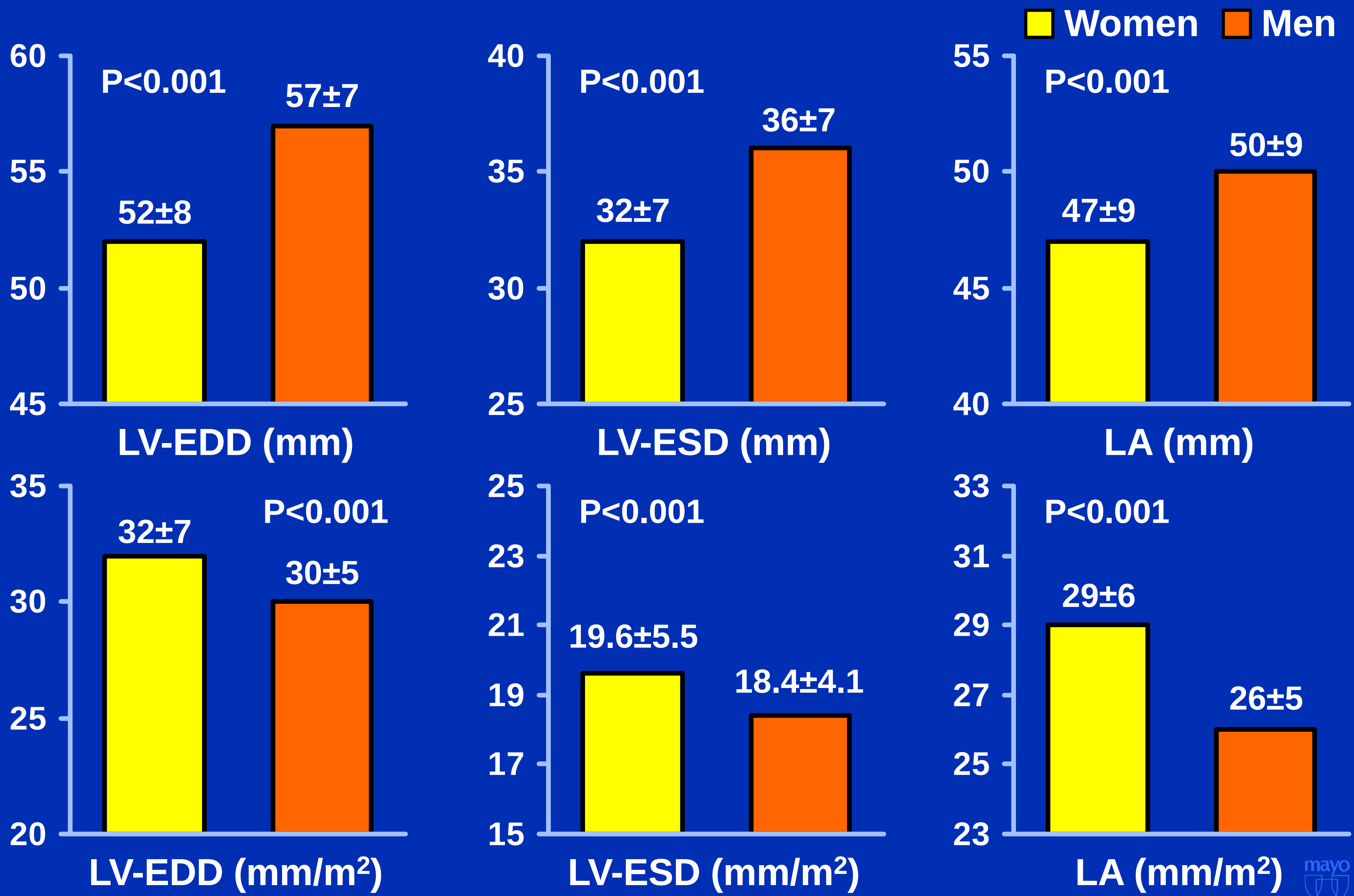
Limitation: Diagnoses were based on echocardiography, and clinical data at initial diagnosis, reason for index echocardiography, and cause of all deaths were lacking.

Conclusion: Morphology and severity of mitral valve prolapse differ according to sex. Among patients with severe regurgitation, women have higher mortality and lower surgery rates than men.

Ann Intern Med. 2008;149:787-794. www.annals.org
For author affiliations, see end of text.

Mitral Valve Prolapse in Men and Women

LV and LA size



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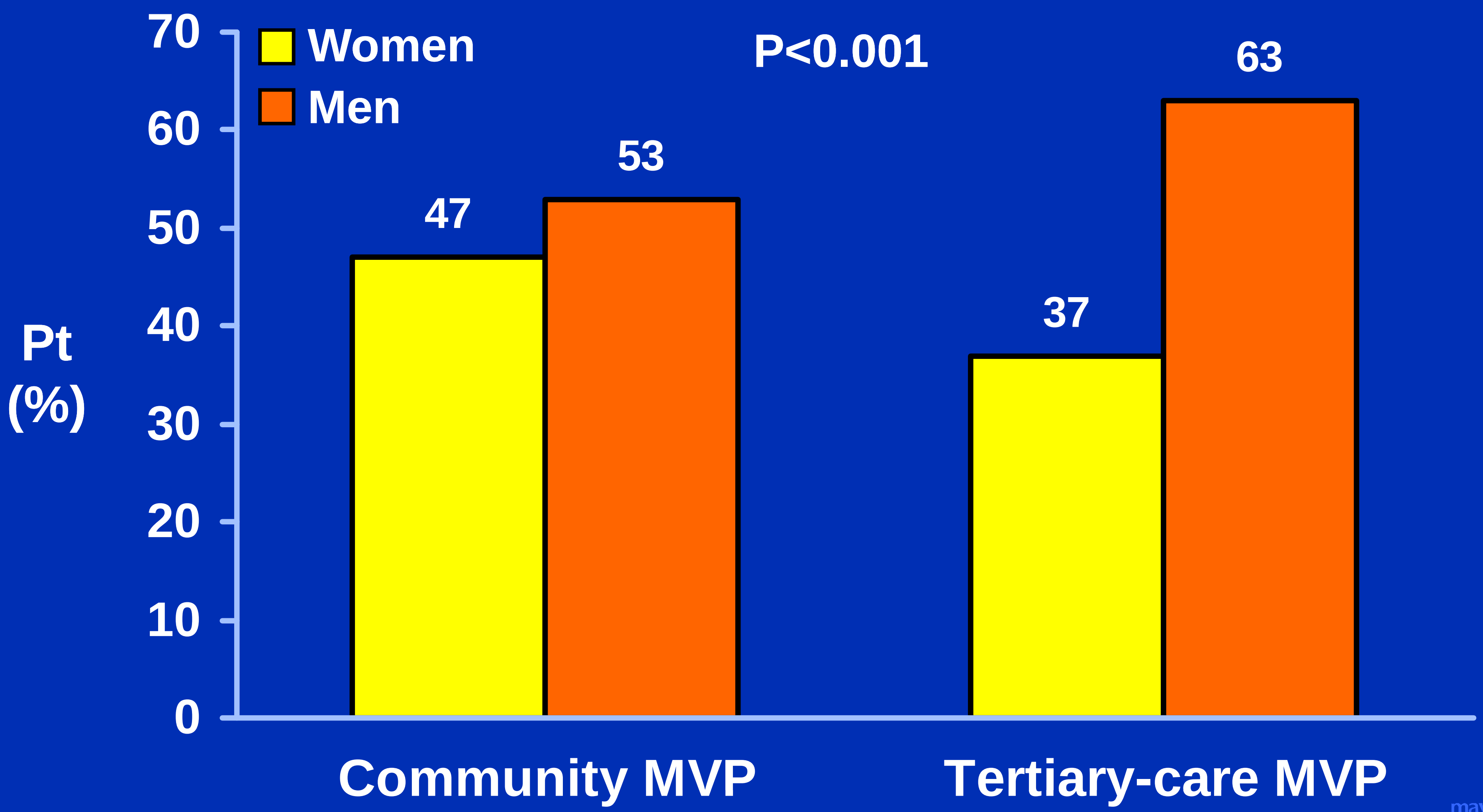
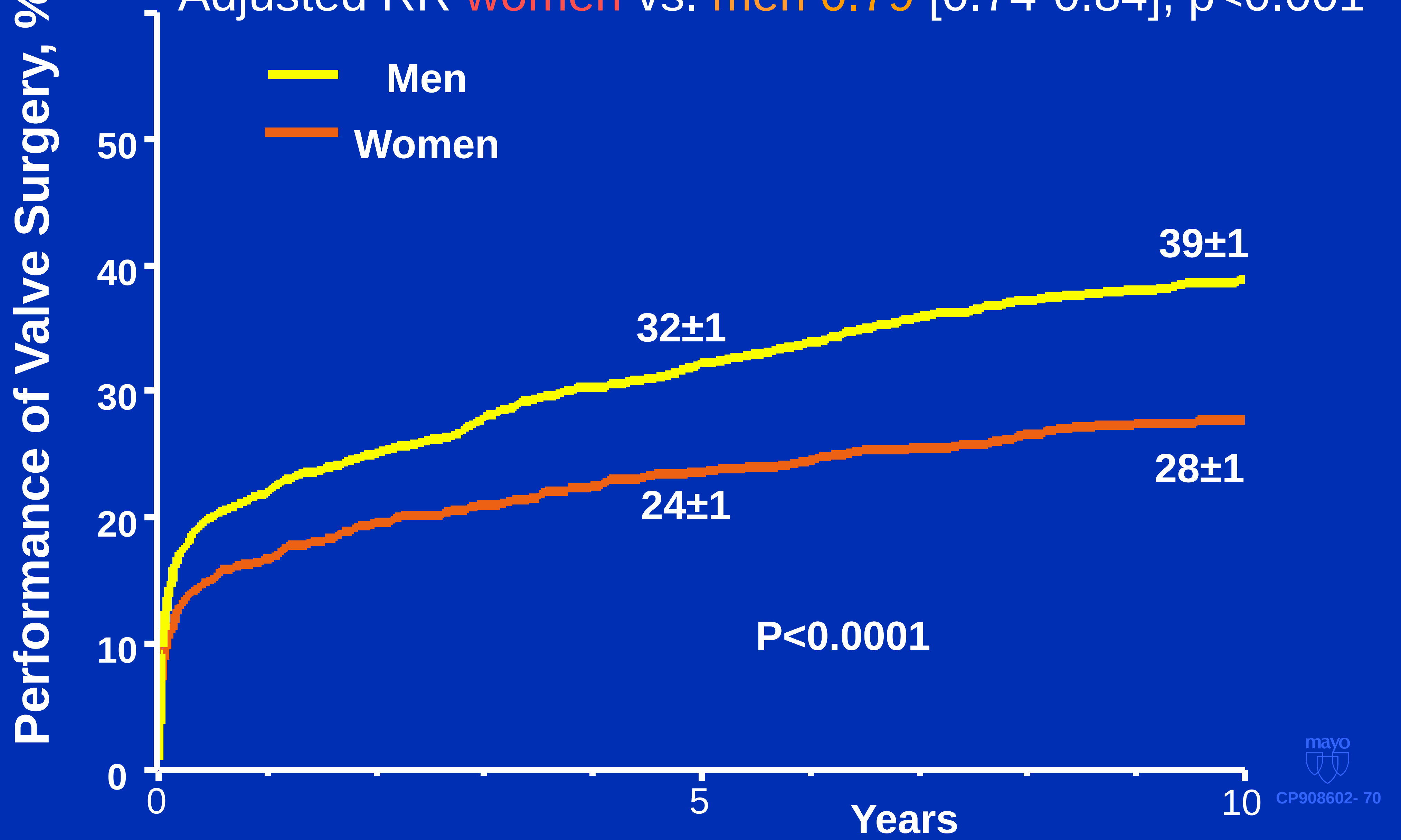
Sex Distribution of Degenerative Moderate or Severe MR



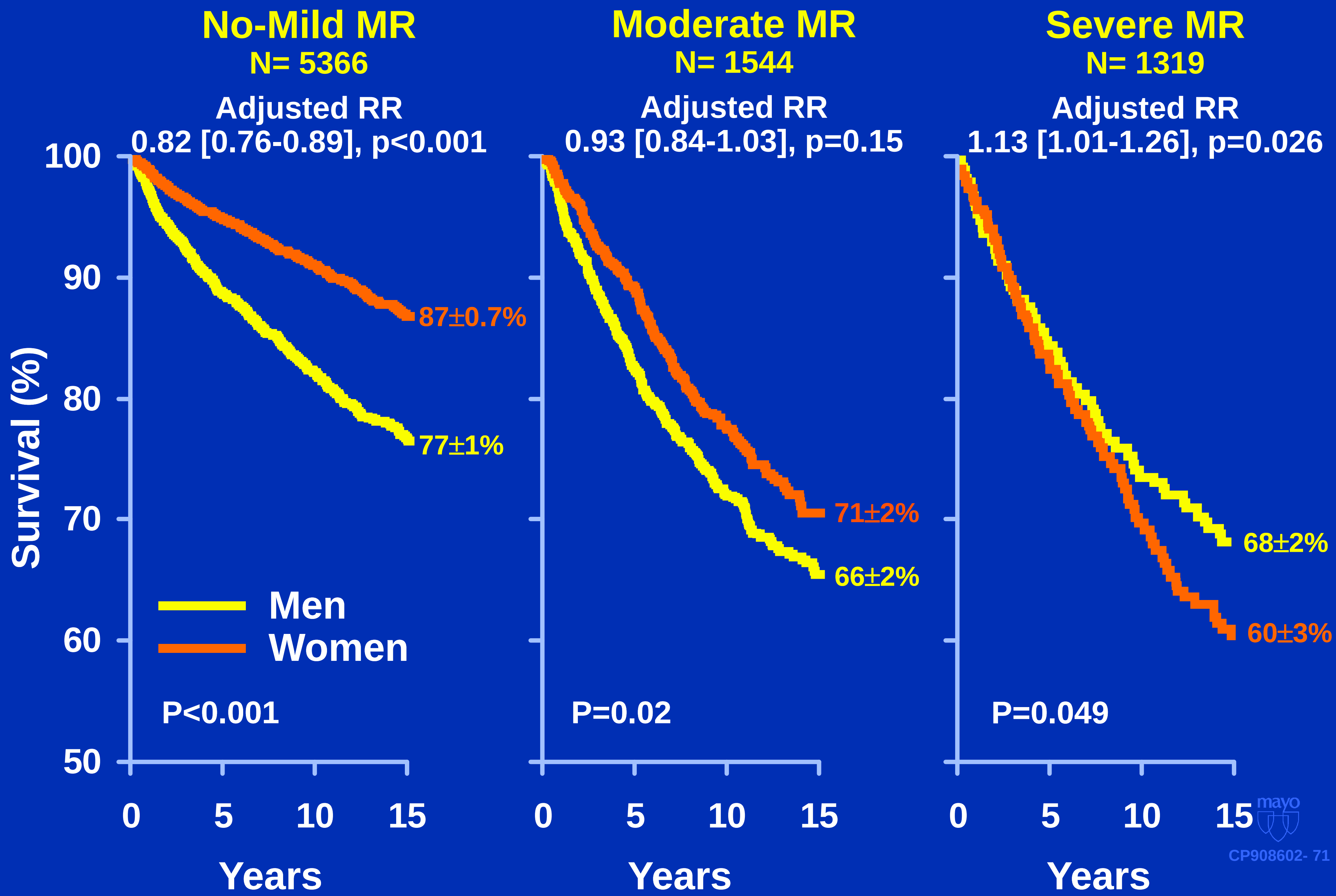
Cardiac Valve Surgery for MVP
The Women Deficit

Adjusted RR women vs. men 0.79 [0.74-0.84], p<0.001



Survival after the diagnosis of MVP

Gender differences



CP908602- 71

Mitral Regurgitation

Absolute LV and LA dimensions

- Severity of MR and overload in women is underestimated by unadjusted diameters
- Women are less often operated for MR than men
- Women with severe MR incur excess mortality vs. men

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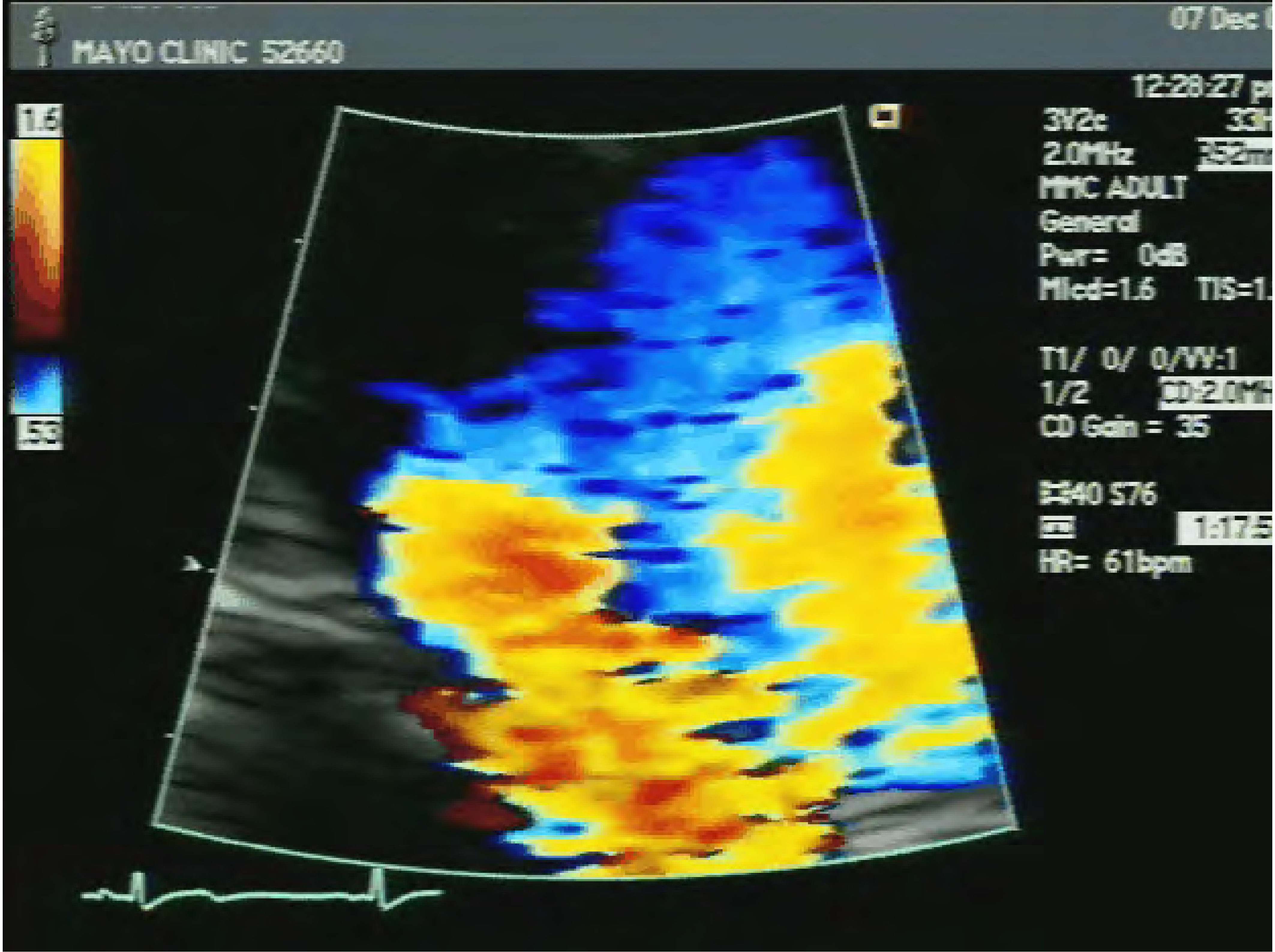

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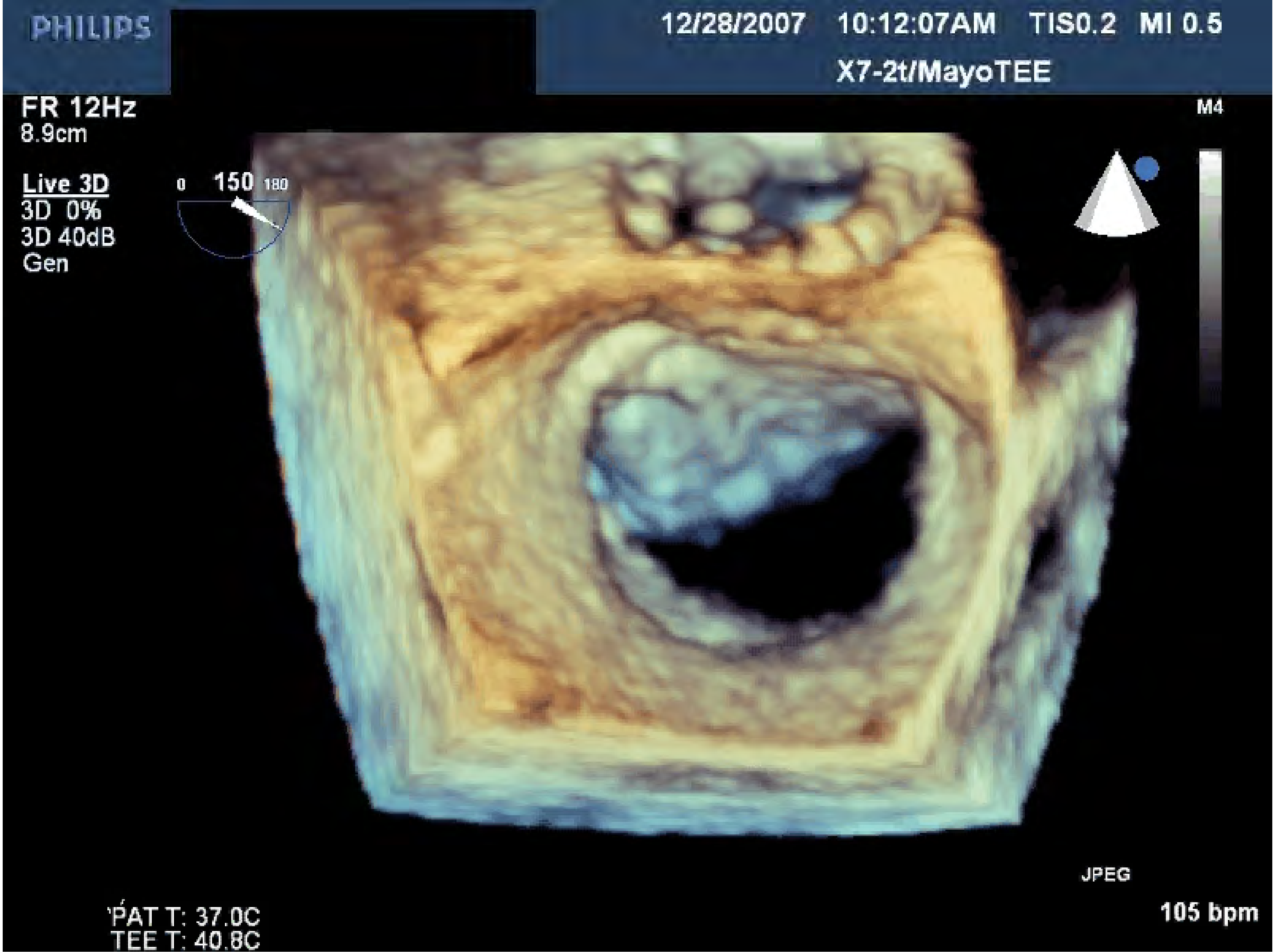
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TEE T: 40.8C
105 bpm

MVP and MR

MVP and MR are heterogeneous conditions of prognosis defined by an array of echo measurements dominated by

- **MR quantified severity**
- **Mitral Reparability**

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THANK
YOU