

Summary

Pertinent aspects of patient and valvular assessments used to guide the optimal timing and type of intervention for severe chronic MR.

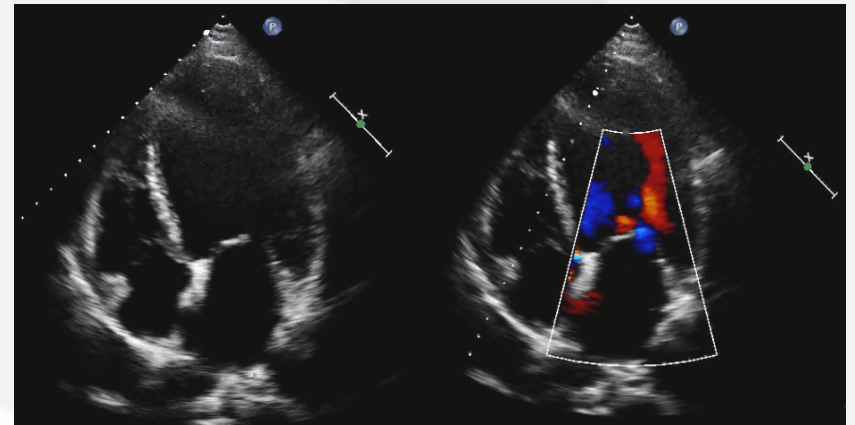
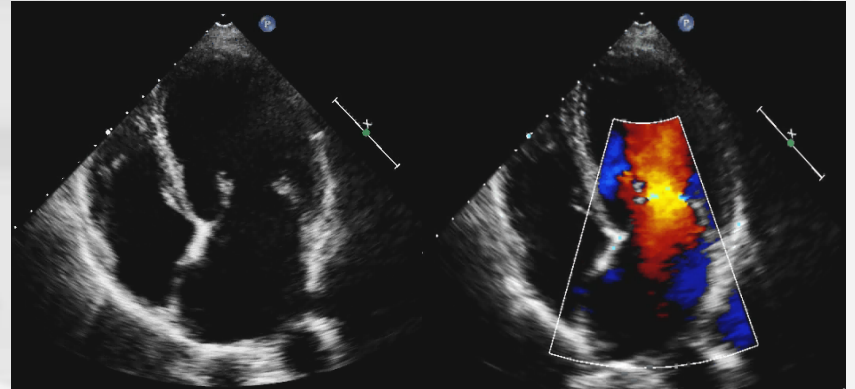
- **Etiology:** primary or secondary MR?
- **Surgical indication?:** surgical decision depends on whether the patient is symptomatic or not. Is LV function normal?
- **Surgical risk assessment:** once a patient has developed an indication for valvular surgical intervention, consideration is next focused on the balance of procedural risks and anticipated benefits.
- **Anatomical criteria:** in considering patient candidacy for surgical/percutaneous mitral valve repair, detailed anatomical assessment of the valve anatomy is critical.

Etiology

Management is dependent on differentiation between primary and secondary mechanisms of regurgitation

Primary MR: the pathology of ≥ 1 of the components of the valve causes valve incompetence. *MR is the disease. Correction of the MR is curative.*

Secondary MR: MR is only 1 component of the disease. Thus, *the best therapy* for chronic secondary MR *is much less clear* than it is for chronic primary MR



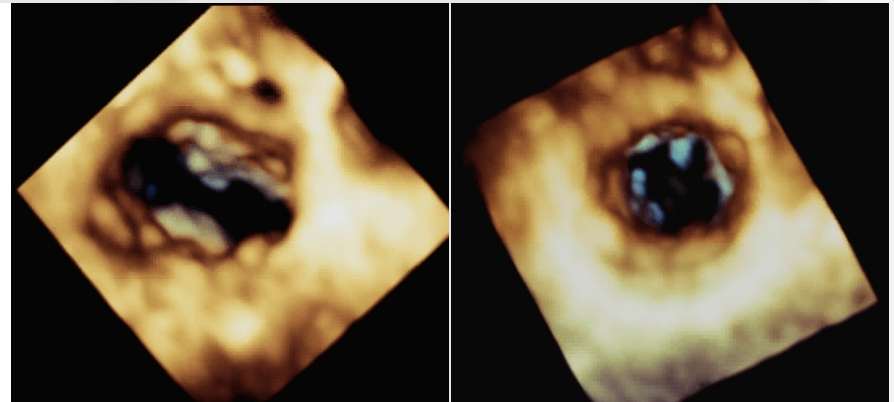
Etiology

TTE is indicated for baseline evaluation of LV size and function, RV function and LA size, pulmonary artery pressure, and mechanism and severity of primary MR in any patient suspected of having chronic MR

EAE/ASE Recommendations for Image Acquisition and Display Using Three-Dimensional Echocardiography

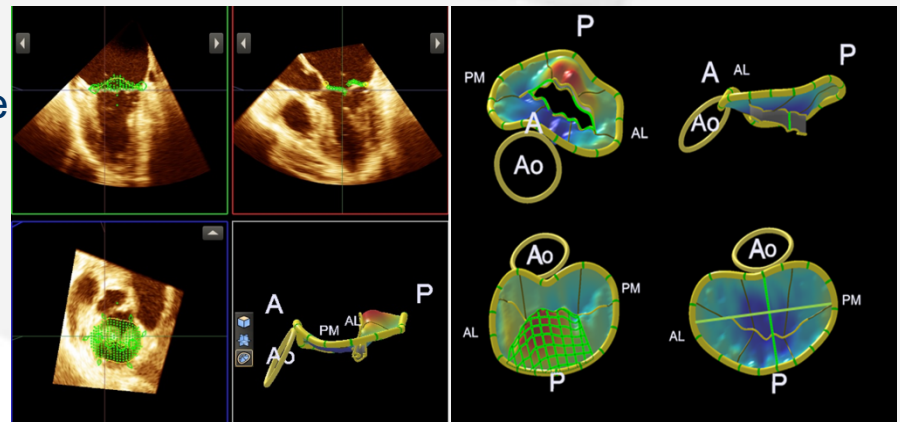
Roberto M. Lang, MD, FASE^{*,†}, Luigi P. Badano, MD, FESC^{†,‡}, Wendy Tsang, MD^{*}, David H. Adams, MD^{*}, Eustachio Agricola, MD[†], Thomas Buck, MD, FESC[†], Francesco F. Faletra, MD[†], Andreas Franke, MD, FESC[†], Judy Hung, MD, FASE^{*}, Leopoldo Pérez de Isla, MD, PhD, FESC[†], Otto Kamp, MD, PhD, FESC[†], Jaroslaw D. Kasprzak, MD, FESC[†], Patrizio Lancellotti, MD, PhD, FESC[†], Thomas H. Marwick, MBBS, PhD^{*}, Marti L. McCulloch, RDCS, FASE^{*}, Mark J. Monaghan, PhD, FESC[†], Petros Nihoyannopoulos, MD, FESC[†], Natesa G. Pandian, MD^{*}, Patricia A. Pellikka, MD, FASE^{*}, Mauro Pepi, MD, FESC[†], David A. Roberson, MD, FASE^{*}, Stanton K. Shernan, MD, FASE^{*}, Girish S. Shirali, MBBS, FASE^{*}, Lissa Sugeng, MD^{*}, Folkert J. Ten Cate, MD[†], Mani A. Vannan, MBBS, FASE^{*}, Jose Luis Zamorano, MD, FESC, FASE[†], and William A. Zoghbi, MD, FASE^{*}

European Heart Journal 2012



‘3D echocardiographic imaging modalities are ideal for interrogating the anatomy and function of each of the individual components of the mitral apparatus’

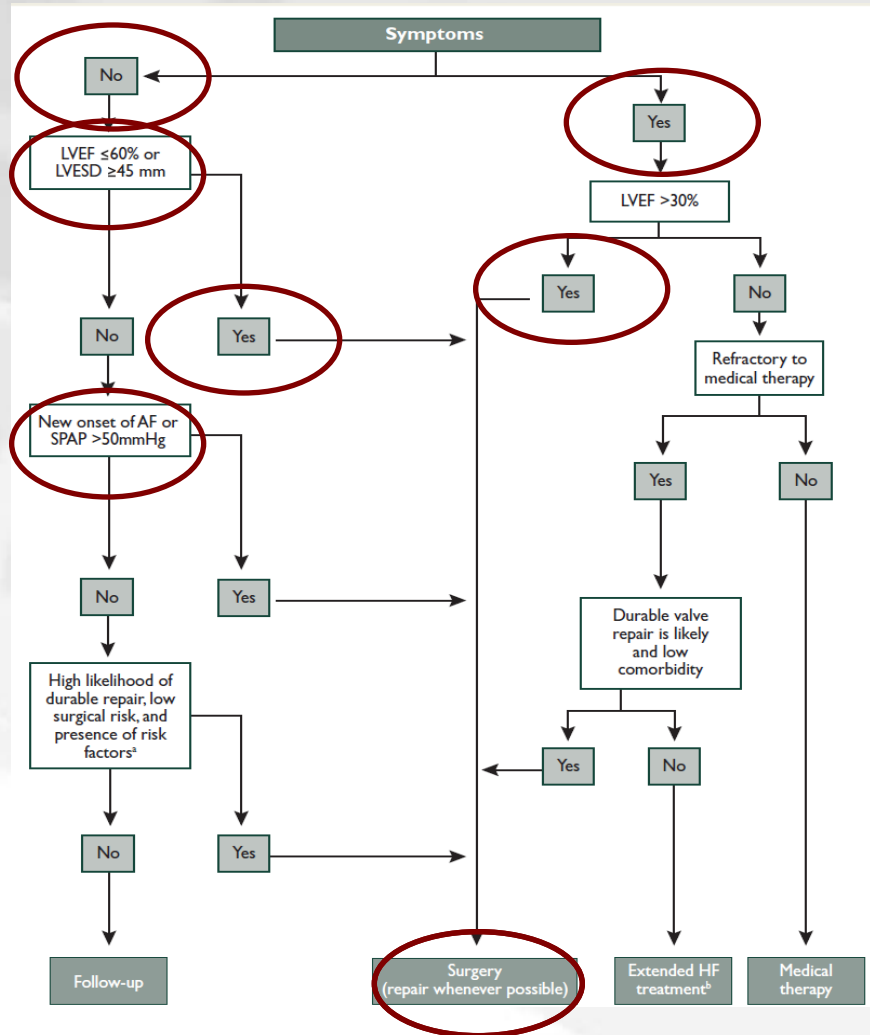
3D TTE



3D TEE

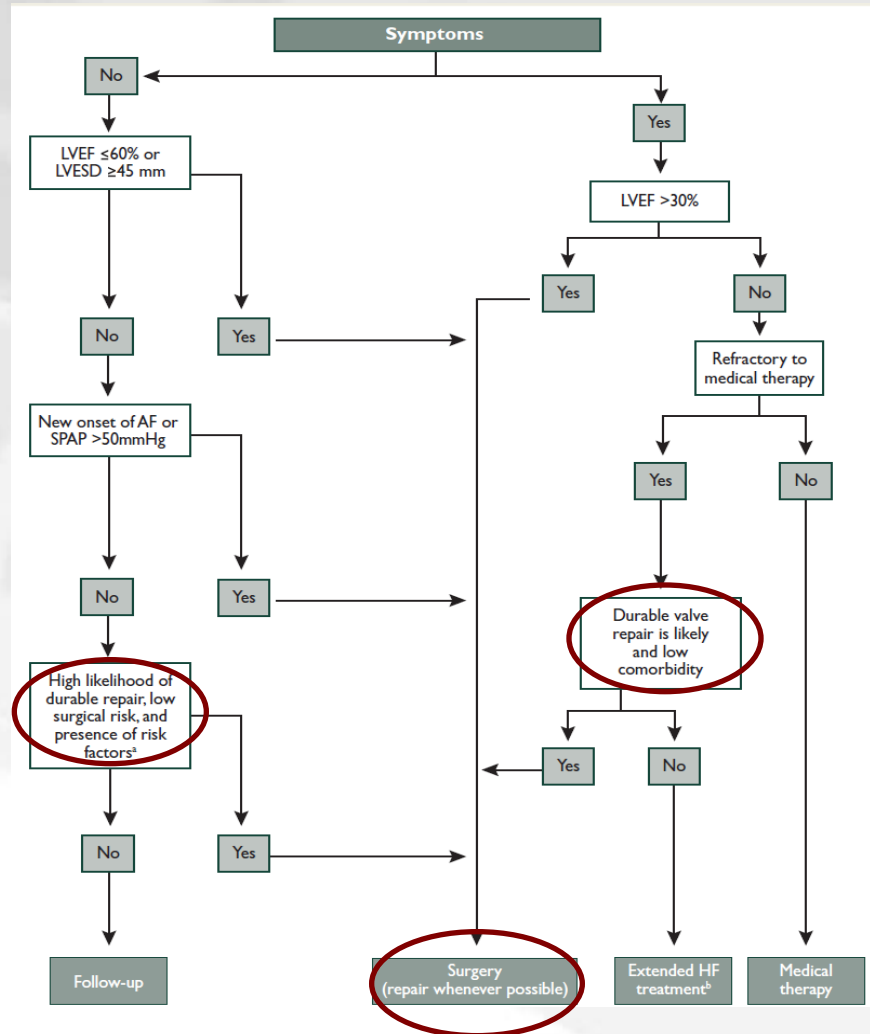
Etiology and symptoms

Primary MR



Etiology and symptoms

Primary MR



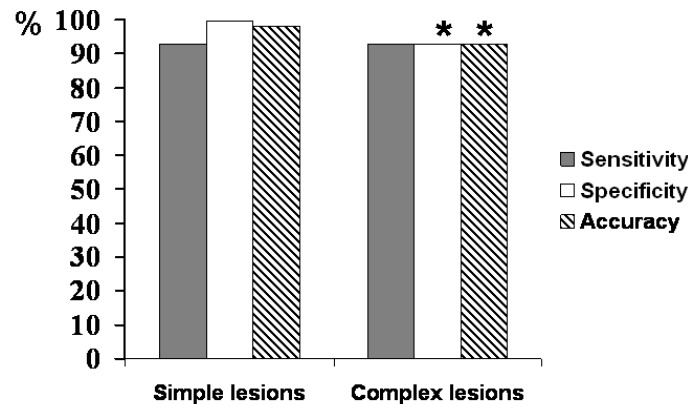
Anatomy: primary MR

The likelihood of a durable and safe MV repair strongly depends on the **anatomy** of the MV. The complexity of the surgical procedure is related to the complexity of the MV lesions.

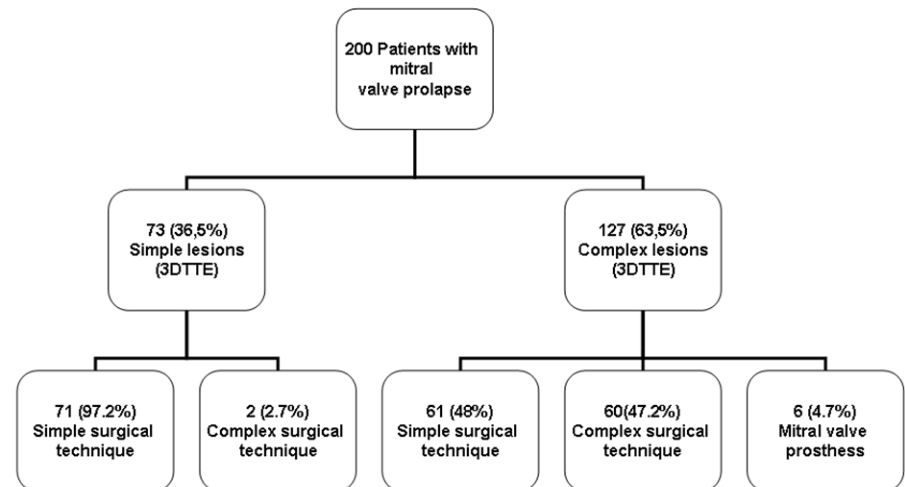
Pre-operative transthoracic real-time three-dimensional echocardiography in patients undergoing mitral valve repair: accuracy in cases with simple vs. complex prolapse lesions

Gloria Tamborini*, Manuela Muratori, Anna Maltagliati, Claudia Agnese Galli, Moreno Naliato, Marco Zanobini, Francesco Alamanni, Luca Salvi, Erminio Sisillo, Cesare Fiorentini, and Mauro Pepi

Eur J Echocardiogr 2010



- 200 pts with degenerative MR
- 3D TTE vs surgical inspection
- 95% accuracy of all MV lesions
- the complexity of MV lesion by 3D TTE correlates to surgical procedures.



Etiology and symptoms

Secondary MR

	Class ^a	Level ^b
Surgery is indicated in patients with severe MR ^c undergoing CABG, and LVEF >30%.	I	C
Surgery should be considered in patients with moderate MR undergoing CABG. ^d	IIa	C
Surgery should be considered in symptomatic patients with severe MR, LVEF <30%, option for revascularization, and evidence of viability.	IIa	C
Surgery may be considered in patients with severe MR, LVEF >30%, who remain symptomatic despite optimal medical management (including CRT if indicated) and have low comorbidity, when revascularization is not indicated.	IIb	C

Guidelines on the management of valvular heart disease (version 2012)

Recommendations

- MV surgery is reasonable for patients with chronic severe secondary MR (stages C and D) who are undergoing CABG or AVR
- MV surgery may be considered for severely symptomatic patients (NYHA class III/IV) with chronic severe secondary MR (stage D)
- MV repair may be considered for patients with chronic moderate secondary MR (stage B) who are undergoing other cardiac surgery

COR
IIa
IIb
IIb

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary

Surgical risk assessment

Mitral valve surgery is a low-risk operation (operative mortality < 1%).

Despite this low procedural risk profile, there continues to be a broad spectrum of risk based on individual patient characteristics

Factors Contributing to Prohibitive Risk for Mitral Valve Surgery

- High 30-day predicted operative mortality risk: **STS, Euroscore**
- **Cardiopulmonary comorbidities**: high risk of LIMA injury in reoperation, RV dysfunction with severe TR, severe pulmonary hypertension
- **Ascending aortic disease**: porcelain aorta, mobile atheroma
- **Hostile chest**: prior mediastinitis, postradiation mediastinum, ≥ 2 prior cardiac operations, aorta adherent to posterior sternal table
- Other comorbidities: severe **liver disease** or cirrhosis, major bleeding diathesis, high risk of aspiration, chemotherapy for malignancy, **severe renal dysfunction** creat $\geq 2,5$ mg/dL
- **Major organ system compromise**
- **Frailty**: cognitive impairment, slow gait or poor ambulation, needing assistance with activities of daily living



Surgical risk assessment



European Heart Journal (2007) 28, 1358–1365
doi:10.1093/eurheartj/ehm001

Clinical research
Valvular heart disease

What are the characteristics of patients with severe, symptomatic, mitral regurgitation who are denied surgery?

Mariana Mirabel¹, Bernard Lung^{1*}, Gabriel Baron², David Messika-Zeitoun¹, Delphine Détaint¹, Jean-Louis Vanoverschelde³, Eric G. Butchart⁴, Philippe Ravaud², and Alec Vahanian¹

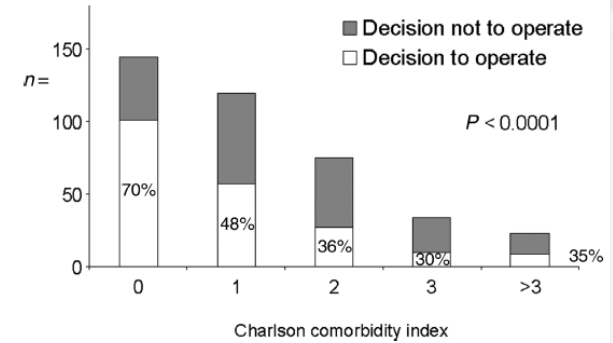
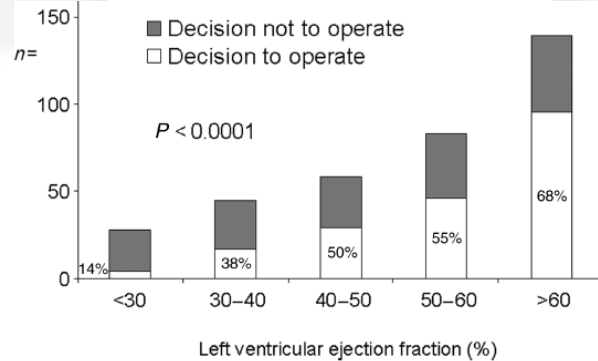
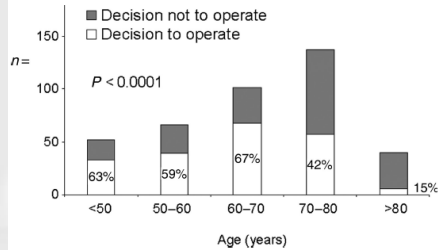

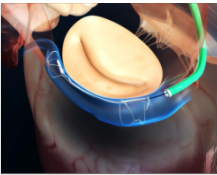

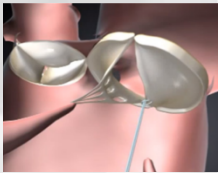
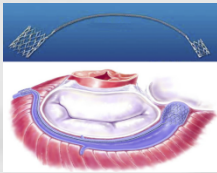

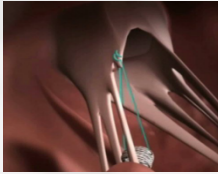
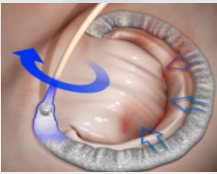


Table 3 Factors associated with a decision not to operate. Multivariable analysis

	<i>P</i>	Odds ratio	95% CI
LVEF (per 10% decrease)	0.0002	1.39	(1.17–1.66)
Aetiology	0.0006		
Ischaemic		1	
Non-ischaemic		4.44	(1.96–10.76)
Age (per 10-year increase)	0.001	1.40	(1.15–1.72)
Charlson comorbidity index (per 1 point increase)	0.004	1.38	(1.12–1.72)
Degree of MR	0.005		
Grade 4/4		1	
Grade 3/4		2.23	(1.28–3.29)

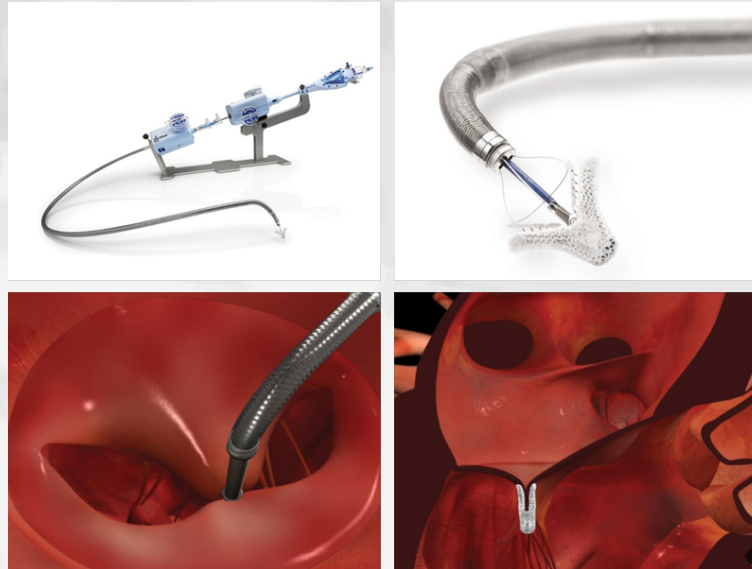
Hosmer-Lemeshow goodness-of-fit $\chi^2 = 9.84$ (df = 8), $P = 0.28$.

Percutaneous mitral valve repair

Leaflets procedure		Annuloplasty procedure		MV implantation	
Mitraclip system		Carillon		Tiara	
NeoChord		Monarc		CardiAQ	
Babic Device		Viacor		Lutter prosthesis	
V-Chordal		Cardioband		Endo valve-Herrmann	
MitraFlex		Ample PS3		CardioValve	
Percu-Pro		Myocor I-Coapsys			
Thermocool		Mardil BACE			
		Accucinch System			
		Mitralign			
		Mitral Cerclage			
		QuantumCor			
		ReCor			

Mitraclip system

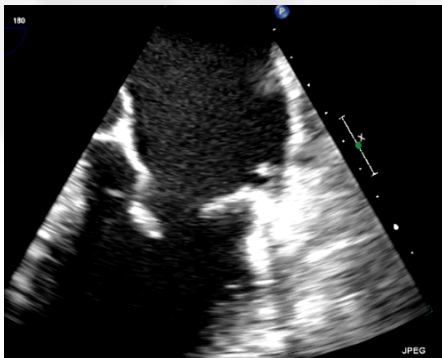
The MitraClip device is based on the surgical double orifice (Alfieri) approach that uses a clip rather than suture to secure the mitral leaflets and is performed on the beating heart to treat **functional** and **degenerative MR**.



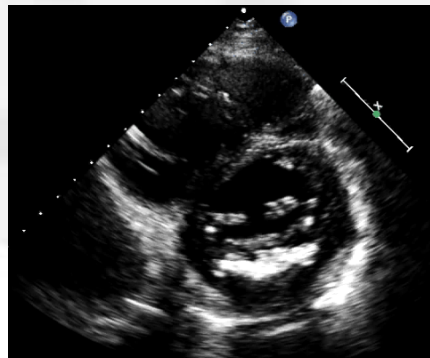
Selection of patients candidate for MitraClip implantation includes an accurate evaluation of mitral anatomy and of the mechanisms of insufficiency, to ensure both suitability and durability of the implant.

Mitraclip: anatomic key eligibility/key exclusion criteria

- severe mitral annular calcification
- prior mitral valve leaflet surgery
- evidence of intracardiac mass, thrombus or vegetation
- active infections requiring current antibiotic therapy
- presence of a permanent pacemaker or pacing leads that may interfere with placement of the MitraClip implant
- patients in whom transesophageal echocardiography is contraindicated.



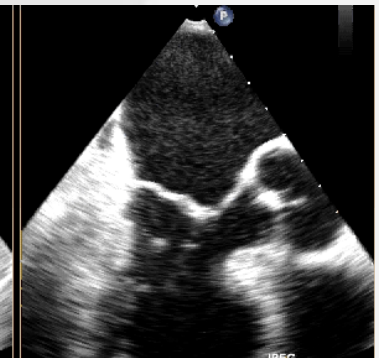
vegetation



annular calcification

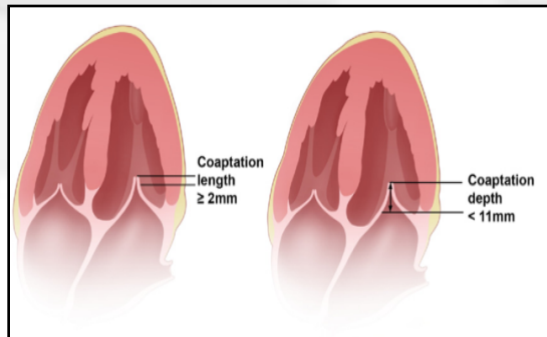
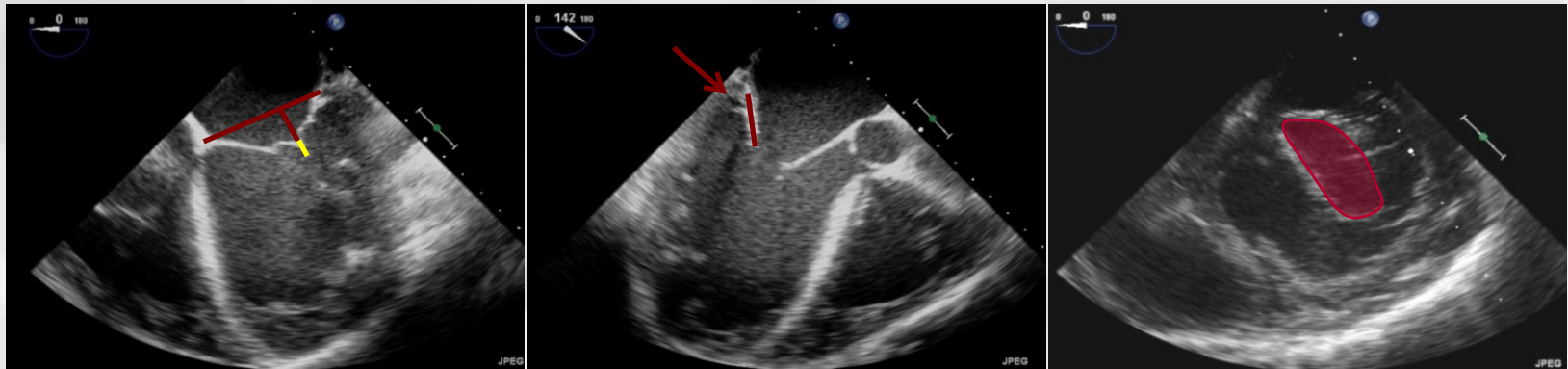


prior surgery



Mitraclip: anatomic key eligibility/key exclusion criteria

Functional MR



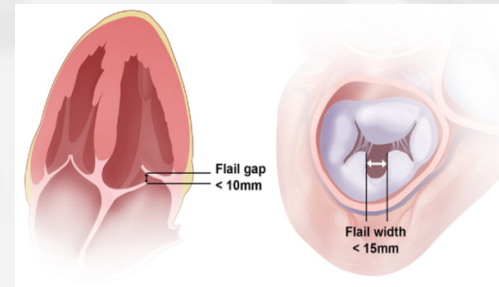
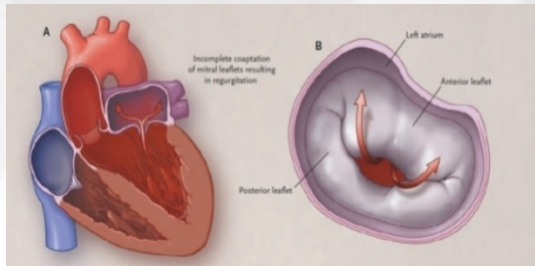
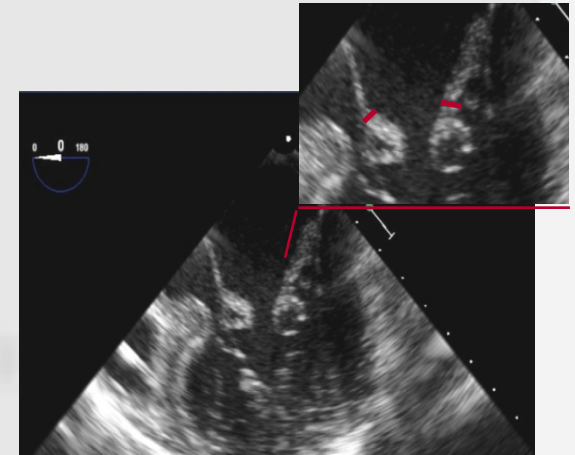
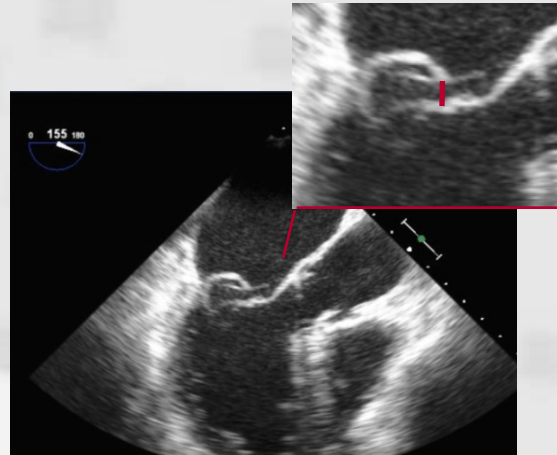
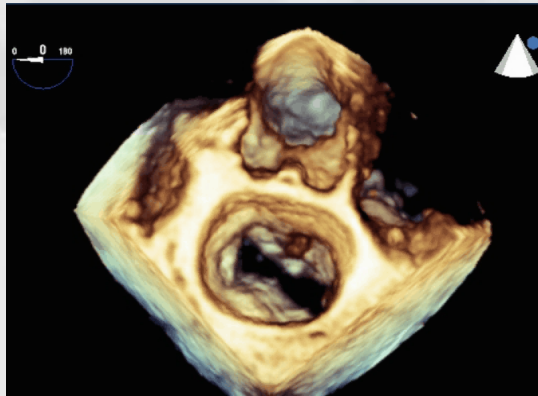
Feldman et al, JACC 2009
(EVEREST)

Leaflets length
(> 10 mm)

Area
(> 4 cmq)

Mitraclip: anatomic key eligibility/key exclusion criteria

Degenerative MR

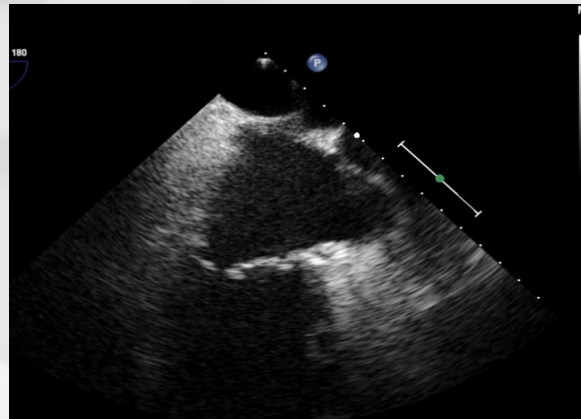
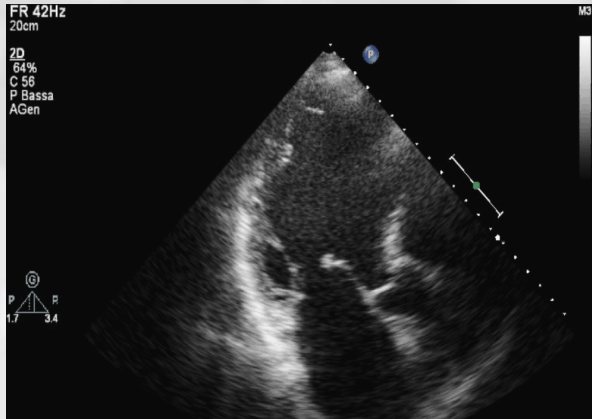


Primary regurgitant jet from the A2/P2 scallops

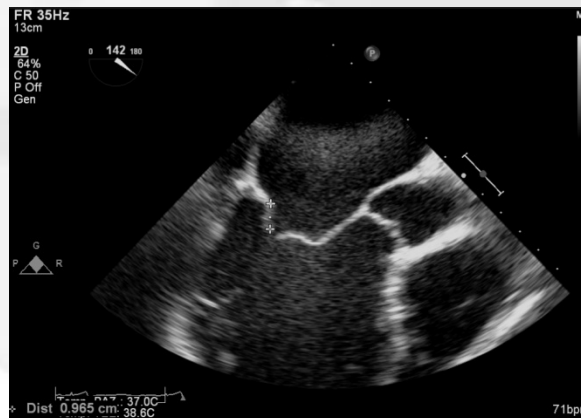
Flail gap < 10 mm
Flail width < 15 mm

Thickness (< 5 mm)

Mitraclip: exclusion criteria

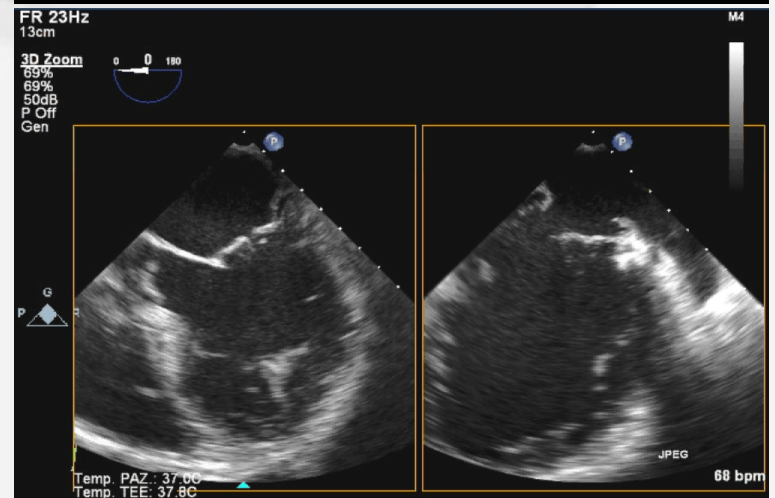
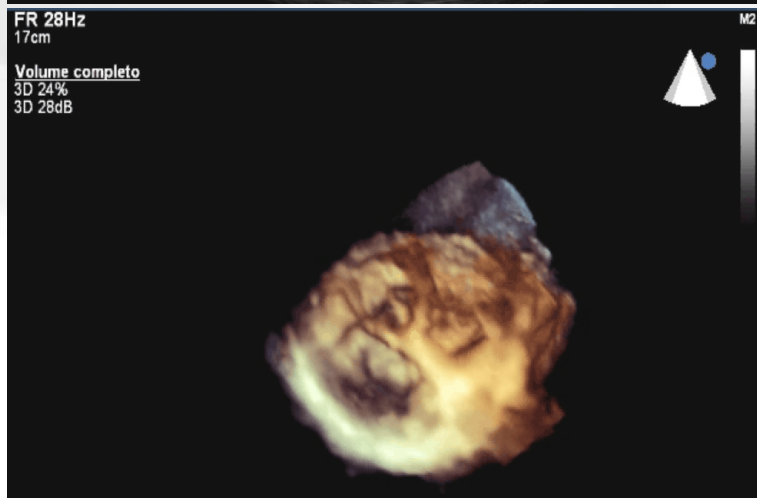
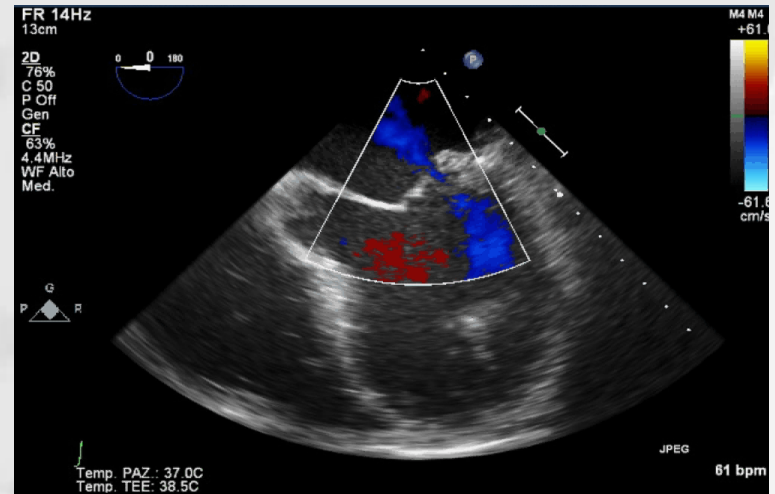
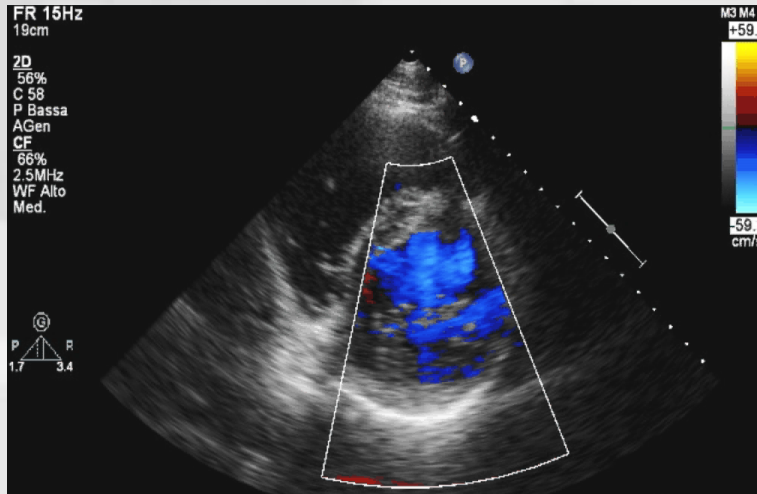


Insufficient coaptation length



Inadequate length of the posterior leaflet

Mitraclip: exclusion criteria



Mitraclip: echo screening

Patients selection for MitraClip: Time to move to transthoracic echocardiographic screening?

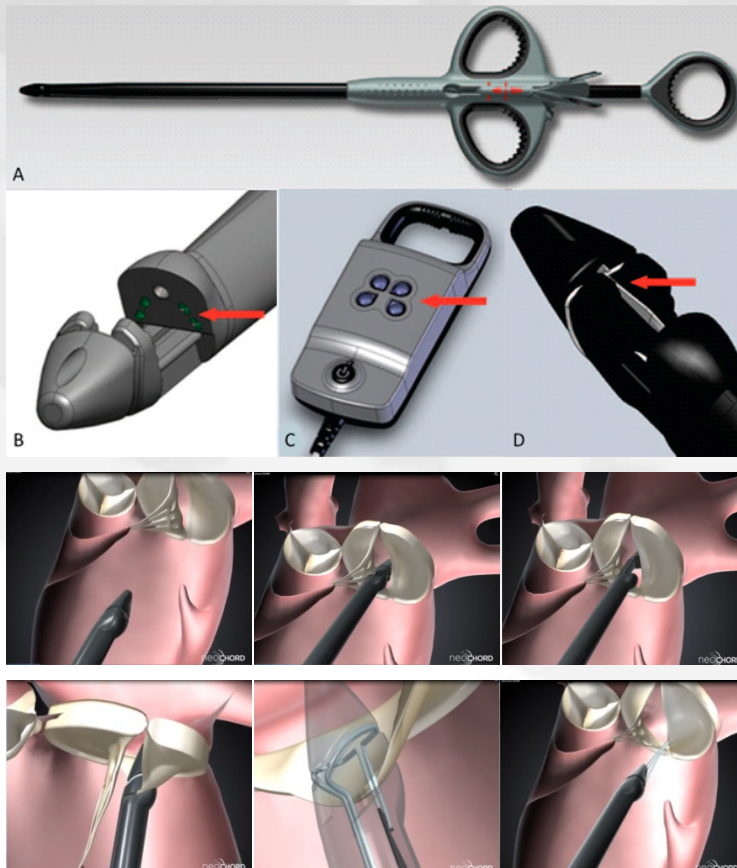
Paola Gripari ^{a,1}, Francesco Maffessanti ^{a,*1}, Gloria Tamborini ^a, Manuela Muratori ^a, Laura Fusini Sarah Ghulam Ali ^a, Cristina Ferrari ^a, Francesco Alamanni ^{a,b}, Antonio L. Bartorelli ^{a,b}, Cesare Fiorentini ^{a,b}, Mauro Pepi ^a

	TTE vs TEE p-value
Quantitative parameters	
Valvular area 2D (cm ²)	<0.01
Valvular area 3D (cm ²)	0.17
Coaptation	
Length (mm)	0.32
Depth (mm)	0.26
Flail gap (mm)	0.45
Leaflet length	
Anterior (mm)	0.14
Posterior (mm)	0.81
Leaflet thickness	
Anterior (mm)	<0.01
Posterior (mm)	<0.01
Jet width (mm)	0.69
Qualitative parameters	
Calcification, grasping zone	1.00
Calcification, subvalvular apparatus	1.00
Myxomatous leaflet thickening	1.00
Nodulation	1.00
Cleft	1.00
Poor leaflet mobility	1.00
Chordal rupture	0.72
Commissural jet	0.78

- **excellent agreement** between TTE and TEE in the assessment of quantitative and qualitative morphological aspects involved in patients eligibility for MitraClip procedure
- **the same thresholds** and criteria adopted for patient selection based on TEE could be used interchangeably for TTE except for leaflet thickness
- **the accuracy of a TTE-based patient selection** for Mitraclip compared to a TEE-screening protocol is **high**.

NeoChord DS 1000

The NeoChord DS1000 is a disposable device that is intended to replace damaged chordae in **degenerative MR** by delivering artificial chordae tendinae or "neochords" in a beating heart using a transapical approach.

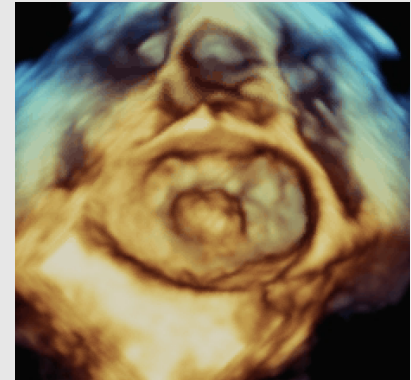


- CE marked
- 3D TEE as intraoperative guidance
- Postero-lateral LV entry site.
- Multiple chordal implantation (3 min, recommended 4)
- **Prognostic classification** based on preoperative **mitral valve anatomy**

NeoChord: patient anatomical stratification

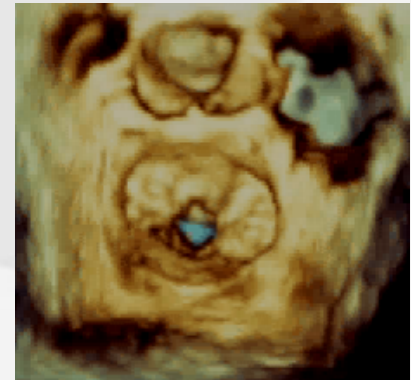
- **Type A “Ideal” Patient**

- Central P2 prolapse
- >8mm predicted coaptation length with repair



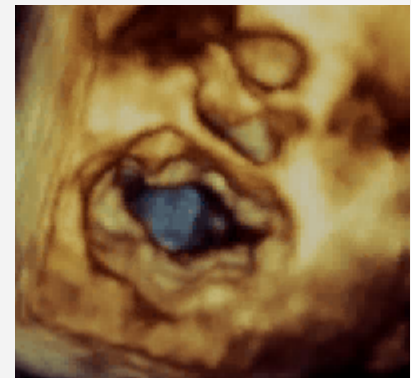
- **Type B “Adequate” Patient**

- Less than 8 mm coaptation length
- Prolapse extending to portions of P1 or P3



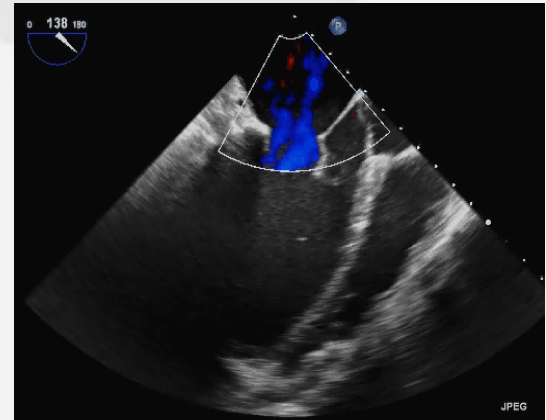
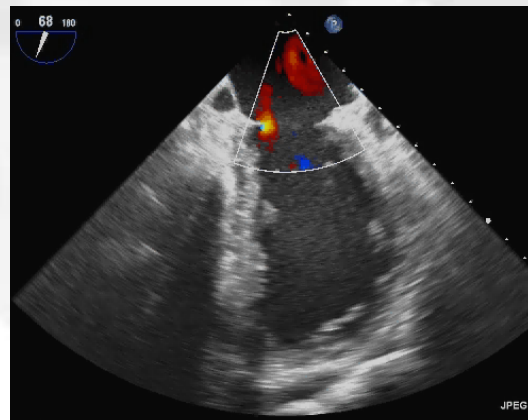
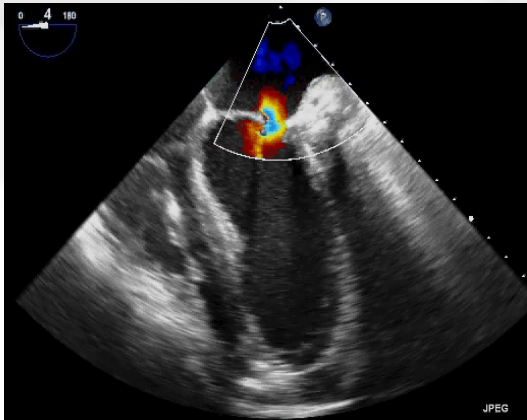
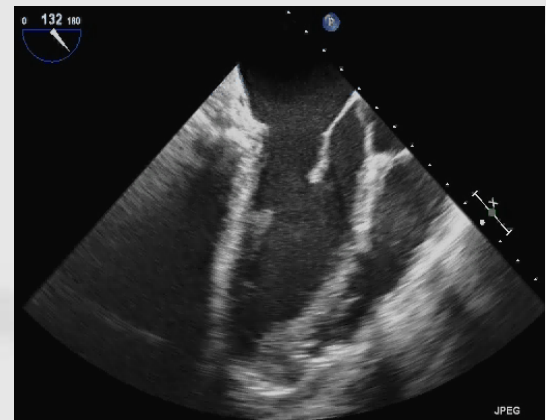
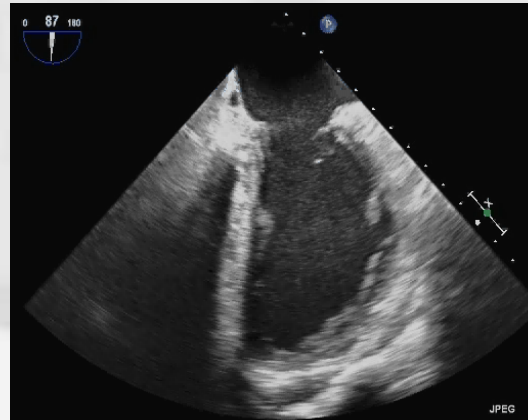
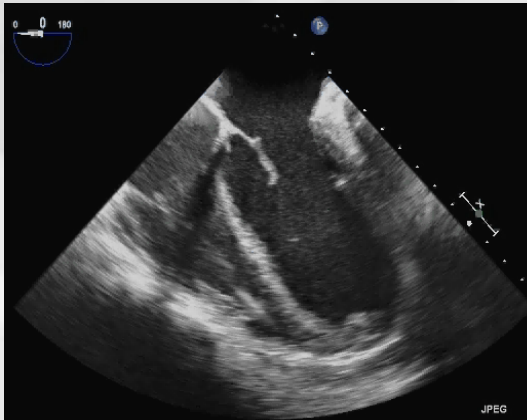
- **Type C “Challenging” Patient**

- Prolapse involving commissures or anterior leaflet
- LV dilatation with tethering of leaflets
- Central regurgitant jet component
- Calcified leaflet segments



NeoChord: a challenging patient

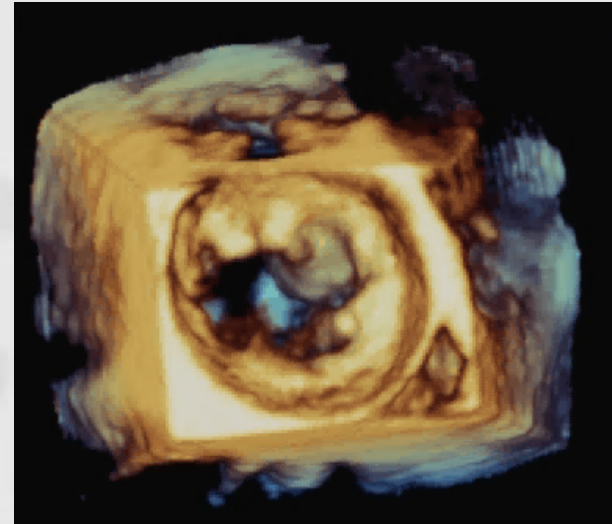
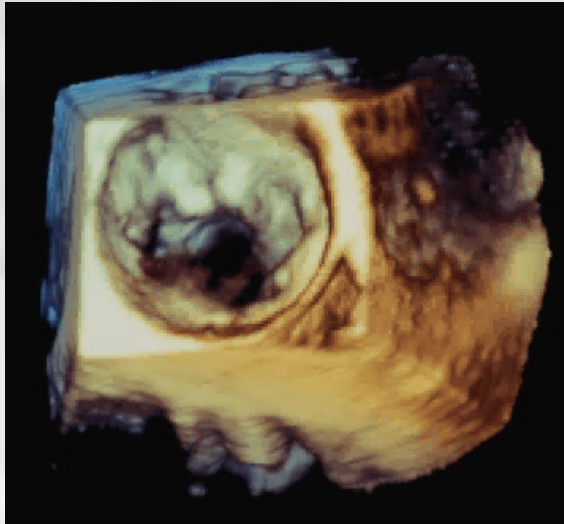
2D TEE



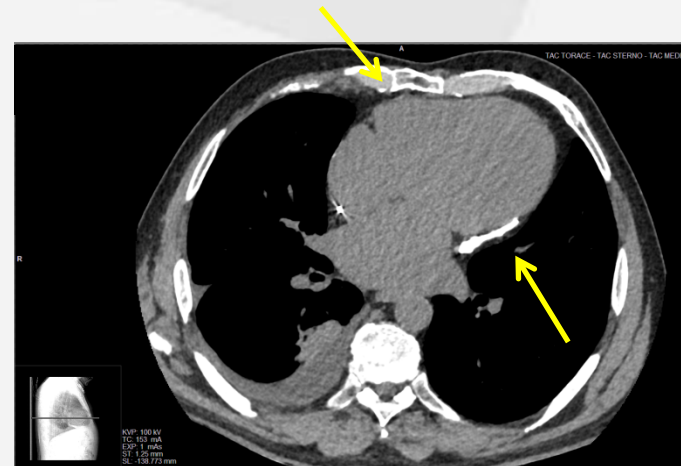
2D TEE colorDoppler



NeoChord: patient anatomical stratification



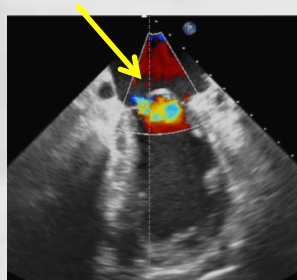
- Etiology? Primary MR
- Surgical indication? NYHA class II, new onset of AF, \uparrow sPAP
- Surgical risk assessment:
60 yrs
1983 pericardiectomy
Hostile chest
- Anatomical criteria?



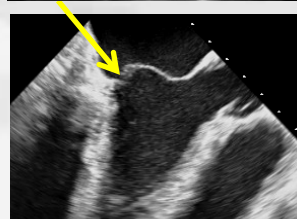
NeoChord: a challenging patient

Mitraclip?

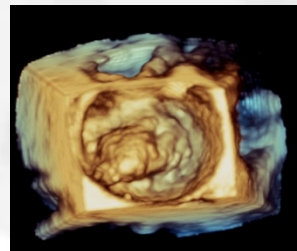
Central jet



Leaflet thickness 4 mm
Flail gap 4 mm



Flail width 17 mm

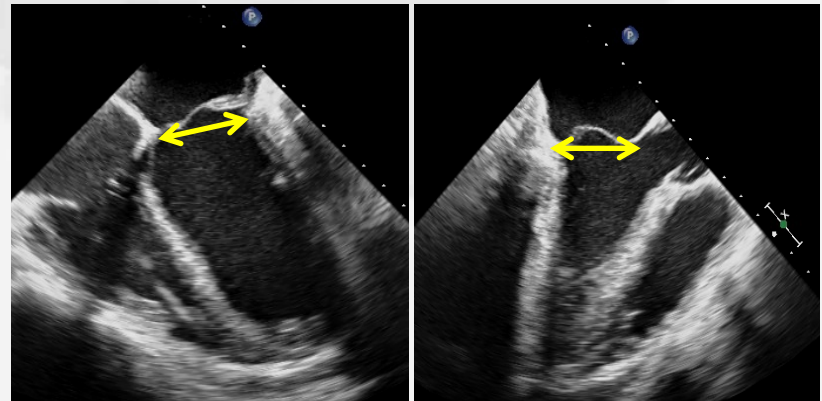


Annular calcification
Small posterior leaflet 5 mm

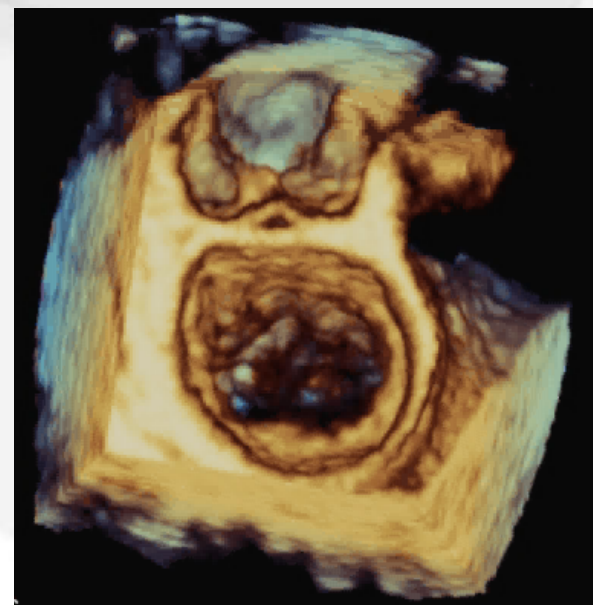
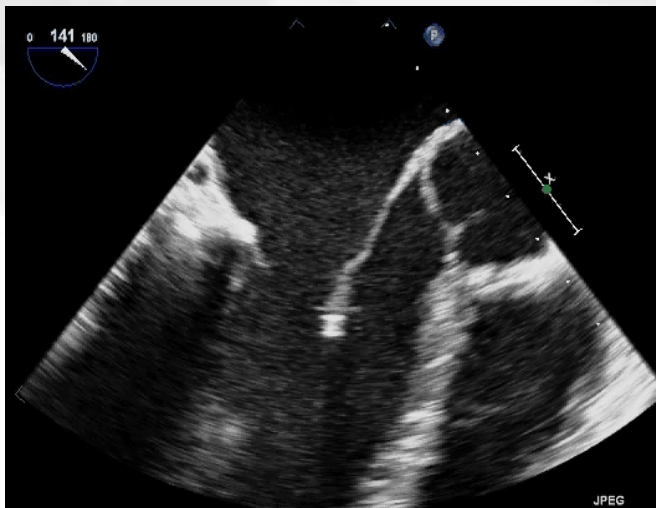
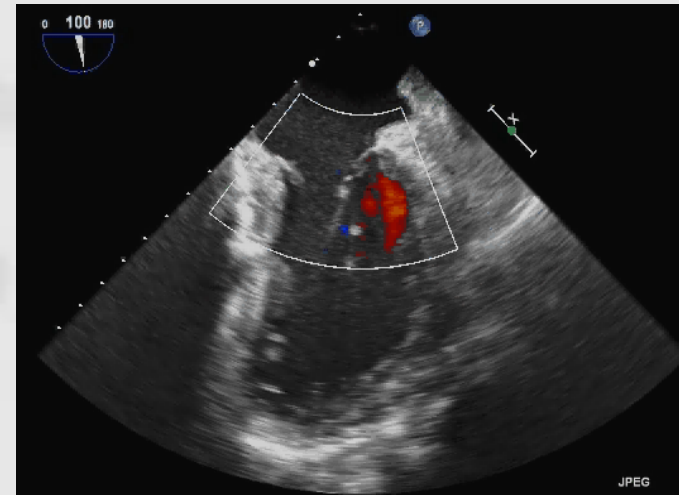
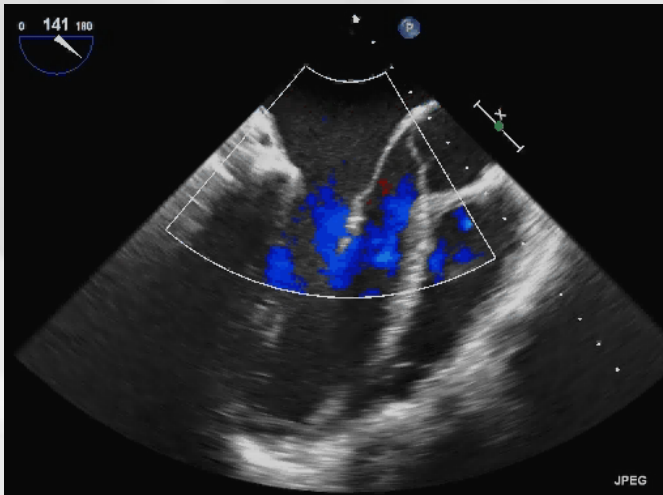
NeoChord?

“Challenging” patient: prolapse involving the anterior leaflet

no annular dilation



NeoChord: a challenging patient



Conclusions

Mitral valve surgery improves morbidity and mortality in patients with chronic MR.

Half of the patients are at elevated surgical risk.

Transcatheter/minimally invasive MV repair offers an alternative treatment option for many of these patients

Detailed clinical and anatomical assessment is mandatory to ensure delivery of the appropriate therapy at the appropriate time point to these patients

On the top of standard anatomic evaluation, device-specific criteria based on echo need to be fulfilled in case of transcatheter approach

A **multidisciplinary team approach** is optimal for the evaluation of these patients and provides multifaceted expertise for a successful mitral valve program



Centro Cardiologico
Monzino



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Insufficienza mitralica. Come scegliere il candidato ideale alla
riparazione dell'apparato valvolare mitralico

*Quali sono i criteri che possono indirizzare verso diverse strategie
di correzione*

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