

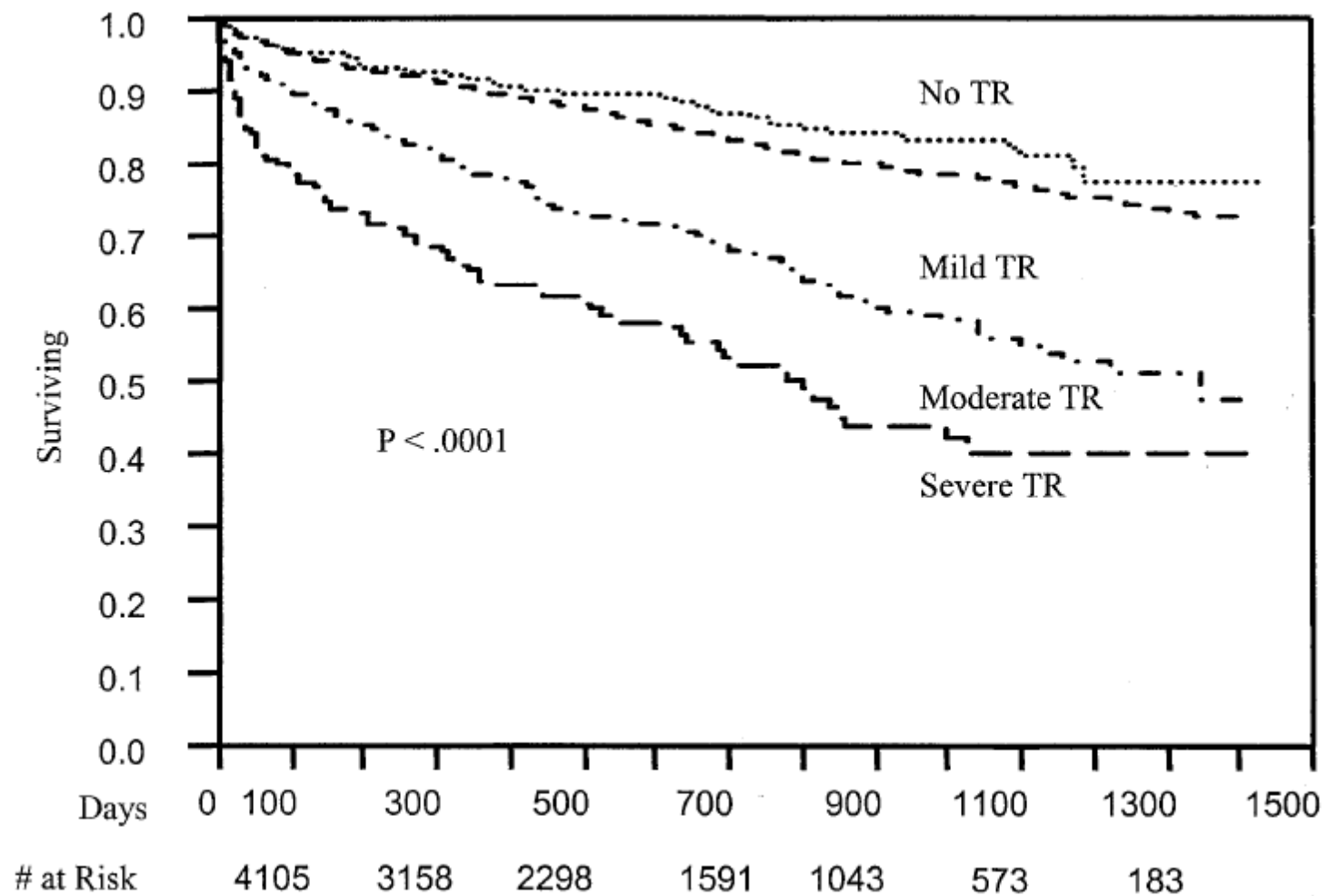
Late secondary TR after left sided heart disease correction: is it predictable and preventable

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PREDICT

Incidence of secondary TR after MV surgery

- up to 50% of mitral valve (MV) surgery patients develop tricuspid regurgitation (TR) to various degrees.
- impacts secondary TR mortality : 1-year survival
- **Absent TR, 91 %**
- **Mild TR, 90 %**
- **Moderate TR 70%**
- **Severe TR 60%**

The Mayo Clinic Data

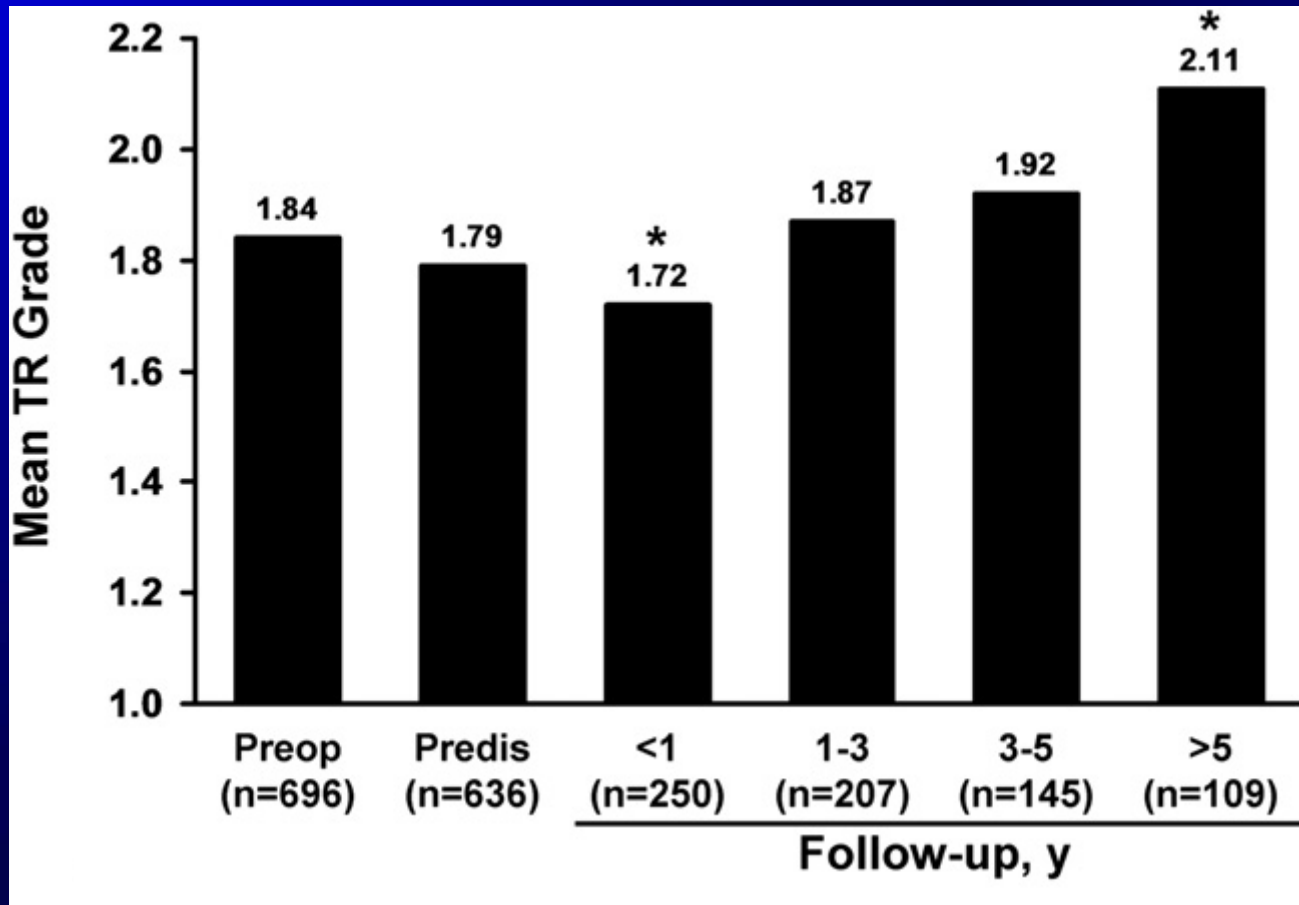
Conclusion at 5 years relies upon **109 pts ONLY** (out of initial cohort of 696)

TR is separated into 1+ / 2+ vs 3+ / 4+ (n= 109)

Preop 1+ / 2+ : n = 93
 3+ / 4+ : n = 15 (13 %)

Postop 1+ / 2+ : n = 77
 3+ / 4+ : n = 32 (29,4 %)



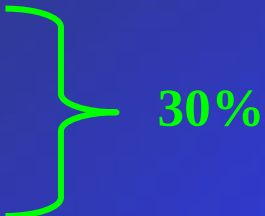


N=699. MV repair without TV intervention

Secondary tricuspid dilatation with or without regurgitation

Postoperative tricuspid regurgitation

TR grade	M.V.R.		M.V.R.+T.V.R.	
	pre	post	pre	post
0	54	8	38	102
1	102	33	92	41
2	7	67	16	4
3	0	40	2	1
4	0	15	0	0

 30%

TRICUSPID VALVE REPAIR DURING MV SURGERY: Why?

TR grade	Baseline	5 years	p
0	54	8	
1	102	33	
2	7	67	
3	0	40	
4	0	15	
Mean	0.7 ± 0.5	2.1 ± 1.0	< 0.001

163 patients undergoing mitral valve repair.
Significant late TR developed in 34% of patients.

TRICUSPID VALVE REPAIR DURING MV SURGERY: When?

AHA/ACC 2006 Guidelines for TR management

European Society of Cardiology. 2007

Class I

Tricuspid valve repair is beneficial for severe TR in patients with MV disease requiring MV surgery. *(Level of Evidence: B)*

Class IIa

1. Tricuspid valve replacement or annuloplasty is reasonable for severe primary TR when symptomatic. *(Level of Evidence: C)*
2. Tricuspid valve replacement is reasonable for severe TR secondary to diseased/abnormal tricuspid valve leaflets not amenable to annuloplasty or repair. *(Level of Evidence: C)*

Class IIb

Tricuspid annuloplasty may be considered for less than severe TR in patients undergoing MV surgery when there is pulmonary hypertension or tricuspid annular dilatation. *(Level of Evidence: C)*

Class III

1. Tricuspid valve replacement or annuloplasty is not indicated in asymptomatic patients with TR whose pulmonary artery systolic pressure is less than 60 mm Hg in the presence of a normal MV. *(Level of Evidence: C)*
2. Tricuspid valve replacement or annuloplasty is not indicated in patients with mild primary TR. *(Level of Evidence: C)*

Indications for intervention in functional TR Class

Severe TR in a patient undergoing left-sided valve surgery I C

Moderate secondary TR with dilated annulus (>40mm) in a patient undergoing left-sided valve surgery

IIa C

TR ASSESSMENT BEFORE SURGERY

Pre-operative T.R. assessment is NOT reliable

TR severity is dependent on physiological conditions which cannot be controlled / quantified

- preload
- afterload
- RV function

Changes in preload, afterload can unmask previously undiagnosed significant TR.



TR - STANDARD ASSESSMENT

- **Echocardiography Assessment**
 - No TR - mild TR
 - mild TR – moderate TR
 - severe TR

TR ASSESSMENT BEFORE SURGERY

**Annular dilatation is more relevant than
regurgitation grading**

Tricuspid annular diameter > 3.4 cm
seems a better marker than TR grading to
predict secondary significant TR

Proposal for a « New Assessment »

TR GRADING

LEAFLET COAPTATION MODE

ANNULAR DILATATION

No TR / Mild TR

At annular plane

Below 35/ 40
mm

Mild TR /
Moderate TR

Below annular
plane

Above 35/40
mm

Severe TR

Surface vs edge to
edge



FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION

• Stage 1

No TR/ mild TR

No TAD dilation

Normal leaflet
coaptation

• Stage 2

Mild / Moderate TR

TAD dilation

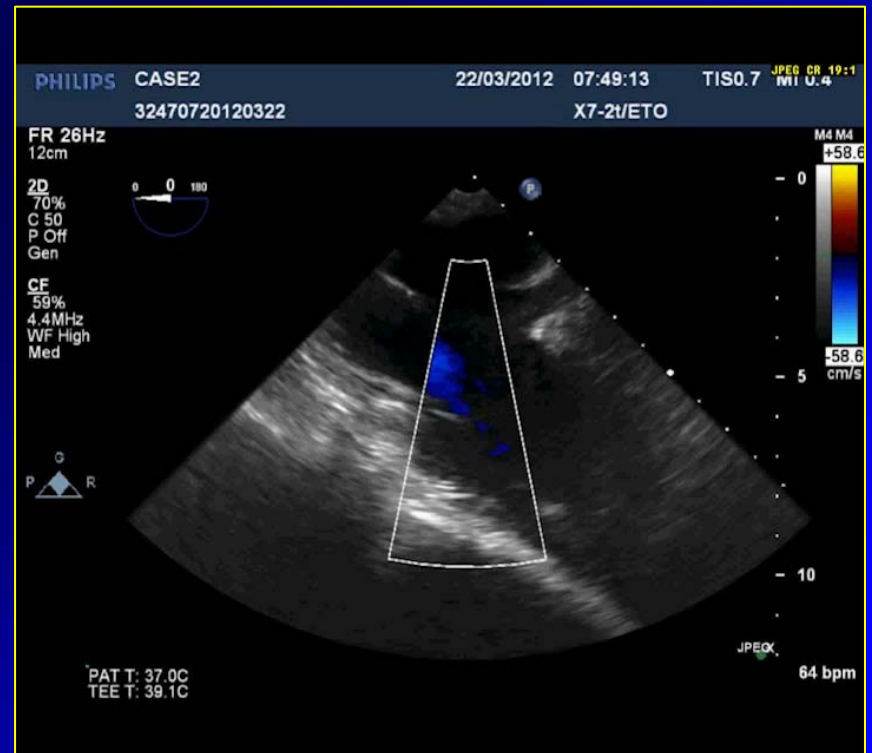
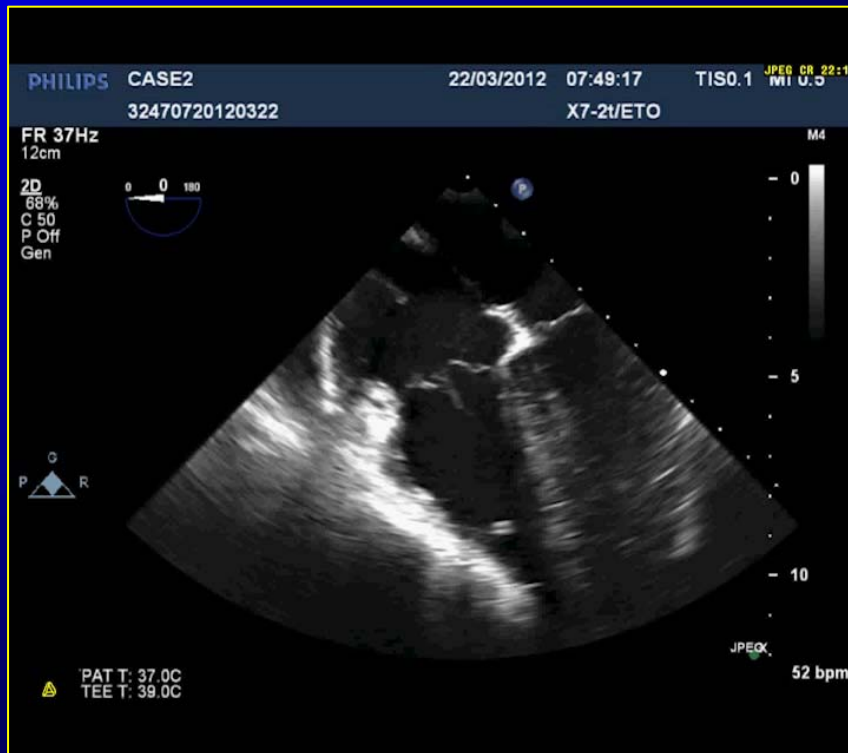
Little coaptation/
No effective
coaptation

• Stage 3

Severe TR

Lack of coaptation
with or without
leaflet tethering
(tethering height
>8 mm)

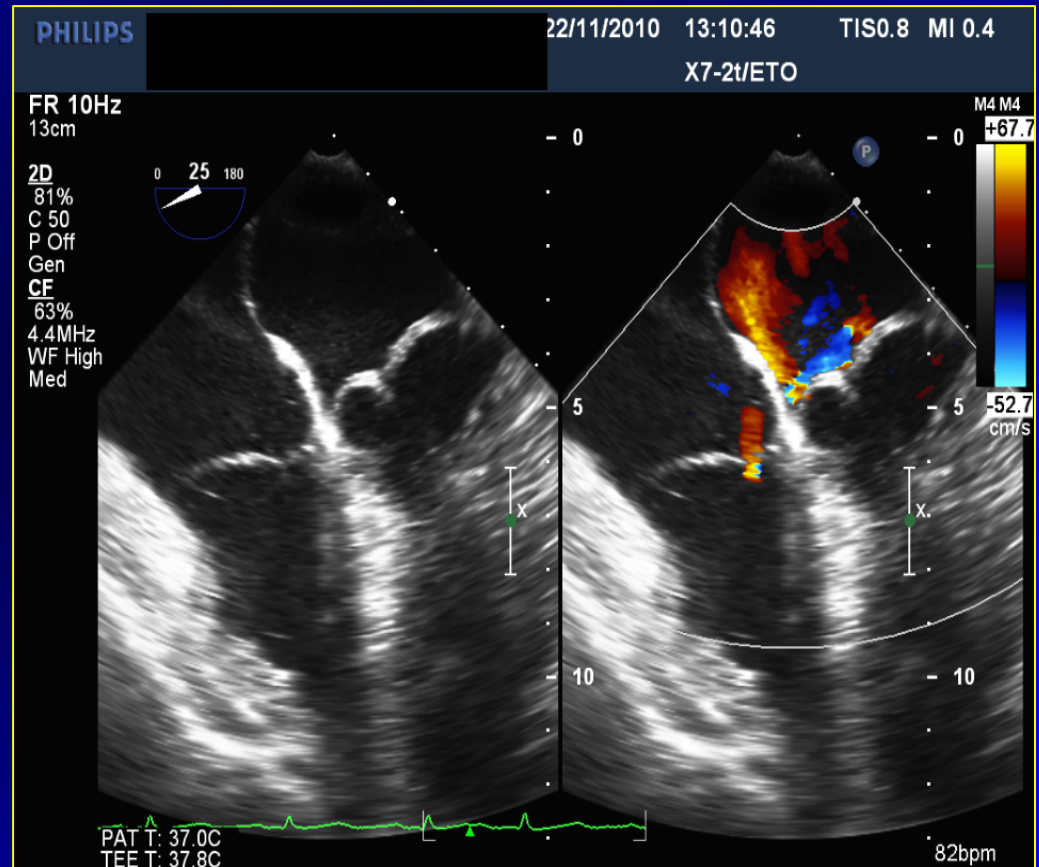
FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION



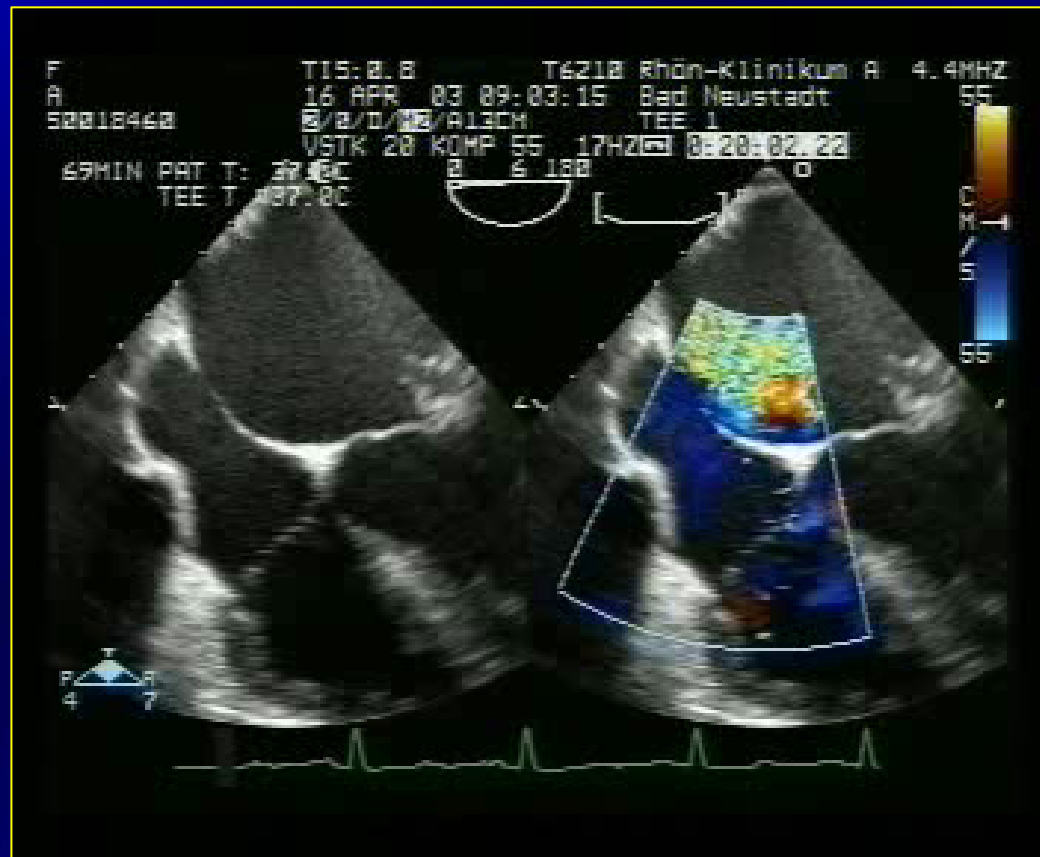
STAGE 1

FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION

- Stage 2
 - Mild TR/
Moderate TR
 - TAD dilation
 - Little
coaptation/No
effective
coaptation

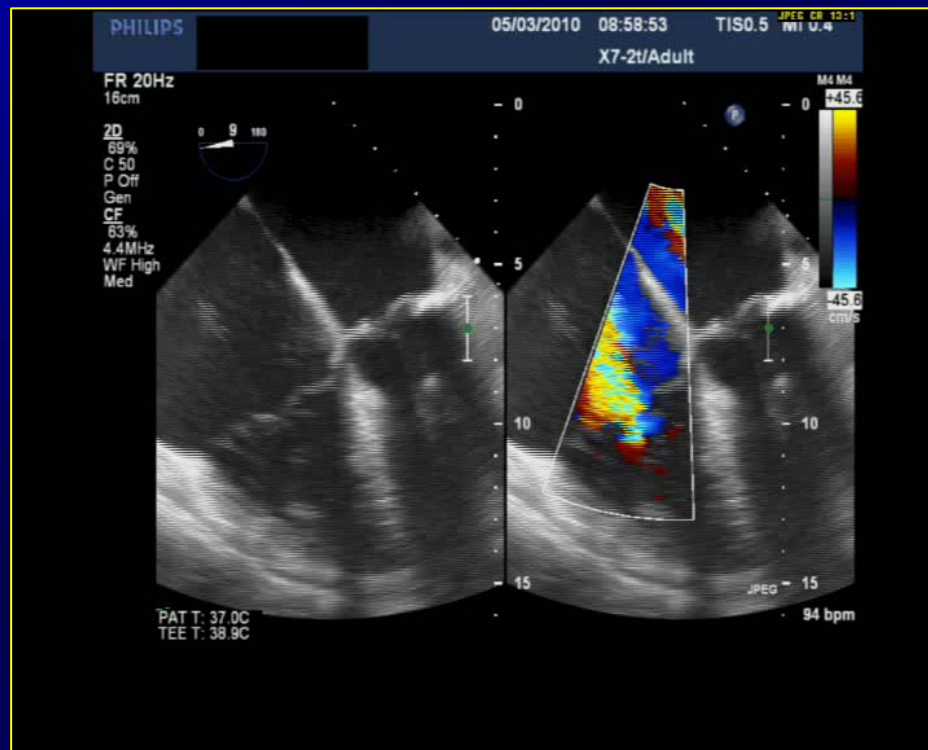


FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION



STAGE 2

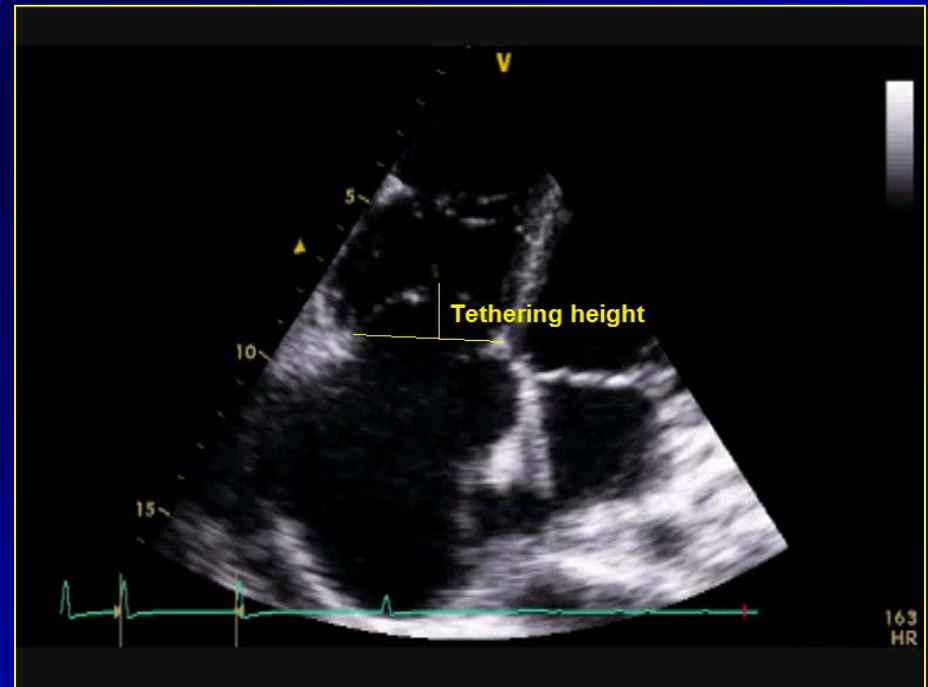
FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION



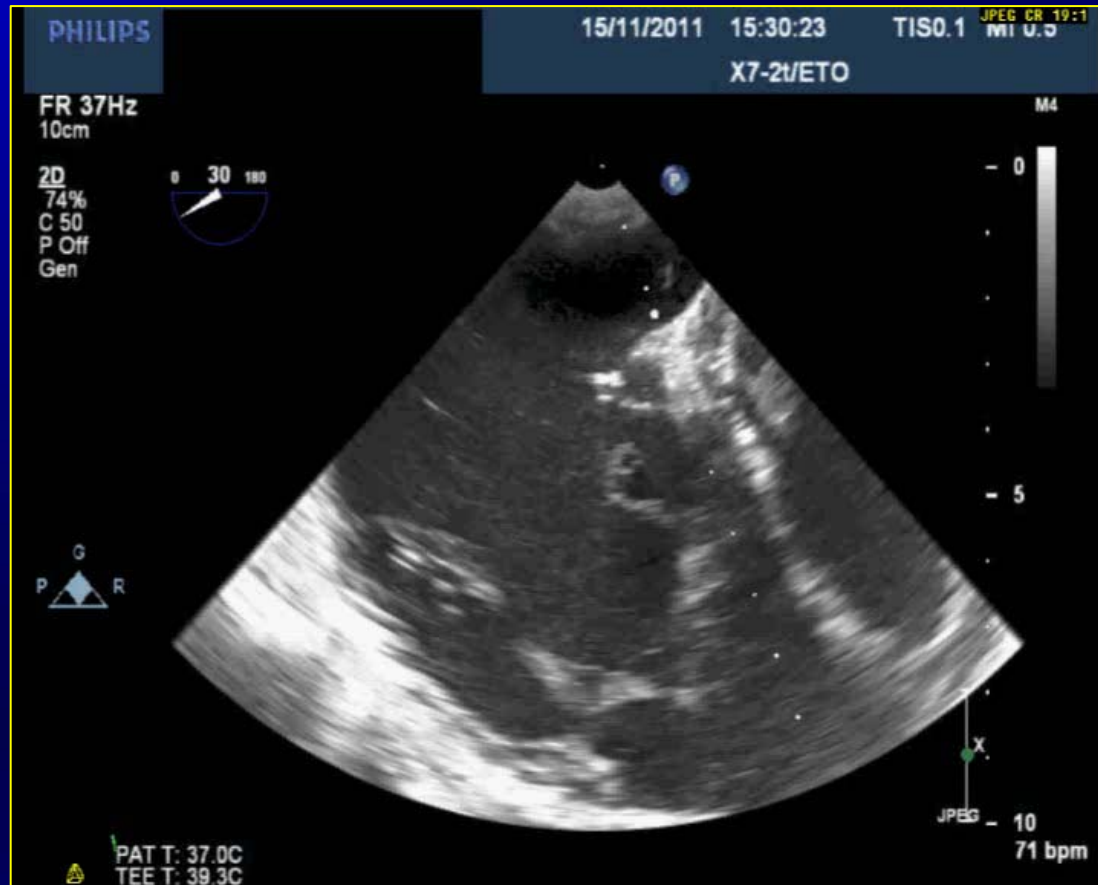
STAGE 2

FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION

- Stage 3
 - Severe TR
 - Lack of coaptation
 - WITH or WITHOUT LEAFLET TETHERING (tethering height >8 mm)



FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION



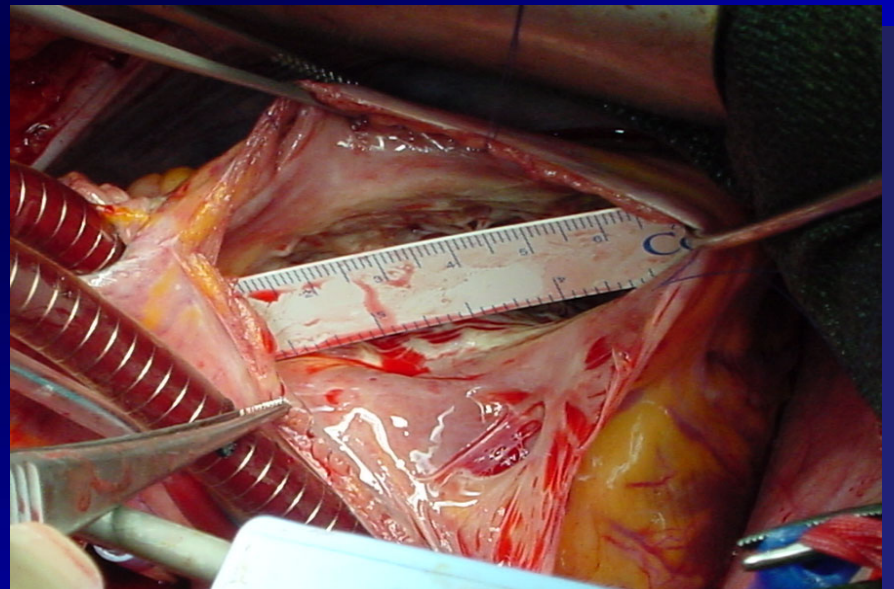
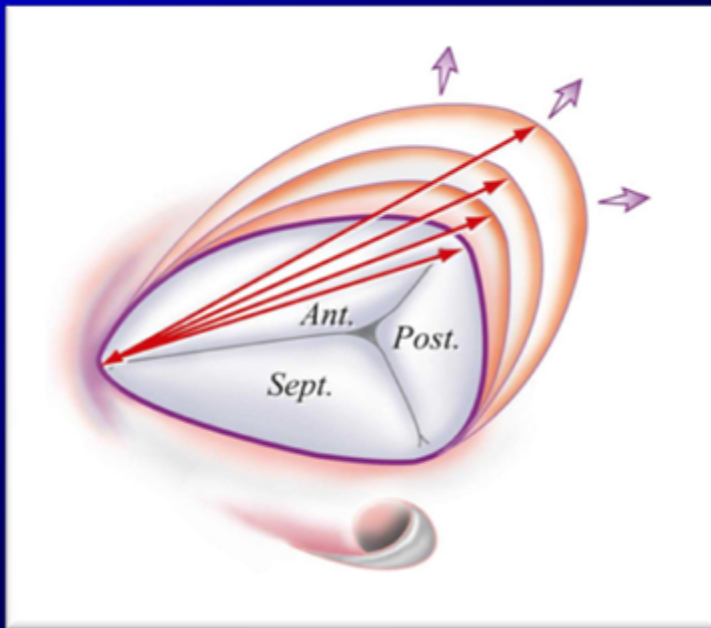
Stage 3

PREDICT

**What the guidelines
ignore ?**

What the guidelines ignore ?

1. TRICUSPID ANNULAR DILATATION



Normal tricuspid annular diameter: 35 mm.

Dilated > 70 mm in 48% of patients undergoing mitral valve surgery.

What the guidelines ignore ?

2. ABNORMAL COAPTATION MODE

- EDGE TO EDGE COAPTATION

- NO COAPTATION

- SEVERE TETHERING

What the guidelines ignore ?

3. Less than moderate TR in patients undergoing MV surgery

Others determinants of late TR

Longer time from onset of MV disease to surgery *Wang*

Larger LA *Song et al.*

Atrial fibrillation *Kim et al*

Dysfunction of mitral prosthesis *Shiran and Sagie*

Right chambers dilatation *De Bonis*



PREVENT

FUNCTIONAL AND ANATOMICAL TR CLASSIFICATION

• Stage 1

No TR/ mild TR

No TAD dilation

Normal leaflet
coaptation

• Stage 2

Mild / Moderate TR

TAD dilation

Little coaptation/
No effective
coaptation

• Stage 3

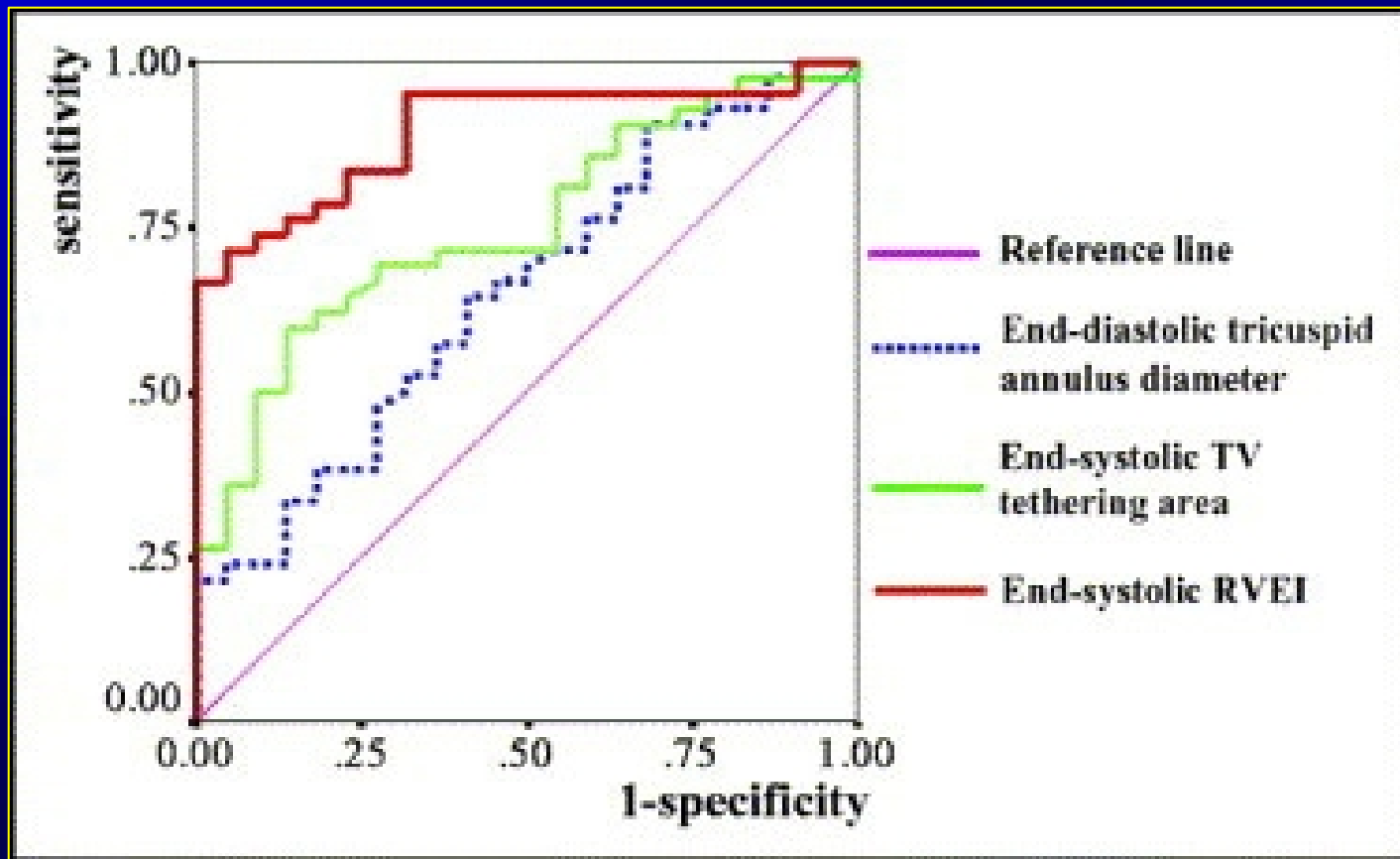
Severe TR

Lack of coaptation
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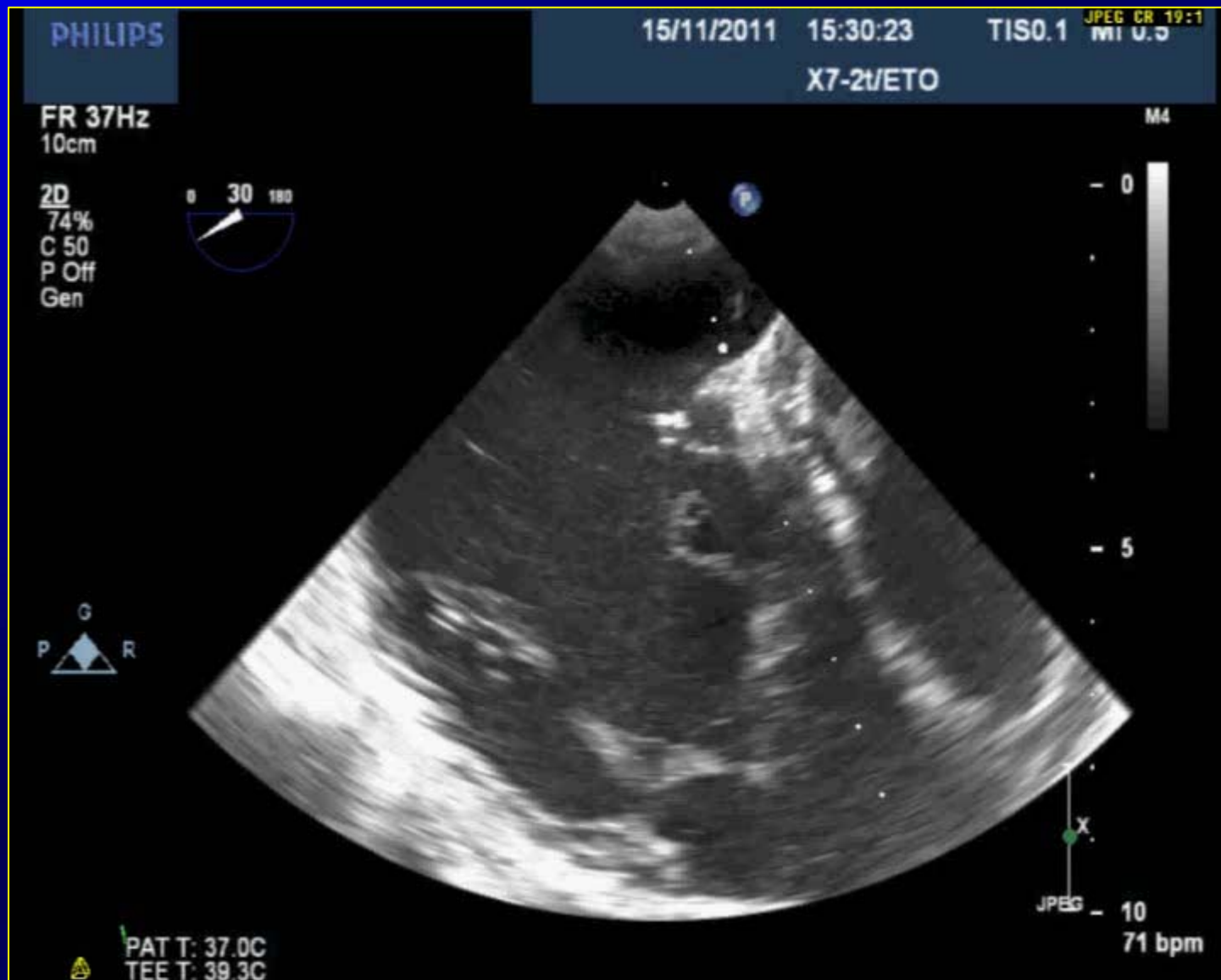
TRICUSPID VALVE REPAIR DURING MV SURGERY: HOW?

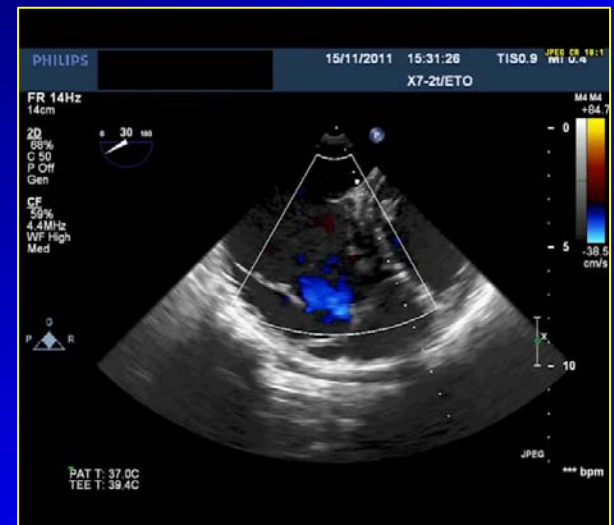
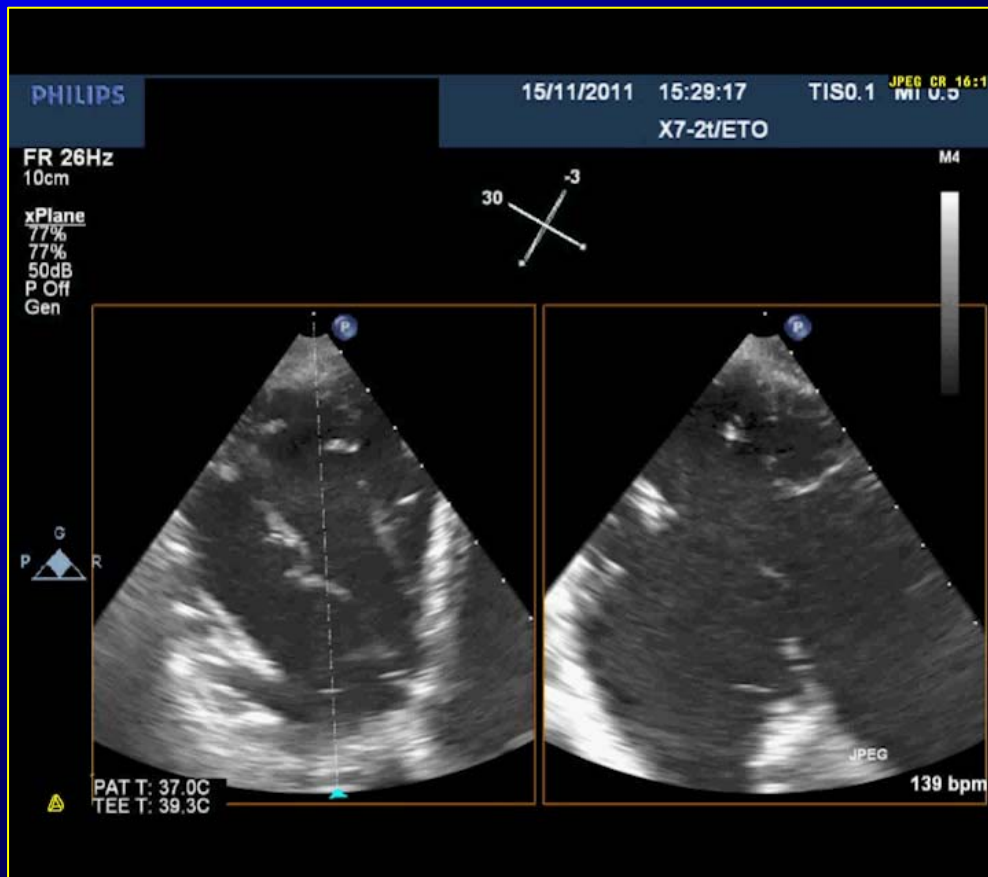
- Stage 1 – **No annuloplasty**
- Stage 2- **annuloplasty alone** when TAD > 70 mm in operative room (Echo based /Surgical checking)
- Stage 3 -**annuloplasty alone** (without tethering)
-**complex REPAIR** – (with tethering)
achieve TV coaptation

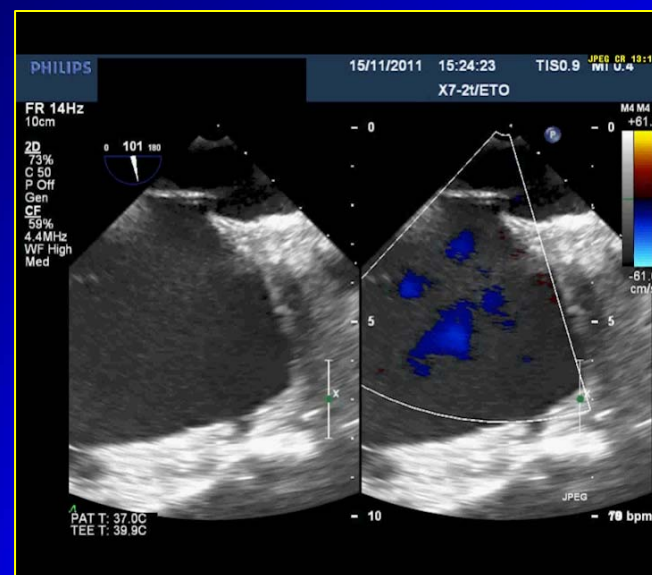
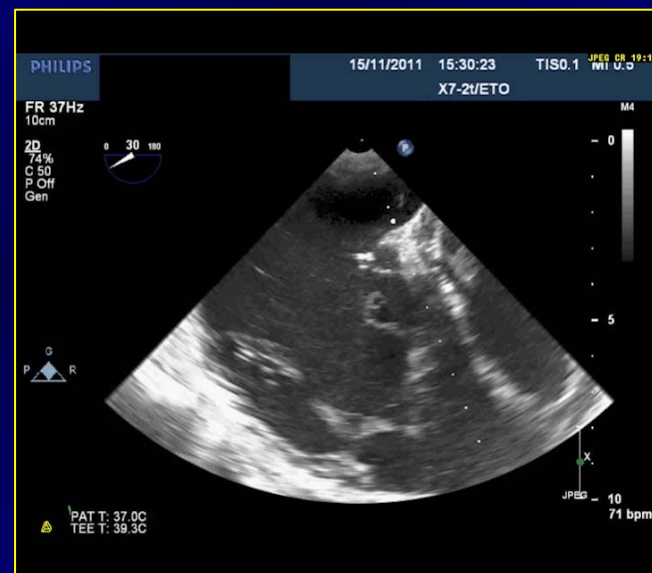
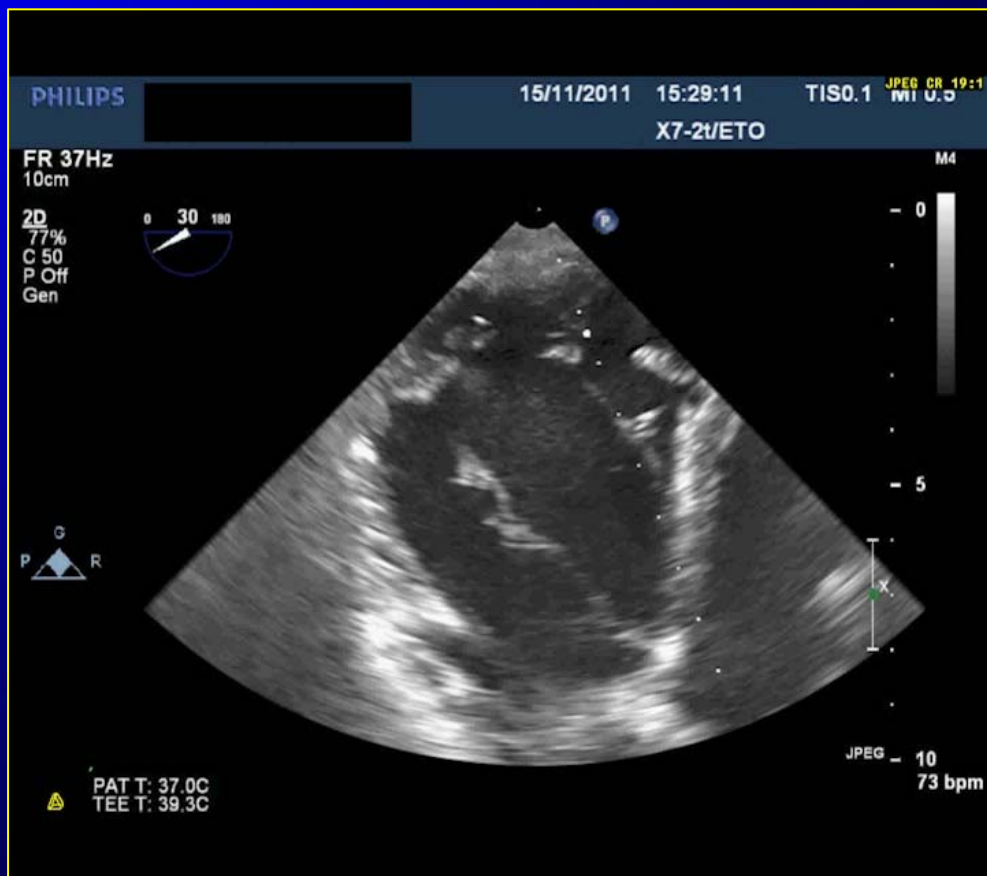
BEST VALUES OF PREDICTORS OF FUNCTIONAL TR

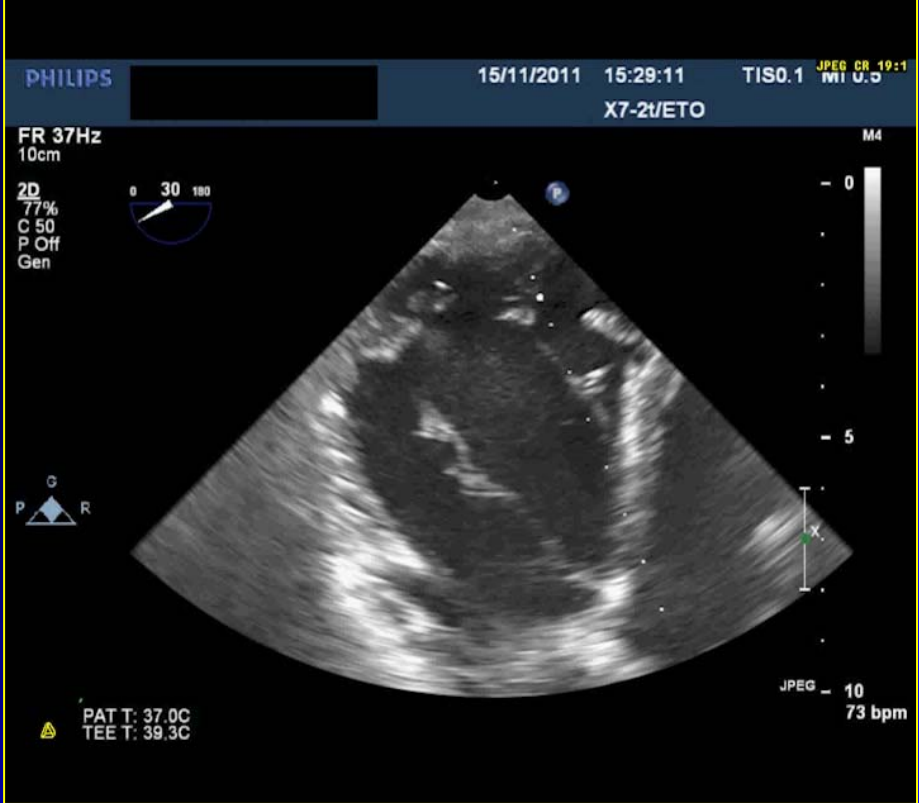
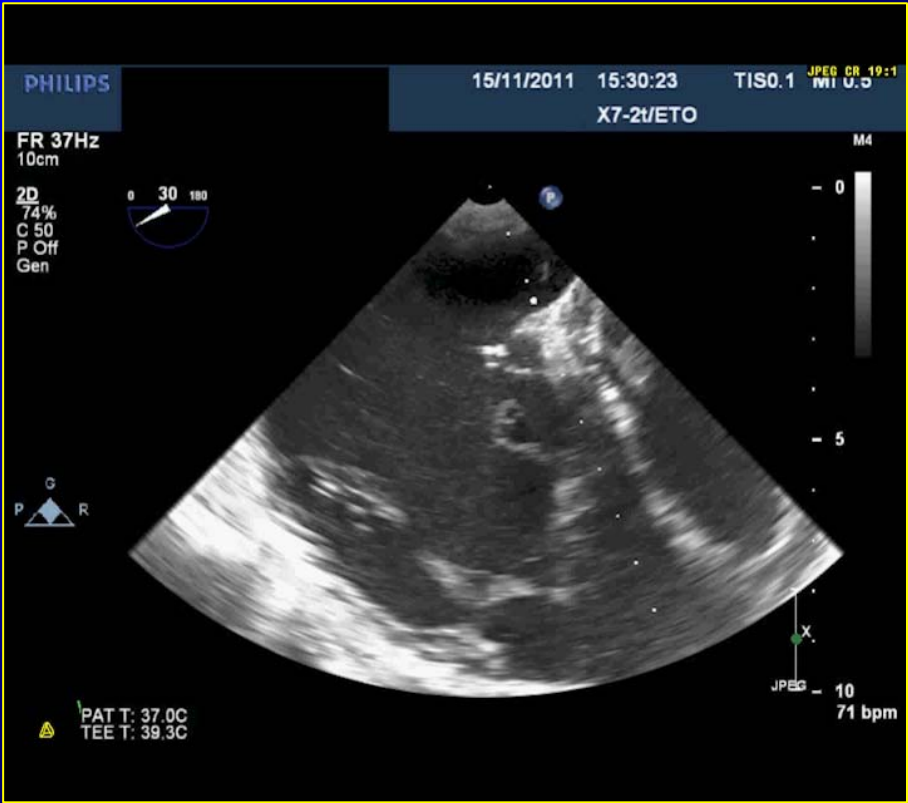


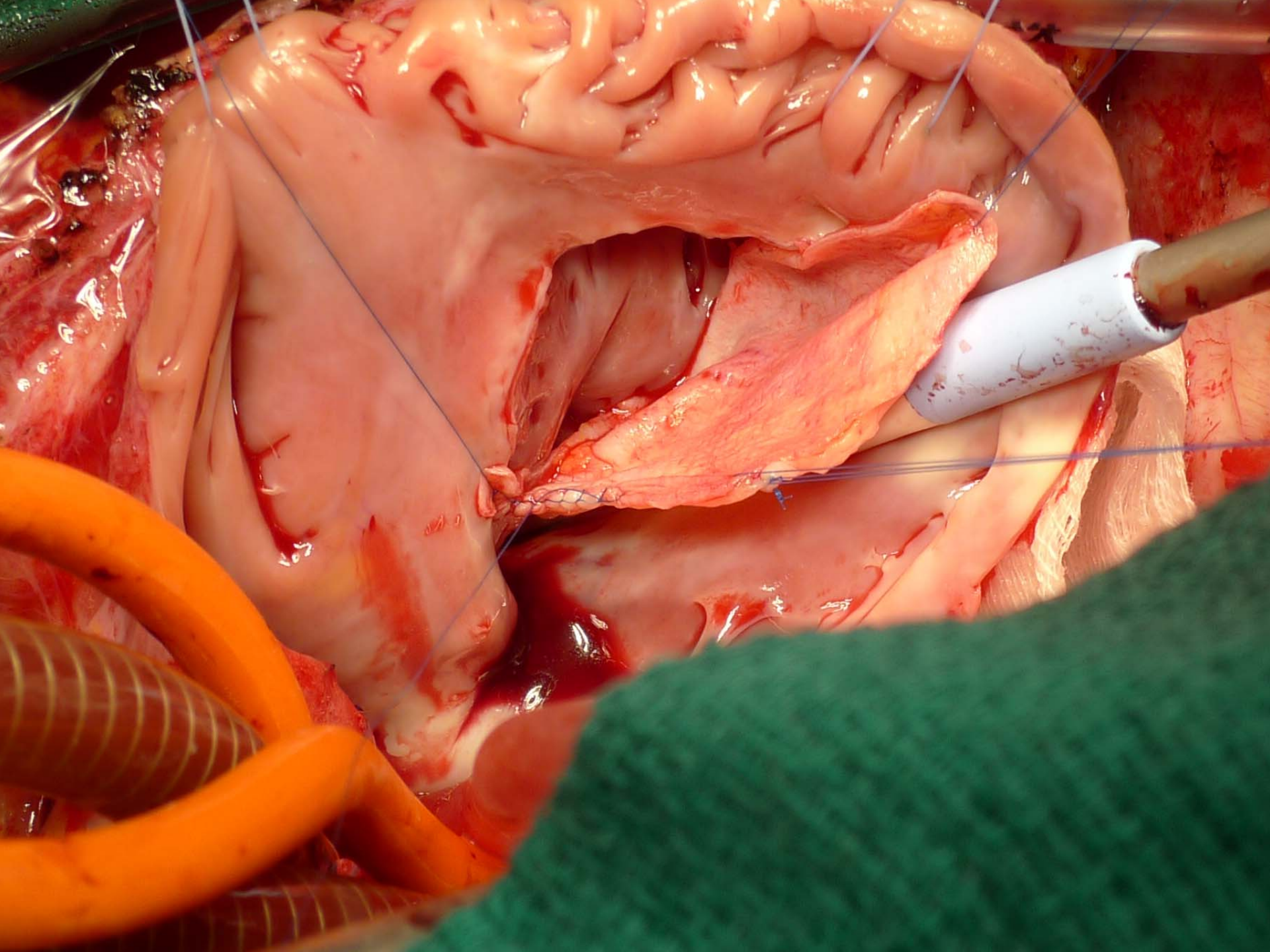
Tethering & Annular Dilatation

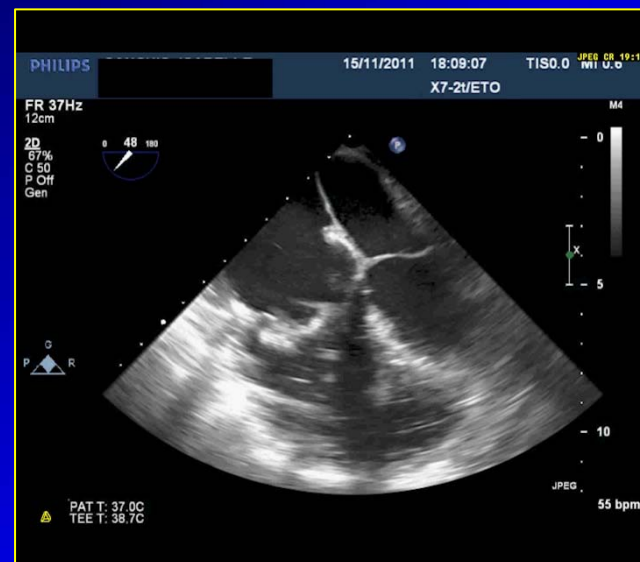
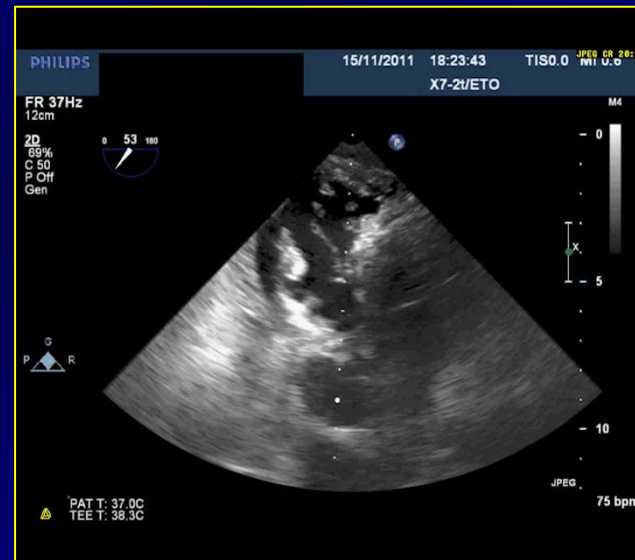
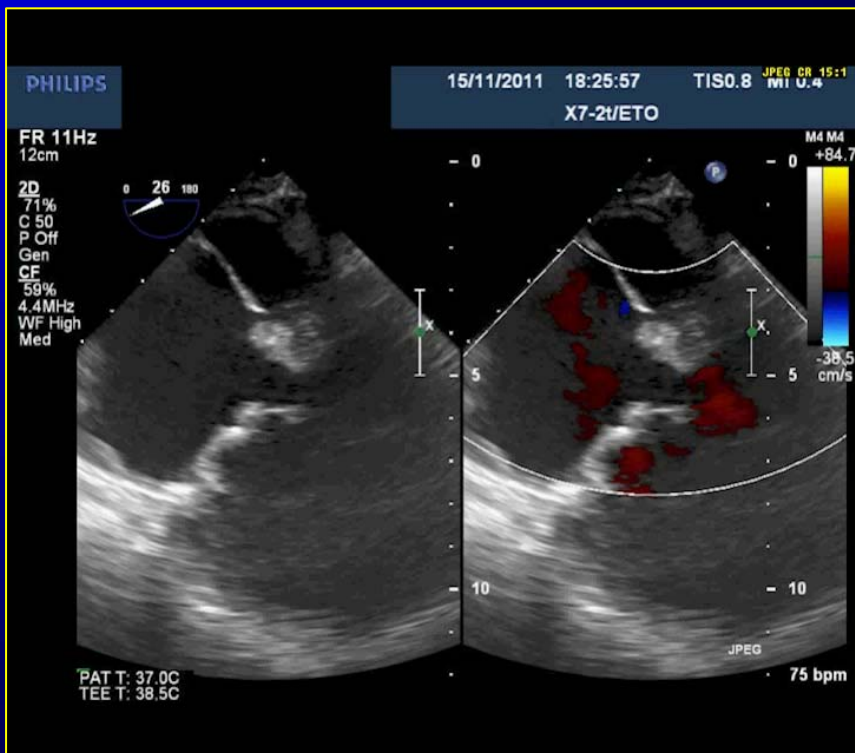




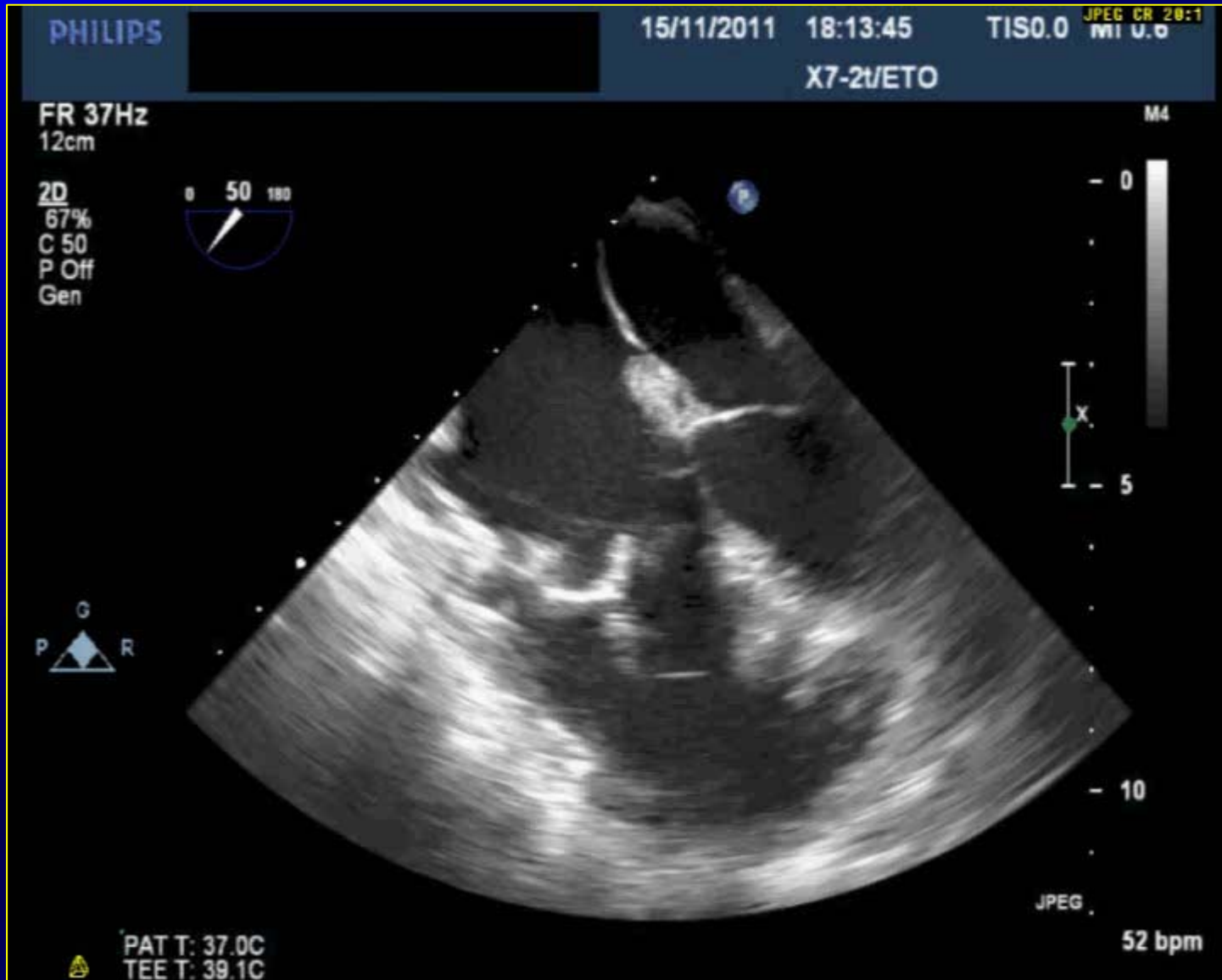








Tethering & Annular Dilatation



METHODS

Study aim

To determine the effects of tricuspid leaflet augmentation on indices of tricuspid leaflet tethering

Inclusion criteria

All patients receiving concomitant tricuspid valve repair.

Study period

1 March 2009 and 31 May 2010.

METHODS

Tricuspid valve assessment

1. TR severity

- 0: none, 1: mild, 2: moderate, 3: severe

2. Annular diameter

- Distance between insertion sites of septal and anterior leaflets in four-chambers view

3. Tethering indices

- Tethering height
- Tenting area

METHODS

Indications for concomitant tricuspid valve repair

- Irrespective of TR grading
- Significant tricuspid annular dilatation
 - > 40 mm by echo
 - > 70 mm intra-operatively

Indications for anterior leaflet augmentation

- Significant leaflet tethering
 - Tethering height > 8 mm.

METHODS

Group 1 (n = 43)

Tricuspid annuloplasty alone performed.

- CE Classic Tricuspid Annuloplasty Ring.
- Sized by measurement of anterior leaflet.

Group 2 (n = 13)

Complex tricuspid repair with AL Augmentation

Tricuspid annuloplasty + leaflet augmentation.

RESULTS - BASELINE

	Group 1 Annuloplasty	Group 2 AL Augmentation	p
Age (years)	65.9 (2.3)	58.2 (6.0)	0.15
NYHA class (1-4)	2.8 (0.2)	3.5 (0.2)	0.03
LVESD (mm)	38.9 (1.3)	36.2 (2.8)	0.35
Ejection fraction (%)	63.8 (1.7)	56.3 (3.4)	0.04
PA (mmHg)	40.6 (2.0)	50.3 (6.2)	0.06

RESULTS - BASELINE

	Group 1 Annuloplasty	Group 2 AL Augmentation	p
Tricuspid valve data			
TR grade (0-3)	2.0 (0.1)	2.9 (0.1)	0.0002
Ann diameter (mm)	43.4 (0.6)	43.8 (1.1)	0.89
Tethering height (mm)	7.5 (0.4)	12.4 (1.0)	<0.0001
Tethering area (mm ²)	188.0 (15.6)	354.4 (30.0)	0.0001

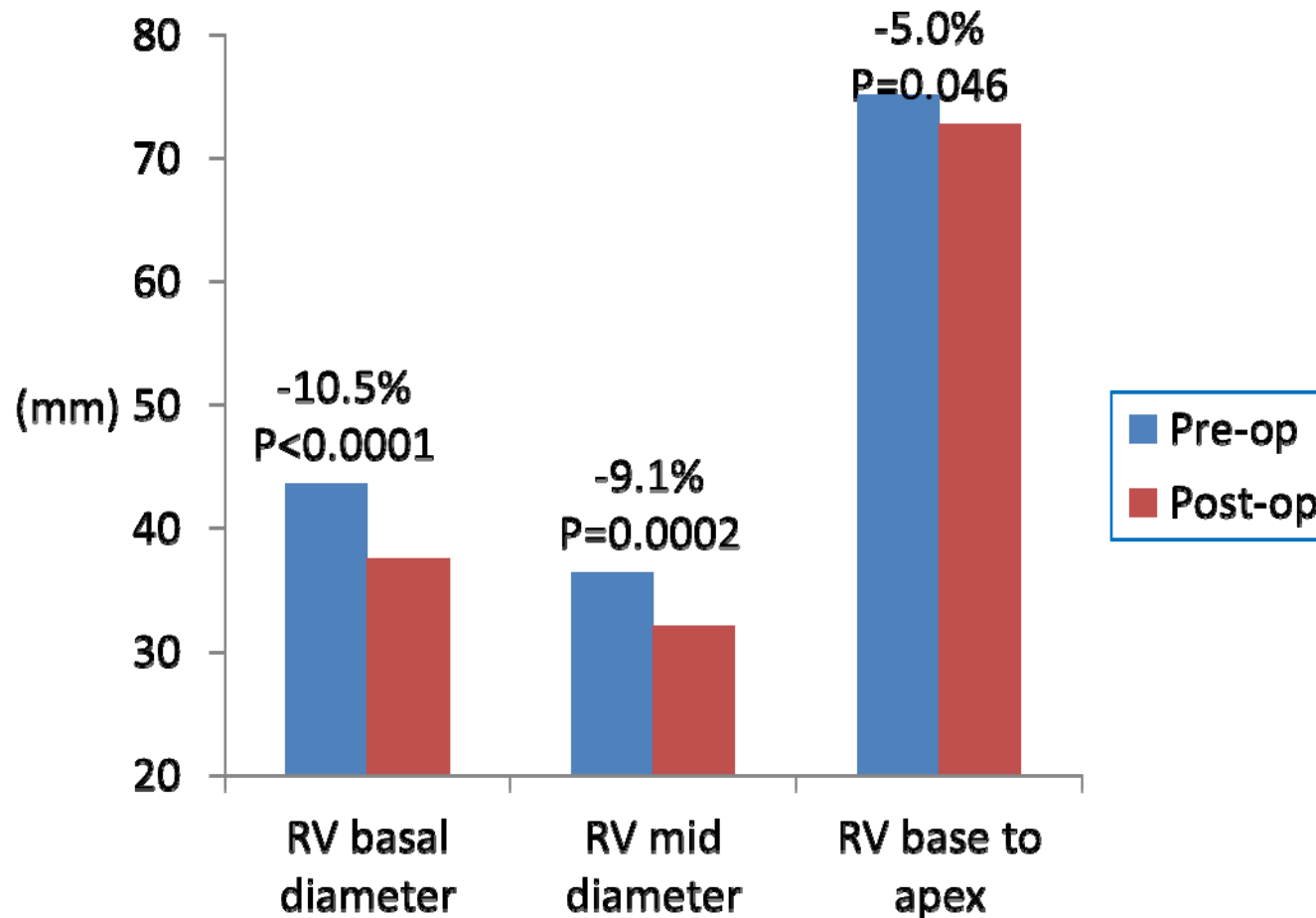
RESULTS - OPERATIVE

	Group 1 Annuloplasty	Group 2 AL Augmentation	p
CPB time (min)	127.5 (6.0)	133.9 (11.2)	0.55
Cross clamp time (min)	101.1 (5.4)	95.1 (10.4)	0.64
Annuloplasty ring size (mm)	32.6 (0.3)	32.5 (0.5)	0.77
Associated procedures	39 MV surgery 4 AVR 5 AF ablation 1 CABG 1 ASD closure	10 MV surgery 1 AVR 2 CABG 2 AV repair	

RESULTS – POST-OP

Changes in RV dimensions

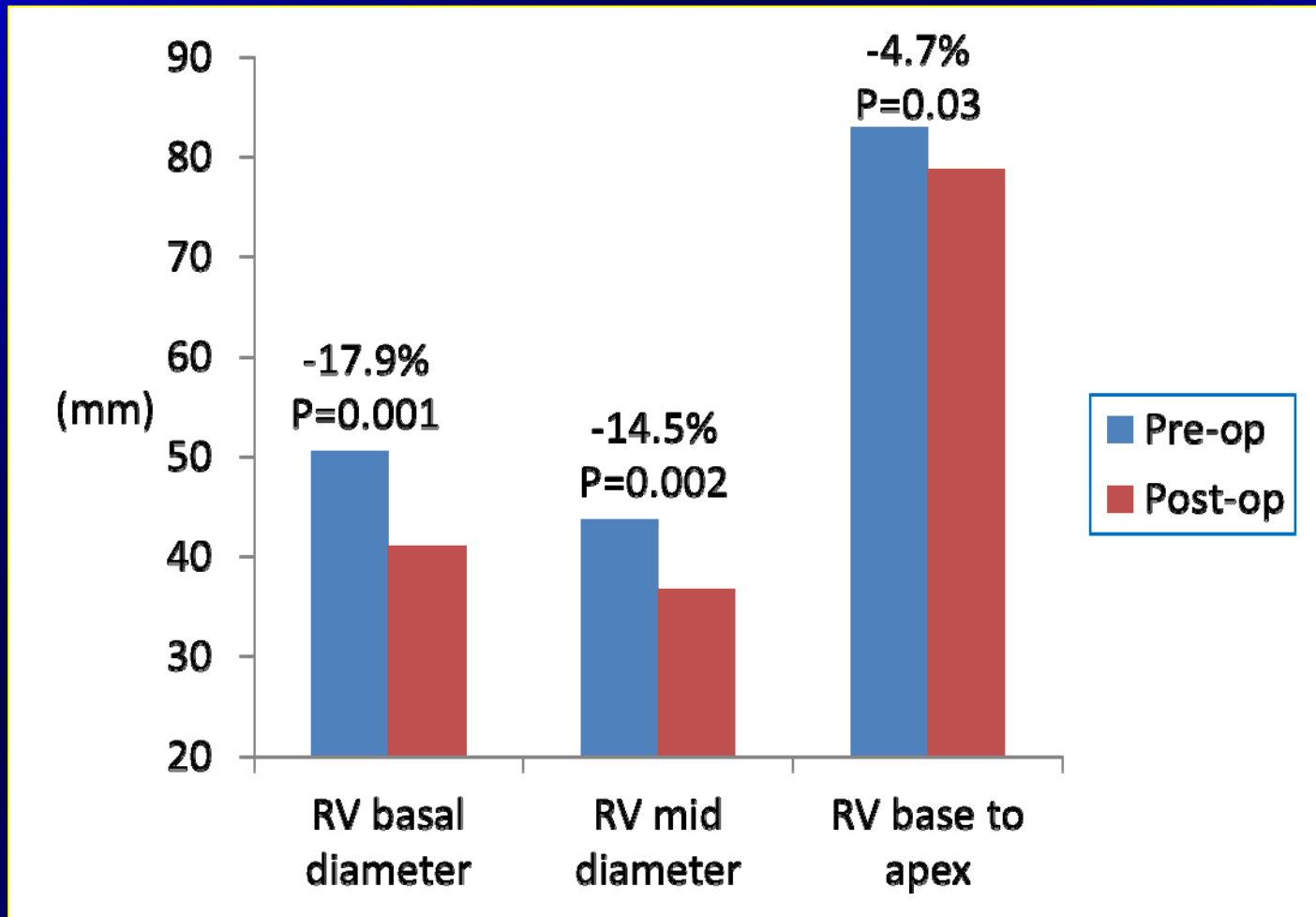
(Group 1: Annuloplasty)



RESULTS – POST-OP

Changes in RV dimensions

(Group 2: Leaflet Augmentation)



RESULTS – POST-OP

	Group 1 Annuloplasty	Group 2 AL Augmentation	P
TR grade (0-3)	0.4 (0.1)	0.7 (0.3)	0.15
Tethering height mm	6.4 (0.3)	7.6 (0.6)	0.04
Δ mm	-0.9 (0.4)	-4.5 (1.0)	0.0001
Δ %	-10.0 (4.4)	-30.6 (8.4)	0.03
Tethering area mm ²	107 (7)	131 (12)	0.19
Δ mm ²	-63 (11)	-191 (29)	<0.0001
Δ %	-28.5 (4.8)	-56.5 (4.5)	0.004

CONCLUSION

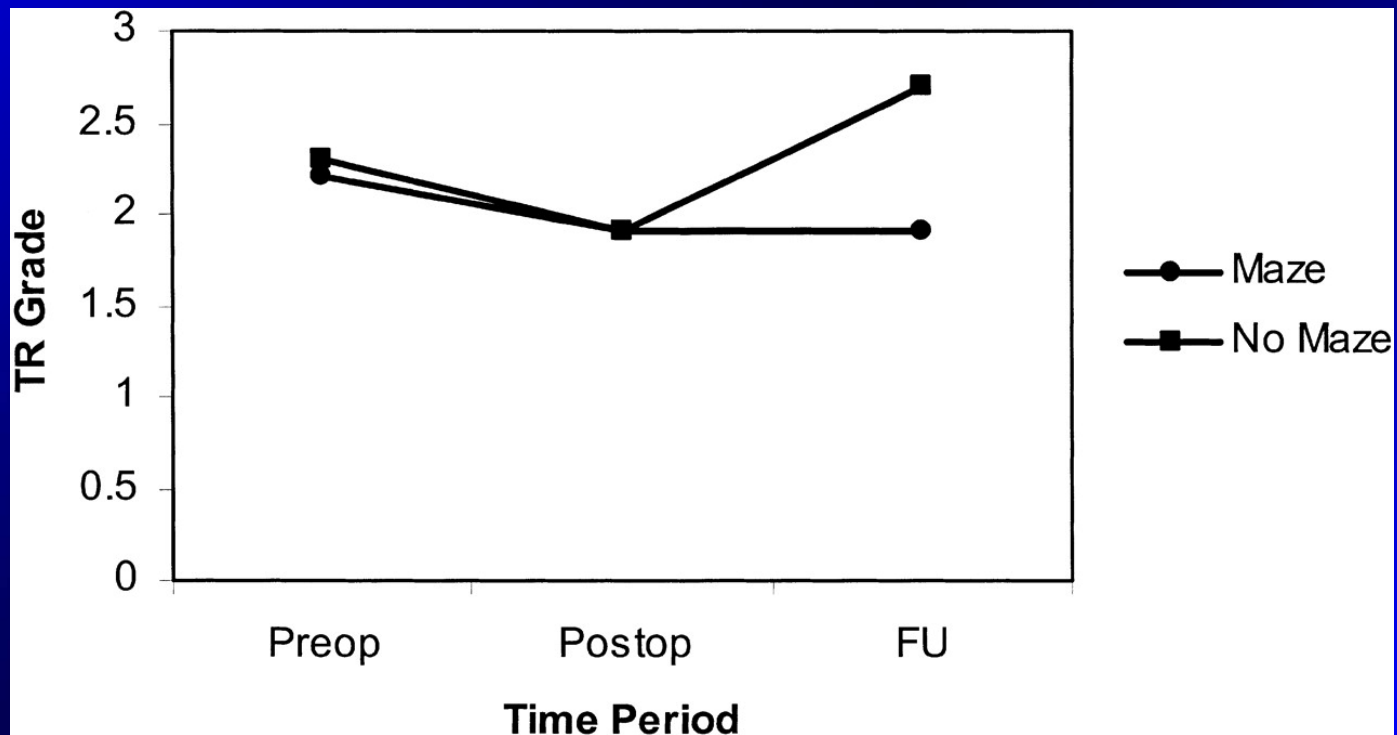
Functional tricuspid pathology should be revised completely taking into consideration :

- grading / annular dilatation / leaflet coaptation

Significant leaflet tethering is an entity of its own

- which is not addressed by annuloplasty alone
- which can explain high incidence of early failure after tricuspid annuloplasty

Tricuspid regurgitation (TR) grade



Stulak J. M. et al.; Ann Thorac Surg 2008;86:40-45