

Mitral valve score for valve  
anatomy and suitability for  
Balloon Mitral Valvuloplasty  
(BMV)

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- Percutaneous balloon mitral valvuloplasty (BMV) was introduced in 1984 by Inoue et al, for treatment of selected patients with mitral stenosis. (J Thorac Cardiovasc Surg 1984;87:394-402)
- BMV – treatment of choice for majority of patients with moderate or severe rheumatic mitral stenosis (ACC/AHA guidelines)

- **Wilkins score** (MGH score/Boston score/Abascal score).
- **Commissural calcium score.**
- **Cormier score** (lung-cormier score)
- **Real-time 3D echocardiography score** (RT 3DE score/  
Anwar score)

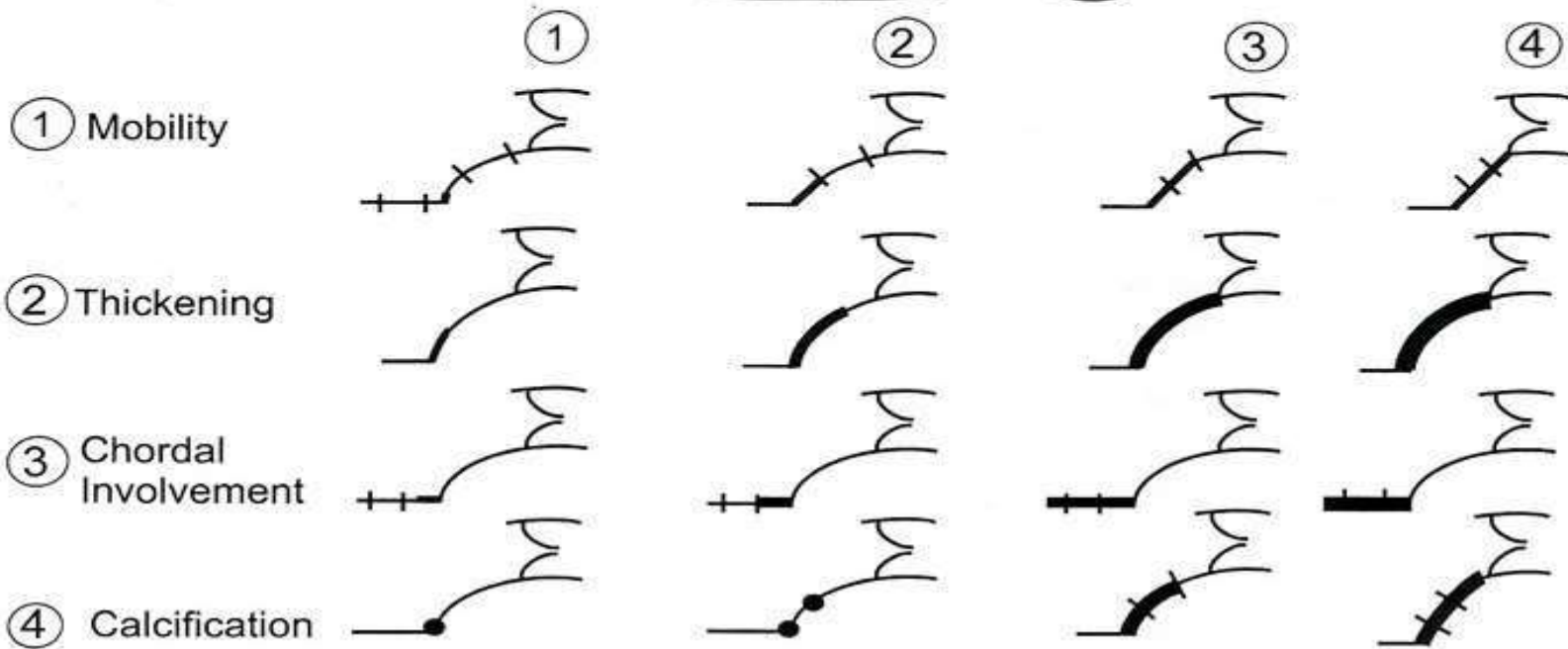
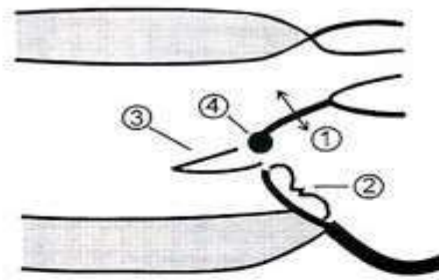
- **Chen et al score**
- **Reid score**
- **Nobuyoshi score**

# Wilkins score


- Most commonly used
- 2D TTE assessment of mitral valve -> **leaflet thickening, leaflet mobility, calcification and subvalvular involvement** .
- Each feature is graded on a scale of 1 to 4, yielding a maximal score of 16 and minimal score of 4.

Grade	Mobility	Thickening	Calcification	Subvalvular Thickening
1	Highly mobile valve with only leaflet tips restricted	Leaflets near normal in thickness (4-5 mm)	A single area of increased echo brightness	Minimal thickening just below the mitral leaflets
2	Leaflet mid and base portions have normal mobility	Midleaflets normal, considerable thickening of margins (5-8 mm)	Scattered areas of brightness confined to leaflet margins	Thickening of chordal structures extending to one-third of the chordal length
3	Valve continues to move forward in diastole, mainly from the base	Thickening extending through the entire leaflet (5-8 mm)	Brightness extending into the mid-portions of the leaflets	Thickening extended to distal third of the chords
4	No or minimal forward movement of the leaflets in diastole	Considerable thickening of all leaflet tissue (>8-10 mm)	Extensive brightness throughout much of the leaflet tissue	Extensive thickening and shortening of all chordal structures extending down to the papillary muscles

# Wilkins score



Schematic demonstration of the calculation of the mitral stenosis score.  
work of Wilkins et al.

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- In 1988, Wilkins and coworkers found that total MV echocardiographic score was the best predictor of immediate outcome after BMV. (Br Heart J.1988;60:299-308)
  - High score (advanced leaflet deformity) was associated with a suboptimal outcome while a low score (a mobile valve with limited thickening) was associated with an optimal outcome.
  - All patients with score  $< 9$  had optimal results and those with score  $> 11$  had suboptimal results. Score failed to predict outcome in those with scores of 9 to 11.



- MV morphology is considered favorable for BMV if total score  $\leq 8$ .
- A score  $>8$  does not preclude BMV, but is associated with less optimal results

- Wilkins score – not able to predict which patients will develop significant MR after PTMC.

Abascal MV, Wilkins GT, Choong CY, Block PC, Palacios I, Weyman AE. Mitral regurgitation after percutaneous balloon mitral valvuloplasty in adults: evaluation by pulsed Doppler echocardiography. J Am Coll Cardiol 1988;11:257- 63.

## *Limitations of wilkinsscore*

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- Assessment of commissural involvement not included.
- Limited in ability to differentiate nodular fibrosis from calcification.
- Doesn't account for uneven distribution of pathologic abnormalities.
- Frequent underestimation of subvalvular disease.
- Doesn't use results from TEE or 3D echo

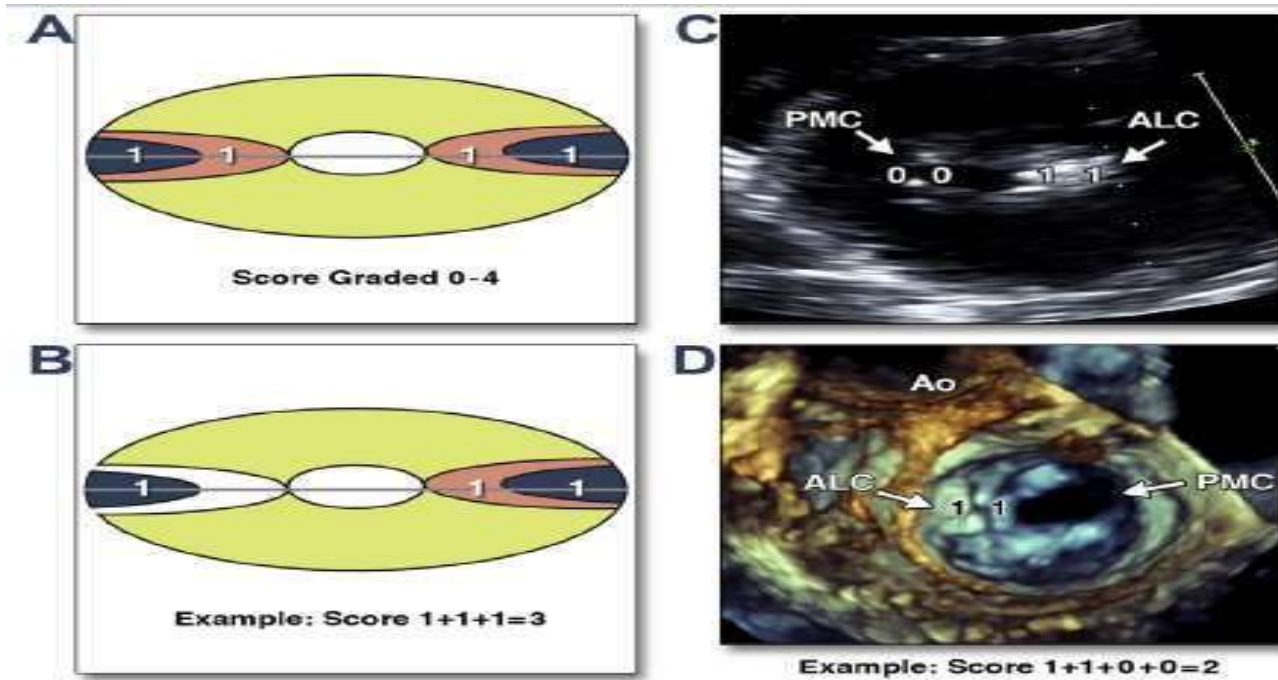
# Commissural Calcification Score

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- **Extent of commissural calcification is quantified** – each half commissure (anterolateral & posteromedial) is given a score of 1 for detection of high-intensity bright echoes.
- Ranges from **grade 0 to grade 4**.
- Commissural calcification is a strong predictor of adverse outcomes of BMV as well as of the occurrence of severe MR as a major complication of BMV.
- Influence of commissural score – most evident in pt with wilkins score <8; not significant in pt with wilkins score >8.

- Commissural calcification is a strong predictor of adverse outcomes of BMV as well as of the occurrence of severe MR as a major complication of BMV.
- Influence of commissural score – most evident in pt with wilkins score  $<8$ ; not significant in pt with wilkins score  $>8$ .

# Commissural Calcification Score



**Figure 7. Evaluation of Commissural Calcification Score**

Commissural calcification is quantified by giving a half commissure each (anterolateral and posteromedial) with detection of high-intensity bright echoes a score of 1. Commissural calcification can therefore range from grade 0 (no calcification) to grade 4. (A) Both commissures are completely calcified. (B) An example in which half a commissure is calcified on the left side and the entire commissure is calcified on the right side. The added score is therefore 3. (C) A 2-dimensional transthoracic short-axis view at the level of the mitral leaflets shows that only 1 commissure is completely calcified, whereas the other commissure shows no calcification. (D) The corresponding left atrial 3-dimensional transesophageal echocardiographic aspect is presented. The calculated score in this example is 2. ALC = anterolateral commissure; Ao =

## *Cormier score*

- Derived from a study which assessed late functional results after successful PTMC and its determinants ( Lung et al, J Am Coll Cardiol 1996;27:407-14)
- Based on echocardiographic and fluoroscopic assessment of valve mobility, subvalvular disease and leaflet calcification

- By multivariate analysis, the independent predictors of good functional results were **echocardiographic group** ( $p = 0.01$ ), **functional class** ( $p = 0.02$ ) and **cardiothoracic index** ( $p = 0.005$ ) before the procedure and **valve area after the procedure** ( $p=0.007$ ).



# *CormierScore*

Echocardiographic group	Mitral valve anatomy
Group 1	Pliable non-calcified anterior mitral leaflet and mild subvalvular disease (i.e. thin chordae $\geq 10$ mm long)
Group 2	Pliable non-calcified anterior mitral leaflet and severe subvalvular disease (i.e. thickened chordae $< 10$ mm long)
Group 3	Calcification of mitral valve of any extent, as assessed by fluoroscopy, whatever the state of subvalvular apparatus

- Wilkins score in the range of 7-9 correlates with echocardiographic group 1.
- a range of 8-12 correlates with echocardiographic group 2.
- a range of 10-15 correlates with echocardiographic group 3

lung et al, J Am Coll Cardiol 1996;27:407-14

## *RT-3DE score*

- Based on real time 3D TTE
- Highly reproducible, good interobserver and intraobserver agreement

# RT-3DE score

**Table 3. Real-Time Transthoracic 3-Dimensional Echocardiographic Score for the Evaluation of Mitral Stenosis Before Percutaneous Mitral Balloon Valvuloplasty**

	Anterior Mitral Leaflet			Posterior Mitral Leaflet		
	A1	A2	A3	P1	P2	P3
Thickness*	0-1	0-1	0-1	0-1	0-1	0-1
Mobility*	0-1	0-1	0-1	0-1	0-1	0-1
Calcification†	0-2	0-1	0-2	0-2	0-1	0-2
	Subvalvular Apparatus‡					
	Proximal Third		Middle Third		Distal Third	
Thickness	0-1		0-1		0-1	
Separation	0-2		0-2		0-2	

The anterior and posterior leaflets are each divided into 3 segments (anterior leaflet: A1 [lateral segment], A2 [middle segment], A3 [medial segment]; posterior leaflet: P1 [lateral], P2 [middle], P3 [lateral]).\*Each segment receives a separate score (either 0 for normal or 1 for abnormal) for thickness, mobility, and calcification. Normal score = 0, mild = 1 to 2, moderate = 3 to 4, severe =  $\geq 5$ . †Absence of calcification is scored as 0, calcification in A2 or P2 (middle segments) is scored as 1, and calcification of commissural segments of both leaflets (A1, A3 and P1 and P3) is scored as 2. For calcifications: normal score = 0, mild = 1 to 2, moderate = 3 to 5, severe =  $\geq 6$ . ‡The anterior and posterior chordae are scored at proximal (mitral valve level), middle, and distal (papillary muscle level) levels. At each level, the anterior and the posterior leaflet is scored for thickness and separation in between. Normal thickness is scored as 0, and abnormal thickness is scored as 1. Normal chordal separation (defined as distance  $>5$  mm) is scored as 0, partial separation (defined as distance  $<5$  mm) is scored as 1, and absence of separation is scored 2. The individual points are added, with the total score ranging from 0 to 31 points. Mild MV involvement is defined as  $<8$  points, moderate MV involvement is 8 to 13, and severe MV involvement is  $>14$  points. Adapted, with permission, from Anwar et al. (63).

- Incidence and severity of post- procedural MR were associated with high RT-3DE score

- Another 2DE score by **Chen et al.** is a modified Wilkins score parameter for subvalvular thickening according to the involved segment of chordal length: (1) if less than  $1/3$ , (2) if more than  $1/3$ , (3) if more than  $2/3$ , and (4) if involved the whole chordal length with no separation.

- **Reid score** includes leaflet motion, leaflet thickness, subvalvular disease, and commissural calcium.
- Leaflet motion was expressed as a slope by dividing the height (H) by the length (L) of doming of anterior leaflet. Leaflet thickness was expressed as the ratio between the thickness of the tip of MV and thickness of posterior wall of aortic root.
- The score was assigned as 0 for mild affection, 1 for moderate , and 2 for severe affection

# Nobuyoshi Score

Nobuyoshi score

Component	Score	Definition
Leaflet mobility	1	Pliable leaflets with minimal restriction of leaflet tip mobility
	2	Semi-pliable leaflets with restriction of leaflet body mobility
	3	Minimal forward movement of the leaflets
Commissural disease	1	No commissural disease
	2	One commissural disease
	3	Both commissural disease
	4	Diffuse commissural disease
Subvalvular disease	1	Minimal thickening of chordae
	2	Thickening and shortening of chordae
	3	Fused subvalvular apparatus



## **MR- Echo Score** (Padial et al. JACC1996;27:1251-31)

- Total MR-Echo score – only independent predictor of significant MR following PTMC using Inoue technique.
- Total MR-echo score of 7 → Positive predictive value 97.7%.

**Table 1. Echocardiographic Score for Severe Mitral Regurgitation After Percutaneous Mitral Valvulotomy**

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- I-II. Valvular thickening (score each leaflet separately)
    - 1. Leaflet near normal (4–5 mm) or with only a thick segment
    - 2. Leaflet fibrotic and/or calcified evenly; no thin areas
    - 3. Leaflet fibrotic and/or calcified with uneven distribution; thinner segments are mildly thickened (5–8 mm)
    - 4. Leaflet fibrotic and/or calcified with uneven distribution; thinner segments are near normal (4–5 mm)
  - III. Commissural calcification
    - 1. Fibrosis and/or calcium in only one commissure
    - 2. Both commissures mildly affected
    - 3. Calcium in both commissures, one markedly affected
    - 4. Calcium in both commissures, both markedly affected
  - IV. Subvalvular disease
    - 1. Minimal thickening of chordal structures just below the valve
    - 2. Thickening of chordae extending up to one-third of chordal length
    - 3. Thickening to the distal third of the chordae
    - 4. Extensive thickening and shortening of all chordae extending down to the papillary muscle
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The total score is the sum of these echocardiographic features (maximum 16).

# *Limitations of scoring system*

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- No individual scoring system is superior to another. Complement each other for comprehensive echocardiographic assessment.
- All scoring system have got variable reproducibility
- All scores are semiquantitative
- Subvalvular disease is frequently underestimated

# *Ideal echo scoring system*

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- Inclusion of all points that proved to predict and affect the BMV outcome via large study.
- High reproducibility and reliability
- Easily applicable and interpretable by most cardiologists within a reasonable time.
- Validation in large studies that include pt with different age groups (not only young)
- Global and segmental evaluation of each MV apparatus component separately to localize the deformity in a specific portion of MV apparatus.
- Unified for both TTE & TEE approaches