



## Original Article

# Mitral Leaflet Separation Index (MLSI): A step ahead to assess severity of mitral stenosis in patients with Atrial Fibrillation

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## Abstract

**Background:** Assessment of severity of mitral stenosis by using planimetry and pressure half time method has been difficult and inaccurate at times and therefore an alternate method mitral leaflet separation index (MLSI) was advised. We correlated the severity of mitral stenosis by this method with mitral valve area by using planimetry and pressure half time.

**Methods:** The study was a hospital based prospective study and was done in S.N Medical College Agra between March 2013 and August 2014. Study included the patients who were having mitral stenosis, already diagnosed and those who were diagnosed for the first time in our department. Severity of mitral stenosis was assessed using Planimetry and Pressure Half Time. MLSI was measured by measuring maximal separation between inner edges of leaflets on parasternal long axis view and apical 4 chamber view and average of the two was taken.

**Results:** MLSI correlates very well with both planimetry ( $r = 0.962$ ) and pressure half time method ( $r = 0.955$ ). The value of correlation coefficient by both methods is very near to 1 and hence shows that there is very high degree of correlation between both the variables. While assessing the severity of mitral stenosis in patients with atrial fibrillation MLSI correlates very well MVA by planimetry ( $r = 0.895$ ) and MVA by pressure half time ( $r = 0.836$ ), however correlation with MVA by planimetry is much higher than MVA by pressure half time method

**Conclusions:** Specially in patients with Atrial fibrillation where pressure half time method is not reliable and planimetry is not able to assess the area accurately due to calcification of leaflets leading to irregular margins or poor echo window on parasternal short axis view in some cases like obese, emphysematous chest or females, Mitral leaflet separation index can be used as reliable method to assess the severity.

**Keywords:** mitral leaflet separation index; mitral stenosis; planimetry; atrial fibrillation; pressure half time.

## Introduction

Rheumatic fever is the leading cause of mitral stenosis (MS).<sup>[1]</sup> Other less common etiologies of obstruction to left atrial outflow include congenital mitral valve stenosis, mitral annular calcification with extension onto the leaflets, cor-

triatricum, systemic lupus erythematosus, left atrial myxoma, rheumatoid arthritis and infective endocarditis with large vegetations.<sup>[2,3]</sup> However in developing countries like India rheumatic heart disease is the most common cause. The importance of assessing the severity of MS

provides the baseline for deciding the management. Direct measurement of mitral valve area (MVA) by planimetry is accurate but is highly operator dependent and sometimes laborious.<sup>[4]</sup> The reliability of the pressure half-time method is affected by changes in preload or left ventricular compliance.<sup>[5]</sup> A novel index Mitral leaflet separation index was advised to overcome the discrepancy shown by the conventional methods. This index would also help when there is a discrepancy between severities of MS estimated by existing methods, in presence of atrial fibrillation (AF) and in the presence of mitral regurgitation. This new index could be a useful surrogate measure of the MVA.<sup>[4]</sup>

### Aims and Objective

To evaluate the severity of mitral stenosis using mitral leaflet separation index and its significance over planimetry and pressure half time method especially in patients with Atrial fibrillation.

### Material and Methods

The study was a hospital based prospective study and was done in S.N Medical College Agra. The study was done among the patients having mitral stenosis attending O.P.D and those admitted in PG Deptt. of Medicine S N Medical College Agra including those who were already diagnosed and those who were diagnosed for the first time in our department and was done between March 2013 and August 2014. A total of 100 cases between 18-60 yrs of age were included in the study. Cases already diagnosed with mitral stenosis but have undergone valvuloplasty or with severe co-morbid illnesses or other underlying cardiac abnormalities like infective endocarditis, Atrial septal defect, ventricular septal defect were excluded from the study. Severity of mitral stenosis assessed using Planimetry and Pressure Half Time using Phillips HD11XE echo machine by using 2-4 MHZ transducer. Written consent was taken from all the patients. Multiple views i.e. Parasternal long axis, short axis, apical 4 chamber, 5 chamber, 2 chamber and 3 chamber were taken to visualize all

4 cardiac chambers clearly. Measurements were taken as per the recommendations of The American Society of Echocardiography.<sup>[6]</sup>

**Mitral leaflet separation index-** was measured by measuring maximal separation between inner edges of leaflets on parasternal long axis view and apical 4 chamber view. These two parameters are then averaged to measure mitral leaflet separation index.<sup>[7]</sup>

$$\text{MLSI} = \frac{\text{Maximal separation on PLAX} + \text{A4C}}{2}$$

Maximal separation of inner edges of mitral leaflets on parasternal long axis view and apical four chamber view is measured and then averaged. In patients with atrial fibrillation 3 reading of each were taken and then averaged. However while taking the reading and assessing the maximal separation in patients with atrial fibrillation it was observed that mean of the three reading and each reading individually was same and hence need for taking multiple reading can be omitted.

### Observations

Total 100 patients were included in the study and out these 35 patients were having atrial fibrillation and rest were in sinus rhythm. Mitral valve area was calculated by using Planimetry and pressure half time methods and MLSI was calculated by using above mentioned formula. By using the American society of echocardiography guidelines<sup>[6]</sup> patients could be classified in to mild, moderate and severe stenosis which has been shown in Table 1. Correlation coefficient was evaluated between the area calculated by both methods and MLSI which has been shown below. In patients with sinus rhythm following observation correlation was observed.

**Table 1**

Severity /method	Planimetry	Pressure half time method
Mild	20	22
Moderate	31	31
Severe	49	47

1. The correlation coefficient between the mitral leaflet separation index and the mitral valve area as measured by planimetry is 0.962 and the coefficient of determination is 0.927 which shows

a very high correlation between both the methods. [Figure 1] shows the Correlation between MVA by planimetry and MLSI.

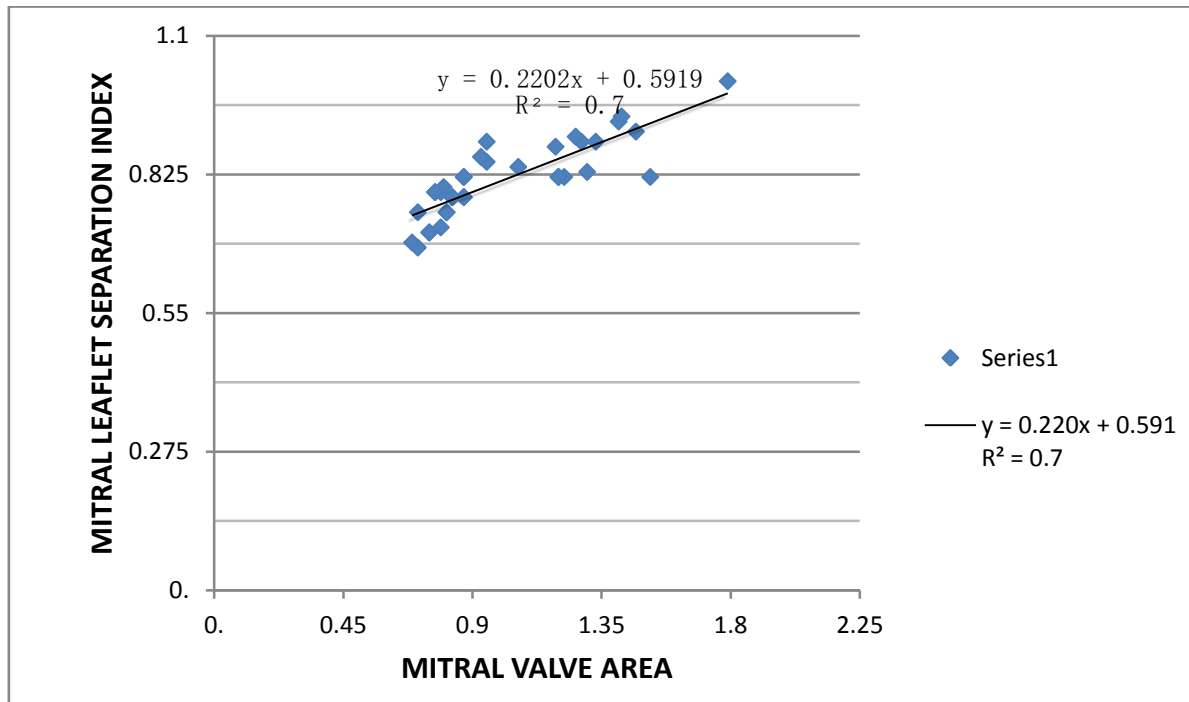


Figure 1 - Correlation between MVA by planimetry and MLSI

2. The correlation coefficient between the mitral leaflet separation index and the mitral valve area as measured by planimetry is 0.9555 and the coefficient of determination is 0.913 which shows

a very high correlation between both the methods. [Figure 2] shows the correlation between mitral valve area by pressure half time method and mitral leaflet separation index.

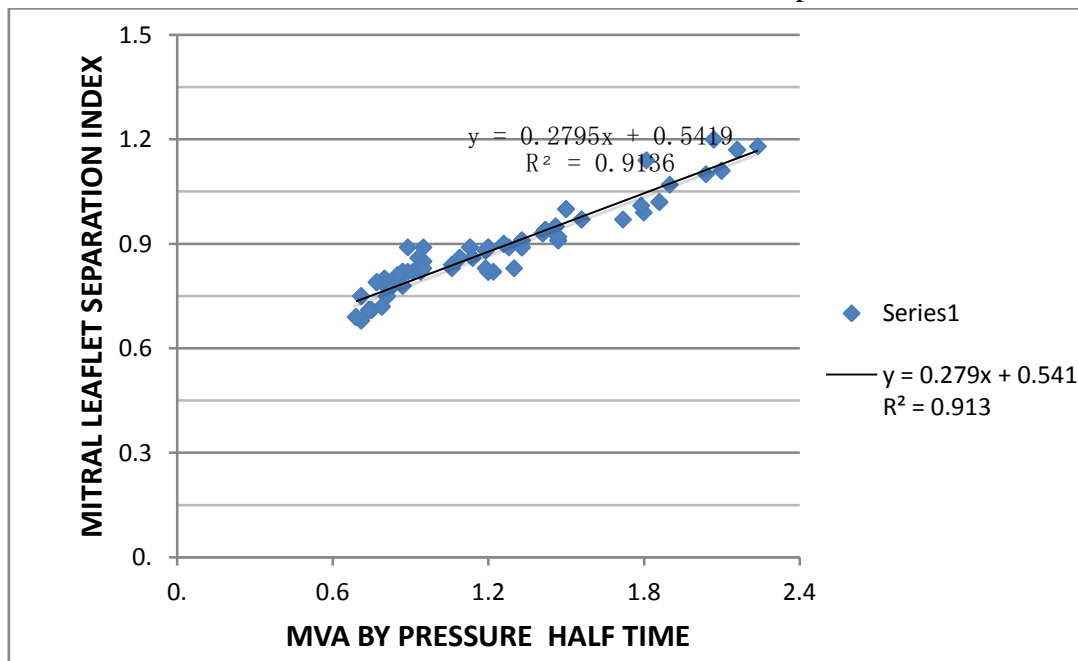
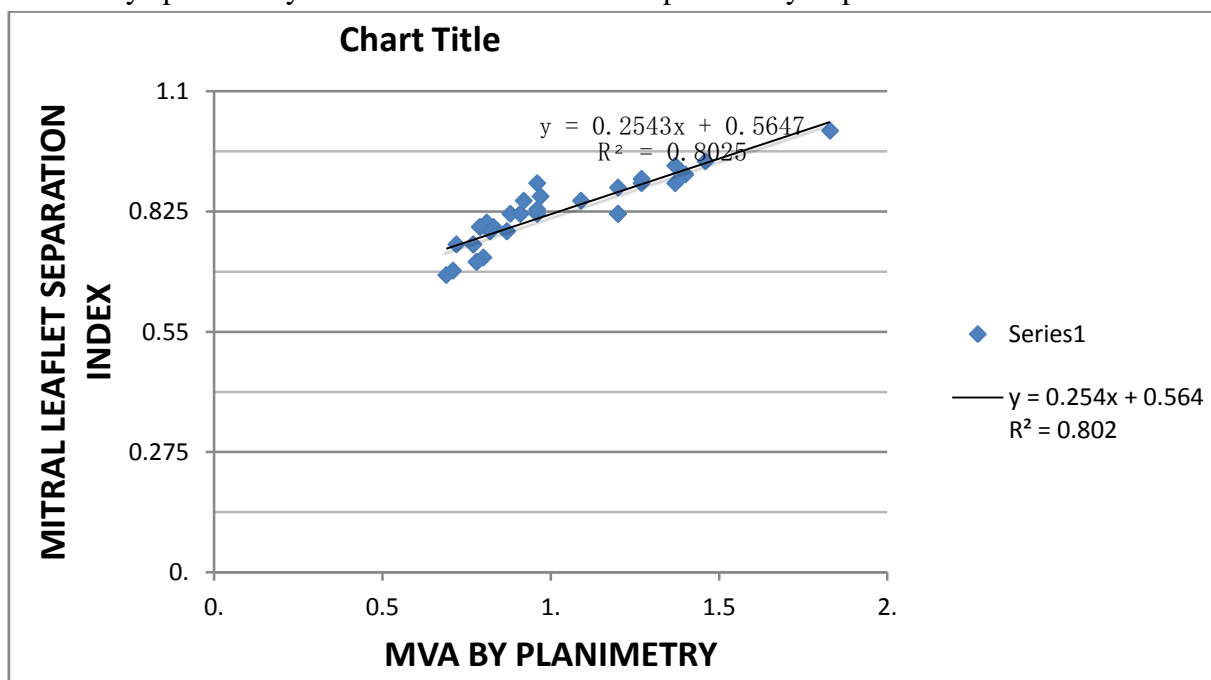


Figure 2- Correlation between mitral valve area by pressure half time method and mitral leaflet separation index

In patients with atrial fibrillation following correlation was observed

1. The correlation coefficient between the mitral leaflet separation index and the mitral valve area as measured by planimetry is 0.895 and the

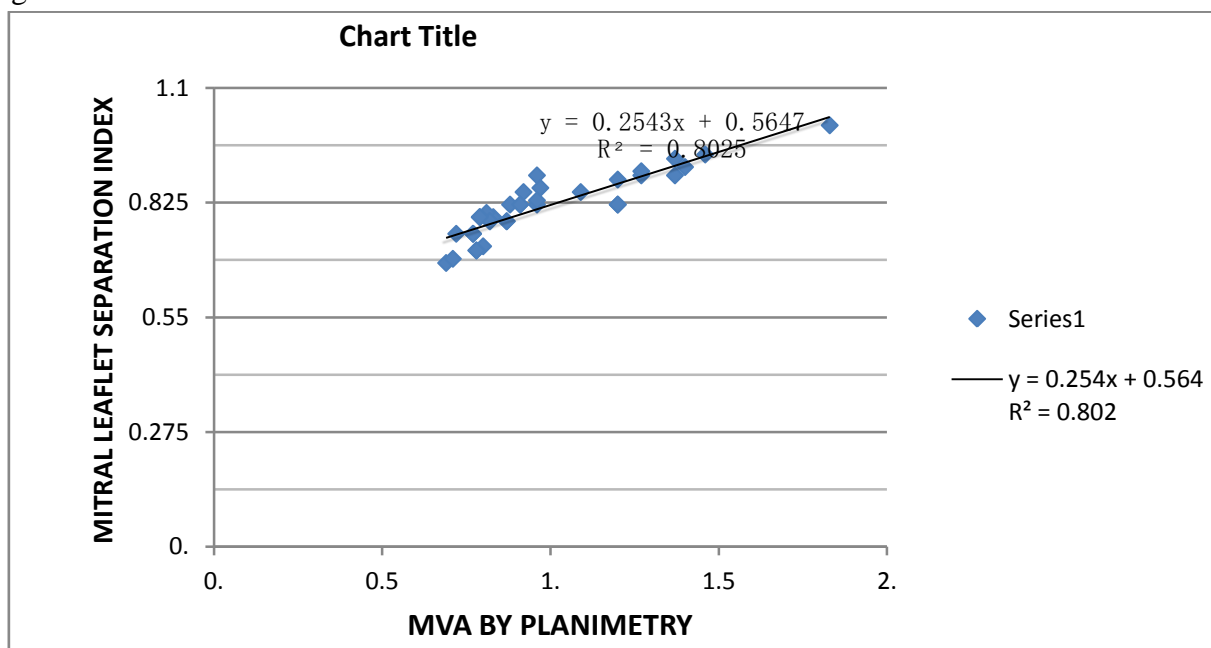
coefficient of determination is 0.802 which shows a very high correlation between both the methods. [Figure 3] shows Correlation between mitral leaflet separation index and mitral valve area by planimetry in patients with atrial fibrillation



**Figure 3-** Correlation between mitral leaflet separation index and mitral valve area by planimetry in patients with atrial fibrillation

2. The correlation coefficient between the mitral leaflet separation index and the mitral valve area as measured by planimetry is 0.836 and the coefficient of determination is 0.7 which shows a very high correlation between both the methods.

[Figure 4] shows correlation between mitral leaflet separation index and mitral valve area by pressure half time method in patients with atrial fibrillation.



**Figure 4-** Correlation between mitral leaflet separation index and mitral valve area by pressure half time method in patients with atrial fibrillation

**Table 2** showing correlation coefficient between MVA by planimetry and PHT and MLSI in patient with and without atrial fibrillation

	In patient with no Atrial fibrillation	In patients with Atrial Fibrillation
Correlation between MVA by planimetry and MLSI	0.962	0.895
Correlation between MVA by PHT and MLSI	0.955	0.836

### Discussion and Review of literature

MLSI was first described in 1979 by Fisher et al and since then has been studied by various research groups and has been proven to be method of advantage in assessment of severity of mitral stenosis. Mitral valve area (MVA) determined at cardiac catheterization was compared with M mode echocardiographic measurements in 44 patients with mitral stenosis and no substantial mitral regurgitation.<sup>[7]</sup> They concluded that despite statistically significant correlations, assessment of anterior leaflet motion, including rate of diastolic closure (EF slope) were not useful in predicting severity of mitral stenosis. In contrast, maximal diastolic separation of anterior and posterior leaflets (SEP) was more closely correlated with MVA and appears to have some predictive value. Narrow separation was associated with severe mitral stenosis. Wide separation was associated with comparatively mild stenosis. Intermediary values in 16 of 44 patients (36%) were not of predictive value. Recognizing this restraint, measurement of maximal diastolic mitral leaflet separation from M mode echocardiograms was projected as a simple and valuable method for assessing severity of mitral stenosis.<sup>[7]</sup> Vimal Raj BS et al (2008) studied 150 consecutive patients with MS who underwent 2D echo. In each patient the severity of MS was assessed using 2D mitral valve area, pressure half time and MLS index. There were 22.7% patients with mild MS, 34.7% patients with moderate MS and 42.7% patients with severe MS. MLSI of 0.80 cm or less recognized severe MS with 92% sensitivity and 92% specificity. MLS index of >1.11 cm identified mild MS with 97% sensitivity and 97%

specificity. They showed that MLS demonstrate an excellent correlation with MVA by planimetry and the pressure half-time method. It is also appreciably different for different grades of mitral stenosis severity, representing high discriminatory ability. It therefore reliably segregated patients with hemodynamically significant stenosis from those without. The MLSI showed fine correlation with MVA by planimetry in subgroup analysis of patients with Atrial fibrillation. They concluded that the MLS index can be used as a screening method to semi quantify patients with mitral stenosis and should be added into yet another method to assess the severity.<sup>[8]</sup> Holmin C, et al (2010) enrolled 90 consecutive patients, and concluded that no threshold value could predict a non-severe MS with both a sensitivity and a specificity greater than 80%. A threshold value of 0.97 cm provided the best combination of sensitivity and specificity (86% and 75%, respectively). Yet, an MLSI of 1.2 cm or more provided a good specificity and positive predictive values for the diagnosis of nonsevere MS (85% and 89%, respectively) and an MLSI of less than 0.8 cm provided a tremendous specificity and positive predictive value for severe MS (98% and 96%, respectively) and concluded that the MLS index cannot be considered as a substitute for MVA, however it can be used as a semiquantitative and complementary method for the integrative assessment of MS severity.<sup>6</sup> Thus it remains accurate even in the presence of AF. It is a better indicator of MS severity than pressure gradient and can be used as a reliable tool to assess the severity of mitral stenosis in the presence of mitral regurgitation when mean

gradient may overestimate the severity of mitral stenosis. Thus it is a better predictor of stenosis severity in the presence of mitral regurgitation.<sup>[4]</sup> Joby K. Thomas et al (2011) studied Mitral Leaflet Separation Index and concluded that MLS index is a reliable measure of MS severity, which can be used as a simply obtainable adjunct and sometimes as a surrogate to current methods of assessment but not as a replacement for other echo parameters. This index was also found to be useful when there is a inconsistency between severities of MS estimated by existing methods, in the existence of atrial fibrillation and mitral regurgitation.<sup>[8]</sup>

Above described observations clearly state that there is strong correlation between the area measured by Planimetry and Pressure half time and MLSI. However it is stronger between Planimetry and MLSI than Pressure Half time and MLSI especially in patients with atrial fibrillation. Going through the literature it can be concluded that Mitral leaflet separation index worked as a good index to assess the severity in patients with mitral stenosis and was also found to be useful in patients where parasternal short axis view at the level of mitral valve was not possible due to altered cardiac anatomy or obese patients.

The main advantage of the MLSI index is its simplicity and ease of measurement in comparison with planimetry and Pressure half time. It provides a quick estimate of MS severity from standard 2D echocardiographic views without having to resort to tedious measurements as it is technically easy to obtain.

While collecting the data it was found that MLSI in these patients correlated very well with their symptoms, with severe the symptoms, lesser was the value of Mitral leaflet separation index. Mitral leaflet separation index can be used as a measure for assessing the severity of mitral stenosis and it correlates very well with both planimetry ( $r = 0.962$ ) and pressure half time method ( $r = 0.955$ ). The value of correlation coefficient by both methods is very near to 1 and hence shows that there is very high degree of correlation between

both the variables. While assessing the severity of mitral stenosis in patients with atrial fibrillation MLSI correlates very well MVA by planimetry ( $r = 0.895$ ) and MVA by pressure half time ( $r = 0.836$ ), however correlation with MVA by planimetry is much higher than MVA by pressure half time method. It is due to the reason that pressure half time is not a perfect method to assess the mitral valve area as the pressure gradient between LA and LV changes with each cardiac cycle. While calculating the MLSI it was also observed that in patients where the mitral valve area was too irregular due to calcification of the leaflets it correlated well with the symptoms of their symptoms and with pressure half time method or invasive methods.

### Conclusion

MLS index is a reliable method to assess severity of Mitral stenosis, and can be used as surrogate to current methods of assessment but not as a substitute for other echo parameters. This index can be helpful when there is a inconsistency between severities of MS estimated by present methods, in the existence of atrial fibrillation and in the presence of mitral regurgitation or where it is not possible to perform MVA calculation by planimetry. Specially in patients with Atrial fibrillation where pressure half time method is not reliable and planimetry is not able to assess the area accurately due to poor echo window or calcification of leaflets leading to irregular margins, Mitral leaflet separation index can be used as reliable method to assess the severity.

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The Author(s) declare(s) that there is no conflict of interest'.

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