Echocardiographic visualization and quantification of mitral complex during mitral repair for severe functional mitral regurgitation

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Video clip is available online.

It has been reported that patients with functional mitral regurgitation (MR) who underwent mitral valve repair without recurrent MR had greater left ventricular (LV) reverse remodeling than did the patients who underwent valve replacement.¹ To prevent recurrent MR completely in severe functional MR, our team has used triple repair, which consists of annuloplasty, anterior leaflet augmentation with a large pericardial patch, and papillary muscle (PM) suspension (Figure 1).

The presented images are from a case of triple repair. Postoperative transesophageal echocardiography shows sufficient leaflet coaptation, which is counted on for prevention of recurrent MR (Figure 2 and Video 1). Three-dimensional images of the leaflets in systole reconstructed by a dedicated quantitative software (Real View, Nara, Japan) demonstrate the postoperative improvement of leaflet tethering (Figure 3 and Videos 2 and 3). The preoperative and postoperative distances between mid anterior annulus and each PM tip were 36.4 and 34.9 mm in anterior PM, and 42.1 and 41.6 mm in posterior PM. The sutures visualized in Figure 4 (Video 4) are expected for the

Preoperative and postoperative 3D reconstructed mitral leaflet, annulus, papillary tips.

Central Message

For successful mitral repair and for further improvement of the quality of surgery, preoperative and postoperative clear visualization and precise quantification of mitral valve complex are essential.

See Editorial Commentaries pages 1256 and 1258.

prevention of further leaflet tethering and thereby recurrence of MR.

In our experience of severe functional MR cases with LV ejection fraction less than 35% and LV diastolic dimension greater than 65 mm, 11 patients were treated with mitral annuloplasty alone before 2012; since then, 10 patients have undergone triple repair. Reduction of MR to less than mild at discharge with no operative deaths was achieved in both groups. Cumulative freedoms from recurrent MR at 1 year and 5 years in the mitral annuloplasty series were 90.9% and 55.7%, respectively, whereas there has been no recurrent MR greater than mild to date in the triple repair group except 1 patient with patch failure.

FIGURE 1. The triple repair consisted of papillary muscle (PM) suspension, anterior leaflet augmentation, and annuloplasty. The pericardial patch for the augmentation of the anterior leaflet was designed to cover the whole annular plane.

FIGURE 2. Postoperative long-axis view on transesophageal echocardiography visualized deep coaptation and sufficient opening of leaflets. Video of this view is in [Video 1](#), along with postoperative transthoracic echocardiography with and without color Doppler mode.

VIDEO 1. Postoperative long-axis views by transesophageal echocardiography (*left*) and by transthoracic echocardiography with (*right*) and without (*middle*) color Doppler flow. Video available at: [http://www.jtcvsonline.org/article/S0022-5223\(17\)30555-X/addons](http://www.jtcvsonline.org/article/S0022-5223(17)30555-X/addons).

FIGURE 3. Preoperative (*left*) and postoperative (*right*) 3-dimensional models of the reconstructed mitral leaflet, the annulus, and the positions of the papillary muscle (PM) tips are shown. Multidirectional observations of these 3-dimensional images are available in [Video 2](#) and [Video 3](#). M, Medial; P, posterior; A, anterior; L, lateral.

VIDEO 2. Multidirectional observation of 3-dimensional reconstructed preoperative mitral valve complex. *L*, Lateral; *M*, medial; *P*, posterior; *AL*, anterior papillary muscle tip; *PM*, posterior papillary muscle tip. Video available at: [http://www.jtcvsonline.org/article/S0022-5223\(17\)30555-X/addons](http://www.jtcvsonline.org/article/S0022-5223(17)30555-X/addons).

VIDEO 3. Multidirectional observation of 3D reconstructed postoperative mitral valve complex. *A*, Anterior; *L*, lateral; *M*, medial; *AL*, anterior papillary muscle tip; *PM*, posterior papillary muscle tip; *P*, posterior. Video available at: [http://www.jtcvsonline.org/article/S0022-5223\(17\)30555-X/addons](http://www.jtcvsonline.org/article/S0022-5223(17)30555-X/addons).

FIGURE 4. Volume-rendering image of transesophageal echocardiography with the transgastric approach allows us to visualize the postoperative sub-mitral apparatus. The pairs of suture for papillary muscle (PM) suspension were clearly visualized (Video 4). The sutures were connected to each fibrous trigone, which can be plainly recognized in this image.

VIDEO 4. Volume-rendering image of postoperative mitral valve complex. PM, Papillary muscle. Video available at: [http://www.jtcvsonline.org/article/S0022-5223\(17\)30555-X/addons](http://www.jtcvsonline.org/article/S0022-5223(17)30555-X/addons).

Further studies in large numbers are warranted to confirm the long-term effectiveness of the procedures. In addition, we believe that optimal imaging and precise quantification in every single case are important for the assessment of the procedures. This will lead to the improvement of the results and therefore outcomes.

Reference

1. Lorusso R, Gelsomino S, Vizzardi E, D'Aloia A, De Cicco G, Lucà F, et al; ISTIMIR Investigators. Mitral valve repair or replacement for ischemic mitral regurgitation? The Italian Study on the Treatment of Ischemic Mitral Regurgitation (ISTIMIR). *J Thorac Cardiovasc Surg.* 2013;145:128-39; discussion 137-8.