FIGURE 1. Anterolateral view of left ventricle and mitral subvalvular apparatus.

Moreover, all pulmonary vein orifices cannot be visualized from this view; only right superior and inferior pulmonary vein orifices can be visualized.²

As a second point, an ideal annuloplasty technique should primarily address the septolateral diameter with less impact on transverse diameter, aiming to avoid distorting both leaflets, especially in the case of functional mitral regurgitation,³ where type IIIb dysfunction is observed if fibrotic changes do not exist. It can be speculated that papillary muscle sling placement will fail to reduce equatorial septolateral dimension

while exerting its main effect on transverse diameter when spatial locations of papillary muscles in left ventricle are taken into account. Because septolateral dimensional change is one of the most important determinants of recurrence after mitral valve repair,^{4,5} papillary muscle sling placement technique seems not to add much to the conventional downsizing ring annuloplasty when long-term outcomes are evaluated.

In conclusion, correction of the illustration as shown in [Figure 1](#) can be useful to avoid misunderstandings. We appreciate the authors for their

efforts and thank them for sharing their experiences.

Murat Tavlascoglu, MD^a

Ahmet Baris Durukan, MD^b

Hasan Alper Gurbuz, MD^b

Ugur Kucuk, MD^c

^aDepartment of Cardiovascular Surgery

Diyarbakir Military Medical Hospital

Diyarbakir, Turkey

^bCardiovascular Surgery

Medicana International Ankara Hospital

Ankara, Turkey

^cDepartment of Cardiology

Van Military Medical Hospital

Van, Turkey

References

1. Santana O, Solenkova NV, Pineda AM, Mihos CG, Lamelas J. Minimally invasive papillary muscle sling placement during mitral valve repair in patients with functional mitral regurgitation. *J Thorac Cardiovasc Surg*. March 29, 2013 [Epub ahead of print].
2. Carpentier A, Adams DH, Filsoufi F. Surgical anatomy and physiology. In: Carpentier A, Adams DH, Filsoufi F, eds. *Carpentier's reconstructive valve surgery*. Philadelphia: Saunders; 2010:27-43.
3. Maisano F, Redaelli A, Soncini M, Votta E, Arcobasso L, Alfieri O. An annular prosthesis for the treatment of functional mitral regurgitation: finite element model analysis of a dog bone-shaped ring prosthesis. *Ann Thorac Surg*. 2005; 79:1268-75.
4. Tahta SA, Oury JH, Maxwell JM, Hiro SP, Duran CM. Outcome after mitral valve repair for functional ischemic mitral regurgitation. *J Heart Valve Dis*. 2002;11:11-8; discussion 18-9.
5. Kwon MH, Lee LS, Cevasco M, Couper GS, Shekar PS, Cohn LH, et al. Recurrence of mitral regurgitation after partial versus complete mitral valve ring annuloplasty for functional mitral regurgitation. *J Thorac Cardiovasc Surg*. 2013;146: 616-22.

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Reply to the Editor:

We greatly appreciate Tavlascoglu and colleagues' interest in our recent publication, which reported the safety and feasibility of the placement of a papillary muscle sling during minimally invasive mitral valve repair for functional mitral regurgitation (MR).¹ We appreciate their illustration, because ours was more of a

general representation. We respectfully disagree, however, with most of their comments and conclusions.

Their statement that “an ideal annuloplasty technique should primarily address the septolateral diameter” implies that annular dilatation plays an important role in the cause of the MR and that addressing this issue should solve the problem. This thinking is erroneous. Most patients with functional MR have a structurally normal mitral valve; however, the valve is incompetent because of left ventricular remodeling that has disturbed the relationship between the subvalvular apparatus and the mitral valve leaflets. In vitro models have demonstrated that the coaptation length of the mitral valve leaflets is sufficiently redundant, permitting an approximate 1.8-fold increase in annular area before MR develops.² This means that the relative contribution of annular enlargement to the overall regurgitant burden in functional MR is minor relative to that imparted by the tethering forces on the mitral valve leaflets as a result of the apical and posterolateral displacement of the papillary muscles. The main cause of MR is thus leaflet malapposition, which is the failure of the leaflets to close on the same plane, as opposed to leaflet malcoaptation, which is the failure of the leaflets to meet. What this means is that functional MR is mainly a ventricular problem, rather than a valve problem.

To support their premise that a papillary muscle sling would not work, Tavlasoglus and colleagues state that “septolateral dimension change is one of the most important determinants of recurrence after mitral valve repair” and cite references from Maisano and coworkers³ and Tahta and associates.⁴ Neither of these references

supports their comments; in fact, Maisano and coworkers³ clearly stated that “a significant correlation was found between recurrent MR and declining left ventricular function,” that in functional MR “mitral valve annuloplasty is simply a temporizing measure,” and that “a simple ring annuloplasty does not definitively restore” the optimal left ventricular geometry. Nowhere do they make any comment to support the statements of Tavlasoglus and colleagues. Tahta and associates⁴ reported on a study comparing complete annuloplasty rings with partial rings. They did not state that a septolateral dimension change was the cause of recurrent MR. Data from the Cleveland Clinic have demonstrated that in patients undergoing undersized annuloplasty for functional MR, 28% will have moderate or more MR develop 6 months postoperatively. It is believed that the recurrent MR is caused by the underlying process of left ventricular dilatation from left ventricular remodeling, which continues despite having “fixed” the valve.

Because the recurrent MR rates are so high with an undersized annuloplasty technique, many authors are exploring other adjunctive procedures to reduce this recurrence. This includes restraint devices such as the Coapsys system and the Acorn Corcap, which are intended to improve left ventricular function by reducing wall stress, provide passive diastolic support, and reduce continued left ventricular dilatation. Along similar lines, papillary muscle sling placement is being evaluated to reduce the progression of left ventricular remodeling. Work by Hvass and Joudinaud⁵ has demonstrated that placement of a papillary muscle sling in patients undergoing annuloplasty for functional MR is

associated with improvement in ejection fraction, reduction in the end-diastolic and end-systolic diameters, and reduction in the mean pulmonary arterial systolic pressure. Our results have been similar to theirs. Although the optimal approach to the management of individual patients with ischemic MR has not been established, we believe that an undersized annuloplasty approach is not enough, and other techniques need to be explored.

Orlando Santana, MD^a

Natalia V. Solenkova, MD^b

Andres M. Pineda, MD^a

Christos G. Mihos, DO^a

Joseph Lamelas, MD^c

^aColumbia University Division of Cardiology

^bDivision of Internal Medicine

^cDivision of Cardiac Surgery

Mount Sinai Heart Institute

Miami Beach, Fla

References

1. Santana O, Solenkova NV, Pineda AM, Mihos CG, Lamelas J. Minimally invasive papillary muscle sling placement during mitral valve repair in patients with functional mitral regurgitation. *J Thorac Cardiovasc Surg*. March 29, 2013 [Epub ahead of print].
2. He S, Lemmon JD Jr, Weston MW, Jensen MO, Levine RA, Yoganathan AP. Mitral valve compensation for annular dilatation: in vitro study into the mechanisms of functional mitral regurgitation with an adjustable annulus model. *J Heart Valve Dis*. 1999;8:294-302.
3. Tahta SA, Oury JH, Maxwell JM, Hiro SP, Duran CM. Outcome after mitral valve repair for functional ischemic mitral regurgitation. *J Heart Valve Dis*. 2002;11:11-8.
4. Kwon MH, Lee LS, Cevasco M, Couper GS, Shekar PS, Cohn LH, et al. Recurrence of mitral regurgitation after partial versus complete mitral valve ring annuloplasty for functional mitral regurgitation. *J Thorac Cardiovasc Surg*. 2013;146:616-22.
5. Hvass U, Joudinaud T. The papillary muscle sling for ischemic mitral regurgitation. *J Thorac Cardiovasc Surg*. 2010;139:418-23.

<http://dx.doi.org/10.1016/j.jtcvs.2013.07.023>