accomplished via suture or graft-based techniques⁴ (Table 1). Combining annuloplasty with a papillary muscle intervention may support: (1) a reduction in septal-lateral annular dilatation; (2) movement of the anterolateral papillary muscle closer to the annulus; (3) correction of the lateral displacement and apical restriction of the posterior papillary muscle; and (4) alleviation of chordal tethering forces, which affect the balancing forces necessary for proper leaflet closure and competence.^{2,3} Furthermore, supporting the subvalvular apparatus by targeting the papillary muscles allows for consideration of a true-sized ring placement for annular support, which may help avoid the untoward effects of augmented posterior leaflet tethering, and functional mitral stenosis, that can occur with restrictive annuloplasty.⁵

Addressing the mechanisms underlying ischemic mitral regurgitation is critical to applying the optimal surgical strategy. Although combined annuloplasty and papillary muscle interventions targeting the annular and subvalvular distortions present in ischemic mitral regurgitation are promising, the reported data are from small, single-center, retrospective or observational studies. Multicenter registries and future randomized trials are warranted to define the durability of these procedures.

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WE NEED A BETTER WAY TO REPAIR ISCHEMIC MITRAL REGURGITATION

Reply to the Editor:

We very much appreciate the interest of Mihos and Santana in our study, “Predicting Recurrent Mitral Regurgitation After

Mitral Valve Repair for Severe Mitral Regurgitation.” We developed a model that demonstrates good discrimination in identifying patients with severe ischemic mitral regurgitation (MR) who, with repair, will survive 2 years without moderate or severe MR. We agree with their concept of a pathophysiologically guided approach to surgical mitral valve repair, including the use of various papillary muscle interventions possibly to improve the durability of reduction annuloplasty repair for ischemic MR. Although there have been individual reports of subvalvular approaches to mitral repair in this setting, these have not been subjected to large scale trials across multiple centers. We agree that additional work is needed to ensure adequate and durable correction of severe ischemic MR with repair techniques tailored to the anatomy and physiology of individual patients. We have a limited but improving understanding of why and when MR recurs after repair for severe ischemic MR. Patients who have the appropriate preoperative pathophysiology would serve as the best subjects for new repair techniques that can be rigorously tested in a randomized fashion.

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ORIENTATION OF BILEAFLET MECHANICAL AORTIC VALVE PROSTHESES FOR OPTIMAL EVALUATION BY TRANSTHORACIC ECHOCARDIOGRAPHY

To the Editor:

Transthoracic echocardiography remains the first step in the noninvasive assessment of prosthetic valve function. Adequate visualization of leaflet mobility and surrounding structures are essential parts of the routine echocardiographic evaluation of prosthetic valves. Many prosthetic components, however, particularly those of mechanical valves, do not transmit ultrasound and generate artifacts

FIGURE 1. A and C, Schematic parasternal short-axis (A) and long-axis (C) views in systole of a bileaflet mechanical aortic valve prosthesis with the disks (heavy black lines) oriented perpendicularly to the ultrasound beam; acoustic shadowing (gray shaded areas) precludes the adequate visualization of the posterior aortic root. B and D, Short-axis (B) and long-axis (D) views of a mechanical aortic valve prosthesis with the disks oriented parallel to the ultrasound beam; shadowing artifacts are significantly reduced. RCA, Right coronary artery; RV, right ventricle; TV, tricuspid valve; R, right coronary sinus; PV, pulmonary valve; N, noncoronary sinus; L, left coronary sinus; RA, right atrium; IAS, interatrial septum; LCA, left main coronary artery; LA, left atrium; AO, ascending aorta; LV, left ventricle. Courtesy of Luis Míguez-Rodríguez.

that limit the interpretability of the final imaging of the prosthesis and distal structures, interfering significantly with the diagnostic capabilities of echocardiography.

In the particular case of mechanical aortic valve prostheses, the best quality images by transthoracic echocardiography are usually obtained through the parasternal window, because the transducer is closest to the prosthesis in that position. Nonetheless, evaluation of leaflet mobility may be challenging, and the assessment of the posterior aspect of the valve and aortic root may be obscured by acoustic shadowing and reverberations.

These artifacts are most evident when the leaflets are oriented perpendicularly to the ultrasound beam. In this case, the disk that is closest to the transducer reflects the ultrasound, impairing the visualization of the other disk and of the posterior aortic root. On the other hand, when the leaflets are parallel to the ultrasound beam, it is usually possible to visualize the mobility of both disks in the parasternal short-axis view, and the artifacts affecting the imaging of the posterior aortic root are significantly reduced (Figure 1).

We therefore suggest that all bileaflet mechanical aortic valve prostheses be implanted in a manner such that both

leaflets are parallel to the ultrasound beam in the parasternal view. This may be accomplished by orienting 1 of the 2 pairs of hinge points of the leaflets towards the ostium of the right coronary artery at the time of surgery, because this anatomic landmark lies immediately below the parasternal window. We speculate that such prosthesis orientation would improve diagnostic performance of transthoracic echocardiography, especially in cases of suspected prosthetic aortic valve endocarditis, and would also be very helpful in the assessment of leaflet mobility, particularly if high transprosthetic gradients are recorded, potentially reducing the need for transesophageal echocardiography and other downstream imaging tests.

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Video clip is available online.

**TURNING TO THE TRUTH:
IS MECHANICAL AORTIC
VALVE ORIENTATION
IMPORTANT IN
TRANSTHORACIC
ECHOCARDIOGRAPHIC
DETECTION OF PROSTHETIC**

**DYSFUNCTION AND PARAVALVULAR
ENDOCARDITIS COMPLICATIONS?**

Reply to the Editor:

We read with interest the letter by Bouzas-Mosquera and Álvarez-García proposing universal positioning of bileaflet mechanical aortic prostheses with the hinge points of the occluders oriented from the right to the left coronary cusp to maintain the ultrasound beam parallel to the disks in the transthoracic echocardiographic (TTE) parasternal short-axis view during postoperative imaging. According to the hypothesis of Bouzas-Mosquera and Álvarez-García, this not only would allow adequate visualization of dual disk

mobility by TTE but would increase the sensitivity for detection of endocarditis-related perivalvular complications, particularly posterior aortic root abscess.

Rational concern with this hypothesis exists on both fronts, however. Although occluder orientation could theoretically play a role in the quality of leaflet mobility visualization by TTE, other factors such as body habitus, gain or compression settings, and prosthesis size are critical. In fact, although it is uncommon, it is certainly feasible to visualize bileaflet disk mobility with occluder orientation opposite to that suggested by Bouzas-Mosquera and Álvarez-García. As shown in Figure 1, clear systolic visualization of both disks in the parasternal long-axis view (Figure 1, A, arrows) as well as the parasternal short-axis view (Figure 1, B, arrows, and Video 1) is obtained in a patient with a body mass index of 26 kg/m², a large aortic prosthesis, and excellent acoustic windows.

Notably, when prosthetic obstruction is suspected, TTE visualization of disk mobility alone is not sufficient to differentiate instances of pseudoobstruction, such as patient-prosthesis mismatch, from fixed anatomic obstruction. In these cases, assessment of opening occluder angles (as specified by the prosthetic device manufacturer) is critical but rarely possible by TTE¹ or even transesophageal echocardiographic visualization of leaflet mobility. Figure 2 shows early systolic (Figure 2, A, arrows) and late systolic (Figure 2, B, arrows) bileaflet disk mobility by transesophageal echocardiography (parasternal short TTE-equivalent view; Video 2) in an obese patient with a small prosthesis where leaflets were indistinguishable by TTE. Although the orientation of this patient's prosthesis fits the "ideal" according to Bouzas-Mosquera and Álvarez-García, it is, in fact, impossible to determine the systolic opening angles of the disks because the anatomic level of the tomographic plane is unknown. Rather, fluoroscopic imaging perpendicular to the lateral long axes of

FIGURE 1. A, Transthoracic echocardiographic parasternal long-axis view systolic still frame shows a mechanical aortic valve with good systolic bileaflet visualization (arrows) even though disks are oriented perpendicular to the ultrasound beam. B, Transthoracic echocardiographic parasternal short-axis view systolic still-frame on the same patient also shows good systolic bileaflet visualization (arrows) despite valve orientation. RV, Right ventricle; LV, left ventricle; LA, left atrium; RA, right atrium.