The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

## TWENTY-YEAR FOLLOW-UP AFTER VALVE-SPARING AORTIC ROOT REPLACEMENT WITH THE YACOUB OR DAVID PROCEDURE IN MARFAN PATIENTS

**To the Editor:**

The pursuit of the best valve-sparing treatment strategy for aortic root disease in patients with Marfan syndrome has been the subject of intense debate over the past few decades. Two surgical approaches are commonly employed and are known as the remodeling (ie, Yacoub) or reimplantation (ie, David) technique.[1,2] During the mid-1990s, the topic was center stage at the American Association for Thoracic Surgery and other prominent surgical meetings. Sir Magdi Yacoub and Tirone David were advocating for their respective techniques, and each had contemporary proponents, which is the case to this day.

Urbanski and colleagues[3] recently demonstrated their results with a modified remodeling technique in patients with Marfan syndrome and concluded that it is an effective and durable method. However, mean follow-up of their cohort was just 6.1 ± 3.1 years, ranging from 0.8 to 14.2 years, and reaching a verdict this early may just have been a little premature.

We are now beginning to gain new insights because patients with 20 years of follow-up after undergoing Yacoub or David procedure are returning to our clinics (Figure 1). Our concern has been that although both procedures adequately address the acute pathology, long-term successful outcomes are limited by recurrence of aortic annular enlargement, or more importantly, aortic root dilation in patients who have undergone the remodeling technique. Although clinicians have neglected to consider recurrent aortic root enlargement as a possibility, this is exactly what we are witnessing today.



Urbanski and colleagues[3] state that recurrent dilatation of the neosinuses occurs due to unstable suture lines, and that a more precise suturing to the annulus, rather than the aortic wall remnant, would provide lasting durability and aid with hemostasis. This sentiment is derived from the early days, when Sir Magdi Yacoub advocated for this approach to achieve a durable annuloplasty effect (Video 1) as he referred to the ringlike junction of the aortic wall and ventricle as the surgical annulus.[1]

Schneider and colleagues[4] as well as Lansac and colleagues[5] have hypothesized that the better long-term results seen with the reimplantation technique are likely due to better annular stabilization and have henceforth added an annuloplasty to their remodeling technique to obviate the future annular dilatation in Marfan patients. This stems from a better understanding of the functional aortic annulus and the need for a more durable annular stabilization at the level of the virtual basal ring. Thus, proponents of the remodeling technique have understood that a meticulous suturing technique alone, closer to the hinge point of the valve leaflets—the surgical annulus—may not suffice.

Annular dilatation is certainly a concern but it isn't the only area of interest. We now know that recurrent aortic root enlargement in Marfan patients can occur in the absence of aortic annular enlargement, and despite a meticulous suturing technique. The dilation can occur in any unsupported area, such as the interleaflet/subcommissural triangles, as well as any remaining aortic root tissues left behind. Moreover, even the suture line between the graft and the valve insertion is at risk (Figure E1). The reimplantation technique not only provides an effective annuloplasty, but it also functionally excludes all the tissues at risk for dilation through inclusion within the prosthetic graft and thereby eliminating possible recurrent aortic root dilatation later.

Twenty years after aortic root replacement for aortic root aneurysm in a Marfan patient with the reimplantation technique, we are seeing a stable annulus and stable aortic root, without any aortic root dilatation (Figure 1). In contrast, despite our meticulous suturing technique (Video 1), after a valve-sparing remodeling procedure 20 years ago, we encountered a severe aortic root enlargement (Figure 1). This occurred in the presence of aortic annular enlargement (3.2 cm) but the indication for surgery was driven by the severe aortic root enlargement (6.2 cm), and hence required a redo valve-sparing reimplantation technique. The substrate for the recurrent severe aortic root dilatation was the combination of chronic suture line dehiscence as well as enlargement of any remaining aortic tissues between the valve insertion and the suture line (Figure E2, *A* and *B*).

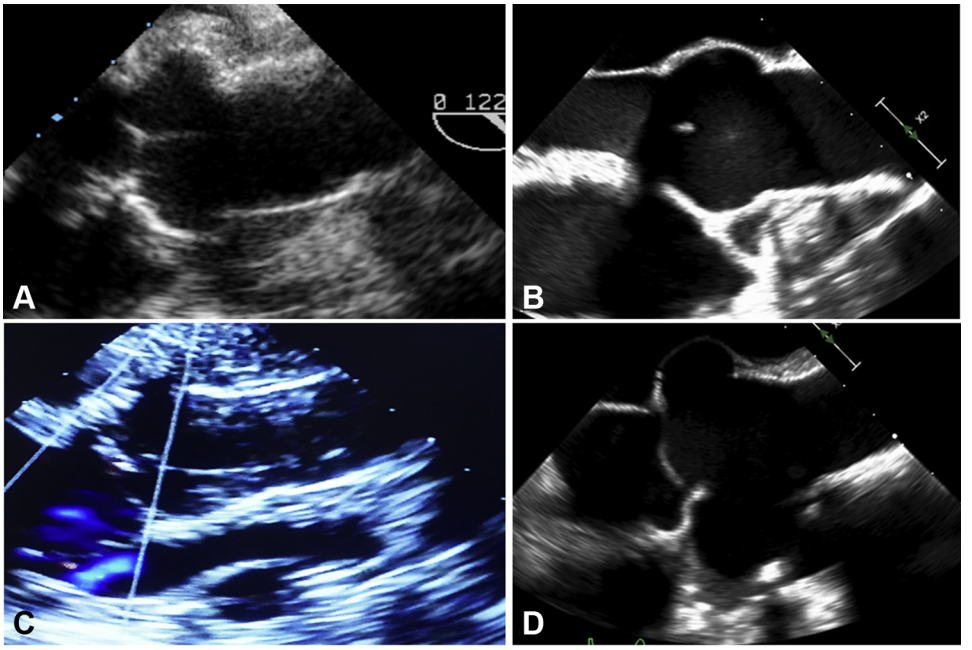
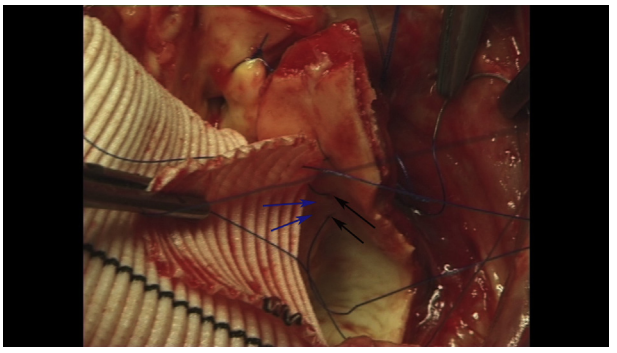



**FIGURE 1.** Echocardiography images for reimplantation (A and B) and remodeling (C and D) technique in Marfan patients. A, Immediate postoperative echocardiographic image after reimplantation technique. B, Echocardiographic image after 20 years following reimplantation technique shows a stable aortic root. C, Immediate postoperative echocardiography image after remodeling technique. D. Echocardiography image after 20 years following remodeling technique shows severe aortic root enlargement (6.2 cm).

We are just now starting to see the 20-year results after initial valve-sparing aortic root replacement in Marfan patients. And what we observe is recurrent severe aortic root enlargement after the remodeling technique, and stable repair after the reimplantation technique.



**VIDEO 1.** Our remodeling (Yacoub) technique over the past 3 decades. The video describes our suture technique for the prosthetic graft to the aortic remnant during the remodeling technique. Video available at: https://www.jtcvs.org/article/S2666-2736(21)00199-6/fulltext.

*Jama Jahanyar, MD, PhD, FACS*
*Laurent de Kerchove, MD, PhD*
*Daniel E. Munoz, MD*
*Gebrine El Khoury, MD, PhD*
*Department of Cardiovascular and Thoracic Surgery*
*Cliniques Universitaires Saint-Luc*
*Université Catholique de Louvain*
*Brussels, Belgium*

## References

1. Sarsam MA, Yacoub M. Remodeling of the aortic valve anulus. *J Thorac Cardiovasc Surg*. 1993;105:435-8.
2. David TE, Feindel CM. An aortic valve-sparing operation for patients with aortic incompetence and aneurysm of the ascending aorta. *J Thorac Cardiovasc Surg*. 1992;103:617-21.
3. Urbanski PP, Jankulowski A, Morka A, Irimie V, Zhan X, Zacher M, et al. Patient-tailored aortic root repair in adult marfanoid patients: surgical considerations and outcomes. *J Thorac Cardiovasc Surg*. 2018;155:43-51.e41.
4. Schneider U, Ehrlich T, Karliova I, Giebels C, Schafers HJ. Valve-sparing aortic root replacement in patients with Marfan syndrome-the Homburg experience. *Ann Cardiothorac Surg*. 2017;6:697-703.
5. Lansac E, Di Centa I, Varnous S, Rama A, Jault F, Duran CM, et al. External aortic annuloplasty ring for valve-sparing procedures. *Ann Thorac Surg*. 2005;79:356-8.

https://doi.org/10.1016/j.xjon.2021.07.013

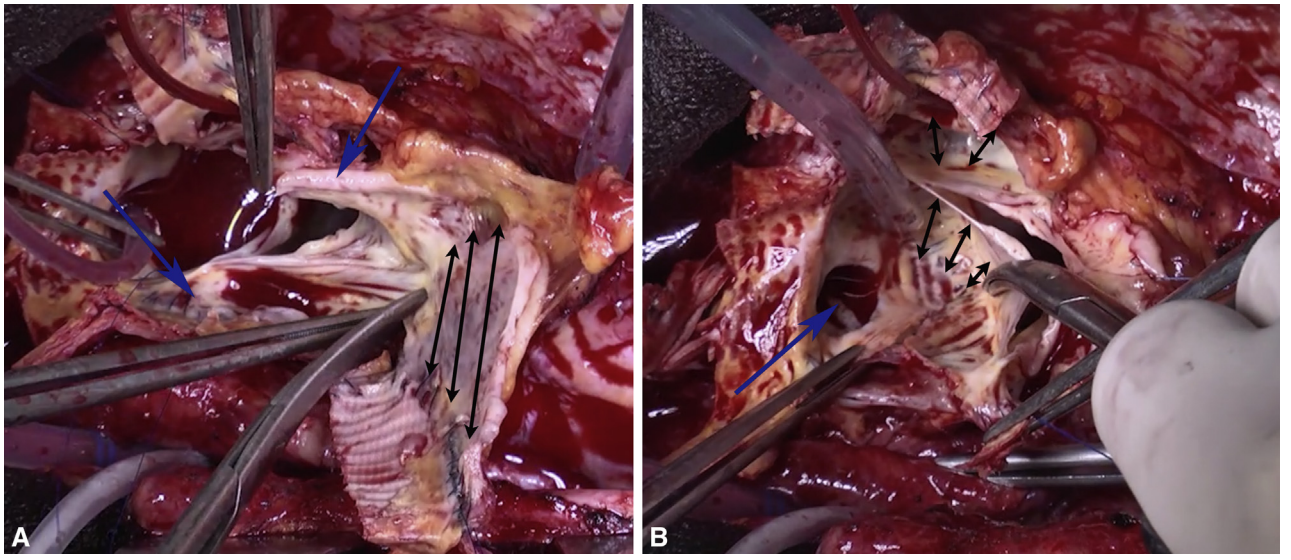



**FIGURE E1.** A, *Blue arrows* depict the commissures. *Black arrows* depict severe enlargement of the aortic tissues between the prosthetic graft and the valve insertion/suture line at the non/right commissure. B, *Blue arrow* depicts the left coronary artery ostium, whereas *black arrows* show enlargement versus dehiscence between the prosthetic graft suture line and the valve insertion.

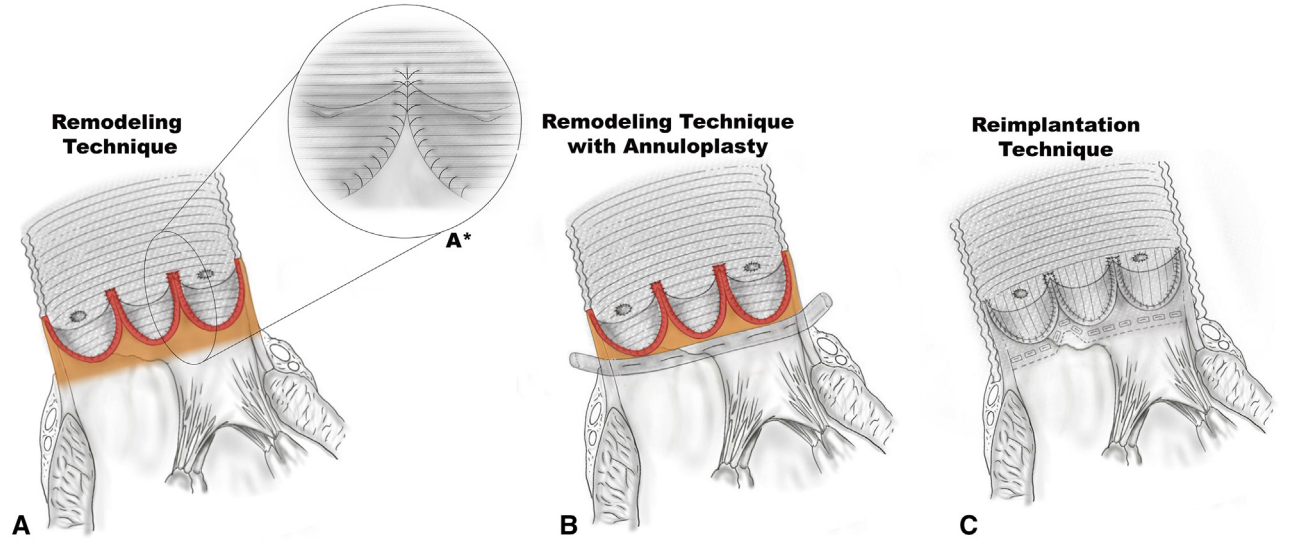



**FIGURE E2.** A, Remodeling technique in patients with Marfan syndrome. The *red area* depicts the area at high risk for dilation or dehiscence. *Orange area* depicts annular and subcommissural area at risk for dilatation. A*, Magnification of commissures depicting the correct suturing technique at the valve insertion. B, Remodeling technique and annuloplasty in Marfan syndrome. *Colored area* indicates area at risk for dehiscence and dilatation. C, Reimplantation technique in patients with Marfan syndrome.