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Commentary: Through thick and thin

Jonathan C. Hong, MD, MHS, and
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The skeleton of the aortic root is a complex structure consisting of the virtual basal ring, aortoventricular junction, and sinotubular junction.¹ In brief, the virtual basal ring is defined by the nadirs of the aortic valve leaflets. The aortoventricular junction is where the ventricular septum and aortic–mitral curtain intersect with the arterial system. The sinotubular junction is demarcated by the top of the aortic valve commissures. The interplay between the aortic leaflets and anatomic skeleton dictates the function of the aortic root.^{2,3}

Understanding the spatial relationships among the parts of the aortic root is crucial for surgeons performing valve-sparing root replacement. In this issue of the *Journal*, Irace and colleagues⁴ describe the first in vivo analysis of the aortic root in 10 consecutive valve-sparing aortic root replacements by the reimplantation (ie, David) technique. All patients had an aortic root aneurysm with a trileaflet aortic valve and some degree of regurgitation. Dr De Paulis, developer of the Valsalva aortic root graft and a leading expert in valve-sparing aortic root replacement, has described a thorough root dissection to the aortoventricular junction.¹ In particular, the dissection was carried past the aortopulmonary ligament and fat pad into the muscular plane between the left and right coronary cusps. Six pledgeted sutures were placed circumferentially along the virtual basal ring (nadir and interleaflet triangle) and were anchored to the Valsalva graft. Surgical clips

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The reconstructed ventricular aortic junction is slightly asymmetrical compared with the virtual basal ring after valve-sparing root replacement by the reimplantation technique.

were placed at the knots of the annuloplasty sutures and knots of the commissures at the neo-sinotubular junction. The inner annuloplasty of pledgets represented the virtual basal ring, and the outer annuloplasty of the surgical clips along the base of the Dacron graft represented the aortoventricular junction of the reconstructed root after the reimplantation technique. Electrocardiography-gated computed tomography was performed, and 3-dimensional modeling was used to analyze the spatial relationships within the reconstructed root.

Irace and colleagues found that the reconstructed aortic root corresponded to normal human anatomy. The inner annuloplasty of pledgeted sutures were oriented in a circular plane at the nadirs of the valve leaflets. The outer annuloplasty demarcated by the proximal edge of the Valsalva graft was slightly asymmetric in height and thickness with respect to the virtual basal ring. The height of the reconstructed aortoventricular junction was closest and thinnest at the noncoronary sinus and farthest away and thickest at the left and right commissures. As surgeons, we expect this asymmetry, as our dissection is limited by the muscular and membranous septum.⁵

Where do we go from here? The function of the aortic root is a time-related interaction between the aortic root skeleton and aortic leaflets. It would be useful for subsequent in vivo analyses to include a time dimension to understand the structure of the reconstructed root across the cardiac cycle and evaluate whether these spatial

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relationships change over time. This methodology also could help determine the effect of these spatial relationships on durability, specifically whether we need to be dissecting deeper in the muscular septum or whether we can get away with a less aggressive dissection. In conclusion, Irace and colleagues have confirmed our understanding of the structure of the reconstructed root and the crucial need for surgeons undertaking valve-sparing procedures to fully appreciate this complex anatomy.

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Commentary: The depth of the virtual basal ring

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The anatomic demarcation between the left ventricular outflow tract (LVOT) and the aortic root, and thus the beginning of the arterial system, is the ventriculoaortic junction (VAJ). However, in an anatomic study in human hearts, we have demonstrated that the VAJ is rather curvilinear.¹ It crosses the base and insertion of the right coronary cusp and lays a few millimeters above the virtual basal ring (VBR; defined as the plane passing through the nadirs of each aortic cusp), in between the left/right and the right/noncoronary commissures. Thus, the VAJ is farther away from the VBR, facing the right ventricular outflow tract (RVOT). Nonetheless, it is this muscular portion of the

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Deep dissection of the aortic root is needed to allow for a 360° aortic valve annuloplasty at the true depth of the virtual basal ring.

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VAJ that becomes dilated in patients with root aneurysms. Although the VAJ has to be supported during repair, it constitutes an anatomic rather than an echocardiographic or surgical landmark. In the reimplantation technique, the vascular graft is anchored to the aortic annulus at the level of the VBR. This circumferential annuloplasty helps to prevent future dilatation, as it includes and supports the VAJ 360°.

Our colleague and friend Ruggero De Paulis and his group² in Rome have done much in the past to further our understanding of the aortic root. Here they study and examine the aortic root after surgical intervention,