

Surgery for Diseases of the Aortic Root



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KEYWORDS

• Cardiac surgery • Aortic root • Diagnosis • Management • Outcomes

KEY POINTS

- The aortic root represents the outflow tract from the left ventricle where it acts as a bridge between the left ventricle and the ascending aorta.
- The aortic root comprises the aortic valve and the coronary ostia.
- Aortic root surgery is indicated in the setting of aneurysmal dilatation, acute aortic dissection, and acute endocarditis.
- Repair frequently involves the replacement of the aortic root including the aortic valve, which can include a prosthetic valve, cryopreserved homograft, or a pulmonary autograft.
- Many patients are candidates for aortic root reconstruction with valve sparing of the native aortic valve.

INTRODUCTION AND ANATOMY

The aortic root is the origin of the aorta, commencing where the ventricular musculature of the left ventricular outflow tract changes to that of the fibroblastic wall of the ventricular arterial junction.¹ It begins with the aortic annulus, the hemodynamic boundary between the left ventricle and the aorta, and ends at the sinotubular junction just distal to the aortic valve commissures (**Fig. 1**). It contains the aortic annulus, the aortic cusps, the aortic sinuses from which the coronary arteries originate, and the sinotubular junction, all of which function physiologically as a unit. The aortic annulus has a scalloped shape and is attached directly to myocardium in approximately 45% of its circumference and 55% to fibrous structures. The diameter of the aortic annulus is 10% to 20% larger than the diameter of the sinotubular junction in younger patients but becomes equal with age as its elastic fibers allow dilatation over time.

Leonardo da Vinci described the anatomy of the aortic root in 1513, depicting both the opened and closed aortic valve within the cylinder of the aorta.² In 1740, Valsalva correctly suggested that coronary artery filling takes place during diastole from these sinuses.³ Since then, a fundamental understanding of the anatomic and functional relationships of the components of the aortic root have developed. These, in turn, have allowed for the development of sophisticated surgical procedures to both replace and reconstruct the aortic root, depending on the pathologic process. Tirone David, one of the world's authorities on the pathophysiology and surgical reconstruction of the aortic root, nicely described the relationships of the aortic valve cusps to each other and to the sinotubular junction: "During diastole, the free margins and part of the body of the three cusps touch each other approximately in the center of the aortic root to seal the aortic orifice. Thus the average length of the free margins of three aortic

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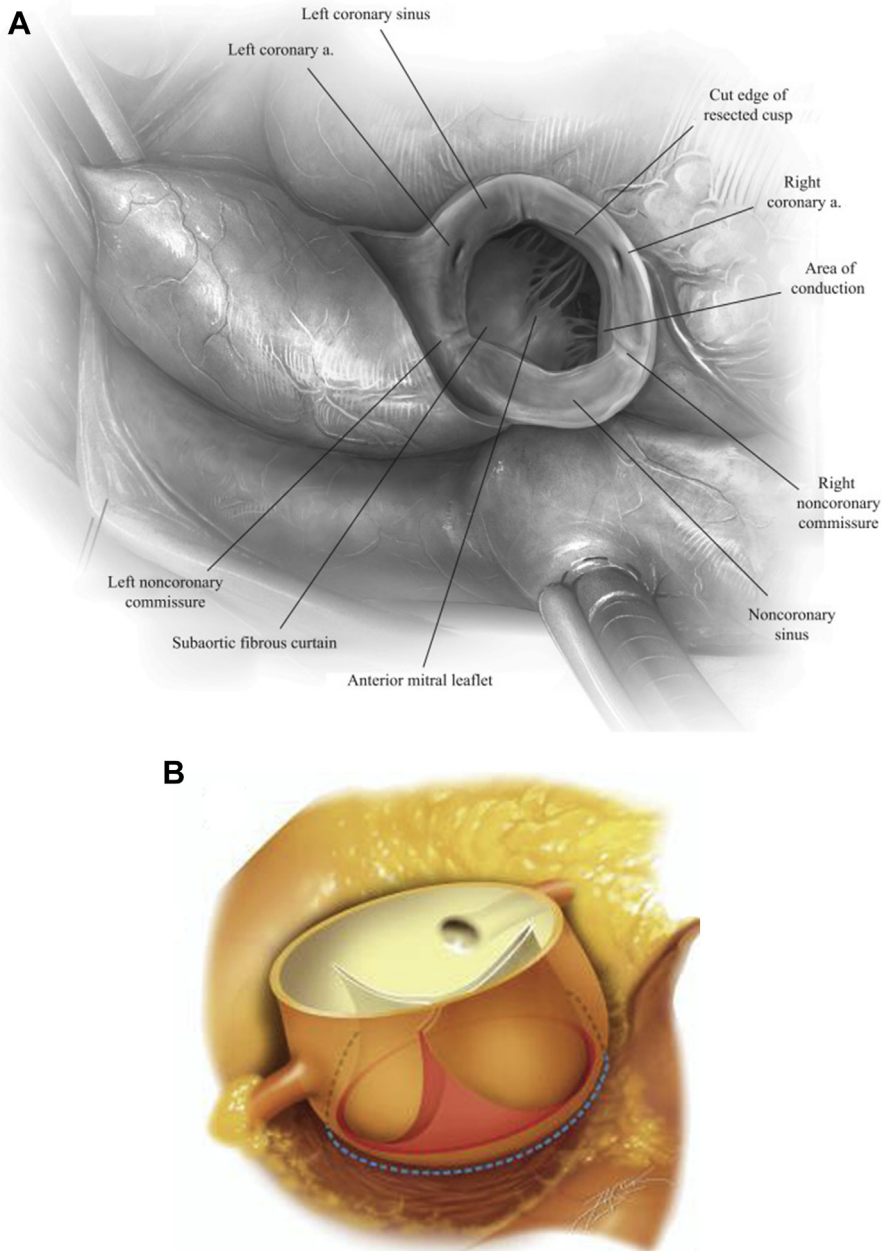


Fig. 1. (A) Anatomy of the aortic root shows the valve cusps have been excised to show the aortic annulus and aortic outflow tract. (B) Anatomy of the aortic root shows the aortic root with aortic valve intact. (Adapted from [A] Grubb, KJ. Aortic root enlargement during aortic valve replacement: nicks and manouguian techniques. *Oper Tech Thorac Cardiovasc Surg* 2015;20(3):206–18, with permission; and [B] Holubec T, Higashigaito K, Belobradek Z, et al. An expansible aortic ring in aortic root remodeling: exact position, pulsatility, effectiveness, and stability in three-dimensional CT study. *Ann Thorac Surg* 2017;103(1):83–90, with permission.)

cusps must exceed the diameter of the sinotubular junction to allow the cusps to coapt centrally and render the aortic valve competent. If a pathologic process causes shortening of the length of the free margin of a cusp or if the sinotubular junction dilates, the cusps cannot coapt centrally resulting

in aortic insufficiency. If the length of a free margin is elongated, the cusp prolapses, and depending of the degree of prolapse, aortic insufficiency ensues.⁴ Dilatation of the aortic root with and without aortic insufficiency is most commonly caused by abnormalities of the connective tissue

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