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Commentary

Dr Grande-Allen and colleagues used finite element analysis to compare the stress and strain on the aortic cusps in normal aortic roots and in surgically reconstructed roots by means of aortic valve-sparing operations. They used magnetic resonance imaging of normal human aortic roots to establish the geometry of the model for their finite element analysis and made theoretical assumptions on three types of aortic root reconstruction with preservation of the native aortic cusps and anulus. They assumed that the technique of reimplantation of the aortic valve[1,2] creates a "cylindrical" aortic root of Dacron fabric without sinuses, the technique of remodeling of the aortic root[1,2] creates a supra-annular "cylinder" of Dacron fabric without aortic sinuses, and finally the technique of reimplantation of the aortic valve into a Dacron graft with a scalloped subannular suture line creates three "pseudosinus."[3] Although the aortic cusps in all three theoretical models of reconstructed aortic root had increased stress and strain when compared with the normal aortic root, the first technique was associated with the highest and the one with neo-aortic sinuses with the lowest stress and strain. Those investigators concluded that "valve-sparing techniques that allow the potential for sinus space formation (tailored, pseudosinus) result in simulated leaflet stresses that are closer to normal than the cylindrical technique."

In addition to the limitations of the study pointed out by the authors, another important limitation was the theoretical assumptions on the geometry of the reconstructed aortic roots after various types of aortic valve-sparing operations. They used magnetic resonance images of human aortic roots to create the "normal" model for the finite element analysis and used their imagination to create the models of the reconstructed roots. Had they used magnetic resonance or echocardiographic images of reconstructed aortic roots, the results would have been quite different. More important, the results would vary from patient to patient depending on who had the same type of aortic root reconstruction.

I have had no clinical experience with the third type of reconstruction of the aortic root these authors described,[3] but I have reconstructed almost 200 aortic roots using the techniques of reimplantation of the aortic valve and remodeling of the aortic root.[1-2] During the first few years of my experience with these operations, I used almost exclusively the technique of reimplantation of the aortic valve. Then I met one of the investigators of this study, Dr Karyn Kunzelman, who convinced me that the aortic sinuses were important for normal aortic valve closure and possibly durability,[1] and I began to use the technique of remodeling of the aortic root. Contrary to hypothetical geometric models of reconstructed roots described by Dr Grande-Allen and colleagues,

remodeling of the aortic root creates three neo-aortic sinuses when correctly performed. The areas of these neo-aortic sinuses depend on the height of the tailored portion of the tubular graft. The more graft used to suture along the scalloped shape of the aortic anulus, the more neo-aortic sinus is obtained. When this technique is used, the resulting echocardiographic image of the reconstructed root resembles that of a normal aortic root. Thus, if geometry of the aortic sinuses is important for cusp stress and strain, this technique should offer the best results.

Creation of neo-aortic sinuses is also feasible when the technique of aortic valve reimplantation is used. One of the most difficult aspects of these operations is the selection of graft size. I have always used a graft larger than what I think is necessary. After discontinuation of cardiopulmonary bypass, the motion and function of the aortic cusps are assessed by echocardiography. If there is central regurgitation or the leaflets do not coapt properly, it is possible to correct the problem by adjusting the diameter of the sinotubular junction of the reconstructed aortic root. If the cusps move normally, a space between them and the graft wall is almost invariably present and can be documented intraoperatively by M-mode echocardiography.

It is possible that reimplantation of the aortic valve into a tubular Dacron graft increases the stress and strain on the aortic cusps, but after 12 years of clinical experience with aortic valve–sparing operations, reimplantation of the aortic valve has provided the most durable and event-free survival of all aortic valve–sparing operations I have performed.

This operation is easier to perform and it is reproducible by other surgeons. Remodeling of the aortic root requires greater knowledge of the functional anatomy of the aortic root, and the results may be more dependent on the surgeon's ability to restore normal aortic root anatomy using a tailored tubular graft.

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