

# THE FLANGE TECHNIQUE: A NEW MODIFIED PROCEDURE FOR RECONSTRUCTED CONTINUITY OF THE AORTIC VALVE AND ASCENDING AORTA

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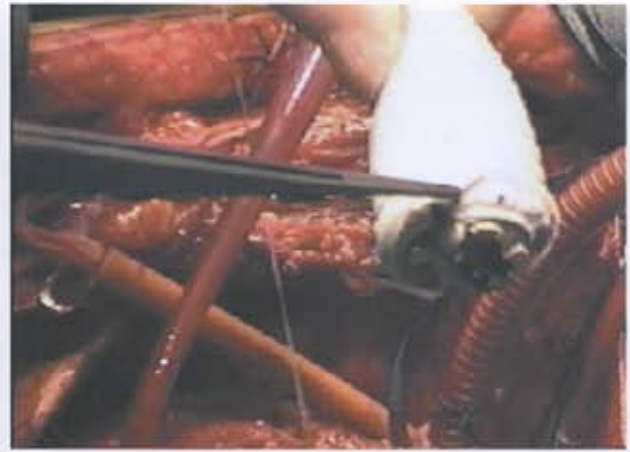
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**S**hould the correction be performed for aortic valve and ascending aorta, the procedure will be a composite valve graft device. Replacement of the aortic root, first performed by Bentall and DeBono in 1968, has been applied to a variety of aortic diseases to provide continuity of the aortic valve and ascending aorta (1). Reconstructed continuity of the aortic valve and aorta requires precise geometry in such an operation. Most important keys to successful aortic root replacement appear to be providing effective hemostasis, and elimination of tension particularly on annular and coronary ostial anastomoses. The need to modify aortic root replacement is a consequence of certain pathologies like calcific aortic annulus, massive destruction of the aortic annulus by endocarditis and primary aortic wall disease. For a better morphological basis for Bentall procedure and reducing the incidence of complications, a modified flange technique has been used in Koşuyolu Heart and Research Hospital. The original technique has been modified for reducing major hemorrhage and leakage from the composite graft and preventing pseudoaneurysm formation at suture lines and progression of aneurysmal disease and/or dissection in the remaining aortic segment, especially in patients with Marfan's syndrome or in patients with aortic dissection. The flange



**Figure 1.** Folding the collagen-impregnated Dacron vascular prosthesis.



**Figure 2.** Composite graft procreation with continuous 4-0 polypropylene sutures from the inflow aspect.

technique consists of placement of a composite collagen-impregnated Dacron vascular graft and a prosthetic valve with reimplantation of coronary ostia by the button technique.

Since September 1996, 69 consecutive patients (42 male and 27 female with a mean age of  $48.3 \pm 1.2$ ) were operated on by using the flange technique in which a flanged material has secured the sewing cuff of an appropriate size prosthetic valve using 4-0 running sutures.

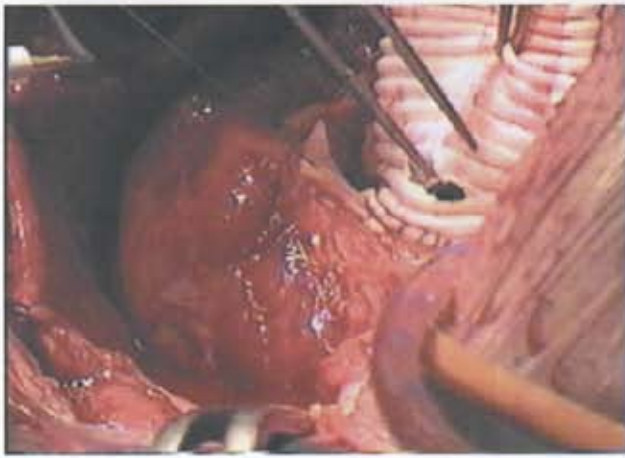
### OPERATIVE TECHNIQUE

Cardiopulmonary bypass (CPB) is initiated with femoral artery and double venous cannulation. The left ventricle is vented

through the right superior pulmonary vein. Myocardial protection is obtained by continuous retrograde isothermic blood cardioplegia. After deciding on the appropriate size of the valve and graft, the collagen-impregnated Dacron vascular prosthesis is folded outside (Figure 1) and the valve prosthesis is sutured inside of proximal end of the vascular prosthesis with continuous 4-0 polypropylene sutures (Figure 2). The composite graft is procreated with a 0.5 - 0.7 cm flanged part added to the proximal of the prosthetic valve from inflow aspect. Then the secure flanged part of the graft is implanted at the aortic annulus with continuous polytetrafluoroethylene sutures (Figures 3 and 4) or interrupted 2-0 polyester Teflon pledged



**Figure 3 and 4.** The flanged part of the graft was implanted at the aortic annulus.



**Figure 5 and 6.** Aortic button technique was carried out for reimplantation of coronary orifices.

mattress sutures according to patients' aortic annulus characteristics (calcification, infection, friability, annular ectasia, etc.), passing through the graft from inside to outside and then downward to aortic annulus externally. Aortic button technique is carried out for reimplantation of coronary orifices. Both coronary ostia are anastomosed to the holes of the composite graft with running 5-0 polypropylene sutures (Figures 5 and 6). Finally, distal anastomosis is performed end-to-end with a continuous 4-0 polytetrafluoroethylene or polypropylene sutures, optionally in a brief hypothermic circulatory arrest and/or retrograde cerebral perfusion (Figure 7).

Hypothermic circulatory arrest is required to prevent an intimal tear extending to the aortic

arch or to permit resection of the aortic arch and facilitate anastomosis of the composite graft to the arch. When an open distal anastomosis is required for an aortic arch repair or an arch replacement, the patient's temperature is lowered to 18°C. Retrograde cerebral perfusion through the superior vena cava cannula is initiated with a flow rate of 150-250 ml/min and internal jugular vein pressure of lower than 25 mm Hg.

## DISCUSSION

The aortic root has been shown to be a highly distensible structure. The function of the aortic valve is intimately related to the expansion of the aortic root, thus, non-distensible stent designs may affect its performance. In vivo distensibility of the aortic root is much greater than what is measured in vitro (2).

The importance of the sinus curvatures and interleaflet triangles (3) and their impact on stress distribution among the leaflets were studied in dogs by using marker fluoroscopy techniques (4). By biomedical engineering analysis, the stress carried by the leaflets in diastole was calculated to be four times as high as the stress in the sinuses (5). If the leaflet stress were not shared by the sinuses, the interleaflet triangular walls would be pulled inward during diastole. The challenge exists in making a graft design that resembles the native aorta more closely, to improve physiologic function of the valve and the



**Figure 7.** The aortic root continuity ensured by flanged composite graft.

long-term durability of the repair.

Current data imply that the graft should incorporate sinuses for proper valve closure and sharing stress with leaflets (4). Properly shaped sinuses will allow stress sharing with the leaflets. An optimal design for root replacement would incorporate sinuses and sinus ridge to promote valve opening and closure, as well as decreased stress on the leaflets.

All parts of the aortic root should have the capability to expand simultaneously as a unit during the cardiac pressure cycle. We suggest that if the aortic root is calcified and relatively non-distensible, the implanted valve conduit will need to expand for proper geometry. According to our initial experience of inserting the composite valve graft slightly deeper in the outflow tract, the flange technique improves aortic root distensibility more than the other modified Bentall techniques. This application ensures a lower level of shear stress on the aortic annulus. The sutures placed on the proximal cuff of the graft towards outside the aortic annulus reinforce the proximal suture line. On the other hand, to reconstruct the aortic root without applying tension on the graft may result in asymmetry, distortion of the coronary ostia, excessive postoperative hemorrhage and false aneurysm formation.

Two main issues should be addressed when analyzing the benefits of the flange technique: obtaining:

- i) a more precise geometry, and
- ii) more elasticity.

These two issues are related since the flanged composite graft provides a larger stress distribution secondary to an adequate geometry. The medium-term clinical results are encouraging, yet still there are several concerns about the procedure. This new technique provides a flexible and secure aortic continuity by preventing excess bleeding and narrowing of the root.

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