

Floating Bentall procedure for aortic root enlargement



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Institutional review board approval was not required.

The patient consented to intraoperative recording and disseminating de-identified data for research purposes.

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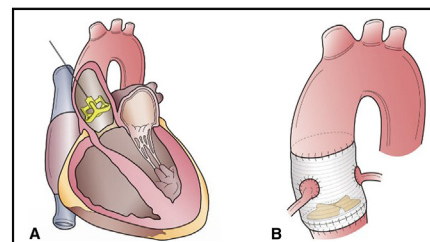


Illustration of the end result of the floating Bentall procedure.

CENTRAL MESSAGE

Floating Bentall technique is a useful technique to augment valve size for patients with a small aortic annulus that minimizes prosthesis-patient mismatch and allows for future transcatheter intervention.

▶ Video clip is available online.

In patients with a small aortic annulus undergoing aortic valve replacement, prosthesis-patient mismatch (PPM) is a clinical challenge associated with increased mortality, valve degeneration, and other adverse postoperative outcomes.^{1,2} PPM occurs when the effective orifice area of the implanted prosthesis is too small for the patient's cardiac output requirements.^{1,2} It also makes future valve-in-valve interventions challenging.

Several techniques have been described to enable placement of a larger-sized prosthesis to prevent PPM. The aortic root enlargement techniques, including Manouagian, Nicks, Konno-Rastan, Nunez, and the Y-incision, all require an incision in the aortic annulus and subannular region and use of patch material to enlarge the region.^{3,4} Here, we describe a technique, the floating Bentall, that does not require an annular incision or a subannular patch and can be used to upsize a valve by 2 to 3 sizes. Institutional review board approval was not required; the patient consented to intraoperative recording and disseminating de-identified data for research purposes.

CASE

A 66-year-old woman (height, 161 cm and body surface area, 1.67 m²) presented with severe high gradient aortic valve stenosis (peak/mean gradient, 129.4/74.0 mm Hg and aortic valve area, 0.34 cm²) with an aortic annulus measuring 21 × 17 mm and an annulus area of 290 mm². Intraoperatively, after her native aortic valve was resected, a size 19 bioprosthetic valve sizer did not fit in the annulus.

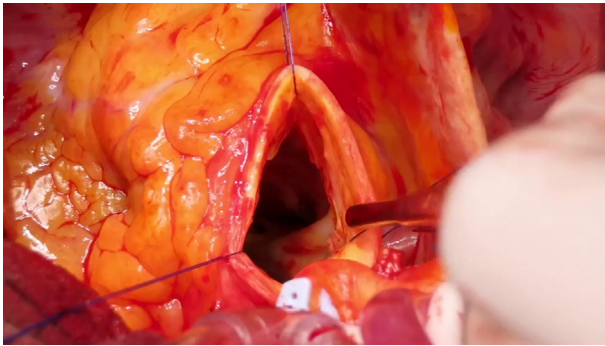
An incision in the noncoronary sinus allowed the 19 sizer to be introduced through the sinotubular junction (STJ), but it was still too large for the annulus. A floating Bentall technique was employed to augment the size of the valve. Using this technique, a 21-mm Magna Ease (Edwards Lifesciences) valve was accommodated within a size 24 Gelweave graft (Terumo Aortic). The mean postoperative gradient was 7 mm Hg, with normal coronary flow. This patient was discharged without complications. An echocardiogram performed 2 months postoperatively showed no regurgitation and a mean gradient of 8.2 mm Hg across the valve.

OPERATIVE TECHNIQUE

The surgical technique is shown in [Video 1](#).

Aortotomy and Exposure

Cardiopulmonary bypass is typically instituted with distal ascending aortic and right atrial cannulation with antegrade and/or retrograde cardioplegia for myocardial protection. Following aortic crossclamping, a transverse aortotomy was performed 1 cm above the STJ, commissural retraction sutures were placed, and the distal aorta was retracted cephalad.



VIDEO 1. Clinical case that portrays the floating Bentall procedure with the preoperative case information and postoperative outcomes. Video available at: [https://www.jtcvs.org/article/S2666-2507\(24\)00237-2/fulltext](https://www.jtcvs.org/article/S2666-2507(24)00237-2/fulltext).

Valve and Root Assessment

The aortic valve and root were inspected for tissue quality and calcification, particularly around the coronary ostia. The aortic valve leaflets were resected, and, in this case, a size 19 sizer would not fit through the STJ. The STJ was incised, allowing the 19 sizer to fit into the aortic root but not through the annulus. A floating Bentall technique was employed to augment the valve size. The coronary ostia were harvested and cardioplegia catheters were secured for intermittent delivery of cold blood cardioplegia periodically without interrupting the operation flow.

Floating Bentall Graft Preparation

A size 21 Magna Ease bioprosthetic valve was sutured within a size 24 Dacron graft leaving a rim of Dacron graft (3-4 rings) below the valve sewing ring. Typically, the Dacron graft chosen is 3 mm larger than the valve size for bioprosthetic valves and 5 mm for mechanical valves.

Proximal Anastomosis

The conduit is implanted onto the native aortic annulus using 2-0 Ethibond simple, interrupted sutures, although other suture techniques can also be performed. Notably, the sutures are passed only through the polyethylene terephthalate rim 1 to 2 mm below the valve sewing ring. The distance between this suture line and the sewing ring allows a larger prosthesis to be implanted just distal to the annulus (Figure 1).

Coronary Button Reimplantation and Distal Anastomosis

Coronary button anastomoses are performed as usual for a Bentall procedure, above the level of the valve sewing ring, using a running 5-0 polypropylene suture. Mobilization of the coronary buttons is typically not necessary but may be required in redo settings to enable the coronaries to be implanted at a sufficient height. The distal

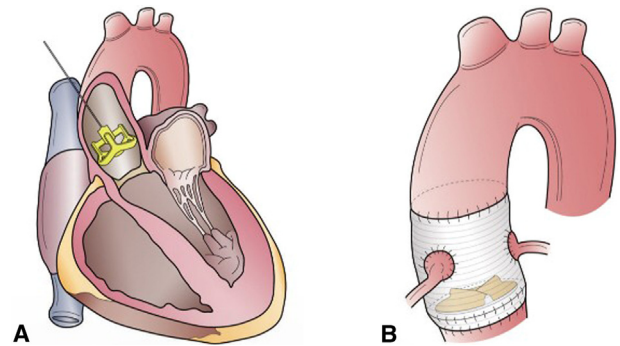


FIGURE 1. A, Illustration of a sizer not fitting inside an aortic annulus. B, Visualization of the aortic valve prosthesis sitting above the aortic annulus in the floating Bentall procedure.

anastomosis can be performed at any point in the normal ascending aorta.

DISCUSSION

We describe a Bentall technique modification to enable upsizing the prosthetic valve in a patient with a small aortic annulus. This technique is termed a floating Bentall as the implanted prosthetic valve floats 1 to 2 mm above the true aortic annulus, allowing for upsizing by 2 to 3 sizes. Advantages of this technique include avoidance of an incision through the aortic annulus and implantation of a patch; flexible polyethylene terephthalate rim adapts easily to the native annulus enabling placement of a larger polyethylene terephthalate graft in a small annulus; in an open reoperation, the valve can be replaced without the need to remove the entire composite graft as would be the case for a typical Bentall procedure; and this concept can be extended to cases where subvalvular reconstruction is required (eg, extensive calcification or endocarditis) by leaving behind a longer polyethylene terephthalate rim below the valve sewing ring.

Pitfalls

It is essential to ensure that the distance between the proximal suture line (polyethylene terephthalate to annulus) and the valve sewing ring is not too long because it will make coronary button reimplantation difficult. In addition, insertion of a much larger-sized prosthesis in a small root can lead to kinking of the right coronary artery. When using this technique, it is important to address any subvalvular pathology contributing to stenosis (eg, subvalvular membrane or hypertrophic septum). In cases where the annulus is the narrowest limiting segment, a vertical incision through the annulus can be made in the middle of the noncoronary sinus and the polyethylene terephthalate segment below the prosthetic valve can be used to augment this region. We recommend augmenting the prosthesis by no more than 2 to 3 sizes. Finally, peri-ostial calcification may make coronary

button implantation more challenging and should be considered a relative contraindication for this technique.

CONCLUSIONS

The floating Bentall technique is a versatile and effective method to augment valve size for patients with small aortic annulus, minimize PPM, and set the stage for a future valve-in-valve transcatheter aortic valve implantation procedures perhaps better than an aortic valve replacement with an isolated aortic root enlargement because this technique can also be used to increase coronary height. This technique can also be considered in routine Bentall procedures because it allows a larger prosthesis to be inserted.

Conflict of Interest Statement

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.

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References

1. Blais C, Dumesnil JG, Baillet R, Simard S, Doyle D, Pibarot P. Impact of valve prosthesis-patient mismatch on short-term mortality after aortic valve replacement. *Circulation*. 2003;108(8):983-988. <https://doi.org/10.1161/01.CIR.0000085167.67105.32>
2. Herrmann HC, Daneshvar SA, Fonarow GC, et al. Prosthesis-patient mismatch in patients undergoing transcatheter aortic valve replacement: from the STS/ACC TVT Registry. *J Am Coll Cardiol*. 2018;72(22):2701-2711. <https://doi.org/10.1016/j.jacc.2018.09.001>
3. Massias SA, Pittams A, Mohamed M, et al. Aortic root enlargement: when and how. *J Card Surg*. 2021;36(1):229-235. <https://doi.org/10.1111/jocs.15175>
4. Yang B, Ghita C, Makkinejad A, Green C, Wu X. Early outcomes of the Y-incision technique to enlarge the aortic annulus 3 to 4 valve sizes. *J Thorac Cardiovasc Surg*. 2024;167(4):1196-1205.e2. <https://doi.org/10.1016/j.jtcvs.2022.07.006>