

Valve: How To Do It

Y Incision and Roof Technique for Aortic Root Enlargement: A Minimally Invasive Approach



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The Y incision and roof technique for aortic valve replacement enable implantation of a large prosthetic valve and extensive enlargement of the sinotubular junction. Surgeons have been reluctant to adopt a minimally invasive approach for this procedure because of its complexity and risk. The Stonehenge technique was designed to achieve an ideal surgical view of the aortic root through a small right thoracotomy. Herein, we report implementing a Y incision and roof technique for aortic valve replacement through a minimally invasive approach facilitated by the Stonehenge technique.

(Ann Thorac Surg Short Reports 2023;1:422-425)

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Techniques for aortic root enlargement during aortic valve replacement (AVR) have recently gained more importance in patients with small aortic annuli as a component of lifetime management of reinterventions, including valve-in-valve transcatheter AVR (VIV-TAVR).¹ The Y incision technique, first reported by Bo Yang, enables implantation of valves 3 to 4 sizes larger than the native annulus.² In addition, the roof technique facilitates enlargement of the sinotubular junction (STJ), providing a favorable platform for future VIV-TAVR.³ However, surgeons have been reluctant to adopt a minimally invasive approach for this procedure because of its complexity. The Stonehenge technique of Yamazaki and colleagues⁴ achieves an ideal surgical view of the aortic root through a small right thoracotomy. Herein, we report implementation of the Y incision and roof technique in AVR through a right infra-axillary thoracotomy using the Stonehenge technique.

TECHNIQUE

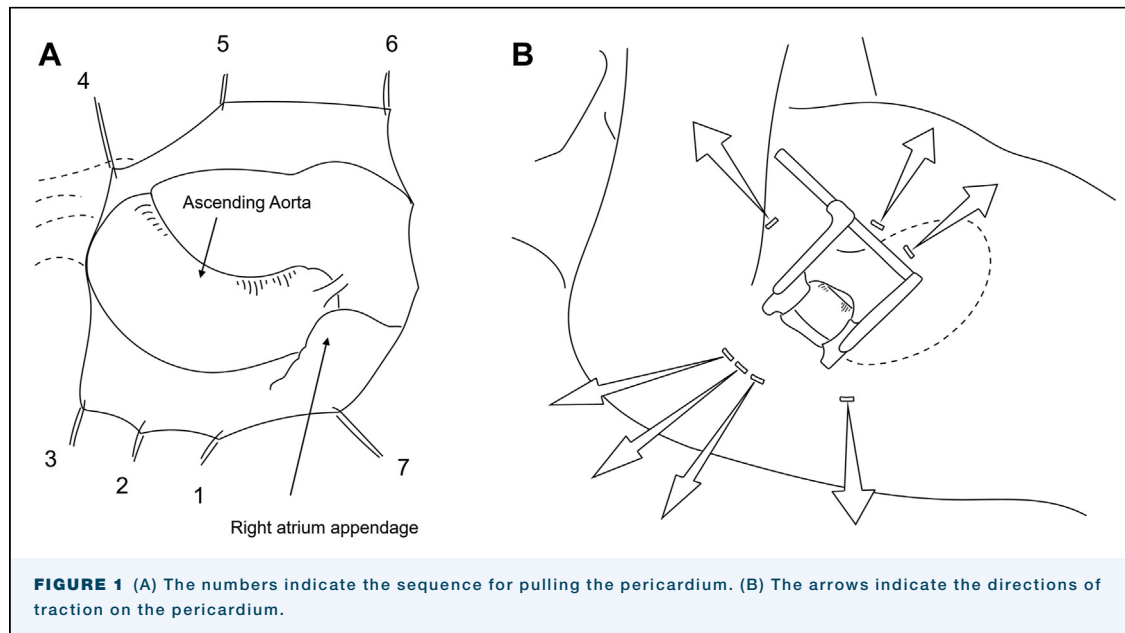
A 6- to 7-cm skin incision is made along the edge of the pectoralis major muscle in the right anterior axillary line, and a thoracotomy is performed through the third or fourth intercostal space. Cardiopulmonary bypass is established through the right femoral artery and vein. By placement of several retraction stitches on the

pericardium as described for the Stonehenge technique, the aortic root is approximated toward the chest wall (Figure 1).⁴ After aortic cross-clamping and antegrade cardioplegia, a two-thirds circumferential transverse incision is made in the ascending aorta 1 cm superior to the STJ (Figure 2A). After resection of the leaflets and débridement of the aortic annulus, the right end of the aortotomy is extended by splitting the commissure post between the left and noncoronary cusps and extending along the annulus to the nadir of the left and noncoronary cusps (Figure 2B; Y incision technique).² A rectangular patch (autopericardium or Hemashield [Maquet]) is trimmed to match the distance between the 2 coronary cusp nadirs. Running 4-0 polypropylene (Prolene; Ethicon) is used to stitch the patch to the aortomitral curtain and Valsalva sinus along the Y incision (Figure 2C). After sizing of the aortic annulus, a prosthetic valve is fixed in an intra-annular position with pledgeted 2-0 polyethylene terephthalate sutures (Ethibond; Ethicon) on the patch and single interrupted 2-0 sutures on the native aortic annulus (Figure 2D). The distal part of the patch is trimmed into a triangle shape (Figure 3A). The ascending aorta is incised longitudinally 3 cm from the right end of the aortotomy, which is then closed by fitting the triangular part of the patch to the longitudinal aortotomy with running 4-0 Prolene sutures (Figure 3B; roof technique)³ (Video).

Accepted for publication May 16, 2023.

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We have performed AVR by the Y incision and roof technique through a right mini-thoracotomy using the Stonehenge technique in 3 women aged 63 to 74 years, 1 of whom underwent concomitant septal myectomy. The preoperative aortic annulus was 17 mm in 1 patient and 19 mm in the other 2 patients. All 3 implanted prostheses were 23-mm Inspiris Resilia aortic valves (Edwards Lifesciences LLC). A Dacron patch was used in 2 patients and autopericardium in 1 patient. The cardiopulmonary bypass and aortic cross-clamp times were 224 and 149 minutes and 201 and 144 minutes, respectively, in 2 cases, and 224 and 166 minutes in the patient requiring septal myectomy.

COMMENT

Since the advent of TAVR, management strategies for aortic stenosis have changed considerably,¹ and as VIV-TAVR has attracted more attention, surgical interventions for aortic root enlargement have regained momentum.⁵ Implanting a larger bioprosthetic valve eliminates the risks of immediate prosthesis-patient mismatch and early valve deterioration and facilitates successful future VIV-TAVR.

There are several maneuvers for enlarging the aortic root with patch augmentation. The procedures of Nicks and colleagues⁶ and Manougian and Seybold-Epting⁷ enlarge the posterior aortic ring by extending the aortic incision into the anterior mitral leaflet. Although these procedures are relatively simple and widely accepted, the extent of enlargement of the aortic annulus and STJ is limited. The Konno procedure enlarges the anterior aortic ring extensively

by incising the aortic annulus, right ventricle, and ventricular septum.⁸ However, the complexity and extensiveness of the right thoracotomy approach make it appear challenging.

The Y incision and roof technique enable remarkable expansion of the aortic root components, including the aortic annulus, Valsalva sinus, and proximal ascending aorta.³ These procedures are so complex that exposure of the aortic root is of utmost importance. The challenge, which has not yet been met to our knowledge, has been to devise a minimally invasive means of performing this innovative procedure.

The Stonehenge technique entails shifting the whole heart by pulling it with pericardial retraction stitches toward the right chest wall, thus making surgical procedures through a right infra-axillary thoracotomy as easy and safe as through median sternotomy.⁴ The benefits of this technique are the following: a typical AVR can be performed without use of special minimally invasive surgery instruments; it provides a good, inverted cone-shaped surgical view, allowing intermittent lung inflation during the procedure; and use of a soft wound protector decreases the thickness of the chest wall and reduces the distance from the wound to the aortic root. All 3 of our procedures were completed within reach of the fingers without assistance of long-shafted surgical instruments or knot pushers and without videoscopic assistance. These factors may encourage surgeons to take up the challenge of performing these novel techniques through a minimally invasive approach in patients with small aortic annuli.

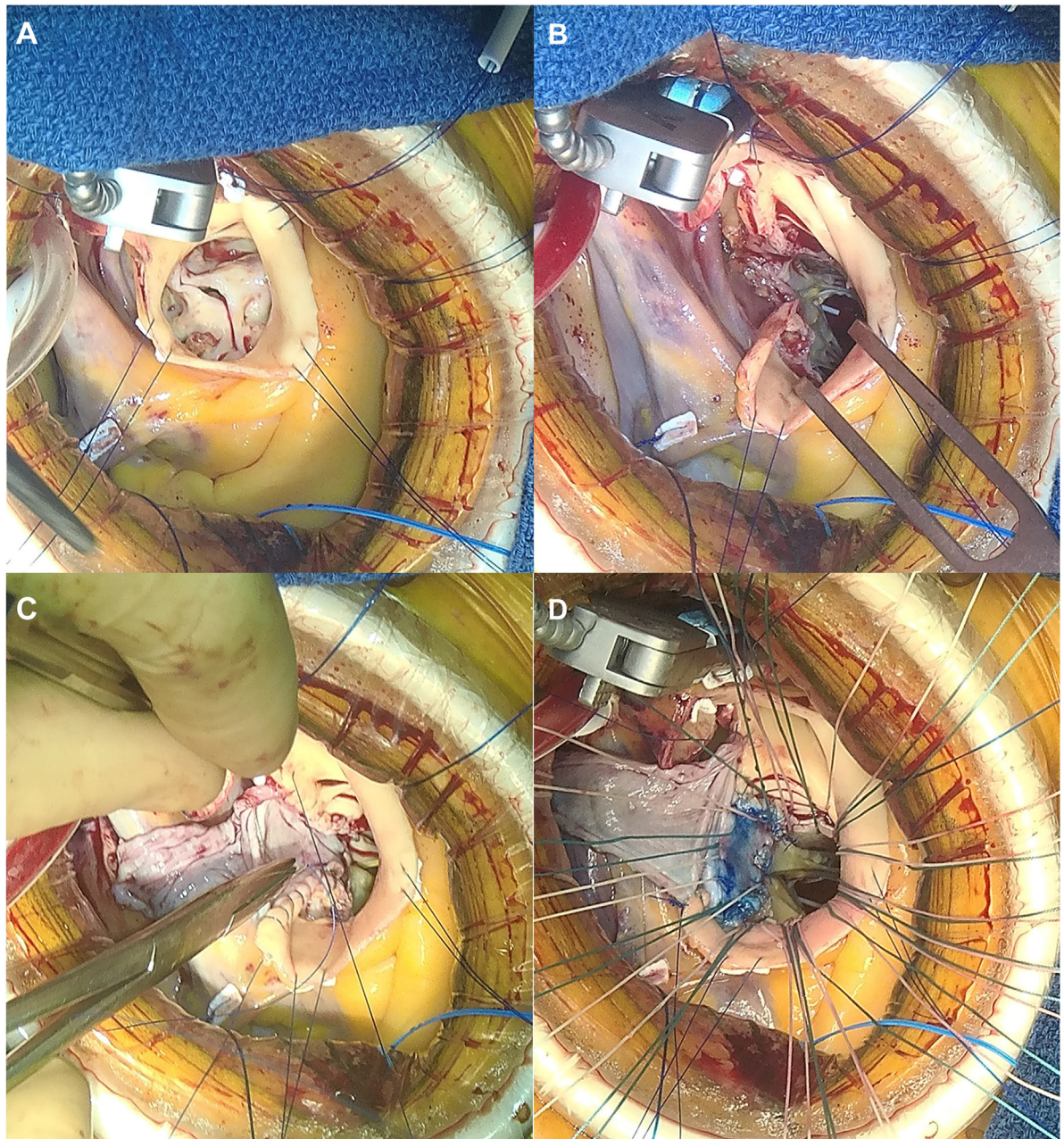


FIGURE 2 Intraoperative photographs. (A) Two-thirds circumferential transverse incision in the ascending aorta. (B) Y incision into the aortic annulus. (C) The trimmed autopericardium is sutured along the Y incision. (D) Annulus sutures are placed in a single interrupted fashion, and pledgeted mattress sutures are placed from outside the pericardial patch (along the blue line on the patch).

In conclusion, we have performed Y incision and roof techniques for AVR through right infra-axillary thoracotomies. These procedures can be performed successfully by the Stonehenge technique. This less invasive approach may encourage patients with borderline indications for transcatheter procedures to accept surgical options.

The Video can be viewed in the online version of this article [<https://doi.org/10.1016/j.atssr.2023.05.007>] on <http://www.annalsthoracicsurgery.org>.

The authors wish to thank Dr Trish Reynolds, MBBS, FRACP, from Edanz (<https://jp.edanz.com/ac>) for editing a draft of this manuscript.

FUNDING SOURCES

The authors have no funding sources to disclose.

DISCLOSURES

The authors have no conflicts of interest to disclose.

PATIENT CONSENT

Obtained.

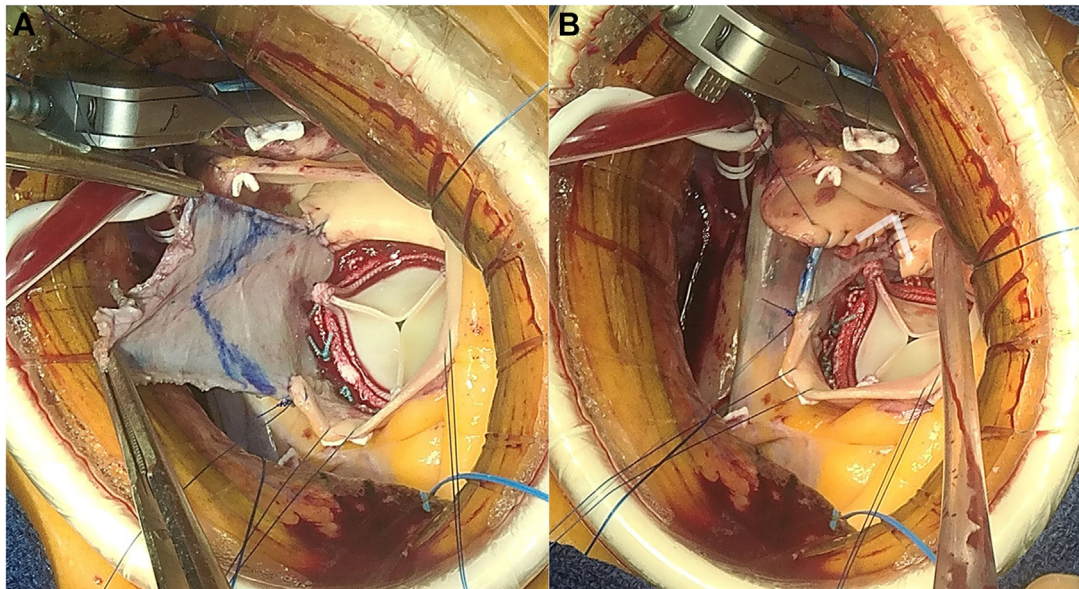


FIGURE 3 (A) After valve implantation, the patch is trimmed into a triangle shape along the blue line on the patch. (B) The aortotomy is closed by fitting the triangular part of the patch to the longitudinal aortotomy (white lines).

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