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Aorta: How To Do It

"Arc" Modification of the Patch for the Y-Incision Aortic Annular Enlargement

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Y-incision aortic annular enlargement has been used for 4 years with favorable early outcomes. Occasionally, we have seen a tensed anastomotic suture line of the rectangular patch to the aortomitral curtain/mitral annulus. We developed an Arc modification of the rectangular patch that completely resolved this issue. The Arc modification has been our new routine since May 2024 for Y-incision aortic annular enlargement in all first-time aortic valve replacements or in some reoperative aortic valve replacements if the aortomitral curtain was preserved. The outcomes were favorable, and there were no issues of hemostasis of the suture line.

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Since the first case of the Y-incision aortic annular enlargement in August 2020,[1] we have made a modification to the closure of the aortotomy—the Roof technique—in patients with a small ascending aorta (<35 mm)[2] to enlarge the proximal ascending aorta and sinutubular junction for future valve-in-valve transcatheter aortic valve replacement. Occasionally, we have observed the suture line of the patch to the aortomitral curtain/mitral annulus to be tensed between the left and right fibrous trigones after an upsized prosthetic valve has been implanted. To create a tension-free suture line between the 2 trigones, we have developed the Arc modification.

TECHNIQUE

A complete transverse aortotomy was made ~2 cm anteriorly and beveled to 1 cm posteriorly above the sinutubular junction. The aortic annulus was 21 mm. A standard Y incision (Figure 1A) was made through the left noncommissure, right underneath and parallel to the aortic annulus undermining the left and noncoronary annulus to each respective nadir into the left and right fibrous trigones.[1] A 2- × 3-inch (5- × 7.5-cm) rectangular Hemashield Dacron patch (Boston Scientific) was trimmed to 3.5 to 4 cm wide. An Arc was created at the short side of the patch 0.5 to 1 cm high and 2 to 2.5 cm wide to match the triangular shape of the aortomitral curtain (Figure 1B). The patch was anchored at the left fibrous trigone and sewn to the aortomitral curtain along the 2 sides of the triangular shaped aortomitral curtain to the right fibrous trigone with running 4-0 PROLENE suture (Ethicon). The patch was overlapping the fibrotic tissue of the aortomitral curtain (Video).

The suture line was transitioned to the aortic annulus at the nadirs of both left and noncoronary sinuses, sutured along the longitudinal length of the patch to the level of the aortotomy incision, and secured. At the completion of this procedure, the suture line of the patch to the aortomitral curtain was curvilinear, resembling an Arc. The distance between the anterior mitral annulus and the top of the Arc was ~1 cm (Figure 2).

The valve was sized to be size 29 with the replica of the valve sizer touching the 3 nadirs.

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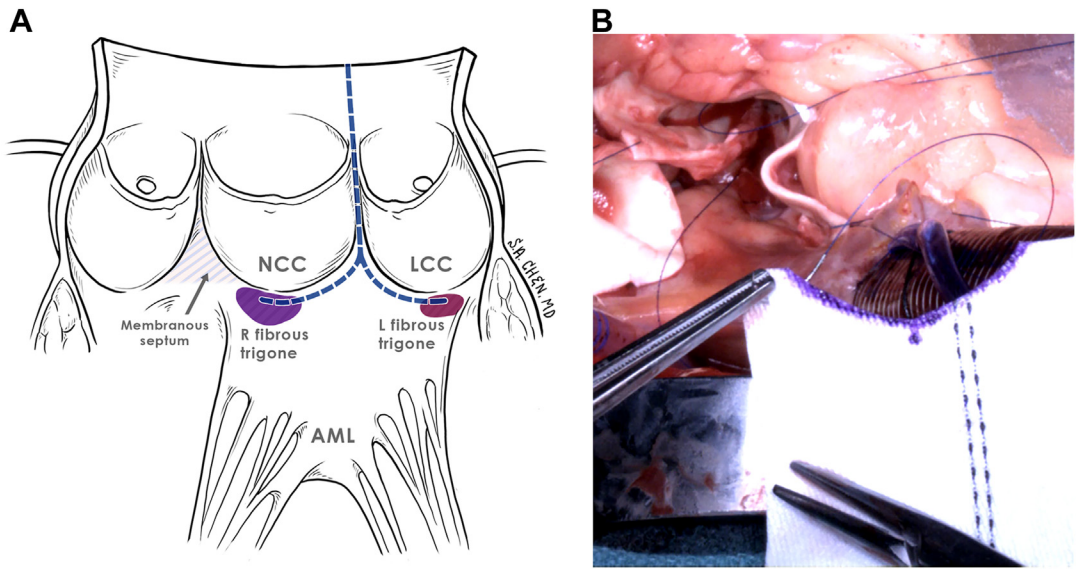

FIGURE 1 (A) A standard Y incision dividing the left noncommissure into the aortomitral curtain, undermining the crown-like aortic annulus into the left and right fibrous trigones. (B) A 5- × 7.5-cm Hemashield patch was trimmed to 3.5 to 4 cm wide and an Arc (0.5 to 1 cm high and 2.5 to 3 cm wide) was created at the lower end. (AML, anterior mitral leaflet; LCC, left coronary cusp; NCC, noncoronary cusp.)

The position of the sizer was marked on the patch for valve suture placement. Nonpledgetted 2-0 ETHIBOND sutures (Ethicon) were placed along the native aortic annulus and patch in a noneverting fashion. The valve sutures were evenly distributed on the sewing ring of the bioprosthetic valve, with 1 strut aligned with the native left-right commissure. The 3 pairs of

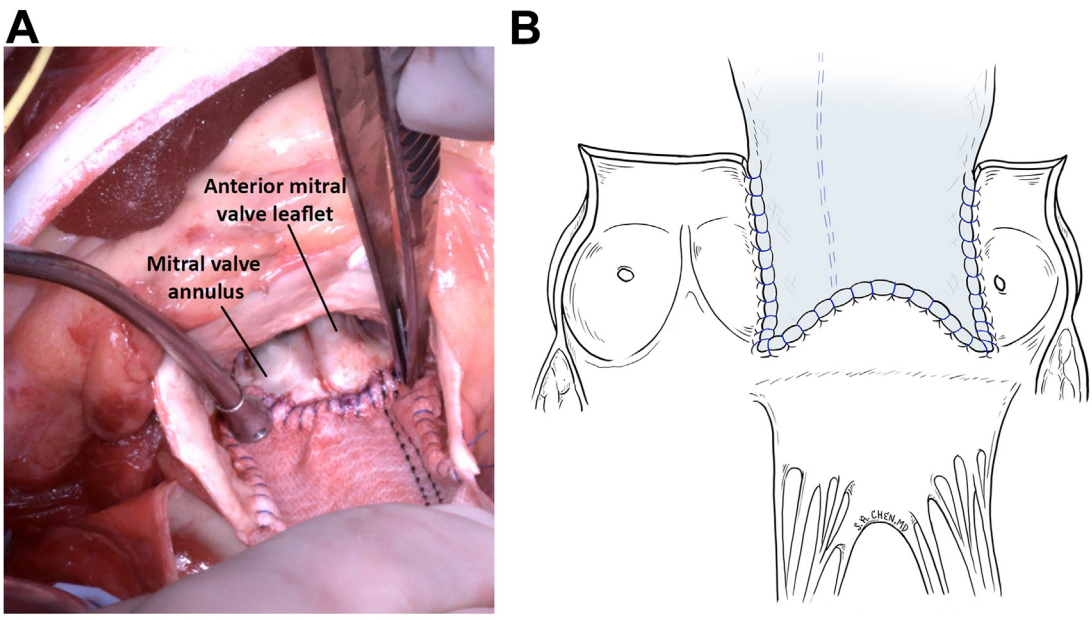

FIGURE 2 (A) The Hemashield patch was sewn to the aortomitral curtain. The suture line is curvilinear, with its top ~1 cm away from mitral annulus. (B) The illustration shows the bottom curvilinear suture line.

Ann Thorac Surg Short Reports
2025;3:14–17

sutures at the nadirs of the noncoronary and left coronary sinuses, the lowest point of aortic annulus, were tied first. The basal ring maintained its natural shape and normal size after the size 29 bovine pericardial valve was tied down (Figure 3).

A 2- to 3-cm longitudinal aortotomy was made at the posterior proximal ascending aorta, and the distal end of the rectangular patch was trimmed in a triangular shape. The aortotomy was closed with 4-0 PROLENE, incorporating the triangular patch extension into the longitudinal aortotomy as the Roof technique.[2]

COMMENT

To date, we have performed this procedure in 163 cases, with excellent hemodynamics and favorable early outcomes.[3,4] Tensing of the bottom suture line of the Hemashield patch on the aortomitral curtain could potentially occur due to the rigidity of the patch, frequently seen when the bottom suture line fails to curve up in a cephalad fashion but instead follows a very straight line close to anterior mitral annulus. Additionally, this could occur in mechanical valve replacements because mechanical valves are more rigid and the sewing ring is positioned in a flat plane, unlike the crown shape visualized at the surgical aortic annulus. Based on previous experience, tensing at the bottom suture line does not affect hemodynamics[3,4]; however, visually it appears less natural. By cutting an Arc shape in the patch, there was a curvilinear appearance at the patch to the aortomitral curtain suture line, which increased the length of the suture line between the left and right fibrous trigones (Figure 2). Furthermore, this left more native tissue of the aortomitral curtain intact and not covered by the patch (Figure 3).

Ultimately, the Arc modification was able to prevent tensing of the rectangular patch to the aortomitral curtain suture line between the 2 trigones, preserve some flexibility of the aortomitral curtain and basal ring, and help maintain the normal shape of the basal ring after a large valve was implanted along the crown-shaped aortic annulus (upsize from a 21-mm aortic annulus to size 29 valve) (Figure 3). An additional benefit of the Arc modification was that it could guide the surgeon's suture line along the patch to the triangular-shaped aortomitral curtain to avoid suturing the patch to the anterior mitral valve leaflet, causing displacement of the leaflet and subsequent severe mitral regurgitation.

This modification did not increase difficulty of the technique. The height of the Arc was 0.5 to 1 cm because the height of aortomitral curtain was 1.5 to 2 cm based on our measurements. The width of the Arc was 2 to 2.5 cm because the distance between the left and right fibrous trigones was 2.5 to 3 cm. Generally, the smaller rectangular patch (3.5 cm wide) and Arc modification (2 cm wide) were used for female patients, whereas a larger patch (4 cm) and Arc modification (2.5 cm wide) were used for male patients (Figure 1B). This modification may be confusing when surgeons sew the right corner of the Hemashield patch to the right fibrous trigone below the nadir of the noncoronary aortic annulus before transitioning to suturing the patch to the aortic annulus. Surgeons must pay close attention when putting the corner of the Hemashield patch below the nadir of the noncoronary aortic annulus and then transition to suturing the aortic annulus to the long side of the patch, starting from the nadir all the way to the aortotomy (Figure 2B).

Since the Arc modification was developed in May 2024, this technique has been used in 17

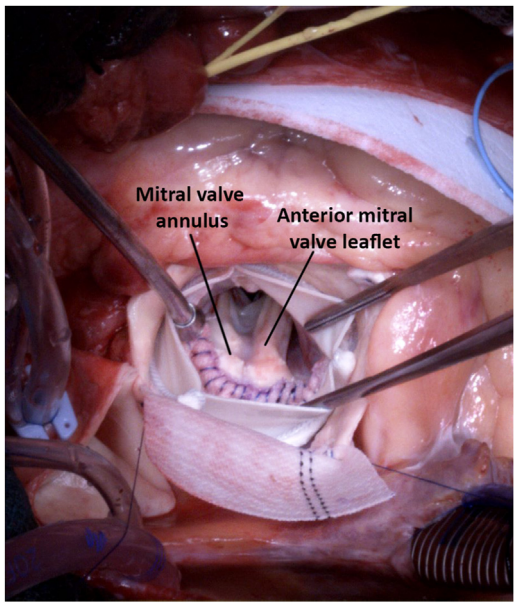

FIGURE 3 The size 29 valve sat very well. The suture line of the Hemashield patch to the aortomitral curtain was curvilinear without tension. The shape and size of the basal ring was maintained well underneath the prosthetic valve.

cases, with no hemostasis issues. The Arc modification of the rectangular patch can be used in all first-time AVR and in some reoperative AVRs if the aortomitral curtain remains after the prior prosthetic valve is removed. If the aortomitral curtain is completely damaged after the prior prosthetic valve is removed, we suture the patch without the Arc modification to the anterior mitral annulus (but not the anterior mitral leaflet) for Y-incision AAE, producing favorable early outcomes.

The Video can be viewed in the online version of this article [https://doi.org/10.1016/j.atssr.2024.09.008] on https://www.annalsthoracicsurgery.org.

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