AORTIC ROOT ENLARGEMENT PROCEDURES

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The mismatch of aortic valve size and aortic root is the most unexpected and disturbing scenario during an aortic valve operation. If this unexpected disorder is unable to be managed with different surgical techniques, it results in inadequate and deficient operation. Replacement of under sized valve results in mismatch of valve postoperatively. Furthermore, the mismatch of valve increases afterload, thereby leading to ventricular hypertrophy, arrhythmia and such other cardiac disorders. This complicated process eventually causes worsening of quality of life and increases mortality. Consequently, the patient can be prevented from this pathological process through a good operation planning and managing the unexpected events with surgical experiences. The major surgical solution for these patients is the enlargement of aortic root and left ventricle outflow tract (LVOT) if required, with different surgical methods. There are two main enlargement procedures: anterior and posterior enlargement methods. Posterior enlargement methods consist of Nicks, Manougian and Yang additionally anterior enlargement method consists of Konno-Rastan operation technique.

A- POSTERIOR AORTIC ROOT ENLARGEMENT PROCEDURES

1- Nicks Procedure:

Standard cardiopulmonary bypass (CPB) is done routinely. An oblique incision is made to the ascending aorta which is reaching to the noncoronary sinus of the sinus of Valsalva. The incision is extended to subannular segment about 4 mm, until the margin of mitral annulus. Patch material is prepared according to the planned size and shape of the enlarged segment. Suturing the patch begins from the mid of aortotomy segment and continued from both sides until the left-noncoronary commissure level. Aortic valve size is measured after the patch attachment and optimal prosthetic valve is sutured to the annulus either with pledgets or simple sutures (Figure 9.1). The closure of aortotomy with remaining patch material should be made carefully, and an optimal aortic anatomy should be reconstructed (Figure 9.2). In this method, reconstruction of aortic root can be managed and LVOT can be enlarged 2 to 4 mm.

TROUBLESHOOTING

- If the graft is placed too small, a larger valve may not be placed at the intended size.
- After closing the aortotomy, if there is a king in the ascending aorta, a second cross clamp should be placed and the configuration should be corrected.
- If stitches cannot be placed in case of bleeding from the aortic root of the graft, it may be necessary to place a second cross-clamp.

TIPS & PITFALLS

- Avoid transverse aortotomy in patients with possible root enlargement.

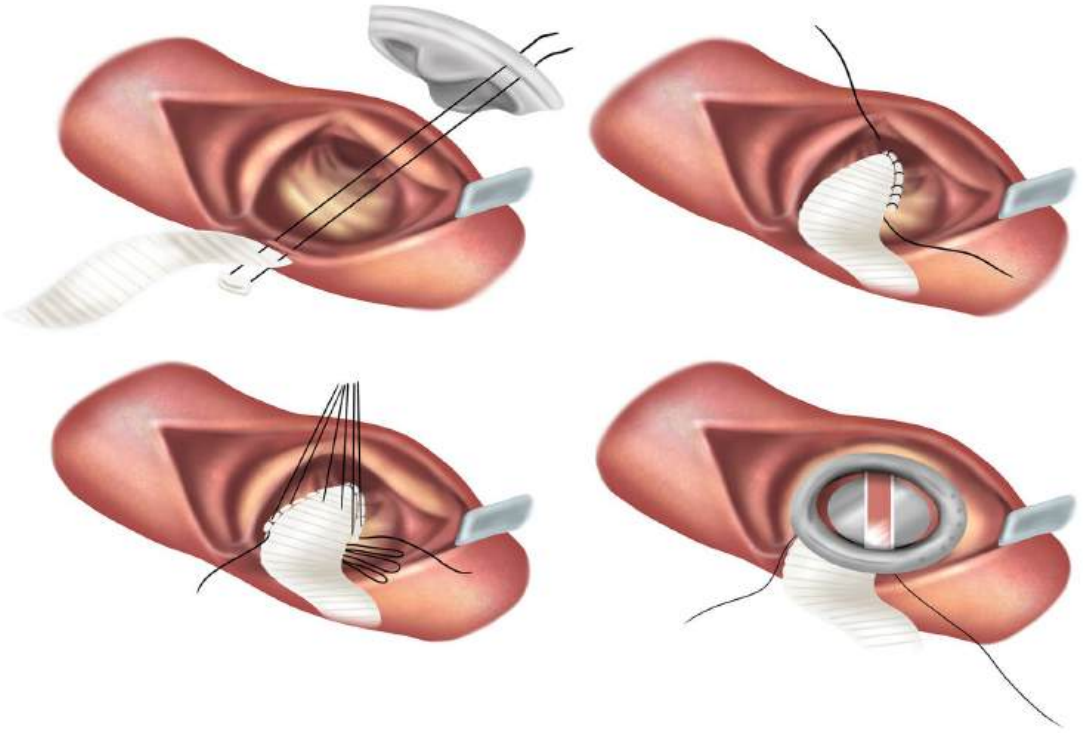

Figure 9.1. Aortic root enlargement with Nick's method.

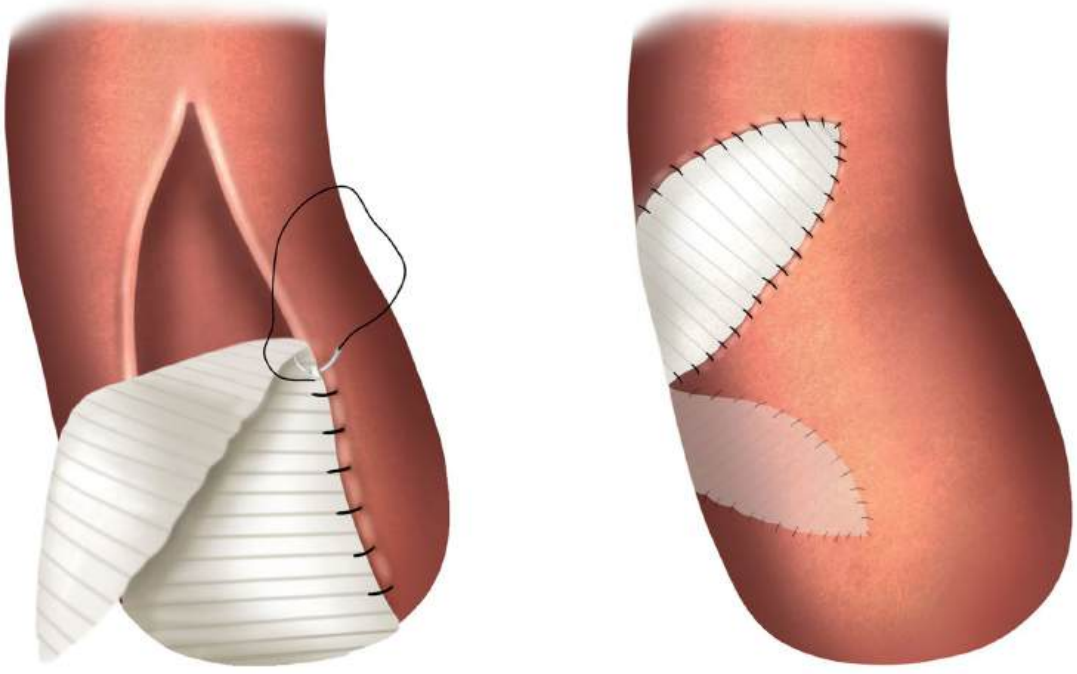

Figure 9.2. The final state of the graft after aortic root enlargement using Nick's method.

- While performing the aortotomy through an oblique incision, allow the incision extend into the non-coronary sinus.
- The size and length of the graft to be used for root enlargement must be carefully adjusted.
- The stitches on the non-coronary cusp side should be passed by pulling the graft up and leaving the stitches outside the aorta.
- While closing the aortotomy, care should be taken to ensure that the aorta is not kinking.

2- Manougian Root Enlargement Procedure:

Standard CPB is done routinely. An oblique transverse incision is made to the ascending aorta targeting the midline of the noncoronary sinus. The incision is passed through the mitral annulus and the roof of left atrium is opened (Figure 9.3). This incision extends to the mid portion of anterior cusp of mitral valve. The shape and length of prosthetic patch should be planned according to the planned LVOT enlargement diameter. Prosthetic patch is

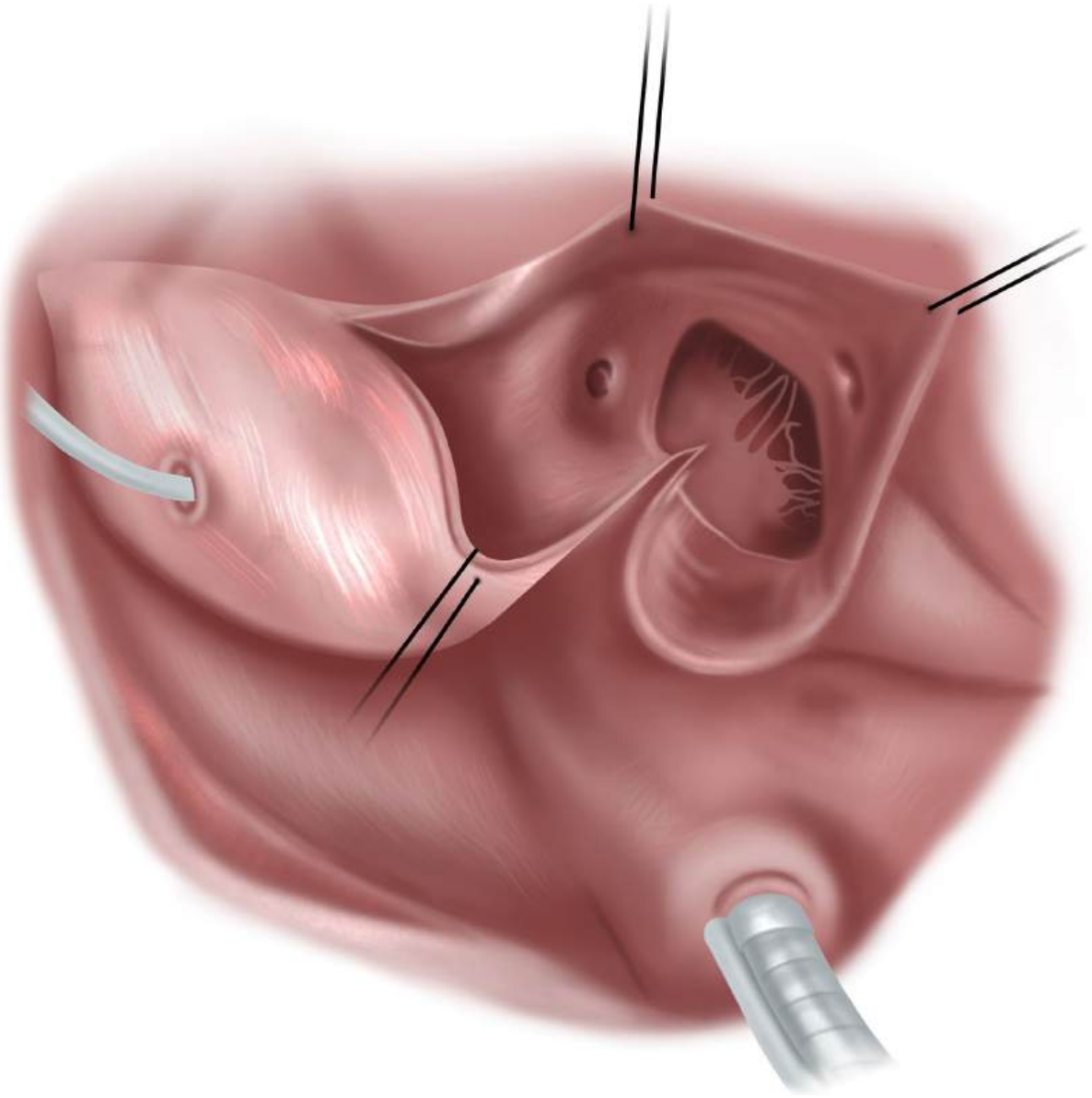

Figure 9.3. Extension of the incision to the mitral valve in Manougian root enlargement.

attached to the aortic-mitral valve by using running sutures. The attachment is done, until the level of aortic annulus and prosthetic valve size is measured (Figure 9.4).

Meanwhile, the opening of left atrium roof is closed with the attachment of a small, triangle-shaped separate patch material. Prosthetic valve is placed to the aortic annulus by using pledgets or simple sutures. If pledget sutures are used, the pledgets are left at the outer side of the patch material. Aortotomy is closed by using the remaining patch material and simple suturing of contralateral aortotomy continuously (Figure 9.5). In this method, a 4 to 6 mm enlargement of aortic root can be achieved.

TROUBLESHOOTING

- All troubleshooting seen in Nick's procedure can be done.
- In case of postoperative mitral valve insufficiency, the procedure should be reviewed from the beginning.

TIPS & PITFALLS

- Care should be taken to keep the aortotomy incision in the midline, while advancing it from the aortic annulus to the anterior leaflet of the mitral valve.
- In case the roof of the left atrium is opened, it must be repaired with a second graft.
- Stitching should be done more carefully to avoid bleeding, particularly below the annulus level.

3- Yang Root Enlargement Procedure:

Standard CPB is done routinely. An oblique incision is made to the ascending aorta which is reaching to the noncoronary left commissure. A subannular, reversed Y-shaped incision is extended to the left and noncoronary annulus (Figure 9.6). This incision reaches the noncoronary right commissure at the right side and to the margin of left coronary ostium at left side. Aortic root is opened widely with this annular dissection.

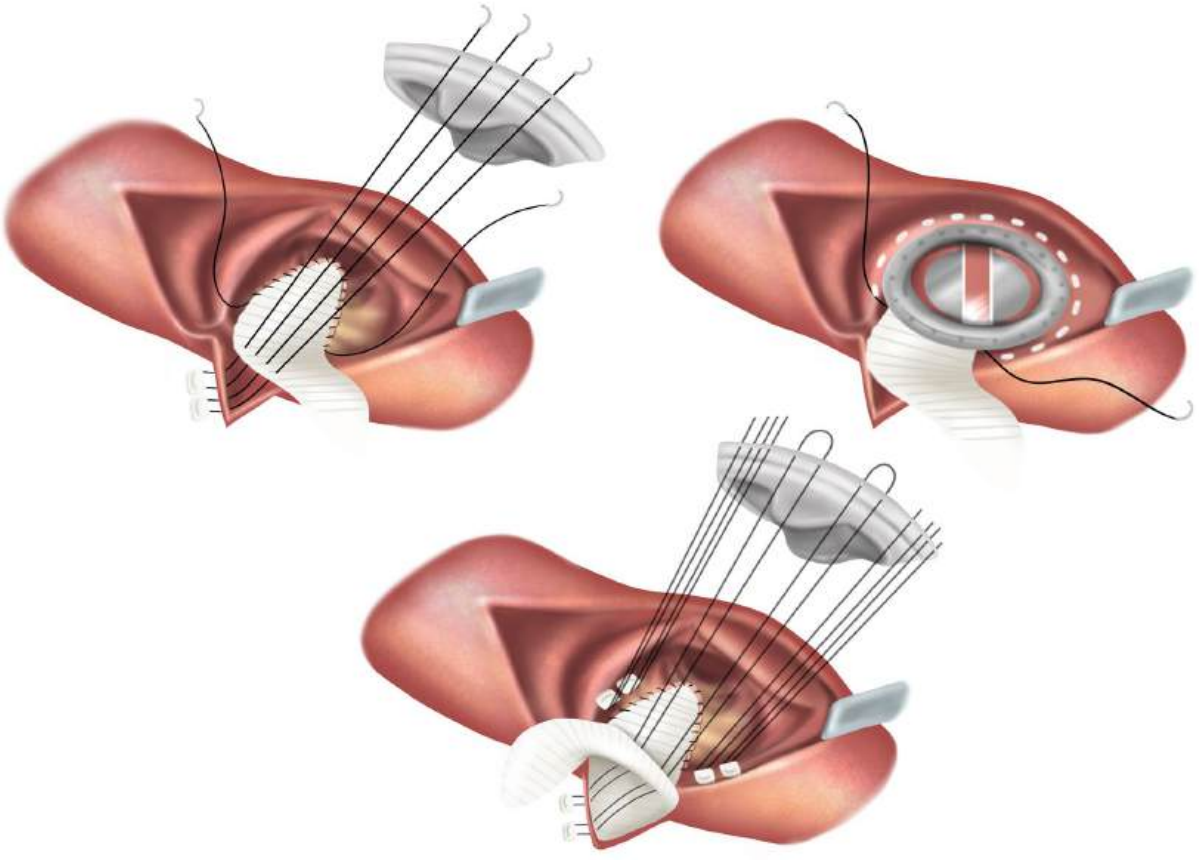

Figure 9.4. Manougian root enlargement procedure.

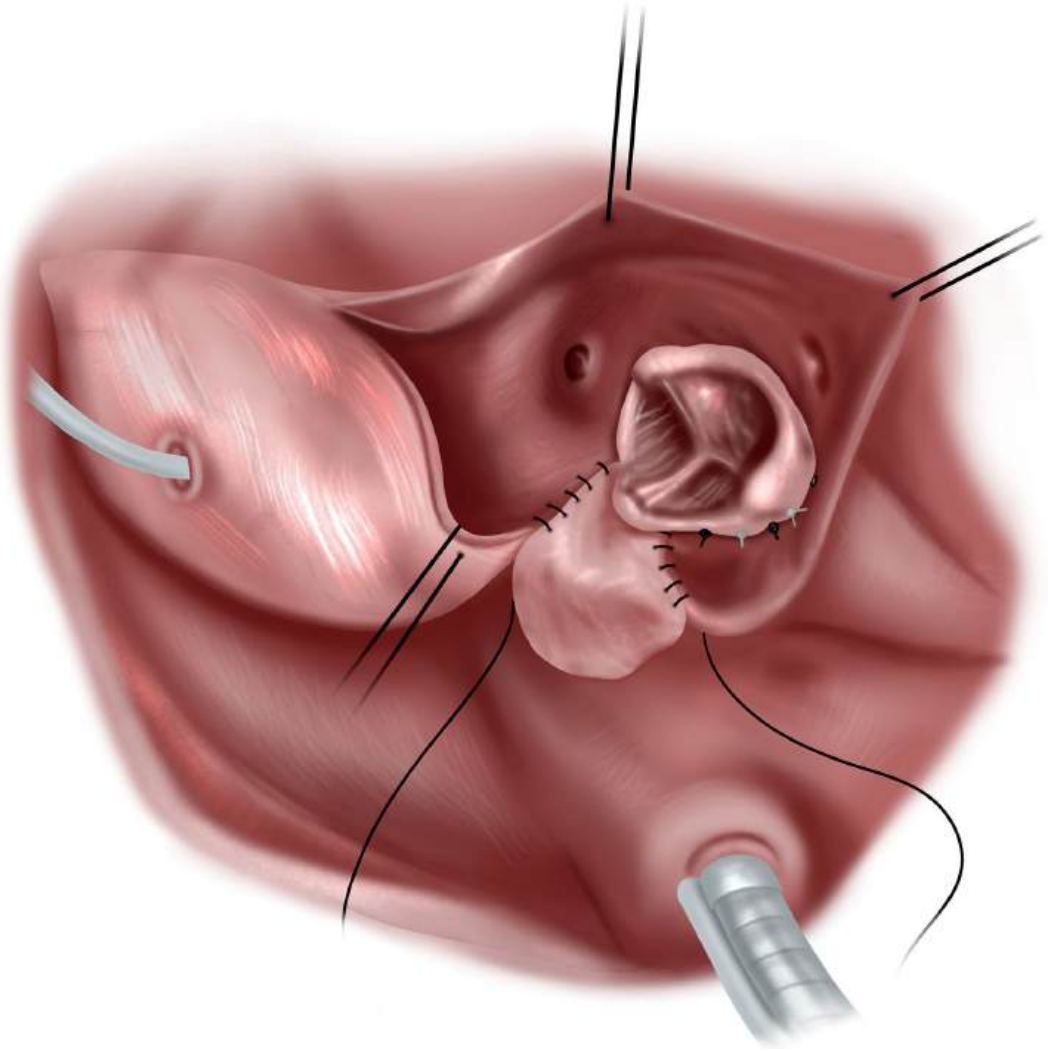

Figure 9.5. Closure of Manougian root enlargement aortotomy.

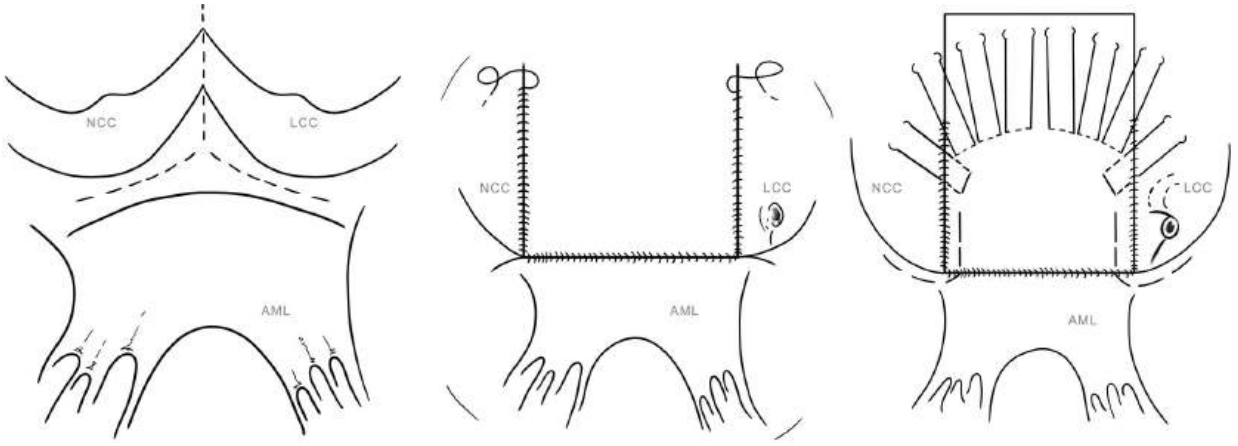

Figure 9.6. Yang root enlargement procedure.

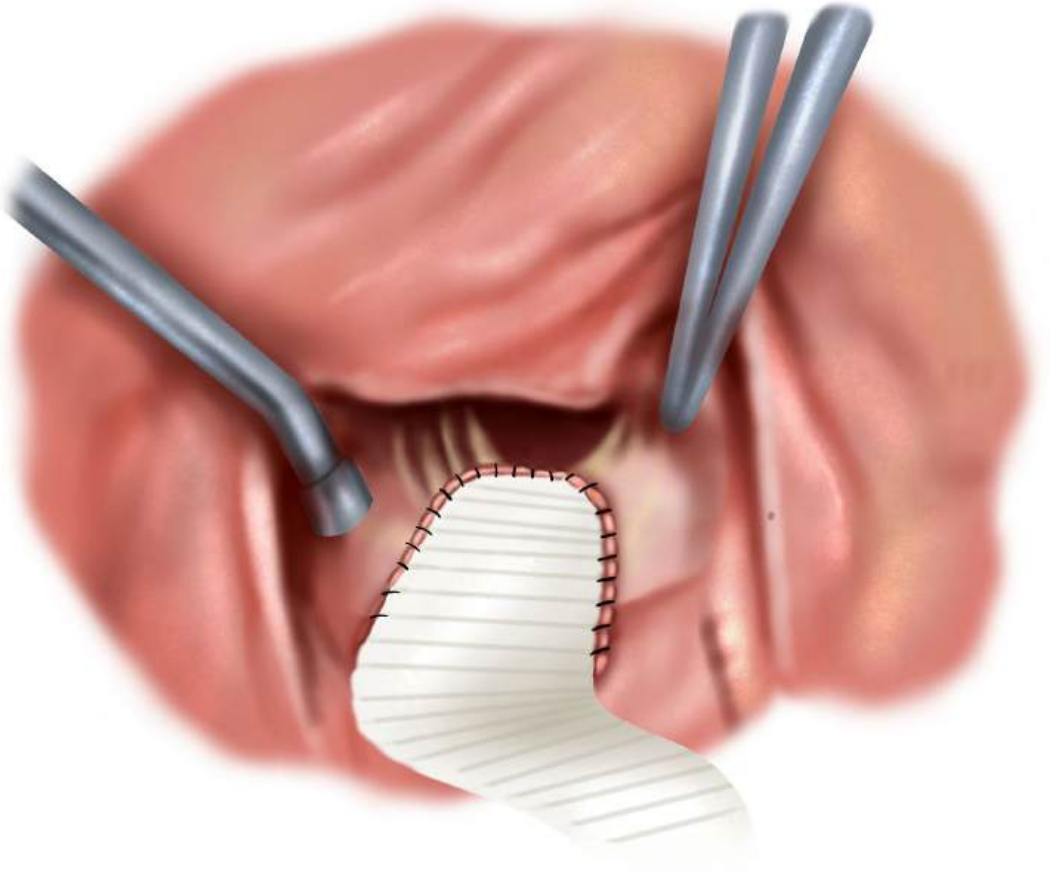

Figure 9.7. Yang root enlargement procedure. The graft is sewn to the annulus.

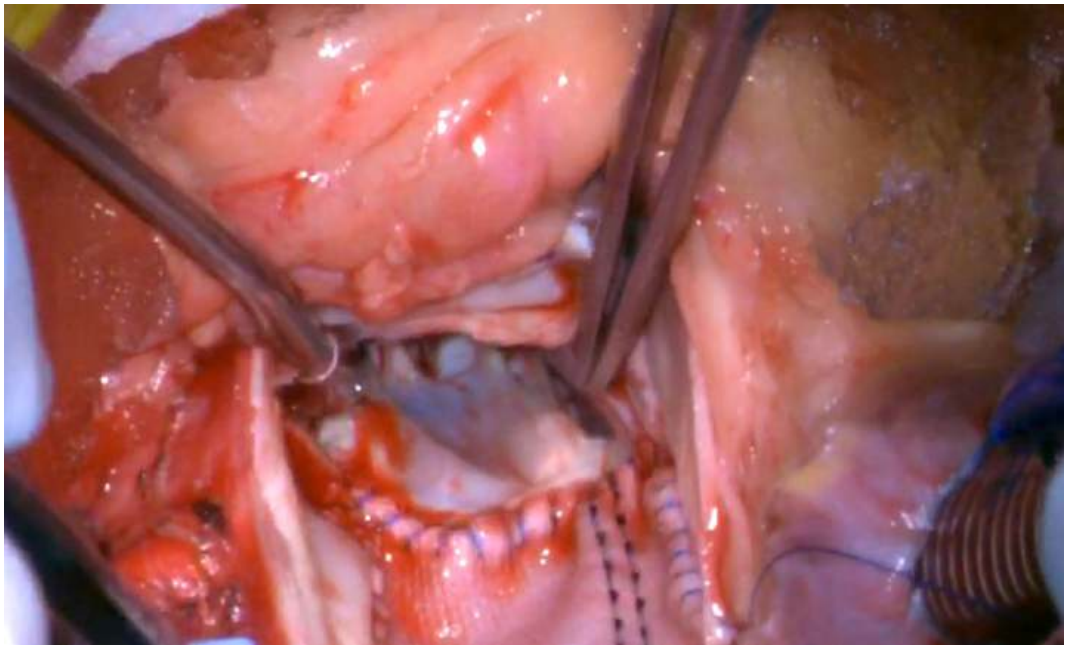

Photo 9.1. Yang root enlargement procedure. The graft is sewn to the annulus.

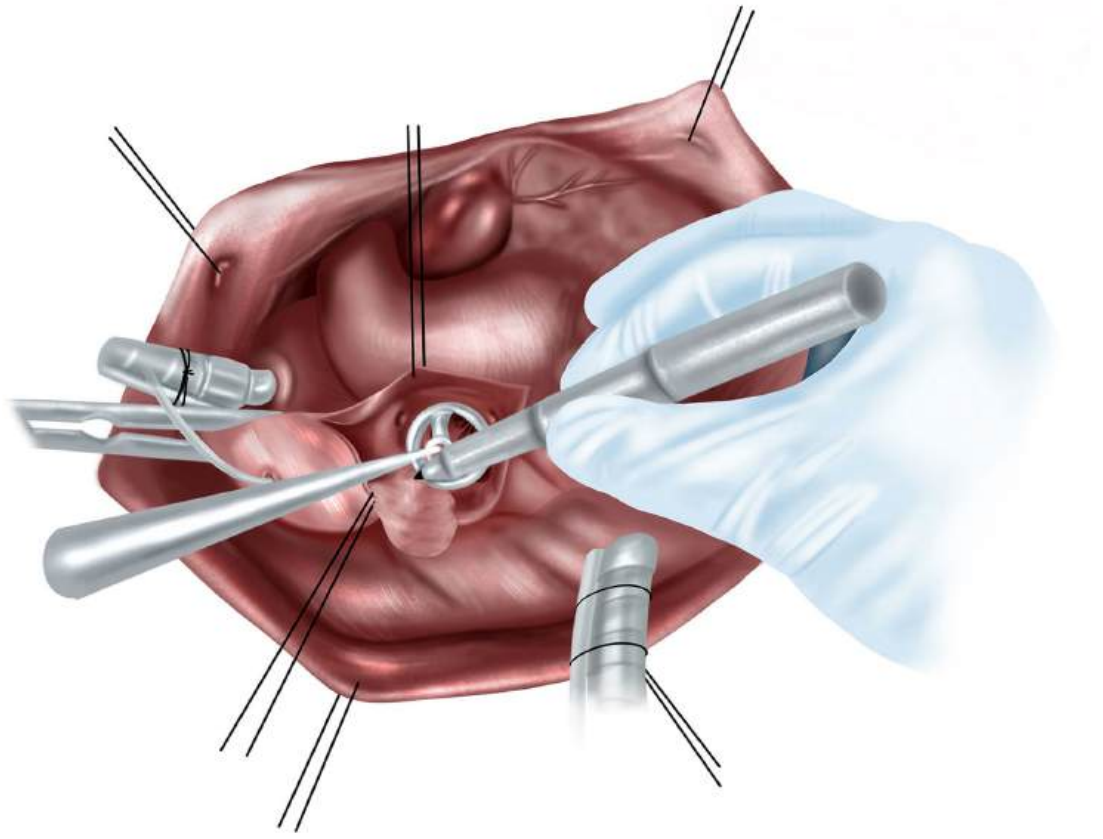

Figure 9.8. Drawing of the graft area where the valve will be placed using the Yang root enlargement procedure.

Photo 9.2. Valve sizer is used to mark the suture line for the prosthesis.

A rectangular shaped prosthetic material is attached to the both aortic walls and mitral fibrous segment with running sutures (Figure 9.7; Photo 9.1). The valve sizer is placed in the enlarged root and the position of the sizer on the patch was marked to point the line of valve sutures (Figure 9.8; Photo 9..2). The measured prosthetic valve is placed to the aortic annulus by using pledgets or simple sutures (Photo 9..3). Aortotomy is closed by using remaining patch material and simple suturing of contralateral aortotomy continuously. In this method, LVOT is enlarged by two valve sizes.

TROUBLESHOOTING

- All troubleshooting seen in Nick's procedure can be done.
- If the coronary artery ostia are damaged and kinking is present, coronary artery bypass grafting (CABG) may be necessary.

TIPS & PITFALLS

- The ring scale can be used as a guide, while placing the stitches on the graft.
- Since the prosthetic aortic valve sits obliquely, care must be taken to ensure that the graft does not kink under the valve.

B- ANTERIOR AORTIC ROOT ENLARGEMENT PROCEDURES

1. Konno-Rastan Aortoventriculoplasty Procedure:

This is a major aortic root and subannular LVOT enlargement procedure. Standard CPB procedures are done routinely with bicaval venous cannulation. An oblique incision is made to ascending aorta from right to left, targeting mid-portion of the right coronary sinus. Subsequently, the right ventricle outflow tract (RVOT) incision is made at the margin of pulmonary valve. The RVOT incision extends toward aortotomy incision to make a linear, continuous dissection. Ventricular septum is explored definitely with these cardiac dissections (Figure 9.9). In this case, an important anatomic structure, ventricular conal septum, should be explored and marked. Aortoventricular incision

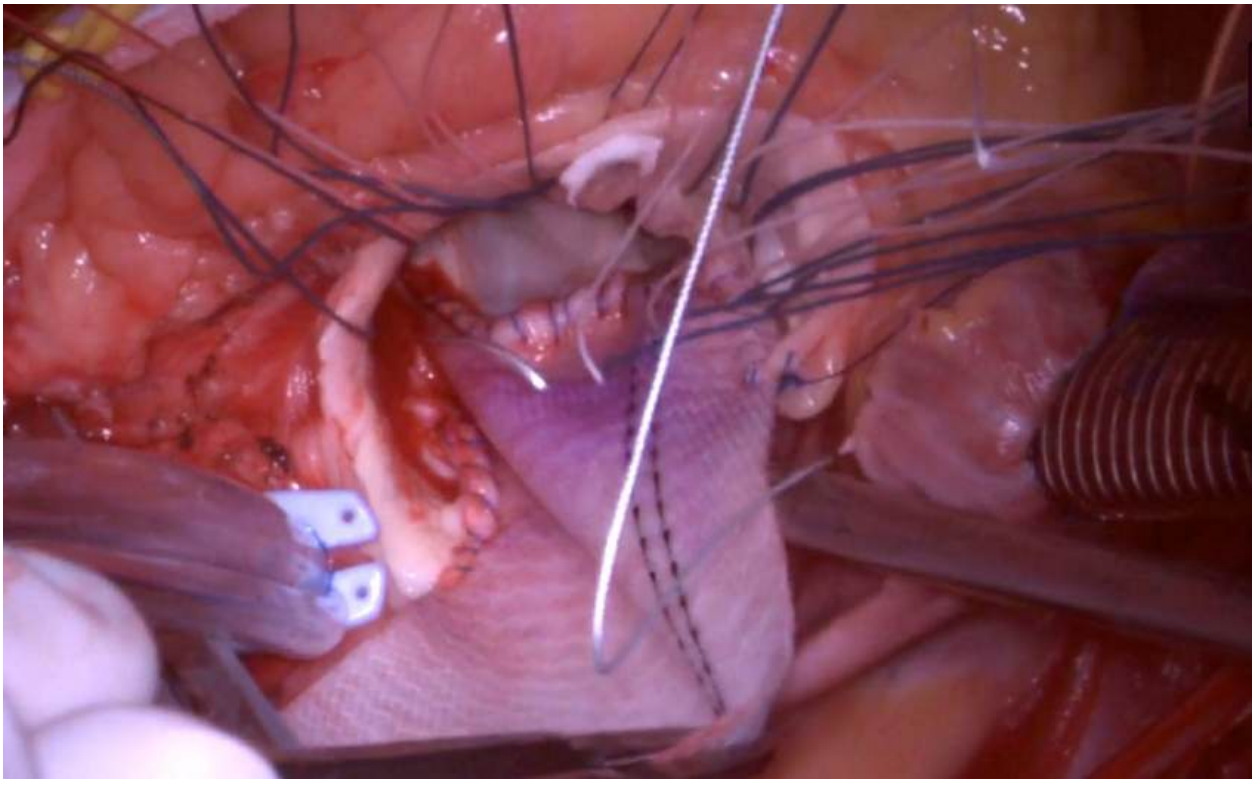

Photo 9.3. The sutures are passed from the graft prior to the implantation of the prosthesis.

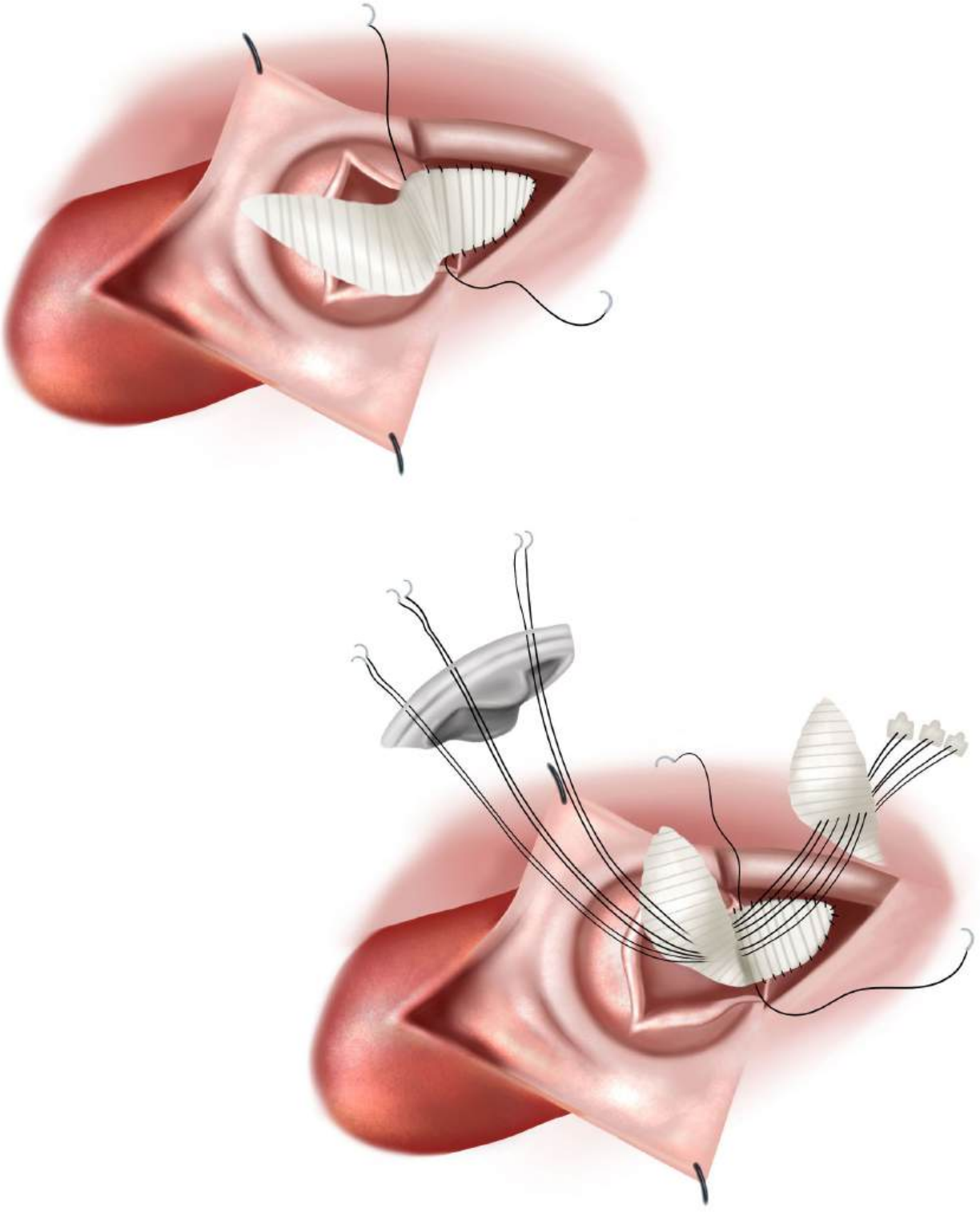

Figure 9.9. Incisions made in the Konno-Rastan aortoventriculoplasty procedure.

is made beginning from right coronary sinus and ending at the ventricular septal conus. Prosthetic patch material trimmed according to the diameter and length of the planned enlargement. The patch material is attached to the ventricular septum with pledget sutures to the level of aortic tissue. The planned valve is measured with sizer and prosthetic valve is placed with pledget sutures routinely. Subsequently, right ventriculotomy is closed by using a triangle shaped patch material with running sutures (Figure 9.10). The last step of the procedure is closing the aortotomy with patch material by using a running suture. In this method, aortic root and LVOT enlargement is made simultaneously and valve size is increased significantly (Figure 9.11). However, this is a complex procedure and arrhythmia, hemorrhage, patch dehiscence are the complications of this surgical processes.

TROUBLESHOOTING

- If there is a defect in the interventricular septum, ventricular septal defect may occur.
- Stenosis may be observed under the pulmonary valve.
- Arrhythmia problems may occur in the early postoperative period.

TIPS & PITFALLS

- During aortotomy, the cut tissues should be cut in a controlled manner and the incisions should not be extended to the septum and right ventricle more than necessary.
- The anatomy of the fibrous roof of the heart should be restored to its previous state.
- Since double patches are used, great attention should be paid to the length of the patches used.

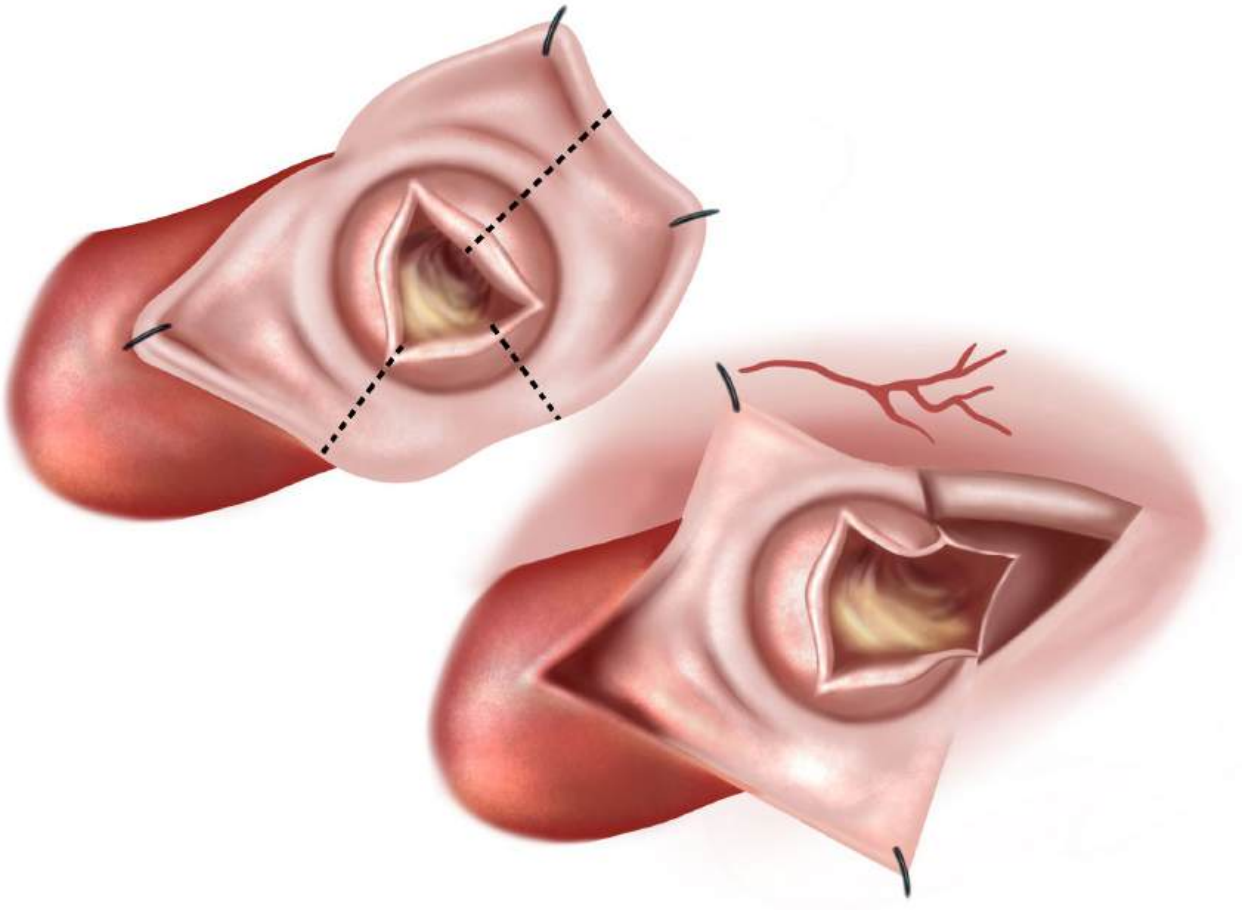

Figure 9.10. Placement of the valve in the Konno-Rastan aortoventriculoplasty procedure.

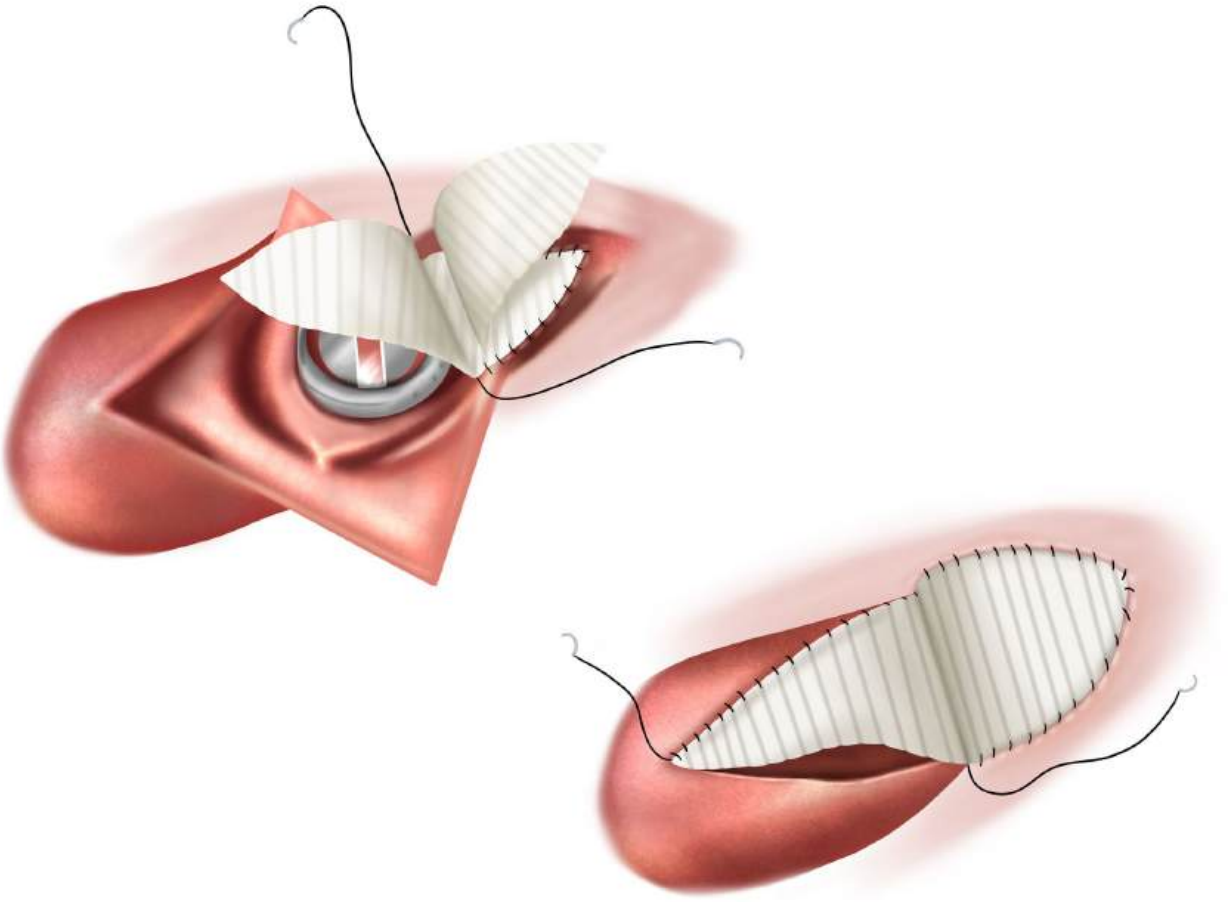

Figure 9.11. The last way the grafts are closed in Konno-Rastan aortoventriculoplasty procedure.

- Pledget sutures can be used in areas where there is fragile tissue to prevent bleeding.

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