Robotic Mitral Valve Repair: The Steps to Success

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Stephanie L. Mick, MD Weill Cornell Medicine, Department of Cardiothoracic Surgery, New York, NY
Brian Kohlbacher Heart and Vascular Institute, Cleveland Clinic, Cleveland, OH
A Marc Gillinov, MD Heart and Vascular Institute, Cleveland Clinic, Cleveland, OH

Corresponding Author:
Stephanie L Mick MD
525 East 58th St, Suite M404
New York NY 10065
212 7466 707
slmick@med.cornell.edu

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Central Message and Perspective Statement:

A successful robotic mitral valve repair depends on patient selection and an organized, stepwise approach in the operating room.
Central Image Legend:
Examination of mitral valve prior to repair using robotic assistance

Abbreviations
Systolic anterior motion (SAM)
Patient Selection (Video 1)

Patient selection is a critically important step in robotic mitral valve repair. While technically, nearly all mitral patients can have robotic surgery, not all should. The highest priority is to provide a safe, effective operation. To that end, we recommend adherence to a strict selection algorithm. As experience grows, some patients with relative contraindications to a robotic approach may be undertaken, as long as excellent outcomes are maintained. [1,2].

Echo Assessment (Video 2)

The surgeon and cardiologist review the intraoperative transesophageal echo to: 1. Confirm no contraindication to robotic surgery is present 2. Make final assessment of need for concomitant procedures 3. Fully characterize the mitral pathology and 4. Estimate the risk of systolic anterior motion (SAM).

General Setup (Video 3)

The patient is intubated with preparations for single lung ventilation. The right internal jugular vein is doubly accessed with central line and micropuncture access to allow for percutaneous venous cannulation. The right side is elevated slightly, and the right arm is flexed. Landmarks are marked.

Incisions (Video 4)

The femoral vessels are initially exposed to provide final confirmation of suitability for peripheral cannulation. Once confirmed, the access incision is made in the fourth interspace and trocars are placed about the access incision. A soft tissue retractor is placed. Either one or two 14-gauge angiocaths are placed to allow for the exteriorization of pericardial stay sutures.

Cannulation (Video 5)

Purse string sutures are placed in the vessels and after heparinization, the patient is peripherally cannulated using transesophageal guidance. Once on bypass, the pericardiotomy will be created, either via direct vision through the working port or with the robotic instruments.
**Pericardiotomy (Video 6)**

The pericardium is incised and pericardiotomy is created. Pericardial stay sutures are placed. The inferior stay sutures are exteriorized through angiocaths to allow for pericardial retraction. Care should be taken not to place excessive tension on these sutures to avoid phrenic nerve palsy. If a Chitwood clamp is used, a long antegrade cardioplegia cannula is placed in the ascending aorta and secured and the Chitwood clamp is passed into the thoracic cavity.

**Exposure (Video 7)**

After cardioplegic arrest, a left atriotomy is made. The atrial lift is placed and positioned to expose the valve and valve analysis is carried out.

**Repair**

A triangle is excised that includes the prolapsing free edge of the posterior leaflet right to the middle of P2. An interrupted suture aligns the free edges of the leaflet. After this interrupted suture, one or more sutures are run down to the annulus then back up to the free edge. The final step is to ensure that there is a smooth surface of coaptation at the free edge[3]. *(Video 8)*

For neochords, we use pre-knotted CV-4 Goretex suture buttressed with a felt pledget on the papillary muscle. In general, we use two sets of neochords for posterior leaflet prolapse, particularly when it is extensive. The second chord is left initially secured only with a surgeon’s knot, to allow for final adjustment of chordal length after the annuloplasty and valve test.

**Annuloplasty (Video 9)**

A flexible annuloplasty band is placed with a running horizontal mattress technique. Three pre-knotted sutures are placed: one from the medial trigone to the middle of the posterior annulus, one from here up to the lateral trigone and one at the lateral trigone itself[3].

**Valve Testing (Video 10)**

After the repair is completed, antegrade cardioplegia is given and a power injector used to fill the ventricle with normal saline to test the valve. The ventricle is filled under pressure, and the valve is assessed to ensure no leak and robust coaptation.
Final Steps (Video 11)
The atriotomy is closed with running CV-4 Goretex[3] over a basket suction placed into the left ventricle. The left side of the heart is preliminarily deaired, aortic perfusion is restored, and the patient is weaned from bypass. Once the TEE shows that there is minimal residual air in the left ventricle, the basket suction is removed. Final deairing takes place via the antegrade cardioplegia cannula (if a Chitwood clamp was used) or via the vent port on the endoballoon. After weaning from bypass completely, the repair is assessed on TEE. After this, the patient is briefly returned to bypass, the atriotomy suture is tied and the atriotomy is reinforced.

Following this, the patient is weaned from bypass, deairing is complete, the antegrade cardioplegia cannula is removed and the aortic site oversewn (in cases where the Chitwood is used), the patient is decannulated, hemostasis is assessed and a chest tube is placed, generally at the site of the right trocar.


Video Legends
1. Patient Selection and Dangerous Traps
2. Intraoperative TEE Assessment
3. Marking and Positioning with Diagram
4. Femoral Exposure and Chest Incisions
5. Preparation for Bypass
6. Atriotomy and Valve Examination
7. Repair with Triangular Resection
8. Repair with chords
9. Robotic annuloplasty
10. Robotic repair valve testing with power injector
11. Final Steps