Robotic-assisted repair of aortic valve leaflet prolapse by cusp plication and annuloplasty

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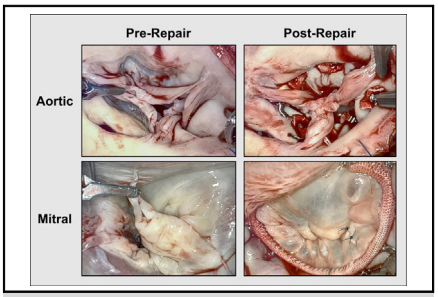


Robotic aortic valve repair with cusp plication and annuloplasty along with mitral repair.

Video clip is available online.

CENTRAL MESSAGE

We present the first case of robotic-assisted aortic valve repair of primary leaflet prolapse with cusp plication and geometric ring annuloplasty. Concomitant mitral valve repair was also performed.

Primary aortic valve repair involving cusp plication and annular stabilization with an external or internal annuloplasty has proven to be a durable solution for the management of aortic insufficiency (AI) due to aortic valve (AV) leaflet prolapse without root disease.[1-3] Our institution was an early adopter of internal geometric ring annuloplasty.[3]

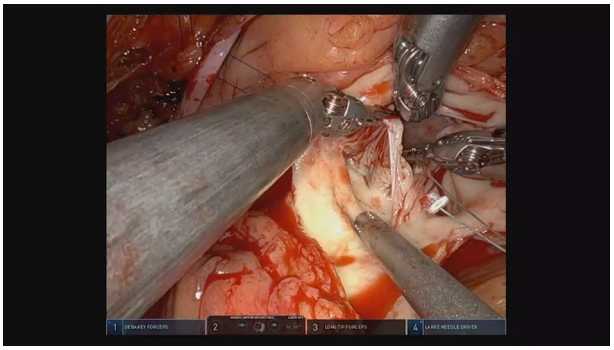
Robotic mitral valve (MV) repair, facilitated by a 3 to 4-cm mini-right lateral thoracotomy at the anterior axillary line, is an established and ever-increasing approach to primary mitral regurgitation (MR), now used in nearly 15% of all cases in the United States.[4] Recently, using the identical lateral approach, robotic aortic valve replacement (RAVR) has been developed.[5] Since 2020, the RAVR lateral thoracotomy approach has treated more than 170 cases of AV disease in our institution, with additional multicenter experience gaining worldwide.

Combing these techniques, we present the first case of fully robotic primary repair of AI due to AV leaflet prolapse using cusp plication and annuloplasty. In the same patient, we performed a concomitant robotic MV repair of a flail P2 segment.

CASE PRESENTATION

A 55-year-old male patient with hypertension, diabetes mellitus, and nonobstructive coronary anatomy presented with presyncopal and heart failure symptoms despite afterload reduction. Transesophageal echocardiography demonstrated noncoronary AV prolapse with moderate-to-severe AI, a flail P2 with severe MR, and mildly reduced left ventricular function. Repair of both valves via sternotomy was recommended, but the patient strongly desired a nonsternotomy approach, as he was a professional coiffeur and used his upper extremities daily.

On January 31, 2023, following fully informed consent for publication of study data and receipt of institutional confirmation of IRB exemption (2005016064; May 29, 2020), the operation was approached using the equivalent robotic MV and RAVR platform previously described.[5] To summarize, via a right 3- to 4-cm fourth interspace working incision at the anterior axillary line, the pericardium was incised and lateralized, femoral arterial and bicaval venous cannulation via the right internal jugular and common



VIDEO 1. Robotic-assisted aortic valve repair and concomitant mitral valve repair for primary leaflet prolapse of both valves. A 55-year-old male patient with symptomatic moderate-to-severe AI and severe MR underwent robotic aortic valve cusp plication of the noncoronary and right coronary leaflets along with geometric ring annuloplasty. Concomitant P2-P3 resection and mitral valvuloplasty was performed. *AI*, Aortic insufficiency; *MR*, mitral regurgitation. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00268-7/fulltext.

femoral facilitated cardiopulmonary bypass, a right superior pulmonary vein vent was placed, and transthoracic crossclamping was followed by robotic-assisted aortotomy and direct ostial cardioplegia due to the significant AI.

Under full robotic assistance, detailed AV analysis demonstrated significant prolapse of the noncoronary cusp and partial prolapse of the right coronary cusp (Video 1). Using 2-0 braided sutures, a true-sized 19-mm ring annuloplasty was performed (HAART 300; BioStable Science & Engineering) and secured with suture fasteners (COR-KNOT; LSI Solutions). To assess the AV prolapse, a 5-0 polypropylene temporary alignment suture through the noduli was placed.[3] This enabled clear visualization of prolapsing defects in both the non- and right cusps. These were each repaired with 6-0 polypropylene paranodular plication to equalize the free margin length and height of all 3 cusps (Figure 1). The alignment suture was removed, and the aortotomy was closed with running 4-0 polypropylene suture. Suture line and AV competence was tested with antegrade root cardioplegia.

The left atrium was then entered to confirm myxomatous degeneration with a large flail P2-P3 segment. Triangular resection of the flail segment and valvuloplasty was followed by implantation of a 38-mm annuloplasty band (CG Future; Medtronic). The atrium was closed with running CV-4 polytetrafluoroethylene suture. The patient was weaned from cardiopulmonary bypass uneventfully in normal sinus rhythm. The crossclamp and cardiopulmonary bypass times were 252 and 308 minutes, respectively. The patient was extubated in the operating room without the need of blood products. The postprocedure transesophageal echocardiogram revealed good biventricular function and no residual AI or MR.

The patient was discharged home on the third postoperative day on antiplatelet therapy and low-dose beta blockade. At 3-week follow-up, the patient reported no symptoms and

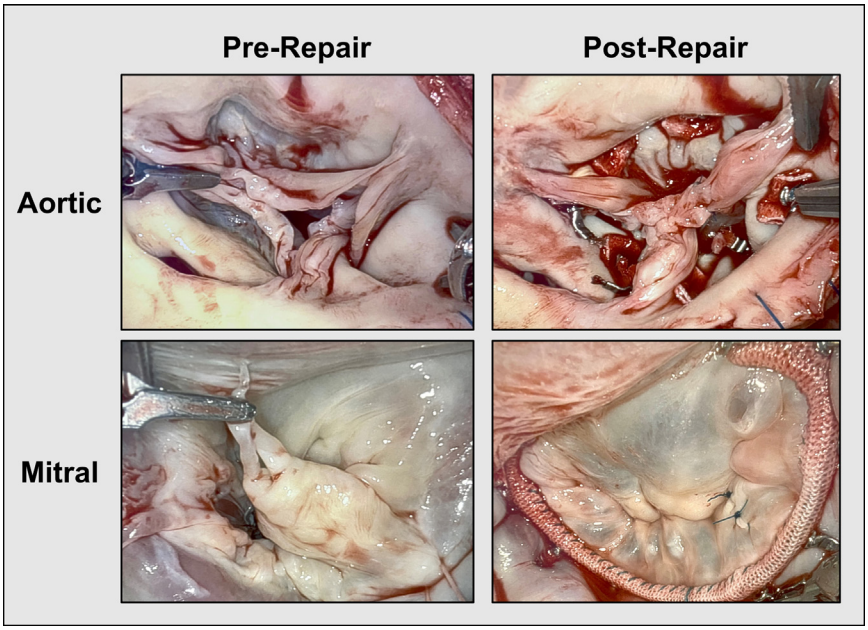


FIGURE 1. Robotic-assisted aortic valve repair and concomitant mitral valve repair. A 55-year-old male patient with symptomatic moderate-to-severe AI and severe MR underwent robotic aortic valve cusp plication of the noncoronary and right coronary leaflets along with geometric ring annuloplasty. Concomitant P2-P3 resection and mitral valvuloplasty was performed. *AI*, Aortic insufficiency; *MR*, mitral regurgitation.

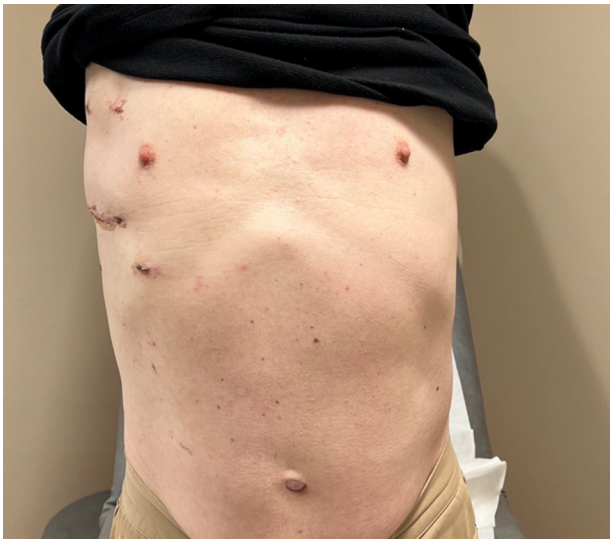


FIGURE 2. Lateral robotic aortic valve approach 3 weeks' postoperatively. Lateral robotic aortic valve approach, with incisions still covered in tissue glue, presenting 3 weeks' postoperatively, with the patient having already returned to work.

that he had already returned to work (Figure 2). His outpatient echocardiogram showed normal ventricular function, no AI or MR, mean aortic valve gradient of 10 mm Hg, and a mitral valve gradient of 2 mm Hg.

DISCUSSION

Building upon established open repair techniques of others, including our own open experience, robotic aortic valve repair (RAVr) follows the technical principles laid out by open methods while extending the established RAVR platform.[1-3,5]

The development of reproducible and stable techniques of AV and MV repair has been a significant advance in cardiac surgery.[1-4] Valve repair, if durable, may afford fewer longitudinal complications in younger patients, who may live without anticoagulation or the liabilities of prosthetic valves. Similarly, currently growing early experience with RAVR using only conventional surgical AV prostheses provides a glimpse into an alternative to reduce the morbidity of anterior thoracotomy incisions with hospital outcomes that approach transcatheter AV options.[5] The current case demonstrates that RAVr can be performed safely with short-term outcomes expected by sternotomy AV repair. Furthermore, we demonstrate that concomitant MV repair is also feasible and safe. This first case of RAVr may represent a possible next evolutionary step in the approach to repair of primary AI due to leaflet prolapse.

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