

Five Maneuvers to Facilitate Faster Robotic Mitral Valve Repair



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Robotically assisted mitral valve reconstruction has become a cornerstone in the management of degenerative mitral valve regurgitation. High-volume centers report exceptional outcomes with minimal morbidity and mortality in select patient populations. As compared to conventional sternotomy, robotically assisted surgery has yielded comparable efficacy and safety, with potential benefits of improved cosmesis and a faster recovery period. Despite the potential benefits of a robotic approach, there has been a reluctance in widespread adoption due to concerns over increased operative and crossclamp times as compared to conventional sternotomy approaches. In light of this specific concern, we have identified opportunities to improve the efficiency of robotic mitral valve repair by application of 5 innovations and surgical strategies.

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INTRODUCTION

Robotically assisted mitral valve reconstruction has become a cornerstone in the management of degenerative mitral valve regurgitation. The enhanced dexterity of the Da Vinci System, with its superior visualization of the mitral valve, enables the least invasive surgical approach to complete mitral valve repair.¹ High-volume centers report exceptional outcomes with minimal morbidity and mortality in select patient populations.^{1,2} Compared to conventional sternotomy, robotically assisted surgery yields comparable efficacy and safety, with potential benefits of improved cosmesis and a faster recovery period.^{1,3}

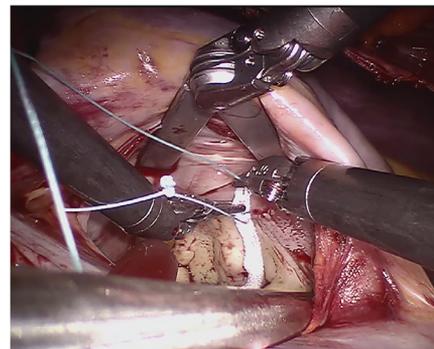
Despite the potential benefits of a robotic approach, there has been a reluctance in widespread adoption due to concerns over cost, procedural complexity with a steep learning curve, and safety and durability of repair. One particular limitation that surgeons express concern with is the increased operative and crossclamp times as compared to conventional sternotomy approaches.⁴ In light of this specific concern, we have identified opportunities to improve the efficiency of robotic mitral valve repair by application of 5 innovations and surgical strategies described below.

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Visualization and set up for robotic mitral valve repair with the Da Vinci platform.

Central Message

Although robotic mitral valve repair can be performed with excellent results, there are concerns over procedural complexity and operative times. We present innovations and strategies to improve efficiency.

SURGICAL TECHNIQUE

As described in previous work,¹ our approach to robotic mitral valve repair involves access through the right chest with a 40-mm minithoracotomy working port using a soft-tissue retractor, 2 intercostal robotic access ports (12 mm), and an atrial retractor port (12 mm) in the fourth intercostal space. Cardiopulmonary bypass is achieved with right femoral arterial and venous cannulation (and in larger patients right internal jugular) under transesophageal echocardiographic guidance. The pericardium is then incised 3–4 cm anterior to the phrenic nerve and suspended with stay sutures for visualization. After insertion of an antegrade cardioplegia catheter into the ascending aorta, we use a Chitwood clamp in the third intercostal space for aortic crossclamping.

Myocardial Protection Strategy

Modification of cardioplegia from our standard Buckberg to a Del Nido solution has permitted single dosing instead of time-consuming intermittent bolusing. With the use of Del Nido cardioplegia (20 cc/kg) in addition to systemic cooling to 30°C, it is rarely necessary to redose cardioplegia as crossclamp times are generally below 60 minutes. However, Del Nido should be avoided in the setting of (1) significant aortic regurgitation or (2) a longer anticipated crossclamp time in which adequate myocardial protection can be compromised. In these scenarios, we have

reverted to the use of Buckberg solution with intermittent dosing. If we employed Del Nido cardioplegia initially and, at 60 minutes of crossclamp anticipate more than an additional 30 minutes of ischemic time, we redose Del Nido cardioplegia at a dose of 10 mL/kg. We have not had any complications, and we rarely do redose.

Our experience with this myocardial protection strategy has helped reduce our operative time while ensuring adequate protection in a safe and efficacious manner sufficient for mitral valve repair.

Use of Neochordae for Mitral Valve Prolapse

Although tissue resection—as pioneered by Dr Carpentier—paved the way for mitral valve repair with durable long-term outcomes, tissue preservation has emerged as an attractive alternative with excellent reproducibility and favorable long-term outcomes.⁵ One particular advantage of using neochordae in a robotic setup is the unparalleled exposure of the papillary muscles, which facilitates easy placement of chords. While also effective, leaflet resection and reconstruction results in a more tedious and time-consuming procedure when performed robotically in comparison to leaflet preservation with neochordae. We use premeasured 4-0 Goretex polytetrafluoroethylene sutures and run both arms in a continuous fashion for chord replacement. For classic P2 prolapse, we generally employ 2 sets of chordae, one affixed to each papillary muscle (Video 1). In the setting of commissural prolapse, we generally prefer to close the commissure via commissuroplasty rather than implant neochordae as performed in bileaflet prolapse.

Running, Preknotted Annuloplasty

Placement of the annuloplasty band can be performed very efficiently in a running fashion using the Da Vinci system. Our preference is to use Medtronic Duran Mitral Annuloplasty bands due to their marked flexibility and ease of suture passage through the material of the band. To further facilitate this procedure, we suture the annuloplasty in place by using nonabsorbable 2-0 PremiCron preknotted sutures; the preknotted sutures

reduce the number of manually-tied knots necessary to complete the mitral valve repair (Fig. 1A). This time-saving maneuver reduces the total number of ties required in a practical manner while ensuring a sturdy annuloplasty suture line (Video 2).

Looped Sutures for Left Atrial Closure

Closure of the left atrium can be further simplified by using a suture fashioned with a small loop at its end. We prefer to use size CV-4 polytetrafluoroethylene suture with a loop and 5–8 pretied knots (Fig. 1B). After passing the starting suture through both lips of the left atrium, the needle is passed through the loop and the suture is pulled through rather than tying a knot in a traditional fashion (Video 3).

Direct Venting Through the Mitral Valve

Venting of air in a minimally-invasive robotic setting can be a challenging task compared to that of traditional sternotomy with direct access to the heart. We have enhanced this process with the use of carbon dioxide insufflation throughout the procedure into the chest at 6 L/min, left lung recruitment, and placement of an additional basket vent across the mitral valve deep into the left ventricular cavity. The vent is removed only after the heart begins to eject during cardiac filling while weaning from cardiopulmonary bypass for valve assessment. We believe that this maneuver expedites deairing and the return of cardiac rhythm and function.

While these valuable techniques focus on improving the efficiency of mitral valve repair, they do not deter from the primary goal of performing a safe operation that results in an excellent repair. In addition, we have not experienced any complications resulting from employment of these surgical techniques. Although we do not present data on the efficacy of these techniques, we have standardized this surgical approach across 3 mitral valve repair surgeons.

Although robotic mitral valve repair necessitates considerable time and effort to ensure safe and effective outcomes, these practical maneuvers can help enhance its learning curve and reduce overall operative time.

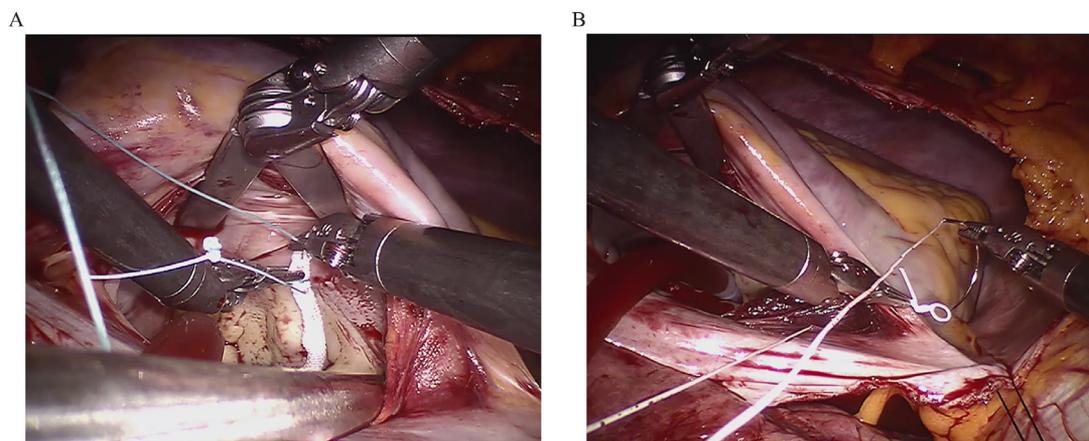
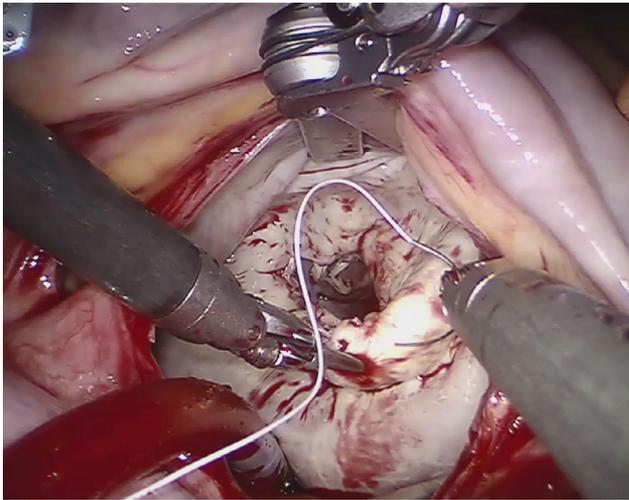


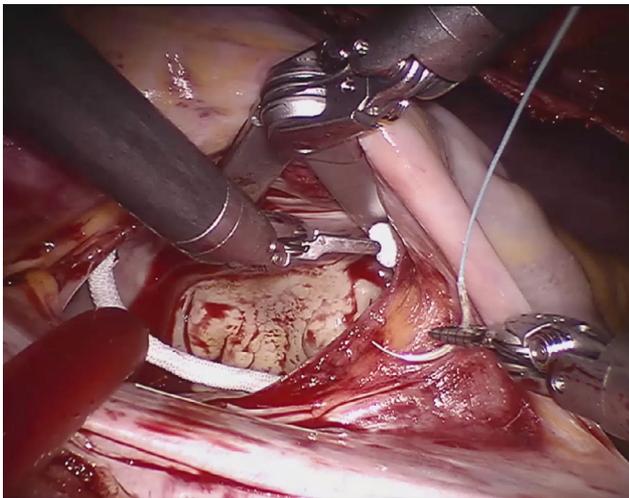
Figure 1. Schematic demonstrating (A) preknotted sutures used for mitral valve annuloplasty band placement, and (B) Gore-tex suture with a loop and pretied knots for closure of the left atrium.

SUPPLEMENTARY MATERIAL

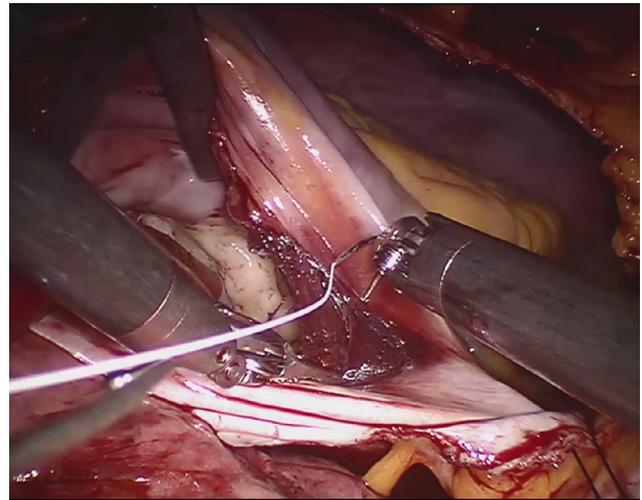
The following is the supplementary data to this article:



Video 1. Video illustrating the use of Gore-tex neochordae between papillary muscle and mitral valve-free leaflet edges.



Video 2. Video illustrating the use of preknotted sutures to simplify mitral valve annuloplasty band placement.



Video 3. Video illustrating the use of Gore-tex suture with a loop and pretied knots to simplify closure of the left atrium.

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