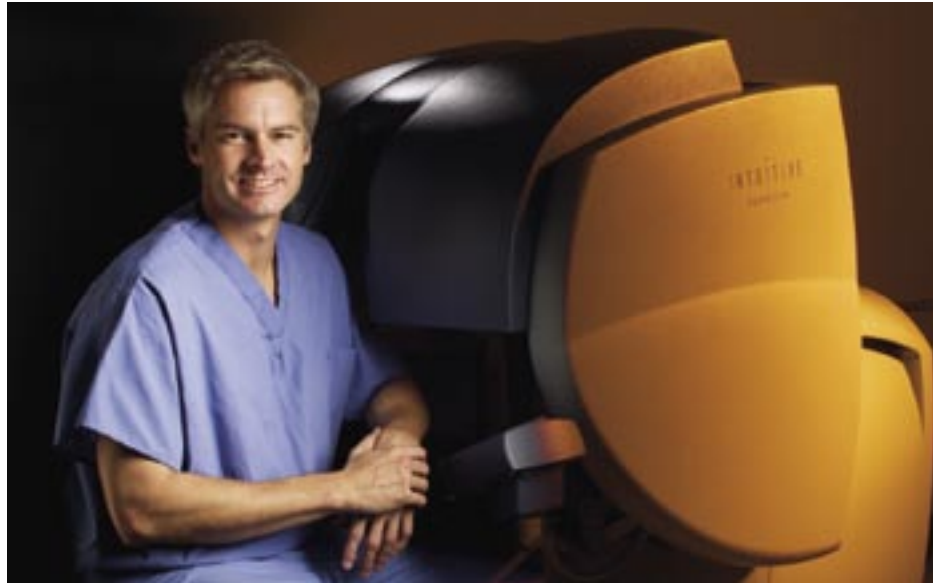


INTUITIVE
SURGICAL[®]



da Vinci[®] Mitral Valve Repair

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Background

Improvements in both visualization and instrumentation have enabled rapid advancement toward video-assisted mitral valve (MV) repairs and replacements. However, because of hand tremor, instrument collisions, and poor assistant command translation, fine reconstructive valve operations are very difficult and often lead to surgical inaccuracies and unacceptable procedure times. Development and perfection of the *da Vinci*® Surgical System has introduced the first possibility of accurate, minimally invasive closed-chest cardiac surgery. This is the first device providing excellent 3D visualization, instrument flexibility, and the dexterity to perform complex operations. We expanded the early use of the *da Vinci*® System for MV repairs and replacements into a routine operation with a large patient series.

Methods

Using the Chitwood Technique, the patient is positioned with the right chest elevated 30°. CPB is initiated through the right femoral artery with venous drainage via the right femoral vein/IVC and right internal jugular vein/SVC. Cold antegrade aortic root cardioplegia and transthoracic aortic cross-clamp occlusion provide cardiac arrest and myocardial protection. Typically, robotic instruments are inserted through the chest wall in the following positions: right instrument port in the 5th ICS, left instrument port in the 3rd ICS, and camera with working port in the 4th ICS. Strict rules are followed to avoid both external and internal instrument conflicts and a 30° scope with high-magnification camera is used. A standard interatrial groove, left-atrial incision is made, and a transthoracic retractor is used to expose the MV. Atrial fibrillation operations can be performed concomitantly with MV repair. After a robotic MV repair or replacement, the left atrium is closed and the heart de-aired meticulously.

Results

To date, we have done 176 *da Vinci*® MV repair procedures. In our early series, we followed strict inclusion and exclusion criteria that included a <35 BMI and solely posterior leaflet pathology. Recently, all MV repair patients are considered as robotic surgery candidates, except those requiring adjunctive CABG or AVR. Also, significant MV annular calcification and patients with previous sternotomies have been operated upon using robotic assistance. We now repair anterior leaflets and bileaflet mitral prolapse routinely. Typical repairs often consist of leaflet resection, a sliding plasty repair, chordal transpositions and an annuloplasty (Table 1). Our CPB and aortic cross-clamp times have decreased progressively despite increasing repair complexity. Three robotic repair patients required a subsequent MV replacement secondary to hemolysis or band dehiscence. We have had one perioperative death due to a protamine reaction and two late deaths. No *da Vinci*® MVR cases have required conversion to sternotomy incision. The average post-op length of stay is 3.8 days. Patients have been more mobile with less pain compared to those with sternotomies. Moreover, most patients return to work within two weeks.

Type of procedure (N = 150)	N (%)
Valve replacements	2 (1.3)
Valve repairs	148 (98.7)
Ring annuloplasty alone	36 (24)
Posterior leaflet resection	94 (62.7)
Sliding annuloplasty	25 (16.7)
Posterior/anterior cleft repair	1 (0.67)
Chordal replacements (GORE*)	9 (6)
Chordal transfer	40 (26.7)
Alfieri	6 (4)

*W.L. Gore & Associates, Inc. Medical Products Division, Flagstaff, AZ

Conclusions

Our clinical experience has been extremely favorable using the *da Vinci*® Surgical System. We now prefer to approach every MV operation using the *da Vinci* System. We are able to do more repairs and more complex repairs. In addition, we are confident that our clinical outcomes for *da Vinci* MVR equal those of traditional open-chest surgery. Patient benefits include shorter hospital stay, reduced transfusions and an expedited return to normal activities. These factors, combined with the ability to repair difficult pathology, portend the greater use of the *da Vinci*® Surgical System in mitral valve procedures worldwide.

da Vinci® MVR: Enhancing the Art of Mitral Valve Repair

da Vinci® Mitral Valve Repair offers patients the benefits of a minimally invasive procedure while providing the surgeon the control of an open-chest procedure.

High Resolution 3D Vision • EndoWrist® Instrumentation • Intuitive Motion

- > Superior visualization of the mitral valve anatomy - including the annulus, leaflets and sub-valvular apparatus
- > Unparalleled precision during delicate reconstruction of the mitral valve
- > Enhanced instrument control facilitates complex MVR - including anterior leaflet and bileaflet prolapse

Procedure Overview: Mitral Valve Repair with the da Vinci® Surgical System

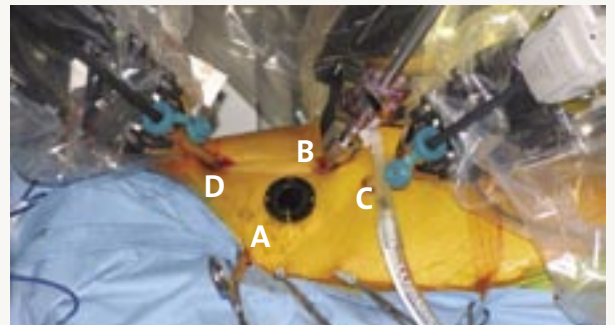
Patient Positioning and Preparation

- > Patient positioned to left of operating table; ports mapped
- > Groin prepped; standard peripheral cannulation performed
- > da Vinci® Surgical System positioned on patient's left side



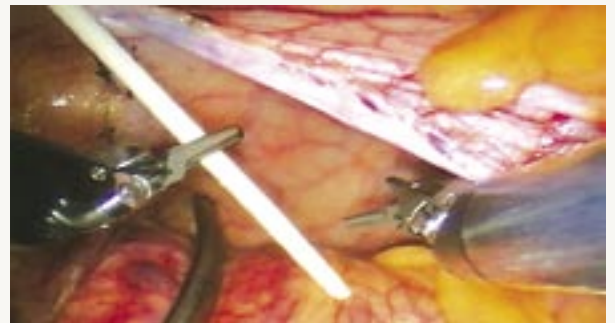
Working Incision and Port Placement

- Small lateral thoracotomy in 4th ICS functions as working incision; care taken to provide minimal rib spreading
- Robotic camera placed in 4th ICS (through working incision or separate port)
- Right robotic instrument port placed in 4th/5th ICS
- Left robotic instrument port placed in 2nd ICS



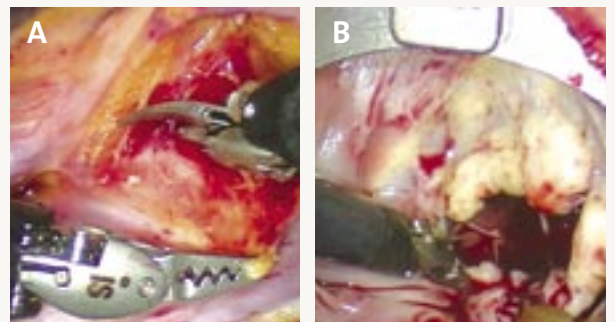
Aortic Cross-Clamping and Antegrade Cardioplegia Delivery

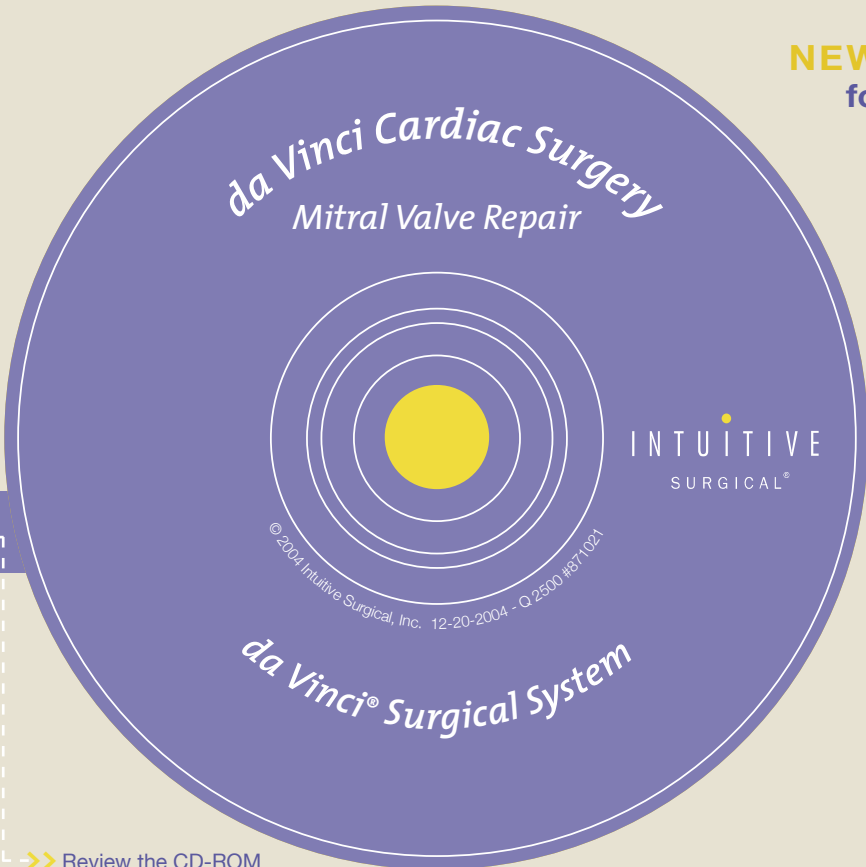
- > Tip-closing grip of EndoWrist® Resano Forceps aides in atraumatic tissue grasping during the pericardiotomy
- > 3D visualization of the aorta and surrounding anatomy facilitates placement of transthoracic clamp (alternative clamping achieved by endoaortic balloon occlusion tech.)
- > Antegrade cardioplegia catheter guided and placed with assistance from EndoWrist® Instruments



Left Atriotomy and Mitral Valve Exposure

- Left atriotomy with EndoWrist® Curved Scissors and Resano Forceps
- Atrial retractor blade placed through working incision; set-up secured to maintain excellent 3D visualization of mitral valve annulus and sub-valvular apparatus

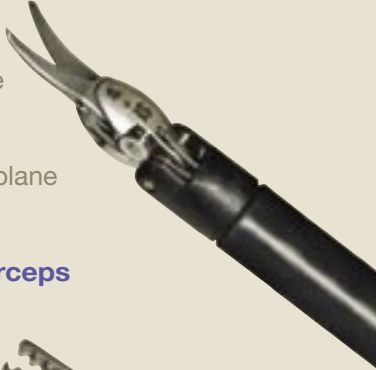




NEW! EndoWrist® Instruments Optimized for da Vinci® Mitral Valve Repair Surgery

EndoWrist® Curved Scissors

- > Narrow cutting profile enables precise sculpting of valve tissue
- > Curved tip enhances visualization of cutting plane



EndoWrist® Resano Forceps

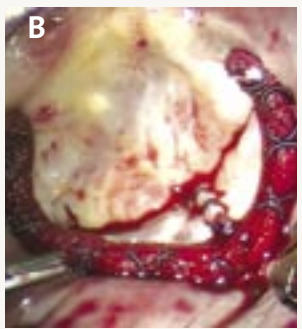
- > Atraumatic jaw design facilitates delicate handling of valve and pericardial tissue
- > Tip closing grip enables secure tissue grasping



>> Review the CD-ROM for an interactive overview of dVMVR

Mitral Valve Repair

- A. *EndoWrist®* Resano Forceps and Curved Scissors enhance precision and dexterity during complex mitral valve reconstruction; unparalleled 3D visualization of mitral anatomy facilitates complex repairs – quadrangular resections, sliding plasties, edge-to-edge approximations, chordal transfers and replacements
- B. Annuloplasty band secured with *EndoWrist®* Large Needle Driver and U-Clip® Valve Fixation Devices



Left Atrium Closure and Decannulation

- > *EndoWrist®* DeBakey or Resano Forceps and Large Needle Driver facilitate continuous, double layer closure of left atrium
- > Heart de-aired from left atriotomy suture line, both lungs ventilated and CPB discontinued; decannulate



Quality Control and Post-Operative Care

- > Port incisions closed
- > Instrument ports to be used for chest tube drainage
- > Mitral valve performance assessed via intra-operative TEE
- > Post-operative pain management achieved using pain pump system



da Vinci EndoWrist® Instrumentation Optimized for Mitral Valve Repair

EndoWrist® Instruments provide enhanced dexterity, precision and control

> 7 degrees of freedom

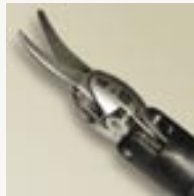
> 90 degrees of articulation

> Intuitive motion and fingertip control

> Motion scaling and tremor reduction

Curved Scissors - NEW!

Product Code 400178



Feature

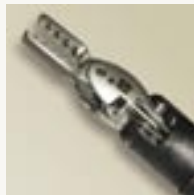
- > Curved jaws
- > Narrow cutting profile
- > Tapered atraumatic tip

Benefits

- > Easier access to difficult tissue planes
- > Better visualization of cutting planes
- > Precise, clean cutting of valve tissue
- > Facilitates blunt tissue dissection

Resano Forceps - NEW!

Product Code 400181



Feature

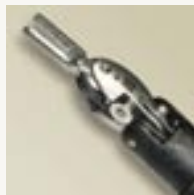
- > Resano-style jaw design
- > Tip-closing grip
- > Low-profile jaw

Benefits

- > Enables firm yet atraumatic handling of valve and pericardial tissue

DeBakey Forceps

Product Code 400036



Feature

- > Classic DeBakey design
- > Updated low profile jaw

Benefits

- > Facilitates atraumatic tissue handling

Large Needle Driver

Product Code 400006



Feature

- > Crosshatch pattern
- > Strong jaw design

Benefits

- > Secure handling of suture/needle combinations
- > Facilitates application of valve fixation device

Long Tip Forceps

Product Code 400048



Feature

- > Long-tip jaw design
- > Increased jaw spacing

Benefits

- > Facilitates extended reach
- > Larger tissue capture (lipectomy, pericardiectomy)

Permanent Cautery Spatula

Product Code 400184



Feature

- > Monopolar cautery device
- > Long paddle-blade design

Benefits

- > Safely coagulates tissues and maintains hemostasis (lipectomy, pericardiectomy)

Round Tip Scissors

Product Code 400007



Feature

- > Strong cutting profile

Benefits

- > Enables cutting of thick, calcified tissue



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