# Minimally invasive mitral valve repair using a semi-rigid annuloplasty ring with a new chordal sizing system: the Memo3D ReChord

**Mattia Glauber, Matteo Ferrarini, Antonio Miceli**

Cardiac Surgery and Great Vessels Department, Istituto Clinico Sant'Ambrogio, University and Research Hospital, Gruppo Ospedaliero San Donato, Milan, Italy

*Correspondence to:* Antonio Miceli, MD, PhD. Cardiac Surgery and Great Vessels Department, Istituto Clinico Sant'Ambrogio, Gruppo Ospedaliero San Donato, Via Favarelli 16, 20149, Milan, Italy. Email: antoniomiceli79@alice.it.

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## Clinical vignettes

### Case 1

We present a 55-year-old male with severe mitral regurgitation who underwent cardiology investigation for palpitations and worsening dyspnea (NYHA functional class II) and subsequently a minimally invasive mitral valve (MIMV) repair through right minithoracotomy (RT).

The patient's height was 175 cm tall and weighed 76 kg. The patient's cardiovascular risk factors were hypertension and history of smoking. The patient has previously undergone surgical bilateral correction of carpal tunnel syndrome. On examination, the patient was in sinus rhythm. Transthoracic echocardiography showed severe mitral valve regurgitation due to posterior prolapse and mild left atrial dilation. The left ventricular ejection fraction was 60% and the systolic pulmonary arterial pressure was 45 mmHg.

### Case 2

We present a 38-year-old woman affected by severe mitral regurgitation who underwent MIMV repair through RT for anterior mitral valve prolapse.

The patient's height was 165 cm and weighed 56 kg. She was diagnosed with a mitral valve prolapse in childhood due to the presence of a systolic murmur. She has been followed up for many years by her cardiologist with transthoracic echocardiography. The patient is asymptomatic and in sinus rhythm. The last echocardiogram showed severe mitral valve regurgitation due to anterior prolapse with mitral annulus enlargement and left atrial dilation. The left ventricular ejection fraction was 60% and the systolic pulmonary arterial pressure was 35 mmHg.

## Surgical technique

Anesthesia is provided according to the standard protocol used for conventional mitral valve surgery. A single lumen tube for intubation is used. In addition to drug administration and venous pressure monitoring, a percutaneous sheath introducer is placed in the same jugular vein for eventual insertion of endocavitary pacemaker leads. Two defibrillator pads are placed across the chest wall to guarantee effective electric conduction. The patient is placed in a supine position with an air sac under the right scapula, elevating the right chest slightly in order to achieve optimal exposure of the working field. RT is performed through a 5-6 cm lateral skin incision at the level of the fourth intercostal space and two 10.5 mm working ports are positioned for a ventricular vent, $CO_2$ line, camera and pericardial stay sutures. One working port is placed in the 4$^{th}$ intercostal space but more laterally than RT (at the level of the anterior axillary line) for video assistance and for passing the pericardial stay sutures. A soft tissue retractor is then placed 2-3 intercostal spaces lower in the mid-axillary line and is used for the $CO_2$ line, ventricular vent and pericardial stay sutures. A soft tissue retractor is then inserted into the minithoracotomy and a spreader is used. With the lungs deflated, the pericardium is usually opened 3-4 cm above the phrenic nerve, taking

 

care not to injure it. After the pericardium is opened, the aorta is exposed up to the left innominate vein and two concentric polyester purse-string sutures for direct aortic cannulation are placed into the ascending aorta in standard fashion. The second purse-string is usually reinforced with two pledgets. The site of cannulation is 2-3 cm above the transverse sinus, being the landmark where we will place the aortic cross-clamp. Once the purse-strings are ready, we go to the groin for percutaneous venous cannulation. Under transesophageal echo guidance using a bicaval view and with the Seldinger technique, a percutaneous cannula is inserted through the femoral vein and advanced into the right atrium and superior vena cava. Cannulation of the ascending aorta is performed under direct vision using a flexible cannula. It is very important in this phase to keep the pressure down. Once the cannula is in the aorta, it is secured with two tourniquets using a silk suture. Vacuum-assisted cardiopulmonary bypass (at 40 to 60 mmHg) is established, the patient cooled to 34 ℃ and a long cardioplegic vent catheter is placed into the ascending aorta. Subsequently, the aorta is cross-clamped using a dedicated minimally invasive detachable clamp (Glauber Clamp). Antegrade warm blood cardioplegia is given into the aortic root. The left atrium is opened at Sondergaard's groove and the mitral valve is exposed using a special atrial retractor with an external mechanical arm. The surgical field is flooded with carbon dioxide at a flow rate of 0.5 L/min until closure of the left atrium. Once the left atrium is opened, careful inspection of the mitral valve performed.

The first patient presented with Barlow disease associated with a prominent P2 prolapse. Once analysis is completed, 2-0 braided sutures are passed through the whole annulus in order to improve the mitral view and allow the correct sizing. A sterile pen marker is used to identify the new coaptation line between the P2 and A2 margin. A double needle 4-0 Polytetrafluoroethylene (PTFE) suture is passed through the corresponding papillary muscle fibrous tip (anterior papillary muscle) and then inserted on the P2 leaflet along the surface of coaptation. A Memo3D ReChord size 38 is chosen. PTFE neochordae are passed inside the prosthetic ring whereas annuloplasty sutures are passed through the dedicated window on the prosthetic ring holder. After parachuting the prosthetic ring, annuloplasty sutures are tied in standard fashion using a knot pusher. The neochordae are first passed through the corresponding loop and then inserted into the P2 prolapsing segment along the surface of coaptation achieving a 'hockey stick' effect. Finally, the coaptation line is brought to the adjacent annulus and PTFE sutures are tied at the level of posterior prosthetic ring in correspondence with the involved loop. Once the mitral valve repair is complete, the loops are removed and the coaptation line is marked with a sterile blue pen to allow the whole surface of coaptation to be viewed. In this case, a good surface of coaptation was achieved in all mitral segments using a pair of PTFE neochordae on P2.

The second patient presented with a wide prolapse of the A2 segment. Similarly to the previous case, the mitral valve is inspected and exposed using annuloplasty sutures. A couple of 4-0 PTFE chordae are subsequently inserted from the fibrous tip of the corresponding papillary muscle to the A2 segment in order to create a new surface of coaptation. A Memo3D ReChord size 32 is chosen after proper sizing. PTFE chordae are then through the dedicated window on the ring holder, the annuloplasty sutures passed through the ring and the prosthesis is parachuted into the annulus. Once annuloplasty sutures are tied, the two PTFE neochordae are passed though the free margin of the A2 prolapsing segment from the ventricular to the atrial aspect, then through the corresponding loops and back again in the A2 segment. The free margin of A2 is brought to the posterior annulus and sutures are tied in a way that the length of the neochordae obtained will exactly match the plane of the native annulus at the coaptation point. Finally, the loops are removed and the surface of coaptation is checked with a sterile pen marker. A good surface of coaptation is thus achieved using two pairs of neochordae on A2. After performing mitral valve repair, a ventricular vent is inserted through the mitral valve and the left atrium closed as usual using 3-0 polypropylene. After rewarming and de-airing, cardiopulmonary bypass is ceased and the arterial cannula is removed. The patient is filled with residual blood via the venous cannula and after protamine administration, the venous femoral cannula is removed. A slight compression at the level of the cannula site (5-10 minutes) is required to secure hemostasis.

## Comments

The rules for mitral valve repair for degenerative mitral valve regurgitation include (I) the preservation or restoration of normal leaflet motion, (II) creation of a large surface of coaptation and (III) stabilization of the entire annulus with a remodeling annuloplasty (1). The 'French correction' described by Carpentier is the most common technique performed world-wide and is associated with excellent long-term results (2). Nevertheless, in recent years

 

a new paradigm of "respect rather than resect" approach has become popular among surgeons and is based on a more extensive use of artificial PTFE chordae associated with limited resection techniques (3,4). This enables correction of the prolapsing segment of mitral valve, displacing the abnormal tissue into the ventricle, and ensures a large surface of coaptation while preserving the leaflet tissue. The crucial point of this technique is to identify the appropriate length of the neo artificial chordae, in order to avoid residual prolapse or a 'frozen' leaflet in case of longer or shorter chordae respectively.

The Memo3D ReChord is a semi-rigid complete prosthetic ring associated with a temporary chordal guide system with the aim of simplifying the implantation of PTFE neochordae without the need for measuring their length. This technique uses the posterior annulus as a reference point for the height of the neochordae, relying on the principle of basal marginal chordae equivalence, where the height of a marginal (primary) chorda is always equal to that of the corresponding basal (tertiary) chorda (5). Once the PTFE chordae are passed through the loops, the free margin of the anterior or posterior leaflet is brought to the posterior annulus, the PTFE are tied and the temporary loops system is removed. The length of the neochordae obtained will exactly match the plane of the native annulus at the coaptation point.

This is a simple and reproducible technique, suitable for both anterior and posterior leaflet prolapse, which restores leaflet motion and ensures a large surface of coaptation. According to our experience, the temporary chordal guide system allows a correct implantation of PTFE neochordae without the need for chordal measurement, short operative times and doesn't require a long learning process. In our opinion, its use might standardize the "respect rather than resect" mitral valve repair technique, further facilitating a MIMV surgical approach.

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## References

1. Carpentier A. Cardiac valve surgery--the "French correction". J Thorac Cardiovasc Surg 1983;86:323-37.
2. Braunberger E, Deloche A, Berrebi A, et al. Very long-term results (more than 20 years) of valve repair with carpentier's techniques in nonrheumatic mitral valve insufficiency. Circulation 2001;104:I8-11.
3. Perier P, Hohenberger W, Lakew F, et al. Toward a new paradigm for the reconstruction of posterior leaflet prolapse: midterm results of the "respect rather than resect" approach. Ann Thorac Surg 2008;86:718-25; discussion 718-25.
4. David TE, Armstrong S, Ivanov J. Chordal replacement with polytetrafluoroethylene sutures for mitral valve repair: a 25-year experience. J Thorac Cardiovasc Surg 2013;145:1563-9.
5. García Fuster R, Martín E, Paredes F, et al. Artificial chordae in the setting of complex mitral valve repair: early outcomes using the folding leaflet technique. Interact Cardiovasc Thorac Surg 2014;18:586-95.

 