

# Notes to Avoid Failure in Mitral Valvuloplasty

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Mitral valvuloplasty can be applied in many situations and is quite effective in many cases. However, since it requires surgical skill based on knowledge and experience, there is a risk for recurrent surgery and reoperation was necessary in 5-8% of all cases in the first three years. 80-95% required no reoperation in ten years. Reoperation was performed mostly in cases of active endocarditis and extensive anterior leaflet prolapse. Reasons for reoperation were incomplete repair, tissue injury on sutured portion, recurrent annulus dilatation, re prolongation of chordae and hemolysis. To attain better surgical results in mitral valvuloplasty the basic technique should consist of the resection and suture method and the fragile portion should be sutured with a patch. Careful attention should be paid to attaining a good coaptation of leaflet at the end of repair, sufficient remodeling of the dilated annulus and to careful suturing of the prosthetic ring.

It is also important to have an experienced operator perform the transesophageal echocardiogram, and if more than 2 cm<sup>2</sup> residual regurgitation is observed, immediate examination and treatment should be performed.

In case of mitral regurgitation after surgery, careful assessment for reoperation can contribute to good late surgical results. (*Ann Thorac Cardiovasc Surg* 2001; 7: 69–74)

**Key words:** mitral valve plasty, Barlow syndrome, sliding plasty

## Introduction

Mitral valvuloplasty is becoming the first treatment of choice for mitral regurgitation.<sup>1)</sup> However problems such as residual regurgitation, early occurring valve dysfunction (early failure) and late occurring regurgitation still occur with this technique. Most recurrent surgery is performed after the long-term observation of residual regurgitation or early occurring valve dysfunction after the first surgery.

The problem of residual regurgitation can be solved by early detection using intraoperative transesophageal echocardiogram and immediate conversion of valvuloplasty to mitral valve replacement if indicated. It is important to improve the surgical results of mitral valvuloplasty and for the patient's quality of life to reduce the rate of early occurring valve dysfunction after surgery.

Mitral valve dysfunction that develops early after sur-

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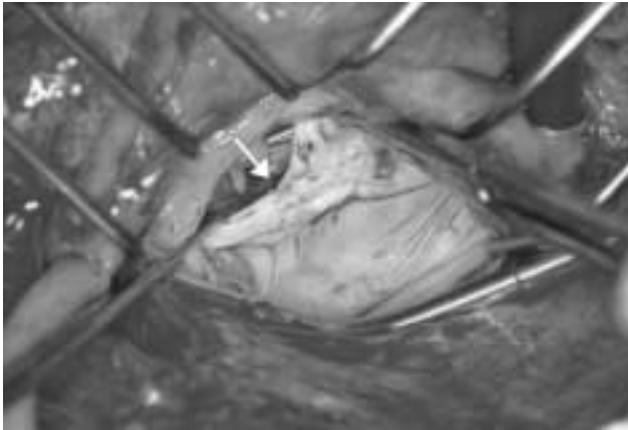
gery should be corrected to improve the surgical results of mitral valvuloplasty and to obtain a good quality of life for patients. The causes of this early dysfunction may be due to dehiscence and a lack of useful techniques for maintaining the function of the valve.

The author reports the notes on the prevention of early dysfunction of the mitral valve after valvuloplasty.

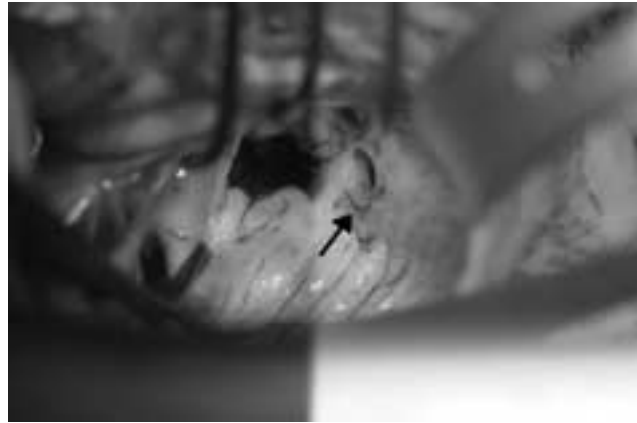
## Dehiscence of Resected and Sutured Portion (Fig. 1)

Resection and suturing are essential techniques for mitral valvuloplasty. It is important to avoid excess tension in the sutured portion. Dehiscence is often found in the annulus (Fig. 2), and plication of this portion by stitching from the ventricle site will help in preventing dehiscence. Supplemental additional plication may be needed if the annulus is fragile. In particular, the annulus should not be resected too widely, especially at the commissure site.

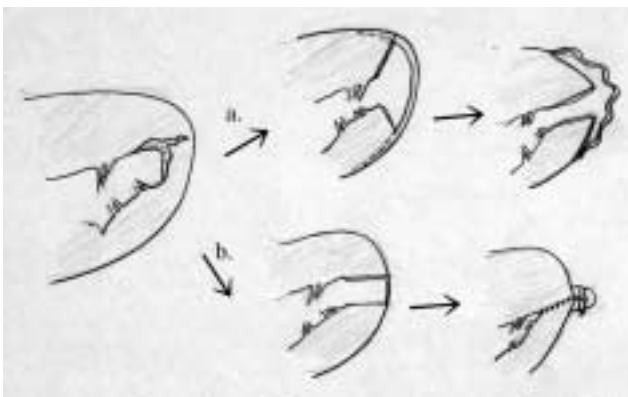
It is important to resect the commissure rectangularly rather than trapezoidally, since a rectangular portion enables the surgeon to perform safe and appropriate mitral



**Fig. 1.** Dehiscence of the top of sutured leaflet.



**Fig. 2.** Dehiscence of the annulus of sutured leaflet.



**Fig. 3.** How to repair the prolapse of the commissure site.

- a: Following the wide trapezoidal resection, the sliding technique is applied.
- b: Following the small rectangular resection, the simple suture technique is performed.

valvuloplasty using only the resection and suturing technique without the sliding technique (Fig. 3). To install the prosthetic ring the stitch has to cross over the repaired annulus. A prosthetic ring installed on the annulus helps to release excess tension in the resected and sutured portion. It is also useful to protect the sutured portion with the patient's own pericardial patch over if the annulus becomes fragile due to active infectious endocarditis (Fig. 4).

### Ring Detachment

Annuloplasty using a prosthetic ring provides a good coaptation of leaflets, a reduction of tension in the sutured portion, good prevention of further dilation of the annulus and a stable late surgical result. However, a lack of experience or a poor technique carries the risk of de-

hiscence or detachment of the prosthetic ring, especially when a rigid ring is selected. It is very important to be aware of the commissure and to place the sutures evenly on the prosthetic ring to fit the patient's annulus accurately.

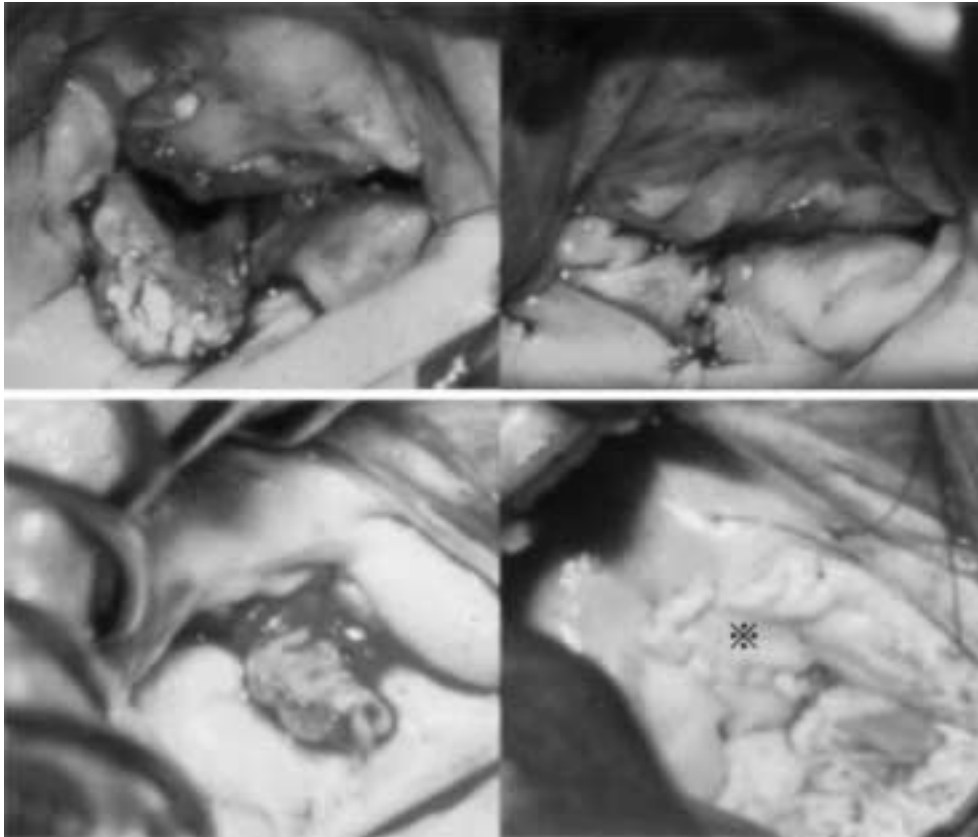
The size of the prosthetic ring has to be matched to the original annulus since mismatched prosthetic rings detach after surgery (Fig. 5). The prosthetic ring should be sutured tightly with a large needle to the annulus tissue and additional everting mattress suture may be necessary to attach it to the annulus more tightly in cases of markedly dilated annulus in dilated cardiomyopathy.

### Chordae Shortening

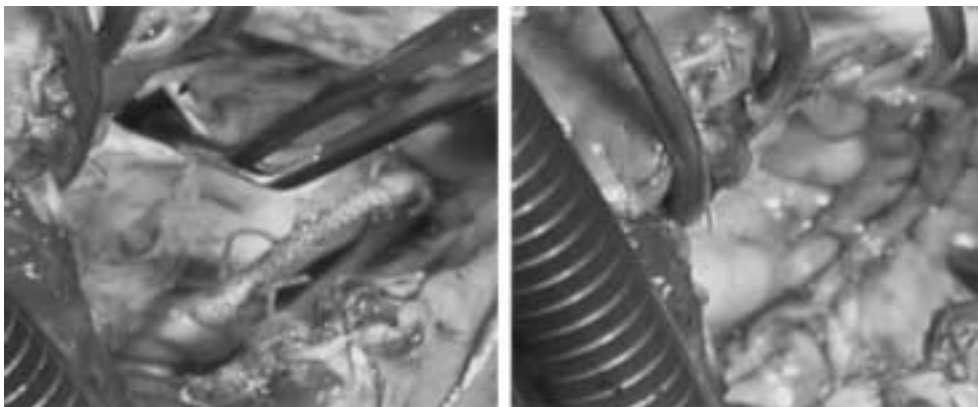
Chordae shortening is a simple technique known as French Correction.<sup>1)</sup> However, the effect of this technique is not persistent. The procedure of chordae shortening is different in details and its technical difference may reflect the late results. Few surgeons now recommend this technique.

### Chordae Reconstruction with PTFE Suture

Chordae reconstruction with PTFE suture has been applied for 15 years since Frater, and David first made a clinical study of this technique. The mattress PTFE suture with small pericardial pledgets is put through the top of the papillary muscle and tied. Both ends of this suture is passed through the rough zone of the prolapsed leaflet from the atrial to the ventricular side and reversed again to the atrial side. The length can be controlled repeatedly and these suture ends are finally tied on the atrial side of the leaflet. No problems relating to destruction have been noted in the last ten years of annual reports.<sup>2)</sup>



**Fig. 4.** Active endocarditis. Upper: resection and suture was done on the destroyed posterior leaflet and debridement was added on the infected anterior leaflet; lower: resection and suture was performed and a pericardial patch was sutured to protect the sutured portion.



**Fig. 5.** Ring detachment and laceration occurred on the anterior annulus (left). The laceration was repaired and posterior annuloplasty using a pericardial strip was employed.

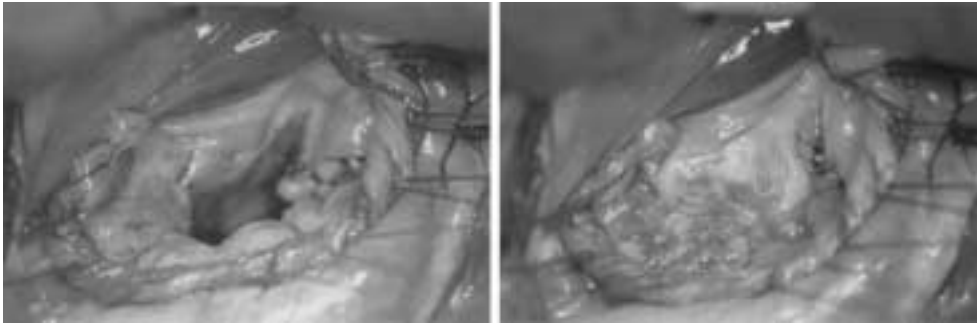
The reconstructed portion seems to be well coated by the patient's own endocardial tissue soon after the operation and no degeneration develops thereafter. This technique provides a good surgical results and is quite effective on anterior leaflet prolapse, thus, it will probably replace chordae transposition and chordae shortening techniques. However, this technique still makes it difficult to adjust the length of chordae.

The useful current approach is to perform chordae transposition or chordae shortening first for better coaptation of leaflet, supplemented by PTFE chordae reconstruction.

### **Total Annular Remodeling and Posterior Annuloplasty**

A pioneer in valvuloplastic surgery, Carpentier proposed remodeling of the annulus with a prosthetic ring (Carpentier Ring) as a standard approach for mitral valvuloplasty in 1970. This technique was based on the concept that the shape of annulus should be kept as it is in systole because the best coaptation of leaflet was accomplished in systole.

Duran reported the effect of a totally flexible Duran Ring, which was able to keep the shape of the annulus



**Fig. 6.** Posterior annuloplasty with a twisted pericardial strip.

both in systole and diastole.

Cosgroove reported the effect of a flexible semicircular Cosgroove Ring, which was based on the idea that only the posterior annulus should be a target for annuloplasty because the anterior annulus of the mitral valve is tightly connected to the aortic valvular ring with fibrous tissue and it is not easily dilated.

The anterior annulus of the mitral valve is connected to the aortic valvular ring with fibrous tissue and it is not easily deformed. Thus, few cases of deformed anterior annulus are seen in surgery in cases of posterior prolapse with a non-dilated annulus. However, this tight fibrous connection does not guarantee the correction distance and position of both valves, and there is still a possibility that the distance will be prolonged and individual variation in the positioning relation of the two valves since there are many individual variations of the position of the two valves. The aortic valve sits in the middle of the anterior annulus of the mitral valve in some cases and in the anterolateral commissure of the mitral valve in other cases. Since the mitral valve opens roundly on diastole, a distinct, flaccid deformity of the anterior annulus in the anterior leaflet prolapse with dilated annulus has been observed during surgery, and there have been insufficient reports to prove the Cosgroove hypothesis.

We have been performing posterior annuloplasty with pericardial strip in cases of posterior leaflet prolapse with a non-dilated annulus (Fig. 6) and total annular remodeling with Carpentier physio ring in cases of anterior leaflet prolapse.

### **Application of Mitral Valvuloplasty on Rheumatic Valve Disease**

Mitral valvuloplasty is a challenging technique for both a surgeon and a patient. The indication of this technique is now widening and even surgeons who feel it has limitations for mitral stenosis still use this technique for mitral regurgitation.

Rheumatic valve disease causes a thickening and shortening of valves and it is impossible to obtain a good coaptation of leaflets without performing plastic surgery on the thickened and shortened leaflet.

Valvuloplasty is now indicated in rheumatic mitral disease with dilated annulus and prolonged chordae producing regurgitation, and it is important to recover the pliability of the leaflet by performing commissurotomy, chordae resection and fenestration (Fig. 7).

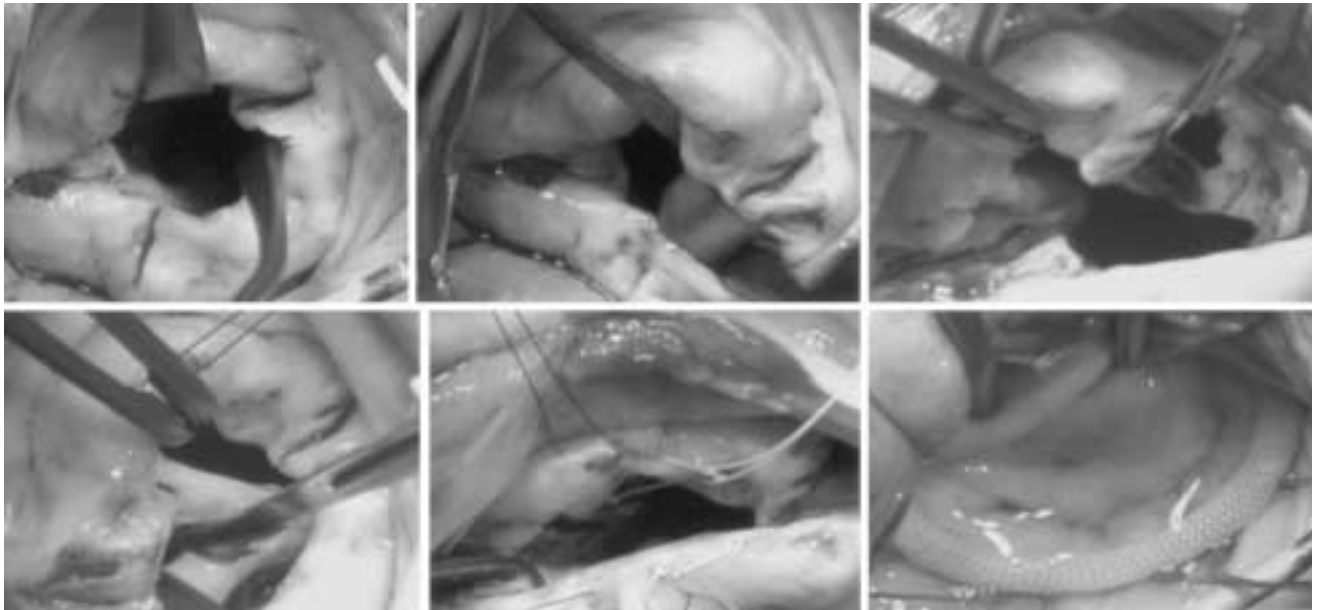
### **Sliding Technique**

Systolic anterior motion (SAM) was complicated in 5-9% of cases of mitral valvuloplasty using a Carpentier ring. The reason for this complication is excess tissue in the posterior leaflet pushing the anterior leaflet to septal site. Carpentier proposed the sliding technique to resect this excess tissue along the annulus for preventing SAM. Sliding technique is not necessary in patients who have no risk of SAM with the resection and suture method. Although this technique has been reported to be useful for commissure prolapse, it can be repaired using the resection and suture method by resecting tissue rectangularly rather than trapezoidally.

### **Extreme Barlow Syndrome**

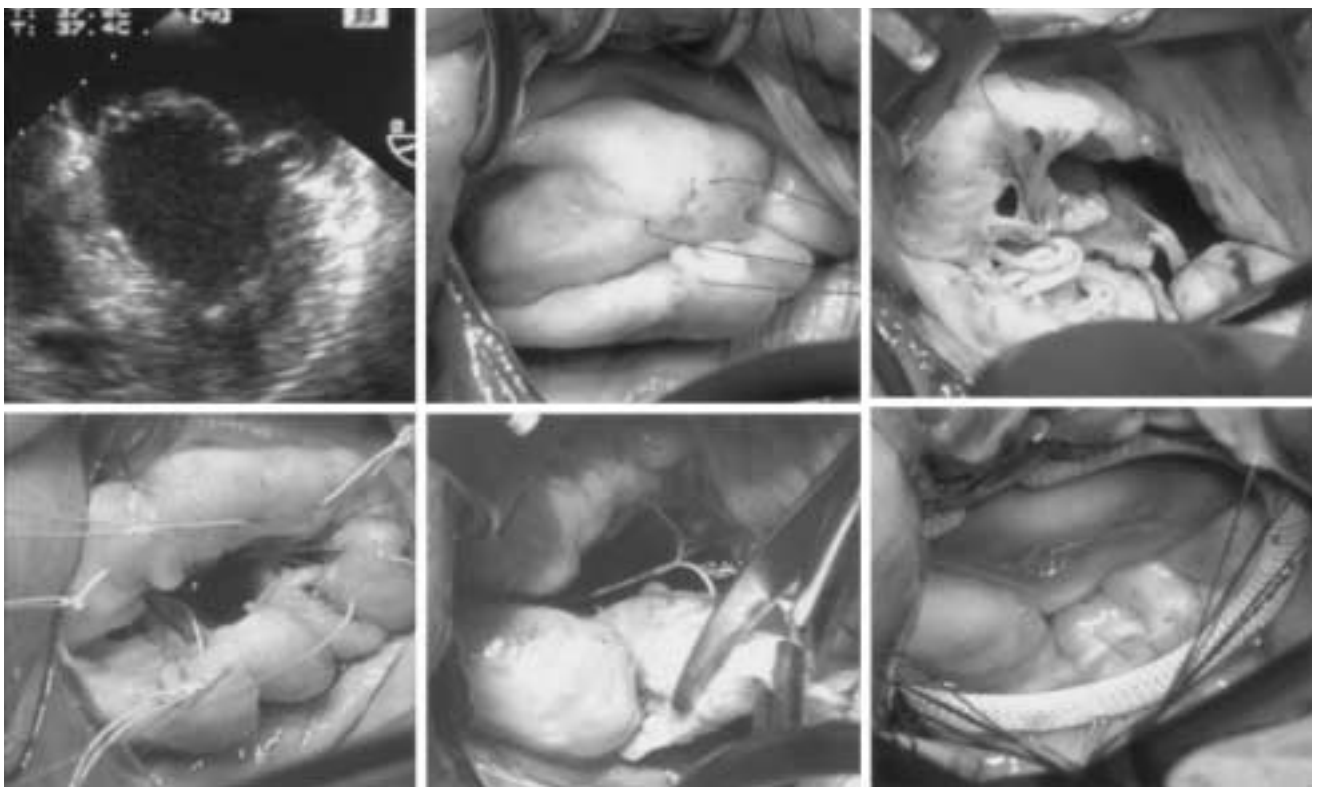
In extreme Barlow syndrome, both the anterior and posterior leaflets are prolapsed making surgical repair extremely difficult.

It is very hard to judge the right length of chordae in this condition. We recommend a rough correction of all strut chordae by the shortening technique first, followed by chordae reconstruction with PTFE on 3-4 chordae pairs of the anterior and posterior.<sup>3)</sup> Patients with extreme Barlow syndrome frequently develop SAM so we reduce the height of the posterior leaflet by one third and accomplish the repair with remodeling using a prosthetic ring (Fig. 8).



**Fig. 7.** Valvuloplasty for rheumatic stenosis and insufficiency. Commissural fusion (a), shortened and fused chordae (b), commissurotomy, chordotomy and pappilotomy on lateral commissure (c), chordotomy and pappilotomy on medial site (d), PTFE chordae reconstruction for the prolapse of both leaflet (e), Carpentier’s annuloplasty ring was applied.

a	b	c
d	e	f



**Fig. 8.** Repair for “extreme Barlow syndrome.”

Echocardiogram showed severe prolapse of the both leaflets (a), the prolapse of whole leaflets was recognized (b). Rough correction of all strut chordae by the shortening technique (c), followed by chordae reconstruction with PTFE (d). Reduction of the height of the posterior leaflet for the prevention of SAM (e), remodeling using prosthetic ring (f).

a	b	c
d	e	f

### Mild Anterior Leaflet Prolapse

It is not rare for severe posterior leaflet prolapse to accompany mild anterior leaflet prolapse due to elongation of the chordae. Recently some reports suggest that treatment on the anterior leaflet is not indicated if annuloplasty using a prosthetic ring has been performed with plastic surgery on the posterior leaflet.<sup>4)</sup> In fact, mild prolapse of the anterior leaflet can be neglected by tight coaptation of leaflet in some cases. However, a prosthetic ring is not useful for correcting the anterior leaflet prolapse, and the anterior leaflet can still cause regurgitation.

### Coronary Air Embolism

One of the complications in mitral valvuloplasty is air embolism, which causes myocardial dysfunction. During the regurgitation test with saline, air in the left ventricle enters into the coronary artery through the aortic valve. Venting from the aortic root helps the evacuation of air from the left heart and retrograde cardioplegic solution is also effective to push air in the coronary artery back to the aorta.

### Aortic Valve Injury

On suturing a prosthetic ring to the mitral annulus, a stitch may anchor the aortic valve, subsequently causing aortic regurgitation. Attention must be paid to avoid such anchoring on suturing from the anterolateral commissure to the anterior annulus with clear imaging of the aortic valve. When aortic regurgitation is found after the release of aortic cross clamping, the prosthetic ring must be removed.

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