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Anatomic and Functional Respect in Ventriculoplasty: The Twist Technique

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Abstract

Many surgical techniques have been developed for the treatment of cardiac aneurysm. These surgical procedures are designed to prevent further enlargement or rupture of the Left Ventricle (LV) and to return to its physiological volume and geometric shape. We have developed an innovative technique of ventriculoplasty, the Twist Technique, which is the result of desire to respect not only volume and shape of the LV but, above all, to restore ejective Counterclockwise (CCW) twisting movement of the cardiac apex through the reset of helical arrangement of its fibers. This technique aims to rebuild the natural apical vortex of the LV. The physiological movement of this new apex, which unfolds in a natural CCW twist, considerably improves LV ejection fraction. We would like to present this technique to Scientific Community.

Keywords: Left Ventricular Aneurysm; Left Ventricular Apex; Myocardial Infarction; Surgical Technique; Ventriculoplasty

Introduction

Since 1944, many surgical techniques have been developed for treatment of left ventricular aneurysm. They are divided into two categories: 1) the direct suture techniques and 2) the patch ventriculoplasty techniques. These surgical procedures are designed to prevent further enlargement or rupture of the Left Ventricle (LV) and to return to its physiological volume and geometric shape [1]. Since 1996, we have developed an innovative technique of ventriculoplasty, the Twist Technique, which aims to respect not only volume and shape of the LV but, above all, to restore the ejective Counterclockwise (CCW) twisting movement of the cardiac apex through the reset of its helical fibers arrangement. This surgical technique rebuilds the natural apical vortex of the LV [2-3]. The physiological movement of this new apex, which unfolds in a natural CCW twist, considerably improves LV ejection fraction. The road map of the operation is drawn by intraoperative Trans Esophageal Echocardiogram (TEE) through which we measure the distance between the apex and the mitral annulus, the end systolic, and diastolic LV volume, the kinetic of the LV, and the aneurismal zone, which has to be excluded. At the end of surgery, TEE also plays a key role for the check of LV global function and segmental kinetic.

The Twist Technique

The left ventriculotomy is performed in the center of the depressed area visualized by aortic vent suction (Figure 1A). If thrombus is present, it is removed from the cavity. In case of documented spontaneous or induced ventricular tachycardia, subendicardial ablation by monopolar radiofrequency is applied on the transitional tissue without mapping. One row of circular sutures (purse string like a tobacco pouch) using 2-0 monofilament polypropylene suture is placed exactly on the border between normal and fibrous tissue (transitional tissue). Careful tightening of the circular stitches is carried out, reconstructing the cavity of the LV and reducing its size (Figure 1B). The reduction of the orifice between aneurysm and LV cavity by these circular stitches prevents the elongation when fibrous rim is approximated. After that, the ventriculotomy closure is carried out by a double running sutures of 2-0 monofilament polypropylene. The first one running suture orients cardiac fibers reconstructing heart apex in a cone shape. It guarantees that radial force lines reproduce physiological CCW torsion of the cardiac apex. It is got with points more outdistanced on the anterior side of endocardial wall and more brought closer

towards the endocardial septal, beginning from the anterior wall at level of the circular suture, determining the exclusion of the blackest portion of the septum which is folded and, therefore, excluded (Figure 1C-1D). Through the entire thickness of excluded endocardium, the second running suture in large needle 2-0 monofilament polypropylene is performed for reinforcement and hemostatic purposes (Figure 1E-1F). The cornerstone of the Twist Technique is the first suture, which returns the physiological orientation of the muscle fibers rebuilding a new morphological and functional LV apex (Figure 1C-1D). It has been performed conducting the running suture of 2-0 monofilament polypropylene with a radiant and spiral shape, which distributes the forces of tension.

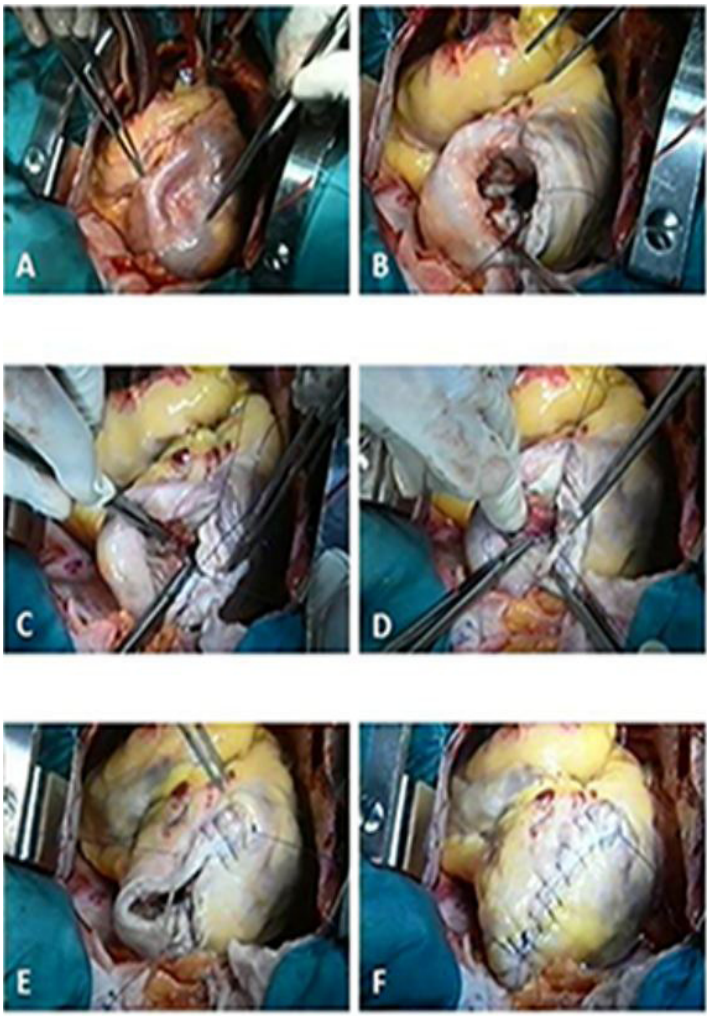

Figure 1(A-F): Surgical view of the Twist Technique.

It also allows the CCW torsion of cardiac apex reducing dyskinetic contraction and improving total physiological cardiac motion. A schematic representation of the Twist Technique is proposed in (Figure 2).

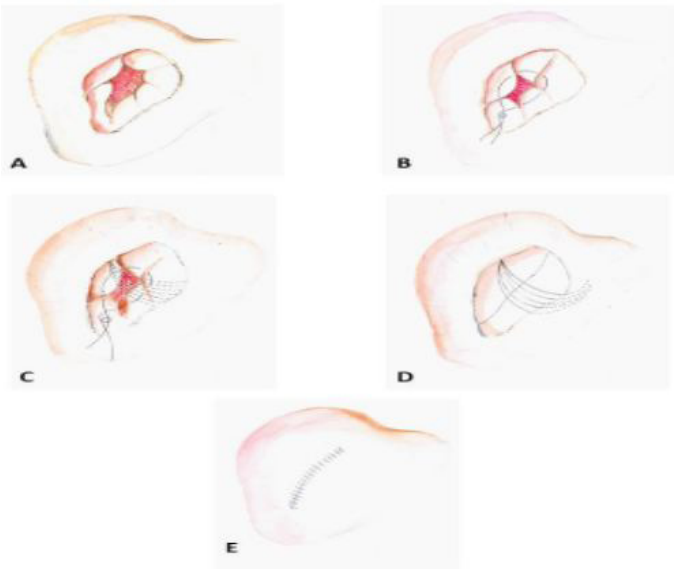

Figure 2: Schematic representation of the Twist Technique.

Discussion

The direct suture techniques hitherto in use restore only shape and volume of the LV. The application of patch restores only shape and volume and, being an inert place of contractile forces, it could predispose to post-ischemic dilated cardiomyopathy, in long-term follow up [4-5]. Instead, the reconstruction of the myocardial fiber orientation of the apex guaranteeing its natural CCW torsion, without use of patch, even in the presence of large loss of substance, returns to the LV its geometric shape, its geometric volume, its mechanics, and its kinetics. It also improves the LV ejection fraction gaining in its global contraction and reducing the sphericity index which is demonstrated to worsen after surgical ventriculoplasty [6]. In our single center experience, the mean EF improvement measure by TTE is 13.8% (sd ± 4.7) and these data are confirmed by the MRI analysis performed on the sample of patients which underwent the Twist Technique since Sept 2014 to Sept 2017. The existence of differences in regional work between the LV interventricular septum and the posteroinferior wall, determined by embryological evolution of the heart, suggests the importance of a careful evaluation for the choice of the best technique to apply in ventriculoplasty [3]. In this context, the selection of the patient who can benefit from the Twist Technique is essential. We recommend the Twist Technique in case of LV aneurysm affecting the cardiac apex with possible involvement of septal and/or anterior, and/or lateral region of the LV.

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