Florida Sleeve Procedure Is Durable and Improves Aortic Valve Function in Marfan Syndrome Patients

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Background. **The Florida sleeve (FS) procedure was developed as a simplified approach for repair of functional type I aortic insufficiency secondary to aortic root aneurysm. We evaluated postoperative aortic valve function, long-term survival, and freedom from reoperation in Marfan syndrome patients who underwent the FS procedure at our center.**

Methods. **All Marfan syndrome patients undergoing FS procedure from May 2002 to December 2014 were included. Echocardiography assessment included left ventricular end-diastolic diameter (LVEDD), left ventricular end-systolic diameter (LVESD), ejection fraction, and degree of aortic insufficiency (none = 0, minimal = 1, mild = 2, moderate = 3, severe = 4). Social Security Death Index and primary care physicians' report were used for long-term follow-up.**

Results. **Thirty-seven Marfan syndrome patients, 21 (56.8%) men and 16 (43%) women with mean age of 35.08 ± 13.45 years underwent FL repair at our center. There was no in-hospital or 30-day death or stroke. Two patients required reoperation due to bleeding. Patients' survival rate was 94% at 1 to 8 years. Freedom from reoperation was 100% at 8 years. Twenty-five patients had postoperative follow-up echocardiography at 1 week. Aortic insufficiency grade significantly decreased after the procedure (preoperative mean ± SD: 1.76 ± 1.2 versus 1-week postoperative mean ± SD: 0.48 ± 0.71, $p < 0.001$), and mean LVEDD decreased from 52.23 ± 5.29 mm to 47.53 ± 8.89 mm ($p = 0.086$). Changes in LVESD (35.33 ± 9.97 mm to 36.58 ± 9.82 mm, $p = 0.58$) and ejection fraction (57.65% ± 6.22% to 55% ± 10.83%, $p = 0.31$) were not significant.**

Conclusions. **The FS procedure can be performed safely in Marfan syndrome patients with immediate improvement in aortic valve function. Long-term survival and freedom from reoperation rates are encouraging.**

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Marfan syndrome (MFS) patients have a genetic connective tissue defect involving several organs [1]. Progressive aortic root aneurysm and subsequent aortic valve insufficiency (AI) are the most common cardiovascular complications of Marfan disease, affecting up to 80% of patients. If left untreated, patients remain at high risk of aortic dissection and rupture [2, 3].

The aortic valve sparing (AVS) approach was introduced to replace the aortic root and repair functional type I AI secondary to aortic root aneurysm [4]. Although the previously known AVS approaches (Yacoub and David procedures) can effectively prevent aortic dissection and rupture in MFS patients [5, 6], because of the complexity of these approaches only a limited number of centers consider them as first-line treatment. Hence, many centers still use full root replacement for patients with aortic root dilation with or without AI, obligating patients to lifetime anticoagulation. The Florida sleeve (FS) procedure was introduced at the UF Health (University of Florida, Gainesville, FL) as a simplified approach for repair of type I AI due to aortic root aneurysm [7]. The FS procedure is a more easily reproducible approach because the aortic root is left intact and protected by a "sleeve." Furthermore, the risk of bleeding is less because the sinuses are not resected and reimplantation of the coronary arteries is not required [7, 8]. Although several studies have reported advantages of the FS procedure and its modifications [8–11], there are still controversies about its long-term durability, dimensional stability, and

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Abbreviations and Acronyms

AI	= aortic insufficiency
AVS	= aortic valve sparing
Echo	= echocardiography
FS	= Florida sleeve
LVEF	= left ventricular ejection fraction
LVEDD	= left ventricular end-diastolic diameter
LVESD	= left ventricular end-systolic diameter
MFS	= Marfan syndrome
PCP	= primary care physician

need for reoperation, which have not been clearly stated for the MFS population [12]. The 2009 report by Hess and colleagues [8] suggested appropriate midterm durability and stability of ventricular dimensions in 18 patients of which 6 had MFS. However, they did not stratify results based on Marfan disease; in three other reports of sleeve re-enforcement, only 1 to 3 MFS patients were included [11, 13, 14], and the results were inconclusive because of the low number of patients. Therefore, we aimed to investigate long-term survival, freedom from reoperation, aortic valve function improvement, and stability of left ventricular dimensions in MFS patients after the FS procedure.

Material and Methods

Patients

In this retrospective, single-center, observational study, 37 MFS patients with AI secondary to aortic root aneurysms underwent the FS procedure. The study was conducted from May 1, 2002, to December 20, 2014, at UF Health (The University of Florida College of Medicine, Gainesville, FL). Patients who underwent the FS procedure after March 2006 have provided consent to allow gathering their follow-up data from outside centers. The institutional review board approved the study protocol and waived consent for patients who had the FS operation before March 2006. Only patients with normal or mildly abnormal leaflets of the aortic valve were eligible for the FS procedure; patients with damaged, prolapsed, or nonfunctional leaflets underwent aortic valve replacement and were excluded. All FS patients had functional type I AI associated with aortic root aneurysm, and patients with type 2 AI were omitted.

Procedure

Hess and colleagues [8] described the technical details of the FS procedure. The FS procedure at our institution typically includes four to six subannular mattress sutures placed in the same horizontal level on either side of the coronary arteries and one under the noncoronary cusp with efforts to avoid the conduction system (Fig 1). Sizing for the conduit was based on the proper leaflet coaptation and valve competence. We used a cylindrical Hegar dilator (Jarit Instruments, Hawthorne, NY) for sizing.

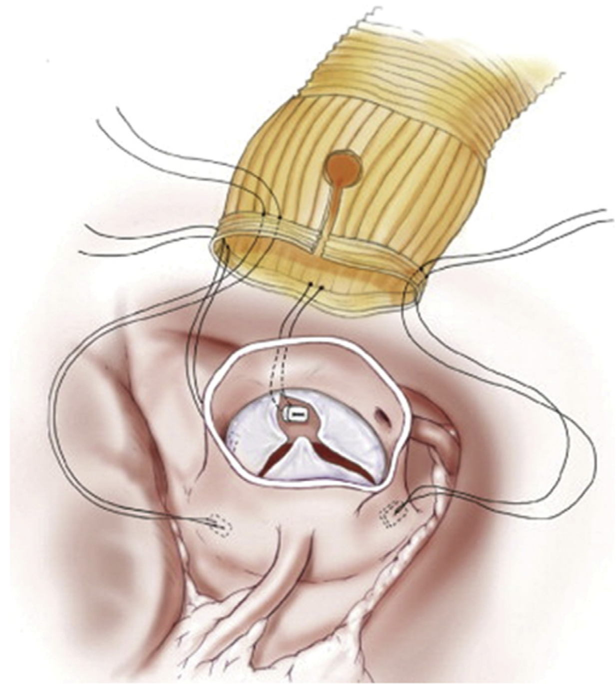

Fig 1. The four subannular anchoring sutures are placed in the same horizontal plane, 2 to 3 mm below the lowest point of the center of the leaflets; three are in line with the commissures, and a fourth is placed under the noncoronary cusp. The left coronary artery keyhole is cut after the sleeve is temporarily seated. The slits in the graft below the coronary keyholes are repaired after the sleeve is seated. (Reproduced from The Annals of Thoracic Surgery, 87;4, Hess, Philip J. et al., Early Outcomes Using the Florida Sleeve Repair for Correction of Aortic Insufficiency due to Root Aneurysms, p. 1161-69, 2009, with permission from The Society of Thoracic Surgeons.)

Then, the subannular sutures were passed through the sleeve graft and tied with the presized dilator across the annulus to prevent excessive narrowing of the annulus. Each subannular mattress suture leads to approximately 1 mm additional annular narrowing. Over time we decreased the subannular sutures from 10 to 12 in the original method to 4 to 6 sutures in the current FS technique; however, caution for annular narrowing still remains necessary. The openings for the coronary arteries are created with slits below them to create “keyholes,” which were repaired by simple sutures below the coronary arteries after the graft was placed over the aortic root. At the distal part of the sleeve graft at the level of the sinotubular junction a horizontal mattress suture secures the aorta to the graft, making sure each commissure is in alignment with the respective aortic valve commissures. This helps prevent valve prolapse and misalignment of leaflets (Fig 2). A slightly smaller tube graft is then used above the FS to reduce the sinotubular junction with a hemostatic running suture incorporating aorta and the sleeve graft to complete the root reconstruction (Fig 3) [8].

Patient Outcomes

The primary end point of this study was to assess the procedural safety and long-term durability of the FS