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Tricuspid annuloplasty with the Millipede ring

Jason H. Rogers [a,*], Walter D. Boyd [b], Steven F. Bolling [c]

[a] Division of Cardiovascular Medicine, University of California, Davis Medical Center, Sacramento, CA, USA
[b] Division of Cardiac Surgery, East Carolina University, Greenville, NC, USA
[c] Department of Cardiac Surgery, University of Michigan Health System, Ann Arbor, MI, USA

Contents

Ring annuloplasty is the surgical gold standard for correcting functional tricuspid regurgitation (FTR), and rigid rings confer superior durability as compared to flexible rings or bands.[1] Although ring annuloplasty can be performed routinely in the operating room, there is an unmet clinical need for transcatheter tricuspid ring delivery, since many patients with symptomatic FTR are high risk for surgical correction. We have previously reported our first in human experience with the surgical and transcatheter delivery of the Millipede semi-rigid complete annular reshaping ring for the treatment of mitral regurgitation (MR) and FTR, and herein we summarize the initial experience with the surgical tricuspid Millipede ring.[2]

The Millipede ring (Boston Scientific, MA) is a semi-rigid, complete ring that has a frame manufactured from nitinol with a "zig-zag" design. There are 8 helical stainless-steel anchors that fix the device to the mitral or tricuspid annulus. At the top of the frame are 8 sliding collars which allow actuation of the device and reduction in annular circumference and diameter. Each collar that is tensioned brings the two adjacent helical anchors closer together. By activating crowns individually, regional annuloplasty can be performed to plicate most dilated portions of the annulus. The 3 basic steps of the Millipede procedure are (1) placement, (2) anchoring, and (3) adjustment (Fig. 1).

The initial clinical experience with the Millipede system involved surgical implantation of the first generation device with median sternotomy and cardiopulmonary bypass. The rationale for surgical implantation was to establish safety and efficacy of the implants prior to transcatheter delivery. The Millipede rings were placed on the mitral and tricuspid annulus using a positioning catheter, and each helical anchor was driven into the mitral and tricuspid annulus under direct vision. After anchoring, the collars were rotated to tighten the device until leaflet coaptation was achieved and there was no MR or TR by surgical "bulb" testing.

Detailed clinical results have been previously reported. Two patients in the initial published series received concomitant mitral and tricuspid Millipede rings for symptomatic MR with associated tricuspid annular dilation and functional TR.[2] The first patient had a baseline tricuspid annular diameter of 48.1 mm by transthoracic echocardiography (TTE) that was reduced to 30.5 mm (36.6% diameter reduction) with ring annuloplasty, and the TR grade decreased from 4+ at baseline to 0 at 30 days. The second patient had a starting tricuspid annular diameter of 47.3 mm that was reduced to 30.4 mm (35.7% diameter reduction), and the TR grade decreased from 3+ at baseline to 0 at 30 days. The fluoroscopic and computed tomographic appearance of the Millipede mitral and tricuspid rings is shown Fig. 2.

In summary, the Millipede ring is a complete, semi-rigid ring which attaches directly to the mitral or tricuspid annulus and can normalize the mitral or tricuspid annular diameter. In the initial previously published experience using open surgical technique, the Millipede ring was used successfully to treat two patients with MR and associated FTR. The Millipede ring has subsequently been implanted successfully in the mitral position through a transcatheter, transfemoral and transseptal approach. Transcatheter tricuspid delivery is currently under development.

Declaration of competing interest

Drs. Bolling, Boyd, and Rogers are consultants to Boston Scientific.

* Corresponding author at: Division of Cardiovascular Medicine, University of California, Davis Medical Center, Sacramento, CA 95817, USA.
E-mail address: jhrogers@ucdavis.edu (J.H. Rogers).

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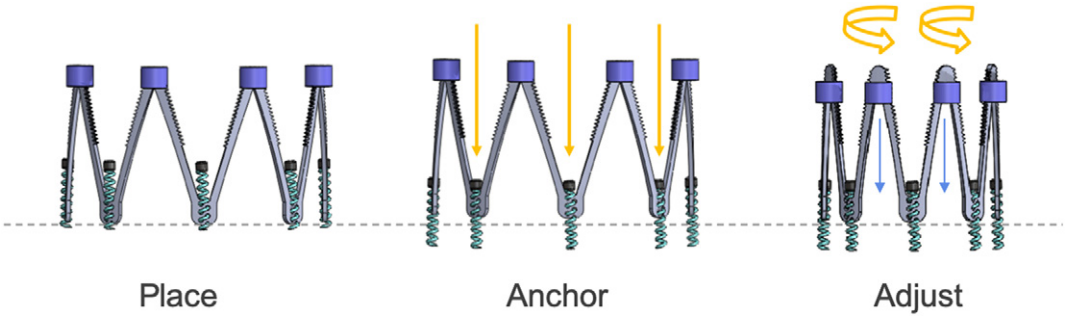

Fig. 1. The Millipede procedure. From left to right, the ring is first placed on the mitral or tricuspid annulus. Next, the ring is anchored to the annulus with 8 helical anchors. Finally, the device is activated by rotating the crown collars, which adjusts the annulus to the desired final diameter.

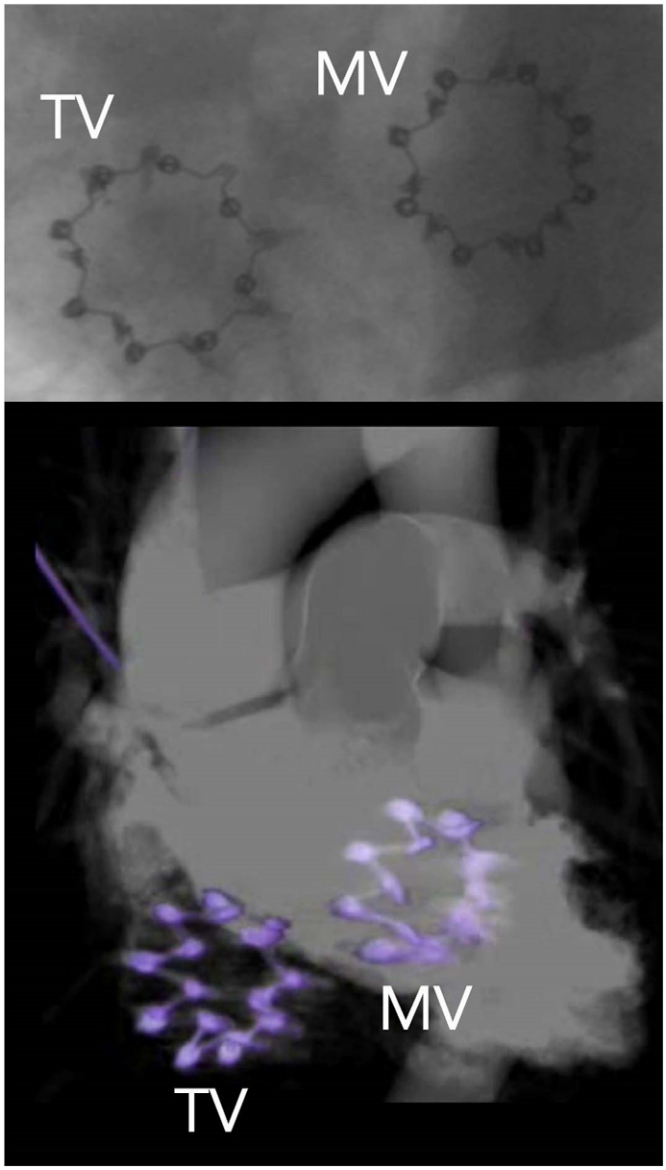

Fig. 2. Mitral and tricuspid rings. Top panel demonstrating tricuspid valve (TV) and mitral valve (MV) Millipede rings on fluoroscopy at 30 days post-implant. Lower panel showing computed tomographic appearance of same rings.

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