Mitral valve intervention in heavy mitral annular calcification (MAC) presents significant surgical challenges. Current dedicated transcatheter mitral valve therapy excludes patients with significant MAC. Transcatheter aortic valve implantation devices have been used for mitral valve-in-valve and valve-in-ring procedures.1 Balloon-expandable valves have been used with some success in the presence of MAC, but their use is limited by the inability to reposition if left ventricular outflow tract (LVOT) obstruction occurs.2 We describe 2 cases, where a self-expanding and repositionable transcatheter valve was implanted in the mitral position using MAC as an anchor.

Case 1
A 75-year-old woman presented with increasing breathlessness after her aortic valve replacement and mitral valve repair in 2014. Echocardiography demonstrated a functioning prosthetic aortic valve and severe mitral regurgitation. The mitral annulus had a measured perimeter of 77 mm and area of 400 mm² (transesophageal echocardiography) with an aortomitral annular angle of 124° (computed tomography).

Case 2
A 62-year-old man presented with New York Heart Association III symptoms. Medical history included Alport syndrome, transcatheter aortic valve implantation (26 mm Sapien XT), and permanent pacemaker. Echocardiography demonstrated a functioning prosthetic aortic valve and severe mitral regurgitation. The mitral annulus had a measured perimeter of 82 mm and area of 440 mm² (transesophageal echocardiography) with an aortomitral annular angle of 140° (computed tomography).

Procedure
In both cases, preprocedural multimodality imaging was crucial to assessment of feasibility (Figures 1 and 2). The procedure was performed via transapical access. The mitral valve was crossed with a multipurpose catheter and exchanged for a SAFARI wire. The procedure was guided by fluoroscopy (initial device placement) and transesophageal echocardiography (assessment of valve function and LVOT obstruction). In the first case, the valve was resheathed after 60% deployment to optimize final position.

In both cases, the LOTUS valve system was deployed with a good waist, excellent hemodynamic performance, and no LVOT obstruction (Figures 3–5). The mean transvalvular gradients were 4 and 7 mmHg, respectively, with no more than mild paravalvular regurgitation. After a period of recovery with no postprocedural complications, both patients were discharged home on day 6 on warfarin.

Discussion
The treatment of degenerative native mitral valve disease is feasible with balloon-expandable transcatheter aortic valve implantation devices. However, this has been associated with LVOT obstruction, embolization/migration,3 and annular damage.4 These potential disadvantages may be overcome by the use of a self-expandable and repositionable device. LVOT obstruction and security of fixation can be assessed once optimal positioning has been achieved. Gradual implantation can also minimize the risk of annular damage (despite deliberate oversizing).

The accuracy of mitral annular sizing and assessment of the potential risk of LVOT obstruction will only improve with more experience. Meanwhile, these initial cases indicate the feasibility and effectiveness of transcatheter mitral valve implantation in MAC using a fully repositionable and self-expanding valve. Similar success has also been reported with the Direct Flow Medical aortic.5 Subject to careful preprocedural anatomic assessment (annular sizing, aortomitral annular, and LV cavity dimensions), this novel approach may prove an effective treatment option for highly selected patients who would otherwise be declined intervention.

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References

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Figure 1. Transesophageal echocardiogram (case 1). Multiplanar reformat ted images demonstrating the measurement of mitral valve annulus size by evaluating the annulus in 2 orthogonal planes (A and B). From this approach, the mitral valve annulus perimeter and area may be measured (C). The arrow shows the sites of mitral valve annulus calcification. LA indicates left atrium.
Figure 2. Multidetector computed tomography (case 2). Multiplanar reformatted images were used to visualize the distribution of mitral valve annulus calcification (A). There is circumferential calcification indicating adequate anchoring properties of the annulus for a transcatheter valve. B and C, The apical long axis and 2-chamber views, the mitral valve calcification, and the relationship with the left ventricular outflow tract. D, Measurements taken to interrogate the annulus and left ventricular outflow tract and the likelihood of postprocedural outflow tract obstruction. The aortomitral annular angle was measured as the angle between the left ventricular outflow tract (LVOT) and the base of the A2 and P2 scallops in the 3-chamber view. Measurements of the annulus and LVOT were also taken in this view. Perpendicular lines measuring 20 mm were then drawn at the bases of the A2 and P2 scallops to project into the left ventricle (LV) to simulate the position of the transcatheter valve and the impact on the LVOT. Twenty millimeter was selected as a means to introduce a margin of safety to account for variable deployment positions. The arrows show the sites of mitral valve annulus calcification. Ao indicates ascending aorta; LA, left atrium; and RV, right ventricle.
Figure 3. Fluoroscopy images (case 2). **A**, The transapical approach with the SAFARI wire across the mitral valve within the left atrium and the deployment of a 22F Cook Sheath. **B**, The unsheathing of the Lotus valve within the mitral annulus. **C**, The evaluation of the Lotus valve unsheathed before deployment. **D**, Lotus valve deployed with the nose cone and SAFARI wire retrieved within the sheath. The white line shows the mitral valve annulus calcification. TAVI indicates transcatheter aortic valve implantation; and TMVR, transcatheter mitral valve replacement.

Figure 4. Postprocedural fluoroscopy images. **A** and **B**, Different fluoroscopic projections of the Lotus valve and Perimount valve in situ (case 1). AVR indicates aortic valve replacement; and TMVR, transcatheter mitral valve replacement.

Figure 5. Three-dimensional transesophageal echocardiogram (case 1). The left atrial surgical view of the Lotus valve in situ in both the closed (**A**) and open (**B**) positions. Corresponding coronal views of the Lotus valve in the closed (**C**) and open (**D**) positions. The white line shows the Lotus valve ring in situ. LA indicates left atrium; and LV, left ventricle.
First Reported Case of Transcatheter Mitral Valve Implantation in Mitral Annular Calcification With a Fully Repositionable and Self-Expanding Valve
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