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CASE REPORT
Other

Successful mitral valve-in-ring repair of mitral annuloplasty ring dehiscence causing severe mitral regurgitation: a case report

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Background Annuloplasty failure caused by ring dehiscence can lead to trans-ring and para-ring mitral regurgitation (MR). Transcatheter treatments are available for patients at prohibitive risk of surgery. In patients unsuitable for edge-to-edge repair, valve-in-ring (ViR) transcatheter mitral valve (MV) implantation has been described to treat trans-ring or para-ring jets but not both concurrently.

Case summary A 78-year-old male presented with severe MR due to dehiscence of a 34 mm Edwards Physio II mitral annuloplasty ring. Transoesophageal echocardiography showed two jets of regurgitation; trans-ring and para-ring. Repair was successfully undertaken with a ViR procedure (29 mm S3 Edwards Lifesciences).

Discussion Patients with failure of MV annuloplasty with trans-ring and para-ring regurgitation can be safely and effectively treated by ViR transcatheter MV implantation.

Keywords Transcatheter mitral valve implantation • Ring dehiscence • Mitral regurgitation • Valve-in-ring • Case report

ESC Curriculum 4.3 Mitral regurgitation • 7.5 Cardiac surgery • 7.4 Percutaneous cardiovascular post-procedure

Learning points

- Valve-in-ring transcatheter mitral valve implantation can be used to treat patients with concurrent trans-ring and para-ring regurgitation.
- Resolution of mitral regurgitation may be linked to distortion of the D-shaped annulus and improved contact between the dehisced annuloplasty ring and the mitral annulus.

Introduction

Surgical mitral valve (MV) repair using a ring annuloplasty has emerged as the gold standard treatment for mitral regurgitation (MR) in patients with severe degenerative MV disease.[1] While mitral annuloplasty provides a durable treatment, recurrence of severe MR is expected in up to 10% of patients within 20 years.[2] Failure of repair may be attributed to a number of complications including incorrect annuloplasty size or position, incorrect artificial chord length, systolic anterior motion, rupture of previously shortened chordae, or even new valvular lesions.[3]

One notable complication is ring dehiscence, which occurs when the sutures anchoring the annuloplasty ring detach from the mitral annulus. Several large registries indicate that ring dehiscence is responsible for annuloplasty failure in 13–42% of cases.[4,5] Such patients pose a treatment dilemma as they may have trans-ring and para-ring leak. Furthermore, the risk of surgical re-operation may be prohibitive, thus transcatheter repair may be the only viable option. Transcatheter edge-to-edge repair is the technique of choice in

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patients ineligible for surgical correction with *de novo* MV disease. However, the same constraints which limit patient selection for primary repair exist for re-repair. A full list of unfavourable characteristics is described in *Table 1*.

In select cases, a transcatheter heart valve (THV) can be implanted in the mitral position via a transseptal approach.[6] Although not widely performed, valve-in-ring (ViR) transcatheter mitral valve implantation (TMVI) for annuloplasty failure has been shown to have relatively low early and midterm mortality, albeit with higher rates of procedural complications and mid-term mortality compared with valve-in-valve TMVI.[7] Previous literature has documented correction of individual trans-ring and para-ring leaks[8] using ViR TMVI but not both concurrently. When both entities co-exist, use of a vascular occlusion device has been described to treat the para-ring leak.[9,10]

This case report uniquely describes simultaneous correction of a trans-ring and para-ring leak using ViR TMVI, obviating the need for further intervention.

Case presentation

A 78-year-old male presented with progressive exertional breathlessness (New York Heart Association Functional Classification 3). He had previously undergone surgical MV repair with a 34 mm Edwards Physio II annuloplasty ring (Edwards Lifesciences, California, USA) for severe MR in 2016 together with tricuspid valve repair. The operation was complicated by bleeding at 48 h and required redo sternotomy. Transoesophageal echocardiography now revealed localized, posteromedial dehiscence of the annuloplasty ring (*Figure 1*). There was severe MR with two large jets; one para-ring jet passing through the dehiscence (vena contracta area of 0.23 cm^2) and one trans-ring jet passing through the centre of the ring (vena contracta area 0.53 cm^2) (*Figure 2* and *Video 1 and 2*). Right heart catheterization showed a pulmonary artery pressure of 50/22 mmHg, mean of 32 mmHg, and pulmonary capillary wedge pressure of 20 mmHg. The patient was considered at prohibitive risk for redo open heart surgery and the patient also firmly declined this option.

Timeline

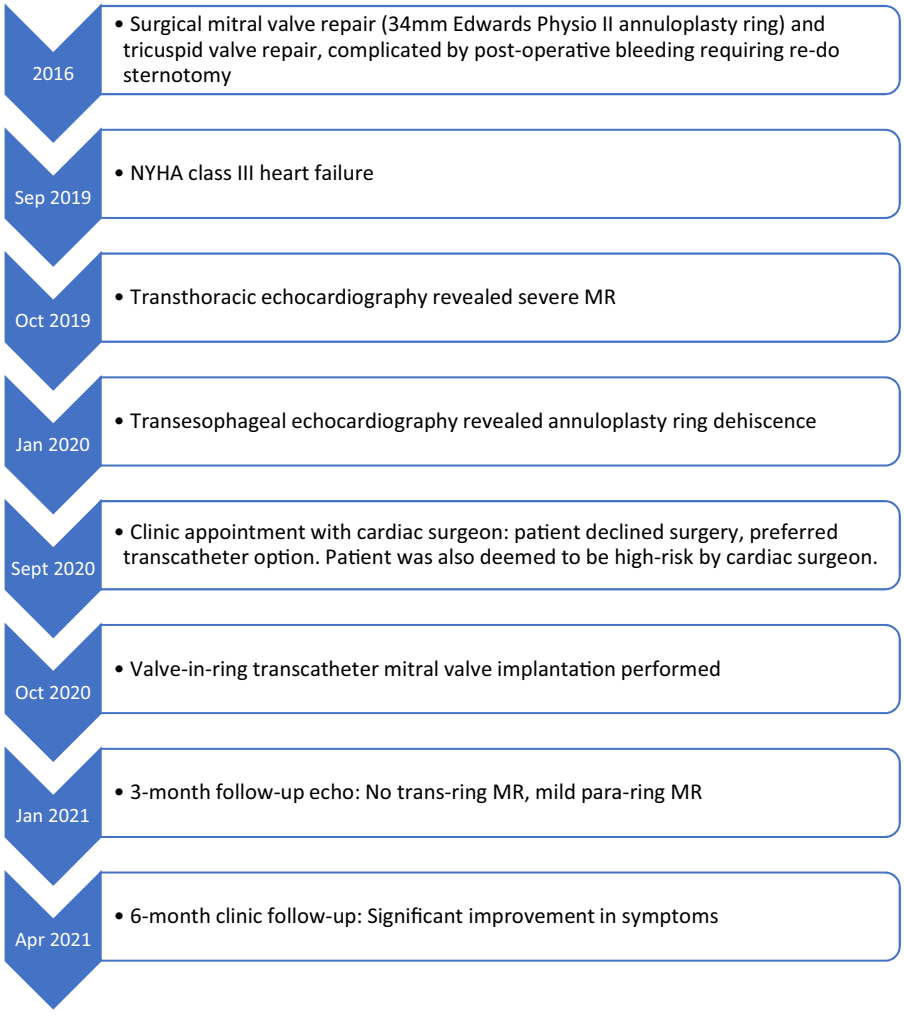


Table 1 Unfavourable characteristics for transcatheter edge-to-edge repair

Prolapse width > 15 mm
Flail gap > 10 mm
Orifice area < 3.5 cm^2
Severe calcification of grasping zone
Commissural lesions
Clefts
Leaflet perforations
Mitral stenosis with baseline mean gradient > 5 mmHg
Endocarditis or rheumatic heart disease

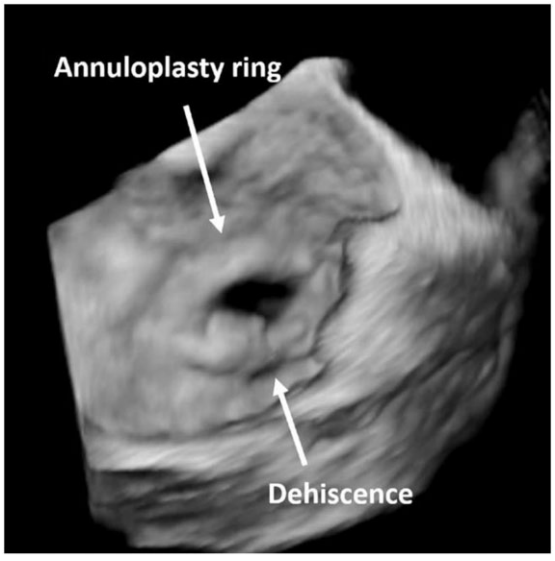
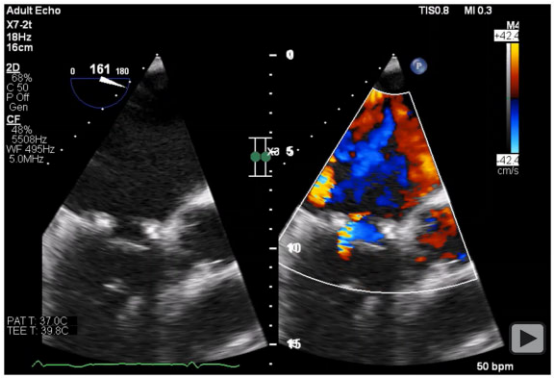


Figure 1 Three-dimensional transoesophageal echocardiography (atrial aspect) showing localized posteromedial dehiscence of the annuloplasty ring.

Edge-to-edge repair was considered, however, anatomy of the MV leaflets was deemed unfavourable due to inadequate length of the posterior leaflet.

After discussion with the Heart Team, a transseptal mitral ViR repair was planned with a subsequent percutaneous intervention to correct MR through the dehiscence with a vascular occlusion device. On computed tomography the annuloplasty ring had internal dimensions of 33 mm × 22 mm and the neo left ventricular outflow tract (LVOT) area was 350 mm^2 with a 29 mm prosthesis thus considered low risk for LVOT obstruction. Under general anaesthesia, the patient underwent ViR TMVI via transseptal approach with a balloon-expandable 29 mm Edwards Sapien 3 THV (Edwards Lifesciences). The THV was successfully implanted with 5 mL overfilling of the deployment balloon (*Figure 3* and *Video 3*). Transoesophageal echocardiography showed elimination of the trans-ring regurgitation (as expected) and surprisingly showed reduction of para-ring regurgitation to a minor, haemodynamically



Video 1 Two-dimensional transoesophageal echocardiography showing severe mitral regurgitation with two jets; one through the posteromedial dehiscence of the annuloplasty ring and the other central through the annuloplasty ring.

Video 2 Three-dimensional transoesophageal echocardiography with colour Doppler of annuloplasty ring from atrial aspect showing severe regurgitation through the centre of the annuloplasty ring and through the area of dehiscence.

insignificant jet (*Figure 4A and B* and Supplementary material online, *Videos 4–6*). The procedure was uncomplicated with no evidence of LVOT obstruction and the patient was discharged the following day. At 3-month follow-up, repeat transthoracic echocardiography (Supplementary material online, *Video 7*) revealed no trans-ring MR and only mild para-ring MR that required no further intervention. At 6-month follow-up the patient reported significant symptomatic improvement.

Discussion

The prevalence of degenerative MR is increasing as life expectancy improves. Elderly patients previously treated by mitral annuloplasty, who experience ring dehiscence, pose a treatment

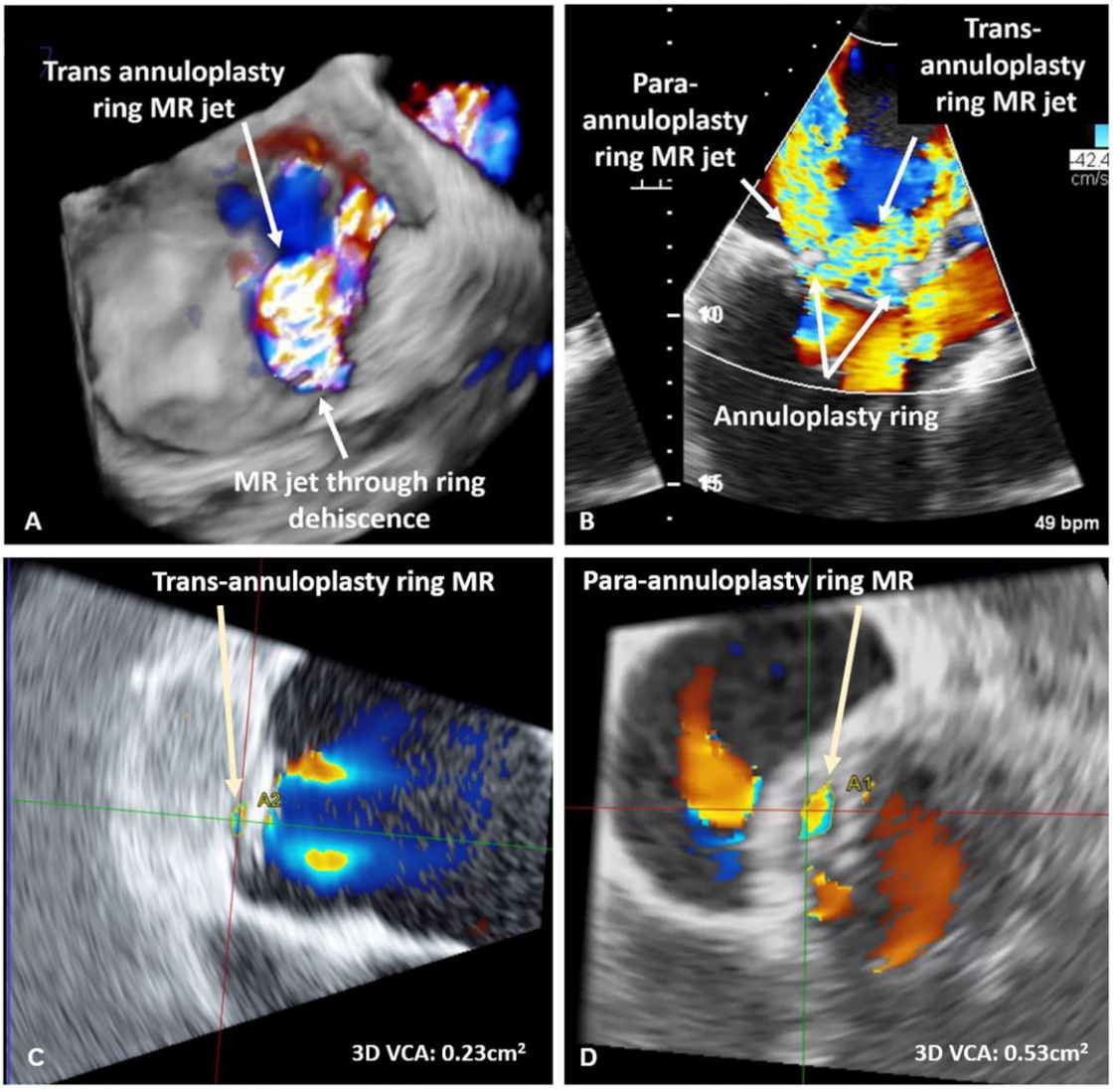


Figure 2 (*A*) Three-dimensional transoesophageal echocardiography with colour Doppler showing severe mitral regurgitation through the dehiscence and centrally through the annuloplasty ring. (*B*) Two-dimensional transoesophageal echocardiography (long axis) with colour Doppler showing severe mitral regurgitation through the dehiscence and centrally through the annuloplasty ring. (*C*) Three-dimensional transoesophageal echocardiography with colour Doppler demonstrating the trans-annuloplasty ring mitral regurgitation jet with a vena contracta area of 0.23 cm^2. (*D*) Three-dimensional transoesophageal echocardiography with colour Doppler demonstrating the para-annuloplasty ring mitral regurgitation jet with a vena contracta area of 0.53 cm^2. MR, mitral regurgitation; VCA, vena contracta area.

dilemma due to high risk of further surgical intervention. In the case described, annuloplasty ring dehiscence occurred posteriorly, which is the site most prone to dehiscence due to lower collagen density and tensile strength of the posterior relative to the anterior mitral annulus.[11]

Edge-to-edge repair, if feasible, is an attractive proposition as this may eliminate MR both trans and para-ring.[12,13] However, ViR TMVI has several potential benefits over edge-to-edge repair including reproducibility and less restrictive inclusion criteria.[14] In the case described, ViR TMVI successfully treated trans-ring and para-ring regurgitation simultaneously.

The Edwards Physio II is a semirigid, complete, annuloplasty ring. We propose that the mechanism by which improvement of the para-ring MR occurred is by the expanded circular THV pushing the D-shaped semirigid ring at the posterior site, thus improving contact between the ring and the posterior annular tissue (*Figure 5*).[15] The observed improvement in para-ring regurgitation may not be extended to rigid complete rings (e.g. Edwards IMR ETlogix or St Jude Saddle annuloplasty rings) as contact between the ring and annular tissue may not be altered. Furthermore, ViR TMVI may also be less effective in reducing trans-ring regurgitation in such cases as good contact between

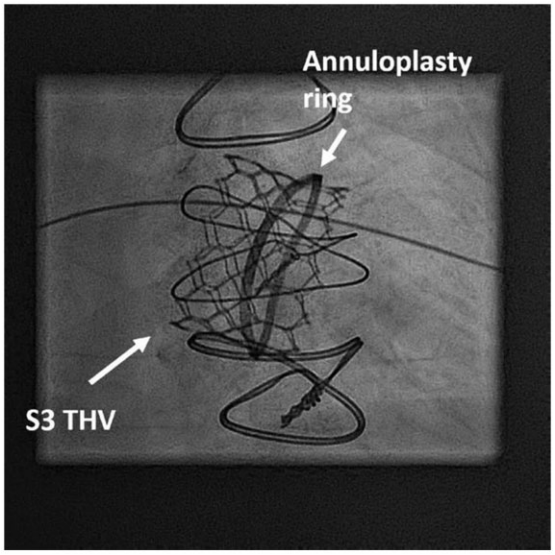
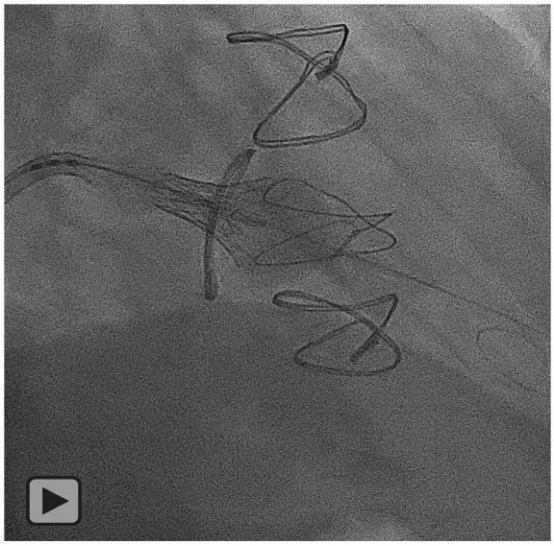


Figure 3 Post-deployment position of 29 mm S3 within the Edwards Physio II (complete) annuloplasty ring. THV, transcatheter heart valve.



Video 3 A 29 mm S3 transcatheter heart valve was deployed with pacing through the LV wire. The deployment balloon was overfilled by 5 mL.

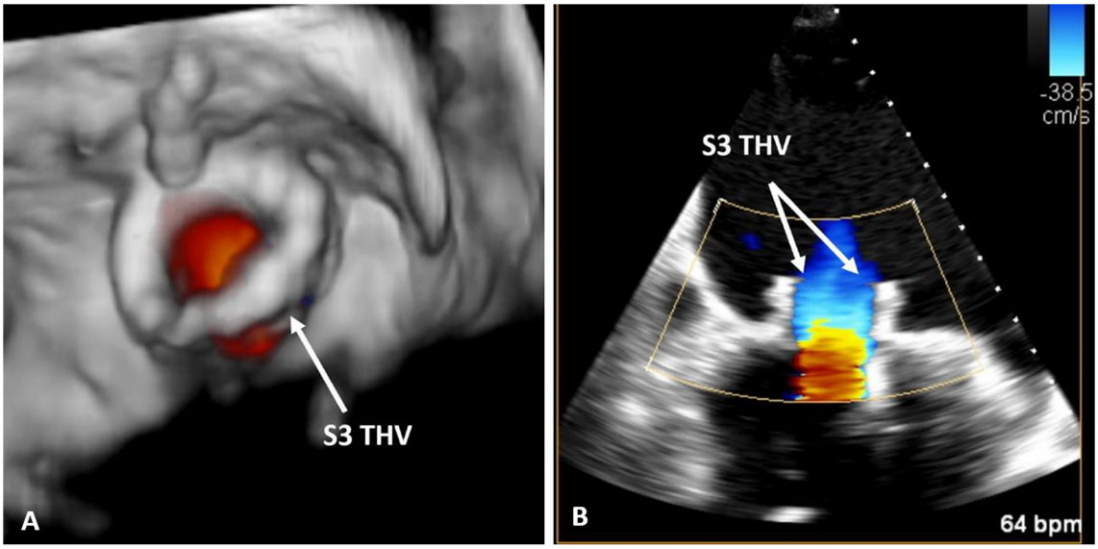


Figure 4 (*A*) Three-dimensional transoesophageal echocardiography (atrial aspect) showing the S3 transcatheter heart valve with no trans-ring or para-ring regurgitation. (*B*) Two-dimensional transoesophageal echocardiography (long axis) with colour Doppler showing absence of trans-ring and only trivial para-ring regurgitation following S3 deployment. THV, transcatheter heart valve.

the THV and the inner angles of the rigid ring may not be achieved. Finally, caution must be maintained due to the risk of ViR procedures deforming the ring and *causing* dehiscence, paravalvular leak,[16] or even complete ring detachment. This case report adds to the growing body of evidence indicating that patients with failure of MV repair can be safely and effectively treated by ViR TMVI and para-ring. Further work is required to evaluate the longevity of this treatment.

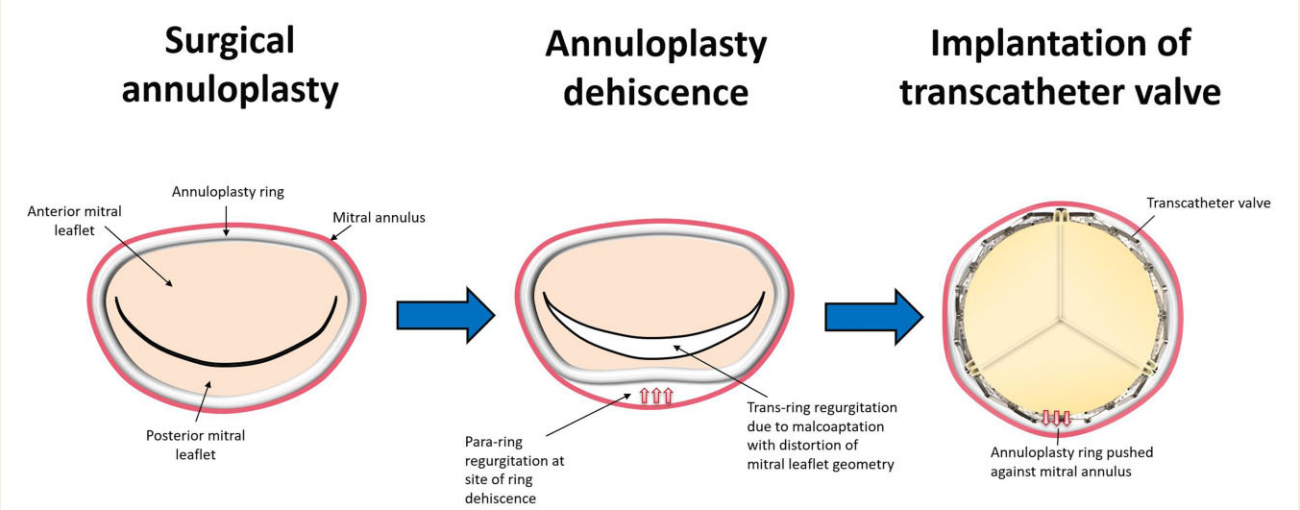


Figure 5 Proposed mechanism of improvement of trans- and para-ring mitral regurgitation caused by annuloplasty dehiscence and treated by transcatheter mitral valve replacement. Force exerted by the expanded circular valve on the semirigid ring re-establishes contact between annuloplasty ring and mitral annular tissue.

Lead author biography

Dr Harish Sharma is a Cardiology Registrar and PhD research fellow studying techniques to improve patient outcomes following intervention for mitral regurgitation.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: S.N.D. is a proctor for Edwards Lifesciences. All other authors declared no conflict of interest.

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