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Balloon-Assisted Leaflet Translocation in Transcatheter ViMAC: First Experience with the BATMAN Technique in Türkiye

CASE REPORT

INTRODUCTION

Left ventricular outflow tract (LVOT) obstruction is a well-recognized and potentially life-threatening complication of transcatheter mitral valve replacement (TMVR), particularly in valve-in-mitral annular calcification (ViMAC) procedures. The risk results from interactions between the anterior mitral leaflet, the septal contour, and the prosthetic valve. These interactions may cause either dynamic or fixed obstruction after device deployment. Recent studies have highlighted the importance of preprocedural assessment of LVOT obstruction risk using advanced multimodality imaging. To mitigate the risk of LVOT obstruction—particularly in anatomically complex cases with borderline or unfavorable neo-LVOT dimensions—several procedural strategies, such as Laceration of the Anterior Mitral Leaflet to Prevent Outflow Obstruction (LAMPOON) and Balloon-Assisted Translocation of the Mitral Anterior Leaflet (BATMAN), have been developed and have shown promising results.[1-4] Here, a high-risk patient who underwent a transcatheter ViMAC procedure using the BATMAN technique to prevent LVOT obstruction has been presented.

CASE REPORT

A 72-year-old female with severe mitral stenosis (Pressure gradient max/mean: 16/10 mm Hg, mitral valve area: 1.5 cm^2) and moderate mitral regurgitation was evaluated for mitral valve intervention. Multimodality imaging, including preprocedural transesophageal echocardiography (TEE) and computed tomography (CT), revealed severe circumferential mitral annular calcification extending into the basal and leaflet segments. Commissural fusion was absent, consistent with degenerative rather than rheumatic mitral stenosis. Therefore, balloon valvuloplasty was not considered a suitable treatment option. Given her advanced age, comorbidities (severe chronic obstructive pulmonary disease and morbid obesity (body mass index: 36.1 kg/m^2)), and elevated the Society of Surgeons (11.6%), the patient was considered at prohibitively high risk for open-heart surgery. The Heart Team concluded that TMVR offered the most appropriate strategy. Preprocedural multimodality imaging, including TEE and electrocardiography-gated cardiac CT, was performed to assess anatomical suitability, prosthesis sizing, and the risk of LVOT obstruction. Transesophageal echocardiography showed an anterior mitral leaflet length of 3.05 cm (Figure 1A). Computed tomography demonstrated severe mitral annular calcification (MAC) (calcium volume 2488.3 mm^2) with a MAC score of 9. The predicted neo-LVOT area was 146.2 mm^2 and the skirt neo-LVOT area 321.5 mm^2 at 45% systole (Figure 1B-D), indicating a high risk of obstruction.[5] Owing to the predicted small neo-LVOT area, adjunctive strategies to mitigate obstruction risk, anterior leaflet modification such as LAMPOON or BATMAN, were considered as part of procedural planning.

Under general anesthesia and 3D TEE imaging guidance. Although the potential benefits of cerebral protection in high-risk TMVR cases are evident, cerebral protection devices could not be used during this procedure due to limited device availability in the country. First, bilateral femoral arterial and venous access

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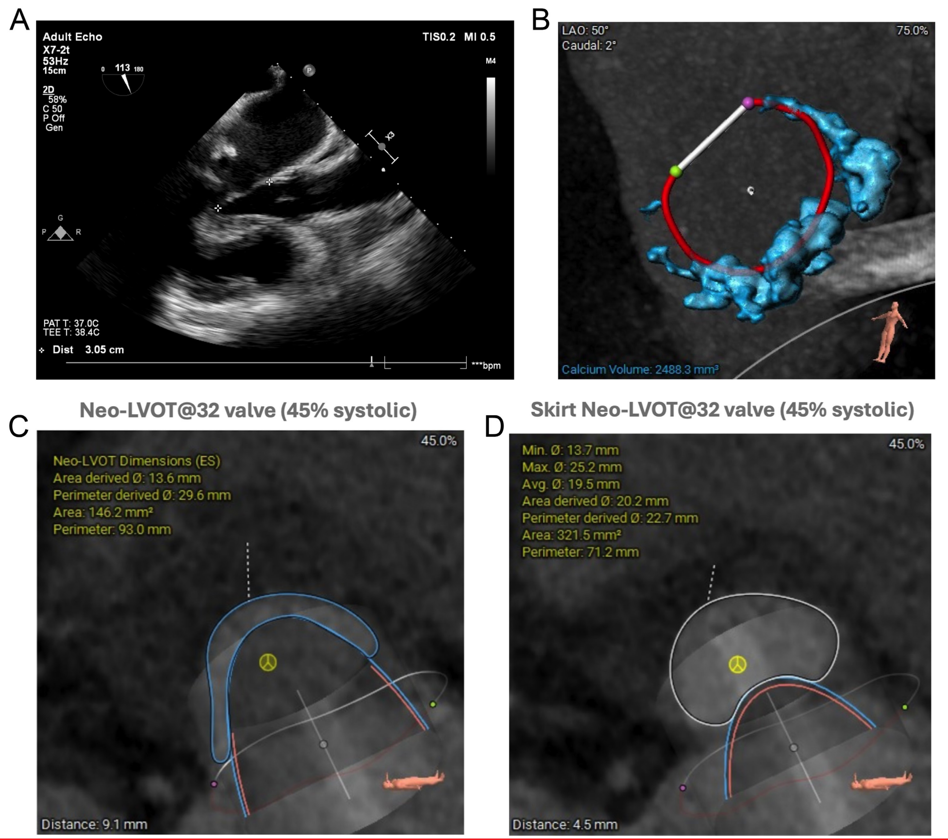

Figure 1. Mid-esophageal long-axis transesophageal echocardiography view demonstrating anterior mitral leaflet length of 3.05 cm (A), and preprocedural multidetector computed tomography simulation showing mitral annular calcium (B), predicted neo–left ventricular outflow tract (C), and skirt neo–left ventricular outflow tract (D) following virtual 32 mm valve implantation at 45% systole.

was obtained, and 6F sheaths were placed. A transseptal puncture was performed via the right femoral vein using an inferoposterior approach. An 8.5F steerable Agilis catheter (Agilis NxT Steerable Introducer; St. Jude Medical, Inc, St. Paul, Minnesota, USA) was advanced into the left atrium. A coaxial system was created using a 7F JR4 guiding catheter inside the Agilis catheter, containing a Finecross microcatheter (Terumo Corporation, Tokyo, Japan) and a 300 cm 0.014″ Astato XS 20 (Asahi-Intecc, Tokyo, Japan) coronary guidewire (Figure 2A). A pigtail catheter was positioned in the noncoronary cusp to facilitate orientation. The coaxial system was carefully advanced to contact the anterior mitral leaflet. Rapid ventricular pacing at 150 bpm was applied to stabilize leaflet motion during positioning and electrification. Leaflet perforation was achieved using 10 W electrocautery applied to the denuded wire tip. Simultaneous 5% dextrose infusion prevented coagulum formation. Successful leaflet traversal was confirmed by TEE, and the microcatheter was advanced into the left ventricle. The Astato XS 20 wire was then exchanged for a 300 cm 0.014″ Pilot 50 wire (Abbott Vascular, Santa Clara, CA, USA). Over this wire, a 4.0 × 20 mm non-compliant coronary balloon (Shunmei Medical Co., Guangdong, China) was advanced, and an intentional laceration of the anterior mitral leaflet was created (Figure 2B), confirmed by the presence of a secondary mitral regurgitation jet on TEE. Following leaflet laceration, the JR4 catheter was advanced into the left ventricle, and a 300 cm 0.035″ pre-shaped Safari wire (Boston Scientific, Marlborough, MA, USA) was positioned. To facilitate valve delivery, a double-wire technique was used. For this purpose, a 90 cm 7F Destination sheath (Terumo Corporation, Tokyo, Japan) was advanced over the Safari guidewire into the left ventricle. Through this sheath, a second 0.035″ Back-Up Meier™ guidewire (Boston Scientific, Marlborough, MA, USA) was introduced to provide additional support for device delivery (Figure 2C). Subsequently, the destination sheath was withdrawn from the right femoral vein. Over the Back-Up Meier guidewire, a 10F sheath was advanced, and over the Safari guidewire, a 14F Python sheath (Meril Life Sciences, Gujarat, India) was introduced via the right femoral vein. Over the 10F sheath and Back-Up Meier wire, a 16 × 40 mm balloon (Meril Life Sciences, Gujarat, India) was advanced; over the 14F Python sheath and Safari wire, the previously sized 32 mm Myval valve (Meril Life Sciences, Gujarat, India) was delivered. Initially, balloon atrial septostomy was performed using the 16 × 40 mm balloon (Figure 2D). Following septostomy, the 32 mm Myval valve was advanced into the left atrium, while the 16 × 40 mm balloon was positioned across the anterior mitral leaflet (Figure 2E). Prior to anterior leaflet translocation, intra-aortic balloon pump support was established via the femoral artery to maintain hemodynamics during the critical phase. The 16 × 40 mm balloon

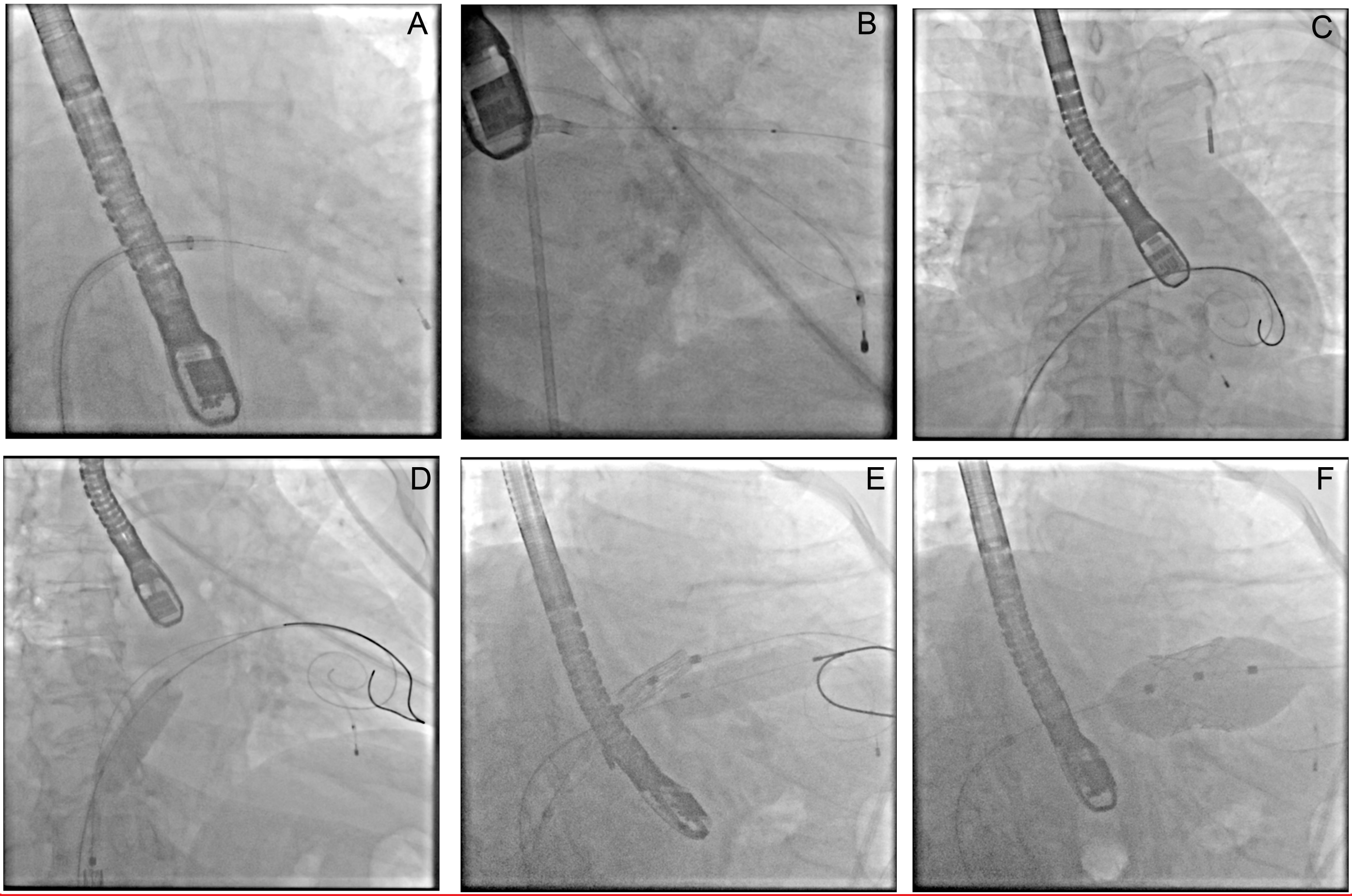

Figure 2. Stepwise fluoroscopic demonstration of the Balloon-Assisted Translocation of the Mitral Anterior Leaflet technique. A coaxial system with Agilis catheter, JR4 guiding catheter, microcatheter, and Astato XS 20 wire is aligned toward the anterior mitral leaflet (A); leaflet laceration using a 4.0 × 20 mm coronary balloon (B); double-wire technique with 0.035″ Safari and Back-Up Meier wires (C); balloon atrial septostomy with a 16 × 40 mm balloon (D); mitral anterior leaflet laceration using a 16 × 40 mm balloon following transseptal delivery of a 32 mm Myval valve into the left atrium (E); final valve deployment after leaflet displacement (F).

was then positioned across the anterior leaflet and inflated to complete the BATMAN technique, displacing the anterior leaflet into the LVOT (Supplemental Video 2 and Video 3). After leaflet laceration with the 16 × 40 mm balloon, the balloon was withdrawn. The 32 mm Myval valve was then advanced from the left atrium to the implantation site defined by MAC anatomy. Under rapid ventricular pacing, the valve was deployed slowly and gradually with minimal forward and backward movement to ensure optimal positioning (Figure 2F) (Supplemental Video 1). The procedure was completed successfully without complications. Post-implantation hemodynamic and 2D and 3D TEE assessments confirmed optimal valve positioning, with no evidence of paravalvular leak, residual mitral regurgitation, or LVOT gradient (Supplemental Videos 4 and 5). Additionally, post-procedural computed tomography clearly demonstrated the spatial relationship between the implanted transcatheter valve and extensive mitral annular calcification in both en-view and en-face orientations (Figure 3A and B) (Supplemental Video 6). The patient was discharged in stable and improved clinical condition 3 weeks following her initial admission. At the 3-month follow-up, transthoracic echocardiography demonstrated a well-seated transcatheter valve with no paravalvular leak, a mean transmitral gradient of 4 mmHg, and preserved left ventricle function. Clinically, the patient improved from New York Heart Association class III to class II, confirming sustained symptomatic and hemodynamic benefit.

DISCUSSION

Among adjunctive strategies to mitigate LVOT obstruction during TMVR, particularly in ViMAC procedures, LAMPOON and BATMAN techniques have emerged as viable options, each with distinct advantages and limitations. Laceration of the Anterior Mitral Leaflet to Prevent Outflow Obstruction enables controlled midline laceration of the anterior mitral leaflet via transcatheter electrosurgery, offering a fully percutaneous approach that preserves leaflet mobility and physiological flow, but it requires advanced operator expertise, specialized equipment, and carries risks such as incomplete laceration or leaflet perforation. Laceration of the Anterior Mitral Leaflet to Prevent Outflow Obstruction is

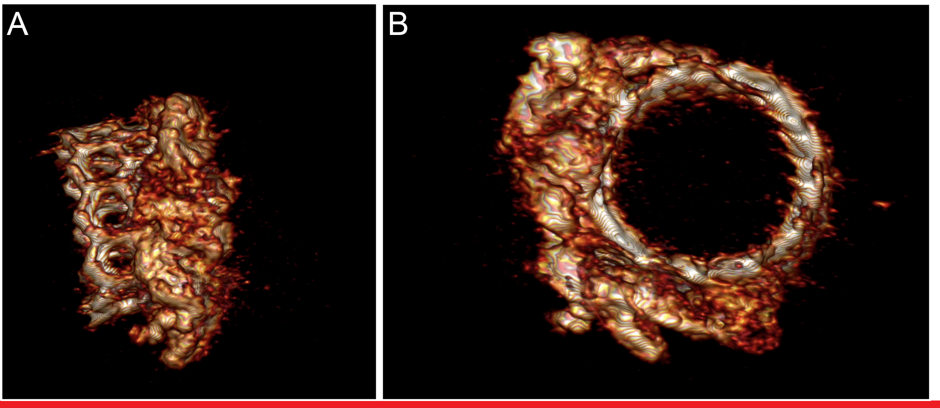

Figure 3. Postprocedural computed tomography demonstrating the relationship between the implanted valve and severe mitral annular calcification in en-view (A) and en-face (B) orientations.

Table 1. Summary of Published Studies Reporting the Use of the Balloon-Assisted Translocation of the Mitral Anterior Leaflet Technique for Anterior Mitral Leaflet Modification in Transcatheter Mitral Valve Replacement Procedures[9-15]

Study/Year	Setting	Approach	Patient Characteristics	Outcomes
Helmy et al,[9] 2020	Saint Louis University (USA)	Transapical, balloon-assisted anterior mitral leaflet perforation	n = 3, high LVOT risk, severe mitral regurgitation, not surgical candidates	100% procedural success; no significant LVOT obstruction; cardiopulmonary bypass time ~42–44 minutes
Oliva et al,[14] 2024	Humanitas, Milan (Italy)	Transseptal, ViR (mitral ring, not MAC)	For Mitral ViR, not ViMAC	Technical feasibility shown; suggests applicability to ViMAC as well
Denti et al,[11] 2024	San Raffaele Hospital, Milan (Italy)	Transseptal BATMAN for ViR	n = 3, high-risk patients undergoing ViR procedures	Feasibility and safety demonstrated in a multicenter case series, no major complications reported
Parekh et al,[10] 2025	Minneapolis Heart Institute (USA)	Transseptal, first-in-human ViMAC case	Severe MAC patient, high LVOT risk	Successful AML translocation; enabled TMVR; no reported LVOT complications
Lawlor et al,[13] 2025	VA Boston Healthcare System (USA)	Transseptal BATMAN in ViV with calcified AML	Transcatheter mitral valve-in-valve implantation in patients with heavily calcified anterior mitral leaflet	Successful valve deployment, effective anterior leaflet displacement; no LVOT obstruction
Seshiah et al,[15] 2025	University of Minnesota (USA)	Transseptal BATMAN using single wire approach for traversing tissue	Patients with challenging anatomy undergoing TMVI	Simplified technique proved effective; shortened procedure time and reduced complexity
Giustino et al,[12] 2025	Multicenter (6 structural heart centers)	Transseptal BATMAN in transcatheter mitral valve implantation (ViV, ViR, ViMAC)	n = 21, high risk for LVOT obstruction; median STS score 19.4%, median LVOT 150 mm^2	90.5% success rate; no residual LVOT obstruction; 9.5% in-hospital mortality (ViMAC only); no stroke/systemic embolism

BATMAN, Balloon-Assisted Translocation of the Mitral Anterior Leaflet; LVOT, left ventricular outflow tract; TMVR, transcatheter mitral valve replacement; ViMAC, valve-in-mitral annular calcification.

well established for LVOT obstruction prevention. Balloon-Assisted Translocation of the Mitral Anterior Leaflet, however, eliminates the need for electrosurgery and complex traversal, making it simpler and potentially easier to reproduce in less experienced centers. The BATMAN technique uses balloon inflation to mechanically displace the anterior mitral leaflet away from the left ventricular outflow tract, providing immediate and visible retraction that facilitates precise valve deployment without the need for prolonged electrosurgical manipulation. Nevertheless, BATMAN is less widely adopted, may be less precise in leaflet manipulation, and may carry a higher risk of leaflet recoil post-implantation. Balloon-Assisted Translocation of the Mitral Anterior Leaflet may be preferred in cases with hostile anatomy or heavily calcified, bulky anterior mitral leaflets, where it minimizes the risk of myocardial injury and serves as a safer alternative to electrosurgical laceration, while LAMPOON is typically favored in patients with thin, mobile leaflets and a small predicted neo-LVOT; the choice of technique should be individualized. Detailed preprocedural imaging and anatomical risk assessment are essential for planning.[6-8] Although broader validation is still needed, early experiences suggest that BATMAN may serve as a practical alternative to LAMPOON in anatomically complex or high-risk ViMAC cases. Helmy et al[9] first described the transapical BATMAN technique in 2020. In 3 high-risk patients, anterior leaflet perforation and ballooning achieved complete success without LVOT compromise.[9] More recently, Parekh et al[10] reported the first transseptal ViMAC case in 2025, demonstrating safe leaflet translocation and uneventful valve implantation. These individual experiences have been supported by data in which patients benefited from high technical success and low procedural mortality (Table 1).[9-15] To date, while Kılıç et al[16] have reported the use of the LAMPOON technique in a case of transcatheter mitral valve-in-ring implantation, the BATMAN technique has not been previously performed or published in valve-in-MAC (ViMAC) procedures in Türkiye. This case is the first to demonstrate the use of transeptal BATMAN during a ViMAC intervention in the country and uniquely demonstrates a step-by-step execution of the procedure using the double kissing wire technique, providing both a technical roadmap and proof of feasibility in this anatomically complex scenario.

Despite its technical simplicity, the BATMAN technique has several limitations. Leaflet recoil or reversion may occur, potentially compromising the intended LVOT area. The long-term durability of leaflet translocation and its impact on valve hemodynamics remain uncertain, as current data are limited to case reports and small series (Table 1).[9-15] Furthermore, while technically less demanding than LAMPOON, BATMAN still requires advanced structural expertise, and its reproducibility in less experienced centers may be limited. These issues underscore the need for further multicenter evaluation and long-term follow-up studies.

Another important aspect is the role of cerebral protection devices during high-risk TMVR procedures. In this case, such devices could not be used due to limited availability in the country. Although no cerebrovascular complications occurred peri- or post-procedurally, the potential benefit of cerebral protection in preventing embolic events remains evident. Future widespread access to these devices may further improve the safety profile of complex transcatheter mitral interventions.

CONCLUSION

For patients with a high-risk anatomy undergoing TMVR, preventing LVOT obstruction remains a critical challenge. In patients with high-risk anatomy undergoing TMVR, the BATMAN technique offers a feasible, simple, and safe mechanical alternative to electrosurgical approaches for anterior leaflet management, representing a more accessible and reproducible option—particularly in anatomically complex ViMAC cases.

No artificial intelligence (AI)-assisted technologies (such as Large Language Models, chatbots, or image creators) were used in the production of submitted work.

Informed Consent: Informed consent was obtained from the patient.

Declaration of Interests: The authors have no conflicts of interest to declare.

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Video 1: Step-by-step fluoroscopic demonstration of the BATMAN technique, showing all procedural steps from transseptal access to final transcatheter mitral valve implantation.

Video 2: Intraprocedural TEE showing leaflet laceration and anterior displacement during the BATMAN technique.

Video 3: Intraprocedural TEE clearly showing a secondary mitral regurgitation jet originating from the anterior mitral leaflet, demonstrating the effectiveness of the BATMAN technique.

Videos 4 and 5: Postprocedural 2D (4) and 3D (5) TEE demonstrating optimal valve positioning with no paravalvular leak, no residual mitral regurgitation, and no LVOT gradient.

Video 6: Postprocedural CT demonstrating the relationship between the implanted valve and severe mitral annular calcification.

REFERENCES

1. Yoon SH, Bleiziffer S, Latib A, et al. Predictors of left ventricular outflow tract obstruction after transcatheter mitral valve replacement. *JACC Cardiovasc Interv*. 2019;12(2):182-193. [CrossRef]
2. Wang H, Song H, Yang Y, et al. Morphology display and hemodynamic testing using 3D printing may aid in the prediction of LVOT obstruction after mitral valve replacement. *Int J Cardiol*. 2021;331:296-306. [CrossRef]
3. Khan JM, Rogers T, Babaliaros VC, Fusari M, Greenbaum AB, Lederman RJ. Predicting left ventricular outflow tract obstruction despite anterior mitral leaflet resection: the "skirt NeoLVOT". *JACC Cardiovasc Imaging*. 2018;11(9):1356-1359. [CrossRef]
4. Guerrero ME, Eleid MF, Wang DD, et al. 5-year prospective evaluation of mitral valve-in-valve, valve-in-ring, and valve-in-MAC outcomes: mitral trial final results. *JACC Cardiovasc Interv*. 2023;16(18):2211-2227. [CrossRef]
5. Guerrero M, Wang DD, Pursnani A, et al. A cardiac computed tomography-based score to categorize mitral annular calcification severity and predict valve embolization. *JACC Cardiovasc Imaging*. 2020;13(9):1945-1957. [CrossRef]
6. El Sabbagh A, Al-Hijji M, Wang DD, et al. Predictors of left ventricular outflow tract obstruction after transcatheter mitral valve replacement in severe mitral annular calcification: an analysis of the transcatheter mitral valve replacement in mitral annular calcification global registry. *Circ Cardiovasc Interv*. 2021;14(10):e010854. [CrossRef]
7. Khan JM, Babaliaros VC, Greenbaum AB, et al. Anterior leaflet laceration to prevent ventricular outflow tract obstruction during transcatheter mitral valve replacement. *J Am Coll Cardiol*. 2019;73(20):2521-2534. [CrossRef]
8. Wang X, Liang J, Mu C, et al. Effect of 3D-printed hearts used in left ventricular outflow tract obstruction: a multicenter study. *BMC Cardiovasc Disord*. 2022;22(1):200. [CrossRef]
9. Helmy T, Hui DS, Smart S, Lim MJ, Lee R. Balloon assisted translocation of the mitral anterior leaflet to prevent left ventricular outflow obstruction (Batman): a novel technique for patients undergoing transcatheter mitral valve replacement. *Catheter Cardiovasc Interv*. 2020;95(4):840-848. [CrossRef]
10. Parekh J, Burns M, Hamid N, et al. Transseptal balloon-assisted translocation of mitral leaflet for mitral calcification: a first in human experience. *JACC Case Rep*. 2025;30(2):102767. [CrossRef]

11. Denti P, Saccocci M, Buzzatti N, et al. Transseptal Batman for high-risk valve-in-ring procedures: a case series. *JACC Case Rep*. 2024;29(4):102200. [CrossRef]
12. Giustino G. Balloon-assisted modification of the anterior mitral leaflet to prevent outflow track obstruction during transseptal transcatheter mitral valve replacement: Batman collaboration. Presented at: SCAI 2025 Scientific Sessions; 2025 May 2; Washington, D.C., USA. Case Exchange (435) Hall D, 11:03–11:11 AM.
13. Lawlor M, Katukuri N, Balsam L, et al. Transcatheter mitral valve-in-valve replacement with balloon-assisted translocation in calcified mitral anterior leaflet. *JACC Case Rep*. 2025;30(19):104045. [CrossRef]
14. Oliva A, Mangieri A, Cozzi O, et al. Transseptal balloon-assisted translocation of the mitral anterior leaflet (Batman) in mitral valve-in-ring implantation. *JACC Cardiovasc Interv*. 2024;17(4):568-570. [CrossRef]
15. Seshiah P, Guddeti RR, Alirhayim Z, et al. Transseptal Batman procedure utilizing a simplified technique: "single wire approach for traversing tissue" (SWATT). *Catheter Cardiovasc Interv*. 2025;105(4):972-979. [CrossRef]
16. Kılıç T, Coşkun Ş, Çakır Ö, et al. Tip-to-base LAMPOON to prevent left ventricular outflow tract obstruction in a valve-in-ring transcatheter mitral valve replacement: first LAMPOON procedure in Turkey and first LAMPOON case for transseptal Myval implantation. *Anatol J Cardiol*. 2021;25(5):363-367. [CrossRef]