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CASE REPORT

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Left femoral vein access for transcatheter mitral valve interventions in unfavorable interatrial septal anatomy

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Abstract

Optimal transseptal puncture (TSP) position on the interatrial septum as well as proper catheter direction and maneuverability in the left atrium (LA) are key elements for successful mitral valve (MV) interventions. TSP is usually performed from the right femoral vein being more comfortable for the operator and easier to reach the fossa ovalis. In the cases reported, TSP was performed from left femoral vein (LFV) to improve delivery system maneuverability and trajectory inside the LA in the context of MV repair with MitraClip. According to this early experience, LFV approach might be considered as first choice or as an alternative solution in patients in whom a higher position of the delivery system relative to the mitral annulus is needed.

KEYWORDS
access site management, left femoral vein, MitraClip, mitral valve percutaneous repair, transseptal puncture, vascular access

1 | INTRODUCTION

Interventional procedures requiring a transseptal puncture (TSP) have significantly increased over the last years.[1] In particular, percutaneous mitral valve (MV) interventions represent a fast-growing field where not only transcatheter edge-to-edge MV repair but also other repair techniques (e.g., annuloplasty), and the more recent transcatheter MV implantation devices will play a central role.[2,3]

Reaching an optimal puncture position on the interatrial septum is a key element for the success of the mitral interventions. One of the most important aspects it to achieve a position in the fossa ovalis as high as possible in relation to the mitral annulus, to enable simpler and safer maneuverability in the left atrium (LA). As for MitraClip (Abbott Vascular, Abbott Park, Illinois), transcatheter MV interventions require a minimum TSP height from the mitral annular plane to allow catheter maneuverability, proper alignment and trajectory toward the MV, and to enable enough stability during leaflet grasping.[4,5] To achieve a high puncture, posterior punctures are usually preferred. In addition, especially in MitraClip procedures, an inferior puncture is, in most cases, advantageous since it allows more freedom for further manipulations. The position of the hinge point (the TSP location) in a poster-inferior puncture should favor an increase of height associated with cranial displacements of the delivery systems. Despite these maneuvers, in some specific anatomies, such as in small-sized LA, the elevation of the delivery system may be insufficient to allow proper maneuvering of the device (e.g., leaflet grasping). The elevation of the delivery system relative to the mitral annulus is depending on several factors including the location of the puncture in the fossa, the LA size (and therefore the anatomy of the fossa), the position of the heart and its orientation in the chest.

TSP is almost universally performed from the right femoral vein (RFV) for two reasons: first, it is easier and more comfortable for the operator, second, the vector forces are more directed toward the

Abbreviations: BMI, body mass index; BRK, Brockenbrough; CDS, clip delivery system; IQR, interquartile range; LFV, left femoral vein; LVEDD, left ventricle end-diastolic diameter; LVESD, left ventricle end-systolic diameter; LVOT, left ventricular outflow tract; MVARC-2, Mitral Valve Academic Research Consortium; NYHA, New York Heart Association; RFV, right femoral vein; SGC, steerable guide catheter; sPAP, systolic pulmonary arterial pressure; TEE, transesophageal echocardiogram; TS, transseptal; TSP, transseptal puncture.

interatrial septum as compared to the left approach. When left femoral vein (LFV) puncture is needed (e.g. in case of right venous system occlusion or thrombotic disease), a left approach can be attempted, although the technique has to be modified. Due to the different vector forces applied by the transseptal needle coming from the left side, the operator has to increase the curvature of the needle to ensure proper pressure on the fossa ovalis (Figure 1). Moreover, following TSP, an additional curve has to be negotiated to advance wires and devices through the septum. For these reasons, TSP from LFV is not perceived as a good solution and RFV approach is usually preferred. But if the left approach is associated to unfavorable vector forces to obtain TSP (tendency to be too far from the fossa), the same forces could be favorable to allow a higher trajectory of the guiding catheter from the mitral annular plane.

We hypothesized that LFV access would allow to reach a more favorable guide catheter height and angle, thus facilitating MitraClip maneuverability and improving trajectory inside the LA. In order to address this issue, two explanatory cases undergoing MitraClip procedure through LFV access are described.

2 | CASE

Two patients, aged 85 and 69, affected by severe mitral regurgitation (MR) and deemed unsuitable candidates for surgery by formal Heart Team, underwent MitraClip procedure. MR mechanism for both cases was degenerative and baseline LA dimensions were 44 and 41 mm, respectively. In both cases, RFV access was selected as a first option for the procedure. However, guide catheter height/trajectory inside LA obtained from the RFV access was inadequate (besides all possible advanced steering manipulations). Consequently, the system was removed and TSP from LFV was performed with the delivery system crossing through the same entry point in the fossa ovalis. Of note, the TSP height remained the same from RFV and LFV in one patient (31 mm) keeping the same hinge point while it increased from 29 to 31 mm in the other case. Alongside TSP height, access site change allowed proper guiding catheter trajectory inside LA. Following TSP, maneuverability of the delivery system was not different from usual, although the transseptal guide catheter was set usually with less curve than with a conventional access. In both patients, two XTR clips were implanted achieving optimal MR correction (post procedural MR 1+).

2.1 | TSP technique

The procedures were performed in a hybrid room, under general anesthesia, and transesophageal echocardiogram (TEE) guidance.

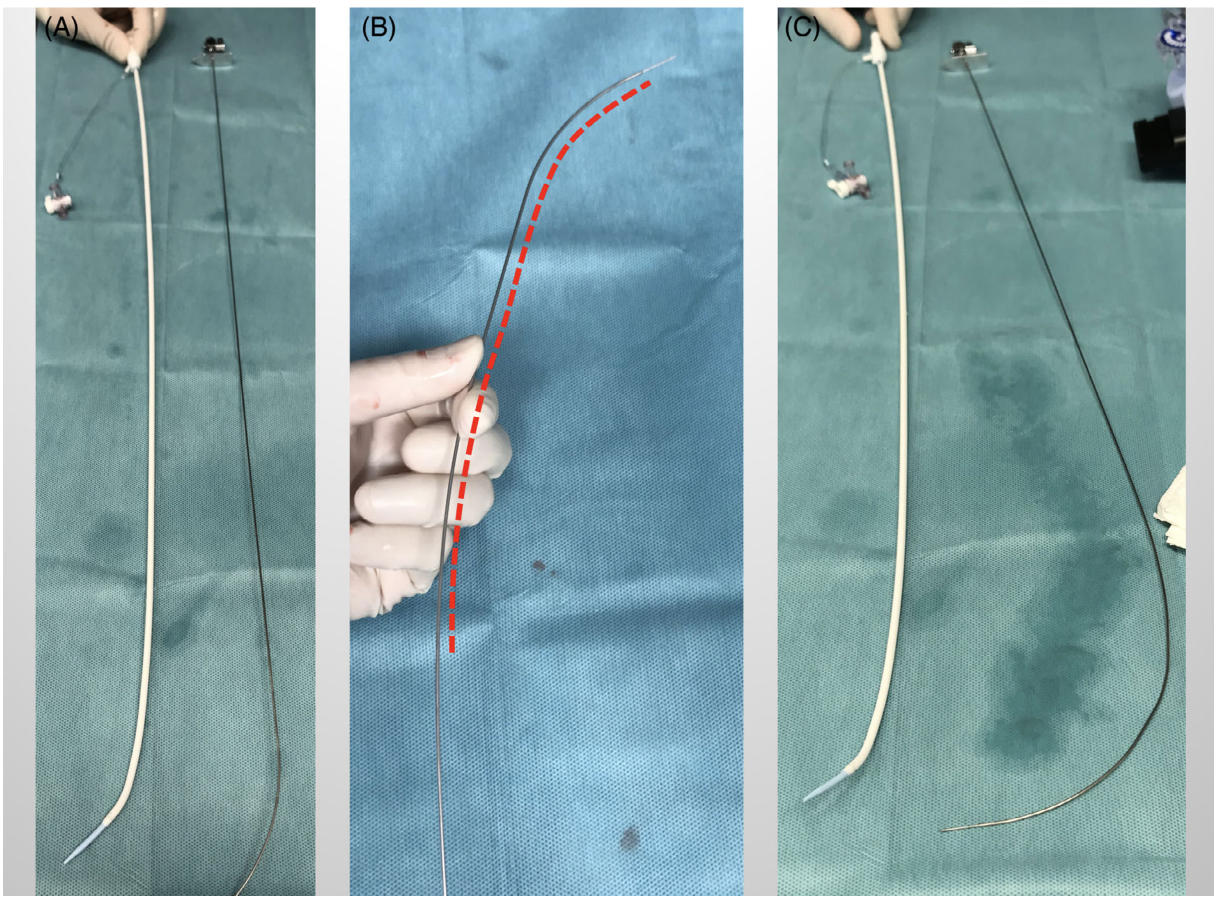

FIGURE 1 Transseptal kit before (panel A) and after additional needle curvature folding (panel B and C) [Color figure can be viewed at wileyonlinelibrary.com]

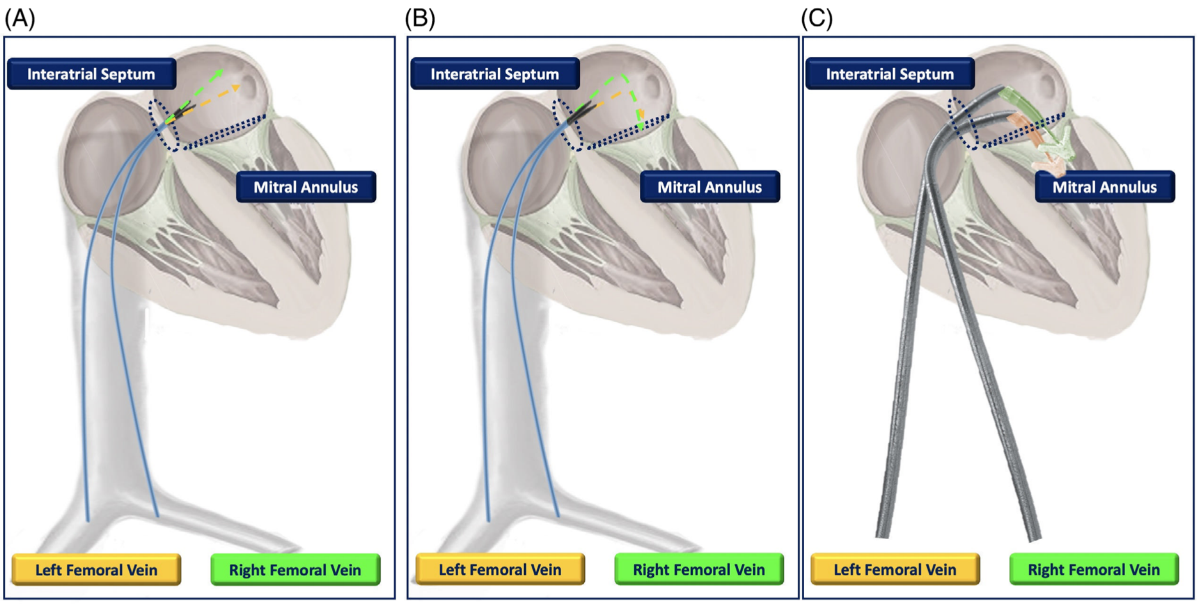

FIGURE 2 Transseptal puncture from left femoral vein and from right femoral vein: although the hinge point remains the same (panel A), the trajectory inside the left atrium as well as the delivery maneuverability changes allowing to gain height from the mitral valve plane and to improve trajectory toward the mitral annulus (panel B and C) [Color figure can be viewed at wileyonlinelibrary.com]

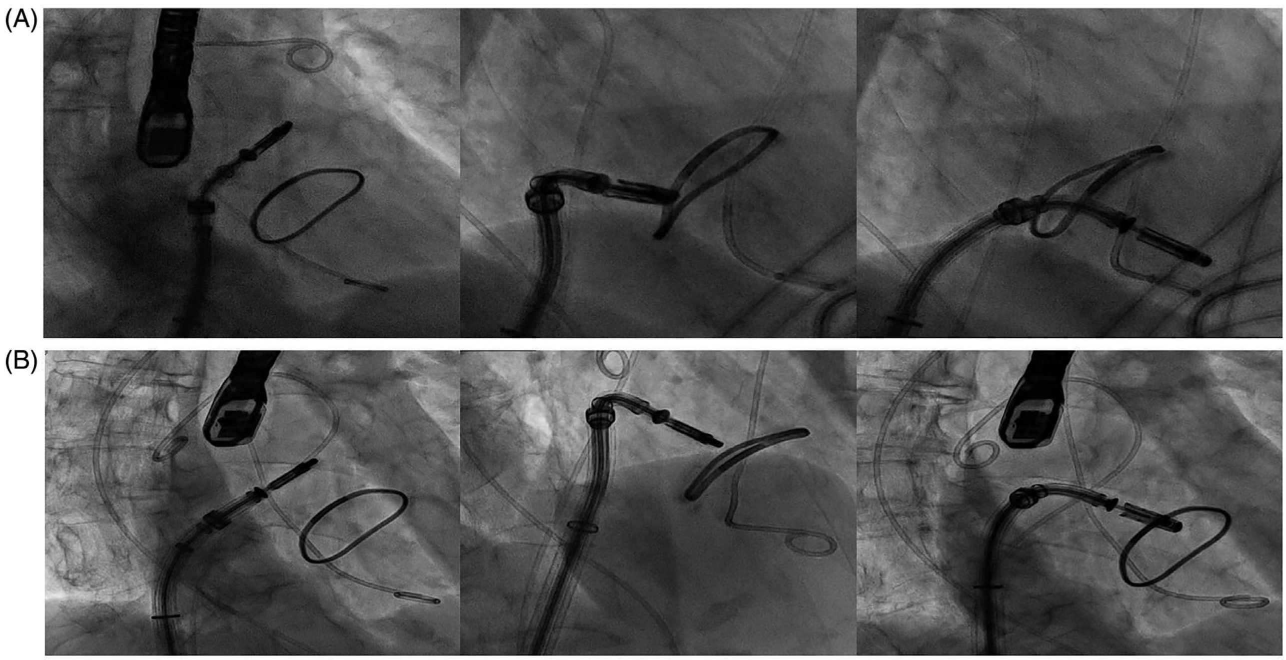

FIGURE 3 Comparison of SGC and CDS trajectory inside the left atrium when the access was performed from the right and left femoral veins, through the same TSP entrance point, in a patient with recurrent severe mitral regurgitation after prior mitral valve annuloplasty. RFV access did not provide a proper CDS position, always crossing the annular level (panel A). LFV access allowing proper CDS trajectory and position above the annulus (panel B)

To achieve a safe venous access, ultrasound-guided femoral vein puncture was performed using a linear vascular ultrasound probe (7–10 MHz). After the puncture, the vein was preclosed using one Perclose ProGlide system (Abbott Vascular), and partial heparinization was administered (2.000 IU).

Under fluoroscopic (anteroposterior projection) and TEE guidance (bicaval view), a 0.032-in. J-tip guidewire was advanced toward the superior vena cava. Maintaining the same fluoroscopic and TEE projections, the 8.5F transseptal sheath (Swartz SL transseptal sheath—Abbott Vascular) was advanced over-the-wire. Once the sheath

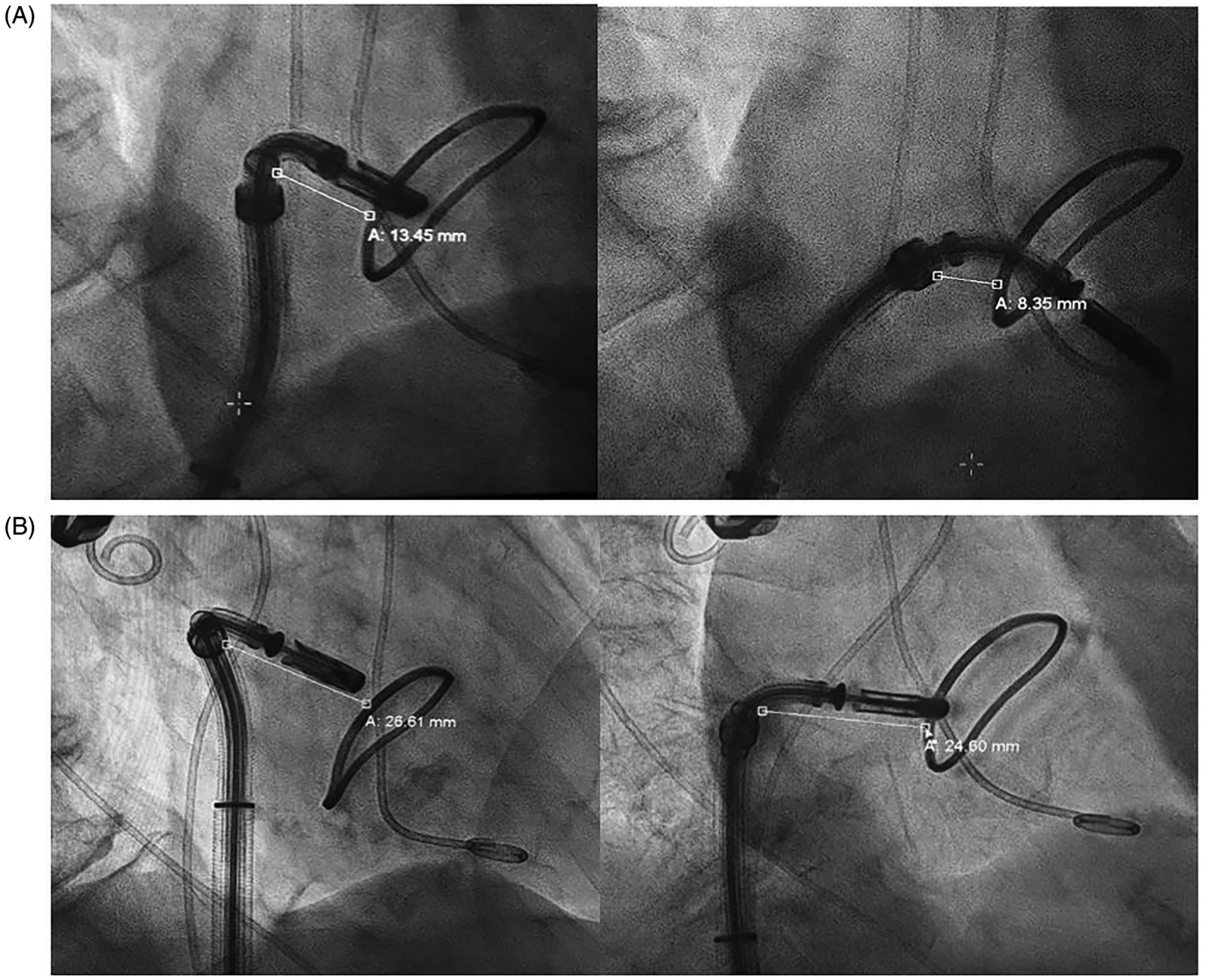

FIGURE 4 Comparison of the distances between the SGC and the mitral annulus plane when the access was performed from the right (panel A) and left femoral vein (panel B)

reached 3–4 cm superior to the cavoatrial junction, the wire was removed, and the Brockenbrough 1 (BRK) needle (Abbott Vascular) was inserted. An additional curve in the mid portion of the needle was usually performed to allow better contact in the fossa ovalis (Figure 1).

Under fluoroscopic and TEE monitoring, the needle and the sheath were pulled back until falling into the fossa under TEE monitoring in the bicaval view. The additional curve favors in general a more inferior tenting. In addition, to target a more posterior location, the needle arrow tip was kept in a 6–7 o'clock position during the pull-back. Following the engagement of the fossa in the bicaval view, the septal tenting was checked in short-axis TEE view to assess the anteroposterior location of the tenting. The bicaval and short axis view of the tenting can also be assessed concomitantly, using an echocardiographic X-plane technology. A four-chamber TEE view was then used to measure the TSP height (distance between the tenting and the mitral annulus). To determine the location of the tenting relative to the MV, a 3D surgical view probing the volume between the tenting on the septum and the annular plane was used. After confirmation of the ideal TSP point, the needle was advanced, and full heparin dose was administered (100 IU/Kg).

3 | DISCUSSION

TSP is a pivotal step of the transcatheter MV interventions, and precise localization is crucial for the whole procedure, determining the device maneuverability and trajectory toward the mitral annulus. Hence, an ideal TSP facilitates the steerable guide catheter (SGC) to navigate and allows the clip delivery system (CDS) to reach the MV target point.[6] On the contrary, if the TSP is not optimally performed, multiple SGC and CDS adjustment maneuvers are required, increasing procedure time and reducing procedure safety and efficacy.[7,8]

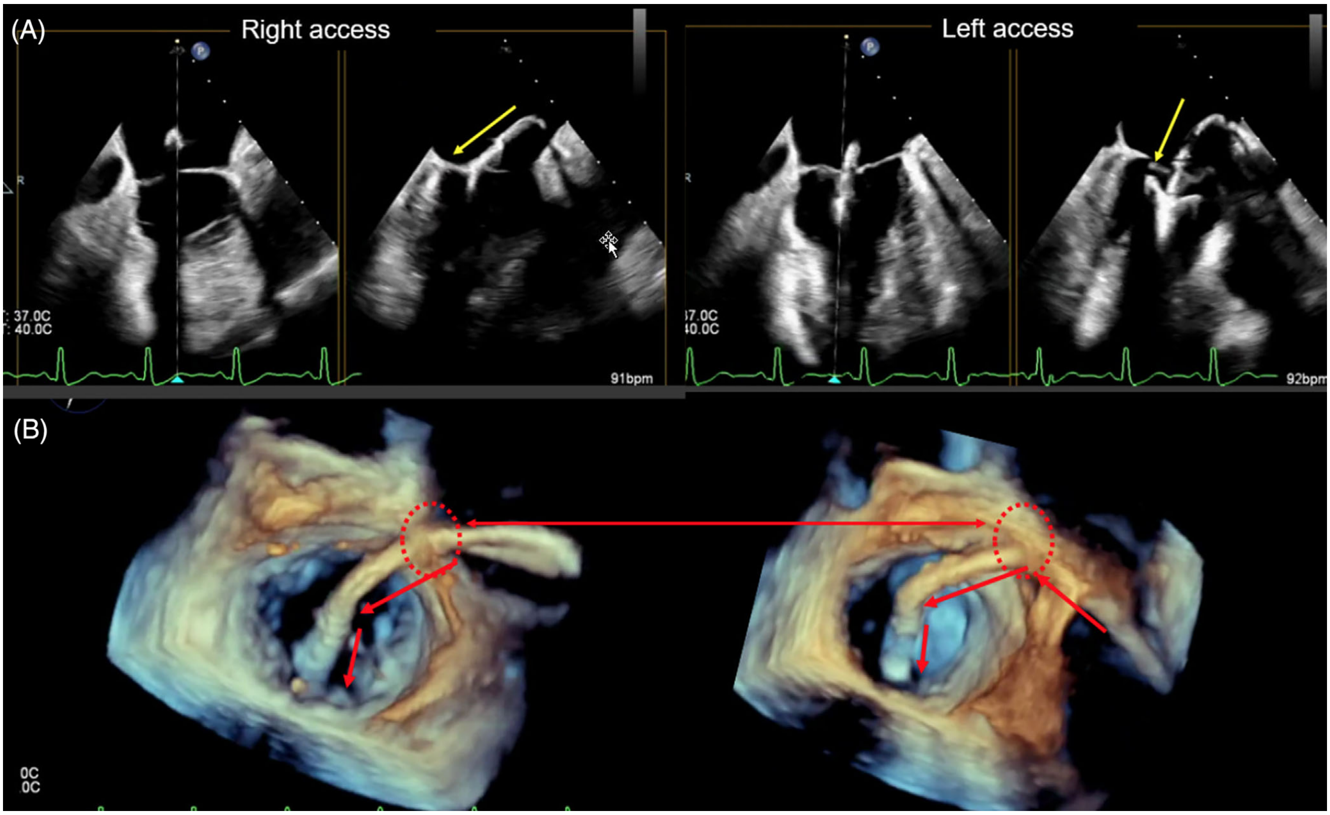

FIGURE 5 Intraoperative transesophageal echocardiogram views showing a comparison of SGC and CDS trajectory inside the left atrium when the access was performed from the right and left femoral veins, through the same TSP entrance point (red dotted circle). In the right access, the delivery system was not perpendicular to the annulus due to the advance steering maneuvers to achieve height [Color figure can be viewed at wileyonlinelibrary.com]

To proceed with the TSP, the venous access is standardly performed from RFV access.[9] This site provides a more comfortable position for the operator, and a more direct access to the fossa ovalis, usually without tortuosity and friction.[10] The LFV access has been described as a reasonable alternative when right side access is not feasible.[11–13] However, the left access is challenged by increasing catheter friction, potentially limiting its torquability, and by a decrease of the contact achievable on the septum (requiring additional curve on the TSP needle). Following the puncture, all wire manipulations are more challenging due to the additional curves, and require increased care from the operators. On the other hand, in our experience, the LFV route might be preferred in selected cases to gain guide catheter height and, more important, to achieve a favorable direction in relation to mitral annular plane and to increase maneuverability inside the LA. One possible explanation for this height gain is that the vector forces associated with the anatomical angle between the iliac vein and the inferior vena cava bring the catheter spontaneously toward the right side of the chest and in the direction of the roof of the LA (Figure 2) even when the hinge point on the septum (the location of the TSP) is unchanged, as compared to the hinge point from the right access.

Herein, we describe our initial experience with LFV access to perform MitraClip procedures. LFV access was chosen to increase SGC height or modify its angle, allowing a proper SGC and CDS maneuverability and trajectory toward the mitral annulus. This approach is particularly useful in patients with small-sized LA (e.g., acute MR), or whenever obtaining proper height from the RFV is difficult.

In addition to the two cases described, the LFV approach was intentionally performed as a first-choice strategy in other seven patients where achieving the proper height and maneuverability inside LA was expected to be difficult with RFV approach (low fossa, small LA, extremely prolapsing MV). In all cases, procedure was successful and no procedural complications, as well as no postoperative major vascular access complications or bleeding were reported.

Figures 3–5 show an illustrative case where adequate SGC and CDS maneuverability could not be achieved from the RFV. Although a really posterior puncture point was targeted, only a 32 mm TSP height was reached due to a small-sized LA. Even after advanced steering maneuvers, the CDS always crossed the MV annulus plane. In an attempt to gain height, the guide catheter was kept straight (applying minus), but this created a very severe “aorta hugging” effect with loss of coaxiality. In this case, a standard “advanced steering maneuver” to achieve height determined a trajectory that would compromise a safe and effective delivery of the clip. By changing the femoral access site, from right to left side, while keeping the same TSP entrance point, maneuverability was enhanced due to a different navigation angle, and the procedure was successfully completed. This simple maneuver allowed to align the CDS above the annulus plane, freely adjusting its position and getting a correct trajectory. The same approach has been recently proposed also for the transcatheter tricuspid interventions.[14] In addition, this approach could be very useful also for transeptally delivered MV replacement devices to gain height and improve trajectory toward MV and device maneuverability inside LA.

To the best of our knowledge, this is the first report of MitraClip procedures intentionally performed from LFV access aiming at improving delivery system maneuverability and trajectory inside the LA.

4 | CONCLUSION

The cases presented in this article suggest that the LFV access could be a useful first choice in patients with small LA or a valuable alternative approach in patients in whom a standard approach does not provide proper device maneuverability or trajectory toward the MV annulus.

CONFLICT OF INTEREST

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DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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