

An All-Inside Repair for Full Radial Posterior Lateral Meniscus Tears



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Abstract: There is controversy about the treatment for unstable full radial posterior lateral meniscus tears, particularly that involving the posterior root. Some surgeons have advocated repairing these types of meniscus tears using various techniques, but their methods are somewhat technical. We developed the technique for an all-inside repair for full radial posterior lateral meniscus tears using the Meniscal Viper (Arthrex, Naples, FL). A doubled thread is passed through 1 edge of the radial tear by the Meniscal Viper and is kept in place without tying the knot. The Meniscal Viper is used again to set a new thread, repeating the same procedure to another edge of the tear. At this step, 2 doubled threads are passed through each stump of the tear, and both a loop end and 2 free ends of each thread are located outside of the joint. Then, 2 doubled threads pass the third thread into its own loop, pulling it out. Finally, the third thread becomes the mattress suture over the radial tear site and is fastened by sliding knot techniques. This procedure makes it easy to strictly, smoothly, and less invasively shorten the gap by drawing each stump of the meniscus in the direction of the circumference.

In conjunction with anterior cruciate ligament reconstruction, lateral meniscal tears that are posterior horn tears, stable radial flap tears, or peripheral or posterior third tears that do not extend further than 1 cm in front of the popliteus tendon can be treated successfully with abrasion and trephination or by being left in situ.¹ However, there is controversy about the treatment for unstable full radial tears at the posterior

lateral meniscus, particularly those involving the posterior third of the meniscus from the site in front of the popliteus tendon to the posterior root of the meniscus. This type of injury characteristically becomes clinically asymptomatic within the short term,¹ although theoretically, most of the meniscus hoop stress is lost.² In addition, only mild lateral joint-space narrowing was measured without significant differences in subjective or objective scores compared with controls at a mean of 10 years of follow-up of posterior lateral meniscus root tears left in situ.³ Therefore, partial meniscectomy or being left in situ is the conventionally selected treatment for unstable full radial posterior lateral meniscus tears.⁴ Some surgeons recently have advocated repairing these types of meniscus tears using various techniques,⁵ because repair is the only choice to theoretically regain the meniscus hoop stress, even if the harmful effects of leaving it in situ are small. Their methods are somewhat technical and may be more risky than leaving it in situ.

We believe the meniscus must be repaired, provided that it can be sutured both safely and simply with certainty. Therefore, we developed a technique of an all-inside repair for full radial tears at the posterior lateral meniscus using the Meniscal Viper Kit (Arthrex, Naples, FL), which is a special instrument for the posterior lateral meniscus longitudinal tear. This

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technique makes it easy to shorten the gap strictly, smoothly and less invasively. We report the details of our technique.

Surgical Technique

This method targets an unstable full radial posterior lateral meniscus tear, especially at the posterior third from the site in front of the popliteus tendon to the posterior root (Fig 1). Table 1 shows the specific equipment required for our procedure.

The patient is positioned supine, and the operative extremity is prepared and draped in the usual fashion for routine knee arthroscopy. Standard 2 anterior knee arthroscopy portals are created. After the surgeon performs diagnostic arthroscopy, the procedure for the lateral meniscal tear is begun in the figure-4 leg lock position. First, we carefully investigated the state of the damaged meniscus using a probe. Grading of the meniscus tear stump degeneration and the condition of the frayed meniscus fiber was conducted. The 2 points for penetrating the meniscus with the needle are decided with care. This positioning is important because it is the positioning that prevents meniscus cutout by the suture line.

After curettage and debridement of the stumps, the Meniscal Viper is inserted into the joint and installed on a predetermined point through the medial or lateral portal. Then, a doubled thread is passed through 1 edge of the stump of the radial tear when the instrument trigger is pushed (Fig 2A). Once the trigger is returned and the instrument is taken out, both a loop end and 2 free ends of a doubled thread are located outside of the joint (Fig 2B). This thread is kept in place without tying the knot.

Table 1. Equipment Required for Procedure

Equipment Without the Standard Arthroscopy Unit	Minimum Use
Meniscal Viper Repair Kit (Arthrex, Naples, FL)	1 set
Meniscal Viper	1
Preloaded 2-0 fiberwire (Arthrex)	1*
Small knot pusher	1
2-0 suture cutter (Arthrex)	1
2-0 fiberwire (Arthrex) for the leading loop line	1*
2-0 fiberwire (Arthrex) for the suture	2-3†

*These two 2-0 fiberwires (Arthrex) can be used repeatedly for the leading loop line.

†Final number of the sutures is necessary.

The Meniscal Viper is used again to set a new thread and inserted into the joint again from the same portal site, repeating the same procedure as mentioned earlier to another stump of the radial tear (Fig 3A). At this step, 2 doubled threads have passed through each stump of the tear, and both a loop end and 2 free ends of each thread are located outside of the joint (Fig 3B).

Then, 2 doubled threads pass the third thread into its own loop, pulling it out. As a result, the third thread becomes the mattress suture over the radial tear site (Fig 4A). As this thread is fastened by sliding knot techniques, 2 stumps of the radial tear can easily be drawn together in the mutual direction of the circumference (Fig 4B).

It is desirable to repeat this procedure more than 3 times to restore the meniscal hoop stress. When repeating the procedure, we adjust passing points of threads, so that each thread crosses in the shape of a cross-stitch mutually to prevent cutout of the meniscal body by the thread. However, because the flexibility of the Meniscal Viper is not as great in the vertical direction as in the horizontal direction, the height of the

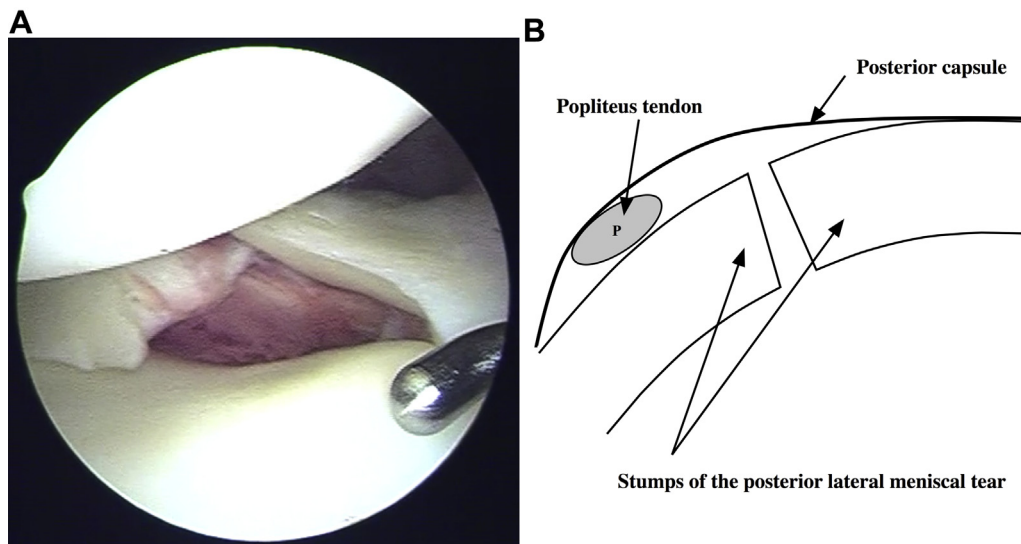


Fig 1. Indication. (A) An illustrative case of an unstable full radial posterior lateral meniscus tear. (B) Schema of an unstable full radial posterior lateral meniscus tear. This becomes the basic diagrammatical view of this later explanation.

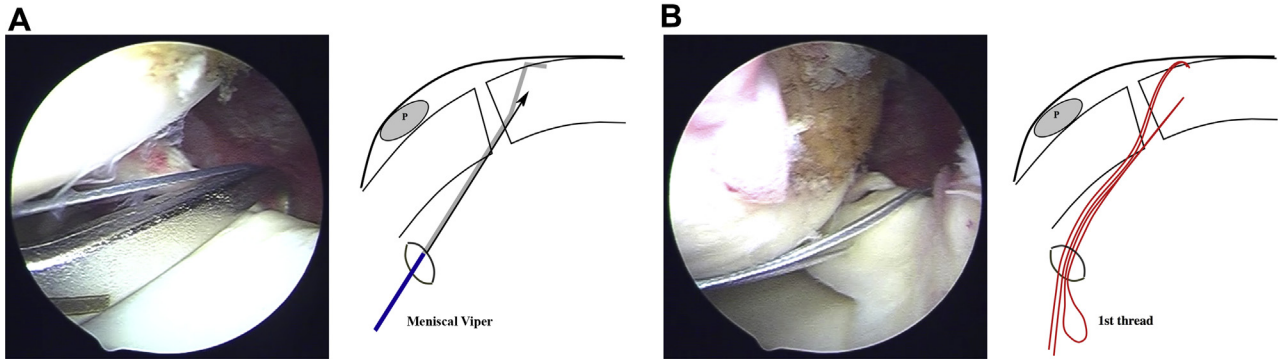


Fig 2. Step 1: First thread. (A) The Meniscal Viper (Arthrex, Naples, FL) is inserted into the joint and installed on a predetermined point through the medial or lateral portal. Then, a doubled thread is passed through 1 edge of the stump of the radial tear when the instrument trigger is pushed. (B) Both a loop end and 2 free ends of the first thread are located outside of the joint. (P, popliteus tendon.)

passing points of threads must be carefully selected intentionally from the first stitch to predict the final result. The surgeon occasionally will need to change the portal between the first and second procedures, or second and third procedures (Fig 5A). Furthermore, if the situation allows, it may be possible to place a mattress suture under the meniscus by stabbing the inferior surface of the meniscus with the Meniscal Viper needle (Fig 5B).

Finally, the full radial tear is completely repaired and firmly secured (Fig 6A). Video 1 shows the real maneuver in an illustrative case, involving the repeat arthroscopic findings (Fig 6B).

Discussion

A full radial tear of the posterior lateral meniscus from the front of the popliteus recess to the posterior tibial insertion site nearly completely loses the meniscus hoop stress function. Therefore, it is theoretically desirable to repair as much of the tear as possible. However, we have to carefully consider how far we

should suture to be appropriately aggressive, because it is possible that the patient will become asymptomatic in the short term regardless of the chosen intervention, although symptoms may return after a longer period of time. It is important to provide surgical intervention that will be more effective than leaving the meniscus in situ, to justify the procedure. It is also important not to add the supplement invasion to a patient.

In the conventional inside-out repair technique⁵⁻⁷ (Fig 7A), the posterior lateral approach is needed to insert the popliteal retractor to protect the neurovascular tissues. Although there is great flexibility in stitching methods, it is difficult to smoothly shorten the gap in the direction of the circumference as long as the suture passes through the posterior articular capsule. The articular capsule is not directly continuous with this segment of the meniscus, so the lateral meniscus has a certain amount of primary anatomic and physiologic mobility. The anatomic mobility of the meniscus will be lost if the meniscus is sutured to the articular capsule. In the all-inside technique, as

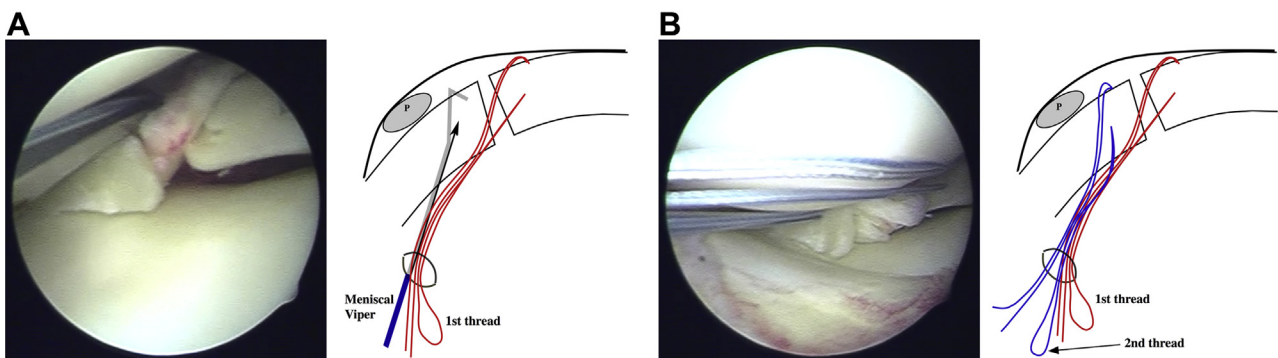


Fig 3. Step 2: Second thread. (A) The Meniscal Viper is again put on another edge of the stump to passing a new doubled thread (second thread). (B) The first and second threads have passed through each stump, and both a loop end and 2 free ends of each thread are located outside of the joint. (P, popliteus tendon.)

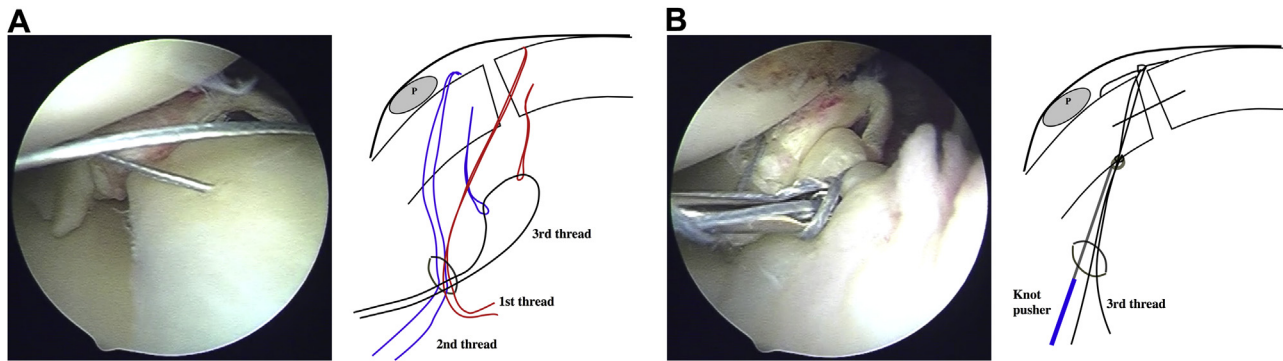


Fig 4. Step 3: Third thread. (A) The first and second threads pass a new thread (third thread) into its own loop, pulling it out. As a result, the third thread becomes the mattress suture over the radial tear site. (B) The third thread is fastened by sliding knot techniques. (P, popliteus tendon.)

with the Fast-fix device (Smith & Nephew, Andover, MA)^{5,6} (Fig 7B), the posterior lateral approach becomes unnecessary. However, as long as the anchor is installed to the outside of the articular capsule, the mobility of the meniscus will be lost for the same reason as occurs with the inside-out technique. If the anchor is installed to the inside of the articular capsule, an unfavorable result may result if the anchor becomes detached inside the joint. Moreover, because the directions of tensioning differ strictly between the outer rim and the inner rim of the meniscus, it can be hard to shorten the gap exactly. The all-inside technique as with the suture hook (Linvatec, Largo, FL)^{5,8} only sutures the meniscus body without passing through the capsule (Fig 7C). It is possible to smoothly shorten the gap by drawing each stump of the meniscus toward the direction of the circumference. The physiologic margin of the popliteus recess also is securable. However, the suture hook method requires high surgical skill. According to the circumstances, posterior lateral portal mastery, which is not common, may be needed, and the

70-degree arthroscope also may be required; thus, this is a technically challenging method.

The technique reported (Fig 7D) uses the Meniscal Viper Kit for longitudinal posterior lateral meniscus tears. As a matter of course, introduction of the apparatus to the joint was easy. In addition, this technique does not require deployment of the popliteal retractor to protect posterior lateral corner neurovascular tissues or require the addition of a posterior lateral portal. Although the Meniscal Viper did not originally have an adaptation for the radial tear, horizontal sutures across a tear become possible, and it is possible to have a shortened gap under moderate strain that does not go through the posterior articular capsule. We were always able to perform the horizontal mattress suture 3 times or more by shifting the passing points of the thread little by little. As a result, the margin of the popliteus recess and the mobility of the popliteus tendon are physiologically securable. This procedure will become easier than other methods of posterolateral meniscus repair if the surgeon becomes skilled in creating the necessary sliding

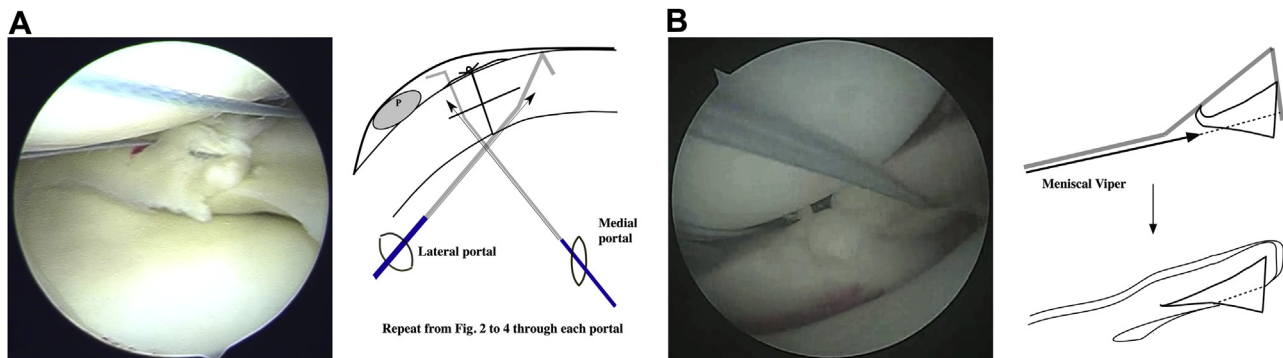


Fig 5. Step 4: Tips for repeating. (A) It is desirable to repeat this procedure from step 1 (Fig 2) to step 3 (Fig 4) more than 3 times. The surgeon will need to change the portal between the first and second procedures, or second and third procedures. (B) It may be possible to place a mattress suture under the meniscus by stabbing the inferior surface of the meniscus. (P, popliteus tendon.)

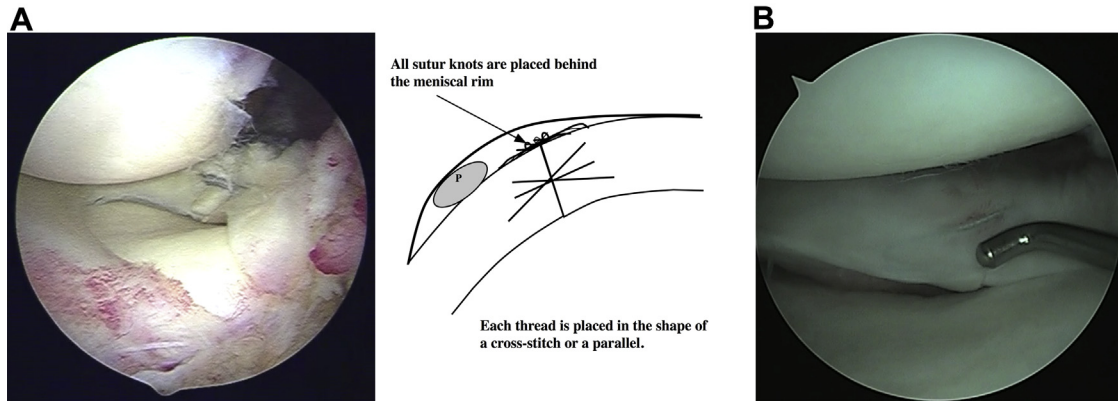


Fig 6. Final view. (A) Finally, the full radial tear is completely repaired and firmly secured. All suture knots are placed behind the meniscal rim. Each thread is placed in the shape of a cross-stitch or a parallel. (B) The second-look arthroscopic finding at 1 year after the repair in this illustrative case. (P, popliteus tendon.)

knots that are not commonplace in knee surgery. However, a suture-passing technology designed to arthroscopically place circumferential sutures around meniscus tears to provide uniform, anatomic compression of the tear edges through an all-inside technique was recently made available from Ceterix Orthopaedics (Menlo Park, CA).^{9,10} It may be superior to our method, but we cannot evaluate it because

there is not yet experience. Even so, it is an advantage that the surface of the meniscus is secured smoothly because all suture knots are placed behind the meniscus rim in our procedure. In addition, by placing a mattress suture at the inferior surface of the meniscus with the Meniscal Viper needle (Fig 5B), our method also makes it possible to compress the tear edges uniformly and anatomically.

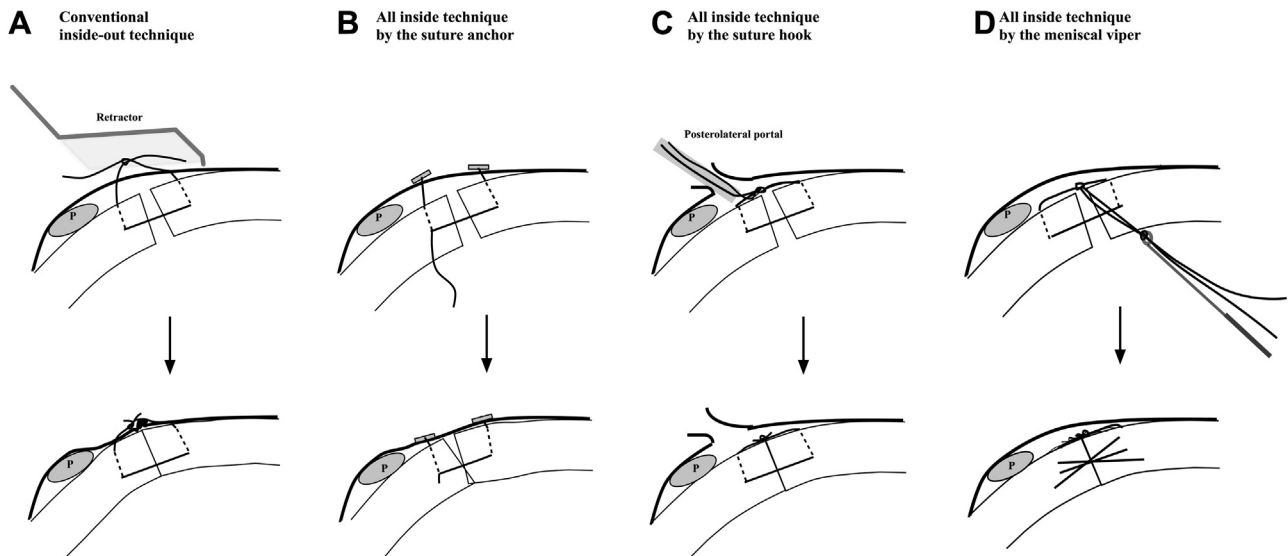


Fig 7. Various repair techniques for full radial posterior lateral meniscus tears. (A) Conventional inside-out technique. The posterior lateral approach is needed to insert the popliteal retractor. It is difficult to smoothly shorten the gap in the direction of the circumference and the anatomic mobility of the meniscus will be lost, because the meniscus is sutured to the articular capsule. (B) All-inside technique with a suture anchor. Because the directions of tensioning differ strictly between the outer rim and the inner rim of the meniscus, it can be hard to shorten the gap exactly. If the anchor is installed to the outside of the articular capsule, the anatomic mobility of the meniscus will be lost. (C) All-inside technique with a suture hook. It is possible to smoothly shorten the gap in the direction of the circumference, and the physiologic margin of the popliteus recess is securable. However, this technique may require posterior lateral portal mastery. (D) All-inside technique by the Meniscal Viper. It is possible to smoothly shorten the gap in the direction of the circumference, and the physiologic margin of the popliteus recess is also securable. Moreover, this technique does not require deployment of the popliteal retractor or the addition of a posterior lateral portal. (P, popliteus tendon.)

Table 2. Pearls and Pitfalls of Procedure**Pearls**

Only standard anterior portals are used.
 The posterolateral incision, popliteal retractor, and posterolateral portal are not needed.
 It is easy to introduce the apparatus because the Meniscal Viper Kit is a special instrument for the posterior lateral meniscus.
 Posterior neurovascular injuries do not occur because all procedures are performed without stabbing the posterior capsule.
 The gap can be shortened easily by drawing each stump in the direction of the circumference without going through the capsule.
 Surface of the meniscus is secured smoothly because all suture knots are placed behind the meniscus rim.
 The margin of the popliteus recess and the mobility of the popliteus tendon are physiologically secured.

Pitfalls

Cutting out the meniscus by the thread may occur depending on the state of the stump or the position of suture points.
 Flexibility of the Meniscal Viper is not as great in the vertical as in the horizontal direction.
 The surgeon must become skilled in creating the necessary sliding knots that are not commonplace in knee surgery.

Conclusions

We developed the technique for an all-inside repair for full radial tears at the posterior lateral meniscus using the Meniscal Viper device, which makes it easy to shorten the gap strictly, smoothly, and less invasively. Pearls and pitfalls of this procedure are summarized in Table 2.

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