Tenosuspension of the Reflected Head of the Rectus Femoris in Hip Arthroscopy: Description of a Portal and a Surgical Maneuver

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Abstract: Arthroscopy is a surgical technique useful in the treatment of intra- and extra-articular hip pathologies, including femoroacetabular impingement (FAI). In the arthroscopic treatment of pincer-type FAI, tendon interposition of the reflected head of the rectus femoris frequently hinders acetabular edge resection in the anterior-superior region (acetabuloplasty) and labrum repositioning, even causing tendon injury during the surgical procedure. Many surgeons do not give importance to the reflected head of the rectus femoris, and during the procedure they try to avoid it, giving 30° of flexion to the hip. However, this does not always prevent tendon injury caused by the instruments. Some surgeons even resect part of the tendon to improve visualization or to use it as a labral graft. The objective of this work is to describe a reproducible surgical maneuver that allows to perform the anterior-superior acetabular edge resection and chondrolabral union repair with less damage to the reflected head of the rectus femoris.

Hip arthroscopy is a demanding surgical technique, useful in the treatment of femoroacetabular impingement (FAI). This technique allows better visualization of central and peripheral compartments, similar to the open techniques such as controlled dislocation.[1]

In certain cases, an anterior-superior acetabuloplasty or labral reinsertion, or both, is required as part of the FAI treatment. In both cases, the exposition of the supra-acetabular margin obstructed by the reflected head of the rectus femoris is required.[2] Because of the proximity of the structures, Foote et al. found a relationship between avulsion injuries of the reflected head of the rectus femoris and labral injuries in 78% patients with a diagnosis of rupture of the reflected head of the rectus femoris, most of which required repair. Therefore, it can be concluded that the injury occurred because of the proximity of the tendon insertion in the supra-acetabular margin to labrum.[3]

The rectus femoris is a biarticular, long, flat, and fusiform muscle that is part of the quadriceps femoris. It is located in the anteromedial part of the 3 vastus muscles.[4,5] It has its origin through 2 portions: a direct cylindrical tendon located in the lateral face of the anterior-inferior iliac spine and a reflected tendon that is flat and originates from the wide and rough groove superior to the acetabular margin, passing through it until it joins to the direct origin; in the anterior region of the capsule, it is mixed up with the iliocapsularis muscle. Both tendons continue through a tendon sheet that descends until the middle third of the muscle to become part of the quadriceps femoris tendon.

The functions of the rectus femoris include the thigh flexion over the pelvis and knee extension. In 3-dimensional anatomic models, it was verified that the rectus femoris remains active in the balancing phase and initial support, even when the vastus muscles were not in continuous contraction, demonstrating its contribution to the hip flexor power. This fact has even questioned the union of the rectus femoris with the other 3 portions of the quadriceps femoris, suggesting an independent action.[5,6]

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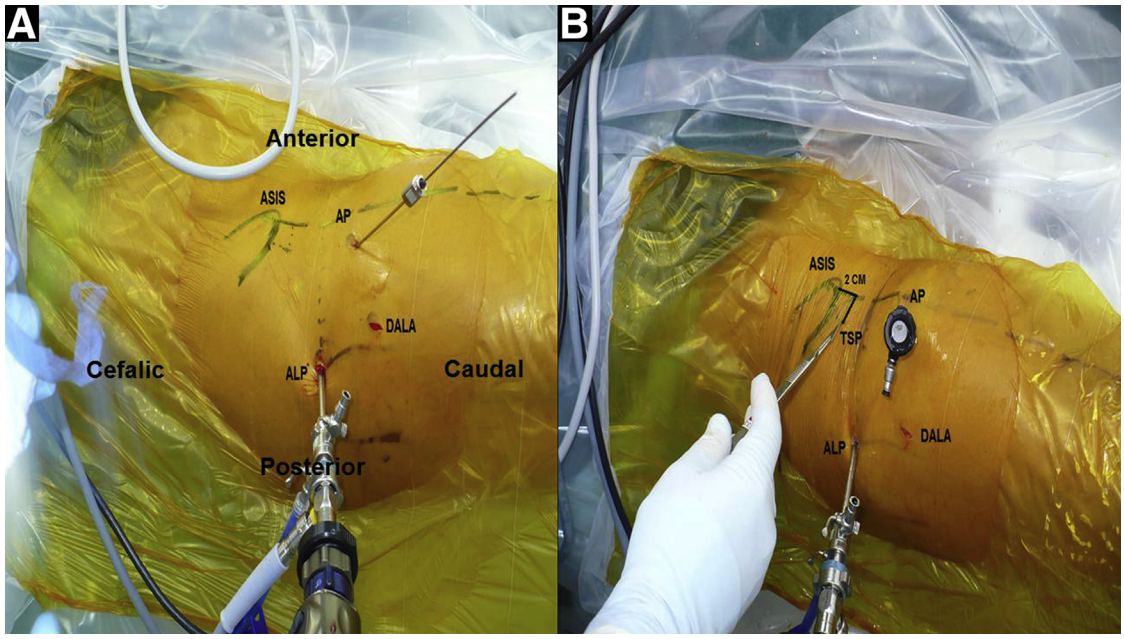

Fig 1. (A) The anterior and anterolateral conventional portals are created with the patient placed in the supine position. The procedure was performed on the right hip. (B) An incision of approximately 2 mm is made to create a new superolateral mini-portal (TSP) located at 2 cm lateral and 2 cm distal to the ASIS. (ALP, anterolateral portal; AP, anterior portal; ASIS, anterior-superior iliac spine; DALA, distal anterior lateral portal; TSP, tenosuspension portal.)

On the other hand, the role of the rectus femoris in hip and knee biomechanics has been studied, discovering a major hypertrophy of the rectus femoris in relation to the vastus muscles when making isometric quadriceps femoris exercises. This reflects the complexity of its structure and its contribution to the hip flexion movement and knee extension, because it is the only biarticular portion of the quadriceps femoris.[7,8]

The contribution of the reflected head of the rectus femoris to the anterior stability of the coxal joint has also been demonstrated in anatomic studies. This tendon contributes fibers that mix to the proximal and superior portion of the iliofemoral ligament, and significantly contributes to the stability in standing position. Walters et al.[9] propose a safety zone of capsulotomy in the outside-inside technique in hip arthroscopy, in which the reflected head of the rectus femoris is not manipulated considering its importance as an anterior stabilizer. Besides, during the walk, the main joint stabilizers and compensators of the abductors' weakness are the biarticular muscles, principally the rectus femoris. In patients with psoas muscle weakness, the rectus femoris in its proximal portion has the important role of increasing its activity to restore the hip flexor moment.[7]

It is important to remember that among the anatomic variations of the area in which the reflected head of the rectus femoris originates are the low implantation of the anterior inferior iliac spine and its lateral and inferior displacement in cases of pincer-type FAI.[10] In these cases, the tendon of the reflected head of the rectus interjects in the arthroscopic surgical exposition of the supra-acetabular groove, hindering acetabuloplasty and chondrolabral union repair.[11]

The purpose of this article was to describe a portal and a surgical maneuver in which an intraoperative

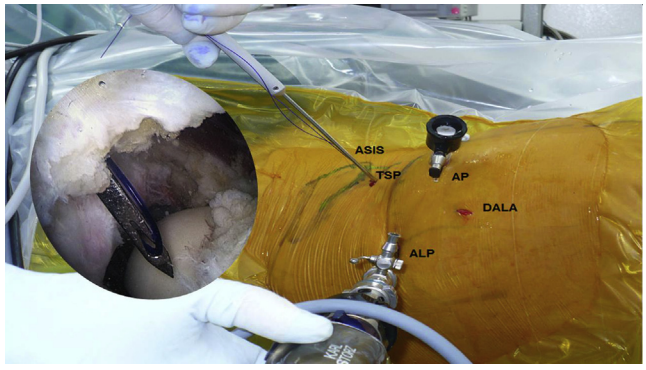

Fig 2. Through the mini-portal (TSP) created on the right hip with the patient placed in the supine position, a cuff stitch—type needle of 20° is introduced with a nonabsorbable monofilament suture loop. The needle is moved toward the superior part of the acetabulum with a caudal direction of 20° and a medial direction of 30°. Arthroscopic view shows the needle with suture loop introduced. (ALP, anterolateral portal; AP, anterior portal; ASIS, anterior-superior iliac spine; DALA, distal anterior lateral portal; TSP, tenosuspension portal.)

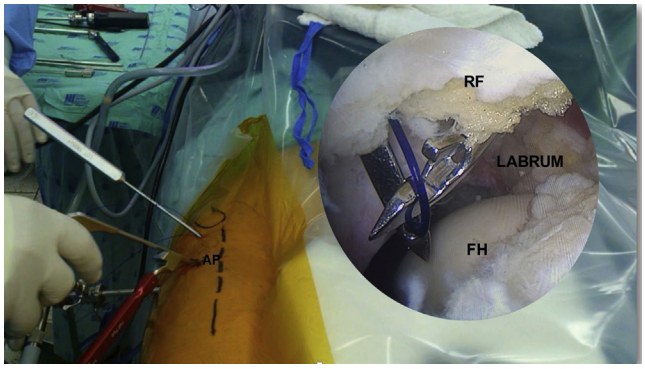

Fig 3. The suture is recovered through the anterior portal with an Arthro-Pierce 35° Upbiter. The arthroscopic view shows the recovery of the suture loop from the posterior and inferior margins of the rectus femoris. The patient is in the supine position and the procedure is performed on the right hip. (AP, anterior portal; FH, femoral head; RF, rectus femoris.)

tenosuspension of the reflected head of the rectus femoris is performed through which exposition of the acetabular margin in the anterior-superior region is obtained, facilitating both acetabuloplasty and labral fixation with anchors using a single maneuver, protecting the rectus tendon and preserving the function of this biarticular muscle.

Description of the Surgical Technique

In cases where tenosuspension is required and once the standard approaches of the hip arthroscopy (anterior and anterolateral conventional portals) are established, taking as anatomic repair the anterior-superior iliac spine, an incision of approximately 2 mm is made to create a new superolateral mini-portal, located 2 cm lateral and 2 cm distal from it (Fig 1). Tenosuspension will be performed through the mini-portal. A cuff stitch—type needle (Orthopaedic Biosystems, licensed to Smith & Nephew, patents pending) of 20° is introduced with a nonabsorbable monofilament suture loop (Fig 2).

The needle is moved toward the superior part of the acetabulum with a caudal direction of 20° and a medial direction of 30°, with which the muscular layer of the fascia lata, and sometimes of the minimal gluteus and bursa, are crossed. Once the needle tip is visualized in the peripheral compartment, it is proceed to cross, from superior to inferior in its posterior side, the reflected head of the rectus femoris at approximately 1 cm from the supra-acetabular margin (Fig 2).

On the posterior side of the rectus and for its inferior margin, the double suture is recovered through an Arthro-Pierce 35° Upbiter (Orthopaedic Biosystems) introduced by the anterior portal, the suture is kept secure to remove the cuff-stitch needle of 20°, leaving the suture crossing the tendon (Fig 3).

Then, an Arthro-Pierce Straight (Orthopaedic Biosystems) is introduced by the superolateral mini-portal and the previous suture loop is recovered, removing it with the precaution of holding the ends (Fig 4).

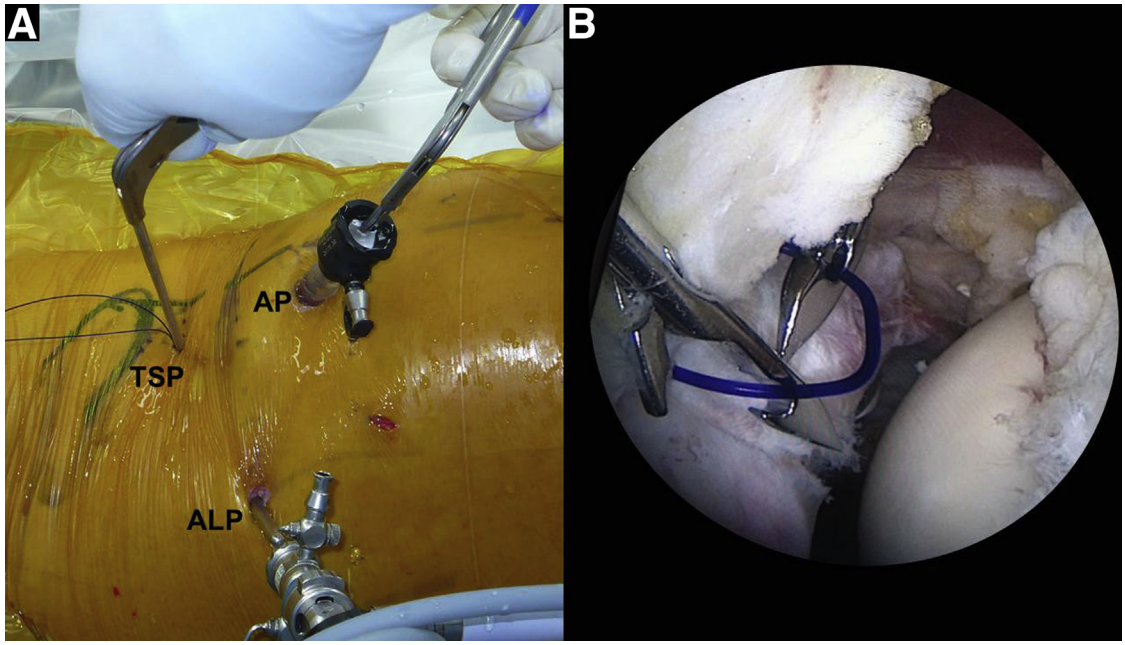

Fig 4. (A and B) The suture is kept secure with the Arthro-Pierce 35° Upbiter. Then, the Arthro-Pierce Straight is introduced through the mini-portal (TSP) and the suture loop is recovered. At this moment, the suture is located around the tendon as shown in the arthroscopic view. The patient is in the supine position and the procedure is performed on the right hip. (ALP, anterolateral portal; AP, anterior portal; TSP, tenosuspension portal.)

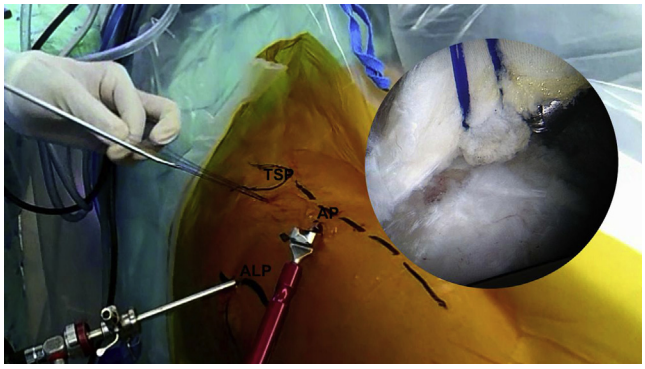

Fig 5. The suture loop and ends are tightened to pull the reflected head of the rectus femoris. In this step, visualization of the acetabular margin is possible as shown in the arthroscopic view. The patient is in the supine position and the procedure is performed on the right hip. (ALP, anterolateral portal; AP, anterior portal; TSP, tenosuspension portal.)

Once the fixation is achieved, the suture loop and ends are tightened to pull the reflected head of the rectus femoris to anterior and superior, allowing the exposition of the acetabular margin (Fig 5). Afterwards, both ends are kept tight through a Kelly pincer (Fig 6). If more exposition of the acetabular margin is required, it is possible to retighten the tenosuspension and put 1 or more sutures to the rectus femoris through the same mini-portal, each with independent traction, making the previously described steps. Video 1 presents a clear demonstrations of our technique.

We recommend that the tendon repair cover at least 50% of its diameter to avoid tears with the suture. Likewise, the fixation with Kelly pincer in the last step (Fig 6) must not maintain excessive compression over the skin because it may cause lesion to the dermis and pain in the immediate postoperative period (Table 1). The pearls and pitfalls of the tenosuspension maneuver are listed in Table 2.

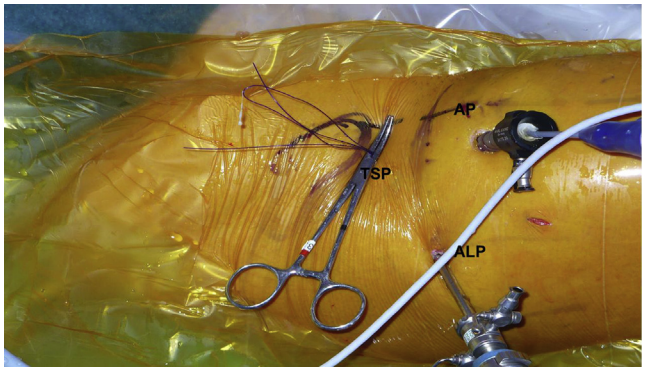

Fig 6. Finally, both ends are kept tight through a Kelly pincer. From this moment on, the procedure can be continued without any obstacle on the right hip. The patient is in the supine position. (ALP, anterolateral portal; AP, anterior portal; TSP, tenosuspension portal.)

Table 1. Advantages and Disadvantages of Tenosuspension Maneuver of the Rectus Femoris

Advantages	Disadvantages
Preservation of the reflected head of the rectus femoris	In long procedures, it could injure the skin as a result of the fixation with Kelly pincer
Better visualization of the supra-acetabular region	Rupture of tendon could occur if the repair does not cover 50% of its diameter
Facilitation of surgery within the acetabular rim and labrum	Injury to cartilage and labrum during the access of the needle

Discussion

Rectus femoris is a biarticular muscle important for the biomechanics and anterior stability of the coxal joint as described in previous studies by Ema et al.[4] Besides, it has such a complex action that even Nene and Byrne doubt it is part of the quadriceps femoris.[5]

The proximity between the reflected head and the labrum, and the presence of concomitant injuries between these structures, are already defined in Foote et al.[3] These injuries can increase in activities that require higher hip flexor potency as Grygorowicz et al.[12] and García et al.[13] show. Although studies clarifying the complex role of the reflected head of the rectus femoris are needed, there is evidence of both its importance in the kinetics of walk[8,9,14] and its stabilizing contribution to the anterior joint.[9] This makes it necessary to attempt to preserve this reflected head during any surgical procedure, in this case, the hip arthroscopy.

There are morphologies in which the reflected head of the rectus femoris covers in a more extensive way the supra-acetabular margin as in the cases of

Table 2. Pearls and Pitfalls of Tenosuspension Maneuver of the Rectus Femoris

Pearls	Pitfalls
• We advise surgeons who undertake this technique the use of a cuff stitch—type needle.	• The surgeon must minimize the time of pressure with the Kelly pincer to avoid damaging the skin.
• If the visualization of the acetabular margin in the anterior-superior region is reduced, the surgeon may put 2 or more sutures to the rectus femoris through the same mini-portal.	
• For a better visualization, it is necessary to use the 30° lens during the surgery.	
• If it is not possible to see the suture, a hip flexion to 30° can be done for an easier visualization.	

Pincer-type impingement or patients with low anterior-inferior iliac spine, which hinders the arthroscopic treatment as the studies by McBride et al.[10] and Larson et al.[11] indicate. It is in these cases especially that the surgical technique we propose plays a major role.

The tenosuspension maneuver of the rectus femoris represents a simple and reproducible solution. It facilitates FAI treatment by an arthroscopic method through improving the exposition during the acetabuloplasty and labral suture and protecting the reflected head of the rectus femoris without increasing soft tissue noxa, which in theory favors early postoperative pain control and early mobility in rehabilitation during active flexion or against hip resistance and at the same time minimizes the biomedical and stability disruption of the joint.

We recommend this maneuver in patients with mixed and pincer FAI, and those with low anterior-inferior iliac spine that limits the arthroscopic visualization of supra-acetabular margin or that hinders the labral fixation for tendon interposition.

In our experience, the technique can be performed with inside-outside or outside-inside approaches, it is reproducible and without complications, and achieves its objective, that is, the exposition of the anterior acetabular edge without damaging the rectus femoris.

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