Surgical Variants in the Treatment of Proximal Hamstring Avulsion

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ABSTRACT

Proximal tendon avulsion of the hamstring insertion is a rare entity. The therapeutic approach is different in contrast to the treatment in common muscle tears. The greater benefit of surgical treatment has been widely verified in the literature, and given the low frequency of this type of injury, few orthopedic surgeons are used to both diagnosis and surgical procedures in this anatomical region. The aim of this article is to report four patients with insertional hamstring rupture and describe the surgical technique used in each case. We present the surgical variants as well as the outcomes achieved.

Keywords: Hamstrings; surgical treatment; functional outcome; sports.

Level of Evidence: IV

Variantes quirúrgicas en el tratamiento de la desinserción proximal de isquiotibiales.

RESUMEN

Las lesiones por avulsión isquiática o rotura tendinosa en la inserción proximal de los isquiotibiales son infrecuentes. El abordaje terapéutico es diferente del de los desgarros. Se ha comprobado ampliamente un mayor beneficio con el tratamiento quirúrgico y, dada la baja frecuencia de este tipo de lesiones, son pocos los cirujanos ortopédicos habituados tanto al diagnóstico como al procedimiento quirúrgico. El objetivo de este estudio es reportar cuatro casos de pacientes con rotura insercional de isquiotibiales y describir la técnica quirúrgica utilizada. Exponer las variantes quirúrgicas y sus resultados.

Palabras clave: Isquiotibiales; reparación quirúrgica; resultado funcional; deporte.

Nivel de Evidencia: IV

INTRODUCTION

Hamstring muscle injury is one of the most common injuries in athletes.[1,2] However, ischial avulsion or tendon rupture in its proximal insertion is infrequent, it has an incidence of less than 5% of all sports injuries.[3,4]

The therapeutic approach is varied; tears tend to be treated conservatively, whereas, for insertional hamstring rupture, the greater benefit of surgical treatment has been widely proven.[5-8] Given the low frequency of this type of injury, few orthopedic surgeons are used to surgical procedures in this anatomical region.[9]

The complications of not treating an insertional hamstring rupture range from chronic pain, [10] significant decline in sports performance [4,11] to sciatic nerve irritation. [10] The latter occurs due to the intimate relationship of said muscle mass with this nerve, where, when the muscle fibers retract, fibrosis occurs that could irritate it, thus causing a "hamstring syndrome", a differential diagnosis within sciatica. [12]

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The aim of this article is to report four cases of patients with insertional hamstring rupture and to describe the surgical technique used with its variants. The long-term results obtained are presented.

CLINICAL CASES

Case 1

A 44-year-old man, with no relevant medical history, a recreational athlete who, during a soccer game, felt a sudden pain in his right thigh after a sweep on the playing field. By ultrasound, he was diagnosed with a 34-mm fibrillar disruption of the semitendinosus muscle with an adjacent 21 mm hematoma. After three months, he returned to consult due to the persistence of pain with functional limitation and without neurological deficit. Magnetic resonance imaging (MRI) was performed showing proximal hamstring avulsion with a retraction of approximately 50 mm. Surgical repair was indicated.

Surgery: Posterior longitudinal thigh approach. Primary anchor repair of the conjoint tendon.

Three years after surgery, after an eccentric contraction while unloading weight at work, he suffered a new ischial injury. Ultrasound revealed an incomplete injury to the semitendinosus muscle. The reoperation was decided.

Surgery: Posterior longitudinal approach extended over the previous scar. A lesion of the semitendinosus muscle was found at the myotendinous junction. A proximal release of the muscle was performed and the anchoring surface in the ischium was prepared. Said anchorage was carried out with two 5 mm double suture anchors. By this means, the distal end of the myotendinous tear was sutured, bringing it closer to the enthesis and the ischium, thus generating a recovery of muscle tension.

Case 2

A 54-year-old woman, with no relevant medical history, a recreational athlete who, during a tennis match, suffered sudden pain in the right gluteus after a sprint start. She was immediately admitted to the Emergency Department, where an extensive hematoma was found on the back of the thigh, with pain on palpation of the ischium without a visible or palpable gap. On radiographs, no associated bone lesions were seen. Ultrasound showed a complete proximal insertional tear of the right hamstring tendons, with distal retraction of approximately 4 mm. The MRI at four days revealed a tendon avulsion of 47 mm. Surgical intervention was decided.

Surgery: Transverse approach on the gluteal fold. Primary repair with conjoint tendon anchors.

Case 3

A 52-year-old woman, with a history of total colectomy due to colon cancer, without residual disease. She arrived at the consultation with a diagnosis of complete avulsion of the proximal right hamstring tendon. She had suffered an indirect sports trauma one week before the consultation. Both the musculoskeletal ultrasound and the MRI of the right thigh revealed a tendon retraction in caudal direction of 6 cm. It was decided to perform a surgical treatment.

Surgery: Posterior longitudinal thigh approach. Primary repair with anchors of both tendons.

Case 4

A 43-year-old woman, with no relevant medical history, a marathoner who suffers a fall from her own height with her right lower limb in knee extension and hip flexion. She consulted for posterior thigh pain radiating to the leg that was exacerbated by extending the knee. A musculoskeletal ultrasound was performed, which showed a complete rupture of the proximal myotendinous junction of the semimembranosus and a total tear of the conjoint tendon. The MRI of the right thigh showed a tendon retraction in caudal direction of approximately 6 cm (Figure 1). Surgical treatment was decided.

Surgery: Transverse approach on the gluteal fold. Primary anchor repair of the conjoint tendon.

Figure 1. Magnetic resonance imaging of the right thigh. **A.** Coronal plane, **B.** axial plane, **C.** sagittal plane. Tendon injury and retraction.

General surgical technique

The patient is placed in the prone position, protecting the bony prominences. The approach depends on the characteristics of the patient. In slim people with acute injuries without tendon retraction, we opted for an approach in the gluteal fold (Figure 2A). This approach poses difficulties for reinsertion, but is more aesthetic. In overweight patients or patients with chronic tendon retraction, we opted for a posterior approach perpendicular to the gluteal fold with a distal extension of 12-15 cm (Cases 1 and 3) (Figure 2B).

In the deep plane, the greater sciatic nerve; the ischium, detached from the tendon insertions; and the detached tendon end are identified by blunt dissection. The fibrosis is resected until an adequate surface is achieved in the ischium for the placement of the anchors. Between two and five anchors are placed, as needed, until the tendon assembly is supported on the bone. We recommend placing at least three anchors in the ischium (distal, medial and proximal). The most distal is sutured 5 cm from the end of the tendon assembly, while the most proximal, close to the tendon end, allowing the tendon to be placed equidistant on its bone insertion. The tendon suture is performed using the Krackow technique (Figure 3). The lower limb is positioned in 90° knee flexion to relax the muscular structures of the posterior compartment.

Once the tendon reinsertion is finished, the closure is carried out by planes maintaining the knee flexion. This position should be maintained postoperatively using a splint.

Rehabilitation protocol

In our institution, the postoperative rehabilitation protocol consisted of immobilization with a splint in knee flexion, avoiding load on the operated limb. The first two weeks at 90°, the third and fourth weeks at 60°, the fifth and sixth weeks at 45° with partial support (Figure 4).

Figure 2. **A.** Posterior thigh hematoma and outline of the incision through the gluteal fold. **B.** Outline of the longitudinal incision.

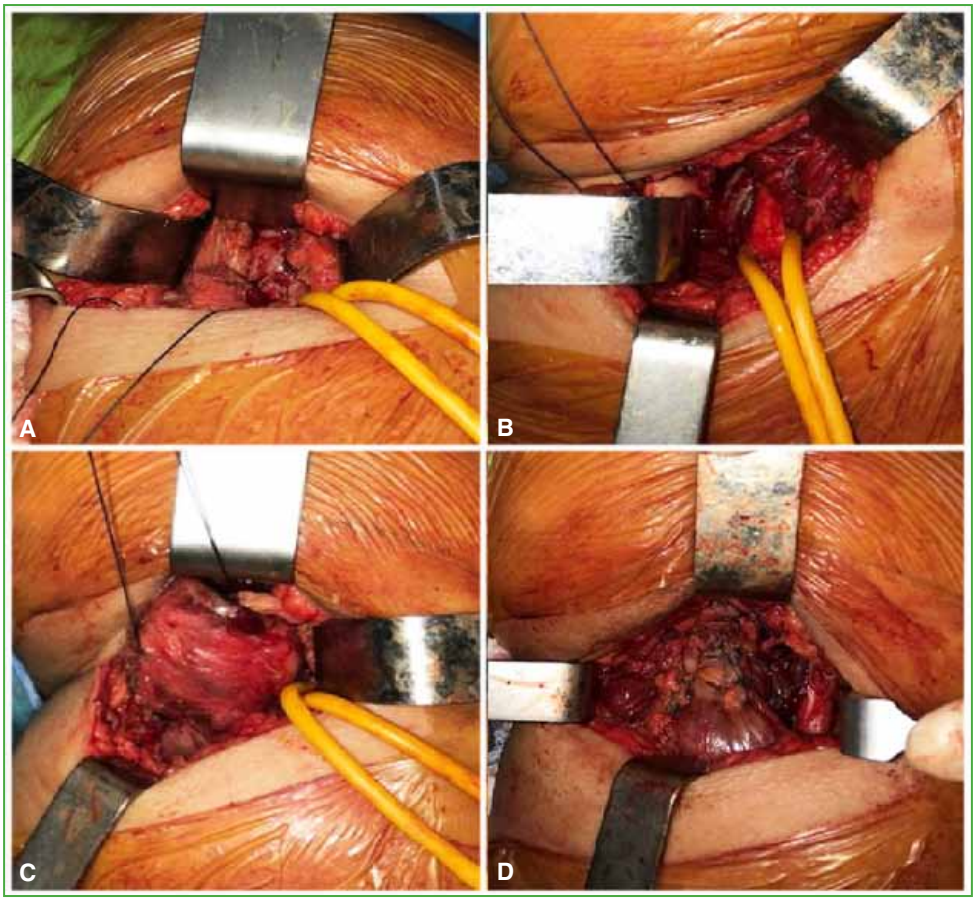

Figure 3. Clinical intraoperative images. **A.** Ischium detached from tendon insertions. **B.** Common sciatic nerve repair. **C.** Conjoint tendon on its anatomical position. **D.** Final anchor repair.

Figure 4. Clinical image of the patient during the postoperative period. Variable fixed-angle splint.

According to published recommendations, at six weeks, total weight bearing begins on the affected limb. [13] After six weeks, we indicate the removal of the immobilizer and allow full weight bearing on the operated limb. From the sixth week onwards, the specific rehabilitation begins. It is indicated to begin with exercises of extension and active and passive flexion of the hip and knee through isotonic exercises and closed chain exercises. This is followed by open-chain exercises that allow the patient to improve and begin to regain strength. [13] It should be noted that strengthening is a necessary factor not only for rehabilitation, but also for the prevention of injury recurrence.

At 12 weeks, the protected sports activity begins, on firm ground and with a linear gait.

FINDINGS

There were no intraoperative complications associated with the procedure. No patient had wound-related complications or had to be reoperated before 12 months after surgery. There were no cases of postoperative pain (visual analog scale: 0/10).

The range of motion of the limb compared to the contralateral was complete. All patients were satisfied with the functional outcomes obtained at the end of the rehabilitation. Although none were high-performance athletes, all engaged in recreational physical activity (tennis and soccer) more than four times a week. Within eight months after surgery, they resumed sports activity. Three of the four patients returned to full sports activity without deficit, as before the injury. The minimum follow-up was six months.

DISCUSSION

The hamstring muscle mass is comprised of three muscles, the semimembranosus, the semitendinosus, and the biceps femoris with its two portions (long and short). It is inserted proximally in the ischium by means of two tendons (Figure 5). A conjoint tendon between the semitendinosus and the long head of the biceps femoris forms an oval insertion.[9] These are separated into two individualized strands at approximately 9 cm. Lateral to this oval complex, there is an independent insertion of the tendon of the semimembranosus. Lateral to the hamstring attachments and 5 cm proximal to the distal border of the gluteus maximus, is the inferior gluteal nerve bundle. The sciatic nerve should be identified 1.5 cm on average from the lateral ridge of the ischial tuberosity. Its function involves two joints, the hip and the knee. The semitendinosus and semimembranosus extend the hip when the torso is fixed. They flex the knee and intra-rotate the leg when the knee is flexed. The long head of the biceps femoris extends the hip when walking, and both the short and long heads flex the knee and extra-rotate the leg when the knee is flexed.

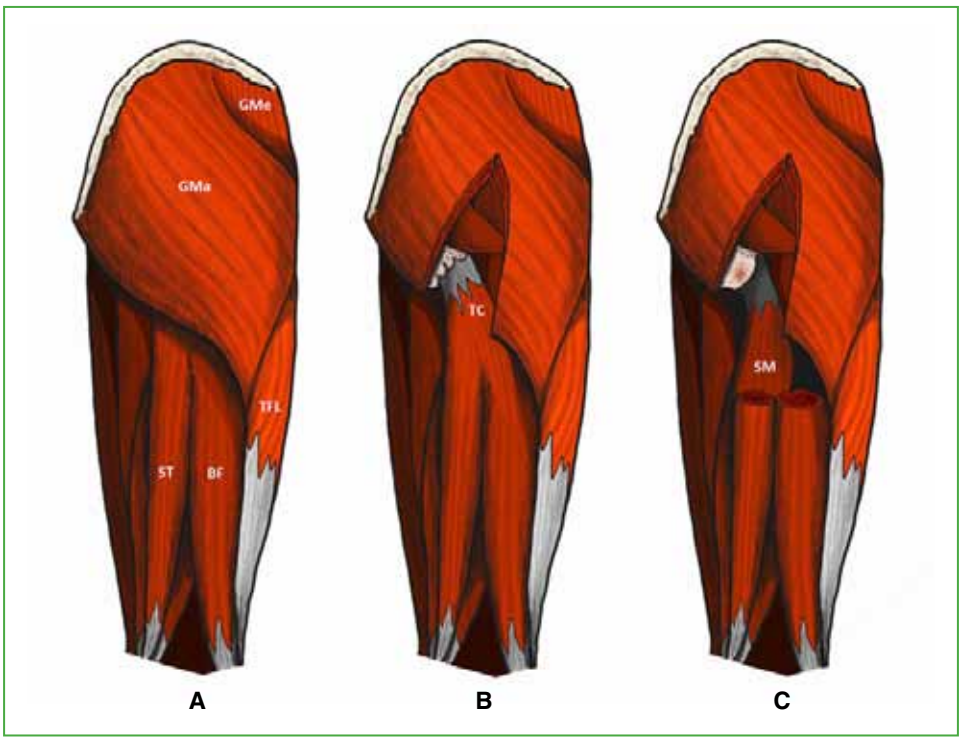

Figure 5. Anatomical diagram by planes of the posterior region of the thigh. Gluteus medius muscle (GMe), gluteus maximus muscle (GMa), tensor fasciae latae muscle (TFL), biceps femoris muscle (BF), semitendinosus muscle (ST), semimembranosus muscle (SM), and conjoint tendon (CT).

There are risk factors for proximal injuries, among them, previous injuries of the hamstring muscles are the main factor, as well as muscle weakness and fatigue, muscle imbalances and lumbopelvic dysfunctions.[14]

The injuries result from excessive stretching at the level of the myotendinous junction. They are generated by contractions with eccentric overload, hip hyperflexion, and knee hyperextension. In contrast, muscle belly tears are caused by a concentric contraction, for example, in a sprint.[15]

The main indication for imaging studies in acute hamstring injuries is the diagnosis of proximal insertion tears.

Radiographs, although limited, allow us to observe bone avulsions at the level of the ischial tuberosity. Computed tomography has been relegated by MRI and ultrasound.[16] Although the latter does not have the precision of MRI, its practicality, low cost, and absence of contraindications and adverse effects make it the gold standard. It allows muscle and tendon analysis, especially in superficial injuries, in a static and dynamic way. It has its limitations for mild injuries with little perilesional fluid or in patients with a lot of body tissue, especially in the proximal portion of the tendon, where the gluteus maximus muscle, which is multi-fasciculated and fatty, makes visualization difficult.[16]

MRI makes it possible to detect injuries ranging from subtle to the most serious and to define their extension, a relevant factor, because it has implications for rehabilitation time.[17] In acute injuries, T2-weighted or fat suppression (STIR) sequences show high-intensity images as a result of edema or hemorrhage surrounding the damaged muscle. Whereas, in the T1-weighted sequences, areas of intermediate intensity are observed that are confused with muscle mass. The insertional hamstring tear can be complete or affect only the semimembranosus portion or the conjoint tendon of the semitendinosus and the biceps femoris. In these circumstances, we find a discontinuity between the bone and the remaining tendon (either partial or complete) that will be surrounded by hematoma or inflammatory fluid that also infiltrates the muscle, to a variable degree, giving it a "feather" appearance.[18]

It is essential to quantify the extent of the tendon retraction when opting for surgical treatment and its immediate relationships with the sciatic nerve.

Lesions can be classified according to their clinical presentation into three grades: grade 1 (mild): excessive stretching with minimal loss of enthesis integrity; grade 2 (moderate): partial detachment and grade 3 (severe): total rupture of the enthesis.[1]

Wood et al. proposed a new classification (Table) in which the lesions are divided into five stages, according to their anatomical location, the degree of detachment (complete or incomplete), the degree of muscle retraction and the presence or absence of irritation of the sciatic nerve.[18]

Table. Wood Classification[18]

Type	Characteristic
1	Bone avulsion
2	Injury to the myotendinous junction
3	Partial detachment
4	Complete detachment without retraction
5	Complete detachment with retraction
5B	Type 5 + sciatic nerve irritation

Most of these lesions respond to conservative treatment with cryotherapy, rest, stretching, and gradual return to normal activities. But, in cases of detachment, greater importance is given to surgical treatment[1,10,15] in athletes who perform speed races and need explosive muscular actions.

Taking this into account, there are two main cornerstones for these injuries: the type of treatment (surgical vs. conservative) and when to perform it (acute vs. chronic).

Historically, surgical treatment to repair hamstring injuries received little attention. Over time, this changed thanks to the understanding of injuries and orthopedic training.[19]

Conservative treatment is the main therapeutic option for partial injuries and insertional tendinopathies.[10,15] However, in athletes, the results are not optimal, therefore surgical treatment is considered. This is recommended for injuries of two tendons and detachments with retractions >2 cm.[4,15] The formation of retracted scar tissue can

inhibit the innervation of the muscle regeneration tissue and reduce its contractility and range of motion, as well as irritate the sciatic nerve in the face of perineural scarring. Fat atrophy has been observed at the margins of avulsed muscle as well as a generalized reduction in muscle volume.[20]

Hofmann et al. evaluated patients who preferred conservative management for complete proximal hamstring tears, and observed deficits in the strength of the affected limb and failure to return sports at their previous level.[11]

In systematic reviews carried out by other authors, it was concluded that surgery improves outcomes in terms of athletic return, strength and endurance.[8,21,22]

Piposar et al. also obtained positive functional outcomes with a significant improvement when comparing patients treated surgically vs conservatively, except in strength where they found no significant differences.[8,23]

However, there are special situations, including partial detachments that usually occur due to repetitive and chronic injuries. Traditionally, these lesions are conservatively treated and surgery is indicated if there is no improvement after six months of non-surgical treatment.[8,23]

Regarding rehabilitation, sports activities can be resumed once the functionality of the lower limb reaches 80% compared to the contralateral one when measured by an isokinetic study. In addition, a return to sports can be considered if there is no pain, the patient can perform sports activities without fear, the strength and elongation of the affected muscle have been recovered and, finally, if the patient is in optimal condition and is self-confident enough to carry out the specific activity. On average, this is achieved between 6 and 10 months after surgery.[13,24]

On the other hand, Hofmann et al. stated that, in cases of conservative treatment, rehabilitation is necessary for a minimum period of 16 weeks before returning to sport. In our case series, no patient received conservative treatment. It should be noted that, with conservative treatment, the reported satisfaction rates are low and a third of the patients are unable to return to their sports activity at the level they had before the injury.[11]

Regarding when to perform a surgical procedure, in some studies, it is argued that surgery in the acute stage improves the evolution of patients with these injuries, determined by strength, pain, return to sports and satisfaction.[22] On the other hand, other authors did not find differences related to the time of surgery.[6]

The study by Blakeney et al. supports the recommendation of surgical treatment in the acute stage.[7,25] However, they consider that favorable results are achieved with surgery in both acute and chronic injuries. The patient in case 1 is an accurate reflection of this.

Differences in surgical technique between acute and chronic injuries mainly depend on tendon retraction, fibrosis around the injury, and the need for augmentation of the remaining tendon. The use of Achilles tendon allograft or fascia lata autograft has been described.[6]

FINAL CONSIDERATIONS

Proximal hamstring detachment is an infrequent condition and there are very few cases in the national literature. Surgical treatment should be considered a valid option. In agreement with the literature, our patients obtained favorable results through surgical treatment.

Conflict of interests: The authors declare they do not have any conflict of interests.

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