

# Surgical Resection of Post-Traumatic Heterotopic Calcification in an Athlete: A Case Report

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**Abstract:** Heterotopic calcification due to muscular trauma, also known as myositis ossificans, is a recognized complication in athletes, although it is not uncommon. One of the first steps in reducing sports-related injuries is to better understand the nature and extent of this pathology. Here, we present a case report of the surgical resection of heterotopic ossification in the adductor muscle of a soccer athlete, including a description of the surgical technique used for resection in the adductor muscle. We describe a 28-year-old male patient, a former professional soccer player who continues to maintain a high level of athletic activity. He reported that after a strain of the right thigh adductor muscle, he developed persistent pain and functional limitation of the hip joint. Clinical investigation and complementary examinations were initiated, leading to the diagnosis of heterotopic ossification in the right adductor muscle. After diagnostic confirmation and eight months of unsuccessful conservative treatment, with persistent limitation and decreased athletic performance, surgical resection of the osseous fragment was proposed.

**Keywords:** Athletes; Myositis Ossificans; Musculoskeletal System/Injuries.



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## 1. Introduction

Heterotopic calcification due to muscular trauma, also referred to as localized myositis ossificans, is a recognized but uncommon complication in athletes. Its first report in the literature dates back to 1740 [1]. Kransdorf et al. [2] defined myositis ossificans (MO) as a benign, solitary, self-limiting soft-tissue mass with ossification potential that typically occurs within skeletal muscle; this is the most widely accepted contemporary definition of the term. The pathophysiology of MO formation remains under investigation, but it is believed to occur through the inappropriate differentiation of fibroblasts into osteogenic cells [3]. It most commonly occurs after contusions with the formation of extensive hematomas, particularly in the quadriceps muscle, affecting active young adults between 30 and 40 years of age, with a slight predominance in men [1, 4, 5].

Pain, muscle shortening, and loss of function are commonly reported symptoms in high-demand athletes; therefore, early diagnosis and treatment are necessary [6]. Classical treatment in the acute phase involves limb protection, cryotherapy, compression, and elevation (PRICE). Some authors advocate the use of Indomethacin when symptoms and signs are pronounced; however, there is insufficient scientific evidence to support its routine use [4,5]. Non-surgical treatment is often successful because MO is self-limiting and frequently resolves spontaneously. In cases where conservative treatment fails, or when

ossification leads to recurrent symptoms such as decreased athletic performance, pain resulting from mechanical irritation of tendons and bursae, compression of neurovascular structures, or reduced range of motion that limits athletic performance, excision of the ectopic bone should be considered [7,8].

Variability in terminology, clinical presentation, imaging characteristics, and histopathology continue to make the diagnosis of MO challenging [9]. For the purposes of this article, the terms heterotopic calcification and myositis ossificans are used interchangeably to describe calcification that occurs after extensive muscle injury. Although myositis ossificans in athletes are well described in the literature, most reports involve muscles such as the quadriceps or brachialis [9]. Occurrence in the adductor muscle complex of the thigh is less frequently reported, and detailed surgical descriptions at this location remain limited, as shown in Table 1.

**Table 1.** Published reports of myositis ossificans in the adductor muscle.

| Autor               | Ano  | Esporte           | Localização              | Tratamento   | Desfecho            |
|---------------------|------|-------------------|--------------------------|--------------|---------------------|
| Lipscomb et al. [7] | 1976 | American football | Adductor                 | Surgical     | Return to sport     |
| Miller et al. [1]   | 2006 | Athletics         | Adductor                 | Conservative | Functional recovery |
| Walczak et al. [9]  | 2015 | Soccer            | Medial thigh compartment | Conservative | Good outcome        |
| Present study       | 2024 | Soccer            | Adductor longus          | Surgical     | Return to sport     |

In this context, we present a case report of post-traumatic heterotopic ossification in the adductor musculature of an athlete, emphasizing the diagnostic approach, the surgical indication after lesion maturation, and the functional outcome following treatment.

## 2. Case Report

A 28-year-old male, a former professional soccer player, continues to maintain a high level of athletic activity, with regular participation in competitive amateur tournaments, strength training, and road running. He reported that after a strain of the right thigh adductor muscle, he developed pain and functional limitation of the hip joint. Conservative treatment was initiated for six weeks for the muscle injury, followed by an attempt to return to sports activities. However, even after completing the entire treatment protocol for the muscle strain, his activities remained limited due to persistent pain at the injury site, particularly during kicking with external rotation of the foot, significantly reducing his athletic performance. After consulting several orthopedists, he reported recurrent use of non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids without symptom relief.

Eight months after the initial strain, the patient presented to our service with persistent pain and limitation of the right adductor musculature, with the presence of a bony excrescence causing local anatomical deformity, painless on palpation, without adhesions or inflammatory signs at the site (Figure 1). Physical examination of the right hip revealed 45° of external rotation and 10° of internal rotation, with shortening of the gluteal and quadriceps muscles measured by the Ely test. Decreased strength with pain associated with resisted contraction of the right adductors was also observed. Magnetic resonance imaging (MRI) was then requested to confirm the diagnosis of heterotopic ossification in the adductor muscle of the right thigh (Figure 2).

After diagnostic confirmation, eight months of unsuccessful conservative treatment, and persistent limitation with decreased athletic performance, surgical resection of the osseous fragment was proposed.

### 2.1 Surgical Technique

With the patient in the supine position, the thigh was abducted and the knee flexed, with a cushion placed under the joint. A skin incision was made in the anterior region of

the right hip, followed by layered dissection. Superficial dissection was performed using curved and blunt scissors, extending approximately 5 cm horizontally through the subcutaneous tissue. Manual dissection was then continued for approximately 5 cm distally until the superficial fascia was identified (Figure 3).

**Figure 1.** Bony excrescence causing local anatomical deformity on physical examination.



**Figure 2.** Magnetic resonance imaging shows heterotopic ossification in the adductor muscle of the right thigh.



Dissection of the adductor muscle group, comprising the gracilis, adductor brevis, adductor longus, and adductor magnus, was then performed. Anatomically, this tendon

group forms a fixed structure with relatively easy surgical access. Using Metzenbaum scissors and electrocautery, the tissues were carefully dissected, exposing the insertion of the adductor longus tendon at the pubic symphysis, where the surgeon could palpate the rigidity of the bony fragment to be removed. Resection was performed through anatomical dissection using scissors and electrocautery between the adductor longus tendon and the aponeurotic system of the thigh, exposing the fragment and removing it at its deepest level (Figure 4). Intermittent hemostasis was performed, followed by layered closure.

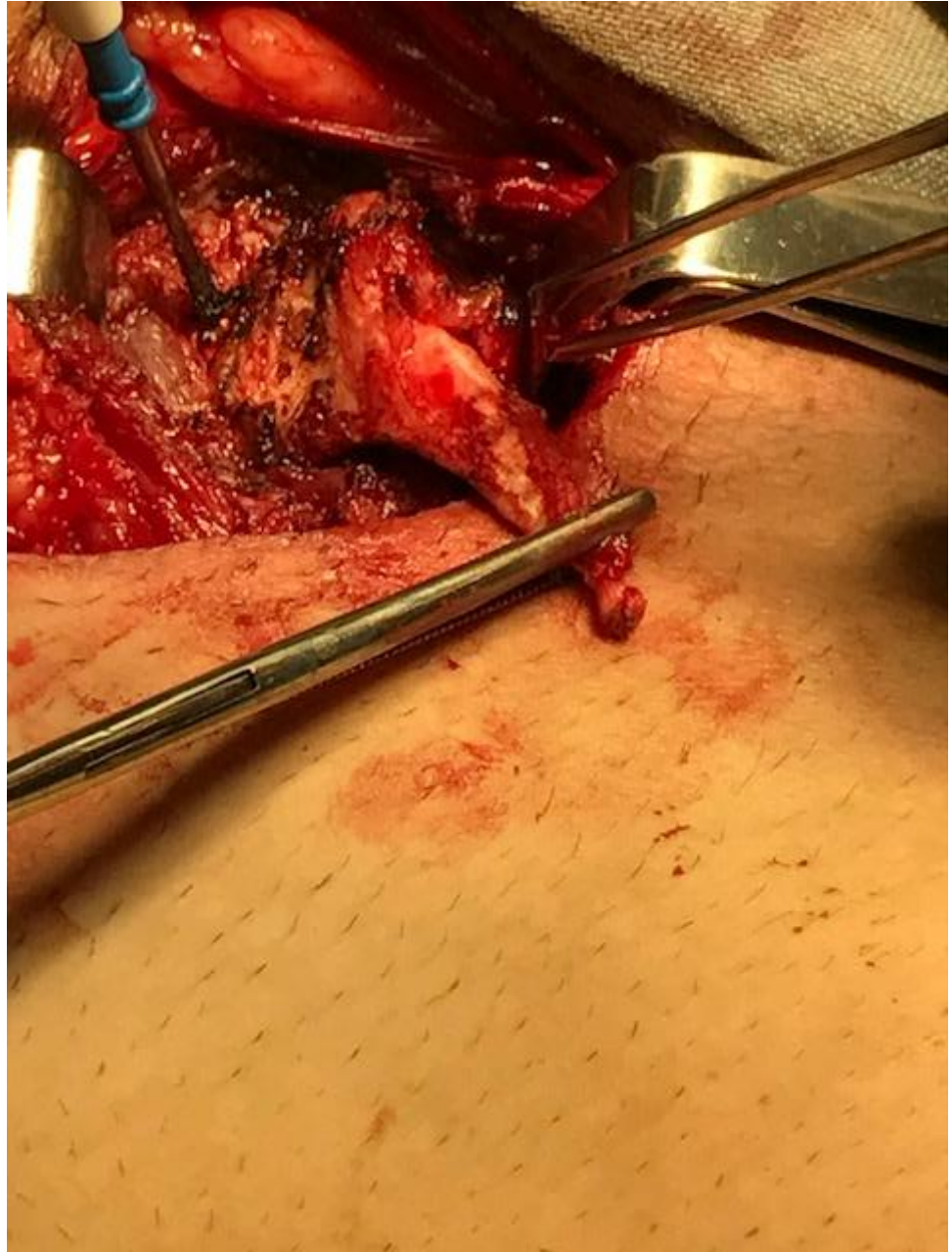
**Figure 3.** Skin incision in the anterior region of the right hip with layered dissection until identification of the superficial fascia.



After resection, the fragment was sent for histological processing. Macroscopically, the specimen consisted of a single osseous fragment weighing 5 grams and measuring  $5.0 \times 3.0 \times 1.0$  cm, with a hardened consistency (Figure 5). Histological sections were examined microscopically and were composed of interconnected mature bony trabeculae containing

viable osteocytes, surrounded by osteoblasts. In the medullary region, multinucleated giant cells of the osteoclast type, mature adipocytes, and blood vessels were observed, without atypia or signs of malignancy. This histological pattern corresponds to the classic zonal phenomenon described by Louis V. Ackerman, characteristic of myositis ossificans and useful in differentiating it from malignant soft tissue neoplasms [10] (Figure 6).

**Figure 4.** Exposure of the osseous fragment and resection at its deepest level.



Postoperative magnetic resonance imaging (Figure 7) and computed tomography with three-dimensional reconstruction (Figure 8) were performed to confirm complete resection of the heterotopic fragment.

## 2.2 Postoperative Rehabilitation

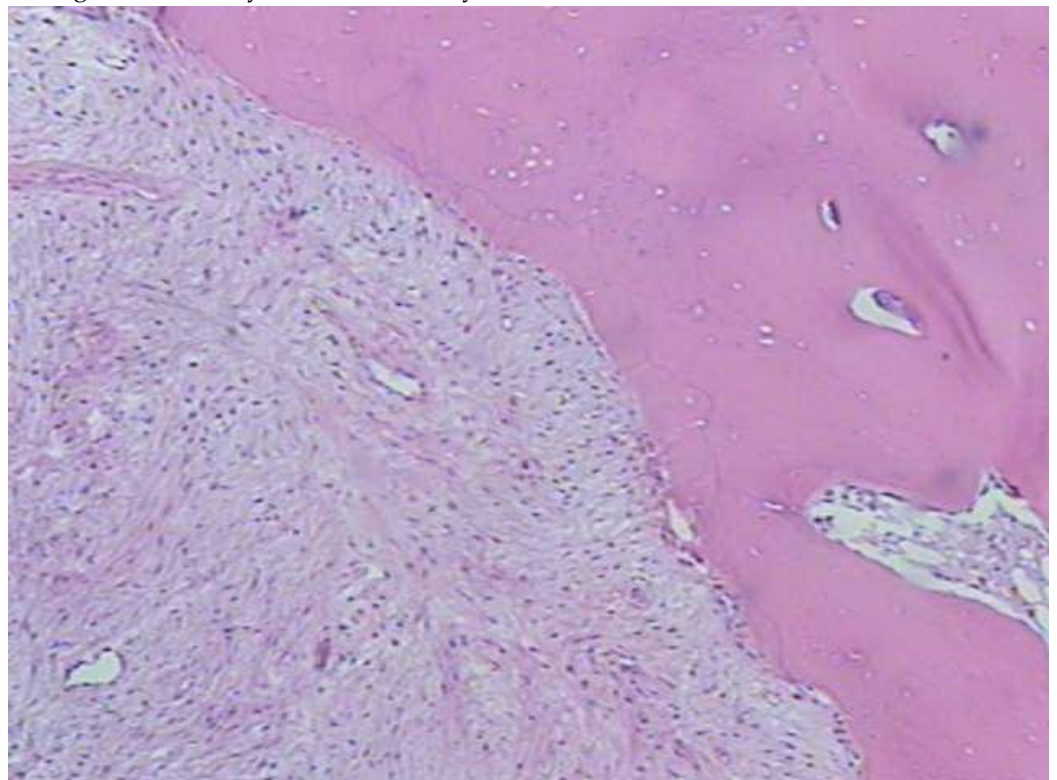
Following the surgical procedure, the patient initiated a progressive rehabilitation protocol initially focused on pain control, early mobilization, and gradual recovery of hip

range of motion. In the following weeks, progressive strengthening exercises for the adductor muscles and hip stabilizers were introduced, along with functional training aimed at returning to sports activities four months after surgical resection of the fragment.

**Figure 5.** Macroscopic appearance of the osseous fragment (single specimen), weighing 5 grams and measuring  $5.0 \times 3.0 \times 1.0$  cm with hardened consistency.

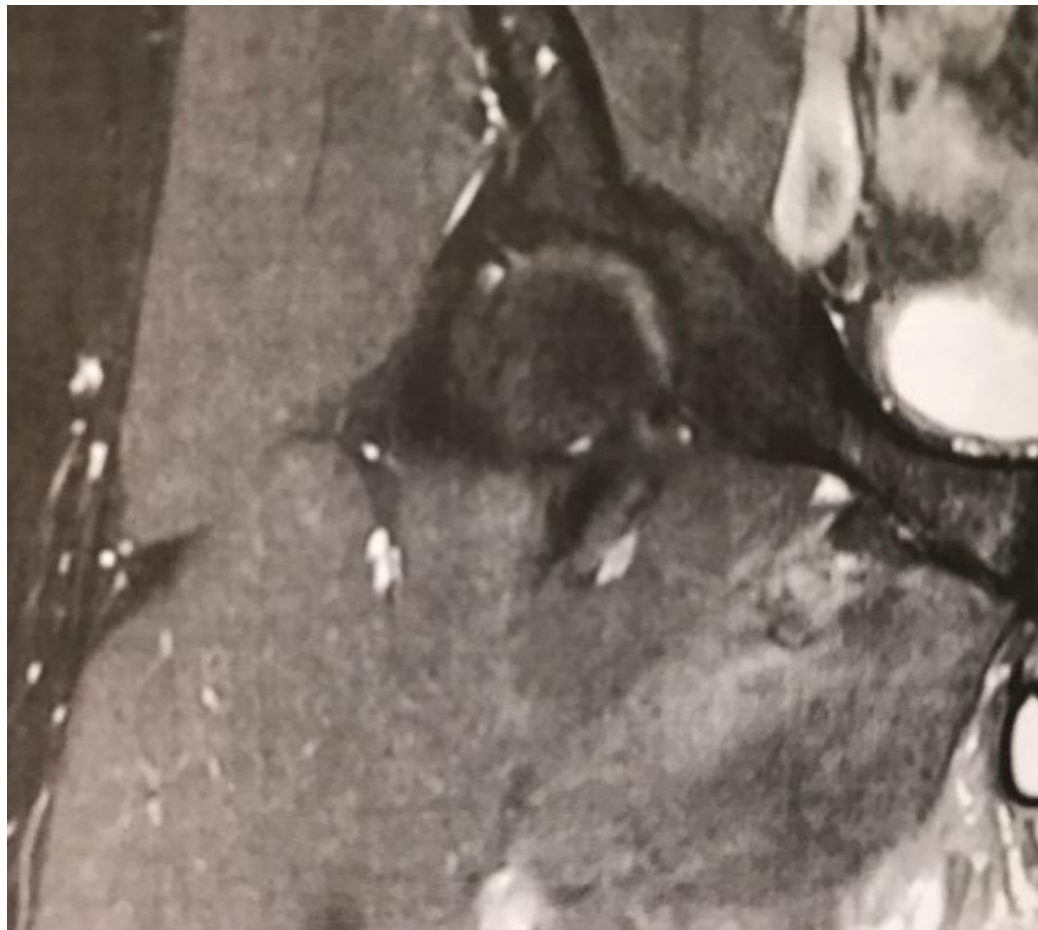


**Figure 6.** Histological section composed of interconnected mature bony trabeculae containing viable osteocytes surrounded by osteoblasts.



The progression of physical activity occurred gradually, beginning with light running after full recovery of joint mobility and progressing to sport-specific exercises approximately six months postoperatively. The patient returned to sports activities without pain after complete functional recovery eight months after surgery.

**Figure 7.** Postoperative magnetic resonance imaging confirming complete resection of the heterotopic osseous fragment.



### 3. Discussion and Conclusion

Muscle injuries are the most common category of injuries in athletes and account for approximately 10% to 55% of all injuries, with about 90% resulting from contusions or strains [11]. Skeletal muscle injury triggers a local inflammatory cascade that leads to the release of cytokines, intensifying the inflammatory process through bone morphogenetic proteins and numerous growth factors [12]. The scar formation process begins almost immediately after injury. Inflammatory cells degrade the hematoma, while fibrin/fibronectin cross-links form an initial extracellular matrix that functions as a scaffold to support the reparative response through immature scar tissue composed mainly of type III collagen, which is more susceptible to re-injury. Over time, the addition of type I collagen increases the tensile strength of the connective tissue scar, thereby reducing the risk of recurrent injuries [13,14].

Neovascularization and regeneration of intramuscular neural units are also critical steps that occur during the repair phase. In cases of extensive injuries with large hematoma formation, excessive fibroblast proliferation may occur, leading to exuberant scar tissue formation [12]. Cytokines acting on vascular endothelial cells of skeletal muscle may induce endothelial-mesenchymal transition. These endothelial-derived mesenchy-

mal stem cells can differentiate into chondrocytes or osteoblasts when exposed to an intense inflammatory environment. The chondrocytes may subsequently undergo endochondral bone formation within soft tissues [15,16]. In the present case, we believe that this cascade was initiated after the muscle strain and subsequently evolved into heterotopic bone formation, which significantly reduced the patient's athletic performance.

**Figure 8.** Postoperative computed tomography with three-dimensional reconstruction confirming complete resection of the heterotopic fragment.



The stages of myositis ossificans (MO) evolution are commonly described as early, intermediate, and mature [9]. The early stage occurs during the first four weeks after injury and is characterized by an inflammatory cascade preceding ossification; therefore, calcifications are usually not radiographically apparent during this period. As the lesion progresses through the intermediate stage (four to eight weeks), calcification becomes visible on radiographic examination. In early stages, when ossification is immature, periosteal osteosarcoma and synovial sarcoma should be considered as differential diagnoses [16]. During the maturation phase, imaging modalities such as ultrasound, magnetic resonance imaging, and computed tomography may be requested to localize the lesion, although findings are often nonspecific at this stage [17].

The mature stage follows, characterized by pronounced peripheral bone formation [9]. At this stage, periosteal osteosarcoma, chondrosarcoma, and metastatic carcinoma should be considered as differential diagnoses [16]. Lesion maturation continues over the

following months, culminating in consolidation and possible regression, which in the present case did not occur significantly even after eight months from the initial injury. Surgical timing is critical, and waiting up to six months from the time of injury may be necessary to ensure complete lesion maturation and thereby minimize recurrence [5].

In the present case, surgical indication was established eight months after the initial injury, considering clinical and radiological criteria compatible with lesion maturation. Imaging studies demonstrated a well-defined ossified mass without signs of active inflammatory edema or progressive growth. Additionally, the patient presented a stable clinical condition with persistent mechanical symptoms and functional limitation, without evidence of lesion progression. These findings are consistent with the mature phase of myositis ossificans described in literature, a period in which surgical excision presents a lower risk of recurrence. Louis V. Ackerman described the classical “zonal phenomenon” of histological changes in myositis ossificans, which allows this condition to be classified as benign because this pattern is not typically found in soft tissue sarcomas [10]. Zone 1 represents the central region of the lesion and shows mitotic activity, variation in cell size and shape, and a high level of cellularity. The intermediate or middle zone corresponds to Zone 2, in which immature osteoid formation may be present. Zone 3 is located at the outer aspect of the lesion and shows mature bone with a more collagenous fibrous stroma [10].

Studies reinforce that the surgical indication for myositis ossificans should be reserved for patients with persistent symptoms after conservative treatment, particularly when there is significant functional limitation or interference with athletic performance. Brian E. Walczak et al. demonstrated that surgical resection performed after lesion maturation presents a low recurrence rate and favorable functional outcomes [9]. Similar findings have been described in clinical studies on muscle injuries in athletes, in which surgical excision was indicated only after failure of conservative treatment and consolidation of heterotopic ossification [5,7,9].

Furthermore, contemporary reviews on heterotopic ossification emphasize that differentiation between benign and malignant lesions depends on the integration of clinical, radiological, and histopathological findings [3,18,19]. The classic zonal phenomenon described by Ackerman remains one of the principal histological criteria for diagnostic confirmation and differentiation from soft tissue tumors [10]. Although the surgical principles employed in this case follow conventional orthopedic techniques of anatomical dissection and lesion resection, the contribution of this report lies primarily in its descriptive and educational nature, detailing the surgical approach to heterotopic ossification in the adductor muscle complex in a high-demand athlete.

Prophylactic strategies, such as the use of nonsteroidal anti-inflammatory drugs (particularly indomethacin) or low-dose radiotherapy, have been described mainly for the prevention of heterotopic ossification following major orthopedic procedures [17]. In the present case of localized post-traumatic myositis ossificans, such measures were not used because the lesion was already mature at the time of resection and was completely removed, thereby reducing the risk of recurrence. Postoperative evolution was assessed clinically, with resolution of pain, complete recovery of hip range of motion, and return to sports activities. However, the absence of validated functional outcome scores represents a limitation of this report. In high-performance athletes, appropriate management of myositis ossificans is particularly relevant, as persistent pain and functional limitation may significantly compromise a safe return to sports [10,18,19].

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**Conflicts of Interest:** All other authors declare no conflicts of interest.

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