

# Endoscopic Extra-articular Surgical Removal of Heterotopic Ossification of the Rectus Femoris Tendon in a Series of Athletes

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**Background:** Calcific deposits in tendon, muscles, and periarticular areas are very common. Heterotopic ossification of the rectus femoris (HORF) is a rare condition, and several theories exist regarding the etiopathogenesis, which appears to be multifactorial with traumatic, genetic, and local metabolic factors involved. Although HORF typically responds to nonoperative treatment, when this approach fails, endoscopic treatment is a minimally invasive technique to address the pathology.

**Purpose:** To report the clinical and radiological outcomes of 9 athletes with HORF who underwent endoscopic resection.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** Nine male athletes were treated with endoscopic extra-articular resection of HORF after failure of a 6-month course of nonoperative treatment. All patients were studied with radiographs, computed tomography, and magnetic resonance imaging. Outcomes were assessed clinically using the modified Harris Hip Score (mHHS), a visual analog scale for sport activity-related pain (VAS-SRP), patient satisfaction, and ability and time to return to the preoperative sport level. Radiographic assessment was performed to determine recurrence.

**Results:** The mean age of the patients was 32 years (range, 23-47 years). Mean follow-up was 44 months (range, 14-73 months). All patients had improved mHHS scores from a mean preoperative of 65.6 (SD, 8.2) to 93.9 (SD, 3.6). Pain decreased from a mean 8.2 preoperatively (SD, 0.9) to 0.4 (SD, 0.7) at last follow-up. There were no complications, and all patients were able to return to their previous sports at the same level except for 1 recreational athlete. There was only 1 radiological recurrence at last follow-up in an asymptomatic patient.

**Conclusion:** To our knowledge, this is the largest case series of athletes with HORF treated with endoscopic resection. We found this extra-articular endoscopic technique to be safe and effective, showing clinical outcome improvement and 90% chance of return to full activity. We also found 10% recurrence rate of asymptomatic heterotopic ossification.

**Keywords:** heterotopic ossification; rectus femoris; hip; arthroscopy

Calcific deposits in tendon, muscle, and periarticular areas are common.<sup>28</sup> Heterotopic ossification of the rectus femoris (HORF) is a rare condition that could be an expression of chronic tendinopathy. Calcific tendinitis is usually a self-limiting disease caused by calcium hydroxyapatite crystal deposition in tendons.<sup>32</sup> Several theories exist on

the etiopathogenesis, which appears to be multifactorial with traumatic, genetic, and local metabolic factors involved.<sup>7,14,29,33</sup> In this sense, any preceding injury to a tendon could provoke healing by calcification rather than by scarring.<sup>27</sup>

The most frequently reported anatomic region involved with calcific deposition is the shoulder, followed by the hip.<sup>4,11</sup> Within the hip, gluteus medius and minimus tendon insertions are the most recurrent locations; however, vastus lateralis, piriformis, iliopsoas, adductor magnus, biceps femoris, and gluteus maximus tendon involvement have been reported.<sup>4,6,11,16,34</sup>

Calcific tendinitis and heterotopic ossification usually respond to nonoperative treatments such as rest, nonsteroidal anti-inflammatory drugs (NSAIDs), heat/cold, physical therapy,<sup>16,24,25</sup> extracorporeal shock wave therapy (ECSWT),<sup>19</sup> and local steroid injections.<sup>13,27</sup> Resection surgery is reserved for chronic cases or when nonoperative

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TABLE 1  
Patient Demographic Data and Outcomes<sup>a</sup>

Patient	Age, y	Sex	Sport (Level)	Symptom Onset to Surgery, mo	HORF-Associated Pathologies	VAS-SRP Score		mHHS Score		Follow-up, mo	Radiographic Recurrence
						Preop	Postop	Preop	Postop		
1	32	M	Soccer (professional)	7	None	8	1	60	91	73	No
2	47	M	Soccer (recreational)	9	FAI: cam lesion	10	0	58	91	60	Yes (asymptomatic)
3	36	M	Soccer (recreational)	6	FAI: cam + pincer lesions	7	0	58	91	54	No
4	27	M	Rugby (professional)	12	None	9	0	70	91	75	No
5	24	M	Soccer (professional)	14	FAI: cam lesion	9	0	60	91	49	No
6	38	M	Bodybuilder (recreational)	6	None	7	1	60	95	30	No
7	23	M	Soccer (professional)	8	None	8	0	70	100	14	No
8	24	M	Soccer (professional)	6	None	8	0	70	95	21	No
9	37	M	Soccer (recreational)	9	FAI: cam + pincer lesions and labral tear	8	2	84	100	23	No

<sup>a</sup>FAI, femoroacetabular impingement; HORF, heterotopic ossification of rectus femoris tendon; M, male; mHHS, modified Harris Hip Score; Postop, postoperative; Preop, preoperative; VAS-SRP, visual analog scale for sport activity-related pain.

treatment fails. In these circumstances, an endoscopic approach has been proposed as a minimally invasive technique to address removal of the calcific tendinitis of the rectus femoris (CTRF).<sup>20,21,25</sup>

The purpose of this case series study was to report the clinical and radiological outcomes of 9 athletes with HORF who underwent endoscopic resection with an entirely extra-articular technique.

## METHODS

Between March 2009 and September 2014, a total of 9 HORF endoscopic resections were performed in 9 male athletes. Five patients practiced sports at a professional level (defined as any player who played for a professional team or for whom competing in a sport is his primary job or source of income), and 4 were recreational athletes (Table 1).

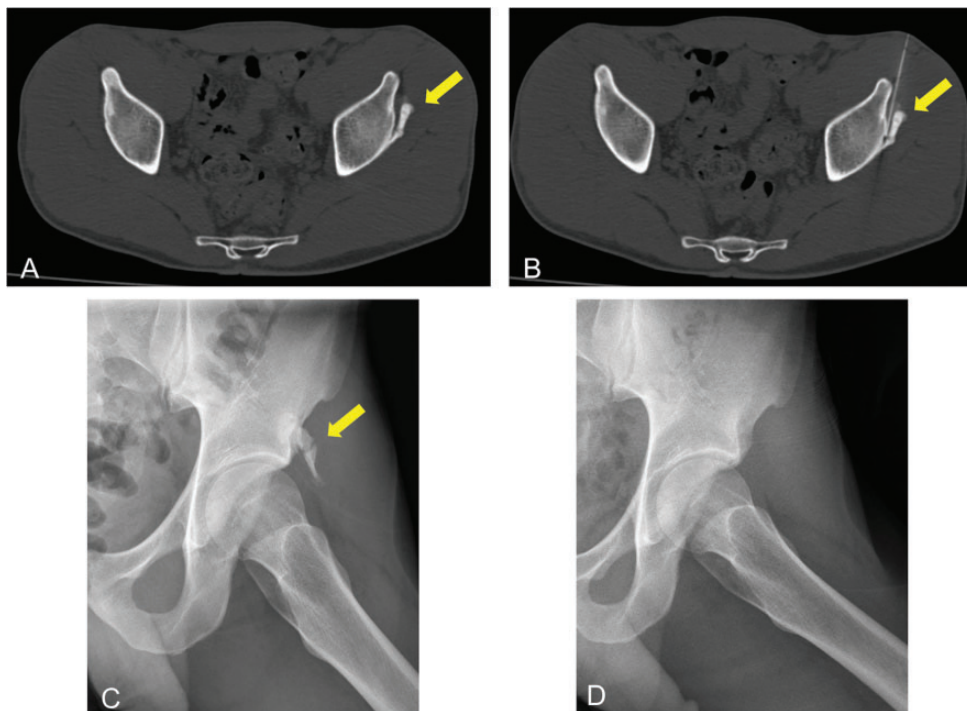
At the time of the initial evaluation, all 9 patients had persistent groin pain during sport activities accompanied by mechanical symptoms. All 9 patients reported having a previous muscle strain in the referred aching area and denied history of pain in the affected hip. Painful range of motion on physical examination was encountered, with tenderness in the groin area and intermittent sharp, stabbing pain with sport practice. A positive impingement test (pain provoked by flexion, adduction, and internal rotation movement) was encountered. Anteroposterior and lateral hip radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) confirmed the diagnosis (Figures 1 and 2). Concomitant femoroacetabular impingement (FAI) was present in 4 patients: 2 cam lesions and 2 combined cam + pincer lesions. Arthroscopic treatment of patients with symptomatic FAI is our standard of care. On the other hand, there is uncertainty regarding the need for treatment of patients with asymptomatic FAI. In a systematic review of the literature, Collins et al<sup>8</sup> concluded

that there is no current evidence to support prophylactic surgery for asymptomatic FAI in the vast majority of cases. Nonetheless, in patients with concomitant HORF and patient radiological signs of FAI, we faced a diagnostic challenge regarding the source of hip pain. Moreover, both entities present similar history of sports-related pain and overlying physical examination findings. In our series, 4 patients presented with combined HORF and FAI, and we decided to address both of them.

Initially nonoperative treatment included rest, NSAIDs, and physical therapy performed at our physical therapy department. If these treatments failed to relieve symptoms, 1 CT-guided steroid and local anesthetic injection was given in the area of the HORF approximately 2 months from the onset of symptoms as a treatment alternative and confirmation of source of pain (Figure 1B). Finally, surgery was indicated only after approximately 6 months of failed nonoperative treatment. An endoscopic resection was performed in all 9 patients utilizing the technique reported by Comba et al.<sup>9</sup>

## Surgical Technique

The surgical technique<sup>9</sup> can be seen in Figures 3 and 4. Patients were placed in the supine position on a traction table with the limb in 15° of abduction and neutral rotation without traction. A C-arm image detector was centered over the operative hip. The relevant landmarks for safe portal placement used were the anterior superior iliac spine, greater trochanter, and femoral pulse. We used 2 portals: the anterolateral portal (1 cm proximal and 1 cm anterior to the tip of the greater trochanter) and proximal accessory portal (3-4 cm proximal to the first portal). The conventional anterolateral portal was established first, and a 15-gauge spinal needle was introduced aiming directly at the calcific lesion under fluoroscopic control until locating and

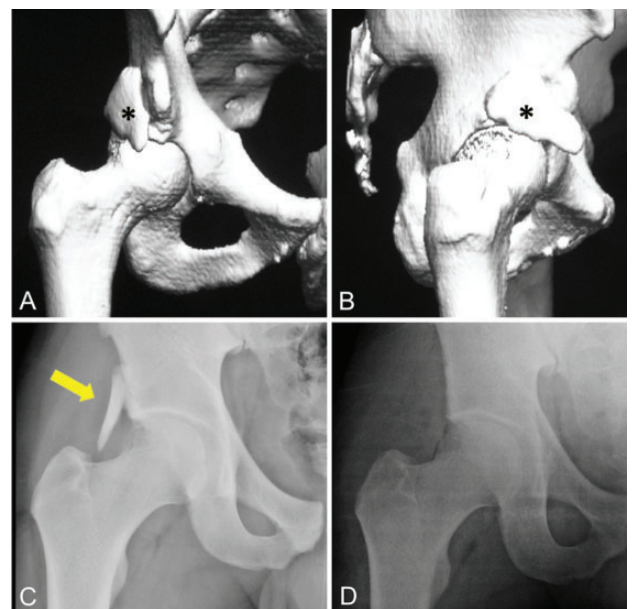


**Figure 1.** (A) Preoperative axial computed tomography (CT) image in a 24-year-old male professional soccer player (patient 8 in Table 1) showing direct-head HORF (arrow). (B) CT-guided steroid injection (arrow), (C) axial radiographic view of a left hip HORF (arrow), and (D) 1-year follow-up axial radiographic view of the left hip of the same patient. HORF, heterotopic ossification of the rectus femoris.

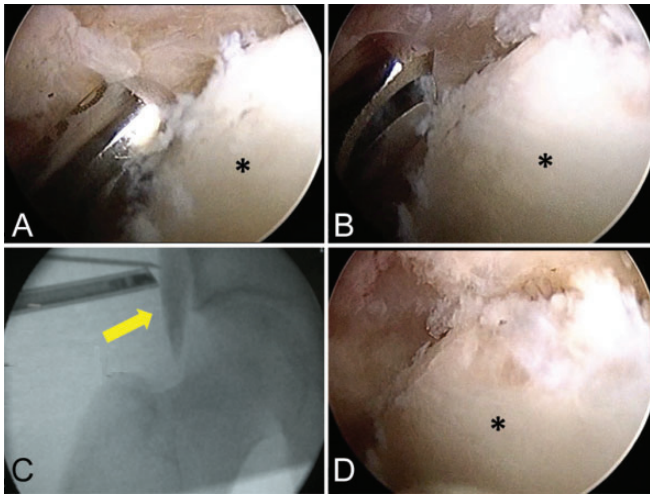
palpating solid bone corresponding to the HORF, which served as a “stop” point (Figure 3C). Subsequently, a nitinol wire was inserted through the needle, and a cannula trocar was assembled over the needle wire. A 70° arthroscope (Arthrex) was introduced through this portal. Subsequently, a second spinal needle was placed through a proximal accessory hip arthroscopy portal under fluoroscopic control and direct visualization aimed toward the HORF (Figure 4C). With the use of a 4.5-mm motorized shaver (Arthrex), the soft tissue layer surrounding the HORF was resected to generate a working space (Figure 3, A and B). Hemostasis was then performed with the use of a radiofrequency ablation device (Arthrex) that also aided in delimiting the entire HORF lesion (Figure 3D). Finally, the entire bone lesion was resected using a 5-mm round bur (Arthrex) (Figures 1D, 2D, and 4B).

In the 4 patients who presented with concomitant FAI, the patients were placed on a traction table with the limb in 15° of abduction and neutral rotation with traction. In these patients, a later central and peripheral hip arthroscopy was performed after resection of the calcific tendinitis to treat the FAI. The mean time from the onset of symptoms to surgical treatment was 8.5 months (range, 6-14 months).

The same standardized rehabilitation protocol was used, mobilizing patients on the first day of surgery.<sup>30</sup> Partial weightbearing with crutches during the first 2 weeks post-operative was allowed, with fixed range of motion exercises at 90° of flexion, neutral internal rotation, 30° of external rotation, and 30° of abduction for 3 weeks. Extension of the hip was restricted for 3 weeks to avoid excessive elongation



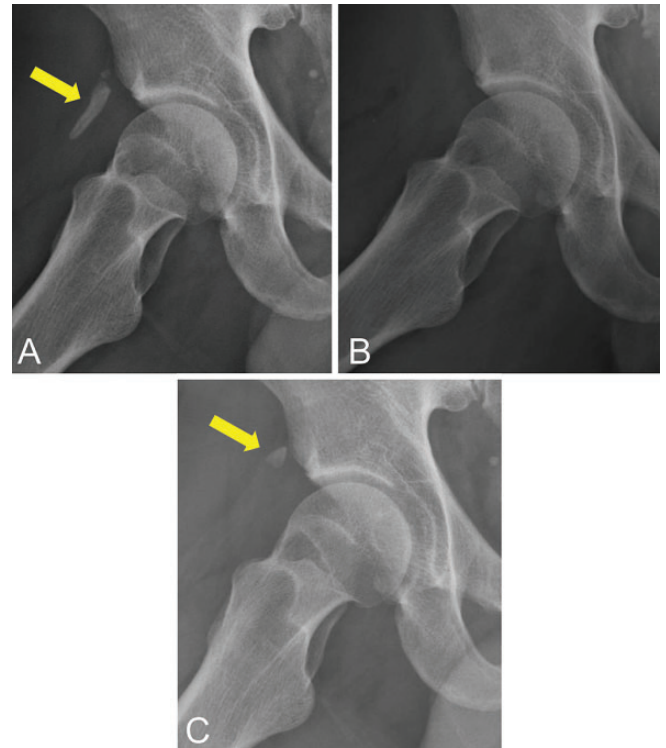
**Figure 2.** Preoperative computed tomography (CT) 3-dimensional reconstruction in a 24-year-old male professional rugby player (patient 4 in Table 1): (A) anteroposterior (AP) view and (B) lateral view of the right hip presenting a direct-head HORF (asterisks). (C) Preoperative AP radiographic view of the right hip showing HORF lesion (arrow) and (D) 2-year follow-up AP radiographic view of the right hip showing complete HORF excision without recurrence. HORF, heterotopic ossification of the rectus femoris.



**Figure 3.** Extra-articular endoscopic views in the right hip of a 27-year-old male professional rugby player (patient 4 in Table 1) (70° arthroscope in the anterolateral portal and shaver in the proximal accessory portal). (A and B) The endoscopic view shows delimitation of the HORF lesion (asterisk) with the shaver, generating space around it. (C) The anteroposterior fluoroscopic view shows a cannula trocar assembled in the anterolateral portal through a previous nitinol wire inserted through an earlier established spinal needle. A second spinal needle, placed under fluoroscopic control and direct visualization, can be seen through the proximal accessory hip arthroscopy portal aimed at the HORF (arrow). (D) Complete demarcation of the HORF lesion (asterisk) and established space before resection with 5-mm burr. HORF, heterotopic ossification of the rectus femoris.

of the rectus femoris tendon. Progressive exercises were then allowed to recover full range of motion. Return to sports was indicated in a 3- to 6-month period depending on the gained muscular strength. All patients received the same prophylaxis for heterotopic ossification after surgery with 500 mg naproxen twice a day for 3 weeks starting within 24 hours after surgery.<sup>2,24</sup>

Patients were evaluated clinically after surgery at regular intervals: 1 week, 2 weeks, 1 month, 3 months, 6 months, and annually thereafter to evaluate HORF recurrence. Clinical outcome was assessed by an independent physician using the modified Harris Hip Score (mHHS).<sup>5,12,31</sup> Subjective clinical evaluation was accomplished by measuring the sport activity-related pain using a visual analog scale (VAS-SRP) with a range from 0 to 10. Patient satisfaction with surgery was evaluated according to 4 grades: very satisfied, satisfied, fair, or not satisfied. We specifically assessed patients regarding the time to return to sports and whether they were able to return to the same level as they had prior to surgery. Special attention was given to inquiring about complications during follow-up. We prospectively followed all patients treated with HORF endoscopic resection with anteroposterior (AP) and lateral hip radiographs taken at 3 months, 6 months, and then annually to assess calcific tendinitis recurrence. Our institutional review



**Figure 4.** (A) Preoperative axial radiographic view of the right hip of a 44-year-old male recreational soccer player (patient 2 in Table 1) presenting a direct-head HORF (arrow). (B) Immediate postoperative axial radiographic view of the right hip showing complete HORF excision. (C) Four-month follow-up axial radiographic view of the right hip showing a small HORF recurrence (arrow). HORF, heterotopic ossification of the rectus femoris.

board approved all data collection. Qualitative variables were expressed as proportions and CIs; quantitative variables as means and SDs.

## RESULTS

The mean age of the patients included in our series was 32 years (range, 23-47 years). The mean follow-up was 44 months (range, 14-73 months). The time from symptom onset to surgery was a mean 8.5 months (range, 6-14 months). The mean preoperative mHHS score was 65.6 (SD, 8.2), with a mean improvement of 28.3 (range, 16-35) at last follow-up (mean postoperative mHHS, 93.9 [SD, 3.6]). All patients improved their pain from a mean preoperative VAS-SRP of 8.2 (SD, 0.9) to 0.4 (SD, 0.7) at final follow-up. We did not encounter differences regarding clinical outcomes of patients with concomitantly treated FAI. One patient rated their pain experienced as VAS-SRP of 2, and 2 patients rated it as a 1; the remaining athletes did not experience pain when practicing sports (Table 1).

We did not routinely take samples for histologic analysis. However, in 5 cases where we could reach such analysis, histological specimens confirmed the presence of mature bone fragments.



No complications related to HORF endoscopic resection were encountered, and a complete HORF resection was confirmed in all surgeries with C-arm and immediate post-operative radiographs. We preserved as much tendon as possible during the procedure, and even though we could not assess the integrity of the entire tendon, no patient presented with restricted range of motion or clinical weakness of hip flexion or knee extension. All patients were able to return to their previous sport at a mean 5.1 months (SD, 1.4 months). Only 1 recreational athlete (patient 9) was unable to reach his previous sport level, indicating that he felt afraid, while all professional players returned to the same level of competition.

At last follow-up, only 1 of the 9 patients was noted to have a recurrence of the calcification in the rectus femoris tendon (Figure 4C). This recurrence (patient 2) appeared 4 months after surgery, was smaller than the original lesion, and remained asymptomatic and unchanged in size until final follow-up at 60 months; the lesion did not interfere with sports practice. Seven of 9 patients stated they were very satisfied with the surgery, and 2 were satisfied.

## DISCUSSION

The rectus femoris tendon may present calcifications in rare instances. The differential diagnoses include calcific tendinitis, heterotopic ossification, avulsion fractures, os acetabuli, sesamoid bones, and myositis ossificans.<sup>‡</sup> CTRF was first described by King and Vanderpool<sup>18</sup> in 1967, and few cases have been reported since.<sup>1,3,22,26,27,35,36</sup> The usual clinical presentation of CTRF is characterized by acute or chronic pain aggravated by hip motion.<sup>1,29</sup> Radiologic progression of the calcification can be static, regressive, or progressive, and imaging (sonography, CT, and MRI) can support diagnosis and disease localization.<sup>3,4</sup> Calcific tendinitis is usually a self-limiting disease, and therefore, it is mainly managed nonoperatively<sup>23,33</sup> with a variety of methods including NSAIDs, physical therapy,<sup>25</sup> radiotherapy,<sup>18</sup> shock wave therapy,<sup>19</sup> and corticosteroid injection.<sup>3,15,26,27</sup> Nonetheless, when there is no spontaneous resolution of symptoms or the pain does not resolve with nonoperative treatment, surgery has been proposed as the choice treatment.<sup>9,17,21,25,35</sup>

Hip arthroscopy has closed the gap between nonoperative and invasive treatment and allows treatment of concomitant intra- and extra-articular disorders.<sup>21</sup> In active patients or athletes who present with intractable HORF with failed nonsurgical treatment, an alternative endoscopic procedure has been proposed as an interesting technique to solve this problem, effectively having a rapid recovery. Kandemir et al<sup>17</sup> was the first to show excellent results with arthroscopic removal of calcific tendinitis of the gluteus medius and minimus tendons at the superolateral margin of the greater trochanter in 1 patient. Subsequently Schmitz et al<sup>28</sup> reported 2 cases of arthroscopic removal of calcific deposition, in the form of calcinosis circumscripta between the labrum and capsule of the hip joint, as an

effective and minimally invasive treatment in young patients with high activity level. To our knowledge, the first authors to report on the successful outcome of endoscopic treatment of CTRF were Yang and Oh.<sup>35</sup> A later study by Peng et al<sup>21</sup> reported hip arthroscopy as an effective therapeutic modality for CTRF, with satisfactory short-term outcomes. In these 3 cases, the calcific tendinitis developed in the reflected head of the rectus femoris and was resected through an intra-articular approach by performing a longitudinal incision in the capsule fibers at the superolateral paralabral sulcus. To date, 1 major case series of arthroscopic excision of CTRF has been reported.<sup>37</sup> In this series of 6 amateur athletes, the authors conclude that this approach yields satisfying results, with few risks as well as rapid recovery. Unlike previous authors<sup>21,35,37</sup> who performed an interportal capsulotomy to resect the CTRF, Comba et al<sup>9</sup> described an entirely extra-articular endoscopic technique to resect heterotopic ossifications of the rectus femoris tendon. The current series of 9 athletes is the first to report clinical and radiological outcomes of this technique that can also be performed in combination with intra-articular endoscopic procedures to treat concomitant pathologies. By using this simple entirely extra-articular HORF resection in young, active patients, we are able to avoid performing incisions in the hip capsule fibers, which may be potentially related to subsequent tissue retraction or instability.<sup>10</sup> We found that a minimal amount of soft tissue removal was required to generate the required space across the entire HORF lesion to do a complete resection.

Histological differential diagnosis between a calcific tendinitis and heterotopic ossification is challenging. All the samples available for histological analysis in our series demonstrated mature bone fragments and viable compact and trabecular bone. These findings are not strong enough to differentiate a CTRF from other causes of HORF.

Our study has several limitations. First, this was a retrospective study. Second, there was no control group to compare different endoscopic or open techniques. Third, a relatively small number of patients was analyzed, all were male, and 8 of 9 were soccer players. Fourth, 4 patients had concomitant FAI that was addressed during the same endoscopic procedure. Fifth, concomitant use of NSAIDs may have caused bias. Further well-controlled prospective studies should be conducted to address the comparison between different endoscopic techniques to treat CTRF that are unresponsive to nonoperative treatment. It is unknown whether our technique will allow faster return to sport or whether it has any advantage compared with a traditional transcapsular approach.

Nonoperative treatment should continue to be the first-line treatment for HORF. Nevertheless, when symptoms persist, endoscopic removal of heterotopic calcification in the rectus femoris tendon has shown to be a valuable therapeutic modality, providing excellent clinical outcomes while being able to address concomitant lesions.

## CONCLUSION

To our knowledge, this is the largest case series of athletes with HORF treated with endoscopic resection. We found

<sup>‡</sup>References 3, 13, 14, 17, 21, 27, 28, 35, 37.

this extra-articular endoscopic technique to be safe and effective, showing clinical outcome improvement and 90% chance of return to full activity. We also noted a 10% recurrence rate of asymptomatic heterotopic ossification.

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