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Monitoring The Reactions of Athletes With History of Rectus Femoris Proximal Tear Healed With Different Methods to Training Load With Thermography

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Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

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Abstract

Although rectus femoris (RF) injuries are rare, it is an important muscle that should be considered because of its contribution to actions such as shooting and fast running in football. In the literature, there is no consensus on which conservative or surgical methods should be preferred in RF total rupture. Although MRI is the gold standard method in the detection of injury, there is a controversy in the literature for post-injury imaging and follow-up. In addition, there is a lack of diagnostic imaging methods in the literature on how training load affects athletes. In current study, the effect of training load on athletes is evaluated by thermography after treatment of the RF muscle with different methods. This study is worthy of being a case report in terms of providing evidence on how the training load affects the sports lives of athletes who return to sports after surgery or conservative treatment.
Keywords: Sports injury; Exercise; Rectus femoris; Rehabilitation; Sports medicine; Thermography

Farklı Tedavi Yöntemi İle İyileşmiş Rektus Femoris Proksimal Yırtığı Öyküsü Olan Futbolcuların Antrenman Yüküne Verdikleri Tepkilerin Infrared Görüntüleme İle Takibi

Özet

Rektus femoris yaralanmaları nadir görülen yaralanmalardan olmakla birlikte, futbol sporunda şut atma ve hızlı koşu gibi eylemlere katkısından dolayı üzerinde durulması gereken önemli bir kastır. Lietaratürde RF total rüptüründe konservatif veya cerrahi yöntemlerinden hangisinin tercih edilmesi gerektiğine dair bir fikir birliği bulunmamaktadır. Yaralanmanın tespitinde MR altın standart yöntemi olmasına rağmen yaralanma sonrası görüntüleme ile takip için de literatürde fikir birliği yoktur. Buna ilaveten literatürde antrenman yükünün sporcuları nasıl etkilediğine dair diagnostik görüntüleme yollarında da eksiklik bulunmaktadır. Yapmış olduğumuz bu çalışmada RF kasının farklı yollar ile tedavisi sonrası antrenman yüküne karşı sporcuların etkileniminin termografi ile değerlendirilebileceğini düşünmekteyiz. Cerrahi veya konservatif tedavi ile spora dönen sporcuların spor yaşamlarında antrenman yükünün nasıl etkilediğine dair kanıtlar sunması açısından vaka sunumu olmaya değer bir çalışma olduğunu düşünmekteyiz.

Anahtar Kelimeler: Spor yaralanması; Egzersiz yapmak; Rektus femoris; Rehabilitasyon; Spor ilacı; Termografi

INTRODUCTION

The rectus femoris (RF) muscle is one of the four parts of the quadriceps femoris, and the caput rectum starts from the anterior inferior of the spina iliaca, and the caput reflexum starts from the os ilium above the acetebulum. The two heads come together in front of the hip joint, this muscle, which is bipennate, ends in the patalle as a common tendon (29). The RF muscle is separated from the other parts of the quadriceps by containing more type II fibers than the other parts of the quadriceps muscle and folding two joints (12). RF muscle has an important place in football sports due to its role in the actions of running faster and shooting (16). In RF injury, which is common in football players, chronic injuries occur near the origin of the muscle, while acute injuries occur more often in the lower parts (13, 19). RF injuries are usually caused by eccentric loading of the hip flexors and knee extensors (3, 18). The knee joint can be torn in case of its sudden and forceful extension. The upper part of the muscle is pulled up and a gap is formed at the rupture site (28). Rupture of the RF muscle is a difficult type of injury to follow because it is rare and often overlooked. Conservative treatment takes about 6-12 weeks (9). Although the diagnosis of RF injuries can be made by both ultrasonography (5) and MRI, the gold standard method is MRI. Follow-up is important in terms of shortening the recovery period, preventing the formation of complications, and reducing the immobility period (25). However, there is no definite protocol for the treatment after RF injuries in the literature (29). In recent years, it has been stated that potential sports injuries can be determined in studies on sports injuries with thermography. By evaluating the asymmetry between the extremities of the athlete, thermography provides an inexpensive, non-invasive evaluation opportunity to those who are interested in athlete health (1, 11, 14). Thermography is also a method to determine and classify the grade of fatigue (7).

MATERIALS AND METHODS

In our research, we tracked professional Turkish Super League football players during their injury treatment process with the approval of the KTO Karatay University Medical Faculty Ethics Committee (date: 24.04.2020 and no: 2020/005). The concept of the study was clearly explained to the participants and their written concents were taken before IR imaging.

Case 1

The 22-year-old (172 cm, 72 kg) offensive player could not complete the match in the Turkish Super League due to the pain in the anterior thigh area. While the player was attempting to shoot with his right foot during the match, his left foot was caught in the grass and his left quadriceps muscle was overstretched. In the post-match examination of the player, there was a temperature difference on the right and left, and pain in the proximal left rectus femoris. He said that he felt a burning sensation when the actor flexed the active hip joint and regressed the hip joint. Grade III muscle strain interpretation was performed with loss of muscle-tendon continuity in the proximal left thigh. Grade III rectus femoris injury was reported in the MRI examination of the same date. Conservative treatment method was applied to the actor. The player participated in the training at the beginning of June 2010, which is 72 days after the rehabilitation practices, and returned to the field (Fig. 1).

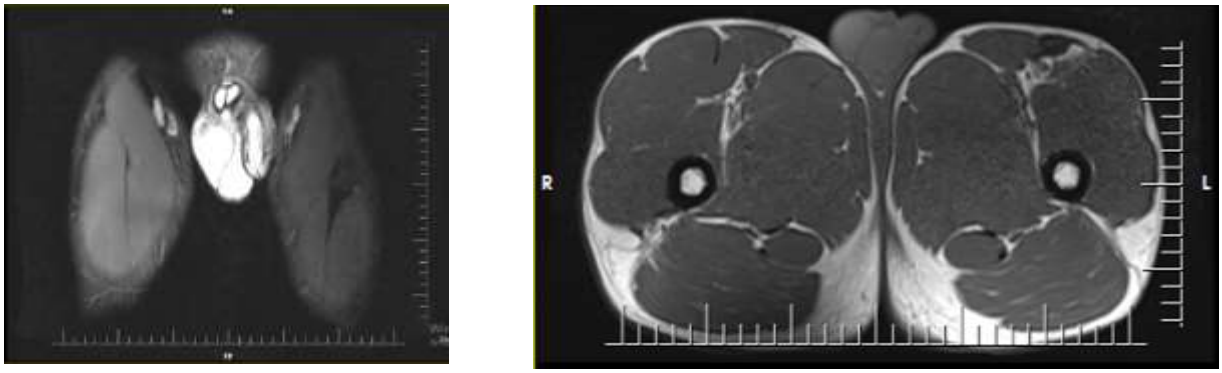


Figure 1: Case 1: RF grade III injury on the left side of the player, who returned to sports with conservative treatment, MR image after recovery

Case 2

A 31-year-old (189 cm 79 kg) attacking player, he was injured twice in the right rectus femoris region between March and April 2010. During the training on May 10, 2010, he could not complete the training with a sudden pain and burning sensation during the sprint. The investigations revealed a grade III injury on the proximal region of the right side RF muscle. The treatment of the athlete was carried out operationally. The athlete started training after 73 days (Fig. 4).

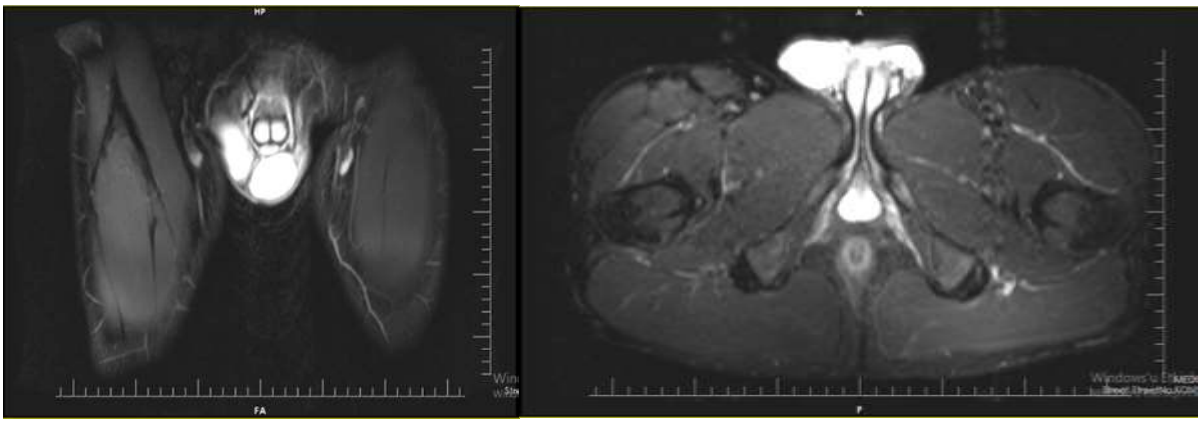
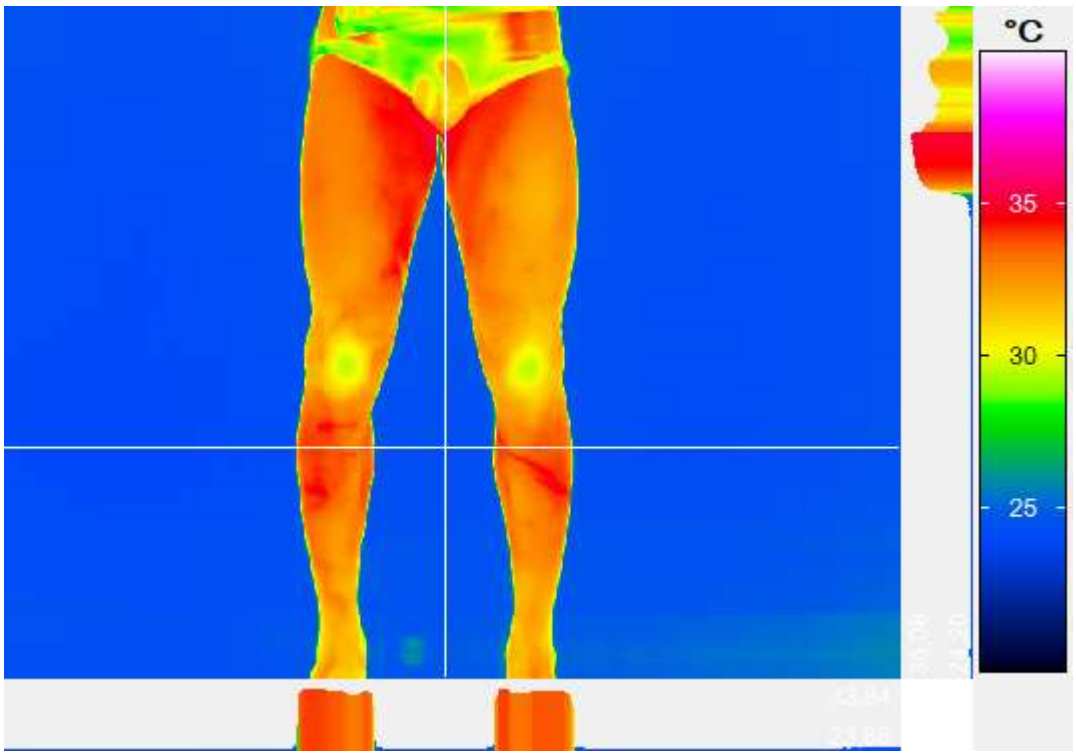


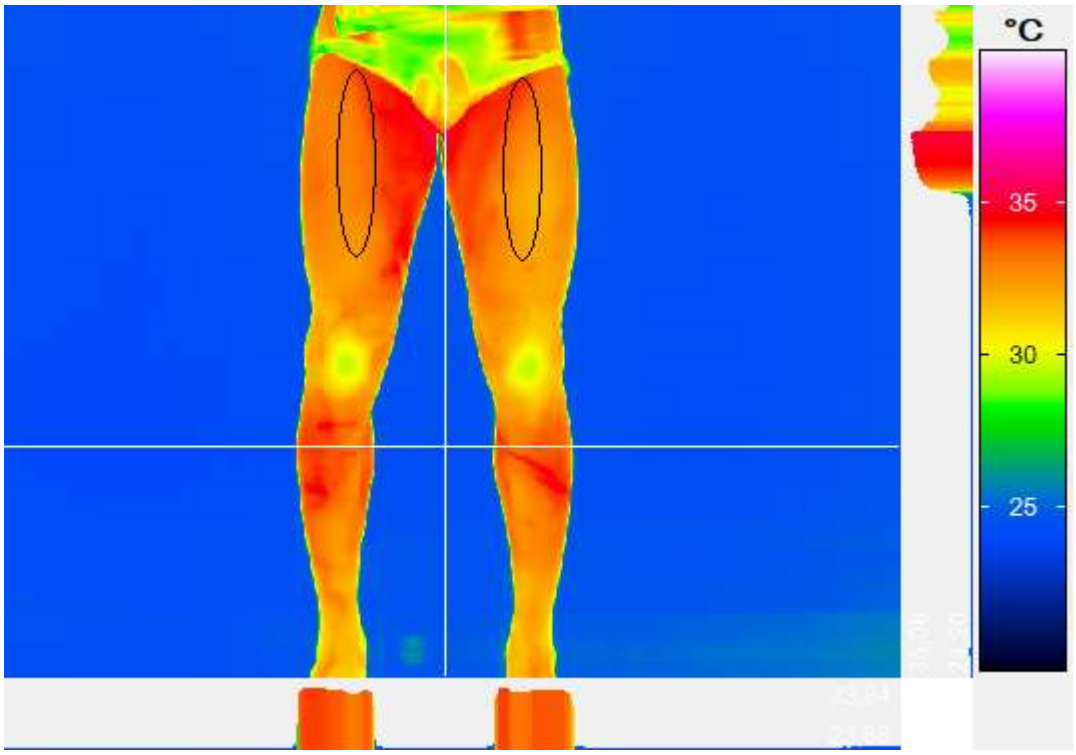
Figure 4: Case 2: Right side RF grade III injury that returned to sports with surgical treatment, MR image after recovery

RESULTS

Case 1

In the evaluation made before the training, it was seen that the average temperature difference between the right and left sides was 0.40 degrees, with the right side being higher, and the minimum temperature difference was 0.57 degrees. The maximum temperature difference was found to be 0.11 degrees higher in favor of the left side than in the right side (Fig. 2).

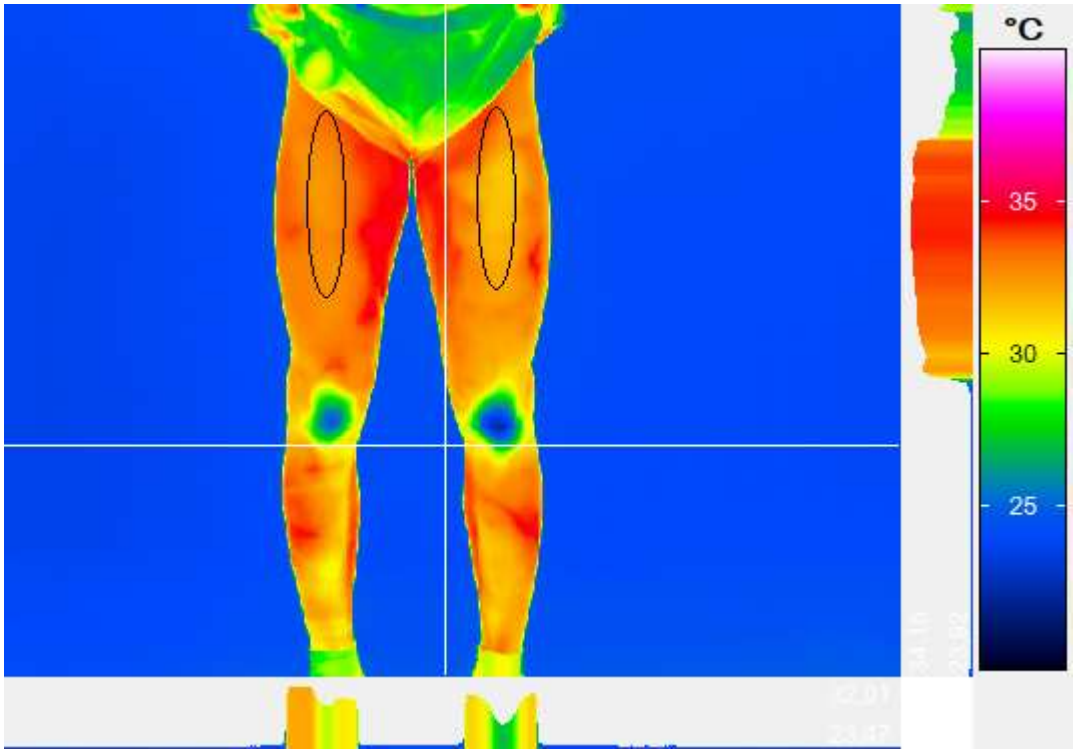




ID	Avg	Min	Max
E1	32,97	32,20	33,99
E2	32,57	31,67	34,10

Figure 2: Case 1 pre-training thermal image and temperature difference (E1: right side rectus region, E2: left side rectus region, Avg: average, min: minimum, max: maximum).

In the evaluation made after the training, it was seen that the average temperature difference between the right and left sides was 0.73 degrees, with the right side being higher, and the minimum temperature difference was 1.02 degrees. The maximum temperature difference was found to be 0.29 degrees higher in favor of the left side compared to the right side (Fig. 3).



ID	Avg	Min	Max
E1	32,66	32,25	33,59
E2	31,93	31,23	33,88

Figure 3: Case 1 post-training thermal image and temperature difference (E1: right side rectus region, E2: left side rectus region, Avg: average, min: minimum, max: maximum).

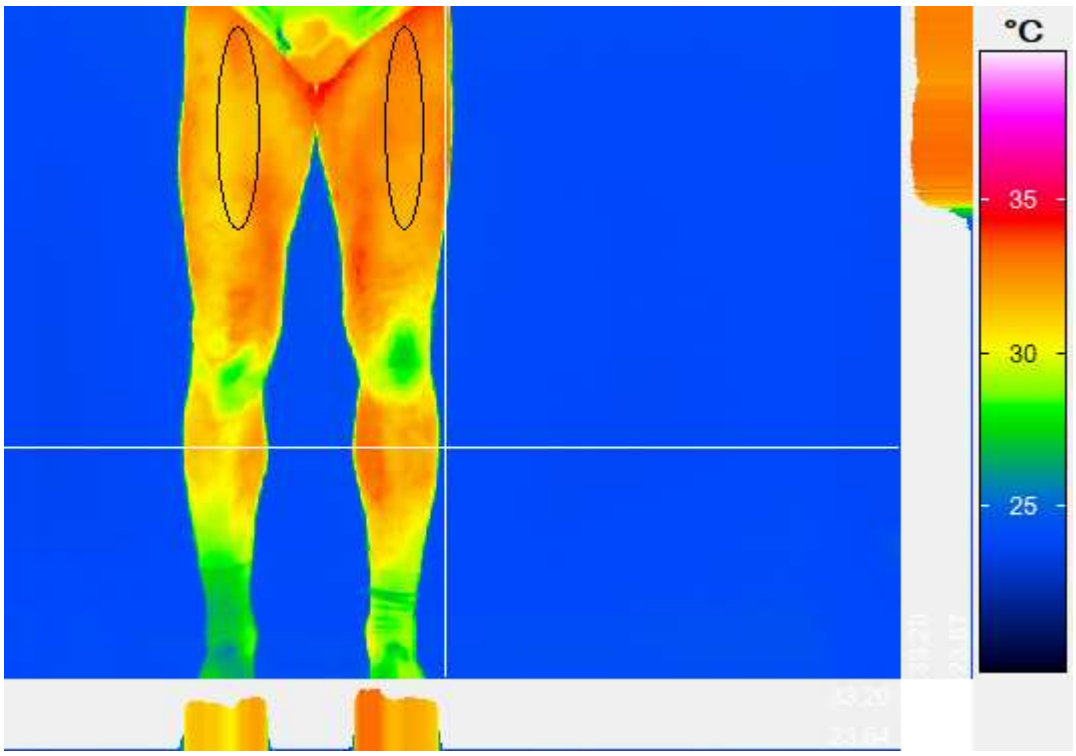
When we look at the values before and after the training, it was seen that the right and left side heat exchange differences were 0.33 degrees on average, a minimum of 0.45 degrees and a maximum of 0.18 degrees. This shows that before and after the training, the scissors between the right and left sides open in this difference size (Table 1).

Table 1: Case 1 temperature difference before and after training

Case 1	Mean Difference	Minimum Difference	Maximum Difference
Before the Training	0.40	0.57	- 0.11
After the Training	0.73	1.02	- 0.29
Change	**0.33**	**0.45**	**0.18**

Case 2

In the evaluation made before the training, it was determined that the average temperature difference between the right and left sides was 0.69 degrees, the minimum temperature difference was 0.70 degrees, and the maximum temperature difference was 0.30 degrees (Fig. 5).



ID	Avg	Min	Max
E1	31,62	30,74	33,15
E2	32,31	31,44	33,45

Figure 5: Case 2 pre-training thermal image and temperature difference (E1: right side rectus region, E2: left side rectus region, Avg: average, min: minimum, max: maximum).

In the evaluation made after the training, it was determined that the average temperature difference of the right and left sides was higher on the right side, 0.21 degrees, and the maximum temperature difference was 0.75 degrees. The minimum temperature difference was found to be 0.19 degrees higher on the left side (Fig. 6).

ID	Avg	Min	Max
E1	32,41	31,12	34,10
E2	32,20	31,31	33,35

Figure 6: Case 2 post-training thermal image and temperature difference (E1: right side rectus region, E2: left side rectus region, Avg: average, min: minimum, max: maximum).

When we look at the values before and after the training, it was seen that the right and left side heat exchange differences were 0.90 degrees on average, 0.51 degrees minimum and 1.05 degrees maximum. This shows that before and after the training, the scissors between the right and left sides open in this difference size (Table 2).

Table 2: Case 2 temperature difference before and after training

Case 2	Mean Difference	Minimum Difference	Maximum Difference
Before the Training	-0.69	-0.70	-0.30
After the Training	0.21	-0.19	0.75
Change	**0.90**	**0.51**	**1.05**

It was observed that the responses of case 1 and case 2 to the same training were different. It was observed that the thermal response of case 2, who recovered with surgical treatment, to the training load was higher.

DISCUSSION

While RF muscle injuries are common in sports, rupture of RF proximal tendons are rare injuries (8). Since RF proximal tendon injuries are rare, there is no definitive protocol on how to treat this injury (10, 23, 29). Treatment strategies for proximal injury of the RF muscle have been reported in the literature with good results with different techniques, both operatively and conservatively. In addition, it was stated that the type of disability and the patient's condition are decisive for the decision of conservative or surgical treatment (20). However, according to the literature research, there is no consensus on the treatment of RF proximal tendon rupture. While some studies suggest conservative treatment of sedentary people and operative treatment of athletes (29), some studies focus on the success of conservative treatment in sportive RF injuries (9, 15, 21) However, some studies emphasize that surgical treatment is a method that can be used in sports injuries (27). Although some researchers suggested that surgical management is a preferable alternative in the early period (17), Dalal et al. (2) showed that both conservative and operative treatment provided excellent results in proximal rectus femoris avulsions with similar rates of return to sports and incidence of complications.

Parallel to the lack of consensus on the treatment of the injury, there are currently no standardized recommendations regarding follow-up (20). For the discussion of the treatment method, first of all, correct diagnosis and evaluation are important (5). Along with clinical examination, imaging modalities play a key role in the diagnosis and evaluation of such injuries; clinical evaluation may be insufficient to distinguish contusions or to determine the extent of the lesion and the presence of muscle retraction (24). In ultrasound imaging, both static and dynamic images of the quadriceps muscle can be obtained; considering its low cost and practicality, it is an acceptable method as a first step in evaluation (5). However, MRI is more sensitive than ultrasound imaging in diagnosing these injuries and allows a multidimensional evaluation (4, 22, 25). MRI provides structural information of musculotendinous pathology at a resolution far beyond the capabilities of current ultrasound technology. This allows for more detailed grading of the injury (18). However, ultrasound examination can be considered as an alternative to serial imaging to follow up muscle and tendon injuries due to MRI costs and the inaccessibility of most physicians, however, it has been observed that ultrasound method can not detect changes in injury dimensions over time in quadriceps muscle injuries (6). Consequently, results of ultrasound imaging following muscle injury show that ultrasound resolution currently makes it relatively insensitive to predict or monitor clinical outcomes (23). As a result of all these, there is no consensus on how to follow up RF injuries in terms of rehabilitation follow-up. However, the effect of training load on the athlete with a history of injury cannot be determined without a follow-up protocol. Another result we obtained in these case reports was that 2 weeks later, the case giving more signals against operative and training had a rectus femoris grade II injury in the same region. In case 1, it was observed that the injury did not recur until the publication of the study. As a result, it is not possible to determine the training

load from imaging methods such as USG and MRI before injury occurs. We observed that pre-injury signals can be received thanks to IRT. The injury of Case 2 is the most important indicator of this. This study shows that training load is a tool that can be used to determine the risk of musculoskeletal injury. However, the most important aspect of the study is that it shows that IRT is a useful method in the follow-up of the recurrence of injuries in athletes with a history of injury.In this study, the response of the athletes, who have a history of RF proximal tendon injury and return to sports after treatment with different methods, the same training program was evaluated with infrared thermography. We determined that the thermal response of the athlete who recovered with operative treatment showed more change than the athlete who was treated conservatively. According to the results of our study, it can be said that the athlete who recovered conservatively adapts better to the stress caused by the training. Considering the effect of injury history on the risk of injury, it is suggested that the conservative treatment method is a better method. It is seen that infrared thermography method is an imaging method that can evaluate the training load more effective compared to other imaging methods. These two case reports we have presented in this study will contribute to future literature studies about RF proximal tears in terms of application of a follow-up protocol. We find this study worthy of a case report that can be used while comparing two elite football players who got conservative and operative treatments for their rectus femoris injuries and had the same training. On the other hand, these two cases who recovered in different ways were evaluated by using thermal cameras to see their reactions to the same training. Case 2 who possessed an injury risk had another rectus femoris injury in 2 weeks' time, and according to the data we had this fact is regarded as a significant data to be presented to the literature. In this study, we evaluated the training load with thermal cameras and so it is worth publishing so that it can be used as a case report to indicate injury risk indicator.

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Authors' contrıbutıons

All authors confirm that each of them have contributed equally to the manuscript during data collection, research, writing, editing and submitting. All authors read and approved the final manuscript.

Competıng ınterests

The authors declare that they have no conflicts of interest relevant to the content of this article.

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