

Complete midsubstance rectus femoris ruptures: a series of 27 athletes treated operatively

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Summary

Introduction: Rectus femoris muscle injuries are common in sports. Although majority of these injuries are treated conservatively, some tend to present significant disability which could compromise the returning to pre-activity level of competition in athletes. The purpose of this study is to evaluate possible benefits of operative treatment in acute and recurrent rectus femoris ruptures.

Methods: Retrospectively, a total of 27 patients (23 men, 4 women) with grade 4 rectus femoris muscle rupture which located at the diaphyseal area between proximal and distal myotendinous junctions. Operative treatment was carried out in the acute (8 cases, < 4 weeks after injury) or recurrent rectus femoris ruptures (19 cases).

Results: 20 (74%) patients had excellent or good results, moderate results in 6 (26 %) and poor (required re-operation after re-injury) in 1 (4%) patients. The return to pre-activity level of competition was 5 months on average. Adverse events were haematoma (n=4, percutaneously drained), superficial infection (n=1, healed with cephalixin antibiotics), partial dehiscence of the wound (n=1, no intervention).

Conclusion: Based on these cases, excellent or

good results may often be expected after surgical repair of grade 4 rectus femoris midsubstance ruptures.

Level of evidence: IV, Case series.

KEY WORDS: rectus femoris muscle injuries, surgical repair, athlete injuries.

Introduction

Rectus femoris muscle strains and contusions are common injuries in everyday sport traumatology¹. Most of these injuries can be treated non-operatively with good results^{2,3}. However, some rectus femoris injuries show significant disability and the decision of optimal treatment method is not so evident^{4,5}.

Different classifications for muscle injuries have been proposed in the literature which are used in clinical settings⁴. Although the rectus femoris muscle strains are common, high grade 4 injuries can be seen especially in soccer where sprinting and kicking require eccentric rectus femoris contraction^{6,7}.

The avulsions of proximal rectus femoris from the anterior superior iliac spine have been well documented in athletes⁸⁻¹⁰. Interestingly, the clinical entity considering midsubstance rectus femoris muscle ruptures is mainly lacking in the literature. Only few case reports of rectus femoris repair have been published¹¹⁻¹³. Our aim was to evaluate the outcomes from a retrospective series of 27 cases grade 4 midsubstance ruptures of rectus femoris muscle treated operatively in athletes.

Materials and methods

Total of 27 athletes (23 men, 4 women) with grade 4 rectus femoris muscle rupture, which were located at the midsubstance area were included. Therefore, the ruptures at the proximal rectus femoris or quadriceps tendon were excluded. The patients were all athletes at a competitive level and the injuries of the study population are shown at Table I. The mean age of the patients was 29 years. All included patients were treated operatively. The operation was done in acute phase in 8 cases (<4 weeks), and in 19 cases the operation was done 4 weeks after the injury. Altogether the mean time to surgery after the injury was 112 days (range 2 days - 2 years). The cases with opera-

Table I. Sporting events of the patients with rectus femoris ruptures with mechanism of injury and the delay from injury to the surgery.

Characteristics	Number of cases
Age and sex of the patients	Male / Female
< 15 years	1 / -
16-20	4 / -
21-25	6 / -
26-30	2 / 1
31-35	4 / 1
36-40	2 / 1
41-50	3 / 1
> 50 years	1 / -
Sporting events	
soccer	11
sprinting, hurdling	6
endurance running	4
jogging	3
baseball	1
gymnastics	1
roller skating	1
Mechanism of injury	
sudden falling with knee flexed	14
maximal sprinting	4
kicking hard	4
contusion to the anterior thigh	3
jumping and landing	2
The delay from injury to the surgery	
< one week	2
1-4 weeks	6
1-4 months	13
5-12 months	4
> 1 year	2

tion between 1 to 4 months after injury were due to delayed diagnosis and the cases done after 5 months after were due to unsuccessful results of non-operative treatment. The right side was affected in 15 patients and the left side in 12 patients.

In the clinical examinations, all patients complained pain, discomfort and weakness of the anterior thigh in hip flexion and in knee extension. Signs of hematoma is usually not visible because the common muscle fascia remains intact. They were unable to run, and many had also abnormal gait due to the pain at injured rectus femoris. Addition to the clinical diagnosis made by physician, the diagnosis was also made with bilateral thigh MRI preoperatively (Fig. 1). The clinical and imaging diagnosis were all confirmed during the operation (Fig. 2). The indications for the operative treatment were findings in the MRI, added with significant clinical findings demonstrated above.

The patients were followed at our outpatient clinic with monthly visits up to 4 months and then at 6 and

12 months. Additional visits were scheduled for study purposes until the athlete had full Return – to – Play. In the patient follow-up, the patients were asked about possible symptoms and their ability to return to sports. The mean length of the follow-up was 30 months.

A four-category rating system was used to evaluate the overall result. The result was graded as excellent when the patient was asymptomatic and able to return to the pre-injury level of sports. In the cases rated good, the patient had minor symptoms of pain, stiffness, and/or weakness that, however, did not restrict activity level. A classification of moderate was assigned to the result when the patient's activity level was lowered because of the residual symptoms of pain, stiffness, and weakness of the affected anterior thigh. Finally, the result was classified as poor when the patient had disturbing symptoms even in activities of daily living or reoperations without re-injury. The study was approved by the local ethics committee.



Figure 1. Magnetic resonance imaging showing the rupture of rectus femoris preoperatively. A) Recurrent rectus femoris rupture, A1 coronal view; A2 sagittal view (*). B) Acute rectus femoris rupture with clear empty space and retraction of the ruptured muscle heads, B1 coronal view; B2 sagittal view (arrow).

Surgical technique

The repairs of rectus femoris ruptures were done with apposition of muscle ends using resorbable suture material. Posterior tendon and fascial flap augmentation from both sides were added to the repair area if necessary and in chronic cases. In surgery, the patient was positioned supine. The leg was straight and wrapped so that a full knee flexion could be tested. A longitudinal anterior incision was used. A fasciotomy was done to the rectus femoris in the line of the skin incision. Scar tissue and the ruptured ends of the rectus femoris were debrided (Fig. 2A). The torn ends of the rectus femoris were fixed anatomically by suturing. If there was a clear defect or tightness when flexing the knee, additional augmentation was done using fascial strips from rectus fascia of both sides. This plastic repair was done with absorbable sutures (Fig. 2B). In scarred

and shortened chronic cases near the proximal musculotendinous junction ruptures, a Z-plasty to the proximal tendon part was done together with releases in proximal and distal areas of the rectus femoris. The fascia of the rectus femoris was left open after reattachment. In cases with intra-fascial adhesions and recurrent tears, more mobilization of the muscle with fasciotomy was required (Fig. 3).

Postoperative rehabilitation

Postoperative rehabilitation started with pain free full-weight bearing by extended and with the aid of crutches. Knee bending exercises were started 2 to 3 weeks after surgery and above 90° in 4-6 post-operative weeks. Isometric exercises were encouraged immediately after surgery and were progressed intensively each week after surgery. After 4 post-operative weeks, light pool training including aqua running was

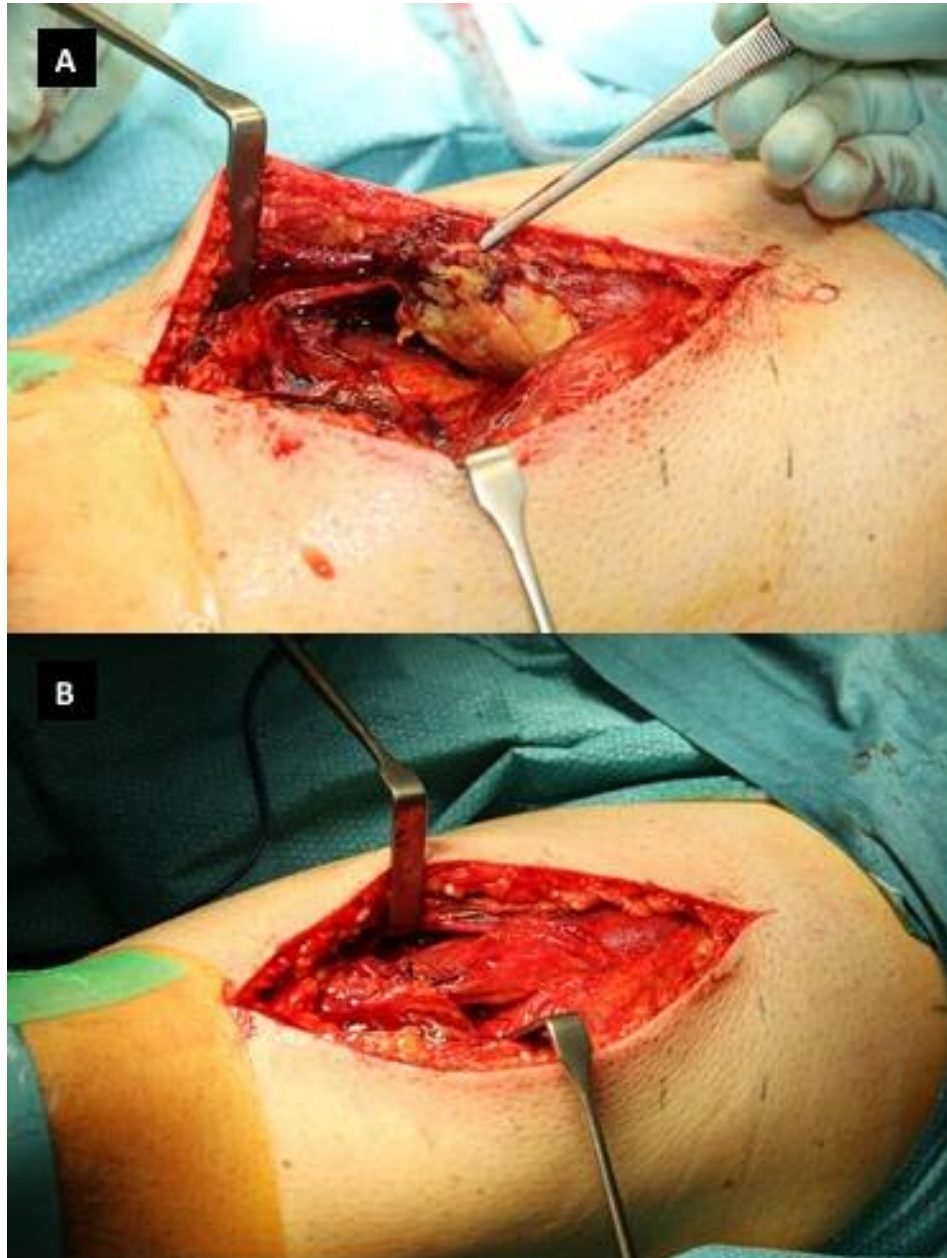


Figure 2. Perioperative images from the repair of rectus femoris. A) Complete rupture of rectus femoris showing clear gap. B) Additional augmentation with fascial strips after anatomical fixation using Kessler sutures.

allowed, and 6 weeks after the operation light gym training and cycling was allowed. Jogging and running were allowed gradually 2 months after the operation and more intensive exercises as kicking, jumping and weight training were committed approximately 3 months after surgery.

Results

MRI and perioperative findings correlated well in cases operated in acute phase (n=8). In those cases, a

rupture was found with the retraction of rupture muscle ends was 3-6 centimetres. In chronic and recurrent cases (the delay from injury to the surgery > 5 months, n=6), scar tissue and adhesions were found at the ruptured area.

Of the 27 patients, 20 (74%) had excellent or good results and they returned to their former level of competition after an average of 5 months. In 6 (22%) patients, all operated after three months from the injury, the result was classified as moderate. One (4%) patient underwent a re-operation due to re-injury after primary operation rehabilitation and was classified as poor.

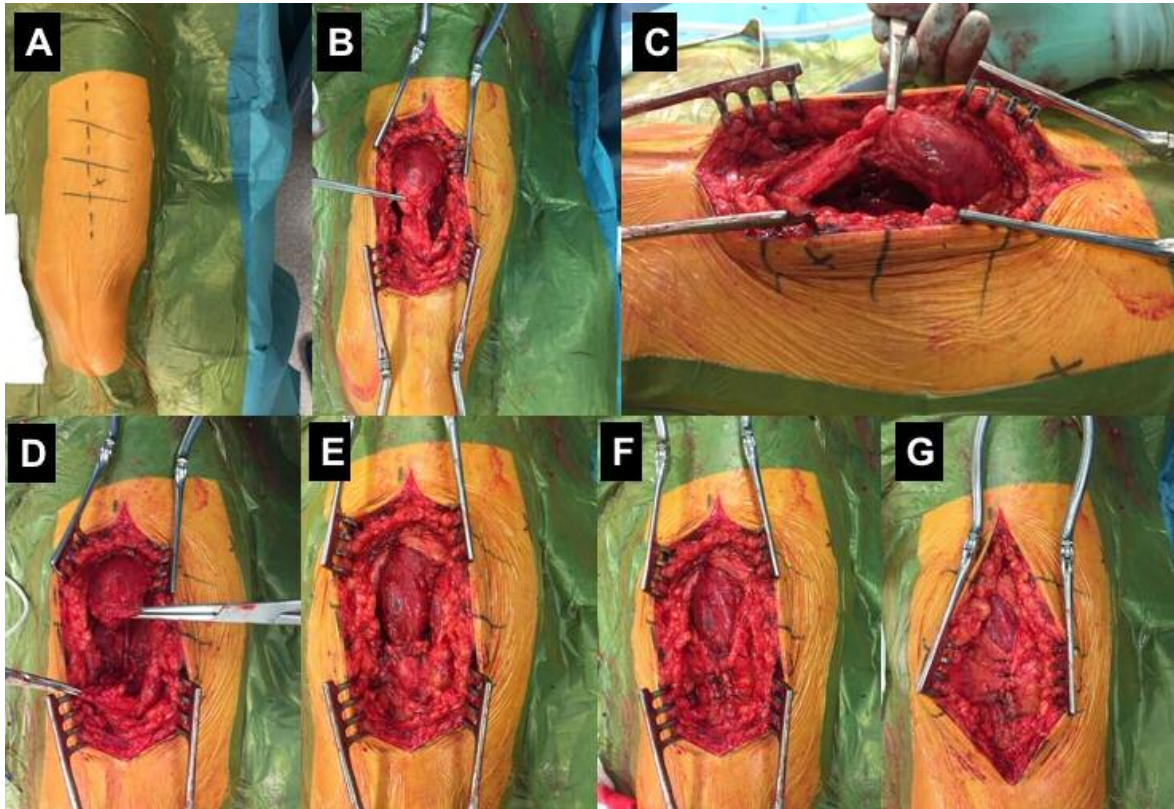


Figure 3. Perioperative images from the fascial bridge technique. A) Midline anterior skin incision. B) Fasciotomy in line with skin incision. C) Revealed chronic rupture with thick scarring. D) The scar and adhesion have been debrided. E) The ends of rectus femoris have been sutured. F) The fascial bridge is made by suturing the fascia to top of the rectus femoris repaired rupture. G) Cranial part of the fasciotomy is left intact during closure.

All 27 patients felt that they had benefited from the surgery. One ectopic calcification was excised after recurrent rupture which was caused by a direct contusion.

The patients had 6 (22%) complications. four hematomas which were percutaneously drained, 1 superficial wound infection treated with peroral antibiotics and 1 partial dehiscence of wound which did not require intervention.

Discussion

Based on the present study, operative treatment for grade 4 midsubstance rectus femoris rupture could be beneficial for competitive athletes. Most of the rectus femoris muscle injuries are treated by non-operative treatment⁴, whereas more aggressive approach to grade 4 ruptures could be warranted. These grade 4 ruptures can cause prominent functional loss in hip flexion and in knee extension strength, poor coordination as well as cramping pain and may require surgical intervention for proper and optimal healing. This has previously been shown also in small case reports¹¹⁻¹³.

The decision for the operative treatment of rectus

femoris rupture should be done individually. Because most of the rectus femoris low grade injuries will heal rapidly, physician treating these injuries should be aware grade 4 injury types which are operated in athletes. The region of the rupture is highly relevant whereas proximal and distal ruptures could benefit from operative treatment^{12,14}. Earlier Oliva et al. reported good outcomes after anterior quadriceps muscle (vastus medialis muscle) after 6 years¹⁵. The anatomy of rectus femoris consists of fast healing peripheral muscle belly and slowly regenerating central tendon¹⁶. The grade 4 midsubstance ruptures in the present study showed good to excellent results after operative treatment which highlight also the importance of morphology at the injured rectus femoris. However, at the recurrent rectus femoris ruptures, the decision making for the best treatment is more controversial. When considering best treatment option for high-demand athlete, the restoration of anatomy after grade 4 rupture seems to produce more rectus femoris strength compared to the nonoperative treatment¹². After a grade 4 midsubstance rectus femoris rupture, the optimal length of the muscle is lost resulting in reduced strength of the rectus femoris together with poorer overall performance of the athlete. In ad-

dition, if the length of muscle tissue is decreased by scarring, the correction of length and debridement of adhesions leads to more dynamic function of the rectus femoris.

The patients of the present study with recurrent rectus femoris injury had persistent pain, discomfort or strength loss of rectus femoris. Some of the recurrent injuries lead to more prominent functional loss of the anterior thigh with lower knee extension strength and may require surgical treatment¹⁷. The operative treatment with moderate results gave all these patients less skin numbness and cosmetic clumps or defects. In our material, operative treatment was done only to those patients who subjectively suffered from a clear loss of extension strength of the thigh, had recurrent injuries or had chronic pain at the injury site.

Rehabilitation of these injuries seems to have different opinions in literature. Straw et al. immobilized the knee to extension splint for 6 weeks¹², Taylor et al. used full weight bearing with knee brace in range of movement of 0-30° for 6 weeks and Shimba et al. commenced non-weight bearing with extension of the knee for 3 weeks^{11,13}. In our 27 athletes, range of movements was restricted between 0-90° of knee flexion for the first 4 weeks. Postoperatively, we also recommend immediate full weight bearing with isometric quadriceps activation.

To date, this is the first study to report complications after operative rectus femoris treatment. Altogether 6 complications were reported. Interestingly, 4 from these complications were hematomas, which were easily drained percutaneously. Previously, Sonnery-Cottet et al. have demonstrated hematoma formation at the proximal part of rectus femoris after operative treatment¹⁸. This could indicate the use of drainage postoperatively. As the rate of the minor complications seems to be rather, we recommend routine physician control after the operation to rule out possible troublesome hematoma formation and superficial skin infection.

Our study has several limitations. The data was gathered retrospectively, and the patients were not systematically analyzed for strength and range-of-motion during different phases of rehabilitation. Although our case series has large number of athletes compared to previous case studies, the present does not conclude clear consensus to operative treatment of rectus femoris ruptures. However, among top level athletes, we believe that restoring the ruptured muscle anatomy near to the preinjury state, the return-to-play to the former competitive level could be achieved more likely compared to non-anatomical tendon healing via non-operative treatment.

Conclusions

Based on the present study, excellent or good results may be often expected after surgical repair of grade 4 rectus femoris ruptures in athletes. Further prospective studies are required to evaluate the role of opera-

tive treatment in grade 4 rectus femoris muscle injuries as well as symptomatic recurrent lower grade rectus femoris ruptures in athletes.

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Ethics

The Authors declare that this research was conducted following basic ethical aspects and international standards as required by the Journal and recently update in¹⁹.

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