



Original article

Better knee function after surgical repair of acute quadriceps tendon rupture in comparison to acute patellar tendon rupture



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ABSTRACT

Introduction: The purpose of this study was to determine if there is a difference in knee function between patients with quadriceps tendon rupture and patellar tendon rupture after acute surgical repair. Our hypothesis was that knee function would be similar between the two groups.

Methods: The study population included 24 patients; 13 patients suffered from quadriceps tendon rupture and 11 patients from patellar tendon rupture. All patients underwent acute surgical repair using heavy non-absorbable trans-osseous sutures; another non-absorbable suture, passed through both retinaculum and around the repaired tendon to augment the repair. Clinical evaluation was performed using the Lysholm, Kujala, and VAS scoring systems. In addition, radiographic evaluation to evaluate patellar height and patello-femoral joint arthritis using Iwano's classification was performed.

Results: The average follow-up time was 70.5 months. All patients in the quadriceps tendon group had full range of knee motion while 3 patients (27%) in the patellar tendon group had reduced knee flexion. Patients in the quadriceps tendon group had a significantly higher Kujala score in comparison to the patellar tendon group (88 vs. 73 $p=0.033$). No significant differences were identified between the two groups according to the Lysholm scoring system. Patients in the quadriceps tendon group had significantly less pain according to VAS scale (1.2 vs. 3.5 $p=0.012$). Radiographic evaluation revealed that two patients from each group showed signs of grade II patello-femoral joint arthritis according to Iwano's classification.

Conclusion: Acute surgical repair of quadriceps tendon ruptures provides better knee function, in comparison to the surgical restoration of patellar tendon rupture.

Level of evidence: Level III, retrospective comparative study.

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1. Introduction

Knee extensor mechanism rupture is an uncommon, but severe knee injury, which requires surgical repair to restore knee function. According to the literature, patients with quadriceps tendon rupture are typically older (>40 years) than those who sustain patellar tendon rupture (<40 years) [1–3]. Comorbidities, such as obesity, diabetes, gout, chronic renal failure, hyperparathyroidism, lupus erythematosus or prolonged use of steroids are reported as causative factors for quadriceps or patellar tendon rupture [1–3]. However, the main cause of traumatic tendon ruptures according to many studies is repetitive micro trauma, due to participation in

strenuous sports activities, which leads to tendon degeneration and chronic inflammation of the extensor mechanism [4–6].

The mechanism of injury in acute rupture of both the quadriceps as well as the patellar tendon is due to a high velocity eccentric contraction of the quadriceps muscle, with the knee in a semi-flexed position [2,4,7].

Clinical diagnosis includes pain, effusion around the knee and inability to voluntarily extend the knee, which is the cardinal symptom of the condition [3,5,8]. Ultrasound has been widely used as a diagnostic tool in knee extensor mechanism injuries [9]. However, magnetic resonance imaging (MRI) is the method of choice to evaluate quadriceps and patellar tendon ruptures but is limited by availability and high cost [10].

The treatment of choice for a quadriceps and patellar tendon rupture is immediate surgical repair. Methods of surgical repair include intraosseous sutures through the patella, end-to-end suturing, cerclage wiring, methods of repair using Dacron

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vascular grafts, polydioxane (PDS) cord, carbon fibre, synthetic prosthetic ligaments, and suture anchors [11–19]. West et al. [20] used intraosseous sutures through the patella and another heavy non-absorbable suture to augment the repair and they reported good or excellent result in all cases. The main advantage of this technique is that there is no need for a second operation for removal of rigid fixation devices and at the same time allows early motion to promote better remodeling of the repaired tendon and to avoid knee stiffness [20,21].

Several authors have reported good to excellent results in 80% to 100% of operatively treated quadriceps tendon ruptures [11,14,21–23]. Many other series report between 70% to 100% good to excellent results, following patellar tendon rupture repair [24–27]. However there is only one study, which evaluates the outcomes in patients with surgical repair of quadriceps and patellar tendon rupture [20].

Therefore, the aim of our study was to evaluate and compare the clinical, functional and radiological results between patients with quadriceps and patellar tendon rupture, after surgical repair, using knee scoring systems and radiological follow up. Our hypothesis was that there would be no differences regarding clinical, radiological results and knee function between the two groups of patients (quadriceps and patellar tendon repair).

2. Materials and methods

2.1. The series

All patients with an acute quadriceps or patellar tendon rupture, treated operatively in our department from 2003 to 2011 (excluding patients with a chronic – more than 3weeks rupture – and patients with a total knee arthroplasty and extensor mechanism rupture), were included in the study. The sample size of this retrospective study, included 24 patients of which, 19 were men and 5 women, aged 34 to 67 years (Table 1). Thirteen patients suffered from quadriceps tendon rupture while 11 patients from patellar tendon rupture. The mean age group of the 13 patients who had sustained a quadriceps tendon rupture was 54.6 years, while those who suffered a patellar tendon rupture had a mean age group of 44.3 years ($p=0.0116$) (Table 1). Body mass index was similar. Two out of the 13 patients in the quadriceps tendon rupture group, had a known history of diabetes mellitus, while none from the patellar tendon rupture group, had any comorbidities. There was no history of steroid use in any patient.

On presentation to the emergency room, all patients were evaluated both clinically and radiologically. In the majority of cases, the diagnosis was made clinically (inability to fully extend the knee and palpable tendon defect). MRI scan was obtained just in 3 cases when diagnosis was in doubt. All 24 patients underwent a surgical intervention, within 48 hours following presentation.

2.2. Surgical technique and rehabilitation

All patients in the quadriceps tendon group had an avulsion tendon injury from the patella, while in the patellar tendon group 4 patients had a mid-substance rupture.

The surgical technique was similar to West et al. [20]. Two No 5 Ethibond heavy non absorbable sutures were passed into the quadriceps or patellar tendon using a Krackow suturing technique. Three parallel drill holes were then created from inferior to superior in the patella. The sutures were passed through the drill holes and tied, in 30° to 40° of flexion, at the inferior or superior pole of the patella, in case of quadriceps or patellar tendon rupture, respectively. All repairs were then augmented with another No 5 Ethibond suture that was passed through both retinaculum and around the repaired tendon (Fig. 1A and B).

The rehabilitation protocol was similar in both groups. All patients were immobilized in a long knee hinge brace for a period of 2 weeks along with passive knee movements from 0° to 30°. At 2–6 weeks interval, 0° to 90° of knee movements were initiated without active quadriceps extension and following 6 weeks, full range of movements were initiated, with active knee extension.

2.3. Evaluation methods

Clinical evaluation at the latest follow-up was performed, by assessing the range of knee motion in all patients as well as the VAS (0–10), Kujala, and Lysholm, scoring systems. Measurement of thigh circumference was performed 15 cm proximal to the superior pole of the patella to evaluate quadriceps atrophy. A discrepancy more than 2 cm in comparison to contralateral leg was considered as thigh atrophy.

Radiological evaluation was performed using lateral radiographs to assess patella height using the Blackburn-Peel ratio, and patella axial views, to assess patello-femoral joint arthritis using Iwano's classification [28].

2.4. Statistical analysis

Statistical analysis included a two tailed, t-test to determine significant differences between the two groups for the Lysholm, Kujala and VAS scoring systems and the Wilcoxon signed rank test for non-parametric data. Significance was set at $p < 0.05$.

3. Results

Follow-up time was 74 (40–128) and 69 (36–102) months for the quadriceps and the patellar tendon group respectively ($p=0.213$). All patients were available for follow-up.

All patients in the quadriceps tendon group had full range of knee motion, while 3 patients (27%) in the patellar tendon rupture had reduced knee flexion ($p=0.042$) (Table 2). All patients had complete active extension. Patients in the quadriceps group had significantly less pain ($p=0.012$) and a significantly ($p=0.033$) better Kujala score (Table 2), which reflects less restrictions, in activities requiring patellofemoral participation. In contrast, no significant differences ($p=0.124$) were found for the Lysholm knee score (Table 2). There was persistent quadriceps atrophy in 1 patient from the quadriceps group and in 1 patient from the patellar tendon group.

Radiological evaluation showed that one patient from each group developed a patella baja according to Blackburne-Peel ratio ($p=0.242$) (Table 3). Knee function in both of these patients was not good mainly because of anterior knee pain problems. Two patients from each group showed signs of grade II patella-femoral joint arthritis, according to Iwano classification ($p=0.532$).

Two patients from the patellar tendon group had difficulties to resume their pre-injury activities. One patient, who was a manual labourer, was unable to carry out his daily work and another one was unable to run. The rest of the patients from both groups returned to their activities. There were no re-ruptures, wound

Table 1
Demographic data.

	Quadriceps (13 tears)	Patellar tendon (11 tears)	p value
Age	54.6 (48–67)	44.3 (34–59)	0.0116
Sex (male/female)	10/3	9/2	NS
ComorbiditiesDiabetes	2	0	NS
BMI	29.6 (24.7–31.4)	28.4 (24.2–30.2)	0.211

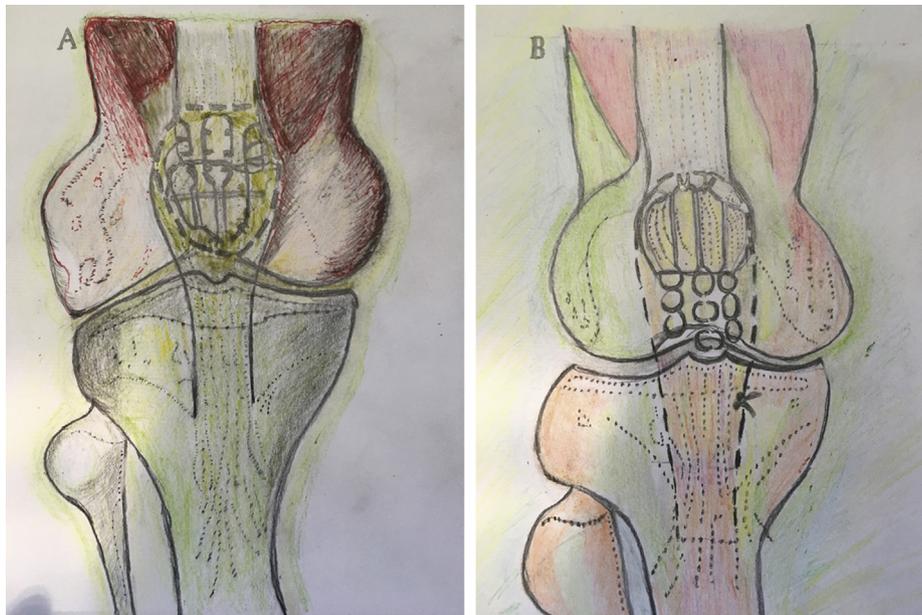


Fig. 1. Sutures passed through the torn (A) quadriceps or (B) patellar tendon and tied at the inferior pole of the patella (A), in case of quadriceps tendon rupture or at the superior pole of the patella, in case of patellar tendon rupture (B). In all cases, a heavy suture was passed through both retinaculum and around the repaired tendon to augment the repair.

Table 2
Comparison of patient evaluation scores between the two groups.

	Quadriceps (13 tears)	Patellar tendon (11 tears)	p value
Lysholm	91 (82–100)	86 (76–96)	0.124
Kujala	88 (75–98)	73 (44–89)	0.033
Vas	1.2 (0–3)	3.5 (1–6)	0.012
Flexion deficit (degrees)	2.6°	11.4°	0.042
Follow-up time (months)	74 (40–128)	69 (36–102)	0.213

Table 3
Comparison of patella height (Blackburne–Peel ratio) and patello-femoral arthritis (Iwano's classification) between the two groups.

	Quadriceps (13 tears)	Patellar tendon (11 tears)	p value
Patella height	0.89 (0.57–0.98)	0.83 (0.51–0.91)	0.242
Patello femoral joint arthritis grade 0 & I	11 pts	9 pts	0.478
Patello femoral joint arthritis grade II	2 pts	2 pts	0.532

healing problems or other complications directly associated to the procedure, in our study population during the follow-up period.

4. Discussion

The main finding of our study was that knee function was better in patients with quadriceps tendon rupture in comparison to patients with patellar tendon rupture, after surgical repair. More specifically, Kujala score and VAS were significantly better in the quadriceps group, mainly because they had less pain and less difficulties in activities, like ascending or descending stairs, prolonged sitting with the knee flexed and no flexion deficits according to our analysis. Therefore, our data do not support our initial hypothesis.

Our technique was quite similar to West et al. [20] using intraosseous sutures through the patella and another heavy non-absorbable suture to augment the repair. The main advantage of this technique is that there is no need for a second operation for removal of rigid fixation devices like other series [29]. At the

same time, this type of repair allows early motion to promote better remodeling of the repaired tendon and to avoid knee stiffness [20,21].

Patients in both groups followed an early functional post-operative rehabilitation protocol to avoid knee stiffness and to facilitate the healing process of the repaired tendons. According to many studies, an early rehabilitation protocol is safe and prevent complications like knee stiffness and quadriceps strength deficit [20,21,24–26]. However, patients in the patellar tendon group had less knee flexion in comparison to quadriceps tendon group in our series. Marder and Timmerman [24] reported also that 5 out of 15 patients had a flexion deficit of 10 degrees or more in their series after primary repair of patellar tendon rupture.

According to our results, patients in the patellar tendon group had more pain after repair in comparison to quadriceps tendon group. Similar to our findings, Marder and Timmerman [24] reported that 35% of their patients (5 out of 14) had anterior knee pain after primary repair of patellar tendon rupture. Moura and Fonseca [30] reported also that residual pain was 1.75 times more present in ruptures of the patellar tendon when compared with those of the quadriceps tendon. Anterior knee pain during squatting, ascending and descending stairs was the main reason for a lower Kujala score in the patellar tendon group, in comparison to quadriceps tendon group in our series.

Knee function after surgical repair of quadriceps and patellar tendon ruptures has been reported to be good or excellent in 70% to 100% according to most studies [11,14,20,21,24–26]. To our knowledge, only West et al. [20] evaluated the outcomes in patients with surgical repair of quadriceps and patellar tendon rupture. They reported good and excellent results in all patients. However, they did not make a separate analysis between patients with quadriceps and patellar tendon ruptures and therefore, a direct comparison with our study population, is not possible. In addition, they evaluated their patients using the Lysholm knee score only, which is not specific for knee extensor mechanism and patellofemoral knee disorders.

Similar to our study, most series reported satisfactory outcomes in the vast majority of patients (90% to 100%) after quadriceps tendon repair [11,14,20,21,24–26]. According to O'Shea et al. [11],

the vast majority of patients in their series returned to the pre-injury level of activity and there was no difference in quadriceps girth and no range of motion deficits comparing affected and unaffected limbs. Similarly, Boudissa et al. [22] reported in their series of 50 patients, good and excellent results in 98%, with an average active flexion of 133 degrees, and minor or moderate patellofemoral osteoarthritis was found in 24% of the knees. Marder and Timmerman [24] reported a higher (33%) rate of patellofemoral radiographic changes (slight spurring, ossicles, or calcification) at the inferior patellar pole after patellar tendon repair. According to our results, 17% of our patients had also moderate (stage II) patellofemoral arthritis 6 years after the index operation.

Two patients (8%) in our series developed a patella baja after surgical repair of knee extensor mechanism rupture. Knee function was impaired in both patients and this was probably associated with patella infera. Roudet et al. [27] reported a similar rate of patella infera after patellar tendon repair. However, mean patellar height was normal in our study population like other series [24,27].

A possible explanation for better clinical results in the quadriceps group in comparison to patellar tendon group could be the richer vascularity of the quadriceps tendon and its close proximity with muscle tissue [31,32]. Greater vascularity, at least theoretically, could result in a better healing potential of the tendon and therefore better clinical result. In addition, the bigger and thicker attachment of the quadriceps tendon to the patella (as compared to the patellar tendon) could be also another factor for better tendon healing. According to Staubli et al. [33], the quadriceps tendons was significantly longer and thicker and exhibited a significantly larger bony attachment area than the patellar ligaments. Finally, quadriceps tendon is surrounding by four muscles, which potentially gives more elasticity and less scar tissue around the repaired area, and therefore this may result in less stiffness and pain.

Limitations of our study include its retrospective nature and the relatively small number of patients. Finally, parameters like strength deficit and joint mechanics were not analyzed; they may lead to different objective outcomes. On the other hand, length of follow-up was adequate and functional assessment of the patellofemoral joint was performed using the Kujala score, which has been designed and validated to evaluate patellofemoral disorders.

5. Conclusion

Acute surgical repair of quadriceps tendon ruptures provides better knee function, in comparison to patellar tendon rupture. This is mainly because better range of motion and less pain are expected after repair of quadriceps tendon in comparison to patellar tendon.

Disclosure of interest

The authors declare that they have no competing interest.

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Authors' contributions

M.H. conceived, designed and co-ordinated the study. Critically reviewed the manuscript.

R.M. collected data analysed the data, and drafted the manuscript.

V.R. collected data analysed the data, and drafted the manuscript.

S.V. participated in the design of the study. Critically reviewed the manuscript.

T.K. participated in the design of the study. Critically reviewed the manuscript.

K.M. participated in the design of the study. Critically reviewed the manuscript.

All authors have read and approved the final manuscript.

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