



Surgical Treatment of Chronic Patellar Tendon Rupture: A Case Series Study

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Abstract

Background: Early detection and treatment of extensor mechanism rupture are essential for a long-term functional knee joint. In chronic cases, quadriceps muscle retraction and contracture make surgery difficult and results are less predictable.

Objectives: The purpose of this study was to evaluate outcomes in the cases of late repaired patellar tendon rupture.

Methods: This study included patients with chronic patellar tendon rupture who were operated at Shafa orthopedic hospital from 2006 to 2013.

Results: A total of ten patients were evaluated, with 12 cases of chronic patellar tendon rupture. Patients had a mean age of 34.4 years (range 18 - 58). Seven cases were caused by a traffic accident and three by a fall. The mean length of time from injury to surgery was 23 months (range 3 - 132). The mean time of follow-up was 6.2 years (range 3 - 9). Cerclage wire reinforcements were applied in nine of the knees and three knees had fiber wire reinforcement. Tendon graft augmentation was applied in ten of the knees; six with semitendinosus and gracilis autograft, two with semitendinosus autograft, one with an Achilles tendon allograft, and one with a tibialis anterior allograft. Means for preoperative/postoperative active knee range of motion, extension lag, subjective international knee documentation committee score, and modified Cincinnati scores were 81/117, 32/2, 22.7/84.5 and 24/87, respectively. Wire breakage was seen on all nine knees but wires were removed in only two symptomatic cases.

Conclusions: Good to excellent results were obtained in terms of functioning with operative treatment of chronic patellar tendon rupture. Direct repair with autogenous or allogenic graft augmentation and cerclage wire reinforcement and postoperative cast immobilization are recommended.

Keywords: Chronic Patellar Tendon Rupture, International Knee Documentation Committee Score, Modified Cincinnati Score

1. Background

Patellar tendon can tolerate a force up to 17.5 times body weight. It is the second strongest tendon in the body after the Achilles tendon. Within the patellar tendon is the largest sesamoid bone in the body, the patella. The patellar tendon inserts to the tibial tuberosity (1-3).

Rupture is less common in the patellar tendon than in the quadriceps tendon. Eccentric contraction of the quadriceps muscle with partial flexion of the knee and foot on the ground is the most common mechanism that causes rupture of the patellar tendon. Degenerative changes may be presented due to repetitive micro-trauma before rupture. Trauma, total knee arthroplasty, anterior cruciate ligament reconstruction with bone-patellar tendon-bone graft, intramedullary nailing of tibia and corticosteroid therapy, and systemic or local injection may

cause patellar tendon rupture (4, 5).

Chronic rupture of the patellar tendon can result in a significant disability. Due to proximal migration and contracture of the quadriceps muscle, surgical treatment is technically very difficult. According to the current literature, the functional outcome is suboptimal after delayed surgery of the knee extensor mechanism (4-6).

2. Objectives

This article presents results of operative repair in ten patients with twelve chronic patellar tendon ruptures.

3. Methods

This retrospective study included adult patients with chronic patellar tendon rupture, either at mid-substance

or due to avulsion from patella or tibial tuberosity, who were treated surgically by the senior author. A search of the hospital records from 2006 to 2013 was done to identify these patients. Late or chronic cases were considered as those that had been done three or more months after injury (7, 8). Preoperative subjective international knee documentation committee (IKDC) (9) and modified Cincinnati knee scores (10) were collected from hospital documents. Records of complications such as infection, knee stiffness, rerupture, hospitalization for manipulation or surgical release and device failure or removal were evaluated. All patients came back for a final visit to take lateral knee radiography and complete subjective IKDC and Modified Cincinnati score forms. Conditions of patella Alta or Baja were determined according to the Insall-Salvati index (11).

Continuous data were presented as means and associated range. Categorical data were presented as descriptive row data.

3.1. Surgical Technique

All cases were treated by open surgical repair. Patients were given general or regional anesthesia after routine prep and drape; then a tourniquet was inflated. Longitudinal midline incisions of appropriate length were made over the anterior surface of the knee. In cases of midsubstance tears, tendons were released from scar tissue and mobilized; then direct repair was performed with No. 2 Vicry I (Ethicon Inc., Johnson and Johnson, NJ, USA) absorbable suture. Direct repair to bone was done in cases in which the tendon rupture was near the lower pole of the patella or tibial tuberosity; this was done with No. 2 fiberwire (Naples, Florida, USA) passed through longitudinal tunnels in the patella or a transverse tunnel in tibial tuberosity. In ten cases, the repair was augmented with a tendon graft, either autogenous or allogeneic. The repair was performed without tendon augmentation in two cases with good remaining tendon tissue without quadriceps muscle retraction. Autogenous semitendinosus was detached from the muscle with an open loop tendon stripper but it remained intact at its tibial insertion. The tendon was then passed through a transverse six millimeters tunnel at the tibial tuberosity level and through a six millimeters transverse tunnel in the middle of the patellar bone. The gracilis was detached from its muscle but remained intact distally, and passed through the same midpatellar bone transverse tunnel from medial to lateral. Cerclage wire was applied in nine cases and in three cases fiberwire No. 5 was inserted between the patella and tibial tuberosity for repair reinforcement. (Figure 1) In patellar side, cerclage wire or fiberwire was passed through a transverse tunnel in the patellar bone or through the quadriceps tendon proximal to the upper pole of the patella. In tibial

side, wire or fiberwire was passed through the transverse tunnel at tibial tuberosity level. In the case of Achilles tendon allograft, the tendon was partially divided longitudinally into three parts. One portion was passed through six millimeters transverse midpatellar tunnel and was sutured to itself near tibial tuberosity. One portion was sutured over patella and quadriceps tendon and another portion was sutured over medial retinaculum and quadriceps tendon. The wire was inserted in the form of a circle or a figure of eight. Gentle and slow tightening of the wire reduced the patella; then direct repair of the tendon and augmentation was made by tendon graft. None of our patients required a quadriceps lengthening in order to accommodate a direct repair of the patellar tendon. The intraoperative patellar position was checked by lateral knee radiography. The tourniquet was deflated and careful hemostasis was done. The wound was repaired in the usual manner after insertion of a hemovac drain. A long leg cast was applied in extension. Postoperative isometric quadriceps exercise was begun immediately after recovery from anesthesia. The hemovac drain was removed on the first postoperative day and the patient was allowed to walk with a walker or double crutches and weight-bearing was encouraged as tolerated. The cast was removed after four weeks and then a hinged knee brace was fitted that allowed progressive range of motion of the knee. The senior author did not remove the wire routinely or after breakage unless the patient was symptomatic.

This is a retrospective case series study. All patients with chronic patellar tendon ruptures treated surgically were evaluated.

4. Results

From 2006 to 2013, ten patients with chronic patellar tendon rupture were operated by the senior author at the hospital of a referral center in the capital city. Two patients had bilateral injuries; one was male and the other was female. The mean time from injury to surgery was 23 months (range 3 - 132). Seven cases of injury had been due to traffic accidents and three cases due to a fall. Both patients with bilateral injury had sustained injuries in a high-energy traffic accident. The mean age of the patients was 34.4 years (range 18 - 58). Six ruptures were in the right knee and six in the left. The mean follow-up time was 6.2 years (range 3 - 9). Augmentation was made with both semitendinosus (ST) and gracilis (G) autografts in six of the knees and the only semitendinosus autograft was used in two knees, one knee treated with Achilles tendon allograft and one with tibialis anterior (TA) tendon allograft. In two of the knees with good remaining tendon tissue without quadriceps, the muscle retraction direct repair was made with

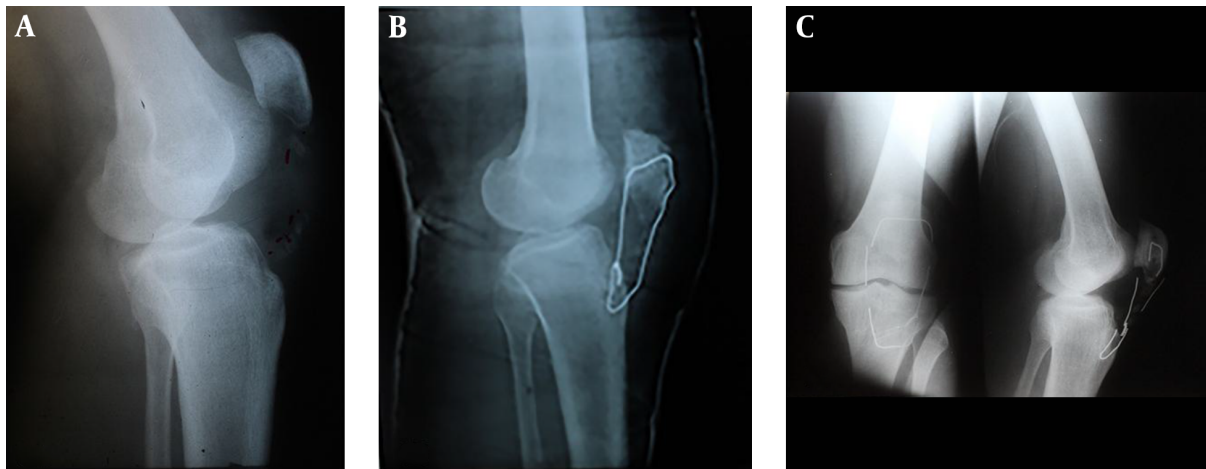


Figure 1. Case 5, A, preoperative lateral knee radiography showing proximal patellar migration after patellar tendon rupture. B, postoperative lateral knee radiography. C, final AP/lateral knee radiography showing asymptomatic wire breakage.

out tendon graft augmentation. In nine knees, reinforcement was made with a cerclage wire and in three knees with fiberwire between the patella and tibial tubercle.

The mean preoperative active range of motion was 81 degrees (range 50 - 90). Passive range of motion (ROM), in all patients under anesthesia, was full without flexion contracture. Mean final follow-up active ROM was 117 degrees (range 110 - 120). Mean extension lag before surgery was 32 degrees (range 20 - 70). Mean postoperative extension lag was 2 degrees (range 0 - 5). Seven knees had no extension lag at the final follow-up. Based on the final subjective IKDC and modified Cincinnati scores, patients showed that an extension lag up to 5 degrees had no detrimental effect on function.

Mean preoperative subjective IKDC score was 22.7 (range 11.5 - 37.9). The postoperative mean subjective IKDC score was 84.5 (range 77 - 92). Mean preoperative modified Cincinnati score was 24 (range 16 - 37). Mean final postoperative modified Cincinnati score was 87 (range 79 - 92). According to this scoring system, one patient had fair preoperative function and nine patients had a poor preoperative function. The final outcome was good for one patient and excellent for nine patients.

Mean patellar height according to the Insall-Salvati index was 1.06 (range 0.75 - 1.28). Two cases had patella Alta, one case had patella Baja, and nine cases had normal patellar height.

No record was made for intraoperative or postoperative complications such as infection, knee stiffness requiring manipulation or surgical release, and rerupture or patellar fracture. Wire breakage occurred in all nine knees reinforced by wire but wires were only removed in

two cases with symptoms.

Data of all patients are presented in [Tables 1](#) and [2](#).

5. Discussion

Early detection and treatment of extensor mechanism rupture are essential for a long-term functional knee joint (12). Patellar tendon rupture is a rare and disabling lesion. Untreated patellar tendon rupture causes severe disability (13). In chronic cases, quadriceps retraction and contracture make surgery difficult and results are less predictable (14). Pengas et al. (15) and Siwek and Rao (8) emphasized that acute repair affords better outcome than repair in chronic or neglected cases and that the time between rupture and repair is the most significant factor for a favorable outcome.

Marder and Timmerman recommended a generous longitudinal midline incision for surgery (14). The senior author preferred a long midline longitudinal incision in order to protect skin perfusion, as well as for complete exposure of all injured tissue and better repair and reconstruction.

Larsen and Lund emphasized the importance of secure but not overly tight repair of extensor mechanism rupture. Patella Alta or Baja may alter the patella-femoral joint mechanics and result in a painful knee joint and early osteoarthritis (13). It is very difficult to achieve normal patellar height in chronic extensor mechanism rupture. The senior author advocates an intraoperative check of the patellar height and identification of the relation of the patella to femoral intercondylar notch and the use of lateral knee radiography to make a comparison with the contralateral

Table 1. Demographic, Augmentation, and Reinforcement Materials Data

Variables	Sex	Age	Side	Time to Surgery, Mo	Accident	F/U, y	Tendon Augmentation	Reinforcement
Case 1	M	45	R	27	Traffic	7	ST and G	W
			L	29		7	ST	W
Case 2	M	31	L	132	Traffic	7	TA	FW
Case 3	M	21	R	3	Traffic	3	-	W
Case 4	F	40	R	12	Traffic	9	ST and G	FW
			L	18		9	ST and G	W
Case 5	M	27	L	30	Traffic	8	ST and G	W
Case 6	M	33	R	3	Traffic	4	ST	FW
Case 7	M	27	R	4	Traffic	3	-	W
Case 8	M	44	L	6	Fall	4	Ach	W
Case 9	M	58	L	7	Fall	4.5	ST and G	W
Case 10	M	18	R	5	Fall	9	ST and G	W

Abbreviations: Ach, Achilles Tendon Allograft; F, Female; F/U, Follow/Up; FW, Fiberwire; G, Gracilis Autograft, M, Male; Mo, Months; R, Right; L, Left; ST, Semitendinosus Autograft; TA, Tibialis Anterior Allograft; W wire.

Table 2. Functional Data and Complications

Variables	Initial AROM	Final AROM	Initial Extension Lag	Final Extension Lag	Initial IKDC	Final IKDC	Initial Cin.	Final Cin.	Insall- Salvati Index	Wire Breakage	Wire Removal
Case 1	90	115	30	5	14.9	85.1	37	86	1.28	Y	N
	90	115	30	5	14.9	85.1	37	86	1.16	Y	N
Case 2	50	110	70	5	17.2	86.2	16	79	1.27	-	-
Case 3	90	120	30	0	16.1	83.9	20	82	1.01	Y	N
Case 4	90	120	30	0	36.8	85.1	24	91	1.16	-	-
	90	120	30	0	36.8	85.1	24	91	1.13	Y	Y
Case 5	80	120	20	5	31	83.9	18	90	1.07	Y	N
Case 6	70	120	30	5	18.4	83.9	24	91	0.80	-	-
Case 7	60	120	30	0	11.5	81.6	16	85	0.85	Y	N
Case 8	80	120	30	0	37.9	85.1	25	90	1.03	Y	N
Case 9	90	120	30	0	20.7	77	28	80	1.15	Y	N
Case 10	90	110	20	0	16.1	92	19	92	0.75	Y	Y

Abbreviations: IKDC, International Knee Documentation Committee Score; Cin, Modified Cincinnati Knee Score; N, No; ROM, Active Range of Motion; Y, Yes.

knee. In our series, at the final follow-up, there were two cases of patella Alta and one case of patella Baja. Patellar position in our series did not have any detrimental effect on the final outcome. One patient with patella Alta had a good final outcome and other patients with patella Alta and Baja had excellent final outcomes according to the modified Cincinnati score.

Ecker et al. reported good results from the reconstruction of four chronic patellar tendon ruptures with autograft using a semitendinosus and gracilis tissue and cerclage wire reinforcement (16).

The senior author prefers autogenously semitendinosus and gracilis tendon tissue for augmentation of all late patellar tendon repairs. Allograft can be used in the selected cases e.g., patients with generalized ligament laxity

or those who need to perform strong knee flexion. There was no difference between the final results of autograft and those of allograft. In exceptional cases with intact retinaculum that prevents quadriceps muscle retraction, direct repair without tendon augmentation can be performed. Wire reinforcement was used in nine of the twelve knees. Routine wire removal was not necessary. (Figure 2) Broken wire was removed only in patients with the associated symptoms. Wires were broken in all nine knees but only removed in two cases due to pain and irritation. In the other three cases, fiberwire was used for reinforcement.

Casey et al. using cerclage wire for repair reinforcement showed that end-to-end repair of chronic patellar tendon rupture may have resulted in limited knee flexion (17). In our series, repair or reconstruction resulted in lim-

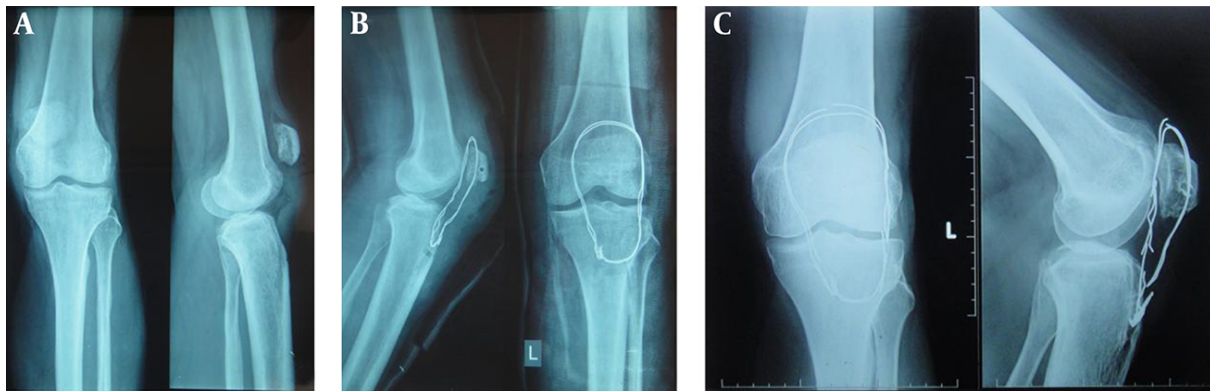


Figure 2. Case 9, A, preoperative knee radiographs showing proximally displaced patella after patellar tendon rupture. B, postoperative knee radiographs. C, asymptomatic wire breakage 4.5 years after surgery.

ited flexion in all patients. The maximum angle of knee flexion was 120 degrees (range 110 - 125). Patients should be informed preoperatively about the limited range of motion in the knee, especially flexion angle to this range. Five cases had an extension lag of about 5 degrees without compromising the function of the extensor mechanism. The active extension is more predictable than flexion resumption.

Multiple operation techniques with different substances for augmentation have been described for extensor mechanism repair. Autograft and allograft tendons, absorbable and non-absorbable sutures, and wires have been used with good results (8, 16-24).

Jesse West et al. reported good and excellent results in 50 patients with quadriceps or patellar tendon rupture treated with direct repair and non-absorbable relaxing suture augmentation (18). Yoon et al. reported good functional outcomes in a patellar tendon rupture that had been neglected for 55 years, reconstructed with Achilles tendon allograft (19). Van der Bracht et al. recommended semitendinosus autograft augmentation for acute patellar tendon rupture in patients with poor tissue quality and in the cases of rerupture (20). Thakkar et al. noted the challenging nature of revision patellar tendon reconstruction and reported successful revision procedure with a quadriceps tendon-patella bone-patellar tendon-bone allograft (21). Temponi et al. reported good results in seven cases of chronic patellar tendon ruptures reconstructed with contralateral bone-patellar tendon-bone autograft (22). Takazawa et al. reported near-normal function in two cases of patellar tendon rupture treated with reconstruction using distally attached semitendinosus-gracilis graft (25). Kasten et al. compared two reinforcing techniques in patellar tendon repair. There was a higher rate of infection in the PDS group than in the cerclage wire

group. PDS did not require a second operation for device removal. Final outcomes were similar between the two groups (26). Elsayed Massoud treated twelve fresh patellar tendon ruptures by direct repair and augmentation with absorbable suturing between the patella and tibial tuberosity with good functional outcomes (23). Sundararajan et al. reported excellent outcomes of seven cases of chronic patellar tendon rupture reconstructed with semitendinosus and gracilis tendon autografts (24). Milankov and colleagues used a double-wire loop to reinforce a chronic patellar tendon rupture reconstruction with contralateral bone-patellar tendon-bone autograft (27).

The subjective IKDC score in our patients changed from 22.7 (range 11.5 - 37.9) preoperatively to 84.5 (range 77 - 92) postoperatively, showing a significant improvement in all patients. According to the modified Cincinnati score, one patient was considered fair preoperatively while nine patients were poor. Postoperatively, one patient was considered good and nine patients were considered excellent, showing a significant improvement in all patients.

The retrospective nature of this study determines that some information such as intraoperative complications might not be included. Lateral knee radiography of the contralateral knee was not taken for comparison with a patellar height between knees, at the final follow-up; instead, the Insall-Salvati index was relied on to determine patellar height. The strength of this study was the number of cases with late presentations, all treated by the same surgeon with the mean follow-up time of 6.2 years.

5.1. Conclusion

All chronic patellar tendon ruptures had enough tissue for direct repair. In all but exceptional cases, tendon graft should be added to the procedure, preferably autogenously semitendinosus and gracilis; alternatively, an al-

lograft could be applied. All patellar tendon repairs must be reinforced by cerclage wire between the patella and tibial tuberosity. Intraoperative lateral knee radiography is strongly recommended to determine patellar position. A period of four weeks of knee immobilization is recommended with a long leg or cylinder cast. Cast immobilization does not compromise a range of motion of the knee joint. After cast removal, a hinged knee brace should be fitted that permits resumption of ROM 10 - 15 degrees/week. Routine removal of the cerclage wire is not recommended. Broken wire only needs to be removed in symptomatic cases. All patients must be informed preoperatively about possible limitations of knee ROM, especially flexion.

Footnote

Conflict of Interest: None.

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