

Original Article
Orthopaedics

SURGICAL RECONSTRUCTION OF NON UNION PATELLA AND NEGLECTED PATELLAR TENDON RUPTURE WITH SEMITENDINOSUS GRAFT – A PROSPECTIVE STUDY

Elango. M¹, Pragash. M¹,
Latchoumibady. K²

¹ - Associate Professor, Department of Orthopaedics,
Sri Manakula Vinayagar Medical College & Hospital,
Pondicherry

² - Professor, Department of Orthopaedics, Sri Manakula
Vinayagar Medical College & Hospital, Pondicherry

Corresponding Author:

Dr. Pragash. M
No. 405 D Block,
Srinivas Towers, Azeez Nagar
Reddiarpalayam, Pondicherry - 605 010
Email: pragashm76@yahoo.com

Submitted on: 01 June 2016

Accepted on: 07 June 2016

Abstract:

Background: Non-union of patella and neglected patellar tendon rupture cause significant disability due to disruption in extensor mechanism of knee. Reconstruction attempted months or years later is prone to unsatisfactory results due to difficulty in overcoming adhesions and contractures. Though a variety of techniques are described in literature, surgical reconstruction using semitendinosus free graft is a promising new technique. The purpose of this study is to prove the efficacy of semitendinosus graft for old patellar tendon rupture and patellar non-union.

Materials and methods: 5 cases of non-union patella and 3 cases of neglected patellar tendon rupture treated by semitendinosus free graft were included in this prospective study. Post-operatively, the functional outcome was assessed using Knee Scoring System.

Results: The mean age of patients was 41.8 years (range 29-55 years). All eight patients were males. The average duration after trauma was 13.8 months (range 3.5 months to 5 years). Pre-operatively, the average extensor lag was 116.33°, average range of motion was 0-121.25° and extensor mechanism gap was 9.93 cm. The average duration of follow-up was 10.5 months (range 8-15 months). In all 8 patients, semitendinosus graft was used to bridge the gap. The average length of the graft used in our study was 16.12 cm. At the final follow-up at 1 year, average extensor

lag was 13.75°, the average range of motion was 0-110° and the residual gap was 4.93 cm in the eight patients. As per the knee functional score, good results were seen in 7 patients (87.5%) and fair result in one patient (12.5%).

Conclusion: Surgical reconstruction of non-union patella and neglected patellar tendon rupture with semitendinosus graft is an effective method of treatment as gauged by post-operative outcome measures in terms of good range of motion of knee and minimal extensor lag.

Key-words: Non-union patella, neglected patellar tendon rupture, semitendinosus free graft.

Introduction:

Disruption of the extensor mechanism of the knee is an infrequent injury, when considering all types of knee injuries. The most common cause is fracture of patella followed by rupture of the quadriceps tendon and rupture of the patellar tendon.

Acute fractures of patella are usually treated by internal fixation thus restoring the continuity of extensor mechanism. However non-union of patella which is not so uncommon in developing countries presents with significant disability due to disruption of extensor mechanism. Non-unions of the patella are very rare with an incidence of 2.4-12.5%.¹ Treatment of non-union depends on the functional demands of the patient. Patients with limited functional demands may be managed by non-operative methods. However for young active individuals surgical intervention is essential to successfully restore the extensor mechanism without compromising the pre-existing mobility of the knee.² No clear-cut evidence is available in literature for the management of non-unions. The surgeon faces with the dilemma of either surgically fixing the non-union or performing a patellectomy. Fixing the non-union can be challenging at times, and performing a patellectomy does not altogether restore the extensor mechanism.

Ruptures of the quadriceps tendon are seen predominantly in patients older than 40 years, while ruptures of patellar tendon are more common among patients younger than 40 years³ and frequently after a direct trauma. Discontinuity of patellar tendon is quite disabling. It can occur following operations on the knee in which the insertion of tendon site has been disturbed, or after traumatic

rupture or laceration of tendon itself. If the disruption is not recognized early or if the initial repair fails, late reconstruction may be needed to allow the patient to walk brace-free. Chronic neglected tears of the patellar tendon represent a significant challenge to the achievement of acceptable structural and functional integrity. Reconstruction done months or years later is prone to unsatisfactory results because of difficulty in overcoming contracture and adhesions.⁴⁻⁶ Several authors have utilized a variety of techniques, but none has attained the stated goals on the treatment of this problem.

Surgical reconstruction with semitendinosus graft is a promising new technique in the management of non union of patella and neglected patellar tendon rupture thereby restoring the continuity of extensor mechanism. The purpose of this study is to prove the efficacy of semitendinosus graft for old patellar tendon rupture and patellar non-union.

Materials and methods:

This prospective study was conducted in the Department of Orthopaedics, JIPMER, Pondicherry between 2002 and 2004 and later continued in the Department of Orthopaedics, Sri Manakula Vinayagar Medical College and Hospital, Pondicherry between 2009 and 2013. Patients of any age with patellar tendon rupture and non-union patella more than 3 months old and extensor mechanism gap more than 5 cm (approximation should not be possible) were included in the study. Based on the inclusion criteria, we had 5 cases of non-union patella and 3 cases of chronic patellar tendon rupture during the study period. All cases had received native treatment

before attending to our institution.

The patients were evaluated preoperatively, in terms of duration since trauma, history of previous treatment, range of motion of knee, degree of pain, limitation of activity, joint instability, extensor lag and extensor mechanism gap. Both anteroposterior and lateral radiographs of the knee were taken to assess the extensor mechanism gap, type of fracture and to note the intra-articular or extra-articular pathology. Preoperatively all patients received physiotherapy to strengthen the muscles around the knee joint. All surgeries were performed by two senior surgeons under spinal anaesthesia with pneumatic tourniquet assistance.

The focus of our surgery was not at achieving union between the patellar fragments (in cases of non-union patella) or end to end suturing of the patellar tendon (in cases of patellar tendon rupture), but reducing and bridging the gap using semitendinosus free graft thereby restoring the continuity in the extensor mechanism.

Surgical technique:

The injured knee was approached by an anterior midline incision. Flaps were dissected to expose the patella, quadriceps and tibial tubercle (tibial tubercle was not exposed in case of non-union patella). Two transverse drill holes were made in the proximal and distal fragments of patella, silk was passed through the holes and patellar fragments were approximated as much as possible and the residual gap was assessed. In cases of patellar tendon rupture, the distal drill hole was made in the tibial tuberosity. The length of the silk needed for the approximation was the length of the graft needed.

Free semitendinosus graft was

harvested from ipsilateral limb. The previous midline incision was extended over the anteromedial aspect of the upper third of tibia and pes anserinus insertion was exposed. The semitendinosus was detached from its insertion. Through another incision at the level of the thigh, semitendinosus was identified and divided at the musculotendinous junction. During the second half of the study, the graft was harvested with a tendon stripper without an additional incision over the thigh. The thickness of the free graft was measured and accordingly the holes in the bone were enlarged to accommodate the graft. The free graft was passed through the drill holes and the patellar fragments were approximated as much as possible after full extension of the knee. In cases of patellar tendon rupture, the graft was passed through one transverse hole in the patella and another in the tibial tuberosity. The patellar tendon was then approximated with knee in extension. The graft ends were sutured under tension with prolene. Wound was closed in layers after achieving haemostasis. The operated knee was immobilized in gutter slab in full extension.

Isometric quadriceps exercises were initiated from the 1st postoperative day. After suture removal on 12th postoperative day, a cylinder cast was applied. X ray of the operated knee was taken to assess the residual gap. At 6 weeks, the cast was removed and progressive knee mobilisation was initiated. Patients were reviewed at regular intervals of 6 weeks, 3 months, 6 months and 1 year. During every review, the patient was evaluated clinically using Knee Scoring System (KSS).⁷ Results were considered good if total score was more than 9 points, fair if the total score was 6 – 9, and

poor if total score was less than 6.

Results:

Out of the total of 8 patients, 5 patients had non-union of patella and 3 patients had neglected patellar tendon rupture. Table 1 shows the demographic and clinical profile of the patients. Age distribution of patients varied from 29-55 years with mean age of 41.8 years. All eight patients were males. Five patients had left sided and three patients had right sided pathology. The average duration after trauma was 13.8 months (range 3.5 months to 5 years).

Pre-operatively, the average extensor lag was 116.33°, average range of motion was 0-121.25° and extensor mechanism gap was 9.93 cm. Quadriceps power could not be assessed due to discontinuity of the extensor mechanism. The average duration of follow-up was 10.5 months (range 8-15 months).

In all 8 patients, semitendinosus graft was used to bridge the gap. By this technique, at the end of 3 months, the average extensor lag reduced to 25°. Failure of graft was noted in one patient who sustained an accidental fall three months post-operatively. Before graft failure, the patient's extensor lag was 10° and range of motion was 0-90°. This patient underwent revision reconstruction with fascia lata. However, the patient developed septic arthritis of the operated knee joint which was treated by arthrotomy and joint lavage along with 6 weeks of antibiotics. During this period, the knee was immobilised in gutter slab for a period of 6 weeks. At three months, the extensor lag was 30° and the range of motion was 0-70°. At six months, the extensor lag was 20°, the range of motion was 0 - 90°, the residual gap was 4 cm and quadriceps

power was three.

The average length of the graft used in our study was 16.12 cm.

At the final follow-up at 1 year, average extensor lag was 13.75°, the average range of motion was 0- 110° and the residual gap was 4.93 cm in the eight patients. As per the knee functional score, good results were seen in 7 patients (87.5%) and fair result in one patient (12.5%).

Discussion:

Patellar tendon is a strong and important structure of the extensor mechanism of the knee. Ruptures of the patellar tendon usually occur during sports activity by violent contraction of quadriceps muscle against a flexed knee⁸ or by a direct trauma. Although the exact incidence of patellar tendon rupture is unknown, it is a relatively common injury of the extensor mechanism next in frequency to patellar fracture and quadriceps tendon rupture.^{9,10} Chronic ruptures are usually the result of missed diagnosis, inadequate initial treatment or late presentation. On the other hand, acute patellar fractures are often diagnosed and treated early. However, non-unions are usually the result of patient's neglect or treatment by osteopath.

Neglected ruptures and non-unions of patella become more evident after some time, because of proximal migration of the patella by the strong pull of the quadriceps. The resultant quadriceps contracture, along with fibrous degeneration, poses a challenge for any type of delayed reconstruction and can compromise even a well-performed repair.¹¹

Diagnosis is made upon clinical examination, inability to extend knee, a palpable defect distal to patella (in patellar tendon ruptures) or a defect

in patella (in non-union patella) and patella alta. Radiographs can clearly distinguish patellar tendon ruptures from patellar fractures.⁸

A variety of materials are available for reconstruction namely synthetic material^{12,13}, autograft using the semitendinosus alone¹³ or together with the gracilis⁸ and the contralateral bone-tendon-bone graft^{10,14}, or allograft using the Achilles tendon.¹⁵⁻¹⁷ However, harvesting a tendon graft¹⁰ from the uninjured leg can seriously limit its function, while the use of synthetic materials¹² and allografts¹⁷ increases the risk of bacterial or viral infection and neoplasia.

A semitendinosus autograft is often used in a wide variety of ligament and tendon injuries around the knee. This autograft is relatively strong and thick to restore the strength and stability of the extensor mechanism with minimal donor site morbidity.^{13,18}

Semitendinosus-gracilis (STG) tendons are rich in tendon fibers and thus serve to provide a strong graft. These doubled semitendinosus tendon grafts have been reported to reach an ultimate tensile strength of 2330N¹⁹ and they are often used in anterior cruciate ligament [ACL] reconstructions. The

strength and stability of the extensor mechanism can also be restored with less morbidity at the donor site.^{13,20} Preservation of the distal insertion of the STG can maintain its own blood supply thereby accelerating the healing process.

A significant challenge often encountered during the treatment of neglected patellar tendon ruptures is the difficulty in maintaining the correct patellar height. The strong force exerted by the quadriceps contracture and fibrosis can result in proximal migration of the patella. Numerous techniques have been previously described in order to adequately mobilize the patella and relocate it to its anatomical position. Mandelbaum⁵ recommended Z lengthening of the quadriceps tendon and Z shortening of the patellar tendon coupled with the semitendinosus and gracilis tendon grafts. In cases with severe contracture of the quadriceps tendon, external fixation with pins and wires⁶ and the Ilizarov method have been employed.²¹ In our study, we had no problems in mobilising the patella intraoperatively and hence we did not employ any additional procedures for its mobilization distally.

The knee function scores also revealed good outcome.

Distinguishing features of this study are:

1. Pre-operative traction was not applied, thus avoiding undue pin tract infection and its sequelae.
2. Artificial implants were not used, thus avoiding the complications of the implants and the need for another surgery for the removal of implant.
3. Quadriceps muscle was not disturbed thus avoiding any undue scarring/weakness of the muscle.

The main limitations of this study are a small sample size and a shorter follow-up period. Further studies are needed to establish the efficacy of this procedure.

Conclusion:

Surgical reconstruction of non-union patella and neglected patellar tendon rupture with semitendinosus free graft is an effective method of treatment as gauged by post-operative outcome measures in terms of good range of motion of knee and minimal extensor lag.

Source of support: Nil
Conflict of interest: Nil

Table 1: Clinical data

Serial No.	Age/Sex	Side*	Diagnosis	Duration of post trauma	Pre-op					Post-op			Total knee functional score	Results
					Extensor lag	ROM	Patellar gap(cm)	Surgical technique	Graft length (cm)	Residual gap (cm)	Extensor lag	ROM		
1	55/M	R	Nonunion patella	3.5 months	100°	0-110°	6.5	A	14	4	0°	0-100°	10	Good
2	29/M	L	Old patellar tendon rupture	5 years	130°	0-130°	15	A	18	8	30°	0-130°	10	Good
3	44/M	R	Nonunion patella	1 year	120°	0-120°	12	A	16	5	10°	0-130°	11	Good

4	50/M	L	Nonunion patella	5.5 months	100°	0-120°	7	A	14	3.5	10°	0-100°	10	Good
5	38/M	L	Nonunion patella	3.5 months	110°	0-110°	8	A	15	4	30°	0-110°	10	Good
6	34/M	L	Nonunion patella	4.5 months	90°	0-100°	7	A	15	4	←————→		-	Failure
			Nonunion patella with graft failure	7.5 months	90°	0-90°	6	B	12	4	20°	0-90°	8	Fair
7	40/M	R	Old patellar tendon rupture	6 months	100°	0-100°	8	A	13	4	0°	0-100°	11	Good
8	45/M	L	Old patellar tendon rupture	8 months	90°	0-90°	7	A	12	3	10°	0-90°	10	Good

Surgical technique

A - Gap reconstruction with semitendinosus graft

B - Gap reconstruction with fascia lata graft

Side*

R - Right

L - Left

Illustrations:

Series of photographs of a patient with patellar non-union



Pre-op clinical photograph of patella non-union



Pre-op extensor lag 120°



Post-op extensor lag 20°



Post-op range of motion 0-110°



Semitendinosus free graft



Intra-op photograph before reconstruction



Intra-op photograph after reconstruction with semitendinosus free graft

References:

- Harris RM. Fractures of the patella. In: Bucholz RW, Heckman JD, editors. 5th ed., Rockwood and Green's fractures in adults, vol. II, 5th ed. Philadelphia: Lippincott Williams and Wilkins;2001.p.1775-83.
- Satku K, Kumar VP. Surgical management of neglected fractures of the patella. Injury 1991;22:108-10.
- Matava MJ. Patellar tendon ruptures. J Am Acad Orthop Surg 1996;4:287-96.
- Takebe K, Hirohata K. Old rupture of the patellar tendon. Clin Orthop Relat Res 1985;196:253-5.
- Mandelbaum BR, Bartolozzi A, Carney B. A systematic approach to reconstruction of neglected tears of the patellar tendon. Clin Orthop Relat Res 1988;235:268-71.
- Siwek CW, Rao JP. Ruptures of the extensor mechanism of the knee joint. J Bone Joint Surg Am 1981;63:932-7.
- Levack B, Flannagan JP, Hobbs S. Results of surgical treatment of patellar fractures. J bone Joint Surg Br 1985;67:416-9.
- Van der Zwaal P, Van Arkel ER. Recurrent patellar tendon rupture: Reconstruction using ipsilateral gracilis and semitendinosus tendon autografts. Injury 2007;38:320-3.

9. Kapoora RK, Malhotrab R, Bhanb S. Traumatic bifocal avulsion of the patellar tendon. *Injury* 2005;36:115-7.
10. Milankov MZ, Miljkovic N, Stankovic M. Reconstruction of chronic patellar tendon rupture with contralateral BTB autograft: A case report. *Knee Surg Sports Traumatol Arthrosc* 2007;15:1445-8.
11. Falconiero RP, Pallis MP. Chronic rupture of a patellar tendon: a technique for reconstruction with Achilles allograft. *Arthroscopy* 1996; 12(5):623-6.
12. Kim JR, Park H, Roh SG, Shin SJ. Concurrent bilateral patellar tendon rupture in a preadolescent athlete: a case report and review of the literature. *J Pediatr Orthop* 2010;19:511-4.
13. Van der Bracht H, Verdonk R, Stuyts B. Augmentation of a patellar tendon repair with an autologous graft. *Acta Orthop Belg* 2009;75:417-9.
14. Dejour H, Denjean S, Neyret P. Traitement des ruptures anciennes ou itératives du ligament patellaire par autogreffe controlatérale. *Rev Chir Orthop* 1992;78:58-62.
15. McNally PD, Marcelli EA. Achilles allograft reconstruction of a chronic patellar tendon rupture. *Arthroscopy* 1998;14:340-4.
16. Lewis PB, Rue JP, Bach BR Jr. Chronic patellar tendon rupture: surgical reconstruction technique using two Achilles tendon allografts. *J Knee Surg* 2008;21:130-5.
17. Labib SA, Wilczynski MC, Sweitzer BA. Two-layer repair of a chronic patellar tendon rupture: a novel technique and literature review. *Am J Orthop* 2010;39:277-82.
18. Mihalko WM, Vance M, Fineberg MJ. Patellar tendon repair with hamstring autograft: a cadaveric analysis. *Clin Biomech* 2010;25:348-51.
19. Hamner DL, Brown CH, Steiner ME, Hecker AT, Hayes WC. Hamstring tendon grafts for reconstruction of the anterior cruciate ligament: biomechanical evaluation of the use of multiple strands and tensioning techniques. *J Bone Joint Surg Am* 1999;81:549-57.
20. Tashiro T, Kurosawa H, Kawakami A, Hikita A, Fukui N. Influence of medial hamstring tendon harvest on knee flexor strength after anterior cruciate ligament reconstruction. A detailed evaluation with comparison of single and double tendon harvest. *Am J Sports Med* 2003;31:522-9.
21. Isiklar ZU, Varner KE, Lindsey RW, Bocell JR, Lintner DM. Late reconstruction of patellar ligament ruptures using Ilizarov external fixation. *Clin Orthop Relat Res* 1996;322:174-8.