Neglected patellar tendon ruptures—a simple modified reconstruction using hamstrings tendon graft

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Received: 9 June 2013 / Accepted: 7 September 2013 / Published online: 1 October 2013
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Abstract

Purpose We hereby describe a cost effective and simple anatomical reconstruction without requirement for allograft or implants for neglected chronic patellar tendon injuries. This has been validated in seven patients with an average follow up of greater than three years resulting in good outcome.

Methods Seven patients (six males, one female) of mean age 41.8 years (range up to 57 years) presented with neglected patellar tendon injury. The time since injury ranged between three months and three years (average nine months). Active extension was not possible in three patients, and four patients had an extensor lag between 40° and 80° (average 62.5°). Four patients had quadriceps strength of grade 2/5 and three patients had grade 3/5. All patients had severe functional limitation with an average IKDC score of 46.8 (range 39–57). They all underwent patellar tendon reconstruction using hamstrings tendon autograft.

Results Postoperatively with a mean follow up of 40.7 months (range 31–52 months), all patients had a stable knee with mean flexion of 125° (range 120°–130°) and without any extension lag. Quadriceps power was regained in five cases to 5/5 and in two cases to 4/5. With an improvement in the IKDC score to 86.8 (range 80–92), excellent outcome was noted in five patients and good outcome in two patients. The average postoperative Lysholm score was 92.4 (range 89–95) and the average Kujala score was 94.5 (range 92–97).

Conclusion Patellar tendon reconstruction using hamstrings autograft for neglected patellar tendon injuries provides good stability and excellent outcome. Compared to previous techniques described, our technique is unique in being cost

effective and a simple anatomical reconstruction without the requirement for allograft or implants.

Keywords Tendon injuries · Chronic patellar tendon rupture · Patellar tendon reconstruction · Hamstring tendon graft · Neglected patellar tendon rupture

Introduction

Chronic patellar tendon injuries are rare as acute patellar tendon ruptures are extremely disabling and often primarily treated [1]. The true incidence of patellar tendon rupture is not known. It usually occurs near the inferior pole of patella in individuals younger than 40 years due to sporting activities [2–5]. Patients present late either due to neglect, native treatment or missed diagnosis. Neglected ruptures of the patellar tendon (defined as ruptures presenting after six weeks) are often difficult to repair [3, 6], and different techniques have been described for reconstruction of this uncommon problem that includes use of autografts, allografts and synthetic materials. We present our case series of seven patients with neglected patella tendon ruptures treated by a novel method of reconstruction using hamstrings tendon autograft. Our method of reconstruction has the advantages of being easy, economical and effective without the requirement of allograft or implants.

Materials and methods

Seven patients with neglected chronic patellar tendon ruptures were operated upon between April 2008 and September 2010. The average age was 41.8 years (range 22–57 years) and included six males and one female. The left knee was injured in five patients and the right knee in two patients. The time since injury ranged between three months and two years (average

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nine months). Road traffic accident involving two wheelers was the mode of injury in five patients. Other modes of injury included fall from a height in one patient and a penetrating injury to the knee by a knife in another patient. The reason behind delay in treatment was due to missed diagnosis by general practitioners in three cases and osteopath treatment in four cases. Six patients had isolated patellar tendon rupture and one was found to have an associated anterior cruciate ligament tear (Table 1).

All patients presented with symptoms of weakness in the legs with difficulty in getting up from a sitting position, climbing up and down the stairs and frequent falls while walking due to loss of balance. Although walking distance was not limited, the gait was cautious due to fear of buckling of the knee. The range of movements and extensor lag in the knee was measured using a goniometer with the patient sitting on the edge of a couch and legs hanging freely. Clinically, three patients were unable to actively extend the knee against gravity and four patients had an extensor lag ranging between 40° and 80° (average 62.5°). In all these patients' the passive knee range of movements were normal. Strength of quadriceps was assessed by Medical Research Council (MRC) grading of power and found to be of grade 2/5 in four patients and grade 3/5 in three patients. A palpable gap was noted below the patella in these patients due to the absence of resistance from the ruptured patellar tendon (Fig. 1a). High riding patella was noted in these cases compared to the opposite side (Fig. 1b), and the vertical alignment of patella was assessed by the Insaal-Salvati ratio (length of patellar tendon / height of patella in lateral view radiograph with knee flexed to 30°) which was on an average 1.64 (range 1.3–2.1). Quadriceps wasting was present in all cases and it ranged between 1.5 cm and 3 cm (average 2.4 cm) compared to the opposite thigh and its severity varied depending on the time since injury.

Table 1 Clinical data of cases

Case number	Age (years)	Mode of injury	Side of injury	Duration since injury (months)	Associated injury
1	46	Road traffic accident	Left	5	None
2	36	Penetrating knife injury	Left	4	None
3	22	Fall from height	Left	9	None
4	50	Road traffic accident	Right	8	None
5	47	Road traffic accident	Left	24	None
6	57	Road traffic accident	Left	10	None
7	35	Road traffic accident	Right	3	ACL tear

ACL anterior cruciate ligament

Radiologically, none of our patients had prior patellofemoral arthritis. All the patients had severe functional limitation with an average IKDC score of 46.8 (range 39–57) (Table 2).

Diagnosis was confirmed preoperatively by magnetic resonance imaging of the knee. In all these patients, the patellar tendon was reconstructed using semitendinosus and gracilis tendons harvested from the same limb. The patient with an associated ACL tear also underwent arthroscopic ACL reconstruction at the same sitting using quadrupled semitendinosus and gracilis tendon graft harvested from the opposite limb and the graft was fixed using bioscrews. The procedure was performed by a single surgeon (first author) in all patients.

Surgical technique Under spinal anaesthesia, through a long anterior midline incision, quadriceps tendon, patella, ruptured patellar tendon and tibial tuberosity were exposed. Care was taken to preserve the remnant fibres of ruptured patellar tendon and also the patellar fat pad. The proximally migrated patella was brought down to the anatomical position by sequential release of parapatellar retinaculum and patellofemoral joint arthrolysis. None of our patients required quadricepsplasty or quadriceps lengthening to restore the normal position of the patella. Through extension of the same incision, tendons of semitendinosus and gracilis located underneath the sartorius fascia attached to the anteromedial surface of the proximal tibia were exposed. The insertions of these tendons at the proximal metaphysis of tibia were detached, and using a closed tendon stripper these tendons were harvested. Muscle tissue attached to the tendon grafts was removed and both semitendinosus and gracilis tendons were combined and sutured together at their ends to form a single bundle. The diameter of this combined graft bundle was measured. This was found to be an average of five millimetres (range 4–6.5 mm) in our cases. Guide wires were passed horizontally through the lower half of the patella and at the tibial tuberosity parallel to each other near the attachments of native patellar tendon and perpendicular to the long axis of the patellar tendon. Bone tunnels were made over the guide wire using a cannulated drill taking care not to damage the articular surface of patella (Fig. 2a,b). The diameter of the tunnel matched that of combined semitendinosus and gracilis tendon graft size. The tendon graft was then looped sequentially through the bone tunnels prepared in patella and tibial tuberosity in a 'figure of 8' fashion (Fig. 2c). Care was taken to keep the patella in a normal position by matching the length of patellar tendon to that of height of patella, and an image intensifier was used intra-operatively to confirm the position of the inferior pole of the patella in 30° of knee flexion corresponding to the Blumensaat's line in the lateral view. The tendon graft ends were then sutured to one another by double breasting using 2–0 Ethibond sutures with knee flexed to 45° (Fig. 2d). The reconstructed tendon was reinforced by suturing the remnant patellar tendon fibres to the tendon graft.

Fig. 1 **a** Case of chronic patellar tendon rupture with palpable gap inferior to patella. **b** Radiograph confirms high riding patella

The strength of the tendon reconstruction and patella tracking was tested by performing a range of knee movements intra-operatively up to 90°, and it was also confirmed that there was no excessive pressure of patella over the trochlea of femur. Postoperatively, the knee was immobilised in a knee brace but gentle passive knee mobilisation was initiated with a continuous passive motion machine. Patients walked partial weight bearing with the knee brace in situ and with the help of axillary crutches. After six weeks, full weight bearing was allowed along with assisted knee mobilisation. Active knee extension was allowed only after ten weeks. Quadriceps strengthening exercises were allowed after three months with gradually increasing resistance.

Results

The patients were followed up for an average period of 40.7 months (range 31–52 months). All the patients regained stability of the knee with a complete range of movements within six months. The average postoperative knee flexion regained was 125° (range 120–130°) and was comparable to the preoperative flexion. In all these patients quadriceps strength had improved considerably without any residual extension lag at the end of one year. At the final follow up, quadriceps power of 5/5 was regained in five cases and two patients still had a power of 4/5. Quadriceps wasting (range 1–1.5 cm) persisted in three patients with long periods of

Fig. 2 Surgical technique. **a, b** Tunnels are made transversely in patella and tibial tuberosity. **c** Hamstring tendon graft is then passed through the tunnels in a 'figure of 8' fashion. **d** The ends of the tendon graft sutured using Ethibond suture

neglect following injury. The vertical alignment of patella was maintained with an average Insaal-Salvati ratio of 1.08 (range 0.8–1.3). Outcome was evaluated by Siwek and Rao's criteria [1] as well as knee function assessment scores including IKDC score, Lysholm score and Kujala score. Excellent outcome was noted in five patients and good outcome in two patients according to Siwek and Rao's criteria [1] (Figs. 3, 4). There was an improvement in the IKDC score from average pre-operative IKDC score of 46.8 to postoperative average IKDC score of 86.8 (range 80–92). The postoperative Lysholm score was an average

Table 2 Preoperative status

Case number	Extension lag	Passive ROM knee	Quadriceps wasting	Quadriceps strength ^a	Insaal ratio	IKDC score
1	Active extension not possible	0–130°	2 cm	2	1.4	47
2	Active extension not possible	0–120°	1.5 cm	2	1.7	45
3	70 deg	0–135°	2.5 cm	3	1.6	52
4	80 deg	0–125°	2 cm	2	1.5	46
5	40 deg	0–130°	3 cm	3	1.9	39
6	60 deg	0–135°	2 cm	3	2.1	42
7	Active extension not possible	0–130°	1.5 cm	2	1.3	57

ROM range of movement

^a Medical Research Council Grading

Fig. 3 Case example. **a** A 36-year-old female with a four-month-old patella tendon injury and extensor lag. **b** Preoperative radiograph showing high riding patella with Insaal-Salvati ratio of 1.7. **c** Patellar tendon reconstruction was done using hamstring autograft. **d** Postoperative radiograph shows restoration of vertical alignment of patella and position of drill holes for the tendon graft. **e,f** Follow up shows good functional outcome

of 92.4 (range 89–95) and the postoperative Kujala score was an average of 94.5 (range 92–97) (Table 3). There were no major peri-operative or postoperative complications. Minor complications included initial knee tightness and numbness over the lateral aspect of the knee which gradually improved. Radiologically, there were no incidences of patellofemoral arthritis. All the patients have resumed their preinjury occupation and activities.

Discussion

Patellar tendon rupture is usually unilateral and is commonly reported as a result of athletic injury [1, 3]. The condition is

very disabling and often treated primarily. However, chronic patellar tendon injuries are reported either as a result of neglect, native treatment or missed injury. In our series, five patients out of seven had an injury due to a road traffic accident (especially fall from two wheelers), making this the most common cause of injury in our part of the world compared to sports injuries which was described earlier. The delay in treatment was due to missed diagnosis by general practitioners in three cases and osteopath treatment in four cases. Various techniques of reconstruction have been reported by authors largely as case reports and there have been few case series studies for this uncommon problem. Ecker et al. [7] in 1979 reported four cases of late patellar tendon reconstruction using both the gracilis and semitendinosus tendons. Each tendon was passed through

Fig. 4 Case example. **a** A 35-year-old male with a three-month-old patella tendon injury and extensor lag. **b** Confirmed to have associated ACL tear by MRI. **c** Operated by hamstrings tendon graft harvested from both lower limbs for patellar tendon and ACL reconstruction. **d** Postoperative radiograph shows tunnels for ACL and patellar tendon graft. **e,f** Final follow up shows excellent functional outcome

Table 3 Post operative status at final follow up

Case number	Extension lag	Active ROM knee	Quadriceps wasting	Quadriceps strength ^a	Insall ratio	IKDC score	Lysholm score	Kujala score	Outcome ^b	Follow up (months)
1	Absent	0–125°	nil	5	1.3	92	95	94	Excellent	39
2	Absent	0–120°	nil	4	0.8	88	93	96	Good	38
3	Absent	0–130°	1 cm	5	1.2	80	93	95	Excellent	52
4	Absent	0–125°	nil	5	1.1	90	91	95	Excellent	43
5	Absent	0–120°	1.5 cm	4	1.2	82	91	92	Good	33
6	Absent	0–130°	1 cm	5	1.1	86	89	93	Excellent	31
7	Absent	0–125°	nil	5	0.9	90	95	97	Excellent	48

ROM range of movement^a Medical Research Council Grading

^b Siwek and Rao criteria

separate horizontal tunnels in the patella and sutured to each other. A cerclage wire was also used to supplement the stability. This may require implant removal later and also has a risk of iatrogenic patella fractures due to double tunnels in the patella. Dejour et al. [8] in 1992 reported patellar tendon ruptures treated with a contra-lateral autograft composed of a block of tibial bone, middle third of patellar ligament, block of patella, and quadriceps tendon. This has the limitation of producing morbidity in contralateral normal knee. In 2001, Casey et al. [9] reported four cases wherein the retracted patella was mobilised and the ruptured stumps were repaired and protected by multiple cerclage wires. Postoperatively these patients had flexion of 112°. This end-to-end repair in chronic cases may produce shortening of the patellar tendon and may be the cause of restricted flexion. In 2007, Van der Zwaal [10] reported two cases using semitendinosus and gracilis for reconstruction with augmentation of fixation by bioscrews and staples. In 2012, Chen et al. [11] reported two cases using semitendinosus and gracilis for reconstruction retaining the distal insertions of the tendons proposing preservation of vascularity of the tendons. Similar cases have been reported as single case reports using various techniques with different graft choices that included autograft (contralateral patellar tendon [12], semitendinosus tendon [3, 5, 13]), allograft (massive extensor mechanism graft [14], Achilles tendon [15–17]) or synthetic materials (carbon fibre [18], Dacron [19], LARS [20]).

Compared to other methods, our technique uses autograft which is easily available and has minimal morbidity. Using both semitendinosus and gracilis tendon graft with ‘figure of 8’ fastening of the tendon and reinforcement with remaining healthy patellar tendon fibres increases the stability and allows immediate mobilisation of the knee preventing stiffness. The advantage of our procedure is that it does not require any implants for augmentation, thereby reducing the cost and also avoiding second surgery for implant removal. None of our patients required pre-operative pin traction through the patella or intra-operative quadricepsplasty or quadriceps lengthening because excessive retraction of patella was found to be

prevented by the intact para-patellar retinaculum. However, in cases where there is extensive quadriceps contracture, these additional procedures may be required to restore the normal position of patella. The final outcome in our patients was found to be excellent in 71.4 % and good in 28.6 % of cases according to Siwek and Rao criteria [1]. The knee function scores (IKDC, Lysholm and Kujala scores) also revealed good outcome. The recovery in strength of the quadriceps was clinically assessed by MRC grading of power of knee extension. In all our patients we have seen postoperative improvement of quadriceps power by at least one grade and all of them regained full active extension of the knee.

Pre-operative MRI evaluation of the knee in addition to confirming the diagnosis also reveals associated ligament injuries so that they can be managed simultaneously as in one of our cases with associated ACL injury which was simultaneously managed by ACL reconstruction. Intra-operatively it is important to maintain the normal position of patella since both patella alta and patella baja have negative impact on knee function [21]. Maintaining the patellar tendon length avoids any extension lag or restriction of flexion. It is also important to prevent excessive compression of patella over the trochlea of the femur by adequate retinacular release to maintain smooth tracking and gliding of patella over the trochlea thereby preventing anterior knee pain. Gentle passive knee movements performed intra-operatively up to 90° confirms the strength of the reconstruction and the permissible range of movement possible. It also affirms normal patella tracking and smooth gliding over the trochlea without undue pressure. In addition to structural reconstruction of the patellar tendon, postoperative rehabilitation also plays a very important role in achieving an excellent functional result.

The main limitation of our study was the lack of an objectively measured quantitative variable for assessing strength of the quadriceps which would add value to the study. Unfortunately, we do not have such equipment available at our institute. However, any significant change in such a measure would be reflected clinically as a change in MRC grading of muscle power.

Conclusion

Untreated patella tendon ruptures result in severe disability in an active individual. Patellar tendon reconstruction using semitendinosus and gracilis tendon autograft provides good stability and excellent outcome. Compared to techniques described in previous studies, our technique is unique in being a cost effective, simple anatomical reconstruction without requiring allograft or implants.

Acknowledgments We wish to confirm that there are no known conflicts of interest associated with this study. There has been no significant financial support for this work that could have influenced its outcome.

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