

## Clinical Results of Reconstruction of Bilateral Pathological Quadriceps Tendon Rupture in Chronic Renal Patients

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### ABSTRACT

**Background:** Bilateral pathological quadriceps tendon rupture is a rare, challenging problem in chronic debilitating patients. A paucity of research are present in the literature and most of them are case report.

**Objective:** This case series study aimed to evaluate the results of quadriceps tendon repair reinforced by autologous tendon augmentation in chronic renal patients. **Methods:** Six chronic renal patients with bilateral quadriceps tendon rupture (5 males and a female) underwent quadriceps tendon repair augmented with an autologous tendon graft with a new special configuration that allowed early rehabilitation. **Results:** The mean Lysholm score at the final follow-up was  $93 \pm 6.09$  ranging from 85 to 100. We had no extension lag in this study and the mean knee flexion range was  $134.16 \pm 7.63^\circ$  ranging from 125 to  $145^\circ$ . **Conclusion:** Quadriceps tendon repair augmented with autologous tendon graft gives well to excellent results with no re-rupture complication in short-term results. **Level of evidence:** Therapeutic level IV.

**Keywords:** Quadriceps tendon rupture, Autologous tendon graft.

### INTRODUCTION

Bilateral pathological quadriceps tendon rupture is rare, its incidence reported in the United Kingdom was 1.37/100,000 per year [1]. The underlying comorbidities include chronic renal failure, DM, rheumatoid arthritis, gout, and local steroid injection [2]. Rupture of the quadriceps tendon in chronic renal patients occurs mostly at the osteotendinous junction due to secondary hyperparathyroidism and chronic tendon biomechanical changes from long-standing dialysis [3,4].

Surgical management is the treatment of choice for pathological quadriceps tendon rupture. Different techniques were used including simple repair [5], transosseous repair [6], suture anchor repair [7], and autologous tendon graft augmentation [8].

The purpose of this study was to evaluate the results of quadriceps tendon repair augmented by autologous tendon graft in bilateral quadriceps tendon rupture in chronic renal patients.

### PATIENTS AND METHODS

We conducted this retrospective study in the period from January 2018 to October 2022. Six chronic renal patients with bilateral quadriceps tendon rupture (5 males and a female) underwent quadriceps tendon repair in 7 knees, and transosseous suture in 5 knees augmented with an autologous tendon graft. The patient's mean age was 54.2 (ranging from 41 to 62) years. The mechanism of injury in this study was either spontaneous (three cases) or due to an eccentric quadriceps contraction with knee flexed and the foot on the ground that usually occurred during descending stairs to prevent a fall (three cases).

The mean interval between the injury and the surgical procedure was 2.3 (ranging from 1-3) weeks. The average follow-up period was 12 (ranging from 9 to 18) months.

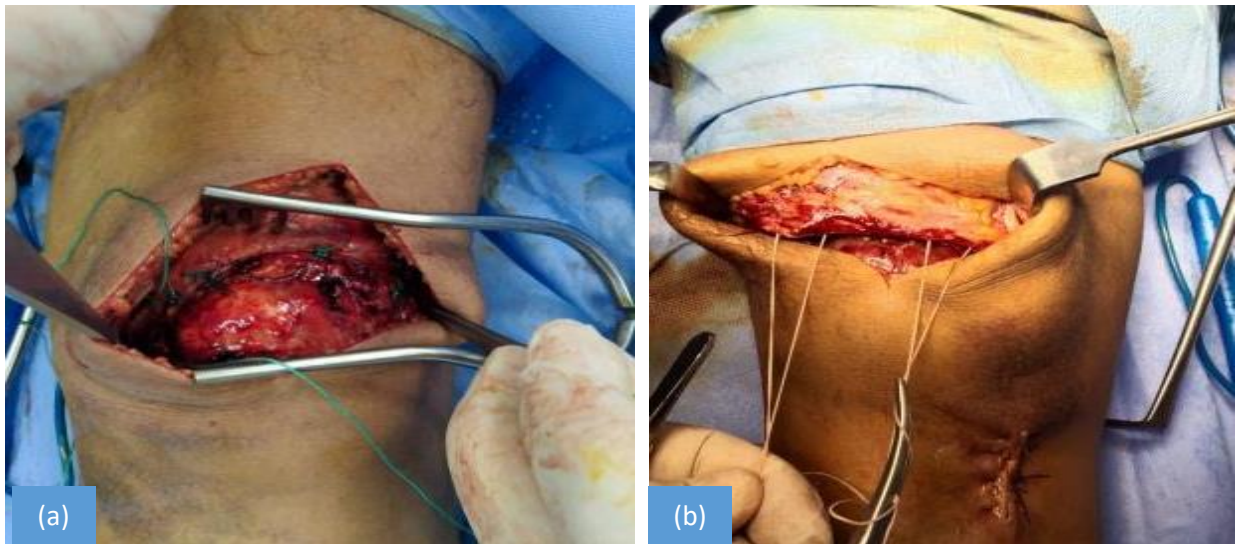
**Eligibility criteria:** Chronic renal patients with bilateral quadriceps tendon rupture with or without minor trauma.

**Exclusion criteria:** Acute traumatic and pathological quadriceps tendon rupture due to causes rather than renal failure were excluded.

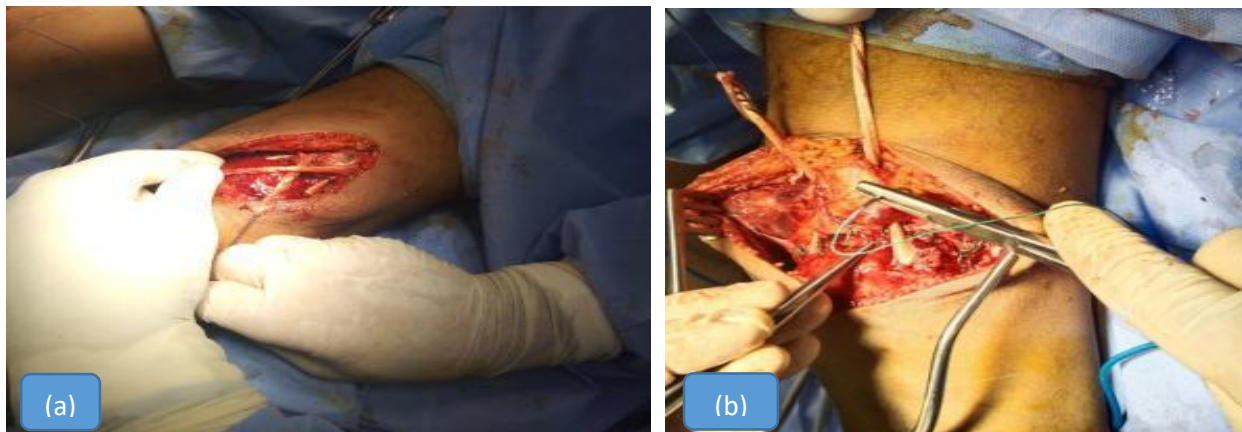
### Technique

With the patient in a supine position and under spinal anesthesia, sterilization and draping of both lower extremities were done after tourniquet application. We performed both sides simultaneously by two teams. An anterior midline incision was performed about 4-5 cm above the patella down to the patellar tendon. Skin and subcutaneous tissues were incised till the ruptured tendon. Any haemarthrosis or frayed tissues were cleaned and removed. An oblique incision was done at the medial aspect of the right proximal tibia for harvesting the gracilis and semitendinosus tendons.

The ruptured quadriceps tendon and the retinaculum were then repaired with non-absorbable suture to the distal stump (Figure 1A). In 5 knees, there was no distal stump and transosseous sutures were performed (Figure 1B). The harvested tendon graft was first passed and locked into the patellar tendon close to the inferior pole of the patella. The two limbs of the graft were then passed through the medial and the lateral retinacula to be inserted and locked into the quadriceps tendon above the site of tendon rupture (Figure 2 A). Each limb of the graft was passed through the quadriceps tendon in oblique manner and then reflected toward the patella in X shaped manner (Figure 2B). By a mean of thin osteotome, two osteofascial tunnels were prepared at the superolateral and superomedial aspect of the patella. The roof of the tunnel was formed of a thin layer of bone of the patella and the covering soft tissues and its floor was the patella itself. Then the two limbs of the graft were passed through osteofascial tunnels (Figure 3). The graft was locked by a simple suture at its entry and exit from the osteofascial tunnel. Reconstruction was then tested by flexing the knee to about 100 degrees. Closure of the wound was done in layers and a long above-knee cast was then applied.



**Figure (1):** (a) Simple suture of the quadriceps tendon rupture with nonabsorbable suture. (b) Transosseous repair with fiber wire sutures in case of quadriceps tendon avulsion.



**Figure (2):** (a) The lateral limb of the graft entered the quadriceps proximal stump from lateral to medial direction, and the medial limb was passed from medial to lateral. (b) The two limbs of the graft were reflected in X shaped manner into the patella.



**Figure (3):** The final shape of the tendon augmentation after its insertion into the osteofascial tunnels.

**Postoperative care and follow-up**

The above knee cast was removed three weeks after surgery then passive extension and assisted active knee flexion were started for the next three weeks. Full knee extension was maintained in between exercises by a knee brace. Active knee flexion and extension were started after the 6<sup>th</sup> postoperative week. Weight bearing was started at the 6<sup>th</sup> week with crutches then full weight bearing was at the 8<sup>th</sup> week. Knee muscles strengthening exercises with a focus on quadriceps muscle was started at the 3<sup>rd</sup> month, which included advance open and closed kinetic chain strengthening and gym strengthening exercises.

**Ethical approval: This experiment was ethically approved by the Faculty of Medicine, Zagazig University. After being fully informed, all participants provided written consent. The study was conducted out in line with the Helsinki Declaration.**

**Statistical analysis**

Data were analyzed using Statistical Package for Social Sciences software program version 23. The numerical values were recorded as means ± standard deviations.

**RESULTS**

The clinical results at the final follow-up were evaluated using the Lysholm score <sup>[9]</sup> and the flexion and extension range of motion. The mean Lysholm score at the final follow-up was 93 ± 6.09 ranging from 85 to 100.

We had no extension lag in this study and the mean knee flexion range was 134.16 ± 7.63<sup>o</sup> ranging from 125 to 145<sup>o</sup> [Table 1]. We had no wound complications nor quadriceps re-rupture till the end of the follow-up. Figure (4) represents the clinical results of one of our cases.

**Table (1): Patient demographics and the clinical results**

Case no	Age [years]	Gender	Mechanism of trauma	Time interval between trauma and surgery [weeks]	Surgical procedure	Lysholm score	Flexion range	Extension lag
1	41	Male	Eccentric quadriceps contraction with foot on the ground to prevent a fall	2	Rt; transosseo us suture and tendon augmentation	Rt; 100	Rt; 145	No
					Lt; simple suture and tendon augmentation	Lt; 100	Lt; 145	
2	55	Male	Eccentric quadriceps contraction with foot on the ground to prevent a fall	3	simple suture and tendon augmentation on both sides	Rt; 96	Rt; 135	No
						Lt; 96	Lt; 135	
3	60	Male	spontaneous	3	simple suture with tendon augmentation on both sides	Rt; 85	Rt; 125	No
						Lt; 85	Lt; 125	
4	58	Male	spontaneous	1	transosseous suture and tendon augmentation on both sides	Rt; 96	Rt; 140	No
						Lt; 96	Lt; 140	
5	62	Female	Eccentric quadriceps contraction with foot on the ground to prevent a fall	3	transosseous suture and tendon augmentation on both sides	Rt; 85	Rt; 125	No
						Lt; 85	Lt; 125	
6	49	Male	spontaneous	2	simple suture and tendon augmentation on both sides	Rt; 96	Rt; 135	No
						Lt; 96	Lt; 135	
The mean± SD	54.16	-	-	2.33	-	93±6.09	134.16±7.63	-



**Figure (4):** Clinical photos showed full knee extension of both sides and his ability to squat denoting full knee flexion.

## DISCUSSION

Bilateral pathological quadriceps tendon rupture is often misdiagnosed [10]. This may be attributed to the rarity of the condition and the absence of trauma in many cases. Moreover, the presence of haemarthrosis may obscure the palpable gap at the superior pole of the patella, which is the diagnostic sign for quadriceps tendon rupture. The delayed presentation usually leads to poorer results [11].

The association between pathological quadriceps tendon rupture and chronic renal failure is well explained. Secondary hyperparathyroidism that results from hypocalcemia and hyperphosphatemia in renal failure is the main pathological factor [3, 11, 12]. Secondary hyperparathyroidism increases osteoclastic activity and bone resorption at the enthesis. This is why quadriceps tendon rupture in chronic renal failure that usually occurs at its insertion at the superior pole of the patella [13, 14]. Chronic biochemical changes from long-term hemodialysis are another pathological factors [4, 12].

Different techniques were described in the literature for quadriceps tendon repair and reconstruction. To our knowledge, there is no comparative study to prove the superiority of any of these techniques over the others.

Isolated simple tendon suture in pathological quadriceps tendon rupture is not recommended by many authors as it may be complicated by knee extension lag or tendon re-rupture [6]. Simple quadriceps tendon suture is usually reinforced with an autologous tendon graft or the use of cerclage wire around the patella [15].

Transosseous repair is commonly used for quadriceps tendon avulsion without distal tendon stump. It involves the reinsertion of the proximal stump into the superior pole of the patella using resistant nonabsorbable sutures [16, 17]. However, this repair usually needs reinforcement especially in pathological tendon rupture [18].

Suture anchor repair was first introduced in 2002 by **Richards and Barber** [7], its main advantages are the short operative time and the high resistance strength of the suture which allows early rehabilitation programs. However, this technique has the disadvantages of being expensive, and also the transosseous repair was proved to have comparable or even more resistance strength than the suture anchor [19].

Autologous tendon graft, semitendinosus tendon was the mostly used in unilateral cases [20, 21], however, both semitendinosus and gracilis tendon were used in bilateral tendon rupture. **Rocha de Faria et al.** [20] recommended the use of the autologous tendon graft especially in delayed diagnosis of pathological quadriceps tendon rupture. The tendon graft alleviates the tension on the suture repair, reinforces the quadriceps repair, and allows early motion [20, 22]. However, graft site morbidity is the main disadvantage.

Simple quadriceps tendon repair was used in 7 knees in this study, more than the transosseous repair, (5 knees). This was because we used simple repair even in the presence of a small distal stump (up to 1 cm) depending on the strong tendon graft reconstruction. The design of tendon graft reconstruction was so strong that it also allowed early knee mobilization from the 3rd postoperative week. And this helped restore the preoperative knee flexion and extension range of motion in all cases at the final follow-up.

There are some limitations in this study. The first limitation of this study is the absence of a control group to compare our results with other techniques. The small sample size is a second limitation that can be attributed to the rarity of the bilateral pathological quadriceps tendon rupture. The third is the short follow-up, so we cannot surely exclude the incidence of quadriceps tendon re-rupture.

## CONCLUSION

This technique gives a suitable solution for strong repair and reconstruction of bilateral pathological quadriceps tendon rupture in chronic renal patients with early rehabilitation and so return to normal preoperative activities.

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**Competing interests:** Nil.

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