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Acute Quadriceps Tendon Rupture: Outcome of Early Mobilization after Suture Anchor versus End-to-End Repair with Wire Reinforcement in 12 Patients

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Abstract

Background: Acute extensor mechanism ruptures are common in young adults with patella fractures more frequent than soft tissue injuries. Several techniques have been suggested for repair of QTR yet little evidence exists pertaining to functional outcome after surgery. The authors intend to test the hypothesis that suture anchoring for acute quadriceps tendon rupture are strong enough to allow for early motion and offer better functional outcomes than traditional methods.

Patients and Methods: A prospective study involving twelve (N=12) cases of traumatic quadriceps tendon rupture managed surgically in our department between August 2012 and September 2016. Range of motion (ROM),

Muscle Tone (MT), time of return to pre-injury activities (t) as well as overall impression (S) and Lysholm Score (LS) was evaluated in the course of follow up.

Results: A mean active flexion of 125° (110-150) was observed in the group with suture anchors. Quadriceps Tone was 4, 5/5 and Lysholm score averaged 92 (85-100 points).The results were excellent in 4 cases, good in 2 with no fairly good or poor results. Mean active flexion was 100° (80-110°), quadriceps tone 3/5 and Lysholm score 85 (75-95) in the control group. The results were deemed excellent in 1 case, good in 3 and fairly good in 2 cases with removal.

Conclusion: Quadriceps tendon repairs by suture anchors are strong enough to permit early motion, weight bearing, while guaranteeing better functional outcome than traditional methods of repair.

Keywords: Acute quadriceps rupture; Suture anchor; Early motion; Functional outcome

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Introduction

Acute extensor mechanism ruptures are often sport related injuries in young adults. Soft tissue injuries are rather less frequent than patellar fractures [1]. Quadriceps Tendon Rupture (QTR) is an uncommon injury, affecting middle aged males with incidence estimated at 1.37/100,000 patients per year [2]. Spontaneous ruptures, even sometimes bilateral, have been reported in the older population with underlying conditions such as chronic renal failure, diabetes mellitus, systemic disease, substance abuse as well as long term fluoroquinolone and corticosteroid use [3,4]. Poor outcomes have been attributed to delayed treatment or chronic ruptures [5-7]. Several techniques have been previously described in literature for QTR repair with very few studies comparing biomechanical advantages and outcome of these different techniques [8-11]. The past 2 decades have seen many surgeons recommend a period of 4 to 6 weeks cast immobilization, 12 weeks of removable bracing after surgical repair of quadriceps tendon ruptures [12-14]. Prolonged immobilization comes with persistent pain, decreased motion and muscle weakness. Its implication in poor cartilage nutrition and loss of bone mass has been well documented in literature [15]. In contrast, the impact of early controlled knee motion and tension applied to the repaired tendon on overall muscle strength and range of motion cannot be overemphasized [16,17]. We hereby present a cohort involving twelve (12) adults operated for acute quadriceps tendon rupture in our department between August 2012 and September 2016. Emphasis is placed on repair using suture anchors with early mobilisation in a young population to guarantee satisfactory outcome.

Materials and Methods

Patients: Fifty six (56) knees were operated in our department between August 2012 and

Figure 1: Preoperative image showing palpable gapping.

Figure 2: Plain knee x-ray lateral view, although not shown in this image x-ray could reveal patellar spurs or fractures.

September 2016 for several adult native knee extensor mechanism ruptures. During this period, 38 patellar fractures and 18 soft tissue injuries were managed surgically. Out of this only 12 knees underwent repair for acute quadriceps tendon rupture by one of the senior authors (A.M) 8 males and 4 females aged between 25 and 48 years (mean age 34, 2 years) were involved. Only two (02) patients had a history of substance abuse or medication: Long term fluoroquinolone use for chronic osteomyelitis of the distal radius and the other an amateur athlete with a long history of anabolic androgenic steroid abuse. A single (01) patient was obese whereas there were no cases of diabetes mellitus, rheumatoid arthritis or evidence of any underlying systemic disease. Indirect trauma was reported in all but one of the cases, with sports being the cause of injury in six (06) patients. Four (04) patients were involved in a road accident with another (01) failing to extend his knee subsequent to a fall from work place. One (01) patient recalled knee pain after weightlifting. The demographic features of all patients are highlighted below (Table 1). Data was collected and analysed using IBM SPSS version 20 for windows. Quantitative variables were analysed using chi^2 test.

Diagnosis and preoperative management: Positive diagnosis was made clinically in ten (10) cases with failure of active knee extension. Palpable gapping and/ or a suprapatellar mass were found in six (06) cases (Figure 1). Plain knee radiographs (AP and lateral views) were performed in all cases to rule out patellar fractures (Figure 2). An MRI scan was also performed in all cases. The mean time between injury and repair was 5, 8 days.

Operative details: All patients were operated in a supine position

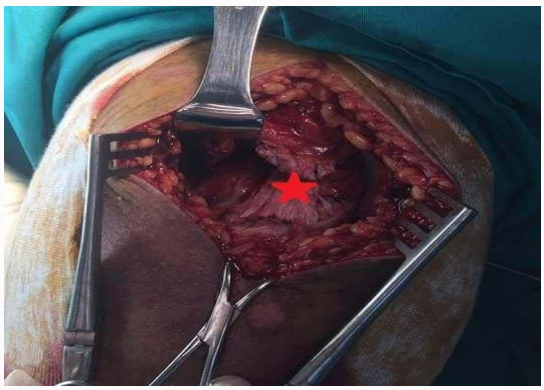

Figure 3: Operative image showing carefully exposed field with midsubstance QTR.

with careful exposition of the operative field albeit aided by an upper thigh tourniquet (Figure 3). A longitudinal midline incision 5 cm -7 cm distal to the superior patella pole was employed. Primary repair using suture anchors or simple suture with wire reinforcement was randomly and consecutively assigned in all 12 cases. Repair was done using PDS II sutures tied with the Krackow whipstitch technique augmented with cerclage wire on 20° knee flexion. In the event of suture anchor repair two 5, 5 mm non resorbable titanium anchors double loaded with 2-0 Fiber wire (FASTak®) were inserted into the patella. The anchor sutures were tied using the same Krackow whipstitch technique on 20° knee flexion. Adequate tensile strength of construct was verified intraoperatively and limb brace was worn post operatively for up to 3 weeks.

Rehabilitation protocol and follow up: The same rehabilitation protocol was prescribed in all cases and follow up was carried out independently by one of the senior authors (K.L). Active knee flexion up to 60° with brace free ambulation was encouraged depending on pain tolerance after 3 weeks. Physical therapy was intensified 4 weeks post operatively with full weight bearing 6 weeks after repair. Details of our knee rehabilitation programme are given in Annex 1. Follow up was done every 2 weeks up to 4 months, every 2 months up to the first year, and then twice a year afterwards. Patient gaits, general complaints and range of motion as well as quadriceps tone were recorded during follow up. Plain x-rays were not routinely required during follow up. After 12 months of follow up, functional outcome was assessed using the Lysholm knee rating system.

Results

The mean follow up was 30, 4 months (range between 16 months to 42 months) with only one patient lost to follow up after 16 months. After 12 weeks, 8 patients had high satisfaction with good pain relief in 7 out of 10 patients. At 6 months the average flexion in the group with suture anchors was 120° (range 100°- 130°) whereas average flexion in the control group was 100° (80° - 110°) (p=0,023). Most patients were able to maintain active knee flexion within 10° of the uninjured limb after 8 months. An extension lag of more than 10° of the uninjured knee was observed in 2 patients, 30 months after repair with simple suture and wire augmentation. Quadriceps muscle tone was good in both groups (4, 5/5 for SA group versus 3, 5 for the control group) Patients reached their preinjury level of activity at an average of 8 months (range between 6 - 12 months) after surgery. Lysholm knee rating scale (L.S) was evaluated by another independent group (B.S and A.N). At 12 months after repair, the

Table 1: Clinical features of patients undergoing QTR repair.

#	Age	Sex	Common Risk factors	profession	Cause of injury	Type of Repair	Delay in repair in days
1	38	M	None	Accountant	Football	SA	8
2	35	M	None	student	RA	SS+WA	3
3	48	F	None	Banker	Skiing	SA	6
4	32	M	None	Trader	Skiing	SS+WA	9
5	28	M	None	student	Football	SA	7
6	45	F	Obesity	Unemployed	Jogging	SS+WA	6
7	26	F	None	athlete	Basketball	SA	5
8	25	M	steroids	Bodybuilder	Weightlifting	SS+WA	6
9	32	F	Long FQ* use for chronic osteomyelitis distal radius	Farmer	Workplace fall	SA	4
10	39	M	None	Labourer	RA	SS+WA	5
11	33	M	None	Unemployed	RA	SA	7
12	30	M	None	Trader	RA	SS+WA	4

FQ: Fluoroquinolones, RA: Road accident SA: Suture Anchor, SS: Simple Suture WA: Wire augmentation

Table 2: Outcome after repair.

Measures	SA	SS+WA	p
ROM	0°-130° (120°)	-10°-100° (100°)	0 ,23
MT	4, 5/5	5-Mar	0,12
LR	92	85	0,14
T	8 months	8, 3 months	
Hardware Complications	0	1	
Rerupture	0	0	
S			
Excellent Good Fairly good or poor	4 2 0	1 3 2	

LR: Lysholm Rating; MT: muscle Tone; ROM: Range Of Motion
S: General impressions
T: Time of return to pre-injury activities
Quantitative variables are given in ranges accompanied by their means

Lysholm score was averaged 94 points (range between 85-100). There were no significant differences in terms of Lysholm rating between the two groups (92 versus 85 for simple suture with wire augmentation and suture anchoring respectively p=0, 14)). These and other pertinent results highlighting functional outcome between the two groups are presented in a table below (Table 2) One (01) patient presented with hardware complications requiring second surgery 2 years after primary repair with wire augmentation. However, there were no cases of re ruptured during the period of our study.

Discussion

The small sample size due to the rarity of the condition means our study is underpowered to detect significant differences with regard to patient outcome and demographics. Secondly differential loss could lead to bias. To reduce these biases we maximized patient follow up for possible hardware complications and failed repair. Patients' satisfaction and functional outcome were only measured in both groups after a minimum follow up of 12 months. Despite its limitations our study has several noteworthy strengths. First, patients involved in our cohort were operated by the same surgeon (A.M) and were alternatively and consecutively assigned to either one of the techniques of repair. Follow up and rehabilitation (Annex1) was the same in both groups and was prescribed by an independent observatory (K.L). The blinded nature of our post - operative follow-up and evaluation is to limit any further selection biases. Historically, operative treatment for acute quadriceps tendon ruptures has been end-to-end repair followed by lengthy periods of cast or brace immobilization [18,19]. However, postoperative immobilization does not allow for controlled stress and early joint motion that have been proven to accelerate and enhance healing of soft tissue injuries [20,21] Since the turn of the century, many authors have advocated the use of techniques that allow early aggressive motion. Recent studies report excellent results with decrease in length of time needed to gain full motion and tensile strength in repaired extensor mechanisms [22,23]. Early repair with early motion yields the best results. Currently, the most common repair method for acute quadriceps tendon rupture involves passing interlocking continuous sutures through patellar drill holes [24-26] although simple sutures still remain useful in repairs for midsubstance tears [27]. Other methods include the use of Dacron vascular grafts, polydioxanone (PDS) cord, carbon fibre, synthetic, prosthetic ligaments, as well as suture anchors which are in many ways similar to patellar tendon repair techniques. Suture anchors, more popular in rotator cuff tears are gaining support in acute extensor mechanism ruptures. The tenets of suture anchoring are well established. Severyns et al. [28] are currently evaluating the results of arthroscopic repair of QTR in a small pilot study. Many authors advocate that the technique is easy and it allows access to implantation site with reduced operative time [29]. In our very own little experience operative time was considerably shorter during repair with anchors (mean time of ins versus 89 mins, p=0,15). Wire augmentation used to protect sutures, like patellar drilling are often tedious to tie down, a compromise between adequate tensile strength, risk of failed repair or hardware complications. In addition, a recent biomechanical study by Bunnel [30] reported that suture anchors for repair of patellar tendon ruptures, may be clinically equal or superior to the established method of using transpatellar tunnels. As in the patellar tendon model, the quadriceps tendon suture anchor method reduces gap formation by providing an aperture fixation construct in which a very small amount of suture exists between the anchor eyelet and its interface with the tendon. Keeping in line with the main goals of current management of extensor mechanism ruptures, surgical treatment should provide enough strength in the construct thus permitting early range of motion exercises, improving function, and allowing earlier return to work or sport especially in a young population. The shift towards more aggressive early motion

is even advocated after repair using single suture augmentation. Reinforcement techniques are generally employed in the presence of poor quality of tendon or in case of delayed surgery and amongst others include wire augmentation [31]. In our case the rationale behind suture augmentation in the control group had no bearing on the quality of the ruptured tendon. Unlike West et al. [17], we strongly believe that augmentation especially with cerclage wire in acute repair could reinforce tensile strength while still allowing early motion. Nonetheless, repair using suture anchors is not without drawbacks. The main limitation is financial as simple sutures with wire augmentation or even patella drilling is far less expensive. A second concern is that of infection. In the event of complications such as deep infection or septic arthritis, removal of all foreign material is much easier in a transpatellar tunnel or cerclage wire augmentation case than a suture anchor case. Osteotomy or ostectomy could even be required to reach buried anchors. In our small series there were no cases of infection, no wound healing problems or anchor migration. One (01) patient had secondary surgery to remove the cerclage wire 2 years after surgery as a result of hardware complications. All but one patient reached their preinjury levels of activity at an average of 8 months. A 48 year old woman was reluctant to resume her light duty work until 12 months after surgery for fear of rerupture. West et al .[17] in a study involving 70 extensor mechanism ruptures, observed that 7 out of the 12 patients who sustained injury during sports activity returned to their preoperative sports 6 months after surgery. 2 patients elected not to return to sports whereas the remaining three barely did any sports after surgery.

Conclusion

Our experience with a limited number of cases has been encouraging, and this is the only series that compares the anchor technique with other traditional methods in terms of outcome. However, a well- planned, randomized, controlled trial would be required to evaluate the suture anchor technique relative to traditional methods vis-a-vis its biomechanical advantage and functional outcome.

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