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**Early patellar tendon rupture after total knee arthroplasty : A direct repair method**

Early patellar tendon rupture : A direct repair method

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## **Abstract**

### **BACKGROUND**

Patellar tendon rupture after total knee arthroplasty (TKA) is a catastrophic complication. Although the occurrence of this injury is rare, it can lead to significant dysfunction for the patient and very tricky to deal with.

### **AIM**

There has been no unified treatment for early patella tendon rupture after total knee arthroplasty (TKA), and long-term follow-up data are lacking. The purpose of this study was to introduce a direct repair method for early patella tendon rupture following TKA and determined the clinical outcomes and complications of this method.

### **METHODS**

During the period of 2008 to 2021, 3265 consecutive TKAs were retrospectively reviewed. 12 patients developed early patellar tendon rupture postoperatively and were treated with a direct repair method. Mean follow-up was 5.7 years. Demographic, operative, and clinical data were collected. The clinical outcomes were assessed using the WOMAC scores, HSS scores, knee range of motion, extensor lag, and surgical complications. The following statistical methods will be employed to analyze the data : descriptive statistics, paired t test.

### **RESULTS**

For all 12 patients underwent direct repair for early patellar tendon rupture, 3 patients failed : 1 knee (8.3%) of infection and 2 knees (17.6%) of re-fracture. 2 knees of re-fracture all underwent reoperation to reconstruct the extensor mechanism and 1 patient with infection underwent revision surgery. The range of motion (ROM) was  $109.2^{\circ} \pm 10.6^{\circ}$  preoperatively to  $87.9^{\circ} \pm 11^{\circ}$  postoperatively, mean extensor lag was  $21^{\circ}$  at follow-up, and the WOMAC and HSS averaged  $65.8 \pm 30.9$  and  $60.3 \pm 21.7$  points

## CONCLUSION

This direct repair method of early patellar tendon rupture is not an ideal therapy. It's actually ineffective for the recovery of knee joint function in patients, and will remain severe knee extension lag, with high complication rates. Compared with the outcomes of other repair methods mentioned in the literature, this direct repair method showed poor clinical outcomes.

**Key Words:** Direct repair; Patellar tendon fracture; Total knee arthroplasty; Reconstruction

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**Core Tip:** This direct repair method of early patella tendon rupture showed unsatisfactory clinical results in this group of patients, and it was actually ineffective for the recovery of knee joint function in patients. Therefore, we suggested that direct repair was not the preferred method to treat early patella tendon rupture, but should boldly choose other reconstruction methods. Our experience would be instructive for clinicians to treat early patella tendon rupture.

## INTRODUCTION

Patellar tendon rupture after total knee arthroplasty (TKA) is a catastrophic complication. Although the occurrence of this injury is rare, with a reported prevalence between 0.17% ~1%(1), it can lead to significant dysfunction for the patient and very tricky to deal with. The cause of the lesion can be traumatic or atraumatic(2). Traumatic rupture is mostly caused by direct trauma, such as a fall(1). Atraumatic ruptures may occur in degenerative tendons, and are usually secondary to immunocompromised conditions such as rheumatoid arthritis, systemic lupus erythematosus, diabetes mellitus or long-term use of steroids, to an infection, or to iatrogenic causes(3, 4).

Patellar tendon rupture occurring within 3 mo of total knee arthroplasty were considered early injuries, and all other injuries were considered late injuries(5). Non-operative treatment<sup>4</sup> of these injuries often results in chronic pain, difficulty with ambulation, extensor lag, decreased range of motion (ROM), limb instability, and increased fall risk(6). Operation must be considered if return to previous level of function and optimal range of motion is desired. There are multiple surgical options for patellar tendon rupture, including direct repair (eg, suture or suture Anchor)(7), reconstruction with allograft (eg, Achilles tendon allograft and whole extensor mechanism allograft), augmentation (eg, semitendinosus tendon)(8), synthetic material (eg, Marlex mesh)(9).

For early patellar tendon rupture, most surgeons still attempt to perform direct repair<sup>2</sup> by drilling tunnels or suture anchors, but the results have been historically poor with complication rates approaching 50%(10). For chronic injuries, direct repair is not suitable, while reconstruction with allografts has<sup>2</sup> been proposed as an alternative treatment for extensor mechanism injuries(10). Results following allograft reconstruction are uncertain, with some series reporting failure rates closing to 40%(11-14), while others report patient satisfaction rates of 89%(15). Direct repair of the extensor mechanism present many challenges both to the surgeon as well as the patient, and there is no consensus regarding optimal treatment. For the treatment of patellar tendon rupture, many surgical methods have not obtained satisfactory results. Nevertheless, there are very limited published reports of direct repair of early patellar tendon rupture in arthroplasty patients at present.

The primary aim of this study is to introduce a direct repair method for early patella tendon rupture following TKA and determined the clinical outcomes and complications of this method, and compared these results to similar studies to summarize potential advantages and disadvantages.

## **MATERIALS AND METHODS**

We retrospectively reviewed the medical records of all patients who underwent TKA from 2008 to 2021 were eligible for inclusion in this study. Patients who early patellar tendon rupture after total knee arthroplasty were recognized. Patients with extensor mechanism injuries and limited motion of hip or ankle before surgery were excluded. Sex, age, weight, height of each patient was noted. Radiological data included a weightbearing full length lower extremity antero-posterior radiograph performed with centered patella showing the entire lower limb, a medio-lateral view performed strictly perpendicularly to the superior face of tibial condyles, and an antero-posterior view performed with strictly centered patella. These radiological data included films taken by the patients before and 3 mo after operation. A consecutive series of 12 patients (1 man and 11 women; mean age 69 years; age range 59–81 years) were found to have patellar tendon rupture following TKA. In 12 patients, 3 with partially ruptured of the patellar tendon, while the remaining 9 were completely ruptured. All the patients had good tissue quality. The preoperative diagnosis was osteoarthritis in 11, inflammatory arthritis in one. The median follow-up period of patellar tendon ruptured was 5.7 years (range 3.3–10.6 years). The average time from patellar tendon rupture to repair was  $1.0 \pm 1.1$  mo (range 0–3 months). No patients were lost to follow-up. All surgery was performed by a senior surgeon. Patients were clinically assessed pre- and post-operation using ROM, extensor lag, Western Ontario and McMaster Universities (WOMAC), the Hospital for Special Surgery Knee Score (HSS), and radiographic evaluation.

### **Surgical Technique**

Patients were positioned supine on the operating table. An anterior midline incision, generally through or excising the prior surgical scar, was made, and medial and lateral fasciocutaneous flaps were raised, exposing the extensor mechanism (EM). Devitalized tissue was debrided, and the patellar tendon was assessed. Two longitudinal tunnels were drilled in the patella using a 3 mm drill. We used two No. 5 non-absorbable sutures running in a locked fashion on the medial and lateral aspect of the quadriceps tendon, then two sutures are passed through the two longitudinal patellar tunnels and

sutured to the medial and lateral sides of the patellar tendon, and the patellar tendon rupture was sutured separately (Fig. 1-A, B) , followed by suturing the joint capsule (Fig. 1-C) . Finally, titanium cable was used to pass through the superior edge of the patella, while the distal end of the titanium cable needed to pass through the tibial tuberosity. The titanium cable was tightened to form a tension band, and the titanium cable was fixed with cable clamps, and cut off the excessive titanium cable (Figure 1-D ) . The purpose of the titanium cable is to further reduce tension on the patellar tendon during postoperative knee movement. Titanium cable is generally removed 2-3 mo after operation. It is necessary to avoid prolonged indwelling of titanium cable, otherwise it may cause irritation to surrounding tissues, titanium cable fracture and limit the range of motion of knee joint of patient, *etc*. In the process of stitching, the suture lines must be continuously tightened to ensure that the EM remains a certain tension. All patients were immobilized with a brace for at least 6 wk and instructed to stay non-weight bearing, after that they were allowed to start partial weight bearing with passive and active physiotherapy(16).

### **Statistical Analysis**

Descriptive statistics are reported as the mean and standard deviation, as the mean and range, or as the number and percentage, as appropriate. Potential risk factors for these events included age, sex, BMI. All statistical tests were 2-sided, the differences in variables were compared using the paired t test, and a p level of <0.001 was considered significant. Analysis was performed using SPSS Version 25.0 software (IBM, Armonk, NY, USA).

## **RESULTS**

### **RESULTS**

Demographic and clinical data are summarized in Table 1. For all 12 patients who underwent direct repair for early patellar tendon rupture, ROM was  $109.2^{\circ} \pm 10.6^{\circ}$  preoperatively to  $87.9^{\circ} \pm 11^{\circ}$  postoperatively, average extensor lag reduced from  $30.2^{\circ} \pm 19.9^{\circ}$  to  $21^{\circ} \pm 18.1^{\circ}$ , and the WOMAC and HSS averaged 65.8 and 60.3 points (all p <

0.001). Among these patients, the patient with the best recovery had a postoperative range of motion of 112 °, extensor lag of 0 °, HSS score of 90, and WOMAC score of 6. However, the patient with the worst recovery had a postoperative range of motion of 70 °, extensor lag of 60 °, HSS score of 35, and WOMAC score of 96. The complication rate was 25%: 1 knees (8.3%) of infections and 2 knees (16.7%) of re-rupture, and all underwent reoperation. the result of this direct repair method after early patellar tendon rupture showed poor outcomes at long-term follow-up. The postoperative patients had low range of motion, accompanied by severe extension lag, and the incidence of postoperative complications was high.

The patient with postoperative early patellar tendon rupture underwent primary knee arthroplasty because of right knee osteoarthritis, and underwent 4 operations because of postoperative complications after primary TKA. The patient suffered from patellar tendon rupture due to trauma, and was treated with suture anchor repair technique in the other hospital (Figure 4-A). However, a large amount of exudation occurred in the knee incision after operation, so open irrigation, debridement, liner exchange was performed, but the knee was painful and had poor flexion. A few months later, the patient was treated with open reduction and this direct repair (Figure 4-B). Unfortunately, the titanium cable in the knee joint was broken after 2 mo and the broken titanium cable punctured the skin to form a sinus (Figure 4-C). To make matters worse, we found *Streptococcus aureus* in the patient's synovial fluid. After consideration, we performed revision total knee arthroplasty on the patient, and reconstructed the extensor mechanism with Marlex mesh (Figure 4-D). After operation, the knee joint was fixed with plaster for 6 wk, gradually increasing the range of motion, and the inflammatory index tended to be normal. For 2 patients with re-rupture after operation, we used semitendinosus as autograft to reconstruct extensor mechanism. After operation, 2 patients achieved a good final outcome, with good range of motion of the knee joint at the latest follow-up.

## **DISCUSSION**



The most important findings of the present study were that the result of this direct repair method after early patellar tendon rupture showed poor outcomes at long-term follow-up. The postoperative patients had low range of motion, accompanied by severe extension lag, and the incidence of postoperative complications was high. Previous studies were limited by the relatively small case number. We provided a more complete case series. Second, our study showed a low success rate of this direct repair and low patient satisfaction compared with other studies. We suggest that direct repair should not be the first choice for the treatment of early patellar tendon rupture.

Although the occurrence of patellar tendon rupture is rare, with a reported prevalence between 0.17% ~1%(1). Once it happened, it would have a devastating impact on the patients' daily life after operation, and often resulted in frequent falls, difficulty in walking, and pain(17, 18). The treatment of extensor mechanism disruption after TKA had remained a challenge for decades(19), the ideal method of treatment remained unclear. There have been few recent reports of direct repair after extensor mechanism disruption in arthroplasty patients, except for published in 2005(20) and 2018(10). And the literatures published in 2005 were specifically studied for quadriceps tendon. Our current case series provides an updated report about patellar tendon rupture.

Tracing back to the source, we found two reports about direct repair of extensor mechanism disruption after TKA in earlier years. In 1987, Lynch *et al* reported extensor mechanism complications in 281 TKA(21). Among these complications were eight extensor mechanism disruptions. All of these complications occurred within 9 mo of the arthroplasty. Of the four patellar tendon ruptures were direct repaired, one re-ruptured at four weeks after the operation, two had residual extensor lags of 18° and 22°, and 1 became infected. The failure rate of directly repair of extensor mechanism disruption is 50%, the average residual extensor lag in successful cases was 17.8 °, and knee flexion of 70°. In 1989, Rand *et al* reported extensor mechanism complications in 16 TKA, all of which were repaired directly except 3 cases(22). Of the nine patella tendon ruptures were treated with direct repair, all nine failed with six re-rupturing after the operation

and three became infected. The mean interval from the last TKA to diagnosis of rupture was seven months (range, 0 to 42 mo). The failure rate of directly repair of extensor mechanism disruption is 85%, the mean range of motion (ROM) was extension of -22° (range, 0° to -35°) and flexion of 86° (range, 30° to 145°). While the results from the Lynch *et al* and the Rand *et al* studies showed equally severe knee extensor lag and poor range of motion compared to our current study.

In the report of Courtney *et al*(10), 19 patients with patella tendon ruptures underwent direct repair. The reoperation rate was 53 %, the mean preoperative extensor lag was 11.7° and the mean postoperative extensor lag was 5.5°, the mean preoperative flexion was 106.0 and the mean postoperative flexion was 103.5°, the mean postoperative KSS was 106.6. Although the postoperative range of motion of the patients in this report was high, there was no significant improvement compared with that before operation, and the incidence of complications was still very high. Reconstruction with extensor mechanism allografts has been proposed as an alternative treatment for disruption of the extensor mechanism in cases of chronic injury or poor tissue quality that would preclude direct repair. However, their data suggest that there is no difference in outcomes between the direct repair and allograft reconstruction group.

In our research, the failure rate of direct repair was 25%, the average residual extensors lag in cases was 21 °, and average knee flexion of 87.9°, the WOMAC and HSS averaged 65.8 and 60.3 points. Combined with the above reports, the postoperative range of motion decreased or had hardly changed compared with that before operation, and the motion is limited. What's more serious was that there was severe knee extension lag, it will seriously affect the knee joint function. High incidence of postoperative complications also greatly increased the failure rate of surgery, and the postoperative scores showed poor recovery. It is far from enough to meet the patients' normal daily life after operation. Judging from these results, the result of direct repair is not satisfactory.

In addition to direct repair, there were other multiple surgical options for extensor mechanism disruption, including reconstruction with allograft, autograft and synthetic material(23). There was no consensus in the report as to the type of extensor mechanism reconstruction that yields the best results. At present, more and more evidence proved that the therapeutic effect of direct repair was unsatisfactory, which made us have to compare with the results of other treatments, in order to judge whether there was a better treatment.

Allograft augmentation had been considered the gold standard with multiple reports(13, 14). In the report of Wise *et al*(24),<sup>8</sup> Sixteen patients with 17 reconstructions (10 patellar tendons, 7 quadriceps tendons) were treated with achilles tendon allograft.<sup>8</sup> All patients underwent evaluation at an average of 45.7 mo. After reconstruction, the average extensor lag was 6.6° and average knee flexion was 105.1°, the extensor lag (6.6° *vs* 21° ) was significantly lower and the knee flexion(105.1° *vs* 87.9° ) was significantly higher than ours. In addition to Allograft, we found an up-to-date literature on synthetic material. Besides, monofilament polypropylene mesh has emerged as the preferred treatment(9). In the report of Buller *et al*(9),<sup>6</sup> 30 patients were treated with Marlex Mesh. The failure rate of the operation was 27%.<sup>6</sup> Of the successful extensor mechanism reconstructions, extensor lag improved a mean of 34°, with the average final lag measuring 9°± 8°, the average final active range of motion was 9° to 107 ± 15 degrees of flexion. The extensor lag (9°± 8° *vs* 21°±18.1°) was significantly lower and the knee flexion (107 ± 15° *vs* 87.9±11°) was significantly higher than ours. Similar results were found in comparison with the literature on autograft(25), where postoperative range of motion and the extensor lag were better than direct repair.<sup>9</sup> Patellar tendon reconstruction with autologous hamstring tendon graft allows for acceptable outcomes in the setting of patellar tendon disruption when direct repair is not possible(26).

In clinical practice, an extended knee fixation period of 4 wk must be performed after patellar tendon rupture to allow wound and tissue healing. Depending on the type of reconstruction performed and patient-related factors, weight-bearing limitations may

range from nonweight-bearing to partial weight-bearing(27). Some studies argued that immobilisation of the knee for 4 or 8 wk could generate post-operative stiffness with adherence and arthrofibrosis(28, 29). So some studies have proposed early rehabilitation after 4 wk, but there is no evidence of superiority of a protocol over another, Based on available data, the post-operative rehabilitation regimen does not influence extensor lag and ROM at follow-up, although early mobilisation has been reported to be associated with a greater knee flexion range at follow-up (27).

There were several limitations to this study, including its retrospective design. A limitation of our study was the small number of cases due to the low incidence of early patellar tendon rupture. We present the largest series to our knowledge. The operative reports were also not consistent in commenting on the quality of the tissues, the characteristics of the rupture.

After comparison with these reports, no matter whether we choose allograft, autograft or synthetic material to reconstruct extensor mechanism, the result of direct repair is not as ideal as that of these treatments. And direct repair had the severe extensor lag after operation, which will have a great impact on the postoperative function of the patients. After the failure of direct repair, these reconstruction methods can also be used as remedial measures. Just like the three patients who failed after operation in our cases, three of them received semitendinosus reconstruction and Marlex mesh reconstruction respectively, and all the patients recovered well after operation.

## **CONCLUSION**

This direct repair method of early patella tendon rupture showed unsatisfactory clinical results in this group of patients, and it was actually ineffective for the recovery of knee joint function in patients. More and more new surgical techniques had also shown better clinical results. Therefore, we suggested that direct repair was not the preferred method to treat early patella tendon rupture, but should boldly choose other

reconstruction methods. Our experience would be instructive for clinicians to treat early patella tendon rupture.

## **ARTICLE HIGHLIGHTS**

### ***Research background***

Patellar tendon rupture after total knee arthroplasty (TKA) is a catastrophic complication.

### ***Research motivation***

There has been no unified treatment for early patella tendon rupture after total knee arthroplasty (TKA), and long-term follow-up data are lacking. The purpose of this study was to introduce a direct repair method for early patella tendon rupture following TKA and determined the clinical outcomes and complications of this method.

### ***Research objectives***

We compared these results to similar studies to summarize potential advantages and disadvantages.

### ***Research methods***

We retrospectively reviewed the medical records of all patients who underwent TKA from 2008 to 2021 were eligible for inclusion in this study. Patients who early patellar tendon rupture after total knee arthroplasty were recognized.

### ***Research results***

For all 12 patients underwent direct repair for early patellar tendon rupture, 3 patients failed : 1 knee (8.3%) of infection and 2 knees (17.6%) of re-fracture. 2 knees of re-fracture all underwent reoperation to reconstruct the extensor mechanism and 1 patient with infection underwent revision surgery.

### ***Research conclusions***

This direct repair method of early patellar tendon rupture is not an ideal therapy.

### ***Research perspectives***

We suggested that direct repair was not the preferred method to treat early patella tendon rupture, but should boldly choose other reconstruction methods.



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Crossref

84 words — 2%
- 3

Brent T. Wise, Greg Erens, Aidin Eslam Pour, Thomas L. Bradbury, James R. Roberson. "Long-term results of extensor mechanism reconstruction using Achilles tendon allograft after total knee arthroplasty", International Orthopaedics, 2018  
Crossref

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C.T. Lim, Derek F. Amanatullah, James I. Huddleston, Alex H.S. Harris et al. "Reconstruction of Disrupted Extensor Mechanism After Total Knee Arthroplasty", The Journal of Arthroplasty, 2017  
Crossref

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Leonard T. Buller, Lucian C. Warth, Evan R. Deckard, R. Michael Meneghini. "Extensor Mechanism

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# Reconstruction Using Marlex Mesh: Is Postoperative Casting Mandatory?", The Journal of Arthroplasty, 2020

Crossref

---

7 JAMES A. RAND, BERNARD F. MORREY, RICHARD S. BRYAN. "Patellar Tendon Rupture After Total Knee Arthroplasty", Clinical Orthopaedics and Related Research, 1989 32 words — 1%  
Crossref

---

8 [www.pubfacts.com](http://www.pubfacts.com) 29 words — 1%  
Internet

---

9 James M. Friedman, Jae S. You, Jonathan D. Hodax, Mya S. Aung, Brian T. Feeley, Alan L. Zhang, C. Benjamin Ma, Drew A. Lansdown. "Patellar tendon reconstruction with hamstring autograft for the treatment of chronic irreparable patellar tendon injuries", The Knee, 2020 25 words — 1%  
Crossref

---

10 Jérôme Harambat, Bruno Ranchin, Laurence Dubourg, Aurélia Liutkus et al. "Renal Function in Pediatric Liver Transplantation: A Long-Term Follow-Up Study", Transplantation, 2008 15 words — < 1%  
Crossref

---

11 Matthew P. Abdel, Christopher G. Salib, Kristin C. Mara, Mark W. Pagnano, Kevin I. Perry, Arlen D. Hanssen. "Extensor Mechanism Reconstruction with Use of Marlex Mesh", The Journal of Bone and Joint Surgery, 2018 12 words — < 1%  
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