Chronic Quadriceps Tendon Rupture After Total Knee Arthroplasty Augmented With Synthetic Mesh

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Abstract

Tear of the quadriceps tendon after revision or primary total knee arthroplasty is a rare complication, but when it occurs, this injury has serious functional consequences. In complete tears, the outcome of direct repair is unpredictable, and several authors recommend that the suture should be reinforced. Several techniques have been described, including the use of autografts, allografts, and synthetic mesh. The goal of this study was to assess the outcomes of a reconstruction technique augmented with synthetic mesh.

A retrospective study was performed involving 3 patients who had chronic partial quadriceps tendon tear after total knee revision. In 2 cases, proximal quadriceps release was performed. When conservative management failed, surgical reconstruction with suture reinforced with synthetic mesh was attempted. The knee was immobilized in full extension for 6 weeks after the surgical procedure. A minimum follow-up of 12 months was required to assess results. All reconstructions showed clinical success at a mean follow-up of 19 months. Mean Knee Society Score improved from 55.7 to 87.3, with average postoperative extensor lag of 3.3° (range, 0°-10°). The mean visual analog scale pain score was 2.3 (range, 0-4). No complications were reported.

Synthetic mesh has previously been shown to be an effective treatment for patellar tendon repairs after total knee replacement, but there have been few articles on quadriceps rupture. Surgical reconstruction with synthetic mesh is a viable option that provides good functional outcomes in chronic quadriceps tendon rupture after total knee arthroplasty. [Orthopedics. 2017; 40(1):38-42.]

Rupture of the extensor apparatus of the knee is an uncommon but serious complication of total knee arthroplasty (TKA). This complication generally presents as avulsion of the patellar tendon at its insertion into the tibial tuberosity. Rupture of the quadriceps tendon after TKA is less common, and there is no consensus on its treatment.

In patients with no history of TKA, the outcome of a primary end-to-end suture after rupture of the quadriceps tendon is very good. Moreover, partial rupture of this tendon responds well to conservative management with immobilization in extension for 4 to 6 weeks. However, in patients who have undergone TKA, in particular, those who have undergone several surgical interventions, the outcome of direct suture is less predictable, and the repair should be reinforced. Various techniques for quadriceps tendon repair have been described, including the use of autografts, allografts, and synthetic mesh to reinforce end-to-end sutures.

This study assessed clinical outcomes with end-to-end sutures with synthetic mesh (MUTARS system; Implantcast GmbH, Buxtehude, Germany) for reinforcement in patients with chronic quadriceps tendon tears after revision TKA.

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**Materials and Methods**

A retrospective study was performed at the study hospital in patients diagnosed with chronic rupture of the quadriceps after revision TKA. In all cases, ruptures were partial and initially were treated conservatively with immobilization. After conservative management failed, surgical interventions were performed with end-to-end sutures and reinforcement with MUTARS synthetic mesh, as described later.

**Patients**

**Patient 1.** A 77-year-old man with no relevant medical history underwent TKA for primary osteoarthritis of the left knee at another hospital in 2007. After 3 years, he attended the authors’ hospital because of progressive knee pain and was diagnosed with aseptic loosening, suggesting the need for revision surgery. In May 2010, he underwent revision surgery, and the original implant was replaced with a constrained condylar prosthesis. This procedure required proximal extensile exposure and is also known as a quadriceps or rectus snip. During the postoperative period, the patient’s pain was resolved, with satisfactory stability and range of motion of 115° in flexion and 10° in extension.

One year after the revision surgery, after trivial trauma, the patient had pain and was unable to extend the knee fully. Examination showed an active knee extension deficit (60°), with limited passive extension (10°) and flexion reaching 120°. There was no evidence of instability as a result of medial-lateral or anterior-posterior ligament laxity. A palpable defect was noted on the lateral side of the quadriceps tendon, approximately 6 cm from the upper patellar pole. Ultrasound and magnetic resonance imaging were performed and confirmed rupture of the lateral side of the quadriceps tendon, spanning 70% of the tendon, with formation of intratendinous scar tissue. After 6 weeks of immobilization and subsequent physical therapy, the patient had nearly full passive extension (5°) but continued to have an active extension deficit (40°). He underwent surgical repair of the quadriceps tendon.

**Patient 2.** A 63-year-old man with a history of hemochromatosis underwent TKA for osteoarthritis in 2007 at the study hospital. Two years later, he was diagnosed with aseptic loosening and required a first revision. In 2013, he had pain and knee instability. He was again diagnosed with aseptic loosening and underwent further revision surgery, with a second change of implant. This time, a constrained, rotating-hinge prosthesis was placed. During the immediate postoperative period, the patient had rehabilitation, with active and passive flexion and extension, and by 3 months after surgery, he had range of motion of 110° in flexion and full extension (0°).

On routine evaluation 6 months after surgery, the patient’s clinical condition had deteriorated. He had pain and a notable decrease in active knee extension (50°). He did not recall any event that could have been the mechanism of injury. Ultrasound showed partial rupture of the lateral side of the quadriceps tendon. Because conservative management and subsequent physical therapy did not lead to clinical improvement, tendon repair surgery was performed.

**Patient 3.** A 65-year-old woman with no relevant medical history underwent TKA for primary osteoarthritis at the study hospital in 2006. In 2008, the patient had severe medial and lateral ligament instability. Total knee revision was performed with a constrained prosthesis with a rotating hinge through a quadriceps snip approach. In February 2010, the patient was diagnosed with aseptic loosening of the tibial component, and the component was replaced in May of that year. She showed good progress, achieving complete range of motion (active extension to 0° and 110° flexion).

Two years after surgery, the patient had acute pain on extension of the knee against resistance. Afterward, she was unable to extend the knee actively. Clinical examination showed a palpable defect in the quadriceps tendon, and after ultrasound scan, she was diagnosed with partial rupture of the tendon. Despite improvement after 6 weeks of immobilization and 6 months of physical therapy, the patient had motor deficit for active knee extension (45°) and underwent repair of the quadriceps tendon.

**Surgical Technique**

The same surgical protocol was followed in all cases. The patient was placed supine on the operating table, with a pneumatic tourniquet placed around the thigh. The tourniquet was inflated after exsanguination with an Esmarch bandage. To preserve blood supply to the skin, the previous skin incision was used. If multiple incisions had been made, then the most lateral incision was used. Dissection was performed with an effort made to preserve the skin with a subcutaneous flap, and the retinaculum and the extensor mechanism were exposed. Culture specimens were obtained and sent to the microbiology laboratory.

After all fibrous tissue was removed, the medial and lateral gutters and the suprapatellar pouch were recreated, and the proximal and lateral parts of the quadriceps tendon were mobilized. Then end-to-end multiple No. 5 Ethibond (Ethicon, Somerville, New Jersey) sutures were placed within the distal and medial parts of the tendon, which remained undamaged in all 3 cases. A polyethylene terephthalate MUTARS attachment tube (Implantcast) was tunneled through the midsubstance of the quadriceps tendon. In addition, a tunnel was created through the patellar tendon sheath to allow it to pass through the mesh (Figure 1). The mesh was drawn distally to the insertion of the patellar tendon and secured distally with multiple No. 5 Ethibond sutures. Finally, the reconstruction was strengthened with multiple No. 5 Ethibond sutures placed between the mesh tube and the repaired quadriceps tendon, with the knee fully extended.
Feature Article

The repair was reinforced with No. 1 Ethibond sutures. The subcutaneous tissues were closed in routine fashion with absorbable sutures (Vicryl; Ethicon), and the skin was closed with staples.

In all cases, the knee was immobilized in full extension for 6 weeks with a knee immobilizer customized to the size of the leg. Postoperative physical therapy included isometric static quadriceps contractions and partial weight bearing with crutches. After the 6-week period, progressive active assisted flexion exercises were initiated under the supervision of a physical therapist. At 3 months, further active flexion was allowed to a maximum of 90°, and quadriceps strengthening exercises were initiated. Although a hinged knee brace with a lockout feature was not used, this type of orthosis would be considered in a patient with low compliance.

A minimum follow-up period of 12 months was established to assess results. Data were collected on passive and active mobility and ability to walk. Clinical status was assessed with the visual analog scale score and the Knee Society Score.

RESULTS

Mean follow-up was 19 months (range, 12-27 months). The Table lists preoperative and postoperative data for all patients. Overall, the patients had satisfactory mobility (Figure 3), with mean range of motion of 111.7° (range, 110°-115°) in flexion and extensor lag of 3.3° (range, 0°-10°). At the last follow-up, 1 patient used a walking stick (case 2), but the other 2 walked without support. The mean visual analog pain scale score was 2.3 (range, 0-4).

When functional outcome was assessed, before surgical intervention, mean Knee Society function score was 55.7 (range, 47-68). Postoperative mean Knee Society Score was 87.3 (range, 85-90). To date, no complications have been reported.

DISCUSSION

Quadriceps tendon rupture is a rare complication of TKA, with a prevalence of 0.1% to 1.1%. Although it is uncommon, it is important for surgeons to be familiar with this complication. As with rupture of other components of the knee extension apparatus, quadriceps tendon rupture can be devastating for the patient and can present a challenge for the surgeon. Trauma can lead to complete or partial rupture of the quadriceps tendon, and there are predisposing systemic conditions. Several authors found an association between rupture of this tendon and diseases such as diabetes mellitus, rheumatoid arthritis, obesity, chronic renal failure, and hyperthyroidism. Various local factors are also associated with quadriceps tendon rupture, including previous TKA, intra-articular steroid injection, lateral retinacular release during TKA, and extensile approaches. In 2 of the 3 current cases, the patient had a history of revision surgery, with a proximal approach extended with incision of the quadriceps tendon at a 45° angle or rectus snip. Various authors showed good results with this type of extensile exposure, but if it is not performed correctly or if the patient has multiple surgical interventions or associated comorbidities, the tendon healing process may be compromised.

Treatment of partial tears of the quadriceps tendon with conservative management with 6 to 8 weeks of immobilization has produced good results. Dobbs et al treated 6 patients with partial quadriceps tendon tear conservatively. None of the patients had another tear or other sig-

Table

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Figure 1: Intraoperative photograph showing dissection of a tunnel through the patellar tendon sheath to allow passage through mesh for fixation of soft tissue to reinforce reconstruction of the tendon.

Figure 2: Intraoperative photograph showing the final appearance of the surgical site after reconstruction of the tendon.
significant complications, achieving mean extensor lag of 1° (range of motion, 0°-10°) and mean flexor lag of 99° (range of motion, 90°-120°) at the last follow-up. However, to avoid lateral movement of the femoropatellar joint, some authors suggest surgical treatment in cases of partial tear of the medial and lateral vastus. In the 3 current cases, the partial tear was located in the lateral part of the tendon, and outcomes were not good after conservative management with immobilization and subsequent physical therapy. The authors believe that conservative treatment may have failed because of the chronicity of the tear.

The outcome of direct suture of complete quadriceps tendon rupture after TKA is unpredictable. Yun et al reported 3 cases of quadriceps tendon rupture that occurred during the early postoperative period after TKA with proximal quadriceps release. These authors reported good results with simple suture repairs, probably because the lesions were diagnosed rapidly. Dobbs et al presented 11 patients with complete quadriceps tendon rupture, 10 of whom had previously undergone tear repair. Outcomes were good in only 4 patients. Complications included 4 cases of rerupture, 2 cases of infection, and 1 case of instability and genu recurvatum. Lynch et al presented 3 cases of quadriceps rupture with poor outcome after repair of the primary suture. Of these, 1 patient had rerupture and the other 2 had limited flexion and extension of the knee.

Based on these findings, the use of a biologic or synthetic method of reinforcement has been recommended. A method that is widely used to repair the quadriceps tendon is based on allografts. Burnett et al reviewed 20 cases of rupture of the extensor apparatus of the knee treated with allografts and emphasized the importance of suturing allografts tightly in full extension. The subgroup of patients treated in this way (13 cases) had a mean extensor lag of 4.3° (range, 0°-15°), with mean flexion of 104°.

On the other hand, good outcomes have been obtained with synthetic implants for reinforcement in patellar tendon rupture after TKA. The use of synthetic materials avoids the elongation observed with allografts. In a recent article on quadriceps tendon ruptures without TKA, Morrey et al showed good results with synthetic mesh augmentation in acute and subacute injuries. In 8 knees treated with this technique, the clinical results were durable, with no intraoperative complications, no reruptures, and extension lag in only 1 knee. Browne and Hanssen concluded that, in most cases, compared with allografts, treatment of patellar tendon rupture with synthetic mesh tubes is reproducible, satisfactory, and lasting, with better outcomes, fewer complications, and lower associated costs. No large series have been published on the use of the synthetic mesh tubes for repair of the quadriceps tendon after TKA. Fernandez-Baillo et al observed a good outcome with the use of Dacron (US Catheter and Instrument, Glen Falls, New York) synthetic tube, especially in patients with poor tendon vascularization, tendon rerupture, or tissue retraction.

Limitations

Limitations of this study include the small sample size, attributable to the fact that this injury is relatively uncommon, and variability in the length of follow-up. Although the use of synthetic materials for quadriceps tendon repair is promising, further research is needed to standardize their use.

Conclusion

This article describes surgical reconstruction of the quadriceps tendon augmented with synthetic mesh because of poor tissue quality as a result of multiple surgical interventions and chronicity of the lesion. All patients had a partial rupture, and conservative management was attempted, in accordance with published recommendations. After conservative management failed, surgical intervention was performed, with no reruptures and good outcomes in mobility, quadriceps strength, pain, and patient satisfaction. This technique is suggested for chronic quadriceps tendon rupture after TKA.

References

1. Kim TW, Kamath AF, Israelite CL. Suture anchor repair of quadriceps tendon rupture


