The Knee 23 (2016) 177–180

Contents lists available at ScienceDirect

The Knee

Polypropylene mesh augmentation for complete quadriceps rupture after total knee arthroplasty

Scott R. Nodzo *, Sridhar R. Rachala

Department of Orthopedics, State University of New York at Buffalo, United States

ARTICLE INFO

Article history:
Received 14 May 2015
Received in revised form 22 July 2015
Accepted 2 September 2015

Keywords:
Quadriceps rupture
Polypropylene mesh
Total knee arthroplasty
Extensor mechanism

ABSTRACT

Introduction: Polypropylene mesh has previously been shown to be an effective treatment for failed patellar tendon repairs after total knee arthroplasty (TKA), but there have been few reports of this synthetic mesh used in complete quadriceps rupture after TKA.
Methods: We retrospectively reviewed seven consecutive cases in six patients with complete quadriceps tears after TKA who had their quadriceps tendon repaired with suture and polypropylene mesh augmentation. All but two patients had previously failed primary suture repair. Patient outcomes were evaluated using the Knee Society Score. Standardized anterior-posterior (AP), lateral and merchant radiographs were evaluated preoperatively and at final follow-up.
Results: Seven knees in six patients were evaluated with a mean follow-up of 34 ± 10 (range 24 to 49 months) months. There were only four clinical successes defined as an extensor lag less than 30°. Of the functioning knees at final follow-up ($n = 5$) the overall extensor lag in this group did significantly improve from 50 ± 13° to 20 ± 15° (range 5 to 40°) ($p = .01$). Mean postoperative flexion at final follow-up was 115 ± 8°. Mean Knee Society Score for function improved from 20 ± 30 to 45 ± 54 ($p = .03$) as did the mean Knee Society Score for pain (44 ± 18 vs. 74 ± 78, $p = .02$).
Discussion: Polypropylene mesh offered limited postoperative functional results when used as an augment to the multiply operated knee that sustains a complete quadriceps rupture after TKA, but did allow for significant improvement in postoperative pain outcomes.
Level of Evidence: IV

1. Introduction

Extensor mechanism rupture after total knee arthroplasty (TKA) is a rare and devastating complication with a prevalence of 0.1 to 2.5% [1–3]. Patients with complete quadriceps rupture after TKA are a small, but challenging population subset, and in one large series represented only 11 of 23,800 TKA patients [1]. A complete quadriceps rupture after TKA has a limited prognosis, and patients often have poor clinical outcomes and a high complication rate with both operative and nonoperative treatment modalities [1]. Direct repair of a quadriceps tear after TKA has shown unsatisfactory results with a high rerupture rate resulting in the exploration of alternate repair techniques [1,2,4]. Multiple surgical procedures have been developed to treat quadriceps rupture after TKA ranging from simple tissue repair to complex hamstring augmentation [1,4–8].

Some authors have proposed the use of synthetic adjuncts to augment a direct repair, or in place of a small quadriceps defect when direct repair is not possible [4]. Polypropylene mesh has been shown to be an effective treatment for failed patellar tendon repairs after TKA, but there have been few reports of this synthetic mesh used in complete quadriceps rupture after TKA [1,9]. Polypropylene mesh is more often used for inguinal hernia repair, and induces a fibrotic healing response in and around the mesh [10]. This fibrotic healing response makes it an attractive option for augmentation of a quadriceps repair.

The multiply operated knee after a TKA often has tenuous tissue quality, and a limited blood supply to both the patella and quadriceps region. The tissue defect and quality is an important factor when attempting to repair the extensor mechanism. In this setting, a synthetic adjunct like polypropylene mesh may add to the repair strength and success. The purpose of this study was to evaluate the effectiveness of quadriceps repair with polypropylene mesh augmentation. We hypothesized that this augmentation would give satisfactory clinical outcomes in the multiply operated knee with a complete quadriceps tendon tear after TKA.

2. Methods

Prior to the start of the study, approval was obtained from our institutional review board. We retrospectively reviewed seven consecutive

* Corresponding author at: Department of Orthopedics, 462 Grider Street, Buffalo, NY 14215, United States. Tel.: +1 716 898 5053; fax: +1 716 898 3323.
E-mail addresses: Spodzo@gmail.com (S.R. Nodzo), srachala@buffalo.edu (S.R. Rachala).

http://dx.doi.org/10.1016/j.knee.2015.09.007
0968-0160/

cases in six patients with complete quadriceps tears after TKA who had their tendon repaired with suture and polypropylene mesh augmentation between September of 2010 and December of 2011. Records were reviewed for patient demographics, knee range of motion (ROM), and any noted complications postoperatively. Knee ROM and extensor lag were measured with a goniometer by the senior author pre- and postoperatively. All patients evaluated had a minimum two-years clinical follow-up.

Patient outcomes were evaluated with pre- and post-operative Knee Society Scores. Standardized AP, lateral, and merchant radiographs were reviewed preoperatively and at final follow-up. The Insall–Salvati ratio was measured from the lateral knee radiographs for determination of patellar height, and the merchant view was utilized to evaluate patellar position in the trochlea.

All patients except two had failed at least one attempt at primary suture repair. One patient had undergone previous patellectomy for an infected patella nonunion after TKA with the remaining patients all having undergone previous patella resurfacing. Two had a failed quadriceps reconstruction in the setting of a periprosthetic infection. One of these patients had a chronic infection and underwent antibiotic spacer placement with intravenous antibiotic therapy before quadriceps repair, and the second was an acute periprosthetic infection, which underwent an irrigation and debridement with polyethylene exchange and intravenous antibiotic therapy before quadriceps repair (Table 1). Both infected patients were infection free at the time of revision quadriceps surgery based on preoperative inflammatory laboratory values and negative preoperative synovial fluid cultures. No patient had clinical signs of an intact extensor mechanism prior to surgery.

Quadriceps repair was performed using two standard running locking stitches placed in the rectus femoris with number five nonabsorbable suture, which were passed distally around the medial and lateral aspects of the patella for primary biologic fixation. A "pants over vest" technique was employed for approximation of the tear site. Proximal mobilization of the tendon was necessary in most cases to disrupt adhesions, but no advanced flap or turndown techniques were needed. Dissection underneath the lateral aspect of the patellar tendon down to the anterosuperior tibia was performed and a small groove approximately an inch wide and deep was created lateral to the tibial tubercle using a burr similar to previous reports using this mesh for patellar tendon reconstruction (Fig. 1) [9].

A 10 × 14 in. sheet of polypropylene mesh was tubularized to be about one inch wide, cemented into the tibial slot with methyl methacrylate, and then augmented with a single screw fixation. The mesh was passed up the lateral aspect of the patellar tendon, and woven through the proximal portion of the repair site in the more robust proximal tendon. Small slits in the tendon were created with electrocautery to help passage of the mesh being careful not to disrupt the previously placed Krackow stitches. The mesh was then brought up the medial aspect of the tendon and then woven through the proximal quadriceps tendon. Finally, the mesh was brought back down the lateral side of the quadriceps and sewn back onto itself distally (Fig. 2). Multiple number one nonabsorbable sutures were used to tack the mesh to the tendon at the four corners of the repair to ensure a secure fixation. A postoperative drain was utilized in all cases.

Postoperatively, patients were made toe touch weight bearing in a splint, then transitioned to a ROM knee brace locked in extension for six to eight weeks. Patients were allowed to increase their knee flexion approximately 10° per week out of the brace gradually over the next four weeks. A progressive increase in weight bearing was instituted at the eight-weeks point with full weight bearing by ten to twelve weeks postoperatively.

Data was evaluated with non-parametric Mann Whitney-U and descriptive statistics with a p-value < 0.05 considered statistically significant. Clinical failure of the repair was defined as a 30° or greater extensor lag at final follow-up, and was based on previous literature evaluating extensor mechanism reconstruction [11].

3. Results

Seven knees in six patients were evaluated with a mean follow-up of 34 ± 10 (range 24 to 49 months) months. There were five females and two male knees with a mean age of 60 ± 6 and body mass index (BMI) of 35.2 ± 8.2 (range 25.7 to 48.4). Three patients had diabetes mellitus, one with rheumatoid arthritis, and four patients had pulmonary disease requiring routine inhaled steroids. Mean time from failure of the primary repair to revision fixation with polypropylene mesh augmentation was three months (range two weeks to 10 months).

There were four clinical successes defined as an extensor lag less than 30°. Two quadriceps tendons re-ruptured and ultimately became infected. One of these knees re-ruptured four months after repair and subsequently became infected. This patient went on to a knee fusion. The second patient re-ruptured approximately three years after surgery and became infected a month later. Prior to his complete re-rupture and infection, he had a persistent extensor lag of 30°. The remaining failed knee had an extensor lag of 40° at final follow-up, but was functioning adequately with this deficit and required no further reoperation.

Of the functioning knees at final follow-up ($n = 5$) the overall extensor lag in this group significantly improved from 50 ± 13° to 20 ± 15° (range 5 to 40°) ($p = .01$), and the Insall–Salvati ratio also significantly improved from 0.76 to 0.99 postoperatively ($p = .03$). Mean postoperative flexion at final follow-up was 115 ± 8°. Mean Knee Society Score for function improved from 20 ± 30 to 45 ± 54 ($p = .03$) as did the mean Knee Society Score for pain (44 ± 18 to 74 ± 78, $p = .02$).

4. Discussion

Extensor mechanism disruption after TKA is a challenging complication that has seen the development of many different repair techniques. Due to the problematic nature of this condition, treatments have ranged from simple suture repair to complete replacement of the entire extensor mechanism with allograft [4,11–13]. Complications and technical considerations vary for patellar tendon and quadriceps tendon disruptions after TKA, and surgical outcomes have been equally disparate [1,3,9,14]. Complete quadriceps rupture after TKA is a catastrophic complication with limited postoperative outcomes. To our knowledge, this is one of the first studies to specifically evaluate polypropylene mesh augmentation after complete quadriceps rupture in

Table 1
Demographics and clinical details of patients treated with quadriceps tendon repair and polypropylene mesh augmentation after TKA. Abbreviations: DMT2, Type 2 diabetes mellitus; COPD, Chronic Obstructive Pulmonary Disease; IVDA, Intravenous Drug Abuse; CHF, Chronic Heart Failure; CKD, Chronic Kidney Disease; RA, Rheumatoid Arthritis.

Age	Sex	BMI	Time from rupture to repair (mos)	Systemic comorbidities	Procedures prior to mesh augmentation	Additional procedures at time of repair	Complications	Final outcome
62	F	29.8	3	DMT2, COPD	Failed quadriceps suture repair	None	None	5° extensor lag
61	F	32.8	0.5	COPD	None	None	None	15° extensor lag
62	F	32.8	0.5	COPD	Patellectomy for infected nonunion	None	Partial rerupture	25° extensor lag
55	M	25.8	3	Hepatitis C, IVDA	Infected TKA with antibiotic spacer placement	Reimplantation of TKA	Rerupture with infection	Antibiotic spacer placement
70	F	31.9	10	DMT2, CKD	Failed quadriceps suture repair	Revision TKA	Rerupture	40° extensor lag
52	F	48.4	1	COPD, DMT2, Tobacco Abuse	None	Polyethylene exchange	None	5° extensor lag
57	M	44.8	1	CHF, RA	Failed quadriceps suture repair; I&D with polyethylene exchange	Polyethylene exchange	Rerupture with infection	Knee fusion