Revision Extensor Mechanism Allografting After Total Knee Arthroplasty

Gabriel E. Lewullis, MD, Jeff G. Jasko, MS, Robert E. Booth III, MD, and Jess H. Lonner, MD

Abstract

This study analyzed the outcomes of revision extensor mechanism allografting (EMA) in 8 patients with failures of previous EMA after total knee arthroplasty. Fresh-frozen allografts were used. Knee Society Clinical Rating System (KSS) scores were used to measure clinical outcomes, with special attention given to presence of extensor lag and assistive ambulatory devices. Patients were observed for an average of 3.1 years. Two patients were considered failures due to infection within the first postoperative year of the revision EMA. In the remaining 6 patients, the average KSS score at most recent follow-up showed no improvement when compared with preoperative scores. Revisions of the failed EMA resulted in a high incidence of functional limitations, which continued to deteriorate over time.

Extensor mechanism disruption is a potentially devastating complication after total knee arthroplasty (TKA), with a prevalence reported to be between 0.1% and 3.0%.[1,2] Studies have shown variable success with a variety of reconstructive options. Extensor mechanism allografting (EMA) is a relatively successful treatment method for extensor mechanism rupture after TKA.[3-6]

Failure of EMA may occur with inadequate tensioning of the graft during surgery.[7] Maximal tensioning of the graft with the knee in full extension has shown to improve outcomes and reduce the incidence and severity of extensor lag after the procedure.[3-7] Nonetheless, residual weakness or graft failure still may occur after EMA. Treatment in these situations often involves extension bracing, but revision EMA or fusion also may be considered. To our knowledge, this is the first published study to report specifically on the outcomes of revision EMA in patients with failures of previous EMA after TKA.

Dr. Lewullis is Resident, Department of Orthopedic Surgery, Drexel University College of Medicine, Philadelphia, Pennsylvania.
Mr. Jasko is Research Coordinator, and Drs. Booth and Lonner are Orthopedic Surgery Attendings, 3B Orthopaedics, Pennsylvania Hospital, Philadelphia, Pennsylvania.

Address correspondence to: Gabriel E. Lewullis, MD, Department of Orthopedic Surgery, New England Baptist Hospital, 125 Parker Hill Ave, Boston, MA 02120 (fax, 617-754-6443; e-mail, lewullis@hotmail.com).

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Materials and Methods

We retrospectively reviewed 8 patients (2 men, 6 women) who underwent TKA and experienced at least 1 failure of EMA. These patients all had an EMA revision as treatment for failure of their initial EMA.

Average patient age at time of revision EMA was 64.5 years (range, 51 to 78 years). Average interval between primary EMA and revision EMA was 2.4 years (range, 0.25 to 3.25 years) (Table I). The 2 senior authors performed the revision EMA procedures. Modes of primary EMA failure in the 8 patients included infection of previous allograft in 2 patients (treated with removal of allograft, all knee components, antibiotic spacer), ruptured patellar tendon in 2 patients, attenuation of allograft in 1 patient, patella fracture in 1 patient (Figures 1, 2), and quadriceps rupture in 2 patients.

Five of the 8 EMA revisions were performed simultaneously with a revision TKA as treatment for failure of the previous TKA. Reasons for TKA revision included removal of antibiotic spacer in 2 patients and loose femoral and/or tibial components in 3 patients. The tibial and femoral components were exchanged in all knees that required a revision TKA at time of EMA revision. The remaining 3 patients were treated with

Figure 1. Anteroposterior view of preoperative patella fracture.

Figure 2. Lateral view of preoperative patella fracture.

revision EMA alone in a well-positioned, well-fixed arthroplasty. In all cases, polyethylene inserts were exchanged. No patellae were resurfaced.

The surgical technique utilized during the EMA revisions was similar to that described by Nazarian and Booth.[3] A fresh-frozen extensor mechanism allograft was used, consisting of tibial tubercle, patellar tendon, patella, and quadriceps tendon. Allografts had at least 5 cm of quadriceps tendon length. Using previous surgical scar, an anteromedial curvilinear incision was made. Medial parapatellar arthrotomy was performed. The previous allograft was removed completely following confirmation of its failure by direct visualization. In all cases, full extension of the knee was achieved prior to placement of the revision allograft.

An allograft was thawed and a trough was made in the tibial tubercle, measuring approximately 4 cm long and 1 to 1.5 cm wide. The allograft was prepared with a dovetail configuration to ensure that the allograft tibial tubercle bone plug fit into this trough and the patellar allograft aligned appropriately within the trochlear groove of the femoral prosthesis (approximately 1 cm above the joint line). The bone plug of the allograft was impacted into place and was secured with either cerclage wires (n = 7) or 2 compressive screws (n = 1) (Figure 3). During tensioning of the graft to the native quadriceps tendon, the knee was maintained in full extension. The quadriceps portion of the graft was secured with a heavy nonabsorbable, braided suture in a running Krackow weave (Figure 4). It was then advanced proximally beneath the patient's native quadriceps tendon and tied under maximal tension. After layered closure, a locked knee brace was applied with the knee in full extension at all times. Postoperative radiographs were taken to exhibit maintenance and fixation of the allograft (Figures 5, 6).

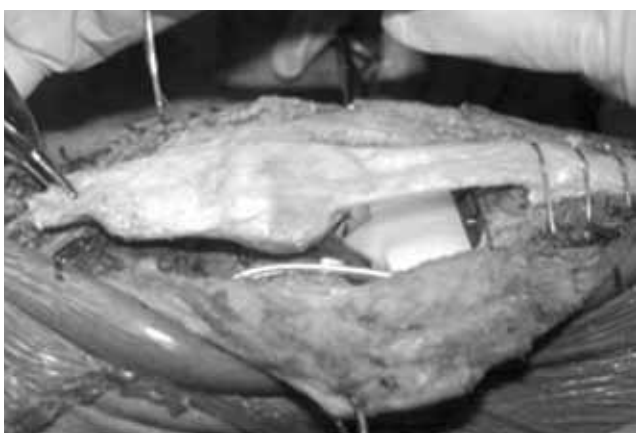

Figure 3. Revision extensor mechanism allograft secured on tibial side with cerclage wiring.

Figure 4. Quadriceps portion of allograft being sutured with knee in full extension.

All patients maintained full extension of the knee for 6 to 12 weeks, after which, passive range of motion between 0° and 30° in a brace was allowed for 6 weeks. For the following 6 weeks, range of motion was advanced, allowing 0° to 90° along with gentle quadriceps strengthening.

Patients were evaluated preoperatively and at yearly intervals postoperatively for a minimum of 2 years.

Table I. Patient Demographics

Patient	Sex	Age (y)	Years From Primary EMA to Revision EMA
1	F	51	1.7
2	F	53	2.7
3	M	66	3.3
4	F	75	1.3
5	F	72	0.9
6	F	68	0.8
7	F	78	0.3
8	M	53	8.0

Abbreviations: EMA, extensor mechanism allografting.

Figure 5. Postoperative anteroposterior view.

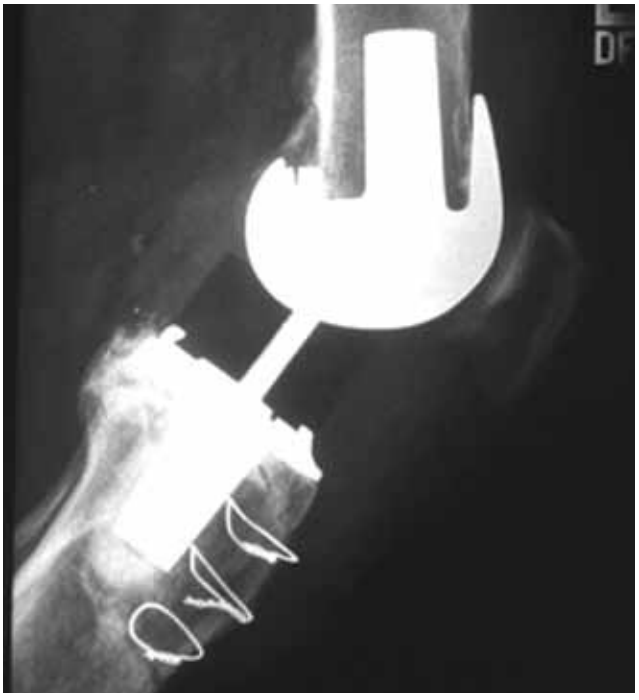

Figure 6. Postoperative lateral view.

Clinical outcomes were measured using the Knee Society Clinical Rating System (KSS) score, with special attention given to presence/absence of extensor lag as well as use of a walking assistance device. This study was approved by the institutional review board. All patients provided verbal and/or written consent for participation in the study.

Results

Two of the 8 patients developed periprosthetic infections within 1 postoperative year of revision EMA; 1 patient ultimately was treated with above-knee amputation, while the other patient was treated with removal of allograft and resection arthroplasty. Both had history of deep infection treated with staged revision prior to EMA revision. An antibiotic-impregnated spacer was used in both cases prior to EMA revision. Their cases were excluded from the final study group but were considered failures in the overall analysis. The remaining 6 patients had an average follow-up of 3.1 years (range, 2 to 6.3 years).

For the 6 patients in the final study group, the preoperative KSS score averaged 60 (range, 37 to 78), increased to 80 (range, 55 to 92) at 1 year after EMA revision, and decreased to 73 (range, 48 to 94) at 2 years after EMA revision. At latest follow-up, 2 patients had extensor lags less than 10° while the remaining 4 patients had extensor lags greater than 20°. At most recent follow-up, 2 patients did not require an assistive device to walk, 1 used a cane, and 3 used a walker (Table II).

Of the 6 patients, 2 were considered a clinical success (both had an extensor lag less than 10°; 1 patient used a cane and 1 patient did not need an assistive device).

Discussion

Loss of the extensor mechanism is a potentially devastating complication of TKA. The incidence has been reported to range from 0.1% to 3.0%.[1,2,8,9] Direct repair often is unsatisfactory because of compromised autogenous tissue of postarthroplasty patients.

Table II. KSS Scores and Postoperative Extensor Lags and Assistive Devices

Patient	Postoperative Follow-up (y)	Preoperative KSS Score	Postoperative KSS Score at 1 Year	Postoperative KSS Score at 2 Years	Extensor Lag at 1 Year	Extensor Lag at Most Recent Follow-up	Ambulatory Aids
1	4	44	55	54	0°	<10°	cane
2	6	63	90	94	<10°	>20°	walker
3	2	37	85	48	10-20°	>20°	none
4	2	63	80	80	>20°	>20°	walker
5	2	78	80	80	>20°	>20°	walker
6	2	77	92	84	0°	7°	none
7	0.25	42	infection	infection/AKA	infection	AKA	AKA
8	0.5	54	infection	infection	infection	no EM/patella	cane

Abbreviations: AKA, above knee amputation; EM, extensor mechanism; KSS, Knee Society Clinical Rating System.

Treating extensor mechanism disruption after TKA with EMA has proven to be successful in most patients to date. Nazarian and Booth showed clinical success in 34 of 36 patients treated with primary EMA at 3.6 years after the procedure.[3] Their study emphasized the importance of tightly tensioning the allograft with the knee in full extension. Burnett and colleagues found that extensor lags averaged 59° when the extensor mechanism allograft was tensioned minimally and averaged 4.3° when the allograft was tensioned tightly with the knee in full extension.[6]

The longest follow-up reported to date on primary EMA is 56 months. Burnett and colleagues used extensor tendon allografts or Achilles tendon allografts in 19 patients. Their results showed a mean preoperative KSS score of 27, which improved to 76 after EMA. Study participants had a mean postoperative extensor lag of 14° at a mean follow-up of 56 months.[6] All participants reported an improvement in functional status and an 89% satisfaction rate with their allograft reconstruction.

While prior studies have shown good results in a majority of patients with extensor mechanism dysfunction treated with primary EMA, the results of revision EMA are less satisfactory. Recurrent extensor mechanism failure following EMA reconstruction after TKA presents a substantial reconstructive challenge. This study shows that revision of the failed EMA has a high rate of failure and a high incidence of functional limitations related to extensor mechanism weakness, which continues to deteriorate over time. In the small subset of patients in this study, only 2 of the original 8 patients had extensor lags less than 10º and did not require an assistive walking device. Although the majority of patients (5 of 8 patients) underwent simultaneous TKA revision and EMA revision, there remained a significant functional impairment, as demonstrated by the limited improvement in range of motion and pain scores reported at follow-up.

Recurrent infection is a concern even after 2-stage revision. Therefore, alternative treatments, such as fusion or nonsurgical management, may be a better option than EMA revision, particularly in the presence of prior infection.

Authors' Disclosure Statement

Dr. Lonner reports that he is a consultant for and receives royalties from Zimmer. The other authors report no actual or potential conflict of interest in relation to this article.

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This paper will be judged for the Resident Writer's Award.