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High Failure Rates of Concomitant Periprosthetic Joint Infection and Extensor Mechanism Disruption

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ABSTRACT

Background: Patients presenting with both chronic periprosthetic joint infection (PJI) and extensor mechanism disruption (EMD) pose a significant challenge. As there is little in the literature regarding outcomes of patients with concomitant PJI and EMD, we performed a multicenter study to evaluate the outcomes.
Methods: Sixty patients with concomitant diagnoses of PJI and EMD were evaluated from 5 institutions. Patient demographics, presentation type, surgical management, and outcomes including recurrent infections, final surgery, and ambulatory status were documented.
Results: Fifty-three of 60 patients had an attempted extensor mechanism reconstruction/repair (EMR) of which 12 (23%) were successful, averaging 3.5 (range, 2-7) intervening surgeries. Forty-one patients (77%) were considered failures with recurrence of infection as most common failure (80%); 26 ended in fusion, 10 in above knee amputation, 3 with chronic resection arthroplasty, and 2 with chronic spacers/EMD. Seven patients had no attempt at EMR but proceeded directly to fusion (n = 6) or amputation (n = 1). There was no statistical difference between groups that had success or failure of EMR in age, American Society of Anesthesiologists Physical Status Classification System, or body mass index.
Conclusion: Our study demonstrates that concomitant EMD and PJI is a dreaded combination with poor outcomes regardless of treatment. Eradication of infection and reconstruction of the extensor mechanism often require numerous surgeries and despite great effort often end in failure. Consideration of early fusion or amputation may be preferable in some patients to avoid the morbidity and mortality of repeated surgeries.

Infection following total knee arthroplasty (TKA) remains one of the most dreaded and difficult complications to treat. The overall incidence of infection in the literature ranges between 0.5% and 2% for primary TKAs and 2% and 4% for revision TKAs [1–4]. In 2005, 16.8% of all revision TKAs in the United States were done because of infection and it is estimated that by the year 2030, 65% of all revision procedures will be performed because of infection [5]. While successful eradication of periprosthetic joint infection (PJI) has been reported in the range of 85%-95%, the mortality associated with PJI is high [6].

Disruption of the extensor mechanism is an infrequent, but catastrophic complication following TKA. Reports in the literature range from 1.4% to 3.2% [7–10]. Repair or reconstruction to the extensor mechanism disruption (EMD) is technically challenging. Multiple techniques have been described and inconsistent results in the literature with variable outcomes have been recorded [11]. A recent longitudinal study of patients treated with extensor mechanism reconstruction (EMR) using allograft demonstrated

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69% of knees retained the allograft at a mean follow-up of 68 months. However, the reoperation rate was high at 58% with the most common reason for reoperation being development of PJI at 26% [12].

Patients presenting with both chronic PJI and EMD pose a significant challenge. Both conditions are rare and the combination of the 2 diagnoses is even more rare. Allograft or synthetic material used for reconstruction can create difficulty for infection eradication. Removal of the extensor mechanism to treat the PJI can create substantial functional disability. While in the past these complications were often treated with fusion, functional limitations associated with arthrodesis have led many to attempt reconstruction/reimplantation in the hopes of maintaining greater function [13,14]. To date, there is little data in the literature to guide surgeons and patients on the outcomes of patients that end up with both of these devastating complications [12]. We performed a multicenter study to evaluate the outcomes of patients who have concomitant PJI and EMD. Our purpose was to evaluate the treatment strategies used and determine the outcomes, including functional status, of patients who present with these complications. In addition, we sought to determine risk factors for failure.

Methods

We performed a multicenter retrospective review of patients with concomitant diagnoses of PJI and EMD regardless of management. A query of the 5 participating tertiary referral centers' databases (OrthoCarolina, Rush, U of Utah, Indiana University, U of Virginia including 16 surgeons) was completed to identify all patients with a diagnosis of PJI (996.66) and TKA removal (CPT 27385 and 27488) with keywords of Marlex, aortobifemoral, quad(riceps) rupture, patella(r) tendon rupture, and disruption. Patients younger than 18 years and native knees were excluded. Patients diagnosed with PJI and EMD but who did not have an attempt at EMR but rather underwent early above the knee amputation (AKA) or knee fusion were included in the study for comparison of clinical outcome based upon number of surgeries, complication rates, and ambulation status at final outcome. These cases were not included in the "failure" rate of attempted EMR.

Patient demographic data at time of index surgery for PJI/EMD were collected retrospectively and included age at the date of surgery, sex, body mass index (BMI), and American Society of Anesthesiologists (ASA) Physical Status Classification System. The timing of the primary TKA, diagnosis of infection, diagnosis of EMD, infecting organism, and antibiotic resistance information were documented. Data were collected regarding the presentation of PJI in relation to the timing of the EMD. Additionally, presentation of PJI in relation to EMD was classified into the following groups for ease of analysis: group A: EMD occurred first and then PJI subsequently; group B: concurrent EMD and PJI; group C: PJI first and then EMD, thereafter. We also recorded the type of EMR (primary repair or reconstruction with augmentation with allograft, Marlex mesh, aortobifemoral endograft, etc.). If concurrent diagnoses of EMD and PJI on presentation, then we also noted surgical management such as 2-stage exchange with EMR, arthrodesis, amputation, etc.

We documented presentation type, surgical management (ie, 2-stage exchange with EMR, arthrodesis, amputation), and outcomes including reoperation (number of operations to final outcome), recurrent infections, and final surgery and ambulatory status. Ambulatory status was noted as yes/no; if yes (household or community) and whether walking aide was required and what type (cane, crutches, walker, none).

We used the Musculoskeletal Infection Society diagnostic criteria [15]. This criteria defines that PJI exists when there is a sinus tract communicating with the prosthesis or a pathogen is isolated by culture from at least 2 separate samples obtained from the affected prosthetic joint or 3 of the following 5 criteria exist: (1) elevated serum erythrocyte sedimentation rate and serum C-reactive protein concentration, (2) elevated synovial leukocyte count, (3) elevated synovial neutrophil percentage (polymorphonuclear leukocyte), (4) isolation of a microorganism in 1 culture of periprosthetic tissue or fluid, or (5) greater than 5 neutrophils per high-power field in 5 high-power fields observed from histologic analysis of periprosthetic tissue at $\times$400 magnification.

Diagnostic criteria for EMD included evidence on clinical examination of extensor lag (>15°) against gravity or more and radiographic evidence of a displaced patellar fracture disrupting the longitudinal patella, patella alta, or patella baja. In some cases, advanced imaging was used to diagnose EMD.

Criteria for successful EMR included clinical evidence of extensor mechanism continuity and function, which included continuously palpated tissue and an extensor mechanism lag of 15° or less against gravity.

Criteria for successful eradication of PJI was determined using the Delphi method described by Diaz-Ledezma et al [16]. The consensus definition of a successfully treated PJI is: (1) infection eradication, characterized by a healed wound without fistula, drainage, or pain, and no infection recurrence caused by the same organism strain; (2) no subsequent surgical intervention for infection after reimplantation surgery; and (3) no occurrence of PJI-related mortality (by causes such as sepsis, necrotizing fasciitis). Chronic antibiotic suppression was used in some cases as morbidity and mortality of recurrent infection would not be tolerated by patient risk factors including age and comorbidities and surgical history.

A total of 60 patients (22 men, 38 women) met the inclusion criteria. The mean age of the cohort was 66 years (range, 38-83; standard deviation, 9.4). The mean BMI was 34 (range, 21-49; standard deviation, 6.8). Overall, ASA score was II in 18, III in 27, IV in 3, and missing for 12 patients. Of the 60 patients, 31 presented with EMD first and subsequently developed PJI (group A), 17 patients presented with concurrent EMD and PJI (group B), and 12 patients developed PJI first and then EMD later (group C). Five of the 60 patients died during the course of treatment.

Results

Seven of the 60 patients were treated with early AKA (n = 1) or knee fusion (n = 6) based upon comorbidities, soft-tissue envelope, etc. We included these for analysis of ambulation and number of surgeries, and we did not include them in analysis of failures of EMR as no attempt at reconstruction was made.

An attempt at EMR was made in 53 of the 60 patients. The types of EMR are listed in Figure 1. Overall, 12 of the 53 patients (23%) had a successful reimplantation of their TKA, defined as presence of a functional and continuous extensor mechanism and no ongoing clinical evidence for PJI based on the defined criteria. The majority of those with a successful outcome (7 of 12) had prior EMD and repair/reconstruction and subsequently developed PJI (group A) treated with a 2-stage exchange reconstruction. These patients underwent an average of 3.5 surgeries (range, 2-7) between diagnosis and last surgery.

Forty-one of 53 patients (77%) were considered failures and averaged 5 intervening surgeries (range, 1-14). The primary mode of failure was recurrence of infection in 80% of patients (33/41), 8 for failed EMR (20%). Of the failures, 26 ended in fusion, 10 in AKA, 3 patients were left with chronic extensor mechanism deficiency, and 2 patients had retained chronic static spacers with unresolved EMD.