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Long Term Treatment Results for Deep Infections of Total Knee Arthroplasty

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ABSTRACT

This study aims to identify the long-term outcomes of total knee arthroplasty (TKA) treated for deep infection. 3270 consecutive primary and 175 revision TKAs were followed prospectively. There were 39 deep infections (1.16%): 29 primary (0.9%) and 10 revision (5.7%) cases. Two-stage resection and re-implantation procedure was performed in 13 primary cases with 10/13 (77%) successfully resolved. Early (<1 month) Irrigation and Debridement (I&D) was performed in 16 primary cases with 100% success. Late (>4 months) I&D was performed in 6 cases with 5/6 (83.3%) successful. Infection following revision TKA resulted in poor outcomes with both two-stage (2/4 successful) and I&D (2/6 successful). Deep infection after primary TKA can be successfully resolved with I&D and appropriate antibiotic treatment in the early postoperative course.

Peri-prosthetic joint infection (PJI) continues to be one of the most challenging complications following total knee arthroplasty (TKA). The percentage of patients who develop an infection after TKA remains in the range of 0.4% to 2% [1–3] and with the demand for TKA projected to increase exponentially over the next 20 years, there will be a commensurate increase in the number of infections [4,5]. Different treatment strategies have been implemented in an attempt to achieve acceptable long-term outcomes after the diagnosis of periprosthetic joint infections.

The management of peri-prosthetic joint infection is complex and current success of surgical treatment reported in the literature varies. Treatment options consist of long-term antibiotic suppression, irrigation and debridement (I&D) with prosthetic retention, one or two-stage resection and re-implantation procedures, definitive resection arthroplasty, amputation, or arthrodesis [6]. Patient, surgical, and organism-related factors all directly affect the course and outcome of the chosen treatment. Currently, there is still no consensus on which strategy is optimal. Of these treatment options, two-stage exchange arthroplasty using an antibiotic-impregnated cement spacer has been considered the gold standard with reported rates of infection control above 85% [7–12]. However, two-stage resection and re-implantation procedure is associated with a great deal of morbidity and cost, including difficult mobility between stages, pain, soft tissue compromise, financial burden, and extended length of treatment course [7,11,13,14]. I&D with implant retention, with or without polyethylene exchange (PE) has been an attractive option in certain clinical situations. Advantages of prosthesis retention include lower cost, lower perioperative morbidity, preservation of bone stock, and decreased technical surgical demand. Unfortunately, success rates with this treatment option are inconsistent, ranging from 12% to 80% [14–17].

Deep infection is a serious complication after TKA and how patients fare in the long-term after various treatment strategies remains uncertain. The purpose of this study was to identify the long-term results of TKA treated after deep infection at a single institution over a 10 year period. Operative treatment technique, antibiotic regimen, infecting organism, and diabetes status were also examined.

Materials and Methods

From June 19, 1999 to September 11, 2009, 3345 consecutive primary (3270) or revision (175) TKAs at Lahey Clinic were followed prospectively. Review of the database, Morbidity and Mortality conference reports and hospital medical records was conducted to identify patients

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who had deep infection after total knee arthroplasty. We included all patients who had primary TKA and revision TKA within our study period. Patients were excluded if they had infection in their operative joint prior to the index operation. Operative date, timing and type of surgical re-operation, presence of diabetes mellitus (DM), organism(s), need for suppressive antibiotic therapy and ultimate success or failure of the operation for infection were recorded.

A deep infection was defined as a positive culture of purulent material, identified below the fascia or joint capsule, either through aspiration or surgical exploration. All infections included in this study were evaluated by an infectious disease specialist and were documented in our institutional database.

Our surgical protocol for early I&D consisted of an extensive synovectomy, copious irrigation and debridement (9 L of NS delivered by pulsatile lavage) dilute betadine soak and wash, exchange of the modular components, and closing the arthrotomy over a drain. The drain was removed post-operatively when the output was less than 10 cc per 8 h shift. Each patient was then discharged and received 6 weeks of targeted IV antibiotic therapy followed by oral antibiotic suppression for at least 1 year. If the infection appeared to have resolved through clinical verification and downtrending inflammatory makers, the chronic oral suppression was discontinued.

All two-stage resection and re-implantations involved temporary antibiotic spacers (static or articulating) for 3 to 12 weeks prior to re-implantation (Table 1). Re-implantation of TKA was performed once infection was cleared based on negative aspiration results, normalization of inflammatory markers, and clinical assessment. An intra-operative frozen specimen was also sent for assessment of infection control with consultation of a pathologist at the time of re-implantation.

Our institutional criterion for eradication of infection prior to re-implantation was established as 5 or less neutrophils per high-powered field. In collaboration with infectious disease specialists, antibiotic regimens were tailored to the bacterial species found and patients were followed closely in the outpatient setting.

Success was defined as retention of TKA prosthesis and clinical resolution or suppression of infection with long-term antibiotic therapy at the most recent clinic visit prior to 2014. Failure was defined as need for definitive resection of prostheses, fusion or cases without clear documentation of clinical resolution or suppression of infection at most recent follow-up or at time of death.

Permission was obtained from the Institutional Review Board (IRB) for review of the medical records, Morbidity and Mortality conference minutes and the *Lahey* Clinic Total Joint Arthroplasty database.

Statistical Analysis

A Fischer's Exact test was used to assess all differences between the two groups with respect to each discrete variable. The *P* value was set at 0.05 for each test before the analysis. Two-by-two contingency tables were designed to assess successful versus failure of treatment of deep infection with regard to diabetic status, post-operative antibiotic regimen and incidence of infection between TKA groups treated with I&D and two-stage resection and re-implantation.

Table 1
GAS: Group A *Streptococcus*, GBS: Group B *Streptococcus*, CNS: Coagulase Negative *S. aureus*, MRSA: Methicillin Resistant *S. aureus*, BHS, Beta-hemolytic *Streptococcus*.

Patient	Procedure	I&D or Two-Stage	Successful (Y/N)	Organism	Diabetes (Y/N)	Specific Antibiotic regimen[a] (Y/N)
AB P1	Primary	I&D	N	No growth	N	N
SA P2	Primary	I&D	Y	No growth	Y	Y
JG P3	Primary	I&D	Y	No growth	N	N
JK P4	Primary	I&D	Y	GAS	N	N
MS P5	Primary	I&D	Y	GBS	N	N
MH P6	Primary	I&D	Y	No growth	N	N
VCP7	Primary	I&D	Y	CNS	Y	Y
RK P8	Primary	I&D	Y	*S. aureus*	N	N
LT P9	Primary	I&D	Y	*Peptostreptococcus*	N	N
JL P10	Primary	I&D	Y	*E. faecalis*	N	N
AG P11	Primary	I&D	Y	*S. marcescens*	N	N
SH P12	Primary	I&D	Y	*S. aureus*	Y	Y
GP P13	Primary	I&D	Y	*S. aureus*	Y	Y
VL P14	Primary	I&D	Y	MRSA	Y	Y
WM P15	Primary	I&D	Y	MRSA	Y	Y
DB P16	Primary	I&D	Y	MRSA	Y	Y
DN R1	Primary	two-stage	N	CNS	N	N
JG R2	Primary	two-stage	N	GAS	N	N
GW R3	Primary	two-stage	N	CNS	N	N
WB R4	Primary	two-stage	Y	CNS (2000), BHS (2011)	N	N
JC R5	Primary	two-stage	Y	CNS	N	N
JM R6	Primary	two-stage	Y	CNS	Y	Y
MT R7	Primary	two-stage	Y	CNS	N	N
JC R8	Primary	two-stage	Y	No growth	N	N
DA R9	Primary	two-stage	Y	GBS	Y	Y
GD R10	Primary	two-stage	Y	GBS	N	N
JV R11	Primary	two-stage	Y	*S. aureus*	N	N
FM R12	Primary	two-stage	Y	MRSA	Y	Y
LV R13	Primary	two-stage	Y	MRSA	Y	Y
CH X1	Revision	I&D	N	CNS	N	N
WH X2	Revision	two-stage	N	*S. aureus*	Y	Y
WF X3	Revision	I&D	N	*S. aureus*	Y	Y
MM X4	Revision	I&D	N	MRSA	Y	Y
PF X5	Revision	two-stage	N	MRSA	Y	Y
JD X6	Revision	I&D	N	MRSA	Y	Y
EH X7	Revision	I&D	Y	MRSA	N	N
JS X8	Revision	I&D	Y	CNS	Y	Y
BL X9	Revision	two-stage	Y	CNS	N	N
DL X10	Revision	two-stage	Y	*S. aureus*	Y	Y

[a] Specific antibiotic regimen = rifampin, doxycycline, a flouroquinolone, or a combination of the 3 for a duration of 3 to 6 months after initial 6 week IV antibiotic therapy.