The Journal of Arthroplasty 31 (2016) 118–123

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Posttraumatic Total Knee Arthroplasty Continues to Have Worse Outcome Than Total Knee Arthroplasty for Osteoarthritis

Matthew T. Houdek, MD, Chad D. Watts, MD, Steven F. Shannon, MD, Eric R. Wagner, MD, Stephen A. Sems, MD, Rafael J. Sierra, MD

Mayo Clinic, Department of Orthopedic Surgery, Rochester, Minnesota

ARTICLE INFO

Article history:
Received 9 April 2015
Accepted 13 July 2015

Keywords:
posttraumatic
total knee arthroplasty
outcomes
distal femur
proximal tibia

ABSTRACT

Small studies have shown that patients who undergo TKA following a distal femur and/or tibial plateau fracture have inferior results. The purpose of this study was to evaluate the mid-term outcomes of a large group of patients undergoing TKA following periarticular knee fractures. We identified 531 patients who underwent a TKA following a periarticular fracture from 1990 to 2012; comparing outcomes to 19,641 patients undergoing primary TKA for osteoarthritis. Periarticular fracture significantly increased the risk of revision TKA, infection and complications. There was no difference in the need for revision TKA or infection based on fracture location. Patients with TKA following a periarticular fracture have worse overall revision free survival compared to with OA, with 1 in 4 patients requiring revision TKA by 15 years.

Distal femur and proximal tibia fractures increase the risk for developing post-traumatic osteoarthritis and functional debility [1–4]. This increased risk is likely related to altered knee mechanics, bone loss, cartilage damage, and fracture fixation [5]. Although total knee arthroplasty (TKA) is an option for improving pain and function for posttraumatic arthritis, it is made difficult due to potential soft-tissue compromise, malunion, nonunion, bone loss, infection, and retained surgical hardware [5–12].

Several studies have examined the outcomes of TKA following distal femoral or proximal tibial fractures. However, they are small studies which are frequently limited to a single fracture location [5–9]. The purpose of this study was to analyze outcomes of patients undergoing TKA with a previous fracture of either the distal femur or proximal tibia; specifically examining complications and implant survival following surgery.

Materials and Methods

Following institutional review board (IRB) approval, we utilized our institution's total joint database to perform a retrospective review of all patients who underwent a primary total knee arthroplasty between 1990 and 2012. During this time period, we identified 23,609 patients who underwent a cemented condylar TKA. Of these, we identified 531 patients (2.2%) who had a history of distal femur and/or proximal tibia fracture. Patients are captured by the registry as having a fracture in this location based off the diagnosis listed by the staff orthopedic surgeon. The mean age of the posttraumatic cohort was 62 years (range 19–89 years), with 60% female (n = 317), and 51% (n = 278) obese (body mass index ≥30 kg/m^2) (Table 1). All patients were followed continuously at regular intervals through participation in the registry, with regular clinic visits or through telephone and/or mail survey until failure of the knee prosthesis or death. Mean follow-up was 6 years (range, 2–22 years). Primary outcome measures included revision surgery (subsequent removal or exchange of any components), infection, and need for an additional procedure on the affected knee for any reason. All outcomes were compared between groups.

In the posttraumatic cohort, 341 (64%) patients sustained a previous proximal tibia fracture and 190 (36%) sustained a distal femur fracture. Sixty-two percent (n = 328) of fractures were treated operatively either with open reduction internal fixation (ORIF) or an intramedullary nail (IMN). There was no difference between patients who had sustained distal femur versus proximal tibia fractures in regards to age (mean 62 years, range 19–88 years vs 63 years, range 28–89 years [$P = 0.44$]) or BMI (30.5 kg/m^2, range 16.9–52.1 kg/m^2 vs 30.5 kg/m^2, range 16.6–54.5 kg/m^2 [$P = 0.96$]). Implants used in this series included cruciate sacrificing (CS, n = 391) and cruciate retaining (CR, n = 72) design TKA, as well as semiconstrained knees (n = 46) and hinge knees (n = 20).

Continuous variables were compared using unpaired Student t-tests and categorical variables were compared with Fisher exact tests. Survival estimates were made using the Kaplan–Meier survival method. Outcomes for patients in the posttraumatic cohort were compared with those of 19,641 patients who underwent TKA for primary osteoarthritis (OA) during the same time period using the log-rank test. Proportional

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2015.07.022.

Source of funding: No disclosures of funding were received for this work from NIH, Welcome Trust, or HHMI.

Reprint requests: Rafael J. Sierra, MD.

http://dx.doi.org/10.1016/j.arth.2015.07.022
0883-5403/

Table 1
Hazard Ratios for Revision, Additional Procedures, Postoperative Infection and Complications Following TKA in Post Traumatic Arthritis.

Risk Comparison Posttraumatic vs. Osteoarthritis	Hazard Ratio (95% CI)	*P* Value
Revision total knee arthroplasty	2.23 (1.69–2.88)	<0.0001
Additional procedure	2.20 (1.79–2.66)	<0.0001
Postoperative infection	2.85 (1.97–3.98)	<0.0001
Postoperative complication	1.44 (1.24–1.66)	<0.0001
Distal femoral fracture vs. proximal tibia fracture		
Revision total knee arthroplasty	1.18 (0.68–2.00)	0.53
Additional procedure	1.21 (0.81–1.78)	0.34
Postoperative infection	0.79 (0.36–1.62)	0.53
Postoperative complication	1.47 (1.09–1.96)	0.01

hazard regression analysis was performed to assess the association of covariates with the risk of implant failure, reoperation for any cause, as well as postoperative infection and complications. Additional complications included deep vein thrombosis (DVT) and pulmonary embolism (PE), hematoma, delayed wound healing, limited knee motion, peroneal nerve palsy, periprosthetic fracture and component loosening. Multivariate regression analysis was not performed due to the limited number of events. All statistic calculations were made using JMP version 9 (Statistical Analysis Software, Cary, NC) with statistical significance set at a *P*-value < 0.05.

Results

Over the course of the study period, 56 patients (11%) in the fracture group underwent revision TKA at a mean of 4 years (range 1 week to 12 years) following primary TKA. Indications for revision included: infection (n = 22), instability (n = 11), component loosening (n = 13), inability to achieve 90° of knee flexion (n = 5), and periprosthetic fracture (n = 5). Furthermore, additional procedures were required for 104 patients (20%) at a mean of 2 years (range 2 days postoperative to 18 years) following surgery. The most common indication for a repeated procedure was manipulation under anesthesia (n = 31 [29.8%]).

Revision Free Survival

The overall 5-, 10-, 15- and 20-year survival, free of revision TKA in the posttraumatic group was 90%, 88%, 77%, and 67%, respectively. This was significantly worse (HR 2.23, $P < 0.0001$) than patients with a diagnosis of OA, where the same respective survivals were 96%, 92%, 85%, and 75% (Table 1). There was no difference (HR 1.18, $P = 0.53$) in revision free survival when comparing patients with a previous distal femur fracture to those with a previous proximal tibia fracture, where the 5-, 10-, 15-, and 20-year revision free survivals were 91% vs. 90%, 86% vs. 89%, 73% vs. 78%, and 49% vs. 78%, respectively (Fig. 1). The risk of revision in the posttraumatic TKA group was found to be increased in patients with an age 60 years or less (HR 2.33, $P < 0.0001$), as well as patients who developed a postoperative infection (HR 17.91, $P < 0.0001$), hematoma (HR 6.06, $P = 0.006$) or deep venous thrombosis or pulmonary embolism (HR 4.07, $P = 0.01$, Table 2) following TKA. There was no difference ($P = 0.31$) in the overall revision free survival when comparing the type of knee component used; however there was a trend for increased risk for revision with increasing knee constraint, with semi-constrained (HR 1.88, $P = 0.14$) knees having an increased risk of revision (Fig. 2).

Additional Procedure Free Survival

The overall survival, free of additional procedure, was also worse for patients in the posttraumatic group when compared to those with OA, with 5-, 10-, 15- and 20-year survivals of 81%, 78%, 67%, and 55%, versus 92%, 88%, 80%, and 70%, respectively (HR 2.20, $P < 0.0001$, Table 1). There was no difference in survival, free of additional procedure, when comparing patients with a previous distal femur fracture to those with a previous proximal tibia fracture, where the 5-, 10-, 15-, and 20-year revision free survivals were 81% vs. 81%, 72% vs. 80%, 59% vs. 70%, 40% vs. 64% (HR 1.21, $P = 0.34$, Fig. 1). The risk of needing an additional procedure in the posttraumatic TKA group was increased in patients younger than 60 years (HR 2.17, $P < 0.0001$), as well as in those with a postoperative infection (HR 10.12, $P < 0.0001$), hematoma (HR 9.84, $P < 0.0001$), or delayed wound healing (HR 9.26, $P < 0.0001$) (Table 2) following TKA. There was no difference ($P = 0.60$) in the overall additional procedure free survival when comparing all the type of knee component used as a group (Fig. 2).

Infection Free Survival

The overall 5-, 10-, 15- and 20-year infection free survival for TKA in patients with a previous distal femur or proximal tibia fracture was 93%, 92%, 91%, and 91%, respectively. This was significantly worse (HR 2.85, $P < 0.0001$) than for patients with a diagnosis of OA, where the 5-, 10-, 15-, and 20-year revision survival was 97%, 97%, 96%, and 96%, respectively (Table 1). There was no difference (HR 0.79, $P = 0.53$) in infection free survival between patients with a previous distal femur fracture compared to those with a previous proximal tibia fracture, where the 5-, 10-, 15-, and 20-year infection free survivals were 94% vs. 92%, 94% vs. 92%, 94% vs. 90%, and 94% vs. 90%, respectively (Fig. 1). The risk for a postoperative infection in the posttraumatic TKA group was increased in morbidly (BMI ≥ 40 kg/m^2) obese patients (HR 3.32, $P = 0.01$), as well as those with a history of fracture malunion or nonunion (HR 2.51, $P = 0.01$), postoperative hematoma (HR 8.56, $P < 0.0001$), or delayed wound healing (HR 15.41, $P < 0.0001$, Table 2) following TKA. Compared to other knee designs, the use of a semi-constrained knees had worse overall infection free survival ($P = 0.003$) and significantly increased the risk of postoperative infection compared to unconstrained PS (HR 4.09, $P = 0.002$) and CR (HR 3.41, $P = 0.03$) designs (Fig. 2).

Postoperative Complications

The overall 5-, 10-, 15- and 20-year postoperative complication free survival for TKA in patients with posttraumatic arthritis was 69%, 59%, 48%, and 23%, respectively. This was significantly worse (HR 1.44, $P < 0.0001$) compared to patients with a diagnosis of OA, where the 5-, 10-, 15-, and 20-year postoperative complication free survival was 75%, 70%, 64%, and 58%, respectively (Table 1). Complications included limited motion (n = 61, 11.5%), delayed wound healing (n = 29, 5.5%), periprosthetic fracture (n = 25, 4.7%), component loosening (n = 21, 3.9%), DVT/PE (n = 15, 2.8%), hematoma (n = 11, 2.1%), peroneal palsy (n = 9, 1.7%). Patients with a previous distal femoral fracture were at increased risk for a postoperative complication (HR 1.47, $P = 0.01$) compared to patients with a history of proximal tibial fracture where the 5-, 10-, 15-, and 20-year complication free survivals were 62% vs. 72%, 50% vs. 64%, 43% vs. 50%, 28% vs. 29% (Fig. 1). Patients 60 years of age or younger (HR 1.36, $P = 0.03$), as well as those with preoperative flexion contracture (HR 1.65, $P = 0.03$), or fracture malunion or nonunion (HR 1.56, $P = 0.005$) were at increased risk of a postoperative complication (Table 3) following TKA. One patient underwent amputation due to a recurrent infection. There was no difference ($P = 0.06$) in the overall complication free survival when comparing all the type of knee component used as a group. However, when comparing the individual components types (CR vs. PS vs. semi-constrained vs. hinge) there was an increased risk of complications (HR 2.56, $P = 0.02$) in hinge knees when comparing them to CR knees (Fig. 2).

Patients undergoing TKA for posttraumatic arthritis had an increased incidence of superficial (OR 2.30, $P < 0.0001$) and deep (OR 3.06, $P < 0.0001$) infection, need for manipulation under anesthesia (OR 2.39, $P < 0.0001$), delayed wound healing (OR 2.68, $P < 0.0001$), postoperative peroneal nerve palsy (OR 2.64, $P < 0.0001$), and subsequent