RESEARCH ARTICLE

Total Knee Arthroplasty in Patients with Retention of Prior Hardware Material: What is the Outcome?

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Abstract

Background: There is an information gap in literature regarding postoperative outcome of total knee arthroplasty (TKA) in patients with hardware in-situ from the previous knee surgery. The present study aims to evaluate impact of retained hardware on short-term outcome of TKA patients.

Methods: Perioperative radiographs of patients who had undergone TKA between 2007 and 2012 were reviewed and patients in whom partial or complete retention of hardware was evident after TKA were included. These patients were matched in 1 to 2 ratio based on age (+/- 2 years), gender, surgeon and year of surgery to a group of patients that underwent primary TKA without hardware in the affected knee. The average follow up of these patients was 43.45 (range 12-155.2) months. Complication rates were compared between the two groups using statistical tests that took into account the matched data structure.

Results: We included a total of 55 cases and 110 controls. The incidence of complications was higher, although not all statistically significant, in the case group. Only mechanical complications were significantly different in the cases group (5.5% versus 0%, *P=0.01*). Time to event analysis using the mixed-effects Cox model didn't show a statistically significant difference between two groups for various outcomes.

Conclusion: Presence of retained hardware around the knee may predispose the patient to a higher rate of complications particularly mechanical complications of the implant after TKA. Further studies are required to investigate impact of retained hardware around the knee in patients undergoing TKA.

Level of evidence: III

Keywords: Arthroplasty, Implant-related infection, Internal fixation of fracture, Knee, Perioperative complication, Replacement

Introduction

Knee trauma associates with fractures, deformities and ligament injuries requires fixation and reconstruction using hardware. Secondary or post-traumatic osteoarthritis (OA) among these patients are common and 12% of patients undergoing TKA suffering from secondary OA (1). When patients with hardware in their knees undergoing TKA, presence of hardware may cause technical difficulty and ultimately increase the risk of postoperative complications (2, 3).

If correct placement of prosthetic components is no possible, based on the surgeon's decision, all or part of the hardware will be removed during knee replacement. However, there is a paucity of data about the impact of a retained hardware on risk of postoperative complications following TKA. Therefore, we conducted this study to evaluate if hardware in-situ affects risk of short-term complications in patients undergoing TKA.

Materials and Methods

We conducted a retrospective, case-control study in a

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single institution. Following institutional review board approval, we queried our institutional joint replacement database to identify patients underwent primary TKA between 2007 and 2012. A total of 5,397 procedures were identified that had available preoperative and postoperative knee radiographs. We retrospectively reviewed perioperative radiographs of these patients and identified those patients in whom partial or total retention of hardware material was evident after TKA. Preoperative radiographs were reviewed to verify that hardware placement was performed prior and not during the TKA. We identified a total of 59 patients that had hardware in place before and after the TKA. Four patients were excluded, one had prior infection after internal fixation and three were lost to follow-up. A total of 55 patients were included that completed a minimum 12-month follow up. Mean age of patients was 56.7 (range: 31.8 – 76.2) years and 62% (34/55) them were male. The average follow up of these patients was 43.45 (range 12-155.2) months based on office appointments records and phone interview with the patients at the time of study.

These 55 patients were matched in a 1 to 2 ratio to 110 patients without history of knee surgery and hardware placement in the affected knee based on age (+/- 2 years), gender, surgeon, and year of TKA. The control group consisted of 110 patients with a mean age of 57.6 (range: 35.0 – 77.3) years and 62% (68/110) of them were male. The average follow up of these patients was 40.52 (range 12-86.2) months.

Of the patients who had prior surgery on the knee with hardware in-situ, a total of 24 (43.6%) had a history of fracture that required open reduction and internal fixation, 24 (43.6%) had an osteotomy, and 7 (12.8%) had a knee soft tissue repair. The hardware was retained in the tibia, femur and both tibia and femur in 36, 15 and 7 cases respectively.

All study patients were managed preoperatively based on our institutional protocol regarding prophylactic antibiotic, venous thromboembolism prophylaxis and physical therapy. All TKAs were performed through a medial Para patellar approach and hardware removal through the same incision. No drain placed and all components of TKA were cemented.

Specific complications were recorded. These complications are among those evaluated and included by the Complications Workgroup of the Knee Society (4). The recorded complications and the definition for the different complications were as follows: 1) artrofibrosis which was defined as compromised range of motion less than 90 degrees of flexion or flexion contracture of greater than 15 degrees; 2) the need for manipulation under anesthesia; 3) presence of knee pain which was defined as persistent pain after 1 month postoperatively; 4) mechanical failure, which was defined by component malposition, instability and loosening; 7) wound problems such as blisters, dehiscence or necrosis which did not require surgical procedure and deep surgical site infection (SSI) which was the one specified by the Center for Disease Control and Prevention (CDC) criteria (5).

Statistical analyses were performed using R3.3.1 (R Foundation for Statistical Computing, Vienna, Austria). Because of the matched nature of the data, paired tests were performed using the 'coxme' package for Cox proportional hazards models with mixed effects, and the 'lmerTest' package which allows for logistic regression with mixed effects. In both cases, the mixed effect model was used to control for the matched patient. *P-values* less than 0.5 were considered to be statistically significant.

Results

Patients with partial or total retained hardware have a significantly higher incidence of mechanical failure (n=3 (5.5%) versus 0, *P=0.01*) compared to patients without any hardware. Although rate of arthrofibrosis, manipulation under anesthesia, SSI, revision for non-septic complications of the implant, residual knee pain and wound complications were higher in the patients with history of hardware placement in the affected knee, it was not statistically significant [Table 1].

Time to event analysis using the mixed-effects Cox model didn't show a statistically significant difference between two groups for various outcomes. The hazard ratio with their associated confidence intervals and *P-values* demonstrated in Table 2.

Table 1. Comparison of complication rates between patients with hardware-in-situ and those patients without history of hardware placement. Table shows results of univariate and ultivariate analysis.

Complication	Hardware in-situ (n=55)	No hardware in-situ (n=110)	*P-value* (Fisher's exact test)	*P-value* (mixed logistic regression)
Arthrofibrosis	4 (7.3%)	2 (1.8%)	0.09	0.06
Manipulation under anesthesia	5 (9.1%)	8 (7.3%)	0.76	0.69
Surgical site infection	6 (10.9%)	5 (4.5%)	0.18	0.10
Revision due to non-septic complications	4 (7.3%)	4 (3.6%)	0.44	0.30
Wound problems	1 (1.8%)	1 (0.9%)	1.0	0.63
Residual pain	4 (7.3%)	4 (3.6%)	0.44	0.30
Mechanical complication of implant	3 (5.5%)	0 (0%)	0.04*	0.01*

*: Statistically significant

Table 2. Result of time to event analysis

Complication	Hazard ratio	95% confidence interval	*P-value*
Arthrofibrosis	4.05	0.73-22.40	0.11
Manipulation under anesthesia	1.26	0.41 – 3.84	0.69
Surgical site infection	2.59	0.78 - 8.57	0.12
Aseptic revision rate	1.42	0.31 – 6.41	0.65
Residual pain	2.23	0.55 – 9.09	0.27

Discussion

This study demonstrated that presence of hardware in-situ might increase risk of mechanical complication of the knee implant after TKA. Overall, patients with hardware in-situ had tendency to have a higher rate complication however, the difference was not statistically significant. Previous studies mainly focused on impact of prior surgical intervention for fractures, alignment procedures and trauma around the knee without reviewing impact of a retained hardware while in the present study we focused on the impact of a retained hardware on outcome of patients after TKA (2, 6-11).

Overall success rate following TKA in post-traumatic arthritis has been reported to be only 71% and TKA after fixation of fracture around the knee might be associated with a high rate of complication (6, 7). Presence of hardware material around the knee and the underlying diagnosis of post-traumatic osteoarthritis may predispose patients to a higher rate of complications after TKA. The higher rate of complications in patients with hardware in-situ can be due to various factors. Technical difficulty in patients who have had previous fractures around the knee has been reported in literature (2). This in turn can lead to increased surgical times, increased exposure and increased bleeding/transfusions which have been shown to increase risk of infection (8, 10, 11). In our study, although rate of SSI was higher in the patients with retained hardware, it was not statistically different from those without hardware in place. Impact of previous placement of hardware around the knee on the rate of infection following TKA is controversial. Klatte et al evaluated 124 patients who underwent TKA after removal of fixation devices and concluded that previously implanted osteosynthetic fixation devices does not increase risk of knee infection (12). However, in another study by Suzuki et al, patients with remnant hardware after open reduction and internal fixation had higher rate of infection following TKA (13).

In our study we found a trend to a higher rate of arthrofibrosis in patients with hardware in-situ although it was not statistically significant. Retained hardware can cause persistence of inflammation and may interfere with normal tissue gliding in knee during range of motion. Local trauma has been proposed to be associated with signals that lead to increased activity of inflammatory factors like prostaglandin E2 and bone morphogenetic proteins as well as differentiation of mesenchymal stem cells into osteoprogenitor cells which leading to tissue ossification (14). Additionally, local inflammatory reaction could potentially cause fibroblast proliferation and extracellular matrix. Both of these factors can promote metaplastic changes and scar tissue formation (15). This could potentially contribute to a higher incidence of artrofibrosis after TKA in patients with hardware in-situ.

This study has several limitations. It is s retrospective study that limits the collected data to what is available in patients' charts. Our sample size is small and the study might be underpowered to detect the difference between two groups regarding other complications. Information regarding the time of hardware implantation is unavailable and therefore no analysis can be performed regarding the effect of the time interval from implantation to TKA on the complication rate. Additionally, patients were not matched by comorbidities and follow up time was relatively short.

Despite these limitations, this study was able to show that retained hardware may increase risk of mechanical complications of the knee prosthesis. Further studies are recommended to evaluate whether or not hardware should be partially or completely removed. Additionally, there should be research conducted towards evaluating if removal should be performed in one or two stages and if additional cultures should be performed to evaluate colonized implants prior to TKA. Given the possibility of a higher rate of complication in patients with previously placed hardware in the affected knee, it is important to inform the patient about the potential risks of the surgery and observe them more closely for the signs and symptoms that may indicate a prompt action to reduce later complications.

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