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SYMPOSIUM: ADVANCED TECHNIQUES FOR REHABILITATION AFTER TOTAL HIP AND KNEE ARTHROPLASTY

Comparison of Outpatient versus Inpatient Total Knee Arthroplasty

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Abstract New protocols have been designed for outpatient total knee arthroplasty procedures, but concerns exist about the potential for increased complication rates. We compared the results of two selected matched cohorts of 64 patients who underwent total knee arthroplasty during the same time period. One cohort of patients, who had no severe medical conditions, lived within one hour of the office, and had help at home, followed an accelerated pathway in which they were discharged within 23 hours of surgery, and the other cohort followed a standard inpatient protocol, with a mean hospital stay of 2.3 days (range, 2–4 days). There were no perioperative complications in either cohort, and none of the patients who followed the outpatient protocol returned to the hospital for any reason. At a mean followup of 24 months (range, 12–41 months), the mean Knee Society knee scores of the outpatient and inpatient cohorts were 96 points (range, 67–100 points) and 95 points (range, 78–100 points), respectively. The mean Knee Society function scores were 89 points (range, 50–100 points) and 90 points (range, 60–100 points), respectively. We believe outpatient total knee arthroplasty may be a safe procedure in certain selected patients, with similar outcomes to a traditional protocol.
Level of Evidence: Level II, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Over the past 20 years, the mean duration of hospitalization decreased for patients who underwent total knee arthroplasties (TKAs) in the United States from approximately 9 to 4 days [9, 11]. This has been attributed to multiple factors, including surgical techniques with less soft tissue damage, improved pain management, early mobilization, changes in rehabilitation techniques, and discharges to inpatient rehabilitation facilities. Two recent studies reported that patients who were discharged from the hospital earlier as part of accelerated clinical pathway programs had similar short-term clinical outcomes to patients who had longer hospitalizations [8, 12]. In addition, some authors have observed successful results for selected patients who underwent unicompartmental or total knee arthroplasties and who were able to be discharged on the day of surgery [1, 3, 4], but none of these studies have examined clinical outcomes for TKAs at greater than 6 weeks followup, so further studies have been indicated to evaluate the safety and clinical outcomes of these procedures.

We developed an accelerated clinical pathway for patients who are indicated for a total knee arthroplasty, and who are considered sufficiently healthy for early discharge.

Two of the authors (FRK and MAM) are consultants for Stryker Orthopaedics. The other authors certify that they have no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.
Each author certifies that his or her institution has approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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This pathway combines preoperative patient education, oral pain medications, early mobilization, and intensive physical therapy. The goal is to allow safe discharge from the hospital on the day of surgery.

We asked whether perioperative parameters (operative times and perioperative complications), postoperative complication rates, Knee Society knee and function scores, ranges of motion, satisfaction scores, and radiographic outcomes were similar for selected patients who were discharged from the hospital within 23 hours of the surgery compared to those who had a conventional inpatient stay of 2 to 4 days.

Methods and Materials

Between January 2004 and July 2006, 150 TKAs were performed at a single institution. All patients who were clinically and radiographically indicated for TKA, who lived within 1 hour from the office, and who had an adult to help them at home were considered for inclusion in the accelerated pathway. We excluded patients who had any history of diabetes, myocardial infarction, stroke, congestive heart failure, venous thromboembolism, cardiac arrhythmia, respiratory failure, or chronic pain requiring regular opioid medications. During the study time, sixty-four patients among the 150 who underwent TKA met the criteria for inclusion in the clinical pathway, and chose to enroll in a prospective study to follow their outcomes. All of the patients were discharged within 23 hours of the procedure, and underwent rehabilitation at home. These patients were matched by age, gender, body mass index, and length of followup to a cohort of 64 patients who underwent TKAs during the same time period by the same surgeons and who had a conventional inpatient stay of 2 to 4 days. The inpatients all met the criteria for TKA, but did not have to meet the other inclusion and exclusion criteria to participate in the study. We compared perioperative (within 90 days of the surgery) complications, Knee Society knee and functional scores [7], ranges of motion, satisfaction scores, and radiographic outcomes of the two patient cohorts. The surgeons, patients, and evaluators were not blinded to the patient allocations during the surgeries and the outcome assessments, but the procedures and evaluations were performed in a consistent manner to avoid bias. A post-hoc power analysis was performed to assess the Knee Society knee scores with an alpha of 0.05, an effect size of 5 points, and cohort sizes of 64 patients each; the power was calculated as 0.88. A post-hoc power analysis for complication rates was performed using a contingency test model, a sample size of 64 patients per group, and an alpha of 0.05, which yielded a power of 0.06. The minimum followup for all patients was 12 months (mean, 24 months; range, 12 to 46 months). This study received full institutional review board approval.

The patients who were in the outpatient cohort consisted of 40 men and 24 women who had a mean age of 55 years (range, 42–64 years) and a mean body mass index of 30.8 kg/m^2 (range, 24.3–38 kg/m^2). The patients who were in the inpatient cohort consisted of 40 men and 24 women who had a mean age of 55 years (range, 42–63 years) and a mean body mass index of 30.8 kg/m^2 (range, 24.2–37.8 kg/m^2). All of the patients had unilateral knee osteoarthritis that was refractory to nonoperative treatment. The mean Knee Society knee and functional scores for the patients who were in the outpatient cohort were 47 points (range, 25–70 points) and 56 points (range, 45–70 points), respectively. The mean Knee Society knee and functional scores for the patients who were in the inpatient cohort were 43 points (range, 17–69 points) and 54 points (range, 30–70 points), respectively. The mean preoperative ranges of motion for the two groups were 117° (range, 90°–130°) and 112° (range, 90°–130°).

Prior to surgery, each patient met with the surgeon to discuss postoperative pain management, mobilization, the rehabilitation protocol, and venous thromboembolism prophylaxis. The patients also met with a physical therapist to be fitted for a hinged knee brace, as well as to learn and practice walking while using the brace with a walker, crutches, and a cane. Each patient demonstrated that he or she fully understood the perioperative and postoperative procedures. A social worker also confirmed that each patient would have somebody to help them, and that the house was adequately set up so that the patient could move around safely.

All surgeries were performed by two authors (FRK, EAM). All of the patients underwent total knee arthroplasty utilizing the Scorpio^{TM} total knee arthroplasty system (Stryker Orthopaedics, Mahwah, NJ). In the outpatient cohort, 35 of the procedures were performed by one author (FRK), and the other 29 were performed by another author (EAM). Anesthesia consisted of a continuous femoral nerve block (ropivicaine 0.2% at 6–12 mL per hour) and a single shot sciatic nerve block (15–20 mL of 2% mepivicaine and 15–20 mL of 0.5% bupivicaine) with intravenous sedation. Both authors utilized a standard medial parapatellar approach, with a 10- to 13-cm incision. Patellar eversion was avoided. All incisions were closed with the knees in extension. Postoperative drains and continuous passive motion machines were not used. The mean operative times for the outpatient and inpatient cohorts were 45 minutes (range, 36–62 minutes) and 45 minutes (range, 32–74 minutes), respectively ($p = 0.802$).

Immediately following surgery, the patients received intramuscular ketorolac (10–15 mg) and/or oral hydrocodone (5 or 7.5 mg) plus acetaminophen (350 mg). The

patients were also given 4 mg of ondansetron intravenously every 4 to 8 hours as needed for nausea, and enoxaparin or fondaparinux once daily for venous thromboembolism prophylaxis. All patients were seen by a physical therapist on the day of surgery, and were encouraged to get out of bed to a chair. They were allowed to ambulate and weight bear as tolerated, with assistance. All patients then followed the "slide and flex, tighten, extend" (SAFTE) rehabilitation protocol [10]. The patients who were in the outpatient cohort were discharged within 23 hours of surgery, after they demonstrated that they could eat food and drink liquid without difficulty, could ambulate with a walker, could perform the SAFTE exercises, and were comfortable with the oral pain medications. These patients were then seen by a home health nurse on the second postoperative day, and they visited a physical therapist on postoperative days 2–5. The nurse and therapist called the office to give report of any potential concerns or complications each day. The patients who were in the inpatient group remained in the hospital for a mean of 2.3 days (range, 2–4 days) postoperatively, were seen twice daily by physical as well as occupational therapists, and were encouraged to perform isometric contractions of the quadriceps muscles, until they demonstrated that they could get out of bed and ambulate with the walker independently. All patients were discharged with a walker. They then continued the SAFTE exercises at home. They managed their pain with oral opioid medications and ice to the affected knee. The surgical staples were removed 10 days postoperatively. Strengthening exercises were added after 4 to 6 weeks, as tolerated, and most patients returned to normal activities 7 weeks after the surgery.

All patients were examined carefully in the recovery room and on the floor prior to discharge by one of the authors (FRK or EAM) for any intraoperative or early postoperative complications. They were also evaluated by the physical therapist to determine whether they met all of the discharge criteria.

Patients returned for followup evaluations at 6 weeks, 6 months, 1 year, and annually thereafter. They were also instructed to call the office regarding any potential complications. At the annual evaluations, the Knee Society scores and range of motion were determined.

Anteroposterior and lateral radiographs were obtained in the recovery room immediately after surgery and at each annual visit.

Two authors (FRK and EAM) independently assessed the radiographs for lucencies using the method described by the Knee Society [6]. The authors were in agreement on their analyses of all of the radiographs. Any progressive radiolucencies or any knees which had radiolucencies that added to more than 4 mm in total length were considered to indicate prosthetic loosening.

The Knee Society scores, ranges of motion, and satisfaction scores of the two patient cohorts were compared using a paired Student t-test, and if the data were not normally distributed, a Wilcoxon signed rank test was used. McNemar's test was used to compare complication rates of the two groups. All statistics were calculated using SigmaStat version 3.5 (SPSS, Chicago, IL).

Results

There were no intraoperative complications in either cohort. There were no episodes of venous thromboembolism, wound problems, or infection. All of the patients who were in the outpatient cohort met the discharge criteria and left the hospital within 23 hours of the surgery. None of those patients returned to the hospital for any reason related to their TKAs. All of the patients completed their physical therapy protocols and progressed to full weight bearing without problems. Four patients who were in the outpatient cohort did not return after the six-week followup and could not be reached for later evaluations, but they did not experience any complications at 90 days. A per-protocol analysis was used for these patients.

The clinical results of the outpatient and inpatient cohorts were similar at the final followup times of 24 months (range, 12–41 months) and 24 months (range, 12–46 months), respectively (Table 1). The mean Knee Society knee scores of 60 of the 64 patients for whom scores were available in the outpatient and inpatient cohorts were 94 $\pm$ 11 points (range, 67–100 points) and 93 $\pm$ 16 points (range, 48–100 points), respectively ($p = 0.260$). The mean Knee Society function scores were 86 $\pm$ 15 points (range, 50–100 points) and

Table 1. Comparison of outcomes of the two patient cohorts at final followup

Data	Mean length of stay in days (range)	Mean Knee Society scores in points (range)		Mean range of motion in degrees (range)	Mean satisfaction score in points (range)
		Knee score	Function score		
Outpatients	0	94 (67–100)	86 (50–100)	123 (100–140)	4.8 (4–5)
Inpatients	3 (2–4)	93 (48–100)	86 (50–100)	121 (105–140)	4.7 (3–5)
p value	< 0.001	0.26	0.966	0.289	0.930

86 ± 15 points (range, 50–100 points), respectively (p = 0.966; 95% confidence interval, –12 to 7.3). The mean ranges of motion of the two cohorts were 123 ± 10° (range, 100°–140°) and 121 ± 10° (range, 105°–140°), respectively (p = 0.289). Confidence intervals could not be determined for knee scores and ranges of motion because the data sets did not follow a normal distribution.

All patients in both cohorts had well-fixed prostheses with no progressive radiolucencies and no other signs of prosthetic loosening at the latest followup.

The final followup complication rates of the two groups were comparable (p = 1.000). One patient, a 54-year-old man who was the first patient to follow the outpatient protocol, developed a foot drop and a heel ulcer secondary to peroneal nerve dysfunction, which eventually resolved with nonoperative treatment. It was believed that this occurred because he had received a continuous sciatic block as part of the anesthesia protocol, so the protocol was modified to a single-shot sciatic block, and none of the subsequent patients developed similar complications. Another patient, a 62-year-old woman who was in the outpatient cohort, had an iatrogenic medial collateral ligament deficiency that was discovered during the procedure, so a Scorpio TS™ (Stryker, Mahwah, NJ) constrained knee prosthesis was implanted. The patient otherwise did well and met the discharge criteria, so she was able to be discharged within 23 hours. Two other patients who were in the outpatient cohort, a 63-year-old man and a 59-year-old man, were scheduled for revisions for a genu recurvatum deformity that was observed 10 months after TKA, and a tibial plateau fracture 1 year after the surgery, respectively. Two additional patients underwent manipulation under anesthesia to treat knee stiffness three and six months after the outpatient procedures, respectively. In the inpatient cohort, two patients, a 52-year old woman and a 58-year-old woman, developed knee joint infections 8 weeks and 16 months after the procedures, so they underwent a liner exchange and a revision, respectively. Four other patients underwent manipulation under anesthesia to treat refractory knee stiffness 3 to 6 months after the procedure.

Discussion

Various changes in perioperative and postoperative management during the past 20 years, including less soft tissue damage during surgery, improved pain control, early mobilization, and new rehabilitation protocols, have led to earlier hospital discharge after total knee arthroplasty. Various studies suggest that patients who are discharged early may have similar clinical results to patients who remained in the hospital longer. Our experience has indicated that selected patients who receive preoperative education might have clinical success when discharged on the day of surgery. To examine this hypothesis, we performed this study to compare the Knee Society scores, ranges of motion, satisfaction ratings, and radiographic outcomes of two matched groups of patients who underwent total knee arthroplasty and who were discharged within 23 hours or remained as inpatients for 2 to 3 days. We found that the two cohorts of patients had no perioperative complications and similar short-term clinical outcomes.

This study had several limitations. The patients were not randomized. Also, we did not match for comorbidities, and given the exclusion criteria for the accelerated protocol, the patients selected for that protocol were likely more healthy as a group than the patients who followed the inpatient protocol. In addition, the followup time was short. Finally, two different surgeons performed the procedures for this study, although they both utilized identical selection criteria as well as inpatient and outpatient protocols. Despite the limitations, we believe that this study demonstrated that for selected patients, outpatient TKA was a safe procedure with no perioperative complications and excellent short-term outcomes that were similar to a matched cohort of patients who had a conventional inpatient hospital stay. In addition, the two surgeons each performed a comparable number of TKAs for patients who were in each cohort, and the surgeons used the same perioperative and postoperative protocols, so the results indicated that this pathway may be used successfully by more than one surgeon.

One other author has examined the results of outpatient TKAs. Berger et al. [3, 4] utilized a minimally invasive approach with preoperative patient education and home physical therapy sessions for 100 patients who followed an outpatient protocol for TKAs. Ninety-eight of the patients went home the day of surgery, one went home on postoperative day 1 after choosing to remain in the hospital overnight, and one went home on postoperative day 2 after his orthostatic hypotension and nausea had resolved. Twenty-four additional patients had hypotension and/or nausea following surgery, but these resolved after treatment with ondansetron and intravenous fluids. None of the patients returned to the hospital for any reasons related to the early discharge, and all of the patients had completed the study protocol at 3 months, with a mean range of motion of 112° (range, 75°–132°) at 1 week following the surgery, although no other clinical scores were reported. The results of the present study are consistent with the study by Berger et al. [3, 4], showing that selected patients can successfully undergo outpatient TKA. The present report adds additional evidence that, at a longer mean followup of 24 months (range, 12–41 months), the clinical and satisfaction scores as well as the radiographic outcomes of the patients were excellent and comparable to a matched cohort of patients who followed an inpatient protocol.

Outpatient hip arthroplasty protocols have also been reported. Berger [2] described a two-incision minimally invasive total hip arthroplasty protocol with an accelerated clinical pathway that allowed 192 of 200 patients to be discharged on the day of surgery, with one readmission at 10 weeks for a traumatic periprosthetic fracture, and no other readmissions for procedure-related complications. However, no clinical outcomes were reported. Bertin [5] compared 10 patients who underwent minimally invasive outpatient total hip arthroplasty with 10 patients who followed an inpatient protocol. The patients who were in the outpatient cohort underwent preoperative training with physical therapy exercises, and were discharged within 12 hours of the surgery. The author stated that no major clinical complications occurred in the patients, and that the costs of the outpatient protocol were a mean of $4,000 less per patient compared with a matched group of 10 patients who underwent a standard inpatient protocol for minimally invasive total hip arthroplasty. No clinical scores or other outcomes were reported. A financial analysis has not been performed for TKAs, but the financial study for THAs indicates another potential benefit of outpatient arthroplasty protocols.

In conclusion, this report demonstrates that an outpatient TKA protocol may be safe for selected patients, with no major perioperative complications, and this pathway may be associated with excellent short-term results that are comparable to conventional inpatient protocols. In addition, this protocol has been successfully utilized by more than one surgeon. Further study is indicated to refine the indications for this protocol, as well as to examine the immediate and long-term patient clinical outcomes.

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