

Perioperative Complications of Simultaneous versus Staged Unicompartmental Knee Arthroplasty

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Abstract

Background The complication risk of staged versus simultaneous total knee arthroplasty continues to be debated in the literature. Previous reports suggest unicompartmental knee arthroplasty provides a more rapid functional recovery than total knee arthroplasty. However, little data exist on whether simultaneous unicompartmental knee arthroplasty can be performed without increasing the perioperative risk compared with staged unicompartmental knee arthroplasty. **Questions/purposes** We therefore asked if there is an increased risk of perioperative complications with bilateral simultaneous unicompartmental knee arthroplasty.

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Each author certifies that his institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at Joint Implant Surgeons, Inc, New Albany, OH, USA.

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Methods We retrospectively compared 141 patients (282 knees) treated with staged unicompartmental knee arthroplasty with 35 patients (70 knees) treated with simultaneous unicompartmental knee arthroplasty to evaluate perioperative complications and short-term results assessed by Knee Society function scores and the Lower Extremity Activity Scale.

Results Patients who underwent simultaneous unicompartmental knee arthroplasty had a shorter cumulative operative time (109 versus 122 minutes), a shorter cumulative length of hospital stay (1.7 versus 2.5 days), higher Knee Society function scores at most recent followup (88 versus 73), and higher Lower Extremity Activity Scale (12.0 versus 10.2) without a difference in perioperative complications. The simultaneous cohort was younger (59 versus 63 years of age) and less obese (body mass index 31 versus 33 kg/m²) than the staged group.

Conclusions Although we found a substantial bias for performing simultaneous unicompartmental knee arthroplasty in younger and less obese patients, these data suggest it can be performed without increasing perioperative morbidity or mortality in this patient population.

Level of Evidence Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Controversy still exists surrounding the performance of bilateral simultaneous versus staged total knee arthroplasty (TKA) [1, 4, 7–9, 11, 12, 15, 17, 18, 21, 23, 24, 27–30, 32–36]. Advocates of simultaneous TKA have cited benefits of a single anesthetic, shorter cumulative hospital stays, patient convenience and satisfaction, and increased cost

effectiveness for the healthcare system without increasing perioperative morbidity and mortality and without compromising the clinical outcomes of the operation [8, 9, 11, 12, 17, 18, 24, 27–30, 32, 35]. Opponents of the simultaneous approach cite increased perioperative complications, including pulmonary embolism, major cardiac events, ileus, higher transfusion rates, confusion, and death [1, 4, 12, 15, 21, 23, 27, 33, 35]. Concern also exists regarding the financial disincentive to the surgeon for performing bilateral simultaneous arthroplasty procedures [2, 6, 28]. However, without a double-blinded, randomized controlled trial comparing bilateral simultaneous with staged TKA, the debate will continue and the surgeon must weigh the risks and benefits with the patient's expectations and goals when bilateral surgery is indicated.

Several reports suggest unicompartmental knee arthroplasty (UKA) has a quicker functional recovery than TKA with decreased length of stay and fewer failures at long-term followup [14, 22, 25]. Coupled with smaller incision surgery and less blood loss [14], UKA has been perceived as a minimally invasive and safer surgery compared to TKA. Despite an abundance of literature on staged versus simultaneous TKA, there are few published data on the safety of bilateral simultaneous UKA. A recent retrospective study comparing staged versus simultaneous UKA [5] reported a considerably higher rate of major complications in the simultaneous group and consequently cautioned against using a one-stage approach when bilateral UKA was indicated [5]. With the increased utilization of UKA, it is important to evaluate the functional outcomes and perioperative risks of performing bilateral procedures in either a staged or simultaneous fashion when indicated.

We therefore addressed the following questions: (1) Is there an increased risk of perioperative complications with bilateral simultaneous versus bilateral staged UKA? (2) Is there a difference in operative times between bilateral simultaneous versus staged UKA? (3) Is there a difference in the length of hospitalization between patients treated with simultaneous versus staged UKA? (4) Is there a difference in Knee Society functional scores and Lower Extremity Activity Scale scores at short-term followup?

Patients and Methods

One thousand medial UKAs were performed by the two senior authors (KRB, AVL) between 2004 and 2008. The indications for unicompartmental medial knee arthroplasty were primary anteromedial osteoarthritis with intact cruciate ligaments with a correctable deformity on an AP valgus stress radiograph. Throughout the duration of the study period, simultaneous bilateral UKA was performed under one anesthetic in 35 patients (70 knees) and staged

bilateral UKA was performed in 141 patients (282 knees) between 6 weeks and 6 months apart. Post hoc power analysis revealed sufficient power to detect a clinically significant difference in all variables studied at 80% with the exception of perioperative complications for which insufficient power was observed. We identified perioperative complications for the first 90 days postoperatively after each surgery. Minimum followup of clinical outcomes was 90 days after each particular surgery and averaged 19.4 and 13.9 months for the simultaneous and staged groups, respectively. No patients were lost to followup. No patients were recalled specifically for this study; all data were obtained from medical records.

Patient demographics, including height, weight, body mass index (BMI), and age, were collected from the preoperative records. The average age of the patients in the simultaneous and staged UKA groups were 58.2 (CI 3.35; 95% confidence interval, 55.4–62.1) and 62.7 (CI 1.49; 95% confidence interval, 61.2–64.2) years of age, respectively. BMI of the patients in the simultaneous and staged UKA groups were 30.9 (CI 1.49; 95% confidence interval, 29.4–32.4) and 33.3 (CI 1.19; 95% confidence interval, 32.1–34.5). Patients who had simultaneous bilateral UKA were younger and had a lower BMI.

Perioperative medical management was performed by a group of medical internists who evaluated the patients preoperatively for medical optimization and surgical risk stratification. Additional medical evaluations and consultations were directed by the internists. The same group of internists cared for the patients during their postoperative hospitalization. In no patient was the initial plan for simultaneous procedures changed to a staged procedure due to medical comorbidities. We followed the Oxford indications for medial UKA [3]. Strict evaluation of preoperative radiographs including stress views was paramount. Intraoperative confirmation of candidacy for UKA is performed. We did not record the incidence of OA in lateral or PF compartments.

We used a less invasive approach with limited medial parapatellar arthroscopy without violating the vastus medialis obliquus and without everting the patella. A cemented Oxford Phase III mobile-bearing unicompartmental knee prosthesis (Biomet, Inc, Warsaw, IN) and a previously published multimodal rapid recovery protocol were utilized for all patients [16]. We adhered to our previously reported surgical technique in all patients [3]. Postoperatively all patients received chemoprophylaxis at the discretion of the medical management providers in addition to mechanical compression boots for venous thromboembolism prevention.

Followup after discharge occurs at six weeks and 90 days postoperatively. The Knee Society Clinical Rating System [10] and the Lower Extremity Activity Scale [31]

are validated, objective outcome scores which are obtained at all followup visits. Clinical evaluation is coupled with AP, lateral, and merchant radiographs. Assuming the patient is doing well, followup is then annually thereafter. During followup we noted progression into one of the other compartments.

We reviewed operative reports to collect operative times, tourniquet times, component types and sizes, blood loss, and intraoperative complications. Hospital records were reviewed to determine the length of stay and perioperative complications. We reviewed outpatient clinical followup notes to assess Knee Society scores, lower extremity activity scale (LEAS) scores, and clinical variances. All patient outcomes were known at a minimum of 90 day followup. Radiographic findings and comparisons were not performed for this study.

To evaluate the normally distributed data with similar variances, we used nonpaired, two-tailed Student's *t* test to evaluate the continuous variables (age, BMI, length of stay, operative time, tourniquet time, cumulative operative time, Knee Society clinical scores, Knee Society function scores, Knee Society pain scores, LEAS) between the two groups. Nonparametric variables (perioperative complications, revisions, additional surgery) were compared using Pearson's chi square test.

Results

Perioperative medical complications were similar for the two groups (Table 1). We encountered no patient with deep venous thrombosis or pulmonary embolism, confusion or delirium; there were no blood transfusions, intensive care admissions, or deaths in the initial 90 days postoperatively. One patient required an arthroscopy to remove part of a drain and one patient required a manipulation under anesthesia for arthrofibrosis during the 90 day postoperative

Table 1. Perioperative complications

Complication	Simultaneous group	Staged group	p Value
Return to operating room within 90 days	0	2 (1.4%)	NS
Cardiac issues	1 (2.9%)	4 (2.8%)	NS
Pulmonary issues	1 (2.9%)	6 (4.3%)	NS
Gastrointestinal (ileus)	0	1 (0.7%)	NS
Wound drainage	2 (5.8%)	7 (4.9%)	NS
Genitourinary issues (UTI, retention)	0	11 (7.8%)	NS
Death	0	0	NS

NS = not significant at $p = 0.05$.

Table 2. Postoperative functional results

Variable	Simultaneous group	Staged group	p Value
Followup (months)	19.4	13.9	0.0013
Knee Society Clinical Scores			
Preoperative	46	38	$p < 0.0001$
Most recent followup	91.4	90.1	NS
Knee Society Pain Scores			
Preoperative	11.6	9.5	NS
Most recent followup	44.6	46.8	NS
Knee Society Function Scores			
Preoperative	58.9	55.6	NS
Most recent followup	87.9	72.9	$P < 0.0001$
Postoperative Lower Extremity Activity Score	11.3	10.2	$p < 0.001$

NS = not significant at $p = 0.05$.

period. Both patients were in the bilateral staged UKA group.

The average per knee tourniquet time for the simultaneous and staged groups were 42.7 and 42.2 minutes, respectively ($p = 0.81$). The simultaneous group had a longer total operating room time (109 minutes) compared with the staged group (61 minutes) ($p < 0.001$). However, the simultaneous group had a shorter cumulative operating room time (109 minutes) compared to the staged group (122 minutes) ($p = 0.04$).

The simultaneous group had a longer length of stay (1.7 days) compared to the staged group (1.3 days) ($p < 0.001$). However, the simultaneous group had a shorter cumulative length of stay (1.7 versus 2.5 days) compared with the staged group ($p < 0.001$).

At latest clinical followup averaging 19.4 and 13.9 months for the simultaneous and staged groups, respectively, the simultaneous group reported higher mean Knee Society function scores and higher LEAS scores compared with the staged group (Table 2). We observed no difference in the mean ROM at latest followup between the two groups. There was no difference in mean Knee Society pain scores pre- or postoperatively and overall mean Knee Society clinical scores were equivalent at latest followup. The preoperative Knee Society clinical scores were higher ($p < 0.0001$) in the simultaneous group compared with the staged group (Table 2).

Discussion

The safety and efficacy of simultaneous versus staged bilateral TKA continues to be debated. However, the literature is scarce regarding the topic of simultaneous versus staged UKA. We therefore compared perioperative

complications of bilateral simultaneous versus bilateral staged UKA. In addition, we evaluated operative times and length of hospitalization between the two cohorts. Finally, we evaluated function outcomes at short term followup utilizing Knee Society scores and Lower Extremity Activity Scale scores.

We note several limitations. First, we observed a heavy selection bias to perform simultaneous UKA on patients who were younger and less obese. Second, the overall rate of complications was low and while there was a trend to a higher rate of perioperative complications in the staged group this was not significant. This may be due to a true lack of difference, or more likely a lack of statistical power resulting in type-II error. Third, we did not distinguish major from minor complications or analyze such differences. Clearly overall rates can be misleading if some are major in one cohort and minor in the other. However, as noted, we did not have adequate power to determine difference even for the overall rates. We can only, therefore, conclude that simultaneous procedures appear safe, but cannot distinguish the rate of complications between groups. Fourth, we did not evaluate the possible effect of medical comorbidities using a standardized index, such as the American Society of Anesthesiologists (ASA) score [26] on the risk of perioperative complications or how these coexisting conditions may have biased the selection of patients for either simultaneous or staged procedures. There is potential that patients with substantial comorbidities were precluded by the surgeon from the option of simultaneous UKA in this study. However, the same medical consulting group prior to either procedure using identical criteria medically cleared all patients. We would, therefore, assume that while the exact quantity and severity of comorbidities was not recorded, no patient was changed from simultaneous to staged based upon their medical conditions. The bias towards performing the procedure in younger, less obese patients occurred through the advice of the surgeon, without exact knowledge of the medical condition. Despite these limitations, this report demonstrates that simultaneous bilateral UKA can be performed with a low rate of major perioperative complications.

Chan et al. had the only other report in the literature focusing on postoperative complications of simultaneous versus staged medial UKA [5]. Their group reported retrospectively on 159 patients (318 knees) treated with one-stage and 80 patients (160 knees) treated with two-stage arthroplasty [5]. In contrast to our study, Chan et al. reported major complications in 8.2% of the one-stage unicompartmental knee arthroplasties, whereas no major complications were encountered in the two-stage group [5]. Ten different surgeons performed the operations in the study and most were considered low-volume unicompartmental knee surgeons. Their anesthetic protocols consisted

of a general anesthetic with local wound infiltrate compared with our combined spinal and general anesthetic with local wound infiltrate. No chemoprophylaxis was used in their protocol for prevention of deep venous thrombosis (DVT) and they reported proximal DVT and pulmonary embolism in 1.9 and 3.8% of patients in the one-stage UKA group, respectively. The one death in the one-stage UKA group was secondary to a pulmonary embolism. In comparison, we identified no patients with deep venous thrombosis or pulmonary emboli in this report using aspirin, low-molecular-weight heparin, or Coumadin based on preoperative risk stratification by our medical staff [13]. Our perioperative results demonstrate no deaths within the first 90 days after surgery regardless of whether the patient underwent simultaneous or staged unicompartmental knee arthroplasty. In one study the cumulative in-hospital mortality rate was 0.35% for all lower extremity arthroplasties [20]. Meding et al. demonstrated the use of prescreening medical evaluations for elective arthroplasty and the medical optimization of the patients likely contributes to the decrease in perioperative complications [19]. The less invasive nature of unicompartmental knee arthroplasty coupled with multimodal clinical pathways and pre- and perioperative medical management by a team of internists likely results in the improved safety profile when evaluating 90-day mortality and perioperative complications [13]. In addition, Chan et al. had a long interval between their staged procedures (1.5 year average) [5] and this could potentially negate any potential perioperative complication that might arise with surgery in a shorter staged timeframe.

Chan et al. reported a much shorter duration of cumulative anesthetic time in their simultaneous versus staged UKA groups (114 versus 129 minutes) [5]. In addition, Chan et al. demonstrated no difference in tourniquet times between the simultaneous and staged UKA groups [5]. These results are consistent with our findings. The simultaneous group in our study had a total operating room time of 109 minutes compared to 122 minutes in the staged group. There was no difference between the groups in per knee tourniquet time.

Chan et al. reported on median length of stay of 5 and 6 days for the simultaneous versus staged UKA groups, respectively [5]. No means were provided in their study [5]. Chan et al. note that all patients were part of an accelerated discharge program with a target discharge within 24 hours of the procedure [5]. In contrast, we report average length of stay which for the simultaneous group was 1.7 days while the staged group was 1.3 days. However, cumulative length of stay of the staged group was 2.5 days. Due to the reported statistical differences, our study cannot be directly compared to the study by Chan et al. regarding length of stay. However, we have

demonstrated short hospitalizations postoperatively with a low rate of complications utilizing our previously reported rapid recovery protocols [16].

There may be a benefit in early functional outcome with simultaneous unicompartmental knee arthroplasty. We found a higher mean Knee Society functional score in the simultaneous group compared with the staged group at most recent followup. In addition, the mean LEAS was higher in the simultaneous group at most recent followup. However, Knee Society pain scores and overall Knee Society clinical scores were similar for the two groups. Comparatively, several authors have demonstrated benefit with bilateral simultaneous surgery for total knee arthroplasty [12, 24, 30]. These authors have demonstrated excellent patient satisfaction, equivalent pain scores, similar narcotic use, and equivalent walking distance in simultaneous bilateral TKA compared with unilateral or staged procedures [12, 24, 30]. Although not directly comparable to our results due to the heterogeneity of the measured outcomes, there does appear to be some potential functional benefit of simultaneous knee arthroplasty, whether total or unicompartmental. However, the results presented here suggest a strong selection bias for younger and less obese patients regarding simultaneous arthroplasty that may contribute to the earlier functional benefit demonstrated in this study.

In conclusion, the results of our study demonstrate a low risk of perioperative complications when performing simultaneous bilateral unicompartmental knee arthroplasty in a surgeon selected cohort. There were no increased perioperative risks identified in this study and no increased mortality. Although we performed simultaneous procedures in younger and less obese patients, our data suggest simultaneous unicompartmental knee arthroplasty can be performed safely in this group. As a result of the paucity of literature on this specific topic, further clinical investigations need to be performed with specific attention to minimizing early failures and investigating the potential cost benefits to the healthcare system. In addition, future randomized control trials could eliminate selection bias and potentially provide stronger conclusions regarding the complication rates between staged versus simultaneous UKA.

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