

Impact of Surgeon Handedness and Laterality on Outcomes of Total Knee Arthroplasties: Should Right-Handed Surgeons Do Only Right TKAs?

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Abstract

In this study, we examined the impact of surgeon handedness on total knee arthroplasty (TKA) outcomes. From 1997 to 2001, a right-handed surgeon performed 728 primary TKAs while standing on the side of the operative extremity—377 on the right and 351 on the left. Extension and Knee Society Function and Pain scores were significantly better for right knees than for left knees 1 year after surgery. This is the first report that shows that handedness can play a role in TKA outcomes. Reasons for the difference have not been determined but may be related to dexterity or proprioception. A surgeon should be aware of this potential problem and take precautions to prevent diminished results when operating.

The effect of handedness on operative psychomotor performance has been documented in numerous studies, predominantly in the general surgical literature focusing on laparoscopic or endoscopic techniques.¹⁻⁶ We found no orthopedic literature references regarding handedness as an independent factor affecting surgical techniques or outcomes. The issue of psychomotor performance is further complicated in orthopedic surgery because laterality plays a larger role than in general surgery. Subjective reports suggest that total knee arthroplasty (TKA) outcomes may be affected by surgeon handedness, in that a surgeon may prefer one side over the other—the side on which the surgeon feels more comfortable or adept. Moloney and colleagues⁷ found that failure of sliding hip screws in femoral neck fractures was statistically associated with

procedures being performed by right-handed surgeons standing on the left side of patients.

In the study reported here, we evaluated the effects of surgeon handedness on TKA outcomes. Our hypothesis was that a right-handed surgeon with a subjective impression of increased comfort operating on the right side of a patient undergoing a right TKA will have better outcomes performing right TKAs than left TKAs.

MATERIAL AND METHODS

The 728 primary TKAs performed by Dr. Lotke between January 1997 and December 2001 were included in this study. Of the 688 patients, 427 were women, and 261 were men (mean age, 68.8 years). The primary diagnoses were osteoarthritis (610 patients) and rheumatoid arthritis (78 patients). We obtained institutional review board approval before proceeding with the study.

“The effect of handedness on operative psychomotor performance has been documented in numerous studies....”

No significant changes were made in surgical techniques over the study period.⁸ The right-handed Dr. Lotke performed the surgical procedure standing on the side of the operative extremity. All procedures were performed in a laminar flow or highly filtered operating room. A thigh tourniquet was applied to the operative extremity, except when contraindicated because of the patient's medical history. A tourniquet and a medial parapatellar approach were used in all cases except those in which previous surgery prevented use of this standard approach. A side-specific posterior-cruciate retaining prosthesis was used in all cases (PFC-CR; DePuy, J&J, Warsaw, Ind). Flexion/extension gap and tibial insert sizing was performed with a combination of measured resection and tension techniques.⁸ Patients were placed in a continuous passive motion machine

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Table I. Summary of Outcomes for All Primary Total Knee Arthroplasties*

	Extension (°)		KS Function Score		KS Pain Score	
	6 Weeks	1 Year	6 Weeks	1 Year	6 Weeks	1 Year
Right	1.3	1.25	56.1	73.5	91	95
Left	1.8	1.75	52.4	70.5	82	87

*All P s < .05. KS indicates Knee Society.

Table II. Summary of Outcomes for All Bilateral Total Knee Arthroplasties*

	Extension (°)		KS Function Score		KS Pain Score	
	6 Weeks [†]	1 Year [†]	6 Weeks	1 Year [†]	6 Weeks	1 Year [†]
Right	1.4	1.1	54.5	75.3	89	93
Left	1.9	1.6	51.3	71.4	86	88

*KS indicates Knee Society. [†] P s < .05.

that was set at 70° to 100° starting in the recovery room and was increased from 0° to 100° on postoperative day 1. Unless contraindicated, deep vein thrombosis prophylaxis was performed with aspirin and foot pumps. Patients were out of bed and fully weight-bearing with walker support the day after surgery. They were stratified by TKA side, left or right. Range of motion (ROM) and Knee Society (KS) Function and Pain scores were evaluated 6 weeks and 1 year after surgery. ROM was measured, not estimated, by a research assistant who did not take part in the surgery and did not know the purpose of taking these measurements.

Forty patients (21 women, 19 men) had bilateral TKAs performed. Mean age was 64.5 years at time of first surgery. These patients' TKAs were subanalyzed, as each patient was also his or her own control.

Further laterality analysis was performed by examining the subgroups of patients who, 1 year after surgery, had a KS Pain score of less than 80 or a KS Function score of less than 50.

Statistical analysis was conducted with SYSTAT Version 10.2 (Chicago, Ill). A nonpaired t test was used to examine data from all patients, a paired t test to examine data from the bilateral-TKA subgroup ($n = 40$), and an odds ratio to examine poor outcomes based on laterality.

RESULTS

Of the 728 TKAs performed, 377 were right side, and 351 were left side ($P = .867$). At 6 weeks and 1 year, extension and KS Function and Pain scores were significantly better for right knees than for left knees (Table I).

At 6 weeks, right TKAs had mean extension of 1.3° and mean flexion of 110.8° (range, -2° to 123°), and left TKAs had mean extension of 1.8° and mean flexion of 110.9° (range, -3° to 125°). Mean flexion contracture was 1.5°, and only 8% of patients did not achieve full

extension. Although there was no significant difference in flexion ($P = .767$) or total ROM ($P = .831$), the difference in extension was significant ($P = .04$). This trend continued at 1 year, when right TKAs had mean extension of 1.25°, and left TKAs had mean extension of 1.75° ($P = .019$). Twelve patients with left TKAs and 9 patients with right TKAs had flexion contractures of more than 5°. There were no appreciable changes in terminal extension or flexion after 1 year.

At 6 weeks and 1 year, mean KS Function scores were significantly better for right TKAs than for left TKAs. At 6 weeks, the right-TKA score was 56.1, and the left-TKA score was 52.4 ($P = .006$). The difference continued to 1 year, when the right-TKA score was 73.5, and the left-TKA score was 70.5 ($P = .03$). Similarly, KS Pain scores were significantly ($P = .006$) better for right TKAs (91) than for left TKAs (82) at 6 weeks—and again at 1 year, when the right-TKA score was 95, and the left-TKA score was 83 ($P = .029$).

Postoperative extension, function, and pain followed the same pattern for the 40 patients who underwent bilateral TKAs. Scores for the right TKAs performed by the right-handed surgeon standing on the right side of the patient were better than those for the left TKAs performed by the surgeon standing on the left side of the patient. At 6 weeks, extension was 1.4° on the right versus 1.9° on the left ($P = .02$). At 1 year, extension was 1.1° on the right versus 1.6° on the left ($P = .03$), and the range for the right side was -2° to 115°, and the range for the left side was -3° to 125°. KS Function and Pain scores followed a similar pattern (Table II). In these patients, there was no difference in postoperative flexion or ROM.

Of the 18 patients who scored less than 80 on KS Pain, 6 had right TKAs, and 12 had left TKAs; the odds ratio for having a worse pain outcome on the left versus the right at 1 year was 1.75. Of the 95 patients who scored less than 50 on KS Function, 41 had right TKAs, and 54 had left

Table III. Preoperative Demographics*

	Total Knee Arthroplasties			P
	All	Left	Right	
No. patients	688	331	357	.55
Age (y)	68.8	70.1	67.7	.64
Sex				
Men	261	120	141	.72
Women	427	211	216	.91
Body mass index	27.9	27.4	28.4	.87
KS Pain score	37	39	35	.49
KS Function score	55	53	57	.78

*KS, Knee Society.

TKAs; the odds ratio for having a poor function outcome on the left versus the right at 1 year was 1.35.

The right- and left-TKA cohorts did not differ significantly in age, sex, weight, preoperative pain, preoperative function, or preoperative ROM (Table III). Incidence of complications during the perioperative and postoperative periods was no different for right and left TKAs, and overall clinical outcomes did not change significantly over the study years.

DISCUSSION

It is generally thought that it is easier for an orthopedic surgeon to perform TKAs on the side of his or her handedness. However, our study results showed that this preference affects outcomes—that there were statistical differences in extension and KS Function and Pain scores in patients who had TKAs performed by a right-handed surgeon standing on the side of the operative extremity. Although the quantitative differ-

determined but may be related to dexterity or proprioception. Three factors have been found to degrade task performance during surgery with current technology: kinematic restriction, reduced tactile feedback, and increased perceptual processing consequent on operating from an indirect image of the operating field.⁴ These restrictions can contribute to iatrogenic morbidity. We offer laterality of operative site with respect to surgeon handedness as a fourth factor affecting task performance and outcomes.

Our study has a few limitations. It is a retrospective review of one surgeon's experience. As such, it could be enhanced by another study using a similar cohort of patients but a left-handed surgeon or by a prospective, multicenter study examining surgery side and surgeon handedness. A prospective trial with close scrutiny of "leggedness" and preoperative gait and activity and a more rigorous analysis of postoperative outcomes would provide even more detail. Furthermore, though Dr. Lotke has a standard perioperative and postoperative plan for all his patients undergoing TKA, we did not control or evaluate other variables that may have contributed to the differences we found. However, given the size of our study population and given that there were no significant statistical differences in the demographic characteristics of the right- and left-TKA cohorts, we are comfortable with our selected patient population and with our conclusions: that these patient groups were similar and that laterality and handedness therefore play a role in TKA outcomes.

Objective and quantitative evidence shows a difference in laparoscopic psychomotor performance

“Objective and quantitative evidence shows a difference in laparoscopic psychomotor performance between right-handed and left-handed surgical residents.^{1,4}”

ences between groups were small, they showed laterality-based differences in a large sample that controlled for other factors not examined in this study. These differences may seem small because the scoring system used may be insensitive to smaller differences. The clinical relevance of the differences between right and left TKAs can be argued, but in fact there are differences. These differences are clearer when examining study group outliers—patients who scored below 80 on KS Pain or below 50 on KS Function. The odds of having a poor outcome on the left versus the right are at least 1.35 times higher. These differences could be magnified with a more sensitive measurement tool or a less experienced surgeon. Dr. Lotke is an experienced surgeon who may have learned to compensate for handedness in a manner that may not be applicable to all surgeons.

The reasons for these differences have not been

between right-handed and left-handed surgical residents.^{1,4} Data also support left-handed general surgeons having longer operative times than right-handed surgeons with laparoscopic cholecystectomies because of “right-handed” laparoscopic equipment, portal locations, and the anatomical location of the gall bladder.^{5,9} Finally, in their review of 244 patients with femoral neck fractures treated with a sliding hip screw at one institution, Moloney and colleagues⁷ found that 12 fixations failed because of screw malpositioning and that the majority of these failures occurred on the left side when the surgical procedure was performed by a right-handed surgeon. Our results mimic and substantiate those of these previous studies.

Potentially following the lead of general surgeons, orthopedic surgeons should conduct larger studies to confirm our findings and to examine the impact of handedness and laterality on procedures such as knee

and shoulder arthroscopy, arthroscopic and open rotator cuff repair, anterior cruciate ligament reconstruction, and computer-assisted knee and hip arthroplasties. Furthermore, researchers should try to arrive at neuropsychological explanations for observed differences in laterality and handedness. Finally, development of tools to improve resident education and the teaching of surgical skills with laterality and handedness in mind should be considered.

Orthopedic surgeons should be aware of the potential problems that may be introduced by their handedness and the laterality of operated extremities. Each surgeon should consider taking extra precautions to

AUTHORS' DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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“Each surgeon should consider taking extra precautions to prevent diminished results when operating on his or her nondominant side.”

prevent diminished results when operating on his or her nondominant side. These precautions may include operating from the same side of the table at all times, adjusting one's body position during surgery, and taking more precautions when handling soft tissue or making bone cuts. In the future, computer-assisted surgery may compensate for any potential errors in technique, but surgeons should be aware of a potential bias when placing markers for computer-assisted procedures.

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