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An Intact Anterior Cruciate Ligament at the Time of Posterior Cruciate Ligament–Retaining Total Knee Arthroplasty Was Associated With Reduced Patient Satisfaction and Inferior Pain and Stair Function

Cale A. Jacobs, PhD [a, *], Christian P. Christensen, MD [b], Tharun Karthikeyan, MD [b]

[a] Department of Orthopedic Surgery, University of Kentucky, Lexington, Kentucky
[b] Lexington Clinic, Lexington, Kentucky

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ABSTRACT

Background: Patients with an intact anterior cruciate ligament (ACL) at the time of ACL-sacrificing total knee arthroplasty (TKA) have been suggested to have inferior outcomes compared with those with a dysfunctional ACL. However, to date, no published clinical studies have evaluated the potential link between the condition of the ACL at the time of posterior cruciate ligament–retaining TKA and postoperative pain, function, and satisfaction. As such, the purpose of this study was to compare subjective function, movement-elicited pain, pain at rest, and patient satisfaction between those with an intact or dysfunctional ACL.

Methods: We identified 562 posterior cruciate ligament–retaining TKAs with complete intraoperative and postoperative data. Patients were categorized based on the condition of the ACL at the time of TKA as either being intact or dysfunctional (absent or lax). Knee Society Function Scores, movement-elicited pain, pain at rest, and patient satisfaction were then compared between groups.

Results: At mean follow-up of 5.1 years, a significantly lower proportion of patients in the intact group were satisfied with their operation (intact: 391/453 [86.3%] vs dysfunctional: 102/109 [93.6%], $P = .0496$). Inspection of the individual activities revealed that the groups did not differ in walking ability or pain when walking; however, the intact group reported significantly reduced ability to navigate stairs with greater pain during that activity.

Conclusion: The lack of difference in pain at rest between groups suggests that pain and functional impairments during more demanding activities such as navigating stairs may be associated with the lost function of the ACL rather than by altered central pain processing.

Approximately 10%-20% of total knee arthroplastic (TKA) patients are dissatisfied with their procedure. Pain and/or dysfunction during activities of daily living are often associated with reduced satisfaction after TKA, especially during more demanding tasks such as navigating stairs [1]. Cadaveric studies have suggested that more normal stability and stair descent kinematics can be achieved by maintaining the function of the anterior cruciate ligament (ACL) through the use of bicruciate-sparing designs [2], posterior-stabilized designs, or posterior cruciate ligament (PCL)–retaining designs with either standard or dished polyethylene liners [3]. Although surgical techniques and/or implant designs may allow the function of the ACL to be postoperatively maintained or restored, the preoperative condition of the ACL may also have a role in postoperative function and pain relief. Patients with an intact ACL at the time of ACL-sacrificing TKA have been suggested to have inferior outcomes compared with those with a dysfunctional or absent ACL [4,5]. However, to date, no published clinical studies have evaluated the potential link between the condition of the ACL at the time of TKA and postoperative pain, function, and satisfaction. As such, the purpose of this study was to compare subjective function, movement-elicited pain (MEP), pain at rest (PAR), and patient satisfaction between those with an intact or dysfunctional ACL. We hypothesized that despite having similar function and

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* Reprint requests: Cale A. Jacobs, PhD, Department of Orthopedic Surgery, University of Kentucky, 740 S. Limestone, Room K426, Lexington, KY 40536-0284.

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MEP, fewer patients with an intact ACL at the time of TKA would be satisfied with their procedure as a result of worse PAR.

Methods

To better understand if there are long-term implications of the condition of the ACL at the time of TKA, we retrospectively reviewed intraoperative findings and clinical outcomes of primary TKA patients with minimum 4-year follow-up from our institutional review board–approved prospective outcomes registry. To minimize the potential confounding effects of surgical technique and implant design, we limited our query to PCL–retaining TKA procedures performed by a single orthopedic surgeon with a single implant design (Vanguard Mono-lock; Zimmer Biomet, Warsaw, IN). All procedures were performed with manual instrumentation, and a gap balancing technique was used to determine appropriate rotation of the femoral component [6]. Patients were not excluded on the basis of age, gender, race, body mass index, or preoperative diagnosis.

The condition of the ACL and the total Outerbridge grade of degeneration were routinely recorded during all primary TKA procedures. The ACL was assessed visually and by palpation during each case and for the current analysis, patients were categorized based on the condition of the ACL as either being intact or dysfunctional, with the dysfunctional group consisting of those with an absent, partially torn, or lax ACL. Total Outerbridge grades were recorded to quantify the severity of degenerative changes in the joint and range from 0 (no degeneration) to 24 (severe degeneration of all six articulating joint surfaces) [7,8]. We recorded the number of patients in both the dysfunctional and intact groups with total Outerbridge grades <15 as patients with less severe disease have been previously demonstrated to have a significantly greater risk of being dissatisfied after TKA [7].

Patient satisfaction was recorded at the patient's most recent follow-up by asking patients if they were satisfied with their TKA. Patients were given the options of answering “Yes,” “No,” or “I'm not sure.” Similar to previous studies, satisfied patients were defined as only those that answered “Yes,” with either the response of “No” or “I'm not sure” being indicative of a lack of satisfaction [7,9]. Patient self-reported function was assessed using the 1993 Knee Society Score questionnaire [10]. We also sought to separately evaluate MEP and PAR as the 2 have different underlying mechanisms. MEP is related to inflammatory pain and/or peripheral sensitization and is commonly associated with the surgical insult, whereas PAR is related to not only peripheral input but with spinal and supraspinal processing as well [11,12]. PAR is common during the initial postoperative period, but alterations in pain processing and pain centralization become more likely the longer pain persists [12-14]. Postoperative MEP and PAR were quantified using the 1993 Knee Society Score questionnaire using previously described methods [10,14]. Two of the questions are specific to MEP (pain when walking or navigating stairs). MEP values range from 0 to 50 points, with higher scores being indicative of less pain. The third question specifically asked the patient to rate PAR. Scores for this question range from 0 to -15, with higher scores associated with less pain.

Knee Society Function Scores, MEP, and PAR were compared between those with an intact or dysfunctional ACL at the time of TKA using 2-tailed independent *t* tests. Categorical variables were compared between the intact and dysfunctional groups using Fisher exact or chi-square tests as appropriate. An alpha level of $P < .05$ was used for all analyses, and all analyses were performed using Microsoft Excel 2013 (Redmond, WA) and GraphPad Software (La Jolla, CA).

Table 1
List of Revision Procedures Performed During the Study Period.

No. of TKAs	Reason for Revision	Components Revised
15	Instability	Polyethylene liner exchange
4	Stiffness	Polyethylene liner exchange
3	Acute prosthetic joint infection	Polyethylene liner exchange
1	Internal rotation of tibial component	Custom liner exchange to correct rotation
1	Flexion instability	Femoral revision with polyethylene liner exchange
1	Instability	Complete revision (all components)
1	Periprosthetic fracture	Complete revision (all components)
1	Chronic prosthetic joint infection	2-Stage revision

TKA, total knee arthroplasty.

Results

We identified 903 PCL–retaining TKAs performed by the senior author between November 2007 and September 2011 that met the inclusion criteria. No patients in this series were revised for aseptic loosening of either the femoral or tibial component; however, 27 TKAs required reoperation (Table 1), and 33 patients (38 TKAs) passed away during the follow-up period for reasons unrelated to their TKA procedure. Of the remaining sample of 838 TKAs, 562 had complete intraoperative data, patient satisfaction, and Knee Society Function, MEP, and PAR scores. The ACL was noted to be dysfunctional in 109/562 TKAs (19.4%). The ACL was absent or torn in 74 knees and lax in 35. There were no differences in either PAR ($P = .39$) or MEP ($P = .88$) between those with absent versus lax ACLs which supports the decision to compile both ACL conditions into a single dysfunctional group. Age, body mass index, race, and duration of follow-up did not differ between those with an intact or dysfunctional ACL at the time of TKA; however, the dysfunctional group was composed of a significantly greater proportion of men and a significantly lower proportion of patients with total Outerbridge grades <15 (Table 2).

At mean follow-up of 5.1 years (range = 4.0-7.7 years), a significantly lower proportion of patients in the intact group were satisfied with their operation (intact: 391/453 [86.3%] vs dysfunctional: 102/109 [93.6%], $P = .0496$). The intact group had significantly inferior Function Scores (intact: 60.3 ± 29.9 vs dysfunctional: 68.5 ± 31.1, $P = .02$) and MEP (intact: 42.7 ± 12.8 vs dysfunctional: 45.3 ± 10.7, $P = .03$), but there were no group differences in PAR (intact: -1.8 ± 3.4 vs dysfunctional: -1.6 ± 3.1, $P = .59$). Closer inspection of the individual activities revealed that the intact and dysfunctional groups did not differ in walking ability or pain when walking; however, the intact group demonstrated significantly

Table 2
Patient Demographics for the Groups of TKA Patients With Either an Intact or Dysfunctional ACL at the Time of TKA.

Variable	Dysfunctional ACL	Intact ACL	*P*
No. of TKAs	109	453	—
Age	64.2 ± 8.2	65.1 ± 8.8	.28
Race, Caucasian/other (% Caucasian)	97/12 (89.0%)	411/42 (90.7%)	.58
BMI	33.8 ± 5.8	34.1 ± 7.2	.61
Duration of follow-up	5.2 ± 0.9	5.1 ± 0.8	.24
[a]Gender, female/male (% female)	54/55 (49.5%)	325/128 (71.7%)	<.0001
[a]Total Outerbridge grade <15	4 (3.7%)	72 (12.8%)	.0003

TKA, total knee arthroplasty; ACL, anterior cruciate ligament; BMI, body mass index.
[a] Statistically significant difference between groups ($P < .05$).