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Original Article

Clinical Outcomes Following the Use of Constrained Condylar Knees in Primary Total Knee Arthroplasty

Mohamed E. Moussa, MD [a,*], Yuo-yu Lee, MS [b], Anay R. Patel, MD [a], Geoffrey H. Westrich, MD [a]

[a] Division of Adult Reconstruction and Joint Replacement Surgery, Department of Orthopaedic Surgery, Hospital for Special Surgery, New York, New York
[b] Epidemiology and Biostatistics Core, Hospital for Special Surgery, New York, New York

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ABSTRACT

Background: Certain clinical or adverse intraoperative situations require the use of increased constraint in primary total knee arthroplasty (TKA). These include significant angular deformities causing incompetent collateral ligaments, or inadvertent intraoperative injury to collateral structures as well as the inability to achieve a balanced flexion and extension gap. Clinical success has been described with the use of constrained condylar knee arthroplasty in the primary setting in these situations. Traditionally, increasing constraint has been in conjunction with intramedullary stems, referred to as stemmed constrained condylar knees (SCCK); however, some devices provide an intermediary option by increasing constraint without the use of stems, herein referred to as nonstemmed constrained condylar knees (NSCCK). The aim of this study was to compare the clinical outcomes of both these devices in primary TKA in terms of revision rates and change in outcome measures over the follow-up period.
Methods: Between 2007 and 2012, 85 SCCKs and 354 NSCCKs were identified in our institutional registry database performed in the primary TKA setting with minimum 2-year clinical outcome measure follow-up. Baseline demographic information, as well as Western Ontario and McMaster Universities Arthritis Index (WOMAC) and Lower Extremity Activity Scale (LEAS) were collected preoperatively at 2-year follow-up. Revision data were also collected.
Results: Both groups showed substantial improvement in WOMAC scores (pain, stiffness, and function), and LEAS at 2 years postoperatively compared with baseline, although the changes in scores were not statistically significant. One of 85 SCCKs (1.17%) was revised for infection, whereas 9 of 354 NSCCKs (2.54%) were revised (6 for mechanical complications, eg, loosening, 2 for periprosthetic fracture, and 1 for infection).
Conclusion: Both cohorts demonstrated improvement in clinical outcome measures at 2-year follow-up. None of the SCCKs performed in the primary setting were revised for a mechanical complication. Although both groups had overall low revision rates, there was trend toward a higher revision rate with NSCCKs. Many of these were revised for component loosening. In summary, when necessary, constrained options in the primary TKA setting provide excellent clinical outcome at short-term follow-up. However, constrained constructs with stemmed fixation may provide more rigid fixation and be less susceptible to mechanical failure.

Achieving stability during total knee arthroplasty (TKA) is necessary for a successful outcome [1]. Certain clinical or adverse intraoperative situations require the use of increased constraint in primary TKA. These include significant angular deformities causing incompetent collateral ligaments, inadvertent intraoperative injury to collateral structures, inability to achieve a balanced flexion and extension gap, or various neuropathic disorders. Clinical success has been described with the use of constrained condylar knee arthroplasty in the primary setting [2-6]. In general, increasing constraint in TKA typically involves a thicker and wider post on the polyethylene insert that conforms more intimately to the femoral box. This creates increased constraint in the varus-valgus coronal plane as well as more rotational constraint. Traditionally, increasing constraint has been coupled with intramedullary stems, referred to

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* Reprint requests: Mohamed E. Moussa, MD, Department of Orthopaedic Surgery, Kaiser Permanente Orange County, 3460 E La Palma Ave, Anaheim, CA 92806.

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Table 1
Demographic Information.

	Group		*P* Value
	NSCCK	SCCK	
	N = 354	N = 85	
	N (%)	N (%)	
Age, mean ± SD	72.4 ± 9.5	66.9 ± 10.8	**<.0001**
BMI, mean ± SD	28.4 ± 5.3	29.9 ± 7.6	.0734
Sex			.1189
Male	114 (32.2%)	20 (23.5%)	
Female	240 (67.8%)	65 (76.5%)	
Race			**.0095**
White	322 (91.2%)	67 (78.8%)	
Asian	1 (0.3%)	0 (0.0%)	
Black	18 (5.1%)	12 (14.1%)	
Hispanics	3 (0.8%)	3 (3.5%)	
All others	9 (2.5%)	3 (3.5%)	
Medicare			**.0002**
No	66 (18.6%)	32 (37.6%)	
Yes	288 (81.4%)	53 (62.4%)	
Medicaid			**<.0001**
No	351 (99.2%)	77 (90.6%)	
Yes	3 (0.8%)	8 (9.4%)	
Self-pay			**.0081**
No	267 (75.4%)	52 (61.2%)	
Yes	87 (24.6%)	33 (38.8%)	
Discharge disposition			.6977
Home	123 (34.8%)	27 (31.8%)	
SNF	21 (5.9%)	8 (9.4%)	
In-patient rehab	205 (58.1%)	49 (57.6%)	
All others	4 (1.1%)	1 (1.2%)	
Primary dx—OA	336 (94.9%)	70 (82.4%)	**<.0001**
Inflammatory	87 (24.6%)	39 (45.9%)	**<.0001**
ASA			0.2241
1-2	276 (78.0%)	61 (71.8%)	
3-4	78 (22.0%)	24 (28.2%)	
Deyo Charlson comorbid index			.3446
0	252 (71.2%)	59 (69.4%)	
1-2	88 (24.9%)	25 (29.4%)	
3+	14 (4.0%)	1 (1.2%)	

Bold values indicate *P* values with statistical significance ($P < .05$).
ASA, American Society of Anesthesiologists; BMI, body mass index; NSCCK, nonstemmed constrained condylar knees; OA, osteoarthritis; SCCK, stemmed constrained condylar knees; SNF, skilled nursing facility; SD, standard deviation.

as stemmed constrained condylar knees (SCCK). Stems have been shown to decrease stress at the bone implant interface [7-10]. Multiple manufacturers have a device of this design that provides additional constraint with the use of intramedullary stems. Alternative devices provide an intermediary option by increasing constraint without the use of stems, herein referred to as nonstemmed constrained condylar knees (NSCCK).

Multiple studies have shown clinical success with both devices at both midterm and long-term outcomes in the primary TKA setting where more constraint is required [2-6,11-14]. However, some concerns have been raised with a NSCCK type of prosthesis as it does not offload stress in the construct to the extent of stemmed designs. Some studies have reported femoral loosening [13], and significant damage was noted in the polyethylene on retrieval analysis [14]. The latter study has suggested that mechanical loads may be too great for the polyethylene insert to withstand. The aim of this study was to compare the clinical outcomes of both these constrained devices in primary TKA in terms of revision rates and change in outcome measures over the follow-up period in a large institutional database.

Methods

Through our institutional IRB-approved Total Knee Replacement Registry, we retrospectively review all patients who underwent primary unilateral TKA between May 2007 and December 2012, 85 SCCKs and 354 NSCCKs were identified with a minimum 2-year follow-up, who had provided informed consent for participation in the registry and completed a preoperative and a 2-year postoperative survey. The SCCK group consisted of implants from 4 manufacturers (Zimmer, DePuy, Smith & Nephew, and Exactech), whereas the NSCCK group consisted of 1 manufacturer (Exactech Optetrak Nonmodular Constrained). Baseline demographic information included age, sex, race, body mass index, year of surgery, side of surgery, Medicare insured, Medicaid insured, commercial health insurance, self-pay health insurance, diagnosis of osteoarthritis, diagnosis of any systematic inflammatory diseases, American Society of Anesthesiologists status, Charlson-Deyo comorbidity index, and individual Elixhauser comorbidities. Clinical outcome measures including Western Ontario and McMaster Universities Arthritis Index (WOMAC) and Lower Extremity Activity Scale (LEAS) were collected preoperatively at 2-year follow-up (Table 1). Operative times, length of hospital stay, and discharge disposition were also collected. The preoperative range of motion data was not available for all patients, as it was not consistently documented among the various surgeons in the cohort. Preoperative deformity measurements were taken of both groups. Most patients did not have a 3-foot standing film preoperatively. As such, short standing anteroposterior knee x-rays were used to evaluate for coronal plane deformity. Femoral rotation was determined to be appropriate based on the patellar shadow being located within the middle of the femur on anteroposterior imaging. Tibial rotation was deemed to be appropriate based on the fibular head apex being bisected by the lateral tibial cortical margin. Overall coronal alignment and deformity was determined by measuring coronal alignment of the femur and the tibia and the Cobb angle formed between these two lines. Femoral measurements were performed from the center of the femoral condyle to a point that was centered in the visible portion of the femoral canal. This created a line, which

Table 2
Outcome Measures.

	Group		*P* Value
	NSCCK	SCCK	
	N = 354	N = 85	
	N (%)	N (%)	
Revised	10 (2.8%)	1 (1.2%)	.496
	Mean ± SD	Mean ± SD	
Baseline			
WOMAC			
Pain	56.8 ± 17.8	52.6 ± 17.1	.0603
Stiffness	48.9 ± 20.7	43.1 ± 20.9	**.0217**
Function	54.6 ± 17.2	50.9 ± 17.6	.1354
LEAS	9.5 ± 3.0	8.5 ± 2.7	**.0062**
2 y			
WOMAC			
Pain	86.6 ± 16.2	84.4 ± 18.3	.2608
Stiffness	76.7 ± 21.1	77.1 ± 21.5	.8763
Function	83.2 ± 16.9	79.5 ± 20.0	.1345
LEAS	11.0 ± 3.4	10.3 ± 3.2	.1069
Change from baseline to 2 y			
WOMAC			
Pain	29.8 ± 20.3	31.6 ± 20.7	.5049
Stiffness	27.7 ± 24.6	33.2 ± 24.0	.0652
Function	28.0 ± 19.2	31.4 ± 18.3	.2102
LEAS	9.6 ± 10.5	10.0 ± 9.7	.7795

Bold values indicate *P* values with statistical significance ($P < .05$).
NSCCK, nonstemmed constrained condylar knees; SCCK, stemmed constrained condylar knees; SD, standard deviation; WOMAC, Western Ontario and McMaster Universities Arthritis Index; LEAS, Lower Extremity Activity Scale.