

Preoperative Knee Stiffness and Total Knee Arthroplasty Outcomes

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Abstract: A retrospective case-control study was conducted to evaluate 1-year total knee arthroplasty (TKA) outcomes among preoperative stiff knees, range of motion (ROM) 80° or less, compared with nonstiff preoperative knees, ROM 100° or greater. A total of 134 stiff knee cases were compared with a matched cohort of 134 non-stiff knee controls. Knee Society Score and Oxford Knee Score change scores from baseline to 1 year were similar between the groups. Stiff knees experienced a significantly greater mean improvement in ROM from baseline to 1 year ($30.8^\circ \pm 18.8^\circ$) as compared with nonstiff knees ($1.1^\circ \pm 12.8^\circ$) ($P < .0001$). Although ultimate ROM of a TKA can be restricted secondary to preoperative stiffness, improvements in outcomes and ROM are not affected. We conclude that progression of stiffness should not in and of itself lead to earlier intervention of TKA in most cases. **Keywords:** total knee arthroplasty, range of motion, stiffness, Knee Society Score, Oxford Knee Score.

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Numerous studies have documented that preoperative range of motion (ROM) is the most significant predictor of ultimate postoperative ROM after total knee arthroplasty (TKA) [1-4]. Knee ROM has been shown to be important for activities of daily living; 65° to 70° of flexion are needed in the swing phase of normal gait, at least 90° to descend stairs, and 105° to rise independently from a low chair [5,6]. There are several studies in the literature that focused on the outcomes of treating the extremely stiff or ankylosed knee, generally with ROM less than 50°, showing benefit with TKA [7-12]. A few other studies have compared the functional outcomes of TKA in patients with poor preoperative ROM (range, 80°-90°) with arthritic knees with relatively preserved ROM [13,14]. These studies suggest that outcomes in the stiff knee are inferior to those with better preoperative ROM.

It has been our observation that although stiff knees seem to achieve poorer ROM after TKA, they still achieve a great deal of functional and symptomatic benefit. Our

objective was to determine whether stiff knees with ROM 80° or less can improve from their baseline function to levels that are achieved by patients who present with a good preoperative ROM of 100° or greater.

Methods

We conducted a retrospective case control study to evaluate the differences in clinical and subjective patient outcomes at 1-year post-primary TKA among patients presenting with preoperative knee stiffness defined as a maximal flexion ROM 80° or less, compared with patients without preoperative knee stiffness, defined as ROM 100° or greater. Cases were identified from a prospective arthroplasty database composed of surgical and outcome data on 3367 primary and revision TKA procedures performed between 2004 and 2008 at 1 arthroplasty center. Preoperative ROM was measured during the preoperative clinic assessment 2 to 3 weeks before surgery. Patients who underwent an elective unilateral primary TKA for osteoarthritis and who were implanted with either a Scorpio fixed-bearing posterior stabilized or fixed-bearing cruciate retaining knee implant (Stryker, Mahwah, NJ) were considered for inclusion in the study. All procedures were performed among 5 surgeons using standard surgical approaches.

In determining study patient eligibility, each TKA case had to have complete preoperative and 1-year postoperative outcome scores including both the Knee Society Score (KSS) and Oxford Knee Score (OKS) [15,16]. Patients scheduled to undergo sequential bilateral or revision TKA, presenting with diagnoses secondary to

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primary osteoarthritis (ie, rheumatoid arthritis, avascular necrosis), or who had a previous high tibial osteotomy were not considered for inclusion in the study.

Cases in the stiff knee group (ROM $\leq 80^\circ$) were matched 1:1 to non-stiff knee controls (ROM $\geq 100^\circ$) for gender, age, body mass index (BMI), and American Society of Anesthetist's (ASA) classification rating of physical status as a measure of medical comorbidity [17].

Data abstracted included demographics (age, gender, and BMI) and ASA rating. Preoperative and postoperative ROM was measured as maximum knee flexion against gravity by a nontreating physiotherapy assistant. Surgical details including soft tissue releases, exposure for tight knee, surgical skin-to-skin operative time, and incidence of any intraoperative complications were abstracted. Postoperative TKA-related complications and return to surgery for manipulation under anesthetic or for revision TKA up to 1-year post-index TKA were abstracted.

All patients followed a standard postoperative rehabilitation protocol involving active ROM exercises with standard physiotherapy supervision. The recommendation for a closed manipulation would occur in those patients achieving less than 80° at the 6-week follow-up visit.

Outcome measures included the clinical KSS and patient subjective OKS assessed preoperatively and at 6 weeks, 6 months, and 1 year postoperative. Individual domains of knee pain were rated on a 5-point Likert scale from no pain to severe pain; stair-climbing ability and ability to kneel down and get up again, both rated on a 5-point Likert scale from easy to impossible, were also abstracted from the OKS at each assessment interval.

The prevalence of patients who showed no clinically important improvement at 1 year after TKA as measured by the OKS using a minimal clinically important difference (MCID) was assessed. The MCID for the OKS was defined as a 5-point change or less, as suggested by Murray et al [18].

The primary outcome measure was difference in TKA ROM at 1 year postoperative. Differences in ROM, outcome scores, and skin-to-skin surgical time were analyzed using paired *t* tests. Differences in proportions were assessed using the χ^2 test or Fisher exact test, where appropriate. $P < .05$ was considered statistically significant for all analyses.

Results

The study sample was composed of 134 elective primary unilateral TKA cases that had presented with preoperative knee stiffness (ROM $\leq 80^\circ$) and met our inclusion criteria. Of the stiff knee cases, 99 (74%) of 134 were implanted with a fixed-bearing posterior stabilized TKA implant, and 35 (26%) of 134 were implanted with a fixed-bearing cruciate retaining TKA implant.

This group of stiff knee cases included 26 (19%) of 134 males and 108 (81%) of 134 females with a mean age of

66.6 years (± 9.9 years) and mean BMI of 34.1 kg/m^2 (± 7 years). Mean preoperative ROM for the stiff knee group was 70° ($\pm 10.2^\circ$) flexion. The stiff knee group was matched 1:1 to a cohort of non-stiff knee controls who had presented with a mean preoperative ROM of 111.2° ($\pm 8^\circ$) ($P < .0001$) (Table 1).

Mean skin-to-skin surgical time was similar between the stiff knee (68.3 ± 20.9 minutes) and the non-stiff knee group (70.1 ± 18.4 minutes) ($P = .548$). There were no specialized exposure techniques including quadriceps turndown, rectus snip, or tibial tubercle osteotomy performed in either group (Table 2). In addition, there were no intraoperative complications noted in either group.

Range of motion at the 6-week, 6-month, and 1-year postoperative intervals was significantly inferior for the stiff knee group ($P < .0001$) (Table 3). Despite inferior ROM at the postoperative assessments, the stiff knees did experience a significantly greater mean change in ROM from baseline to 1 year postoperative ($30.8^\circ \pm 18.8^\circ$) as compared with the non-stiff knee group ($1.1^\circ \pm 12.8^\circ$) ($P < .0001$). Of the stiff knee cohort, 13 (9.7%) of 134 continued to experience marked stiffness with ROM 80° or less at 1 year postoperative, whereas 3 (2.2%) of 134 of nonstiff knees ended up with a flexion range 80° or less at 1 year postoperative ($P = .010$).

Mean clinical outcome scores including the KSS and OKS were significantly inferior for the stiff knee group preoperatively and at 6 months and 1 year postoperative ($P < .05$) (Table 3); however, both the KSS ($P = .081$) and the OKS ($P = .298$) were comparable between the 2 groups at 6 weeks postoperative. Likewise, both the stiff knee and the non-stiff knee groups saw similar mean KSS and OKS change scores from baseline to 1 year postoperative (Table 3).

Of the stiff knee patients, 12 (11.3%) of 134 did not reach the MCID of greater than 5-point improvement in OKS with a mean OKS change score of -0.42 (± 3) points. Comparatively, 11 (8.3%) of 134 ($P = .438$) non-stiff knee patients did not achieve MCID with a mean OKS change score of -0.45 (± 3.9) points ($P = .979$).

Table 1. Demographics and Preoperative Range of Motion

	Stiff Knee Cases (n = 134)	Non-Stiff Knee Controls (n = 134)	P
Gender	81% female	81% female	–
Age (y)	66.6 (SD, 9.9)	66.6 (SD, 9.8)	.566
BMI (kg/m ²)	34.1 (SD, 7)	33.9 (SD, 6.3)	.288
ASA rating			
ASA 1	2/134 (1.5%)	2/134 (1.5%)	–
ASA 2	43/134 (32.1%)	43/134 (32.1%)	–
ASA 3	83/134 (61.9%)	83/134 (61.9%)	–
ASA 4	6/134 (4.5%)	6/134 (4.5%)	–
Preoperative ROM	70° (SD 10.2)	111.2° (SD 8)	.0001

SD indicates standard deviation.

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