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Evaluation of Medial-Lateral Stability and Functional Outcome Following Total Knee Arthroplasty: Results of a Single Hospital Joint Registry

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ABSTRACT

A precept of a successful total knee arthroplasty (TKA) would be a well balanced, stable knee. We analyzed the effects of medial-lateral (ML) stability on functional outcome at 2 years post-operatively. Prospectively collected Joint Registry data of all unilateral primary TKAs between 2004 and March 2008 were used. ML stability (Group 1: <5°, Group 2: 6°–9°, Group 3: ≥10°) was assessed by 3 independent researchers. 1500 patients undergoing 1507 arthroplasties were divided into their various groups. Outcome assessment involved range of motion (ROM) and functional outcome, using the Knee Society Function Score (KSS), Oxford Knee Score (OKS) and SF-36 score. At 2 years, Group 1 patients reported significantly higher KSS ($P < 0.001$) and SF-36 scores. All groups had good post-operative ROM. A stable knee (ML stability <5°) post TKA is likely associated with significantly better functional outcome.

Total knee arthroplasty is widely accepted as the surgical treatment of choice for tricompartmental osteoarthritis of the knee. A common precept of a successful total knee arthroplasty (TKA) would be that of a well balanced, stable knee with a good functional range of motion (ROM). This requires uniform flexion and extension gaps and meticulous varus-valgus alignment [1–6]. While it is known that instability is one of the major causes of implant failure, the verdict remains out there on the need for absolute stability in knee arthroplasties to result in significantly better functional outcomes. However, the commonly used Knee Society rating system seems to suggest that this is essential [7–11]. A total of 15 points are allocated to each category of anterior-posterior and medial-lateral stability. Maximum points in each category are obtained if the knee is only able to be moved <5 mm or <5° respectively. No points are awarded if anterior-posterior translation is >10 mm or if medial-lateral laxity is >15° [8].

At present, no consensus exists with regards to what degree of translation post TKA is optimal to function. Some studies have shown improved range of motion, pain relief and functional outcome in a post arthroplasty knee with increased laxity [10,11]. Warren et al [10] analyzed 64 TKAs post operatively and concluded that increased laxity both increases range of motion and decreases the likelihood of developing a fixed flexion deformity. Other studies like Kuster et al [7] have however disputed this association [12].

At present, few studies have investigated the effects of medial-lateral laxity on functional outcome in patients post TKA. Edward et al [11] examined collateral ligament laxity subjectively and concluded that no significant difference in function could be noted between knees of variable laxities post TKA, although a lax knee (≥10°) may be related to decreased pain post operatively. Matsuda et al [13] reviewed varus-valgus balancing in mobile-bearing total knee arthroplasties and suggested that increased coronal laxity is important in achieving better range of motion.

Some studies have suggested that a slightly lax knee allows greater ROM, hence potentially benefitting the Asian patient more as he may require higher flexion in his daily activities [14,15]. However, deductions occur in the Knee Society score with increasing medial-lateral laxity post TKA, contradicting with the above findings.

At present, no study, to the best of our knowledge, has investigated the relationship between medial-lateral laxity and functional outcome in a large cohort of patients post TKA. Our objective is to analyze the effect of medial-lateral laxity on functional outcome and quality of life in all patients undergoing TKA between 2004 and March 2008 at our center at 2 years.

Material and Methods

Data of all primary unilateral unconstrained TKAs performed at our tertiary institution between January 2004 and March

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2008 were collected post-operatively at 2 years. The study had ethical approval, and patients gave informed consent. All patients received a cemented posterior-stabilized TKA with a fixed bearing tibial prosthesis. Joint exposure was obtained using the traditional midline incision with a medial para-patella approach. All arthroplasties were performed using a measured resection technique.

Patients were included only if they were undergoing a primary unilateral total knee arthroplasty, with the other knee asymptomatic or successfully replaced. Exclusion criteria included: (1) Medical conditions affecting function eg, neurological deficits, cardiac failure, respiratory failure/limitations etc. (2) Spine, upper limb or any lower limb pathology affecting function. (3) Surgery on the contralateral knee within the 2 year follow-up. (4) All infected arthroplasties.

Data collection and patient assessment involved 3 independent observers who were senior physiotherapists at the 2 year follow-up. Knee medial-lateral stability was measured at 30° flexion, from its most varus to its most valgus position and grouped into 3 main categories: Group 1, <5°; Group 2, 6°–9°; Group 3, ≥10°. This angle was measured clinically as to the best of our knowledge, no instrument exists that is able to measure knee medial-lateral laxity precisely in a clinical setting. The knee was measured at 30° flexion as this minimizes the effect of the posterior structures of the knee, which act as secondary joint stabilizers.

To validate the consistency of measurement of medial-lateral stability among our 3 assessors, a pilot study involving 19 patients and the above 3 assessors was performed. The patients were assessed independently by all 3 assessors individually in an enclosed examination room. All 3 assessors were not informed which of the patients assessed were part of this pilot study and both patient and assessor were blinded with regards to their individual assessment outcomes. Inter-observer variability had substantial agreement (Kappa = 0.72) [16].

A total of 1976 patients undergoing 1983 TKAs met the inclusion criteria; 476 patients were lost to follow-up, of whom 26 passed away, 401 patients declined follow-up and the remaining 49 patients were uncontactable. Therefore, a total of 1500 patients undergoing 1507 TKAs were selected and divided into their individual groups based on total medial-lateral laxity (Groups 1: n = 416, Group 2: n = 878, Group 3: n = 213). Majority of the patients were female (80.7%) and had knee flexion ≥90° (96.2%). The mean age was 66.9 years. Almost an equal number of right and left knees were operated on (743 right, 764 left).

Functional outcome was assessed using the Knee Society Function Score (KSS), Oxford Knee Score (OKS) [17] and SF-36 quality of life score [18]. The SF-36 quality of life questionnaire comprises of 8 main domains, which can be broadly grouped into physical and mental health summary measures. Of these 8 domains, an overlap between physical and mental health assessment exists in 3 domains, namely general health, vitality and social functioning. In our study, the original scoring system for the Oxford Knee Questionnaire was used, where a lower score represented a better outcome.

Statistical Analysis

Analysis of the data was carried out using SPSS v17.0 (SPSS Inc., Chicago, Illinois) statistical software. Assuming non-parametric distribution, statistical testing of all 3 groups was performed using the Kruskal–Wallis analysis of variance. A P value of 0.05 or less was considered to be statistically significant.

Post hoc analysis was further performed using the Mann–Whitney U test. A P value of 0.017 or less was considered to be statistically significant after Bonferroni correction was performed.

Results

No significant difference was detected between the patients in all 3 groups pre-operatively. These include body mass index (BMI), range of movement, functional outcome measurements and alignment, with a majority of the patients in varus.

Functional Outcome (Tables 1 and 2)

The mean Knee Society score for all 3 groups showed a progressive decrease in value as knee medial-lateral laxity increased, with Group 1 patients reporting significantly higher sores ($P < 0.001$) than the other 2 groups. This significant difference was also noted when all 3 groups were sub-analyzed.

When analyzed for health outcomes (SF-36 quality of life score), Group 1 patients reported significantly better outcomes for nearly all aspects of physical health except for role functioning (SF-2) ($P = 0.734$), although they had a higher score. Group 1 patients had better physical function (SF-1) ($P = 0.004$), pain (SF-3) ($P = 0.002$) and general health (SF-4) ($P < 0.001$). The mean scores of Group 1 patients for SF-1, SF-3, SF-4 were ≥70. Group 1 patients also reported significantly improved vitality (SF-5) ($P < 0.001$) and mental health (SF-8) ($P = 0.014$). When all 3 groups were sub-analyzed, similar results were obtained except for SF-1 ($P = 0.001$) and SF-8 ($P = 0.004$), where a significant difference was only noted between Groups 1 and 3.

Although Group 1 patients reported a better mean score for the Oxford Knee Score, no significant difference was detected ($P = 0.236$). Analysis of the questions individually showed that kneeling was the commonest difficulty faced by most patients post TKA, regardless of medial-lateral laxity. Almost 80% of patients in each group scored 4 or more points when asked if they were able to kneel and get up again. This contributed to almost a quarter of the total score obtained for most patients.

Range of Motion (Tables 1 and 2)

The data were also examined for the effects of ML stability on range of motion (ROM). Although all groups had a good mean ROM >110°, Group 3 patients had significantly higher overall ROM ($P < 0.001$). No patient underwent revision arthroplasty for instability during this 2 year follow-up.

Table 1
Comparison of Postoperative Functional Outcomes and Range of Motion (ROM).

	Group 1 (<5°)	Group 2 (6°–9°)	Group 3 (≥10°)	P
	n = 416	n = 878	n = 213	Value
SF1 (Physical Functioning)	70.63 ± 18.09	68.88 ± 18.34	66.17 ± 19.59	**0.004**
SF2 (Role Function)	81.67 ± 35.26	80.92 ± 35.74	82.16 ± 35.17	0.734
SF3 (Bodily Pain)	77.14 ± 23.08	73.60 ± 24.00	70.82 ± 23.69	**0.002**
SF4 (General Health)	73.97 ± 20.58	69.80 ± 21.19	69.34 ± 19.23	<**0.001**
SF5 (Vitality)	76.61 ± 19.00	72.48 ± 19.56	69.20 ± 19.25	<**0.001**
SF6 (Social Functioning)	91.32 ± 22.21	91.71 ± 21.73	90.49 ± 23.80	0.771
SF7 (Role Emotional)	94.39 ± 22.45	93.70 ± 23.25	93.74 ± 23.40	0.752
SF8 (Mental Health)	83.47 ± 15.99	83.11 ± 14.46	80.62 ± 15.7	**0.014**
OKS	17.86 ± 4.95	17.96 ± 4.89	18.54 ± 5.31	0.191
KSC	76.1 ± 17.4	73.3 ± 18.1	72.6 ± 18.9	<**0.001**
ROM[a]	112.23° ± 16.59°	115.25° ± 15.79°	119.97° ± 17.00°	<**0.001**

Boldfaced values represent statistical significance of $P < 0.05$.
Values represent mean combined varus/valgus laxity ± (SD).
[a] Values represent mean range of motion (ROM) in degrees ± (SD).