Total Knee Arthroplasty: Does the Tibial Medial Side Defect Affect Outcome?

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Abstract- Primary knee osteoarthritis (OA) is one of the degenerative diseases that destroy auricular cartilage within knee joint and cause pain, varies deformity, decrease knee function. Total knee arthroplasty (TKA) is an effective intervention in order to relieve pain, improve function and QOL (quality of life) in patients with severe osteoarthritis of the knees that have different degrees of varus deformity. However, we are not aware of any study to shows if medial side defect in tibia has any association with outcome. We conceive this study of finding out if medial side defect of tibia affects the outcome. 124 patients (143 knees) with primary knee OA with different stages of defects participated in this study. Patients classified into two groups based on Rand classification of knee defects (patients with Rand I and II in group 1 and patients with Rand III and IV in group 2). Pain and knee alignment have been measured by Visual analog scale (VAS) and 3-joint X-ray and quality of life, knee function and radiographic have been measured by questionnaires of SF 36, WOMAC and KSS score. The mean follow-up was 18. 2 mounts (range 12 to 23 months). The results showed that all of the parameters improved significantly within groups ($P \leq 0.001$). Comparison TKA between two groups in the postoperative analysis shows that there was a significant difference between groups in pain, radiographic and functional KSS and WOMAC score ($P \leq 0.05$). So group 1 had better results in these parameters than group 2 after surgery. TKA is an effective intervention for all patients with severe osteoarthritis and varus deformity. However, the severity of medial tibial defects is an important determinant of outcome. Patients with a more severe deformity have less favorable outcome.

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Introduction

Primary knee osteoarthritis (OA) is one of the degenerative diseases that destroy articular cartilage within the knee joint. Between 27 to 44% adults in the united state suffering from knee OA (1-3). Because 60% of total body weight passes through the medial compartment in healthy subject, medial compartment is more susceptible to cartilage loss and bone deficiency; therefore about 90% of patients with knee OA have medial compartment defects

Management of cartilage and bone loss in order to correct mechanically and weight bearing the axis of the knees is mandatory during the TKA surgery (4,5). Knee arthroplasty is a cost effective approach and should be considered an appropriate investment by physicians. Previous studies evaluated this kind of intervention on knee society score and reported improvement in functional and radiographic results (6-9). Also, it has been approved the mean tibiofemoral angle could improved to 4 degrees valgus in patients with mean 24-degree varus (6).

Although total knee arthroplasty, as the mainstay of treatment in severe osteoarthritis of the knee, improve pain and ROM and QOL (quality of life). Several factors have been shown to be associated with functional outcome following TKA such as instability, ipsilateral hip arthritis, degree of limb deformity and peripheral vascular disease (10,11), however, we could not find any study to reveal the effect of medial tibial defects on functional outcome following TKA. Also, there are controversies about the effect of surgery on QOL of the patients. We designed this study to see if medial side effects have any association with patients QOL prior and after TKA and also in the degree of improvement.

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Materials and Methods

We collected data from our prospective database of Joint Reconstruction Research Center. All patients who undergo total joint replacement are included in this database and all data including patient's demographics, knee society score, WOMAC, and SF-36 are obtained preoperatively and every 6 months postoperatively. Patients who were diagnosed as severe primary knee OA with different stages of medial tibial defects based on Rand classification has been included in this study. According to this classification, defects of less than 25% of medial tibial hemicondyle is considered as type I, 25-50% as type II , 50-75% as type III, and more than75% as type 4.The type of the medial tibial defect is a good indicator of the chronology of the disease (12). Exclusion criteria included other deformities in affected limb (except varus deformity), and other kinds of arthritis (i.e. hemophilic arthritis, rheumatoid arthritis or another secondary type of osteoarthritis), All patients signed a consent form before participating in this study. Ethical approval was obtained from the ethical committee of Tehran University of Medical Sciences.

From January 2010 up to December 2012, 124 patients (143knees consist of 59 patients with type I Rand classification, 59 patients with type II, 29 patients with type III and 4 patients with type IV) have been undergoing TKA in our center and were included in this study. The mean follow-up was 18. 2 months (range 12 to23 months). Patients were followed every 6 mounts, and the last results were recorded.

We combined patients with type I and type II defects as a group I or patients with a minor defect and patients with type III or IV defects as group II or patients with major defects. Normality of data was confirmed by using the Kolmogorov–Smirnov technique. After confirmation of the normality of data, a paired t-test was used for analyzing the effects of surgery before and after arthroplasty in each group. Independent T-test and analysis variance was used for comparison postoperative results between two groups. We also compared the degree of improvement (delta) following TKA between two groups. SPSS statistical software was used for the analysis of data. The level of significance was set at 0.05.

Results

Patients in two groups showed the similar distribution in terms of sex and body mass index (BMI). However, patients with major defects were significantly older. The duration of follow-up was the same in both groups (Table 1).

Table 1. Patient's demographic data

	Group 1 (Rand I and II)	Group 2 (Rand III and IV)	*P*-value
Number	110 (76%)	33 (23%)	
Age	64.64 (32-82)	69.5 (32-84)	0.01
Sex (female)	89%	68%	0.857
BMI	28.74	27.87	0.079
Follow-up duration	18.05	18.72	0.737

All measured variables showed significant improvement following TKA in both groups (Table2).

Table 2. Comparison of measures variables within groups before and after arthroplasty

		Group I	*P* value	Group II	*P*- value
pain	Before	9.19 (1.009)	0.000	9.69 (0.59)	0.000
	After	1.07 (0.98)		2.25 (1.29)	
Knee alignment (varus/valgus)	Before (varus)	12.58 (4.98)	0.000	21.25 (8.11)	0.000
	After (valgus)	3.84 (1.58)		3.66 (1.55)	
KSS (Clinical)	Before	19.65 (14.94)	0.000	10.88 (13.67)	0.000
	After	89.23 (4.21)		86.06 (4.53)	
KSS (Functional)	Before	22.55 (12.38)	0.000	22.34 (9.15)	0.000
	After	95.55 (6.29)		91.25 (4.21)	
SF-36	Before	26.99 (19.8)	0.000	22.38 (8.31)	0.000
	After	67.12 (9.13)		58.91 (5.30)	
WOMAC	Before	61.86 (10.04)	0.000	62.06 (6.63)	0.000
	After	10.39 (1.80)		11.17 (2.9)	

Comparison of test parameters between groups before and after arthroplasty

We also compared preoperative and postoperative pain, knee alignment, clinical KSS, functional KSS, SF-36, and WOMAC scores between two groups. Pain, knee alignment, clinical KSS, and SF-36 were significantly worse in patients with larger tibial defects prior to TKA. However, functional KSS and WOMAC showed no significant difference (Table 3).

Following TKA, all measured variables were significantly better in patients with smaller tibial defects, except for postoperative knee alignment, which was the same in both groups (Table 3).

Table 3. Comparison of test parameters between groups before and after surgery

		Group I	Group II	*P*- value
Pain	Before	9.19 (1.009)	9.69 (0.59)	0.001
	After	1.07 (0.98)	2.25 (1.29)	0.000
Knee alignment (varus/valgus)	Before (varus)	12.58 (4.98)	21.25 (8.11)	0.000
	After (valgus)	3.84 (1.58)	3.66 (1.55)	0.569
KSS (Clinical)	Before	19.65 (14.94)	10.88 (13.67)	0.003
	After	89.23 (4.21)	86.06 (4.53)	0.001
KSS (Functional)	Before	22.55 (12.38)	22.34 (9.15)	0.92
	After	95.55 (6.29)	91.25 (4.21)	0.000
SF-36	Before	26.99 (19.8)	22.38 (8.31)	0.012
	After	67.12 (9.13)	58.91 (5.30)	0.000
WOMAC	Before	61.86 (10.04)	62.06 (6.63)	0.89
	After	10.39 (1.80)	11.17 (2.9)	0.001

We finally measured the degree of improvement in different variables in two groups and compared them (Table 4). Our data showed that patients with minor defects had significantly better improvement in all measured parameters.except for alignment and WOMAC.

Table 4. Comparison of degree o f improvement (delta) within groups

		Group I	Δ1	Group II	Δ2	*P*-value
Pain	Before	9.19 (1.009)	-8.11	9.69 (0.59)	-7.43	0.000
	After	1.07 (0.98)		2.25 (1.29)		
Knee Alignment (varus/valgus)	Before (varus)	12.58 (4.98)	-16.42	21.25 (8.11)	-24.91	0.578
	After (valgus)	3.84 (1.58)		3.66 (1.55)		
KSS (Clinical)	Before	19.65 (14.94)	+69.58	10.88 (13.67)	+75.18	0.001
	After	89.23 (4.21)		86.06 (4.53)		
KSS (Functional)	Before	22.55 (12.38)	+73.00	22.34 (9.15)	+68.90	0.000
	After	95.55 (6.29)		91.25 (4.21)		
SF-36	Before	26.99 (19.8)	+40.12	22.38 (8.31)	+36.53	0.000
	After	67.12 (9.13)		58.91 (5.30)		
WOMAC	Before	61.86 (10.04)	-51.47	62.06 (6.63)	-50.89	0.067
	After	10.39 (1.80)		11.17 (2.9)		

Δ1: Comparison of degree of improvement within groups I
Δ2: Comparison of degree of improvement within groups II
P-value: Comparison of the degree of improvement between groups

Discussion

The main goal of this study was to determine, analyze and explain the effects medial tibial defect on different outcomes including knee pain, knee alignment, KSS, WOMAC and QOL following TKA in subjects with severe knee OA.

Our study showed that all subjective and objectively measured outcomes have significantly improved following TKA regardless of the degree of medial tibial defects. This finding is in line with previous studies that showed significant improvement in patients with advanced OA in knee alignment after TKA (6). Hawker *et al.*, also reported significant and persistent relief of pain and improvement in physical function and satisfaction between 2 to 7 years after total knee replacement (11). Previous investigators reported that QOL had been significantly improved following TKA

regardless of age. They, therefore, concluded that age is not a factor that affect the results of TKA and should not be a limiting factor alone (13). Rissanen *et al*., showed major improvement in pain, ROM and physical ability in patients undergoing TKA, however, these patients were less healthy than general population of same age and it persists for 2-5 years (10). We found that even patients with a large medial bone defect in the tibia benefited from TKA.

The present study clearly demonstrated that patients with larger defects had worse initial scores. As we shown in table 3, patients with larger defects, had more pain, greater varus deformity, less clinical KSS, and worse SF-36 preoperatively in comparison to patients with smaller medial tibial defects. However, functional KSS and WOMAC score showed no significant difference preoperatively. This finding showed that the degree of medial tibial defects could be an indicator of the severity of osteoarthritis. Therefore, patients with larger defects and more severe osteoarthritis have more pain and disability and poorer QOL .before TKA.

One important finding of our study was that patients with larger defects obtained poorer outcome following TKA during the study period. Those patients had significantly more pain, worse clinical and functional KSS, poorer SF-36 and poorer WOMAC score at the final follow-up. The only parameter that showed the same in both groups was alignment. That indicates that proper surgical technique could refine the knee alignment even in patients with larger tibial defects. The amount of improvement in each outcome measure (Delta) other than alignment was significantly higher in patients with the smaller tibial defect. This reiterate the fact that TKA would be a more effective procedure in terms of improvement of patient's pain, function, and QOL if it is performed in the earlier stage of osteoarthritis. Previous studies showed that different outcome measures' including a postoperative range of motion is closely related to a preoperative range of motion (REF).

We also found that patients with larger defects were older; however, our study could not determine that how much the lower functional outcome and QOL in these patients were related to older age of patients compared to more severe osteoarthritis. We think that older age of these patients at the time of presentation could be associated with a longer disease process in the affected knee that lead to more severe osteoarthritis, larger defect and poorer score at the presentation.

In conclusion, TKA is an effective procedure in terms of improvement in patient's pain, function, and QOL. However, patients with larger medial tibial defect showed worse final outcome in comparison to patients with the smaller defect. This finding could be related to more severe osteoarthritis that is associated with poorer initial scores in these patients. This finding could help the operating surgeon and the patients prior to surgery to expect more realistic outcome following TKA.

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