Eklem Hastalıkları ve Cerrahisi
Joint Diseases and Related Surgery

Original Article / *Çalışma - Araştırma*

Eklem Hastalık Cerrahisi
2009;20(2):93-101

A comparison of static and dynamic balance in patients with unilateral and bilateral total knee arthroplasty

Tek taraflı ve iki taraflı total diz artroplastisi uygulanan hastaların statik ve dinamik denge yönünden karşılaştırılması

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Objectives: Unilateral and bilateral total knee arthroplasty (TKA) patients were compared with respect to static and dynamic balance in the postoperative sixth and 12th months.

Patients and methods: Eighty TKA patients 35 unilateral, 45 bilateral were assessed for static and dynamic balance using the balance master test device in sixth and 12th months after surgery. Patients were also measured with respect to Hospital for Special Surgery knee score and range of motions. Differences between groups were statistically evaluated using independent t-tests. Within-group time differences were statistically examined using paired t-tests. Correlation between the measurements was evaluated by the Pearson's analysis.

Results: Sensory interaction balance and unilateral stance test of static balance assessment were similar in unilateral and bilateral TKA ($p>0.05$). Patients with bilateral TKA had statistically significantly better performance at the limits of stability of dynamic balance evaluations ($p<0.05$). There was no significant difference between rhythmic weight shift tests in the sixth and 12th months after surgery ($p>0.05$).

Conclusion: In our study we concluded that while dynamic balance parameters in the daily activities of patients with bilateral TKA were expected to be better than patients with unilateral TKA, there was no significant difference between static balance parameters between the two groups.

Key words: Static and dynamic balance; total knee arthroplasty.

Amaç: Bu çalışmada, tek taraflı ve iki taraflı total diz artroplastisi (TDA) uygulanan hastalar ameliyat sonrası altıncı ve 12. ayda statik ve dinamik denge yönünden karşılaştırıldı.

Hastalar ve yöntemler: Çalışmaya, 35 tek taraflı, 45 iki taraflı TDA olmak üzere toplam 80 hasta dahil edildi. Hastalar, balance master denge ve performans test cihazı ile ameliyat sonrası altıncı ve 12. ayda statik ve dinamik denge yönünden değerlendirildi. Hastalar "The Hospital for Special Surgery" diz skoru ve diz fleksiyon hareket açıklığı bakımından da karşılaştırıldı. İstatistiksel analiz yönteminde, gruplar arası karşılaştırmada bağımsız t-testi, grupların kendi içlerinde ise paired t-testi kullanıldı. Ölçümler arası ilişki için Pearson korelasyon analizi kullanıldı.

Bulgular: Tek taraflı ve iki taraflı TDA hastalarının statik denge değerlendirmesi karşılaştırıldığında, duyusal denge komponentinin klinik testi ve tek ayak üzerinde durma testleri benzerdi ($p>0.05$). Dinamik denge değerlendirmelerinden stabilite limiti testinde, iki taraflı TDA hastalarının daha iyi oldukları belirlendi ($p<0.05$), ritmik ağırlık aktarma testleri bakımından ameliyat sonrası altıncı ve 12. ayda anlamlı bir fark bulunmadı ($p>0.05$).

Sonuç: Çalışmamızda tek taraflı ve iki taraflı TDA hastalarında, statik denge yönünden herhangi bir fark bulunmazken, iki taraflı TDA hastalarının, dinamik denge parametreleri açısından tek taraflı TDA hastalarına göre daha iyi ve günlük yaşam aktiviteleri açısından avantajlı oldukları belirlendi.

Anahtar sözcükler: Statik ve dinamik denge; total diz artroplastisi.

• *Received: April 08, 2009 Accepted: June 11, 2009*

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Total knee arthroplasty (TKA) has become a common surgery in the treatment of severe osteoarthritis (OA). Diminished joint sensation may precipitate degenerative changes, and a strong association between decreased proprioception and function has been identified in patients with knee OA.[1,2] Several authors have demonstrated a decline in joint sense in subjects with OA knees.[3] Osteoarthritis pathology and TKA appear to alter the proprioceptive function of the knee.[4] After TKA, joint sensation is partially restored, which may enhance motor coordination and functional stability of the knee.[1] Recovery rate in proprioception after TKA was reported to be not high,[5] and decline in position sense after TKA also is considered to be important because it may be a significant risk factor in failure of knee arthroplasty.[6]

Control of balance is essential in all postures and situations, both static and dynamic.[7] Changes in the proprioceptive function of the knee joint may contribute to altered balance control during standing and walking.[4] Reestablishing joint sensation and the balance ability are important for maximization of patient outcome. However, little is known regarding the role of knee joint mechanoreceptors in the control of posture and regarding the influence of TKA on postural control recovery strategies.[1] In the literature, hip and ankle joints are accentuated in the control of posture, while the studies investigating the effect of knee joint on balance are rare. These are mostly related to comparative studies between TKA with or without posterior cruciate ligament protection and healthy, osteoarthritic and healthy knees.[4,8-11]

Many patients with arthritic knees have symmetrical involvement and thus require a bilateral operation. When the knees are involved, there exists a choice between staged or simultaneous arthroplasty.[12,13] Although there are studies assessing functional activities related to daily life and knee scores in unilateral and bilateral TKA patients, the effect of TKA on balance has not been clarified yet. There is no study which compares both static and dynamic balance before and after unilateral or bilateral TKA surgery.[4]

The purpose of the study was, therefore, to compare the static-dynamic balance of patients who have undergone unilateral and bilateral TKA in the sixth and 12th months after surgery.

PATIENTS AND METHODS

Between July 2003 and May 2006, a total of 80 consecutive patients 35 unilateral, 45 bilateral with primary cemented TKA performed by the same surgeon (VK) using paramedian approach were included in the study. Patients with heart, liver, renal, gastrointestinal or endocrinological diseases, and with malignancy, rheumatoid arthritis, gout, paresis or previous fracture of the lower limbs were excluded. Although the contralateral knees of the patients in whom unilateral replacement was utilized showed radiological and clinical signs to warrant surgery, it was patients' preference to have unilateral replacement.

All patients had primary OA in their knees bilaterally before arthroplasty. Only the patients with grade three and four according to the Kellgren and Lawrence system were included in the study.[14]

All knees were implanted with cemented, TKA with cruciate retaining (NexGen®, Zimmer, USA). After surgery, all patients received standard postoperative treatment by a physiotherapist, including continuous passive motion, active-assistive and active range of motion (ROM) exercises, isometric and isotonic strengthening exercises, gait training and transfer training. After discharge from the hospital, a home-based rehabilitation program was applied. The patients were instructed to perform the exercises, and were evaluated every two weeks in hospital for examination and instruction of new exercises.[15,16] The patients were evaluated by the physiotherapist preoperatively (SB) and then at two-weekly intervals (BÜ) during the postoperative 12 months using the Hospital for Special Surgery (HSS) knee score and knee ROM.[17,18] In bilateral cases, ROM was evaluated separately for the sides. The HSS knee score criteria is based on a total of 100 points. The score is divided into seven categories: pain, function, ROM, muscle strength, flexion deformity, instability and subtractions. Scores between 100 and 85 points are considered excellent results; scores between 84 and 70 points are good results; scores 69 and 60 points are fair, and scores less than 60 are considered poor results. Range of motion was determined with a universal goniometry by evaluating range of knee flexion and extension.[18]

Instrumentation

Balance Master System (version 8.0, NeuroCom Inc, USA) consists of dual force plate with 150 cm

TABLE I

Comparison of the demographic characteristics of the patients preoperatively

	Unilateral TKA		Bilateral TKA		*p*
	Mean±SD	n/sex	Mean±SD	n/sex	
Number of subjects		35/M		2/F, 43/M	
Age (years)	67.11±9.3		67.17±7.3		0.937
Height (cm)	156.34±6.9		154.77±6.8		0.316
Weight (kg)	75.87±8.5		79.15±12.9		0.178
Body mass index (kg/m^2)	31.15±4.5		33.03±4.9		0.085

TKA: Total knee arthroplasty.

length and computer with software for operation.[19] Patients stand on the dual force plates facing the monitor. It provides quantitative assessment of static and dynamic balance performance and visual feedback of the excursion, movement path and position of the center of gravity (COG).[20-22]

Static balance assessment

Each patient was asked to stand as still as possible in predefined position on the force plates during following test procedures.[19]

Modified Clinical Test of Sensory Interaction on Balance (mCTSIB): Patients were asked to stand in erect position on the firm and foam surfaces with eyes open and closed conditions to determine postural sway velocity in degree per second. Data obtained from surfaces with eyes open and closed compared within and between groups.

Unilateral stance (US): It measures COG sway velocity during standing on single leg with eyes open and closed conditions. The average of all conditions for each group was calculated as compound COG sway velocity for comparisons between groups.

Dynamic balance assessment

Dynamic balance tests quantify balance conditions during different movements that simulate the functional activities.[20]

Limit of stability (LOS): It measures the patient's ability of voluntary sway to eight predefined location in space. The maximum distance a patient can lean in a given direction without losing balance was measured. Data collected during traveling to eight locations averaged as compound data of reaction time (sec), movement velocity (deg/sec), end point excursion (%), maximum excursion (%) and directional control (% path) for comparison between groups.

Rhythmic weight shift (RWS): The ability to control the left-right and forward-backward movements of the COG reciprocally over the base of support, and modification in the timing of movement to match the speed of cue in one, two, and three second pacing time were measured. Data gathered in all pacing times averaged in each group for on axis velocity (deg/sec) and directional control (% path).

The study was approved by the local ethics committee and informed consent was obtained from the patients before inclusion. Ethical committee for human research, Dokuz Eylül University Hospital. Protocol Number 201.

The statistical analysis was performed with SPSS for Windows (version 12.0, SPSS Inc., chicago, Illionis). Between-group differences in the sixth and 12th month changes were evaluated using independent t-tests. Within-group differences in the sixth and 12th month values were examined for statistical significance using paired t-tests. A p value of <0.05 was considered to be significant. The correlation between the measurements was evaluated by Pearson's correlation analysis.

RESULTS

There was no significant difference between the groups in terms of gender, age, height, weight and body mass index (p>0.05; Table I). There was no difference between the groups in terms of preoperative and postoperative HSS scores and knee ROM in the sixth and 12th month (p>0.05; Figure 1, 2).

There was no significant difference between the groups in terms of mod CTSIB and US test in the sixth and 12th month after surgery (p>0.05; Table II).

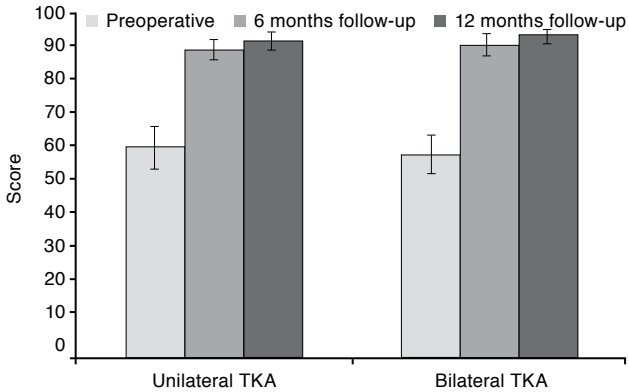

Figure 1. Comparison of the hospital for special surgery score of the patients' preoperative, sixth and 12th month after surgery. TKA: Total knee arthroplasty.

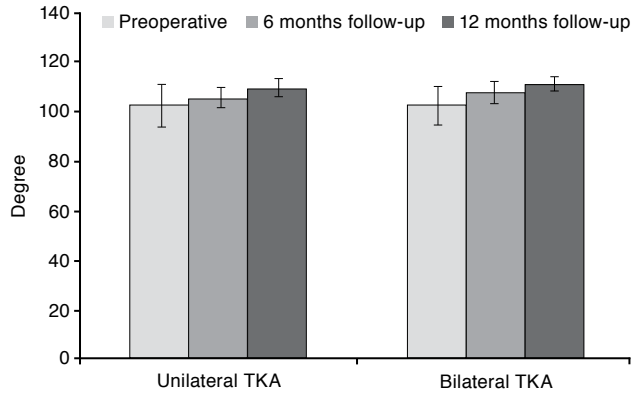

Figure 2. Comparison of the range of motion of the patients' preoperative, sixth and 12th month after surgery TKA: Total knee arthroplasty.

In the sixth month after surgery, patients with bilateral TKA had high scores on only directional control in LOS test compared to unilateral TKA ($p<0.05$), but there was no significant difference between the groups in RWS test ($p>0.05$; Table III). In the 12th month after surgery, bilateral TKA patients had high scores on reaction time, end point exursion, maximum excursion and directional control in LOS test compared to unilateral TKA ($p<0.05$), but there was no significant difference between the groups in RWS test in the 12th month after surgery ($p>0.05$; Table III).

There was no significant difference in favour of static balance when unilateral and bilateral TKA patients' sixth month and 12th month values were compared to each other ($p>0.05$; Table IV).

A significant increase was found in dynamic balance parameters of unilateral TKA patients such as reaction time, movement velocity and directional control in the 12th month in comparison to sixth month ($p<0.05$; Table V).

There was also an increase in all the LOS values of bilateral TKA patients in the 12th month when compared to sixth month ($p<0.05$; Table V).

Pearson's correlation analysis revealed that the results of the HSS knee score and balance parameters were poorly correlated (Table VI).

DISCUSSION

Joint motion and position sense also have important role in the maintenance of balance. Diminished joint sensations are recognized as a factor contributing to balance deficits.[1] Some authors have suggested that there is proprioceptive loss of balance due to arthritis and that this is not improved by TKA.[23,24] In contrast, others have claimed

TABLE II

The comparison of static balance of unilateral and bilateral total knee arthroplasty patients after operation

	Six months follow-up			12 months follow-up		
	Unilateral TKA Mean±SD	Bilateral TKA Mean±SD	*p*	Unilateral TKA Mean±SD	Bilateral TKA Mean±SD	*p*
mCTSIB (degree/second)						
Firm surface eye open	0.24±0.1	0.24±0.9	0.981	0.27±0.1	0.24±0.1	0.252
Firm surface eye closed	0.28±0.1	0.30±0.1	0.453	0.37±0.2	0.30±0.1	0.117
Foam surface eye open	0.92±0.3	0.94±0.2	0.744	0.91±0.2	0.84±0.2	0.233
Foam surface eye closed	2.10±1.0	1.76±0.5	0.042*	1.67±0.5	1.50±0.5	0.179
Compound postural sway	0.90±0.3	0.82±0.2	0.173	0.83±0.2	0.76±0.2	0.228
Unilateral stance						
Compound postural sway	7.87±1.4	8.65±1.0	0.326	8.27±1.8	7.60±0.2	0.246

*: $p<0.05$; TKA: Total knee arthroplasty; mCTSIB: Modified clinical test of sensory interaction on balance.

TABLE III

The comparison of dynamic balance of unilateral and bilateral total knee arthroplasty patients after operation

	Six months follow-up			12 months follow-up		
	Unilateral TKA Mean±SD	Bilateral TKA Mean±SD	*p*	Unilateral TKA Mean±SD	Bilateral TKA Mean±SD	*p*
Compound LOS						
Reaction time (sec)	0.9±0.4	0.7±0.3	0.079	0.7±0.2	0.6±0.1	0.028*
Movement velocity (deg/sec)	3.0±0.9	3.2±0.6	0.187	3.3±0.9	3.5±0.8	0.313
End point excursion (LOS %)	74.7±15.5	76.0±10.2	0.676	76.8±13.4	83.6±10.3	0.013*
Maximum excursion (LOS %)	88.8±11.7	91.4±9.1	0.273	90.9±9.7	95.2±8.2	0.038*
Directional control (LOS %)	75.4±7.3	78.8±5.5	0.027*	78.7±6.8	82.2±3.8	0.006*
Rhythmic weight shift						
On axis velocity (deg/sec)						
Left-right	5.9±1.1	6.0±1.3	0.904	5.5±1.1	5.8±1.0	0.149
Forward-backward	3.5±1.0	3.6±0.8	0.798	3.7±1.0	3.6±0.7	0.649
Directional control (path %)						
Left-right	83.0±4.7	83.4±4.2	0.707	82.5±3.9	83.2±4.4	0.450
Forward-backward	79.1±6.8	76.9±7.6	0.192	77.3±7.1	77.4±6.7	0.929

*: p<0.05; TKA: Total knee arthroplasty; LOS: Limit of stability.

improvement after total knee arthroplasty.[1,11] An increase in postural sway with the decrease of proprioceptive senses was also determined in TKA patients.[10,25,26]

In our study, we found that joint structure rebuilt bilaterally was not superior to joint structure rebuilt unilaterally in terms of static balance in the sixth and 12th months after surgery; therefore, we determined that bilateral TKA surgery had no effect on static balance. Although there was no statistically significant difference in the sixth and 12th months' evaluations in both groups, the decrease in the total value of postural sway in postoperative 12th month supports the expectation of proprioceptive sense reversal by the time, even tough this reversal may be partial.

In addition to joint position sense required for protection of postural stability, visual inputs are also essential.[19,26] Soft surface and disconnection of visual inputs lead to balance disruption in TKA patients.[27] For this reason, we especially considered the assessments on the soft surface. In our study we found that postural sway with eyes open and on firm surface were less in both groups. Results parallel to those in literature were obtained through these studies, and when the eyes are closed the diversion of cutaneal, proprioceptive and joint position sense by soft surface leads to an increase in postural sway.[4]

In our study it was determined that there was no difference between postoperative sixth and 12th assessments of postural sway of unilateral and bilateral TKA patients'' standing on one extremity (Table II). The absence of difference between the postural sway degrees of unilateral patients' arthroplasty and arthritic knee shows that there remains insufficiency in static balance after the surgery. In a study investigating the effects of prosthesis types on proprioceptive sense and postural sway, Gage et al.[4] found that postural sway degree of patients with unicompartmental knee arthroplasty standing on one leg is significantly less than patients with total knee arthroplasty. They indicated that in patients with unicompartmental knee arthroplasty balance structures are better due to more bone stock and protected cruciate ligament structure.

Another reason leading to similar results in both groups is the fact that postural sway is decreased by the stabilization of distal joints such as ankle joint instead of knee joint when standing on one leg.[28] In patients with bilateral TKA the absence of difference between two extremities in terms of postural sway may be explained with the fact that two sides had arthroplasty and with the absence of difference in proprioceptive perception.

TABLE IV

Intra-comparison of postoperative sixth and 12th months of patients with unilateral and bilateral total knee arthroplasty in terms of static balance

	Unilateral TKA			Bilateral TKA		
	Six months follow-up Mean±SD	12 months follow-up Mean±SD	*p*	Six months follow-up Mean±SD	12 months follow-up Mean±SD	*p*
mCTSIB (degree/second)						
Firm surface eye open	0.2±0.1	0.2±0.1	0.240	0.2±0.9	0.2±0.1	0.287
Firm surface eye closed	0.2±0.1	0.3±0.2	0.02*	0.3±0.1	0.3±0.1	0.273
Foam surface eye open	0.9±0.3	0.9±0.2	0.966	0.9±0.2	0.8±0.2	0.306
Foam surface eye closed	2.1±1.0	1.6±0.5	0.078	1.7±0.5	1.5±0.5	0.215
Compound postural sway	0.9±0.3	0.8±0.2	0.713	0.8±0.2	0.7±0.2	0.428
Unilateral stance						
Compound postural sway	7.8±1.4	8.2±1.8	0.308	8.6±1.0	7.6±0.2	0.312

*: p<0.05; TKA: Total knee arthroplasty; mCTSIB: Modified clinical test of sensory interaction on balance.

Dynamic tests assess balance control during voluntary execution of a movement, such as walking or rising from a chair. Dynamic postural stability can be defined as and measured by an assessment of an individual's ability to maintain balance while transitioning from a dynamic to a static state.[29,30] Dynamic balance disorders occur as a result of limitations in joint motion, loss of motor and proprioceptive senses.[19,31]

In our study in bilateral TKA patients' stability limit test analyses movement control in the sixth month, reaction time, movement control and last point reached and maximum distance values in the 12th month were significantly better than unilateral TKA patients (p<0.05; Table III). Contrary to some studies in the literature, this result may be explained as an improvement in proprioseptive sense probably due to rebuilt joint.[23,32]

TABLE V

Intra-comparison of postoperative sixth and 12th months of patients with bilateral and unilateral total knee arthroplasty in terms of dynamic balance

	Unilateral TKA			Bilateral TKA		
	Six months follow-up Mean±SD	12 months follow-up Mean±SD	*p*	Six months follow-up Mean±SD	12 months follow-up Mean±SD	*p*
Compound LOS						
Reaction time	0.9±0.4	0.7±0.2	0.03*	0.7±0.3	0.6±0.1	0.022*
Movement velocity	3.0±0.9	3.3±0.9	0.03*	3.2±0.6	3.5±0.8	0.030*
End point excursion	74.7±15.5	76.8±13.4	0.246	76.0±10.2	83.6±10.3	0.001*
Maximum excursion	88.8±11.7	90.9±9.7	0.217	91.4±9.1	95.2±8.2	0.021*
Directional control	75.4±7.3	78.7±6.8	0.006*	78.8±5.5	82.2±3.8	0.003*
Rhythmic weight shift						
On axis velocity						
Left-right	5.9±1.1	5.5±1.1	0.179	6.0±1.3	5.8±1.0	0.626
Forward-backward	3.5±1.0	3.7±1.0	0.416	3.6±0.8	3.6±0.7	0.915
Directional control						
Left-right	83.0±4.7	82.5±3.9	0.840	83.4±4.2	83.2±4.4	0.682
Forward-backward	79.1±6.8	77.3±7.1	0.254	76.9±7.6	77.4±6.7	0.596

*: p<0.05; TKA: Total knee arthroplasty; LOS: Limit of stability.

TABLE VI

Correlation between hospital for special surgery scores with balance parameters in unilateral and bilateral total knee arthroplasty after six and 12 months follow-up

	Unilateral TKA				Bilateral TKA			
	HSS (6 months)		HSS (12 months)		HSS (6 months)		HSS (12 months)	
	Operated side	Nonoperated side	Operated side	Nonoperated side	Right side	Left side	Right side	Left side
Compound mCTSIB	-0.225	-0.128	-0.248	-0.047	-0.120	-0.225	-0.249	-0.213
Unilateral stance								
Right side eye open	0.038	-0.267	-0.194	0.070	-0.293	-0.184	-0.207	-0.139
Left side eye open	-0.018	-0.020	-0.107	0.225	-0.278	-0.285	-0.069	-0.008
Right side eye closed	-0.140	-0.083	-0.203	0.232	0.196	0.188	-0.136	-0.061
Left side eye closed	0.264	0.269	0.054	0.369*	0.047	0.040	0.085	0.108
Compound LOS								
Reaction time	-0.018	0.039	0.010	0.313	-0.056	-0.123	0.130	0.069
Movement velocity	-0.016	-0.038	-0.154	-0.018	0.210	0.062	-0.150	-0.211
End point excursion	-0.067	-0.095	-0.101	-0.310	-0.038	-0.072	0.142	0.012
Maximum excursion	-0.238	-0.075	-0.127	-0.214	0.093	0.074	-0.131	-0.258
Directional control	-0.200	-0.063	-0.082	-0.092	0.184	0.129	0.227	0.135
Compound RWS								
Left-right								
On axis velocity	-0.082	-0.079	-0.024	-0.272	0.107	0.000	-0.157	-0.292
Directional control	0.205	-0.002	0.302	-0.062	0.084	0.006	-0.099	-0.161
Forward-backward								
On axis velocity	0.101	-0.013	-0.229	-0.133	0.104	-0.008	0.077	-0.140
Directional control	0.422*	0.071	-0.005	-0.250	0.185	0.141	0.060	0.017

*: p<0.05; TKA: Total knee arthroplasty; LOS: Limit of stability; RWS: Rhythmic weight shift; mCTSIB: Modified clinical test of sensory interaction on balance.

Barret et al.[11] and Warren et al.[33] suggested that joint-position sense improves after total knee arthroplasty when compared with that of the contralateral limb and that in an osteoarthritic control group. In TKA patients, proprioceptive sense improvements provide better input through rebuilt joint, as well as a decrease in pain levels and an increase in functional activity related to daily life occur. This condition leads to a decrease in reaction time while increasing movement controls parallel to increased functional activities of the patients.[2,23]

Hospital for Special Surgery score was found to be higher in the patients with unilateral knee arthroplasty by Ünver et al.[15] Contrary to that finding, Mahoney et al.[34] found the higher HSS score in patients with bilateral knee replacement. In our study the HSS scores were similar between the two groups (Figure 1). Thanks to bilateral and unilateral TKA application, a significant improvement was found in postoperative first year HSS score of the patients compared to preoperative period. Additionally, after TKA applications, postoperative functional scores peaked within two years and subsequently declined.[35] In our study there was also a poor correlation between the HSS knee scores and balance parameters. Because of this, we concluded that the HSS scores do not have an effect on balance parameters.

One of the most important targets following TKA is to provide beneficial effects on ROM. The objective of knee flexion gain is to provide the recovery of normal daily activities of the patient. Patients need at least 110 degrees of knee flexion to maintain their activities of daily living. In several studies, motion has been found to increase for the first year and potentially up to three years.[35] The one year follow-up mean knee flexion of our

patients was 110°, which was higher than the suggested value and had a potential to increase in the following years.[36] In this respect, in our study flexion degrees were found similar in both groups, and with these results we concluded that bilateral and unilateral TKA application had no effect on knee flexion gain.

While there are studies in the literature reporting similar improvements in ROM and knee scores of unilateral and bilateral TKA patients, there are also opposite studies showing their different priorities.[15,37] In our study while no difference was found between two groups in terms of ROM and knee scores in nonoperated knee, it was found that patients with unilateral TKA who had arthritic, painful and limited movement structure had poorer dynamic balance than patients with bilateral TKA.

As knee range of motion increase may contribute to dynamic balance supply following TKA, intra-improvement of dynamic balance of unilateral and bilateral TKA patients in the postoperative sixth and 12th months, probably depending on the time, may be explained with the increase in proprioceptive sense, motor function and range of motion. Lugade et al.[38] found no significant difference between total hip arthroplasty patients and healthy group in terms of the postoperative fourth month muscle strength and ROM values, but they reported that deficits in dynamic balance structure continued.

For better observation of the difference of balance function improvement and determination of the effect of TKA on balance, the same parameters should also be assessed in preoperative period. This was the major limitation of our study.

While dynamic balance parameters in the daily activities of patients with bilateral total knee arthroplasty are expected to be better than patients with unilateral total knee arthroplasty, because of weak extensor mechanism, painful non-operated knee joint or hesitating to load the replaced knee because of feeling insecure, and more importantly decreased proprioceptive sensation these factors may be major contributors to lower performance balance ability of patients in unilateral TKA. As a result, it was found that the bilateral TKA is more preferable surgery method than unilateral TKA. In addition to previous studies which reported less hospitalization period and lower costs for the bilateral TKA patients, we concluded that these patients had more advantages for dynamic balance which is important to perform activities of daily living.

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