



Original Article

Balance and quality of life after total knee arthroplasty[☆]



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ABSTRACT

Objective: To evaluate the change in balance and quality of life in patients undergoing total knee arthroplasty for primary gonarthrosis.

Method: Patients aged 60 years or older were evaluated in relation to the balance and quality of life before total knee arthroplasty and six months after surgery. To assess balance, this study used the Motor Scale Test for the Elderly; quality of life was assessed using the Western Ontario and McMaster Universities Osteoarthritis Index questionnaire and the Short Form Health Survey. A control group consisting of healthy adults, age- and gender-paired, was used to compare the balance after surgery results.

Results: Twenty-eight patients completed the study, of a total of 37 arthroplasties. The mean age was 70.18 ± 6.17 years. All variables were statistically significant ($p \leq 0.05$) for improved balance and quality of life after arthroplasty. It was observed that, after knee arthroplasty, the level of balance does not reach that expected for healthy individuals ($p \leq 0.05$).

Conclusion: Total knee arthroplasty is effective at improving balance six months after surgery, as well as all domains of quality of life. However, it is not able to restore balance to a level comparable to that of healthy individuals.

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[☆] Study conducted at Centro de Ciências da Saúde e do Esporte (Cefid), Universidade do Estado de Santa Catarina (Udesc), Florianópolis, SC, Brazil.

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Equilíbrio e qualidade de vida após artroplastia total de joelho

R E S U M O

Palavras-chave:

Artroplastia total do joelho
Equilíbrio postural
Idoso
Osteoartrite
Qualidade de vida

Objetivo: Avaliar o equilíbrio e a qualidade de vida em pacientes submetidos a artroplastia total do joelho por gonartrose primária.

Método: Pacientes com 60 anos ou mais foram avaliados em relação ao equilíbrio e à qualidade de vida antes da artroplastia total de joelho e seis meses após a cirurgia. Para avaliar o equilíbrio, foi usado o teste da Escala Motora para a Terceira Idade; para avaliar a qualidade de vida, foram usados os questionários *Western Ontario and McMaster Universities Osteoarthritis Index* e *Short Form Health Survey*. Um grupo controle de indivíduos saudáveis, pareado por idade e gênero, foi usado para comparação dos níveis de equilíbrio do grupo em estudo após a cirurgia.

Resultados: Completaram o estudo 28 pacientes, em 37 artroplastias. A média de idade foi de $70,18 \pm 6,17$ anos. Em todas as variáveis analisadas, observou-se significância estatística ($p \leq 0,05$) para melhoria do equilíbrio e da qualidade de vida após a artroplastia. Observou-se que, após artroplastia do joelho, o nível de equilíbrio não alcança o nível esperado para indivíduos saudáveis ($p \leq 0,05$).

Conclusão: A artroplastia total de joelho é capaz de melhorar o equilíbrio seis meses após a cirurgia, bem como todos os domínios da qualidade de vida. No entanto, não é capaz de restaurar o equilíbrio comparável àquele dos indivíduos saudáveis.

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Introduction

Total knee arthroplasty (TKA) is one of the most executed elective surgical procedures in orthopedics,¹ with the capacity to improve function, provide pain relief, and restore the quality of life in patients with knee osteoarthritis.¹⁻⁶ In the United States, it is estimated that the surgical demand will grow by 673% (3.48 million) from 2005 to 2030.⁷

In the elderly, balance deterioration and the reduction of muscle strength are the major risk factors for falls.⁸ Individuals with knee osteoarthritis (OA) suffer from progressive loss of function, resulting in a decreased ability to walk, climb stairs, and perform other tasks that rely on lower limb use.⁹ Knee OA is an independent risk factor associated with falls.^{10,11}

Balance control depends on sensory stimuli of the vestibular, visual, and somatosensory systems. In situations where balance is disturbed, the central processing of these stimuli results in coordinated neuromuscular responses that ensure that the center of mass remains within the support base.⁹ Therefore, effective balance control depends not only on accurate reception of stimuli but also on prompt muscle response. In the elderly, balance deterioration contributes to increased functional dependence, fear, and the frequency of falls.¹² Thus, both OA and balance alterations in the elderly increase the risk of falls and fractures, leading to negative functional consequences and economic impact on society due to their high morbidity and mortality.¹³

The influence of TKA on proprioception has been the subject of debates: some authors report benefits after surgery,^{14,15} while others failed in observing the improvement of proprioception after TKA.^{16,17} Many intra-articular structures of the knee have proprioceptive receptors, such as the anterior

cruciate ligament, articular cartilage, and the menisci, among others, which are resected during TKA. Stan et al.¹⁸ suggest that balance control is more limited after TKA, especially in the first days after the procedure, considering that the patients are elderly and their balance control is already compromised, which leads to a greater risk of falls in this period. In turn, Swanik, Lephart, and Rubash¹⁴ suggest that TKA restores the motor and sensory characteristics necessary for balance and dynamic stabilization of the joint, reducing the risk of falls and subsequent injury to this population. Furthermore, Schwartz et al.¹⁹ demonstrated that, in addition to TKA effectively improving the dynamic balance in elderly patients with OA, this balance restoration has a positive correlation with improved function and quality of life. The present study was aimed at assessing the alterations in balance and quality of life of elderly subjects who underwent TKA.

Material and methods

This was a prospective cohort clinical study. Patients aged 60 years or older, diagnosed with knee osteoarthritis and who received an indication for TKA in a state-owned orthopedic reference hospital were invited to participate. Over 12 consecutive months, patients who met the American College of Rheumatology's clinical criteria for the diagnosis of OA of the hip or knee were selected, radiographically confirmed using the classification of Kellgren-Lawrence (grade IV).^{20,21} Those who met the clinical criteria and failed conservative treatment were placed on the waiting list for the proposed surgeries. Therefore, individuals aged 60 years of age or older with TKA indication and who agreed to participate in the study and

signed the Informed Consent Form were considered eligible for the study.

The exclusion criteria were: pain report (visual analog scale [VAS] equal to or greater than 5) in another lower limb joint, unrelated to the surgery performed; those with neurological, cardiovascular, musculoskeletal, or psychiatric diseases that would hinder the application of the required tests, the comprehension of and response to the questionnaires, as well as the adequate performance of the therapeutic process and the physical rehabilitation; any active infection in the lower limbs; revision surgery or periprosthetic joint infection less than six months after the intervention; patients who did not return to the outpatient clinic at the second follow-up evaluation (six months after surgery); and BMI > 40 kg/m².

Primary arthroplasty in the same contralateral joint was not an exclusion criterion. Patients who underwent bilateral arthroplasty were only included in the study after rehabilitation from the first surgery.

The study also included a control group, in order to compare the patients to healthy individuals six months after TKA. The control group consisted of 28 gender-, age-, and BMI-matched individuals, randomly selected, who participated in projects from the State University of Santa Catarina and had no complaints of joint pain in the lower limbs or previous diagnosis of OA.

For the evaluation of the balance, the Motor Scale Test for the Elderly (MSTE),²² validated for the Brazilian population, was used. The scale is progressively scored from level 2 to level 11. A battery of tests is terminated when the subject is unable to take the test at a certain level. The score obtained (0–132) classifies the balance as: very superior (130 or higher), superior (120–129), normal high (110–119), average normal (90–109), low normal (80–89), inferior (70–79), and very inferior (<70).²²

For the evaluation of pain intensity in patients with OA, the VAS was used, in which 0 means total absence of pain and 10, the maximum pain level that the patient can bear.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire, translated and validated for the Brazilian population, was used to assess the function in patients with OA.²³

In the evaluation of health-related quality of life, the SF-36 questionnaire was used, translated and validated for the Brazilian Portuguese language by Ciconelli et al.²⁴

Procedures

All patients included in the sample were evaluated in a clinic, in the outpatient sector of the hospital, before and six months after the surgical procedure. The assessments were performed individually and privately, by a single evaluator; the same procedures were adopted in the two assessments. The surgeon did not participate in the assessments. The initial assessment was performed approximately 30 days before the surgery and the final assessment was performed six months after the surgical procedure.

All questionnaires were answered in the form of interviews. Mass was measured with the subjects in an orthostatic position and barefoot. For the balance assessment, the patients removed the clothes that could interfere with

their movements and remained barefoot; they did not have any previous contact with the instrument, and each test was explained orally and demonstrated by the researcher according to the criteria and sequence determined in the protocol.²²

Individuals from both groups were evaluated by the same research team. Therefore, the same procedures were adopted during data collection in both groups.

The surgical technique consisted of a medial parapatellar access and patellar eversion, as well as tourniquet use; the components were implanted under cementation and a patellar replacement was not performed. The posterior cruciate ligament was preserved in all knees. The Brazilian knee prostheses Metabio[®] and Baumer[®] were used.

All patients were operated by the same surgeon. After surgery, the patients were allowed to walk with the aid of a walker on the first postoperative day and received traditional rehabilitation for at least three days of hospitalization. Patients were discharged after demonstrating independence to walk with a walker. They were referred for rehabilitation near the home, after the first follow-up consultation, 10 to 14 days after the surgery, on which occasion the surgical sutures were removed.

Descriptive statistics were calculated with measurements of central tendency and dispersion. The Shapiro-Wilk test was used to assess whether the variables met normality assumptions. Student's t-test was used to assess variables with parametric data, such as age, height, weight, and BMI. For the other variables, non-parametric tests were used. The Wilcoxon test was used to assess the pre and postoperative differences in the study group; the WOMAC subscales, VAS, and MSTE were analyzed. Mann-Whitney's U test was used to assess whether the patient group after surgery was different from the control group. This test was also used to assess whether there was a difference between the subgroups, such as gender, age group, joint, and schooling. Data processing was done using SPSS[®] Statistics 2011, version 20.0 for Windows (Chicago, Illinois).

The study protocol was approved by the Research Ethics Committee under CAAE (Certificate of Presentation for Ethical Consideration) No. 39714614.4.0000.0118. All patients signed the Informed Consent Form for this study.

Results

A total of 38 patients were considered qualified for the study and 28 completed the evaluations; Fig. 1 presents further details. The mean age was 70.18 ± 6.17 years, ranging from 62 to 82 years. Of these 28 patients, 21 (75%) were women. Nine patients presented bilateral OA, and therefore the study included 37 TKAs. The other descriptive data are presented in Tables 1 and 2 and Flowchart 1.

In all variables analyzed, a statistically significant difference ($p \leq 0.05$) was observed after arthroplasty. A large effect size (>0.5) was observed in VAS, WOMAC subscales (pain, stiffness, and physical function), and SF-36, except for general health, vitality, and physical components, which presented an average effect size (Table 3).

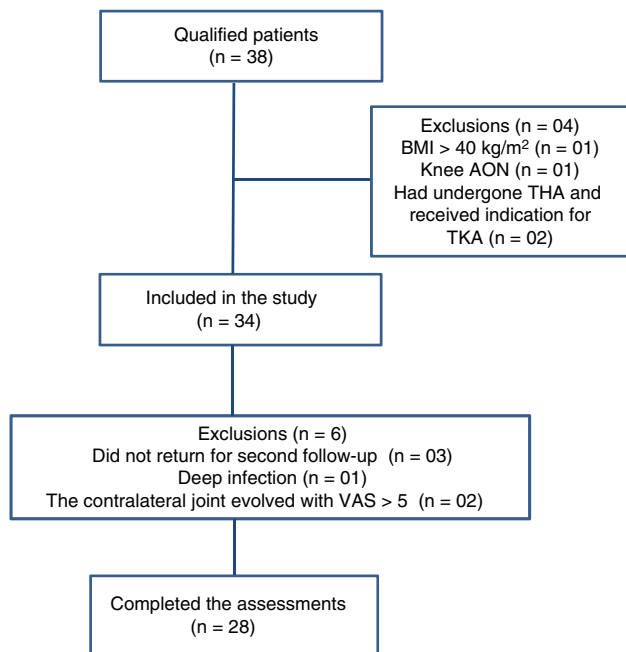


Fig. 1 – Flowchart of the study sample. AON, avascular osteonecrosis; BMI, body mass index; VAS, visual analog scale; THA, total hip arthroplasty; TKA, total knee arthroplasty.

Table 1 – Anthropometric characteristics of the osteoarthritis (patients) and control groups.

Variables	Cases (n = 28) Mean ^a	Control (n = 44) Mean ^a	p-Value
Age (years)	70.18 (6.17)	70.43 (6.20)	0.880
Height (m)	1.62 (0.11)	1.63 (0.05)	0.650
Mass (kg)	80.92 (15.63)	73.75 (9.99)	0.050
BMI (kg/m ²)	30.60 (4.48)	27.59 (3.05)	0.060 ^b

n, sample size.
^a Standard deviation.
^b Significant difference (Student's t-test).

An improvement in the MSTE scores after surgery was observed (median = 60) compared with the preoperative period (median = 24), $z = -3674$; this was a medium to large effect size ($r = 0.491$), shown in Fig. 2 by the right shift of the scores after surgery. Despite this evident improvement in balance, the group of patients presented a score below that of healthy individuals (Table 4 and Fig. 3), a statistically significant difference (Mann-Whitney U test, $p \leq 0.0001$, $r = 0.395$).

Discussion

In addition to the expected pain relief, restoration of function, and improvement in the quality of life,²⁵ this study demonstrated that patients in the final stages of OA who undergo TKA benefit from improved balance six months after surgery. However, they remain below the parameters considered normal for healthy individuals of the same age group. These results help clarify alleged disparities regarding altered balance after joint

Table 2 – Characterization of the patient group.

Variables	Frequency	%
Joint		
<i>Knee</i>		
Unilateral	19	67.9
Bilateral	09	32.1
Total	28	100
Schooling		
1–4 years	19	82.6
5–8 years	01	3.6
9–11 years	02	7.1
>11 years	01	3.6
Total	23	100
Age group		
60–74 years	20	71.4
≥75 years	08	28.6
Total	28	100
Gender		
Male	7	25
Female	21	75
Total	28	100

replacement. These discrepancies may be explained by the difference of study designs, methods, tests used, and follow-up time.

Stan et al.,¹⁸ assessing patients seven days after TKA, stated that the surgery causes more damage to the proprioceptors in knees already compromised by OA and advanced age, and concluded that TKA causes additional instability in the days following the procedure, which results in a higher risk of falls during this period. From another perspective, Bascas et al.²⁶ and Schwartz et al.¹⁹ indicated that, 12 months after surgery, TKA effectively restored balance in the elderly compared to the preoperative state. This difference in results can be explained by the short follow-up period in the study by Stan et al.,¹⁸ which is insufficient for adequate rehabilitation. In the present study, it was observed that, six months after surgery, patients presented a significant improvement in postural balance.

Nonetheless, the improved balance after surgery was not sufficient to achieve levels comparable to those of healthy subjects. The reason for the persistence of the residual balance deficit after TKA remains undefined but is probably related to several factors.^{27,28} Upright posture is dependent on the synergistic effect of sensory afferents, in which performance is associated with factors such as age, comorbidities, psychological aspects, and the contralateral limb, which is commonly affected by the same disease.²⁸ Wada et al.¹⁷ stated that the strength of knee extensors and flexors increases significantly after TKA, but still remains below the strength level of healthy individuals. Despite pain relief and the improved stability and range of motion of the replaced joint, the residual strength deficit may directly influence the postural balance deficit.²⁹

In the present study, patients presented higher health-related quality of life in all SF-36 domains, as well as a significant improvement in the health status evaluated by the WOMAC score. In addition to providing a state of health, the WOMAC score is associated with the risk of falls. According

Table 3 – Pre and postoperative results of the patients with the variables quality of life, pain, and balance.

Scale	n	Median Preop [IQ]	Median Postop [IQ]	Z	p-Value	r
WOMAC (4-0)						
Pain	28	3.10 [1.70]	0 [0.35]	-4.628	0.000 ^a	0.618
Rigidity	28	3.50 [2.00]	0 [0.5]	-4.658	0.000 ^a	0.622
Physical function	28	3.10 [1.47]	0.17 [0.22]	-4.623	0.000 ^a	0.618
SF-36 (0-100)						
FC	28	5.00 [13.80]	70.00 [25.00]	-4.629	0.000 ^a	0.618
LPA	28	0 [0]	100 [25.00]	-4.778	0.000 ^a	0.638
Pain	28	12.00 [22.00]	72.00 [39.00]	-4.627	0.000 ^a	0.618
GHS	28	87.00 [15.00]	92.00 [5.00]	-2.397	0.017 ^a	0.320
Vit	27	80.00 [40.00]	90.00 [5.00]	-3.223	0.001 ^a	0.438
SA	27	0 [37.50]	100 [0]	-4.467	0.000 ^a	0.607
LEA	28	100 [100]	100 [0]	-3.843	0.003 ^a	0.513
MH	27	72.00 [36]	92.00 [20.00]	-3.820	0.000 ^a	0.519
PCo	27	20.70 [8.70]	49.50 [12.60]	-4.469	0.000 ^a	0.608
MCo	27	55.60 [20.60]	63.40 [5.60]	-3.051	0.004 ^a	0.415
VAS (10-0)						
Pain	28	10.00 [1.00]	1.00 [3.00]	-4.639	0.000 ^a	0.620
MSTE (0-132)						
Balance	28	24.00 (24.00)	60.00 [24.00]	-3.674	0.000 ^a	0.491

SA, social aspects; FC, functional capacity; PCo, physical component; MCo, mental component; GHS, general health status; LEA, limitation due to emotional aspects; LPA, limitation due to physical aspects; r, effect size; MH, mental health; Vit, vitality; Z, z-score.

^a Significant difference (Wilcoxon's test).

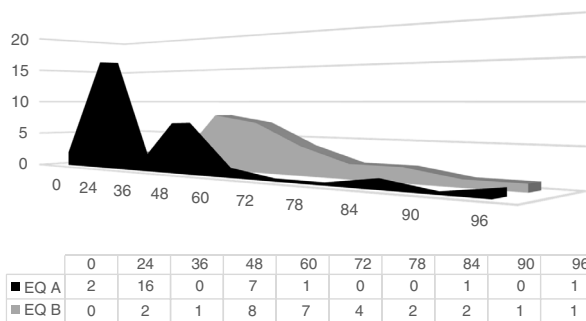


Fig. 2 – MSTE scores pre and postoperatively. X-axis, MSTE score; Y-axis, number of individuals; MSTE, Motor Scale Test for the Elderly; EQ A, balance before surgery; EQ B, balance after surgery.

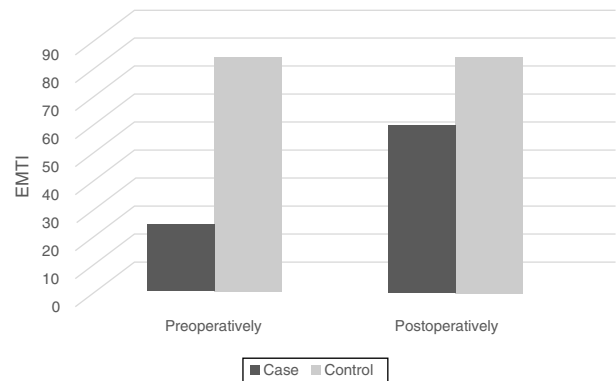


Fig. 3 – Comparison of the pre and postoperative balance of patients with the control group. MSTE, Motor Scale Test for the Elderly.

to Foley et al.,³⁰ the pain and function subscales of the WOMAC and, to a lesser extent, the stiffness subscale, are modestly but independently associated with the risk of falls, so that relief of pain symptoms and joint stiffness, as well

as the improvement in function, contribute to reducing the risk of falls.³⁰ Thus, TKA, besides being effective in pain relief and function improvement, is capable of improving all domains of quality of life and balance after surgery, reducing

Table 4 – Comparison of the results for the balance tests between the control group and the study group after surgery.

Variable		Groups		p-Value	Z	Effect size (r)
		Patients	Control			
		(n = 28)				
Balance	Median [IQ]	60.0 [24.0]	84.0 [45.0]	<0.003 ^a	-2.959	0.395
	Range	24.0-96.0	24.0-132.0			

IQ, interquartile range.

^a Significant difference (Mann-Whitney U-test).

the inherent risk of falls in elderly patients with advanced OA.

The present study has some limitations. Firstly, postoperative rehabilitation after hospital discharge was not directly supervised; however, individuals were oriented before surgery and during the hospital stay; they were discharged after demonstrating their ability to perform the exercises that were taught. Secondly, a control group of the elderly with OA was not adopted. Finally, the low level of schooling of the elderly may have negatively influenced the results evaluated. To reduce this limitation, all questionnaires were applied in the form of interviews. Nevertheless, the results suggest that, regardless of the level of education, TKA is effective in improving quality of life and balance in the elderly with OA.

Conclusion

The clinical impact of the results of this study is promising and suggests that TKA contributes to the improvement of postural balance in elderly patients with OA, with a potential reduction in the risk of falls and injury to this population. Patients benefit from the improvement in all domains of health-related quality of life. Future studies should assess whether specific exercises for balance after TKA may be effective in improving the outcome achieved with traditional rehabilitation models.

Conflicts of interest

The authors declare to have no conflicts of interest.

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