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ORIGINAL ARTICLE

A new methodology for patient education in total knee arthroplasty: a randomized controlled trial

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Abstract

Background We established a method in which patients are instructed before total knee arthroplasty (TKA) in a differentiated way without the necessity of reading any self-orientation, which can be applied even for illiterate patients

Methods We developed a multidisciplinary approach to improve patient education in TKA comprising of a differentiated orientation conducted by an orthopedic surgeon, a nurse and a physiotherapist. It consists of standardized lectures regarding on pre-, intra- and postoperative issues in a randomized controlled trial of 79 consecutive patients undergoing primary TKA. Thirty-four patients received the standard education (control group), and 45 patients received the differentiated education (intervention group). The patients were evaluated during at least 6 months.

Results After a 6-month follow-up period, the Short Form Health Survey (SF-36), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), the visual analogue pain scale (VAS) and knee range of motion (ROM) improved significantly in both groups. Range of motion was better in the intervention group (mean and SD—106.9 ± 5.7 versus 92.5 ± 12.1 degrees, p = 0.02). Moreover, walk ability (more than 400 m) was better in the intervention group compared with the control group (97.4% versus 72.4%, p = 0.003). In the intervention and control groups, respectively, 10.5% and 31% of patients reported the need for some walking devices (p = 0.03).

Conclusions A differentiated educational program with a multidisciplinary team had a positive impact on functional outcomes, improving ROM and walk ability of patients undergoing TKA in a short-term evaluation.

Keywords Arthroplasty · Knee replacement · Osteoarthritis · Patient education

Abbreviations

TKA	Total knee arthroplasty
SF-36	Medical Study 36-item Short-Form Health Survey
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index
ROM	Range of motion
OA	Osteoarthritis
VAS	Visual analog scale

Background

Osteoarthritis (OA) is a chronic and potentially disabling condition related to complex etiology. Its incidence has increased in the last few years, mainly due to population aging and an increased rate of obesity and sports injuries [1–3]. Imbalance between anabolic and catabolic pathways usually leads to gradual cartilage damage [3]. During this process, patients might experience functional impairment, pain and mechanical symptoms, which can impact their quality of life [4].

The knee is the second joint most affected by OA, i.e., approximately 37% of all patients seek medical assistance [5]. Moreover, social and mental distress can be related to knee OA, impacting outcome negatively [6]. Usually surgical treatment is recommended when conservative measures have failed [5]. Total knee arthroplasty (TKA) has proved to be a successful treatment with predictable

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results [7–9]. However, up to 20% of patients after their TKA complain of residual pain, functional impairment or subjective dissatisfaction [9]. Mismatch between medical and patient expectations is one of the possible causes leading to dissatisfaction after TKA. Therefore, educating patients about the disease and the treatment process is an important measure in health assistance.

Patient education refers to any intervention delivered during health assistance which aims to improve knowledge, health behaviors and health outcomes. As patients often forget verbal orientation, written and illustrated materials are effective in maximizing knowledge and adhesion to treatment. However, there are some patients in public hospitals who are illiterate, which hinders this process. The recommended content of education varies across settings, but should comprise of discussion about preoperative procedures, important surgical points, postoperative care, potential stressful scenarios, potential complications, pain management, discharge criteria and also postoperative rehabilitation [10]. Although this preoperative education seems obvious and embedded in the consent process, recent data questioned its efficacy to improve postoperative functional scores [11]. Moreover, when treating illiterate patients, a reinforced educational approach should be applied.

Our hypothesis is that a new educational preoperative approach would improve the TKA results. The purpose of this study is to compare the clinical outcomes for two groups of patients who received different educational approaches before TKA. The groups were compared for function and clinical data.

Methods

A prospective randomized clinical trial was conducted from November 2017 to July 2018. An institutional review board approval from the Ethics Committee of the Universidade Federal de Minas Gerais was obtained for our research protocol to prospective data acquisition (CAAE:11,677,714.4.0000.5149), and an informed consent was signed by all the participants or one person responsible for them.

The sample size was calculated to test the hypothesis that a differentiated education would increase postoperative range of motion (ROM) of the knee joint (primary outcome). Trying to detect a difference of 10 degrees in ROM of the knee joint between groups and based on a power test of 80% and a confidence interval of 5% after assuming a possible 10% lost in follow-up, 15 patients in each group were considered the minimum number of participants.

Secondary outcomes were:

- The Short Form Health Survey (SF-36), which includes questions about patients' general health
- The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)—results range from 0 to 96. It evaluates pain intensity (0–20), stiffness (0–8) and function (0–68)
- The visual analogue pain scale (VAS)—ranging from 0 to 10
- The distance the patients were able to walk and in the last follow-up if they were able to walk 400 m or more
- The capacity to climb and descend stairs.

All variables were collected in the preoperative appointment which occurred at least 2 weeks before surgery and in the postoperative evaluations.

Inclusion criteria: patients with unilateral symptomatic primary or secondary OA of the knee, older than 45 years, with indication of a primary TKA, who signed the informed consent form. Randomization, clinical examination and functional tests were applied to all participants by two investigators (DGKB, DSL).

Patients were then randomized into two groups: differentiated orientation or usual orientation. Randomization comprised choosing one of the 100 closed opaque envelopes, 50 of them with the word "usual" and 50 with the word "differentiated," referring to the approach it would be done. As we had planned 8 months to stop randomization, and considering that 15 patients in each group were considered sufficient to answer the question of the study, we had at that point:

Intervention group (45 patients)*:* after medical appointment, patients received a new multidisciplinary reinforced orientation that included scheduled sessions of lectures done by an orthopedic surgeon, a nurse and a physiotherapist concerning the pre- and postoperative care, pain management, rehabilitation exercises to gain ROM, the basic steps of the surgical procedure and the importance of walking with a walker. This intervention was done 2 weeks before surgery during office consultation. Patients were invited to attend a collective oral session, which included a standardized sequence of slides and images regarding the preoperative preparation, the procedure itself and the rehabilitation with 1) a 15-min lecture done by a nurse, 2) a 15-min lecture done by a physiotherapist and 3) a 15-min lecture done by an orthopedic surgeon, followed by additional time for patients to ask questions. Researchers also provided a phone contact number in case patients had further questions. The cost of this intervention method is low, which turns it feasible to be applied more widely (Fig. 1).

Control group (34 patients): patients were oriented during conventional medical appointments, in which any doubts were clarified. A phone contact of researchers was provided for the patients.

Fig. 1 Eligible patients groups attending a new reinforced educational method session that consisted on illustration based and interactive discussion with TKA candidates

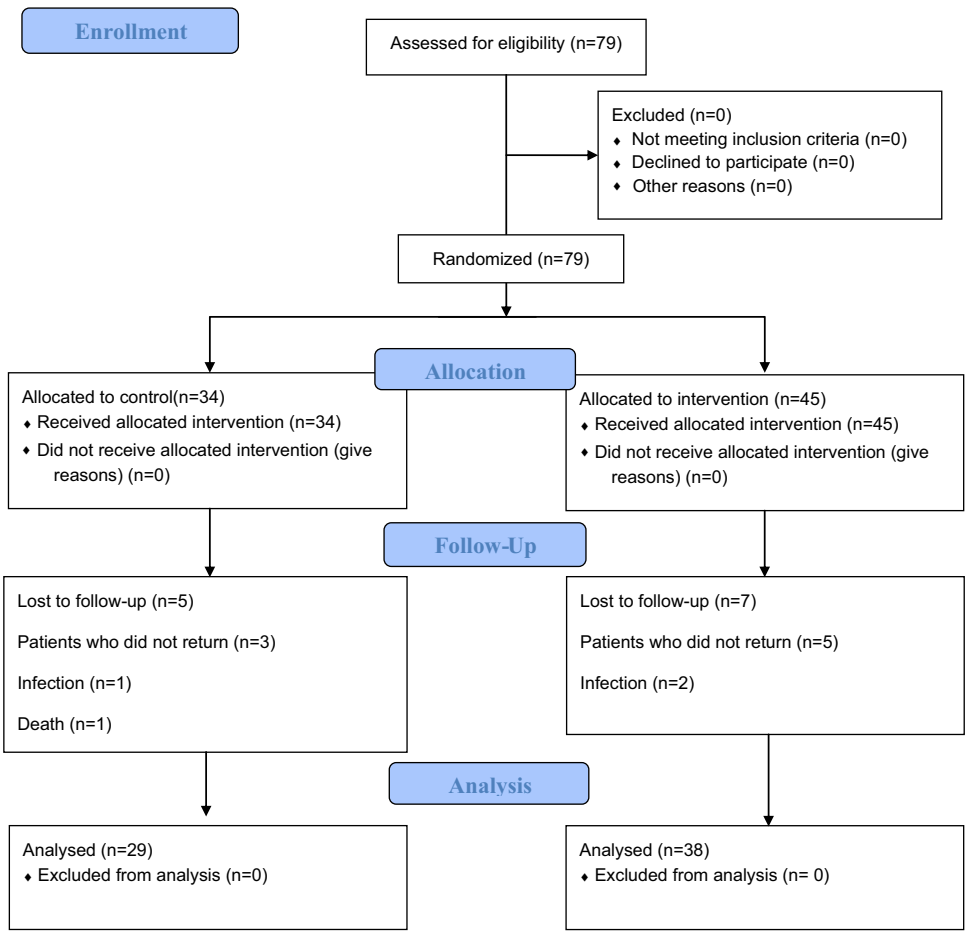
The difference in the number of participants between groups was due to the study closure before 50 patients in each group were reached, considering that the minimal number to confirm our hypothesis was 15 patients.

The postoperative clinical and functional evaluation was performed by three blinded investigators (MVTR, TFGM, FSM). The study was conducted at the Orthopaedic Department of the Federal University of Minas Gerais—Brazil.

Seventy-nine patients were eligible for the study. Twelve were excluded during follow-up—5 in the control group and 7 in the intervention group: one patient died (myocardial infarction), three patients had periprosthetic joint infection and eight did not return for control and were excluded. After exclusions, the control group and the intervention group remained with 29 and 38 patients, respectively (Fig. 2).

All patients were operated on in the same Institution by three different surgeons (MAPA, GMAS, TVOC) who followed the same protocol. Patients received a peridural anesthesia with bupivacaine (0,5%) and intravenous sedation (Diprivan® AstraZeneca). Tourniquet was applied in all cases set to 300 mmHg. Primary TKA was performed

Fig. 2 Patient allocation fluxogram



through a classical medial arthrotomy with patellar eversion. A cruciate retained implant (Nexgen® Zimmer—Warsaw, IN), with patellar substitution, fixed with a non-impregnated antibiotic cement was used in all cases. Postoperative multimodal pain control protocol was made in both groups and started on the same day of the procedure. It consisted of scheduled 1) acetaminophen 133 mg every 6 h, 2) metamizole 500 mg every 6 h, 3) tramadol 50 mg every 8 h for 24 h and 4) morphine 2 to 6 mg every 4 h, as needed. Patients were encouraged to start early ROM and weight bearing with a walker on the first day. Patients were discharged from hospital on day 2 or 3 and were evaluated in 15 days, 1 month, 3 months and 6 months after surgery, and in each session, the scores and the VAS were applied, ROM was evaluated with a calibrated goniometer, and specific questions such as the use of walker or cane, their ability in climbing or descending stairs and the distance they were able to walk were asked.

Statistical analysis was performed to determine statistically significant differences between the 2 groups ($p < 0.05$), using appropriate software (G*Power Version 3.1.9.2) and included analysis of distribution by Kolmogorov–Smirnov test. Independent t test was used to analyze numerical, continuous and normally distributed variables. Qui-square test was used for categorical data. No crossover was observed, so intention-to-treat analysis was not performed.

Results

The two groups were comparable on demographics, clinical and functional tests (Table 1). After a 6-month follow-up period, VAS, WOMAC and SF-36 scores significantly improved in both groups, and no difference was observed between groups. Knee range of motion was higher in the intervention group (mean flexion 106.9 ± 5.7 versus $92.5 \pm 12.1°$, $p = 0.02$). Moreover, at 6 months, 97.4% of patients in the intervention group and 72.4% of patients in the control groups reported an improvement in their ability to walk more than 400 m after surgery ($p = 0.003$). At 6-month follow-up-period, walk assistance was needed in 10.5% of the patients in the intervention group and in 31% in the control group ($p = 0.03$) (Table 2). No significant missing data were observed during this short-term study.

Discussion

This study showed that additional education improves functional results after TKA. Studied parameters were applied differently to both groups with no additional costs. The same infrastructure and health team was utilized in the intervention method. As a result of this intervention, patients who received a reinforced orientation protocol achieved better ROM and could walk more frequently without assistance.

Table 1 Characterization of groups before TKA

	Conventional orientation	Differentiated orientation
N	29	38
Female	23 (79.3%)	30 (78.9%)
Age*	62.8 (11.8)*	65,1 (9.3)*
BMI*	29,2 (5.5)*	30,2 (5.5)*
Secondary osteoarthritis	6 (20.7%)	7 (18.4%)
Right knee	11 (37.9%)	17 (44.7%)
Varus deformity	22 (75.9%)	29 (76.3%)
Comorbidities**	7 (24.1%)	6 (15.8%)
WOMAC	62,8 (15,4)*	60,2 (20,7)*
SF36	62,6 (5,3)*	58.1 (4,6)*
VAS pain scale	7.6 (2.0)*	7.6 (2.0)*
ROM	104.6 (25.5)*	103.9 (22.7)*
Walk ability > 400 m	10 (34.4%)***	13 (34.2%)***
Stair with no impairment	1 (3,4%)***	1 (2,6%)***
Walker and cane use	10(34.5%)***	16(42.1%)***

Groups are comparable, no statistically significant difference between them ($p > 0.0$)

BMI body mass index, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) ranges from 0 to 96. Evaluates pain intensity (0–20), stiffness (0–8) and function (0–68), *SF-36* Short Form Health Survey, *VAS* visual analog scale for pain assessment, range from 0 to 10, *ROM* Knee range of motion

*Mean ± standard deviation, **comorbidities means: diabetes mellitus and/or high blood pressure, *** *n* (%)

Table 2 Comparison between conventional x differentiated orientation 6 months after TKA

	6-month follow-up		*p*
	Conventional	Differentiated	
WOMAC	9.2 (11.9)*	16.8 (20.1)*	0.27
SF36	92.8 (6.7)*	86.7 (6.7)*	0.6
VAS pain scale	2.0 (2.8)*	2.4 (2.7)*	0.96
ROM	92.5 (12.1)*	106.9 (5.7)*	**0.02**
Walk ability > 400 meters	21 (72.4%)**	37 (97.4%)**	**0.003**
Stair with no impairment	15 (51.7%)**	26 (68.4%)**	0.16
Use of walker or cane	9 (31%)**	4 (10.5%)**	**0.03**

WOMAC Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) ranges from 0 to 96. Evaluates pain intensity (0–20), stiffness (0–8) and function (0–68), *SF-36* Short Form Health Survey, *VAS* visual analog scale for pain assessment, range from 0 to 10, *ROM* Knee range of motion

*Values expressed in mean ± standard deviation, **n (percentage)

Regarding postoperative functional scores and pain, no difference was observed between groups.

Achieving good results after total knee replacement depends on many factors, such as patient selection, implant design, surgical technique and postoperative care [12]. However, more than 20% of patients can still have some dissatisfaction after the procedure [13, 14]. It is well known that ROM has correlation with better functional scores after TKA [15].

Biomechanical studies showed that patients require at least 83° of flexion to climb stairs, 100° to descend stairs and 67° to walk normally [16]. Ritter et al. [15] observed worse functional outcomes in patients with less than 118 degrees of flexion. Kotani et al. [17] noted that more than 110° of knee flexion would improve daily living activities. Thereby, a method that could help improving range of motion might favorably impact TKA outcomes.

On the other hand, the role of patient education was questioned due to low-quality evidence of available data [11], but these findings do not invalidate its use and the present study confirms its importance.

ROM evaluation as an independent predictor in TKA had not been clearly studied. Two studies depicted no difference in ROM between oriented and non-oriented patients after hip replacement [18, 19]. Our study shows that a new reinforced education with a team approach improved ROM when compared to the traditional orientation method. This reinforced education would avoid oversights during orientation by improving the understanding of the patient about the procedure. Al-Rub et al. [20] in a cohort study showed that 85% of patients did not know the composition of the implant and only 39% of patients had received advice about dental work after arthroplasty. Educating patients before surgery leads to decreased anxiety, which can be expressed by better ROM and walk ability after surgery [21]. Our method may be applied on illiterate patients with a positive effect. Ayers et al. [22] showed that more than 30% of patients going through TKA have depression or anxiety symptoms, which can be minimized by better orientation. Illiteracy is still highly predominant in developing countries, and therefore, booklets do not prove very effective. The proposed new approach is easy to apply, has low cost and leads to positive outcomes.

There are limitations in this study, and a follow-up evaluation for a short period of time (6 months) can be considered a point of weakness. However, ROM and walk capacity after 6 months can clearly predict long-term results [23, 24]. Subsequently, function improvement is less likely without some medical intervention (manipulation under anesthesia, arthrolysis or revision) [25].

Conclusion

After a mean 6-month period, a new reinforced orientation method comprising multidisciplinary oral presentations with instructional lectures improved the final ROM and also the walking capacity after TKA. This method can be applied even to illiterate patients.

Trial registration

This study adheres to CONSORT guidelines Trial registration: ReBEC (Registro Brasileiro de Ensaios Clínicos) RBR-588cfq Retrospectively registered on 03/06/2020. Trial URL: http://www.ensaiosclinicos.gov.br/rg/RBR-588cfq/.

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Authors' contributions MAPA conceptualized the study and design. DGKB, DSL, MVTR, TFGM and FSM recruited the participants and collected the data. MAPA, GMAS and TVOC prepared the first draft of the manuscript and all authors contributed to writing, as well as review and approval of the final version of the manuscript.

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Availability of data and materials The authors have full access to all dataset in the study and assume final responsibility for the publication. The data used and analyzed during the current study are available through the corresponding author upon reasonable request. The authors have copyright permission for Figs. 1 and 2.

Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest regarding this research.

Ethics approval and consent to participate All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments. The consent obtained from study participants was written and approved by the Ethics Committee. An institutional review board approval from the Ethics Committee of the Universidade Federal de Minas Gerais was obtained for our research protocol to prospective data acquisition of 39 (79) patients undergoing TKA (CAAE:11677714.4.0000.5149), and an informed consent was signed by all the participants or one person responsible for them.

Consent for publication Not Applicable.

Competing interests Authors declare that they do not have any financial and non-financial competing interests.

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