

# A new educational method before total knee arthroplasty to be applied in developing countries: a randomized controlled trial

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## Research article

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# Abstract

## Background

In developing countries, the illiteracy index is high in public hospitals. We describe a method in which patients are instructed before total knee arthroplasty (TKA) in a differentiated way without the necessity of reading any self-orientation.

## Methods

To improve patient education before TKA we developed a multidisciplinary method in which an orthopedic surgeon, a nurse and a physiotherapist give the patients a differentiated orientation with specific lectures regarding the pre, intra and post-operative issues in a prospective case-control study of 79 consecutive patients undergoing primary TKA. Twenty-nine patients received the standard verbal education (control group) and 38 patients received the differentiated education (intervention group). The patients were evaluated during at least six months.

## Results

After a 6-month follow-up period, SF-36 and WOMAC forms, VAS and range of motion improved significantly in both groups. ROM was better in the intervention group (mean and SD –  $106.9 \pm 5.7$  versus  $92.5 \pm 12.1$  degrees,  $p = 0.02$ ). Moreover, walk ability (more than 400 meters) was improved in the intervention group compared with 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 of some walking device ( $p = 0.03$ ).

## 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.

## 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 to the prevalence of predisposing factors such as obesity and sports injuries (1–3). Imbalance between anabolic and catabolic pathways usually leads to gradual cartilage damage. During this process, patients might experience functional impairment, pain and/or mechanical symptoms, which can impact their quality of life (4).

The knee is the second joint most affected by OA leading to around 37% of the patients (5) searching for treatment. In addition to pain, the disease causes social and mental distress which can impact the outcome (6). Usually surgical treatment is indicated when the symptom's control has failed with conservative measures.

Total knee arthroplasty (TKA) has proved to be a successful treatment with predictable results from an intermediate and long-term perspectives (7–9). However, up to 20% of patients after their TKA complain of residual pain, functional impairment or subjective dissatisfaction (9). Therefore, there is a search for tools which can lead to better outcomes and pre-operative education is one of them.

Pre-operative education refers to any educational intervention delivered before surgery which aims to improve patient's knowledge, health behaviors and health outcomes. As patients often forget verbal orientation, written and illustrated materials maximize knowledge and adherence to treatment, the so-called self-orientation. However, in public hospitals of developing countries, the majority of patients cannot read, which impairs orientation. The recommended content of pre-operative education varies across settings, but should comprise discussion about pre-surgical procedures, the surgical procedure itself, postoperative care, potential stressful scenarios associated with surgery, potential complications, pain management, discharge criteria and also postoperative rehabilitation (10). Although this pre-operative education seems obvious and embedded in the consent process, recent data have questioned its efficacy to improve postoperative functional scores (11). Moreover, when we are treating illiterate patients a differentiated approach should be applied.

Our hypothesis was that a differentiated educational pre-operative approach would improve the TKA results. The purpose of this study was to compare the clinical outcomes for two groups of patients that received different educational approaches before TKA. The groups were compared regarding function and clinical data.

## Methods

A prospective randomized case-control study was done from November 2017 to July 2018. An institutional review board approval was obtained for our research protocol to prospective data acquisition of patients undergoing TKA (CAAE:11677714.4.0000.5149), and an informed consent was signed by all the participants or by a person responsible for them.

The sample size was calculated to test the hypothesis that a differentiated educational program would increase post-operative range-of-motion (primary outcome). Trying to detect a difference of 10 degrees in range-of-motion (ROM) between groups and based on a power test of 80% and a confidence interval of 5% after assuming a possible 10% loss in follow-up, 15 patients in each group was considered the minimum number of participants. SF-36 and WOMAC results were considered secondary outcomes.

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. Immediately after sign

the informed consent, pre-operative physical examination and functional tests were applied to all participants by two investigators (DGKB, DSL). Patients were then randomized into two groups (intervention or control), by choosing one of two closed envelopes in which was written the words conventional or differentiated, referring to the approach it would be done. The post-operative clinical and functional evaluation was performed by three blinded investigators (MVTR, TFGM, FSM). The study was conducted at the Knee Surgery facility of Hospital das Clínicas da Universidade Federal de Minas Gerais.

In the control group, a verbal education about TKA was made during the preoperative appointments as done usually at the Institution. In the intervention group, after the usual verbal education, patients received a differentiated orientation that included discussion and lectures done by an orthopedic surgeon, a nurse and a physiotherapist concerning the pre and post-operative care, pain management, rehabilitation exercises to gain ROM, the basic steps of the surgical procedure and the importance of walking with a walker. FIGURE 1

Seventy-nine patients were eligible for the study. Twelve were excluded during follow-up: one patient died with a heart attack, three patients had periprosthetic joint infection and eight did not return for control and were excluded (FIGURE 2).

The two groups were comparable regarding demographics, clinical and functional tests. (Table 1)

Table 1  
– Demographics between groups before study enrollment

	Control	Intervention
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 OA	6 (20.7%)	7 (18.4%)
Right Knee	11 (37.9%)	17 (44.7%)
Varus Deformity	22 (75.9%)	29 (76.3%)
Presence of Comorbidities $\beta$	7 (24.1%)	6 (15.8%)
Analog Pain Scale*	7.6 (2.0)	7.6 (2.0)
ROM*	104.6 (25.5)	103.9 (22.7)
WOMAC*	34.6 (16.0)	37.3 (21.6)
SF36*	84.9 (13.8)	85.3 (14.6)
Walk > 400 m	10 (34.4%)	13 (34.2%)
With Stair Impairment	28 (96.6%)	37 (94.7%)
Use of walkers, canes	10(34.5%)	16(42.1%)
<i>* Mean and standard deviation</i>		
<i><math>\beta</math> comorbidities means diabetes mellitus and/or arterial blood hypertension</i>		

All patients were operated on in the same Institution by three different surgeons (MAPA, GMAS, TVOC) following the same protocol. Patients received a peridural anesthesia with bupivacaine (0,5%) and intravenous sedation (Diprovan®- AstraZeneca). Tourniquet was applied in all cases set to 300 mmHg. Primary TKA was performed 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 acetaminophen 750 mg every 6 hours, metamizole 500 mg every 6 hours, tramadol 50 mg every 8 hours for 24 hours and morphine 2 to 6 mg every 4 hours, as needed. Patients were encouraged to start early ROM and weight bearing with a walker in the first day. Patients were discharged from hospital on day 2 or 3.

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 Zolmogorov-Smirnov test. Independent T-test was used to analyze numerical, continuous and normally distributed variable. Qui-square test was used for categorical data.

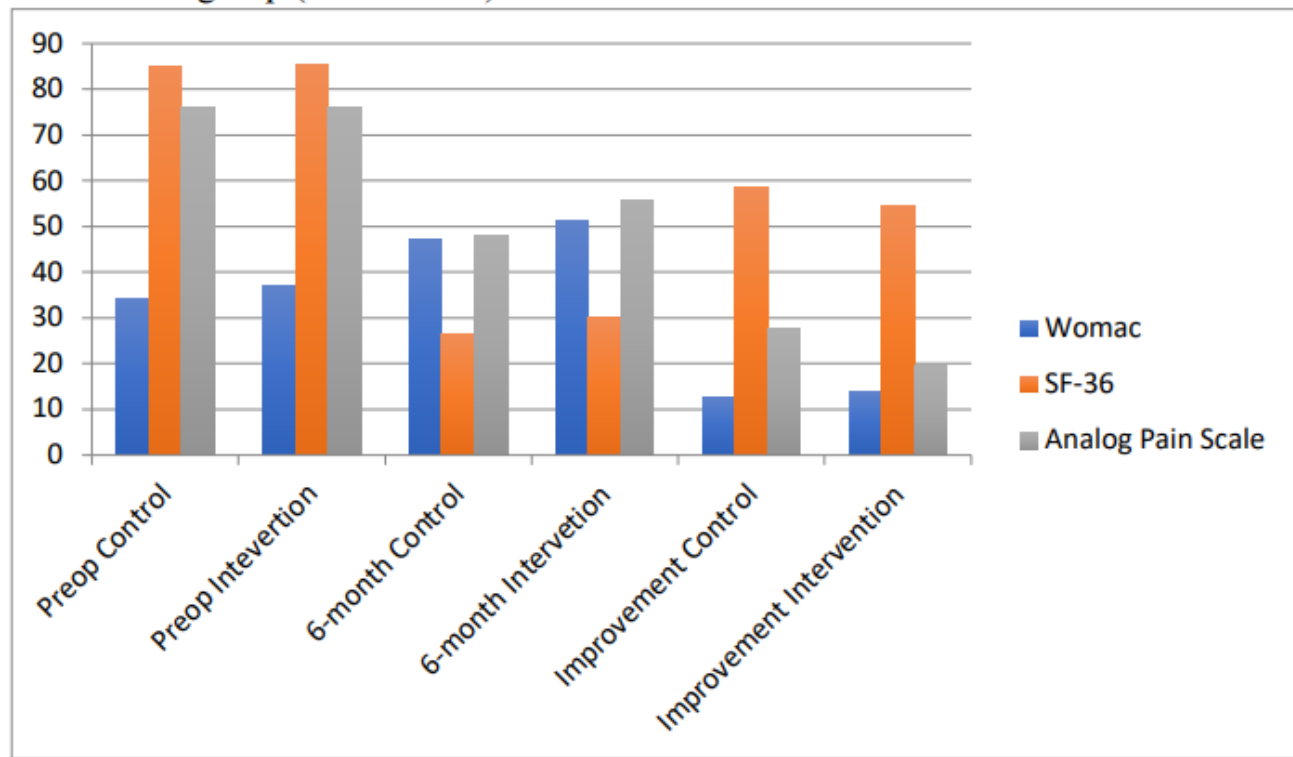
## Results

After 6-month follow-up, visual analog scale (VAS), WOMAC and SF-36 tests significantly improved when compared to pre-surgical data, even though there was no difference between control and intervention groups. ROM was higher in the intervention group, with a mean flexion of  $106.9^\circ \pm 5.7$  compared to  $92.5^\circ \pm 12.1^\circ$  in the control group (T-test;  $p = 0.02$ ). Moreover, walk ability (more than 400 meters) was enhanced in the intervention group (97.4%) compared to the control group (72.4%) ( $p = 0.003$ ). In both groups, there was necessity of some walking device (10.5% in the intervention group and 31% in the control group) ( $p = 0.03$ ) (Tables 2 and 3).

Table 2  
– Functional evaluation after 6-months follow-up

	Control	Intervention	p-value
WOMAC	47.3 (10.4)	51.5 (8.4)	0.5
SF36	26.54 (8.2)	30,8 (6.2)	0.3
Analog Pain Scale	4.8 (1.4)	5.6 (1.1)	0.3
ROM	92.5 (12.1)	106.9 (5.7)	0.02
Walk ability > 400 meters	72.4%	97.4%	0.003
Stair with no impairment	51.7%	68.4%	0.16
Walker and cane use	31%	10.5%	0.03

Table 3 – Functional scores (WOMAC, SF-36 and analog pain scale) evaluation: comparison between preoperative and 6-month follow-up periods between control group (control) and intervention group (intervention).



# Discussion

This study concluded that additional education improves functional results after TKA. It was observed an improvement in all data studied when the pre and post-operative period were compared, however, patients who had received a differentiated orientation by explicative lectures had better ROM and could walk more frequently without walkers or canes. Regarding post-operative functional scores and pain, no difference was observed between groups.

Achieving good results after total knee replacement depends on many factors, namely patient selection, implant design, surgical technique and post-operative 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 total knee arthroplasty (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° of flexion. Kotani et al. (17) noted that more than 110° of knee flexion would improve daily living activities.

In a meta-analysis, pre-operative education was unable to prove efficacy after total knee and hip replacement due to low-quality evidence of available data (11). However, most authors did not evaluate ROM as an independent variable and only two studies depicted no difference in ROM between oriented and non-oriented patients after hip replacement (18, 19). Any method chosen for improving ROM is valid. This study showed that a differentiated education, with multi-professional lectures improved ROM when compared to the traditional form of orientation

A written method 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 more than 85% of 51 patients did not know what the composition of the implant was and only 39% of patients had received advice about dental work after arthroplasty. Educating patients before surgery would lead to decreased anxiety, which can be expressed by better ROM and walk ability after surgery (21). The results of the present study agree with this statement and this new presentation method must be a tool to be applied on illiterate patients.

Ayers et al. (22) showed that more than 30% of patients going through a total knee replacement have depression or anxiety symptoms, which can be minimized by orientation prior to surgery. In the developing countries illiteracy is prevalent and usually booklets are not very useful as patients cannot read them. The proposition of a new approach for illiterate patients in developing countries, as the one presented in this study, can change outcome and is easy to apply with better results.

There are limitations in this study and follow-up evaluation for a short period of time (mean of 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). After that period, function improvement is less likely without some medical intervention (manipulation under anesthesia, arthrolysis or revision) (25).

## Conclusion

In conclusion, after a mean 6-month period, a differentiated orientation using verbal methods with instructional lectures improved the final ROM and also the walking capacity after total knee replacement. Moreover, this method can be applied to illiterate patients, commonplace in public hospitals of developing countries. The continuing cohort evaluation should corroborate these findings from a long-term perspective.

## 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

## Declarations

The authors declare no conflict of interest regarding this research



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No further acknowledgements

## **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.

## **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.

## **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 Helsinki declaration 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 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 do not have any financial and non-financial competing interests.

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## **References**

1. Buckwalter JA. Osteoarthritis and articular cartilage use, disuse, and abuse: experimental studies. *J Rheumatol Suppl.* 1995;43:13–5.
2. Neogi T, Zhang Y. Epidemiology of osteoarthritis. *Rheum Dis Clin North Am.* 2013;39(1):1–19.
3. Murphy L, Schwartz TA, Helmick CG, Renner JB, Tudor G, Koch G, et al. Lifetime risk of symptomatic knee osteoarthritis. *Arthritis Rheum.* 2008;59(9):1207–13.
4. Arden N, Nevitt MC. Osteoarthritis: epidemiology. *Best Pract Res Clin Rheumatol.* 2006;20(1):3–25.
5. Senna ER, De Barros AL, Silva EO, Costa IF, Pereira LV, Ciconelli RM, et al. Prevalence of rheumatic diseases in Brazil: a study using the COPCORD approach. *J Rheumatol.* 2004;31(3):594–7.
6. Utrillas-Compared A, De la Torre-Escuredo BJ, Tebar-Martínez AJ, Asúnsolo-Del Barco Á. Does preoperative psychologic distress influence pain, function, and quality of life after TKA? *Clin Orthop Relat Res.* 2014;472(8):2457–65.
7. Pagnano MW, McLamb LA, Trousdale RT. Total knee arthroplasty for patients 90 years of age and older. *Clin Orthop Relat Res.* 2004(418):179–83.
8. Ethgen O, Bruyère O, Richy F, Dardennes C, Reginster JY. Health-related quality of life in total hip and total knee arthroplasty. A qualitative and systematic review of the literature. *J Bone Joint Surg Am.* 2004;86-A(5):963–74.
9. Shan L, Shan B, Suzuki A, Nouh F, Saxena A. Intermediate and long-term quality of life after total knee replacement: a systematic review and meta-analysis. *J Bone Joint Surg Am.* 2015;97(2):156–68.
10. Louw A, Diener I, Butler DS, Puentedura EJ. Preoperative education addressing postoperative pain in total joint arthroplasty: review of content and educational delivery methods. *Physiother Theory Pract.* 2013;29(3):175–94.
11. McDonald S, Page MJ, Beringer K, Wasiak J, Sprowson A. Preoperative education for hip or knee replacement. *Cochrane Database Syst Rev.* 2014;5:CD003526.
12. Sanz-Ruiz P, Carbo-Laso E, Alonso-Polo B, Matas-Diez JA, Vaquero-Martín J. Does a new implant design with more physiological kinematics provide better results after knee arthroplasty? *Knee.* 2016.
13. Noble PC, Conditt MA, Cook KF, Mathis KB. The John Insall Award: Patient expectations affect satisfaction with total knee arthroplasty. *Clin Orthop Relat Res.* 2006;452:35–43.
14. Bourne RB, Chesworth BM, Davis AM, Mahomed NN, Charron KD. Patient satisfaction after total knee arthroplasty: who is satisfied and who is not? *Clin Orthop Relat Res.* 2010;468(1):57–63.
15. Ritter MA, Lutgring JD, Davis KE, Berend ME. The effect of postoperative range of motion on functional activities after posterior cruciate-retaining total knee arthroplasty. *J Bone Joint Surg Am.* 2008;90(4):777–84.
16. Laubenthal KN, Smidt GL, Kettelkamp DB. A quantitative analysis of knee motion during activities of daily living. *Phys Ther.* 1972;52(1):34–43.
17. Kotani A, Yonekura A, Bourne RB. Factors influencing range of motion after contemporary total knee arthroplasty. *J Arthroplasty.* 2005;20(7):850–6.

18. Gocen Z, Sen A, Unver B, Karatosun V, Gunal I. The effect of preoperative physiotherapy and education on the outcome of total hip replacement: a prospective randomized controlled trial. *Clin Rehabil.* 2004;18(4):353–8.
19. Vukomanović A, Popović Z, Durović A, Krstić L. The effects of short-term preoperative physical therapy and education on early functional recovery of patients younger than 70 undergoing total hip arthroplasty. *Vojnosanit Pregl.* 2008;65(4):291–7.
20. Abu Al-Rub Z, Hussaini M, Gerrand CH. What do patients know about their joint replacement implants? *Scott Med J.* 2014;59(3):158–61.
21. Demir F, Ozsaker E, Ilce AO. The quality and suitability of written educational materials for patients\*. *J Clin Nurs.* 2008;17(2):259–65.
22. Ayers DC, Franklin PD, Trief PM, Ploutz-Snyder R, Freund D. Psychological attributes of preoperative total joint replacement patients: implications for optimal physical outcome. *J Arthroplasty.* 2004;19(7 Suppl 2):125–30.
23. Nilsson AK, Toksvig-Larsen S, Roos EM. A 5 year prospective study of patient-relevant outcomes after total knee replacement. *Osteoarthritis Cartilage.* 2009;17(5):601–6.
24. Papakostidou I, Dailiana ZH, Papapolychroniou T, Liaropoulos L, Zintzaras E, Karachalios TS, et al. Factors affecting the quality of life after total knee arthroplasties: a prospective study. *BMC Musculoskelet Disord.* 2012;13:116.
25. Fitzgerald JD, Orav EJ, Lee TH, Marcantonio ER, Poss R, Goldman L, et al. Patient quality of life during the 12 months following joint replacement surgery. *Arthritis Rheum.* 2004;51(1):100–9.

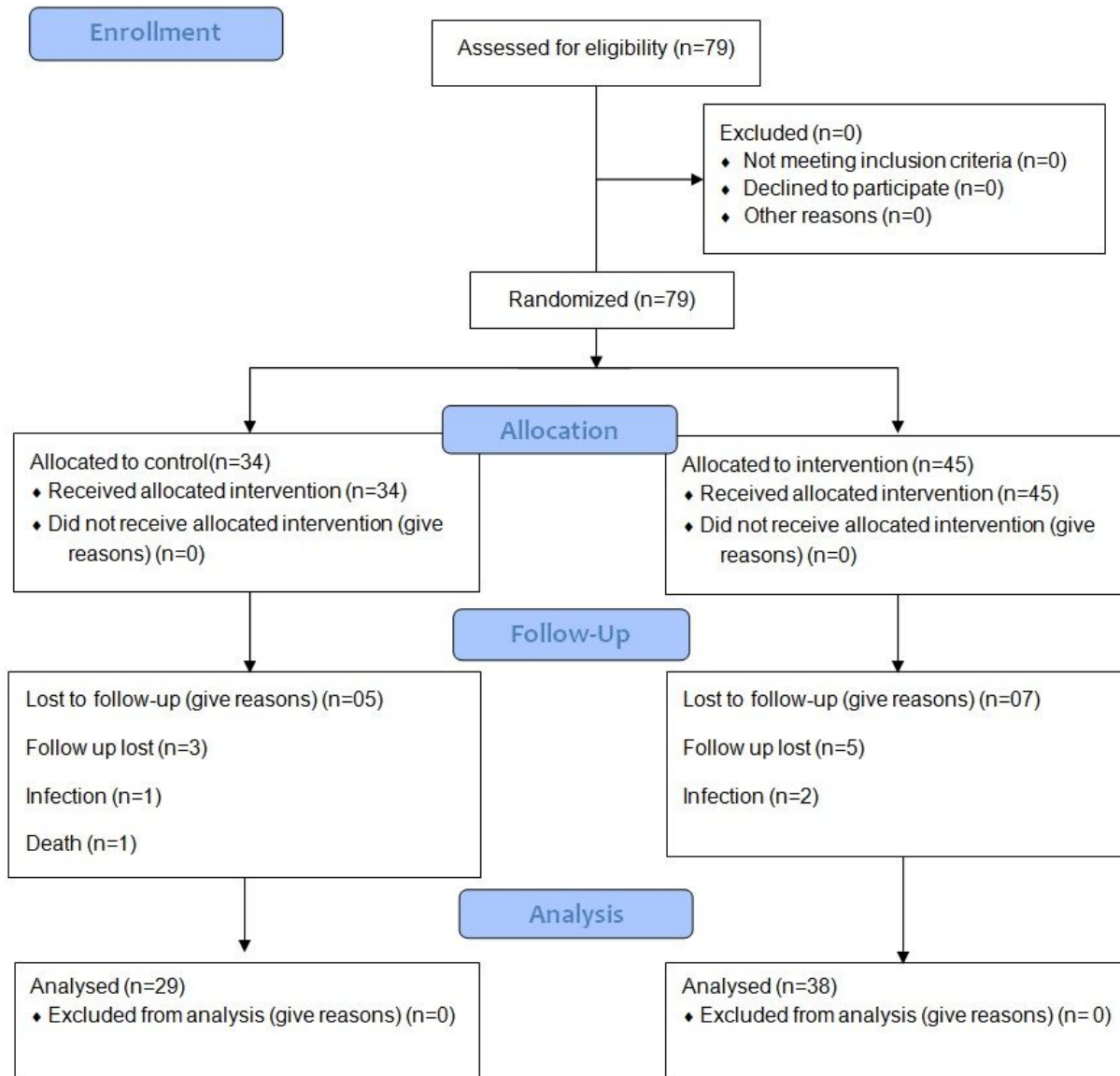
## Figures



**Figure 1**

Group of eligible patients attending differentiated educational session that consisted on illustration based and interactive discussion with TKA candidates

**A new educational method before total knee arthroplasty to be applied in developing countries: a randomized controlled trial**



**Figure 2**

Flowchart of patients' allocation, group formation and drop out

## Supplementary Files

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