

App-based or Live Patient Education before Hip Arthroplasty: A Randomized Controlled Trial

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ABSTRACT

The isolated effect of preoperative patient education on hospital length of stay (LOS) is controversial. Various educational modalities exist, yet evidence of their comparative effectiveness remains limited. We compared the effect of different preoperative education methods on LOS, postoperative outcomes, and patient satisfaction in patients undergoing primary THA. In this prospective, randomized controlled trial, 79 patients scheduled for primary THA were allocated to one of three groups: 29 received only a booklet and information during the preoperative outpatient clinic, 24 received an additional live information session and 26 used an additional mobile application. The primary outcomes were LOS and patient satisfaction regarding the information method. Secondary outcomes included Oxford Hip Score, EQ-5D-3L and EQ-VAS. Mean LOS was 4.25 ± 3 days, with no significant difference between groups ($p = 0.525$). Overall, there were no significant differences in satisfaction with the education method ($p = 0.997$) and its informational content ($p = 0.365$) between the groups. Patients in the mobile application group reported slightly higher motivation for pre- and postoperative exercises, though this was not statistically significant. All groups showed significant improvements in PROMs postoperatively ($p < 0.001$), with no significant differences in the magnitude of change between groups. The method of preoperative education did not significantly influence LOS, patient satisfaction, or postoperative outcomes in THA patients. The additional cost of implementing preoperative live sessions and mobile applications to provide additional information must be weighed against the limited benefits.

Keywords: Total hip arthroplasty, Patient education, mHealth app, Mobile application, Information session, Length of stay.

INTRODUCTION

Total hip arthroplasty (THA) is an effective treatment for end-stage hip joint damage. Over the past two decades, many institutions have adopted fast-track protocols for THA, aiming to minimize perioperative physical and psychological stress while promoting faster recovery^{1,2}. The principles of Enhanced Recovery After Surgery (ERAS), introduced by Kehlet, form the foundation of most fast-track protocols. These include preoperative patient education, minimally invasive surgical techniques, multimodal opioid-sparing analgesia, early postoperative mobilization and optimized perioperative fluid and nutritional management^{1,2}. The implementation of ERAS protocols has been shown to significantly reduce hospital length of stay (LOS) without increasing complications or readmission rates. Moreover, it

contributes to improved patient outcomes and reduced healthcare costs^{1,3,4}.

Patient education is one of the key components of ERAS protocols and is believed to reduce preoperative stress and anxiety, improve adherence to treatment and help manage unrealistic expectations. As a result, it may contribute to reduced postoperative pain, faster functional recovery and a shorter LOS⁵⁻¹⁰. However, the isolated effect of patient education remains debated in meta-analyses, largely due to the wide heterogeneity in educational methods used in different studies, ranging from verbal consultations and printed booklets to videos, websites, multidisciplinary sessions and, more recently, mobile health (mHealth) applications^{5,6,11,12}. Mobile applications offer the ability to combine text, images and video, and can deliver information in a structured and interactive way via push notifications. Additionally, they can

support patients in the postoperative phase, enhancing self-management and potentially reducing follow-up visits and healthcare costs¹³⁻¹⁷.

To date, there is no consensus on the most effective method to deliver patient education and comparative studies evaluating different strategies remain scarce. The aim of this study was to investigate the impact of different preoperative education methods on: LOS, patient satisfaction and patient-reported outcome measures (PROMs).

MATERIALS AND METHODS

Following approval by the local ethics committee, a prospective, unblinded, randomized controlled trial was conducted. Patients scheduled for primary THA were randomized into three educational intervention groups using sealed opaque envelopes with block randomization. Inclusion continued until each group included at least 20 patients with complete datasets. Inclusion criteria were: (i) adult patients scheduled for primary THA, (ii) fluent in either Dutch or French and (iii) having access to a smartphone. Exclusion criteria were revision THA, fracture-related THA and cognitive impairment.

All procedures were performed by one of two senior orthopedic surgeons (DVS, TS), using either a direct anterior (DA) or posterolateral (PL) approach, based on the surgeon's preference. Postoperative care followed a standardized rehabilitation protocol for all patients. Hospital discharge criteria included adequate pain control, satisfactory wound healing and the ability to walk independently, with or without walking aids.

Education method groups

A. Control group

The control group received a detailed explanation by the orthopedic surgeon during the outpatient consultation along with a booklet. This covered the surgical and anesthetic procedure, lifestyle modifications, postoperative rehabilitation and potential complications. The booklet was developed in collaboration with the surgical team, physiotherapists, occupational therapists and nursing staff.

B. Information session group

Patients allocated to the live information session group received the same information during the outpatient visit, as the control group, including the booklet. In addition, they attended a live, multidisciplinary information session, in small groups (maximum of

three patients), scheduled up to six weeks prior to surgery. The sessions were delivered by a surgeon, a nurse and a physiotherapist in either Dutch or French. They were based on a PowerPoint presentation incorporating text, images and video clips.

C. Mobile application group

During the outpatient visit, patients allocated to the mobile application group received the same preoperative information as the control group, including the booklet. Additionally, they were provided with access to the Patient Journey App, developed by Interactive Studios (Rosmalen, The Netherlands). Previous research by the developers^{16,17} demonstrated a positive effect on patient satisfaction, knowledge, physical functioning, quality of life (QoL), health care consumption and pain perception.

The mobile application delivered information using a combination of text, images and video clips. Information was released in three stages: before surgery, during hospital admission and after discharge. Push notifications were sent multiple times per week starting 30 days prior to surgery and continued until 43 days postoperatively. Patients could disable notifications if desired.

Outcome measures

The primary outcomes were LOS, measured in days from admission (Day 0) to the day of discharge, and patient satisfaction with the education method. Secondary outcomes included functional outcome scores.

Patient satisfaction with the education method was assessed using a self-designed questionnaire. The questionnaire assessed the content and the delivery method of the educational material, its perceived effectiveness in motivating patients to perform pre- and postoperative exercises, the consistency between the provided information and the information given by healthcare professionals, as well as the patient's willingness to use the same educational approach for future surgical procedures. All items were rated on a 10-cm visual analogue scale (VAS).

Functional outcome was assessed using the Oxford Hip Score (OHS)^{18,19}. A validated Dutch version of the OHS was used²⁰. Patients' health-related quality of life was measured using the Euro Quality of Life 5 Dimensions Survey (EQ-5D-3L) and the associated visual analogue scale (EQ-VAS). A preference valuation set for EQ-5D health states from the general Flemish public in Belgium was used to calculate the EQ-5D-3L index²¹.

Outcomes were assessed at three different time points: a few days prior to surgery, on the day of discharge, and at the follow-up visit approximately six weeks after surgery.

Demographic data and potential confounders were collected from patients' medical records, including age, sex, relationship status, presence of contralateral THA, postoperative discharge plan, surgical approach and postoperative complications.

Statistics

Continuous data were presented as means with standard deviations. Between group differences were analyzed using one-way ANOVA or Chi-square test. If the analysis showed a significant result, post-hoc tests were conducted. LOS was also analyzed using an ANCOVA test, adjusting for potential confounders including age, gender, relationship status, presence of THA on the contralateral side, occurrence of postoperative complications, postoperative discharge plan, surgical approach, preoperative function (OHS), preoperative QoL (EQ-5D-3L, EQ-VAS) and BMI. Differences between outcome scores on different

time marks were analyzed with a repeated-measures ANOVA.

Statistical analyses were two-sided, with a 5% significance level. All analyses were performed using IBM SPSS Statistics, Version 29 (IBM Corporation, Armonk, NY, USA).

RESULTS

Demographics

The total sample included 79 patients: 26 in the mobile application group, 24 in the information session group and 29 in the control group. Demographics and preoperative PROMs were comparable across groups (Table I).

Length of stay

The overall mean LOS was 4.25 ± 3 days. There was no significant difference in LOS between the three groups ($p = 0.525$, effect size 0.131). The mean LOS was 4.00 ± 2.80 days in the mobile application group, 3.92 ± 1.67 days in the information session group, and 4.78 ± 3.98 days in the control group (Fig. 1).

Table I. — Demographics and preoperative PROMs. Values are expressed as mean $\pm$ SD or % of the population. Level of significance $p < 0.05$.

	Control	Information session	Mobile application	p-value
Age (yrs)	70.39 $\pm$ 10.38	73.29 $\pm$ 7.84	66.92 $\pm$ 11.19	0.084
BMI (kg/m ²)	28.84 $\pm$ 6.38	28.76 $\pm$ 4.12	27.27 $\pm$ 4.39	0.463
Gender (% male)	41.4	37.5	38.5	0.093
Relationship (% single)	27.6	33.3	30.8	0.084
Approach (% DA)	13.8	29.2	42.3	0.086
Contralat. THA (%)	17.2	33.3	15.4	0.267
Oxford Hip Score	24.56 $\pm$ 7.24	28.88 $\pm$ 7.80	25.42 $\pm$ 7.96	0.120
EQ-5D-3L Index	0.49 $\pm$ 0.20	0.55 $\pm$ 0.20	0.48 $\pm$ 0.24	0.549
EQ-5D-3L VAS	64.78 $\pm$ 14.50	67.15 $\pm$ 14.46	63.65 $\pm$ 16.94	0.723

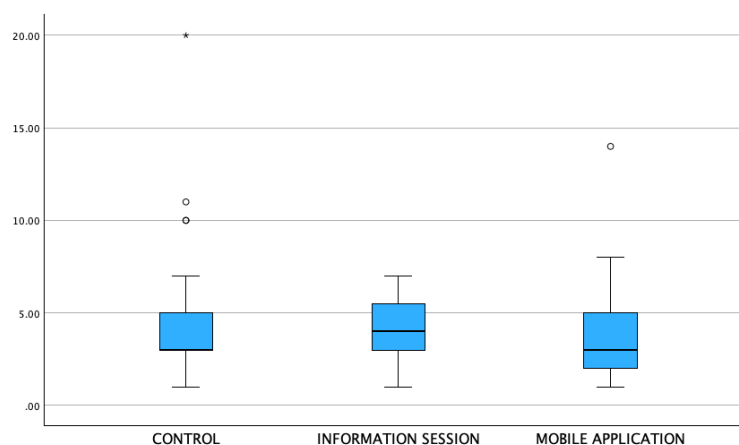


Fig. 1 — Length of stay (LOS) across the three education groups.

After adjusting for potential confounders, LOS remained similar across groups and the type of preoperative education did not have a significant impact on LOS. The only variable with a significant impact on LOS was the discharge plan: patients scheduled for transfer to a recovery facility had a significantly longer hospital stay ($\eta^2 = 0.39$, $p < 0.001$). There was no significant difference in postoperative hospital discharge destination between the three groups ($p = 0.817$). After exclusion of patients scheduled for transfer to a recovery facility (19 patients: 8 in the mobile application group, 5 in the information session group and 6 in the control group), mean LOS was 3.16 ± 1.32 . The mean LOS was 2.83 ± 1.25 days in the mobile application group, 3.42 ± 1.43 days in the information session group, and 3.19 ± 1.29 days in the control group ($p = 0.403$).

Patient satisfaction (Table II)

Overall, patients were satisfied with the way they were informed before THA (mean VAS 8.89 ± 1.32). No significant differences in satisfaction with the education method ($p = 0.997$, effect size 0.009) and its informational content ($p = 0.365$) were observed between the groups. Patients in the information session and mobile application groups reported similarly high

satisfaction with the preoperative information booklet as with their respective additional education modality ($p = 0.058$).

Secondary outcomes (Table III)

No significant differences in OHS (Fig. 2), EQ-5D-3L, EQ-VAS or Δ PROMs were observed between the groups at any time point, apart from a significantly higher EQ-5D-3L score in the information session group compared to the mobile application group at six weeks postoperatively ($p < 0.001$). These results remained unchanged after adjusting for potential covariates.

DISCUSSION

The main finding of this randomized trial was that the method of preoperative education provided to patients undergoing elective THA did not significantly affect length of hospital stay or patients' perception of the surgical experience. Clinical outcome after surgery was also unaffected by the method of preoperative education.

These findings are consistent with a Cochrane⁵ and a systematic review⁶ demonstrating that preoperative patient education before hip replacement could reduce

Table II. — Patient satisfaction with education methods. Values are expressed as mean $\pm$ SD. *Level of significance $p < 0.05$.

	Control	Information session	Mobile application	Total	p-value
Satisfaction: education method	8.88 ± 1.09	8.91 ± 1.62	8.88 ± 1.32	8.89 ± 1.32	0.997
Satisfaction: booklet as education method	8.88 ± 1.09	9.30 ± 0.76	9.23 ± 0.99	9.13 ± 0.97	0.164
Satisfaction: information content	8.50 ± 2.20	9.24 ± 1.31	8.52 ± 2.11	8.73 ± 1.94	0.365
Satisfaction: information content of booklet	8.50 ± 2.20	9.10 ± 0.88	8.95 ± 1.28	8.84 ± 1.57	0.181
Motivational effect: physiotherapy exercises	5.80 ± 3.53	6.16 ± 3.77	7.14 ± 3.38	6.40 ± 3.54	0.390
Willingness to use the same method in the future	9.06 ± 0.97	8.94 ± 2.07	8.77 ± 1.05	8.93 ± 1.39	0.777
Consistency of information between education method and healthcare professionals	8.37 ± 1.61	9.07 ± 1.27	9.47 ± 0.73	8.95 ± 1.33	0.012*

Table III. — Postoperative and delta PROMs. Values are presented as mean $\pm$ standard deviation (SD). *Level of significance $p < 0.05$. PROMs at discharge refer to scores obtained on the day of hospital discharge. Δ PROMs represent the change between preoperative scores and those recorded at the 6-week postoperative follow-up.

	Control	Information session	Mobile application	p-value
OHS at discharge	25.14 ± 9.08	27.67 ± 8.73	25 ± 10.38	0.570
OHS at 6 weeks	38.32 ± 6.45	38.81 ± 4.93	35.17 ± 8.81	0.169
Δ OHS	13.60 ± 9.20	10.57 ± 8.28	9.7 ± 9.44	0.295
EQ-5-3L at discharge	0.49 ± 0.27	0.51 ± 0.22	0.38 ± 0.37	0.422
EQ-5-3L at 6 weeks	0.67 ± 0.17	0.73 ± 0.11	0.57 ± 0.28	0.033*
Δ EQ-5-3L	0.16 ± 0.17	0.19 ± 0.22	0.08 ± 0.23	0.196
EQ-VAS at discharge	70.78 ± 10.07	68.45 ± 15.34	65.80 ± 15.18	0.422
EQ-VAS at 6 weeks	77.50 ± 9.67	79.83 ± 11.40	68.78 ± 23.23	0.058
Δ EQ-VAS	13.58 ± 14.44	12.71 ± 15.90	4.00 ± 20.71	0.122

preoperative anxiety and improve patient satisfaction, but had no significant impact on LOS or other PROMs. A complex interplay of medical and non-medical factors influences LOS^{11,22}. For this, it is unsurprising that preoperative education has only a limited impact on LOS. In our study, LOS was independent of the way patients were informed but was also unaffected by age, BMI, preoperative health status or surgical approach. According to an ANCOVA analysis, only the postoperative discharge plan influenced LOS. As reported previously, in our setting, patients who were scheduled for discharge to a recovery facility stayed longer, demonstrating a chronic shortage of rehabilitation beds in our region²³.

The use of mHealth apps was not included in review papers and their effect on LOS and patient satisfaction is less well documented. The mobile application used in this study encouraged patients to exercise through push notifications and provided them with informational content on a regular basis. This continuous stimulation and the permanent availability of information could be an advantage compared to one-time information sessions. These sessions are often incompletely and/or inaccurately recalled and information retention could decrease over time without the possibility to be retrieved afterwards^{16,24}. As such, patients using the mobile application reported higher motivation to engage in rehabilitation exercises. However, this was not significantly different from the other groups. In contrast, previous studies have shown that mobile applications can enhance patient self-management, confidence and motivation for physiotherapy exercises and self-care^{13,16,17}.

Patients reported high levels of satisfaction with the preoperative education they received, regardless of the method used. No significant differences in satisfaction were observed between the different education modalities. Interestingly, patients in both the mobile application and information session groups rated the quality of the information booklet and its usability comparably high as their respective supplementary educational modality. This emphasizes the fact that the booklet was perceived equally well as both other, more labor-intensive, education modalities.

This study has several limitations that should be acknowledged. First, the relatively small sample size (24 to 29 patients per group) may have limited the statistical power to detect significant differences in length of stay (LOS), patient satisfaction and secondary outcome measures. However, both the effect size on the LOS (0.131) and on satisfaction with the education method (0.009) were small.

Second, patient satisfaction and perception of the different education modalities were assessed using a self-designed questionnaire that was not formally validated. However, to our knowledge, there is currently no validated instrument for this. To ensure clarity and ease of use, the questions were formulated in plain language and responses were collected using a visual analogue scale (VAS). Third, except for LOS, the study relies predominantly on subjective, self-reported outcomes, which may have introduced self-report bias. Additionally, this study did not evaluate objective knowledge retention or information recall, as this was outside the scope of this project. Finally, surgeons and staff were not blinded regarding the type of information that was provided as they were actively involved in counseling the patients during the information sessions. As such, this could have influenced discharge policy. However, discharge from the hospital was a common decision involving the patient, the nursing staff, the physiotherapist, the surgeon and the registrar responsible for the ward.

CONCLUSION

Patient education is an essential part of the informed consent process, ensuring patients are well prepared for surgery and understand the associated risks and expectations. Based on this study, preoperative counseling during the outpatient clinic, supplemented with a booklet resulted in high patient satisfaction with the information provided prior to a THA. Adding live information sessions or providing a mobile application did not reduce hospital length of stay and did not improve patient satisfaction or clinical outcome. As such, we believe that the cost, effort, and logistics of organizing additional live sessions or providing a mobile application is probably not justified.

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