

The Effect of Text Messaging on Medication Adherence After Outpatient Knee Arthroscopy: A Randomized Controlled Trial

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Purpose: *The purpose of this project was to examine if text message reminders can increase postoperative adherence to treatment with acetaminophen among outpatients undergoing arthroscopic knee surgery.*

Design: *A nonblinded randomized control trial.*

Methods: *In this study, 187 patients were randomized to either an intervention group (text message reminders) or a control group (no text message reminders). On the fourth postoperative day, all patients received an electronic questionnaire concerning (1) adherence to treatment with acetaminophen (main outcome), (2) pain intensity, and (3) unscheduled health care contacts.*

Findings: *Data were available from 134 patients (intervention group, n = 70; control group, n = 64). No significant differences between groups were found regarding the median number of missed acetaminophen doses (1 vs 2.5; P = .06), pain intensity at rest and during walking, or the number of unscheduled health care contacts (7 vs 4; P = .35).*

Conclusions: *A nonsignificant trend toward an increased medication adherence of acetaminophen was found.*

Keywords: *postoperative pain, medication compliance, unscheduled contact, text message reminder.*

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EACH YEAR, AN INCREASING NUMBER of surgical procedures are performed as outpatient procedures.¹⁻³ Outpatients are discharged within a few hours after surgery to recover at home, and it is the patient's own responsibility to follow the given instructions regarding pain management.⁴

Unfortunately, the self-administered pain treatment after outpatient surgery is often inadequate, and many outpatients experience moderate to severe pain after discharge.⁵⁻¹⁰ This proves problematic because adequate pain treatment is essential to the convalescence of patients.

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Although nonadherence is a serious problem, its origins are complex and not fully understood. Some of its more commonly accepted causes include complex treatment regimens, side effects, forgetfulness, socioeconomic issues, educational levels, and personal beliefs.¹¹ Written and verbal information regarding pain treatment is often a standard procedure, whereas less attention has been paid to interventions such as patient education, phone calls, and text message reminders.

Text message reminders are known to facilitate self-management of long-term illness and attendance.¹²⁻¹⁴ In a previous study examining the effect of text message reminders in patients with long-term illness, male gender and young age were identified as risk factors for nonadherence or delayed doses of daily medication.¹² Moreover, a recent meta-analysis has shown that the effect of text messaging approximately doubles the odds of medication adherence in patients with long-term illness.¹⁴ However, until now, too little attention has been paid to the effects of text message reminders on short-term medication treatment such as postoperative analgesics after outpatient surgery.

On the basis of the previously described risk factors for nonadherence, we have chosen to focus on patients undergoing outpatient knee arthroscopy because patients undergoing this procedure tend to be younger and of male gender. Furthermore, previous research has shown that nearly one in three patients undergoing outpatient knee arthroscopy has an unscheduled contact with health care services within the first eight postoperative weeks, with pain being the most prominent reason for contact.¹⁵

We therefore aimed to test if text message reminders may serve as a useful tool for increasing adherence to treatment with acetaminophen after outpatient knee arthroscopy. We have chosen to focus on acetaminophen because all patients receive acetaminophen after outpatient knee arthroscopy.

Materials and Methods

We conducted an intervention study with a 4-day follow-up period from the day of surgery up to and including the third postoperative day. After obtaining written informed consent, 187 patients

scheduled for outpatient arthroscopic knee surgery were enrolled at the Day Surgery Unit at Horsens Regional Hospital, Denmark. Exclusion criteria were age less than 18 years, inability to use text message services, not in possession of a mobile phone, daily use of analgesics preoperatively, psychiatric illness, inability to communicate in Danish, or ligament reconstruction (the latter because of a different postoperative care and treatment). The study was approved by the Danish Data Protection Agency (1-16-02-269-15). Furthermore, the study was submitted for approval at the Central Denmark Region Committees on Health Ethics; however, approval was unnecessary, as the Central Denmark Region Committees on Health Ethics' Biomedical Research Ethics Committees System Act did not apply to this study.

Randomization and Intervention

On the day of surgery, patients were randomized to either the intervention group or the control group according to a computer-generated sequence in blocks of 20 with a ratio of 1:1.

Patients in the intervention group received, in addition to the standard written and verbal information regarding pain treatment after discharge, a total of 10 text message reminders with the text "Remember to take the medication as recommended." The text message reminders were preprogrammed and were sent out at 8 a.m., 12 p.m., and 5 p.m., starting from the day of surgery at 5 p.m. up to and including the third postoperative day at 5 p.m. Patients in the control group received standard written and verbal information regarding pain treatment after discharge.

We expected patients in the intervention group to take all 13 doses of acetaminophen (100%) and patients in the control group to take 11 of 13 doses (84.6%). We chose to focus on acetaminophen, because it is part of the basic oral pain treatment after outpatient arthroscopic knee surgery. Moreover, it is very rare that patients have a known allergy to acetaminophen compared with ibuprofen and tramadol.

Pain Treatment

Before the day of surgery, all patients had been instructed to purchase acetaminophen and ibuprofen

for postoperative use: acetaminophen 1 g orally four times daily (8 a.m., 12 p.m., 5 p.m., and 10 p.m.) and ibuprofen 200 to 600 mg orally three times daily (8 a.m., 2 p.m., and 10 p.m.). If ibuprofen was contraindicated, patients were instead provided with 20 pills of tramadol 50 mg orally up to four times daily (8 a.m., 12 p.m., 5 p.m., and 10 p.m.). In addition, patients who needed treatment with more than two doses of fentanyl in the postanesthetic care unit (PACU) were provided with 10 pills of morphine 10 mg.

Patients were discharged directly from the PACU, and oral postoperative analgesic treatment was started before hospital discharge. Patients were provided with a two-page written instruction including information about postdischarge complications such as fever, swelling, nausea, vomiting, and pain. The written instructions also included a medicine list describing to the patient the doses, type of analgesics, and medication time. A PACU nurse explained the medicine list and the written instructions to the patient, emphasizing the importance of taking the analgesics as recommended. The verbal and written instructions were similar in the two groups and the PACU nurses were blinded to the randomization. Before patient enrollment, all PACU nurses were informed about the study purpose and instructed to provide the verbal information regarding the study. This was done to provide uniformity to the verbal information. To reflect the clinical practice as adequately as possible, the instructions were provided by all nurses in the PACU. Patients were told that if they were randomized to the text reminder group they would receive a total of 10 text message reminders within the first three postoperative days.

In case of questions or postoperative problems during the first 24 hours after discharge, patients were advised to contact the day surgery unit at Horsens Regional Hospital or the closest emergency department. After the first 24 hours after discharge, the patients were instructed to contact their general practitioner during daytime on weekdays; otherwise, they should contact the general practitioner on call.

Questionnaire

In the morning of the fourth postoperative day, all patients received an electronic questionnaire in Danish, developed especially for the study, as no

suitable questionnaire existed. On the basis of the literature and experience of the authors, the questionnaire was drafted and adjusted after review by research peers. The electronic survey system, Survey-Xact (Ramboll, Denmark), was used to distribute and handle the electronic questionnaires. The questionnaire contained questions about the number of missed acetaminophen doses (n of 13 possible doses), average daily pain intensity at rest and during walking measured once daily the first three postoperative days (on an 11-point Numerical Rating Scale, with 0 = no pain and 10 = worst possible pain), and unscheduled contacts with health care services (no/yes). Furthermore, the questionnaire also included questions about baseline characteristics such as the level of education, employment status, and marital status.

To achieve the highest response rate possible, a text message reminder was sent to patients in both groups 3 days after they had received the electronic questionnaire by email with the following text "Please remember to fill out the questionnaire. Thank you for your participation." Patients who did not complete the questionnaire within 10 days after surgery were excluded from the analysis.

Statistical Analysis

The sample size calculation was based on the primary outcome. With an 80% power ($\alpha = 0.05$, $\beta = 0.2$) and SD of 4, the sample size was calculated to be 126 patients, that is, 63 patients in each group. Results were presented as either mean \pm standard deviation (parametric data) or as frequencies or medians with interquartile range as appropriate (nonparametric data). All *P* values were two-sided and those less than .05 were considered significant. Data were collected using the software program Survey-Xact (Ramboll) and exported via Excel (Microsoft) into STATA software version 13.0 (StataCorp, TX), with which statistical analysis was performed.

Results

Two hundred and thirty nine patients were assessed for eligibility from October 2015 up to and including December 2015; 7 of 239 patients were excluded based on the exclusion criteria, 36 declined to participate and 9 were missed because of logistic reasons (Figure 1).

A total of 187 patients received an electronic questionnaire on the fourth postoperative day. Data were available for 134 patients: 70 patients in the intervention group and 64 patients in the control group responded to the questionnaire (Figure 1). The nonresponders were equally distributed in the two groups and were younger than the responders.

The randomization was successful regarding baseline characteristics, except from employment status, as more unemployed patients were present in the control group (Table 1).

Medication Adherence

The median number of missed acetaminophen doses was 1 in the intervention group and 2.5 in the control group ($P = .06$). Most patients in both groups responded that they took the acetaminophen doses at different times (± 1 hour) than those recommended.

Nonadherence to the 13 doses of acetaminophen was found in 63.9% of patients in the intervention group and in 67.8% of patients in the control group ($P = .09$) (Figure 2).

Acute Postoperative Pain

No significant differences were found between the two groups regarding pain intensity at rest and during walking (Figure 3A and B). The pain intensity at rest decreased from the day of surgery until the third postoperative day in both groups from 2 [0 to 9] to 1 [0 to 9] in the intervention group and from 2.5 [0 to 8] to 1 [0 to 7] in the control group. The same tendency was found regarding the pain intensity during walking where the pain intensity decreased from 3 [0 to 10] to 2 [0 to 10] in the intervention group and from 4 [0 to 9] to 2.5 [0 to 8] in the control group.

Unscheduled Contacts

In the intervention group, four patients made an unscheduled contact compared with seven patients in the control group ($P = .35$). Sixteen reasons were given for the 11 unscheduled contacts, for example, wound-related problems ($n = 5$), pain ($n = 3$), request for prescription for analgesics ($n = 2$), questions regarding rehabilitation ($n = 2$), rash and swelling ($n = 2$), fever ($n = 1$), and sensory disturbance ($n = 1$).

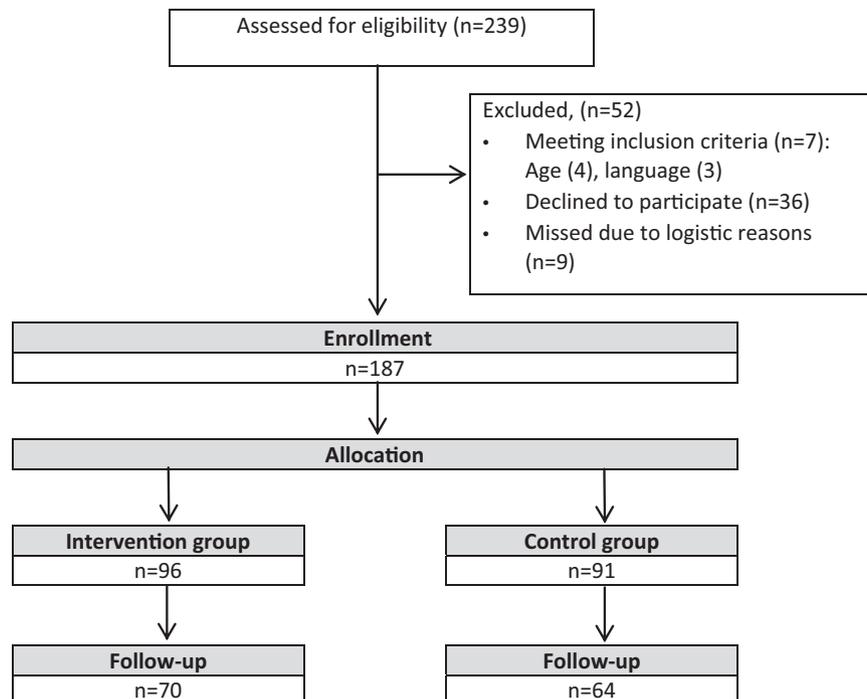


Figure 1. Flowchart.

Table 1. Baseline Characteristics

| | Intervention Group (n = 70) | Control Group (n = 64) | P-value |
|--|-----------------------------|------------------------|---------|
| Age (y), mean \pm SD | 47.5 (16.5) | 46.6 (12.8) | .73 |
| Gender, n (% of total) | | | |
| Female | 34 (48.6) | 33 (61.6) | .73 |
| Education level, n (% of total) | | | |
| Low level of education (>13 y) | 37 (52.9) | 41 (64.1) | |
| High level of education (\geq 13 y) | 30 (42.9) | 21 (32.8) | |
| Missing | 3 (4.3) | 2 (3.1) | .21 |
| Marital status, n (% of total) | | | |
| Single/widowed | 17 (24.3) | 13 (20.3) | |
| Cohabitants/married | 50 (71.4) | 49 (76.6) | |
| Missing | 3 (4.3) | 2 (3.1) | .55 |
| Employment, n (% of total) | | | |
| Yes | 51 (72.9) | 49 (76.6) | |
| No | 6 (8.6) | 11 (17.2) | |
| Retiree | 10 (14.3) | 2 (3.1) | |
| Missing | 3 (4.3) | 2 (3.1) | .04 |

Most unscheduled health care contacts (n = 7) were made during daytime on the first postoperative day to the Day Surgery Unit (n = 5), followed by contacts to the general practitioner (n = 3) and various hospital departments (n = 3).

Discussion

Inadequate pain treatment because of analgesic medication nonadherence after outpatient knee arthroscopy is a major concern because it affects patient comfort, convalescence, and can lead to pain-related unscheduled contacts with health care services. To the best of our knowledge, no

previous study has examined the effect of text message reminders on analgesic medication adherence after outpatient surgery.¹⁵ In this study, we found a nonsignificant trend toward patients in the intervention group being more likely to take the acetaminophen as recommended than patients in the control group.

We were unable to find any significant differences in pain intensity between the intervention group and the control group. However, there was a nonsignificant trend toward more patients in the control group having unscheduled health care contacts compared with patients in the

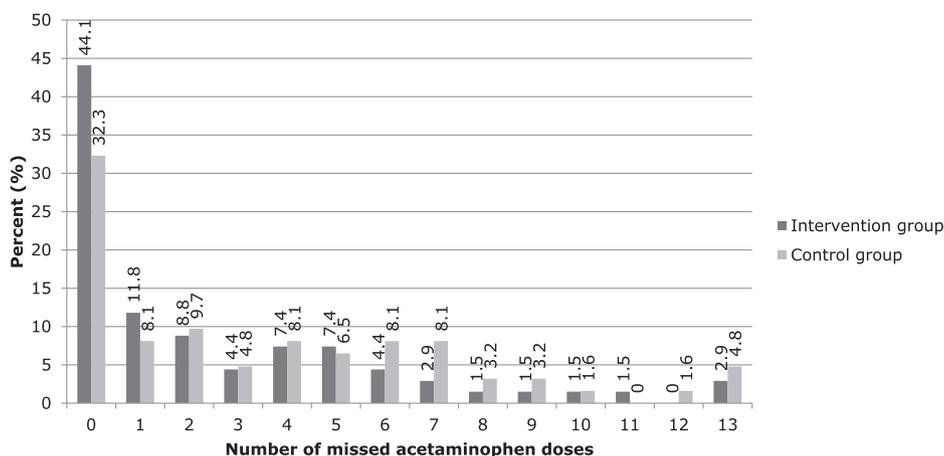


Figure 2. Missed acetaminophen doses. The number of missed acetaminophen doses and the percentage of patients in the two groups.

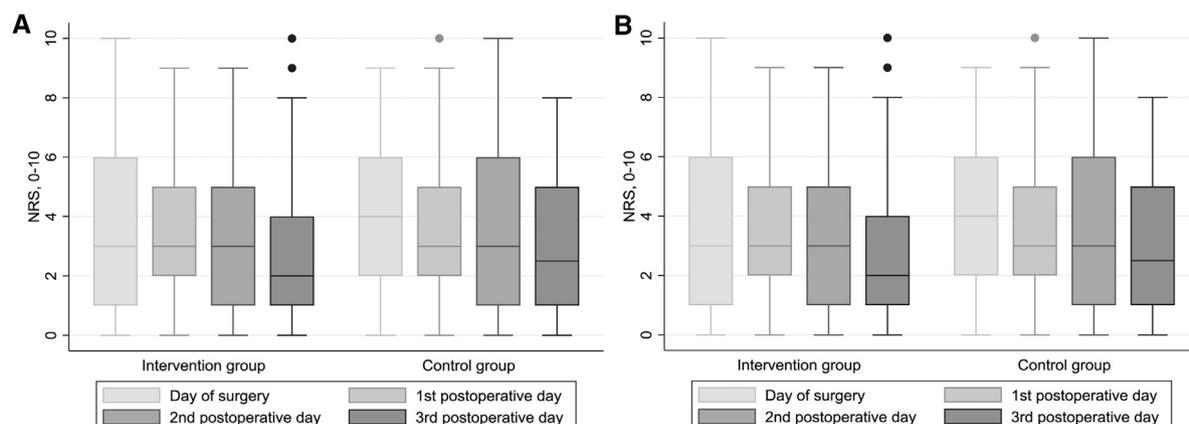


Figure 3. (A) Pain intensity at rest. Average pain intensity (median) during rest from the day of surgery up to and including the third postoperative day measured on a Numerical Rating Scale (NRS) from 0 = no pain to 10 = worst pain possible. No statistical significant differences were found between groups on the day of surgery ($P = .23$), the 1st postoperative day ($P = .28$), the 2nd postoperative day ($P = .54$) or the 3rd postoperative day ($P = .25$). (B) Pain intensity during walking. Average pain intensity (median) during walking from the day of surgery up to and including the third postoperative day measured on an NRS from 0 to 10. No statistical significant differences were found between groups on the day of surgery ($P = .38$), the 1st postoperative day ($P = .53$), the 2nd postoperative day ($P = .53$) or the 3rd postoperative day ($P = .48$). Control group = no text message reminders and intervention group = text message reminders. The • symbols represent outliers.

intervention group. Unemployment has previously been found to be a risk factor for unscheduled health care contacts,^{16,17} and this may explain some of the nonsignificant trends toward more unscheduled contacts in the control group.

Our text message reminders were preprogrammed, which minimizes the consumption of resources and makes it easy to use in a daily clinical setting. Furthermore, it ensures that the text message reminders are consistent and timely. This makes text message reminders clinically applicable and an easy and cost-efficient way of supporting patients in self-management after discharge. Furthermore, support and help at home is associated with better convalescence.^{18,19} It has been suggested that text message reminders may act as a supplement to care given by relatives and health care providers, thus reducing the patient's worry about the responsibility of self-care after discharge.¹⁸

Previous work has shown that the effect of a text message reminder is dependent on diagnosis and gender. Therefore, factors affecting analgesic medication adherence after outpatient surgery are very important beyond the scope of present

study.¹² Future studies should be undertaken to investigate the effect of text message reminders on medication adherence in other patient groups and for other types of analgesics. Moreover, we only tested a one-way text message reminder; future studies may benefit from examining the effect of one-way versus two-way text message reminders.

Some methodological issues must be considered. First and most importantly, the lack of differences in pain intensity can be attributed to low pain intensity scores in both groups. Second, the lack of text message reminders after 5 p.m. may have decreased the effect of the text message reminder. Third, the number of acetaminophen doses may be influenced by recall bias, as patients on the fourth postoperative day were asked to recall the number of acetaminophen doses taken from the day of surgery up to and including the third postoperative day. Finally, there may be patient factors associated with medication adherence that we did not take into account when designing the study, for example, anxiety²⁰ and health literacy.²¹ For future studies we recommend that patients receive a text message reminder on all the recommended medication administration times including in the evening. To reduce recall bias, patients should be

provided with a journal where their daily analgesic consumption and pain intensity could be reported. Moreover, future studies should have a broader focus on the multimodal analgesic regime and examine whether one text message reminder fits all or if patient stratification is needed.

Conclusions

To our knowledge, the present study is the first report testing a text message reminder intervention for analgesic adherence to treatment with acetaminophen after outpatient surgery. No dif-

ferences were found between the intervention and control groups regarding the number of failed acetaminophen doses, intensity of postoperative pain, or the number of unscheduled health care contacts, respectively. However, we found a nonsignificant trend toward an increased medication adherence of acetaminophen, and the effect of text messaging should therefore be tested for other types of analgesics. Furthermore, future studies are needed to explore which groups of patients may benefit from this type of self-management support after outpatient surgery.

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