




Effects of using activity diary for goal setting in occupational therapy on reducing pain and improving psychological and physical performance in patients after total knee arthroplasty: A non-randomised controlled study

Yuki Hiraga^{1,2} , Shinya Hisano³, Katsuhiko Nomiyama¹ and Yoshiyuki Hirakawa¹

Abstract

Background: Psychological factors have been reported to affect chronic pain and may lead to inactivity after total knee arthroplasty. This study aimed to determine whether the use of an activity diary for goal setting during occupational therapy would reduce pain, and improve psychological and physical performance in patients after total knee arthroplasty.

Methods: A total of 41 total knee arthroplasty participants from two cohorts were recruited in the study and allocated by convenience to either the experimental group using an activity diary ($n=20$) or the control group ($n=21$). Occupational therapy intervention (1–2 weeks postoperatively) to promote goal achievement was performed in both groups, and self-monitoring was performed in the diary group by using the activity diary. The outcome indices were Canadian Occupational Performance Measure, pain (resting pain, walking pain), pain catastrophizing (rumination, helplessness, and magnification), anxiety, depression, pain self-efficacy, and physical activity level. Data were evaluated by using analysis of variance analyses with post hoc tests.

Results: A time-by-group interaction emerged for Canadian Occupational Performance Measure, walking pain, pain catastrophizing, anxiety, depression, and physical activity level ($p < 0.05$), both favouring the diary group. The diary group also showed greater improvement in Canadian Occupational Performance Measure, walking pain, anxiety, and physical activity levels at four weeks postoperatively, compared to the control group ($p < 0.05$).

Conclusion: The use of the activity diary in this study increased occupational therapy effectiveness, reduced patients' pain, and prevented a decline in physical performance. We believe that the use of an activity diary is an effective and feasible addition for total knee arthroplasty patients.

Keywords

Total knee arthroplasty, activity diary, pain, psychosocial factor, physical activity, occupational therapy

Received 6 October 2018; accepted 15 April 2019

Introduction

Based on an epidemiological survey regarding musculoskeletal chronic pain in Japan, the rate of complaints was 11.1%, and approximately 30% of patients with chronic pain have a history of morbidity ≥ 5 years; additional patients continue to receive treatment (Nakamura, Nishiwaki, Ushida, & Toyama, 2014). Because of significant increases in medical costs due

¹Fukuoka Rehabilitation Hospital, Japan

²Graduate School of Kyushu University, Japan

³Prefectural University of Hiroshima, Japan

Corresponding author:

Yuki Hiraga, Fukuoka Rehabilitation Hospital, 770-7, Nokata, Fukuoka Nishi-ku, Fukuoka 8198551, Japan.

Email: nokopata_nokopata@yahoo.co.jp



to musculoskeletal chronic pain, as well as social losses, there is an increasing need to prevent musculoskeletal chronic pain.

Many musculoskeletal diseases that cause chronic pain are reported as lumbar diseases, with the exception of osteoarthritis of the knee. Total knee arthroplasty (TKA) may be the result of chronic pain in approximately 15% of cases (Ackerman, Graves, Wicks, Bennell, & Osborne, 2005). Despite surgical operation, urgent countermeasures are needed to prevent chronic pain and reduced physical activity. Negative psychological factors, such as anxiety, depression, and pain catastrophizing, etc., have been reported to affect chronic pain after TKA (Sullivan et al., 2011). However, self-efficacy is regarded as a positive psychological factor for mitigation of pain catastrophizing (Wylde, Dixon, & Blom, 2012). van den Akker-Scheek, Stevens, Groothoff, Bulstra, and Zijlstra (2007) reported that self-efficacy affected walking and pain after TKA. These prior studies indicated that pain catastrophizing, anxiety, and depression are related to chronic pain after TKA; and pain and self-efficacy are related to the restriction of activity levels.

We previously reported a relationship between Canadian Occupational Performance Measure (COPM) and pain catastrophizing after TKA (Hiraga, Hirakawa, Hisano, & Shiota, 2015). Notably, improvement in helplessness (i.e. helplessness in a painful situation) was recognised by occupational therapy (OT) practitioners after establishing the COPM goal in a quasi-randomised controlled trial (Hiraga, Hisano, Hirakawa, & Nomiya, 2016). However, improvements were not observed in pain, rumination (i.e. attention to pain), or magnification (i.e. overestimation of pain threats) (Hiraga, Hisano, Hirakawa, & Nomiya, 2017). Furthermore, it was not possible to examine effects on anxiety, depression, or physical activity in the prior studies. Therefore, it was necessary to develop OT treatment and practice protocols that addressed psychological factors for chronic pain after TKA.

There have been recent studies of interventions in which chronic pain patients wear pedometers to self-manage activity, thereby avoiding increases in pain and enabling them to record daily activities (Hirase et al., 2018; McDonough et al., 2013). We previously reported a case in which use of an activity diary together with OT resulted in improvement of pain, psychological factors, and activity levels; the protocol encouraged self-management of walking and pain (Hiraga et al., 2017). Importantly, it is necessary to clarify the effects of self-management with a daily activity record regarding pain, psychological factors, and activity levels.

Therefore, we investigated whether the use of an activity diary for goal setting during OT would reduce pain, and improve psychological and physical performance in patients after TKA.

Methods

Study design

This study comprised a non-randomised controlled trial. Patients were divided into: the diary group (OT plus activity diary) or control group (OT alone).

Ethical considerations

All participants provided informed consent, and the study design was approved by the appropriate ethics review board at Fukuoka Rehabilitation Hospital (FRH 2014-R-010).

Participants

Power analysis. We used G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) to perform preliminary test force analysis and estimate the required sample size. The power was set at 0.8, and the significance level (α) was set at 0.05 (Cohen et al., 1992). Effect size was set at 0.25, which constitutes a moderate standard for two-way analysis of variance. The power analysis indicated that 24 patients (12 per group) were required for pre- and post-evaluations.

Target participants. Inclusion criteria were TKA performed between May 2014 and September 2016 in Fukuoka Rehabilitation Hospital (Fukuoka, Japan); 45 patients were evaluated. Patients hospitalised May 2014–June 2015 were assigned to the control group; those hospitalised July 2015–September 2016 were assigned to the diary group. Exclusion criteria included diagnosis of dementia and obvious mental illness (e.g. depression) that would interfere with completion of the questionnaire, as well as refusal to participate in OT. Additional exclusion criteria comprised postoperative complications (e.g. nerve injury and deep vein thrombosis), other significant medical diseases interfering with postoperative rehabilitation, previous TKA (TKA of the opposite limb and revision), and TKA performed for causes other than degenerative diseases (e.g. rheumatoid arthritis and bone necrosis). Two of the 45 patients were excluded, resulting in a total of 43 TKA patients from two cohorts; these patients were allocated by convenience to either the experimental group using an activity diary ($n = 21$, four males, 17 females; age: 76.1 ± 7.1 years) or the control group ($n = 22$, two males, 20 females; age: 76.4 ± 5.4 years).

All patients received general anaesthesia; non-steroidal anti-inflammatory drugs were administered at a dose of 60 mg (three tablets per day) for two weeks postoperatively. All patients followed the same physical therapy and OT protocols after operation. All patients began physical therapy, including knee joint range of motion exercises (flexion–extension) and stretching, on the first day postoperatively. OT began at 1–2 weeks postoperatively for the purpose of improving everyday life. Patients were discharged upon the physician’s approval and on patient request at four weeks postoperatively.

OT for each group: Goal setting and practice

We used a previously reported method (Hiraga et al., 2016) for goal setting and practice in the diary and control groups at 1–2 weeks after surgery. The implementation procedure used COPM (Law et al., 1990) to list five target goals and determine the priority of the goals. After determining the priority order, we evaluated the performance of each goal with a 10-point scale (1: not possible; 10: very good). Satisfaction was also evaluated on a 10-point scale (1: not satisfied; 10: very satisfied). Performance and satisfaction scores were determined for each factor.

In practice, the patient may write, ‘I want to be able to do the clean-up’. The patient starts with a low load, such as standing position, progresses to movement, and then practices using what is necessary for cleaning. Ultimately, this practice encourages the patient to achieve the goal in cleaning. All OT interventions required 40 min per day.

OT using the activity diary

We used an activity diary developed by Fukuoka Rehabilitation Hospital for intervention in the diary group (Hiraga et al., 2017) but not in the control group. The activity diary was designed to record date, steps, and pain (11 items) daily; this facilitates achievement of activity goals while encouraging active self-management. A pedometer (Pleasure Walker PZ-150; Yamasa Co., Ltd, Tokyo, Japan) was used to record the number of steps per day; the pedometer was attached to the foot of the non-operative side. Previous studies have reported that a pedometer attached to the foot is superior to a pedometer worn on the wrist for detecting the amount of activity (Rhudy & Mahoney, 2018). In addition, we focused on improving activity, rather than solely evaluating pain. Pain levels and comments were recorded in the activity diary, and we implemented a feedback protocol to enable patients to experience achievement. For example, if a patient commented, ‘I am in pain every

day’, we asked ‘why do you have knee pain?’ ‘How can this be done easier?’. This feedback protocol was implemented to shift from negative to positive comments. Such intervention was incorporated into the OT programme of 40 min/day. Use of the activity diary began on Day 1 at the start of OT (Figure 1).

Assessment

The assessment was performed pre-OT (1–2 weeks postoperatively) and post-OT (4 weeks postoperatively).

Pain. The numerical rating scale (NRS) (Jensen, Turner, & Romano, 1994) was used to evaluate pain on an 11-point scale (0: no pain; 10: worst imaginable pain). Resting and walking pain were both assessed on the NRS.

Pain catastrophizing. The Pain Catastrophizing Scale (PCS) (Sullivan, Bishop, & Pivik, 1995) was used to evaluate pain catastrophizing. The PCS comprises 13 items and uses self-evaluation on three subscales: rumination, helplessness, and magnification. The patient evaluates the time spent on the condition on a five-point scale (0: not at all; 4: all the time). A high score indicates strong pain catastrophizing.

Anxiety and depression. The Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) was used to evaluate anxiety and depression; HADS comprises 14 questions. The patient evaluates anxiety and depression, and how much time is spent in that state, on a four-point scale (0: not at all; 3: most of the time). HADS subscale scores were also evaluated in this study.

Pain self-efficacy. The Pain Self-Efficacy Questionnaire (PSEQ) (Adachi et al., 2014) was used to evaluate self-efficacy for pain. PSEQ uses self-entry of scores for 10 items on a seven-point scale (0: not at all confident; 6: completely confident).

Physical activity levels. An activity meter (Active Style Pro; OMRON Corp., Kyoto, Japan) was used to evaluate physical activity. The activity meter was worn on a patient’s foot for 24 hours. Steps and physical activity were measured, and times for metabolic equivalents were calculated in minutes for physical activity. Previously, Ohkawara et al. (2011) found high reliability in the calculation of steps and physical activity levels using the Active Style Pro.

Statistical analysis

We used t-tests to evaluate significant differences in age, body mass index (BMI), and hospital inpatient

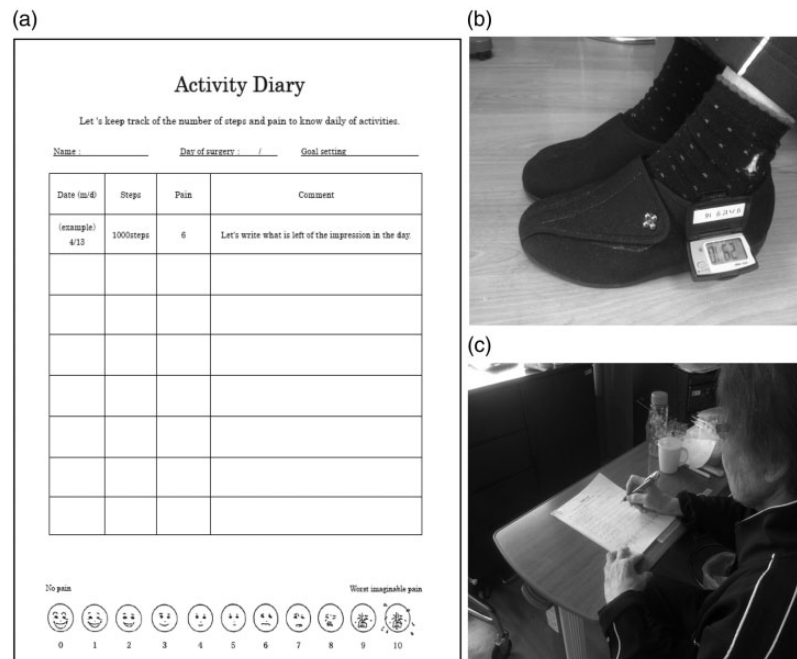


Figure 1. Activity diary. (a) Self-management was accomplished by recording the number of steps, evaluation of pain, and comments; (b) pedometer attached to the foot on the non-operative side; and (c) recording in the activity diary.

days. We used Chi-squared tests for group comparisons in demographics such as gender, employment, smoking, and drinking. We analysed the effects of the intervention protocol on outcome measures using a 2×2 (time (baseline and pre- to post-OT) \times group (diary and control groups)) analysis of variance. Post hoc Bonferroni tests were used for specific comparisons, and two-sided significance was determined. Statistical analyses were performed with IBM SPSS Statistics Version 22 (IBM Corp., Armonk, NY, USA).

Results

Figure 2 presents a flow chart outlining participation in this study. In total, 45 participants were screened for enrolment, and two failed to meet the inclusion criteria ($n=2$). We enrolled the remaining 43 participants in the study and non-randomly allocated each patient to either the activity diary group ($n=21$) or the control group ($n=22$). One patient from each group withdrew from the trial and could not be evaluated. A total of 20 patients in the diary group and 21 patients in the control group completed the study. All patients in the diary group completed the pain, number of steps, and comment categories of the diary.

Baseline characteristics

Table 1 summarises the baseline characteristics of patients. There were no significant differences in age,

sex, BMI, employment, smoking, drinking, goal setting, pain intensity, psychological status, or physical activity between the two groups.

Length of hospital stay

The length of hospital inpatient stay was significantly better for the diary group than for the control group (31.4 ± 4.6 days versus 40.8 ± 13.0 days; $p=0.002$).

Diary group and control group effects

Figure 3 presents the progress of activity diary use on daily step count and pain (11 items). Table 2 presents the interaction between the groups (time (baseline and pre- to post-OT) \times group (diary and control groups)). There were no significant differences between group measurements for the diary and control groups in NRS rest pain score, PCS rumination score, PCS helplessness score, or PSEQ total score.

Diary group effects

Table 3 presents the results of outcome measurements in the diary and control groups. The mean COPM performance and satisfaction scores post-OT were significantly better for the diary group than for the control group (COPM performance: 8.6 ± 1.3 for the diary group versus 6.3 ± 2.7 for the control group, $p=0.001$; COPM satisfaction: 8.3 ± 1.9 for

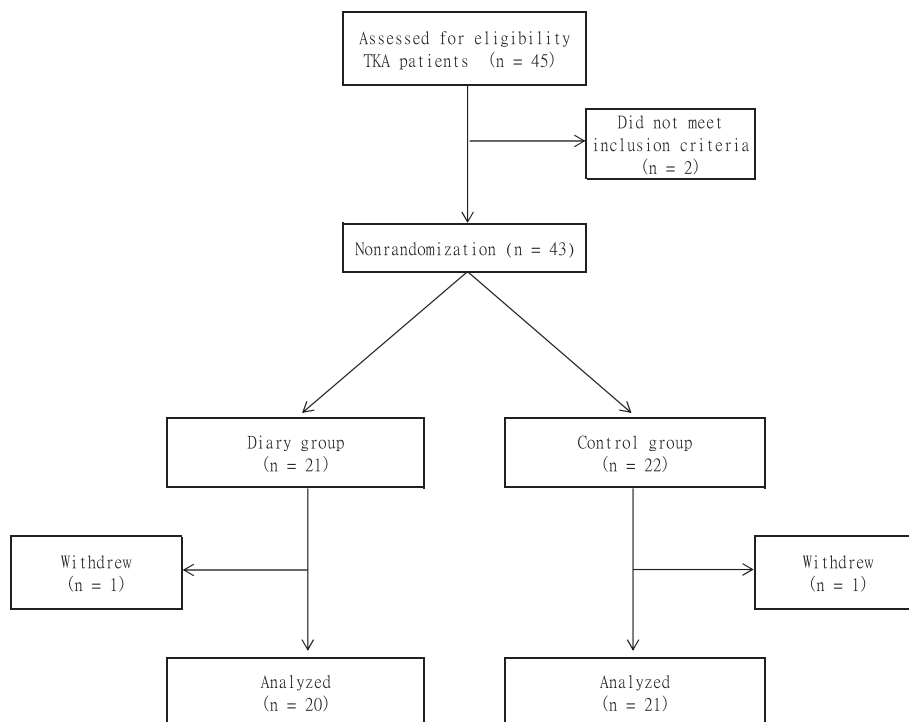


Figure 2. Patient recruitment and flow through study.
TKA: total knee arthroplasty.

Table 1. Baseline characteristics of patients, by group.

Variable	Diary group (n = 20)	Control group (n = 21)	p-value	Mean difference (95% CI)
Age (years)	76.4 ± 7.1	76.6 ± 5.5	0.466	0.16 (−4.19 to 3.86)
Female, n (%)	16 (80.0)	19 (90.4)	0.132	
BMI	24.9 ± 3.7	25.1 ± 4.6	0.435	0.21 (−2.89 to 2.46)
Nonworker (%)	17 (85.0)	19 (90.4)	0.716	
Nonsmoker (%)	18 (90.0)	21 (90.9)	0.959	
Nondrinker (%)	19 (95.0)	18 (85.7)	0.316	
COPM performance (points)	3.4 ± 2.4	4.3 ± 2.3	0.230	0.90 (−2.41 to 0.60)
COPM satisfaction (points)	3.1 ± 2.2	3.9 ± 2.3	0.269	0.79 (−2.22 to 0.63)
NRS rest pain (points)	2.9 ± 2.4	2.8 ± 2.4	0.929	0.06 (−1.47 to 1.61)
NRS Walk pain (points)	3.5 ± 2.3	3.8 ± 2.7	0.892	0.10 (−1.46 to 1.67)
PCS total score (points)	27.5 ± 7.9	25.5 ± 10.2	0.494	1.97 (−3.81 to 7.77)
Rumination score (points)	14.9 ± 2.9	15.1 ± 4.7	0.877	0.19 (−2.70 to 2.31)
Helplessness score (points)	7.9 ± 4.7	6.3 ± 5.0	0.297	1.61 (−1.47 to 4.71)
Magnification score (points)	4.6 ± 3.2	4.0 ± 3.1	0.582	0.55 (−1.46 to 2.56)
HADS anxiety (points)	7.7 ± 3.4	6.6 ± 3.1	0.297	1.13 (−0.95 to 3.21)
HADS depression (points)	6.9 ± 3.2	5.0 ± 3.2	0.339	1.03 (−1.13 to 3.21)
PSEQ total score (points)	35.9 ± 13.1	36.6 ± 16.4	0.870	0.76 (−10.21 to 8.67)
Daily step count (steps)	831.2 ± 413.3	834.8 ± 306.1	0.628	166.89 (−525.13 to 856.90)
Physical activity time (seconds)	1069.5 ± 288.1	902.7 ± 190.3	0.974	3.66 (−232.66 to 225.35)

BMI: body mass index; CI: confidence interval; COPM: Canadian Occupational Performance Measure; HADS: Hospital Anxiety and Depression Scale; NRS: numeric rating scale; PCS: Pain Catastrophizing Scale; PSEQ: Pain Self-Efficacy Questionnaire. Values are expressed as means ± standard deviation.

the diary group versus 6.1 ± 2.8 for the control group, $p=0.007$). Within the diary group, the mean COPM performance and satisfaction post-OT scores improved significantly over those of the pre-OT

values ($p=0.000$ and $p<0.000$, respectively). The mean NRS walking pain score post-OT was significantly better for the diary group than for the control group (1.3 ± 0.2 versus 3.2 ± 0.6 ; $p=0.010$). Within

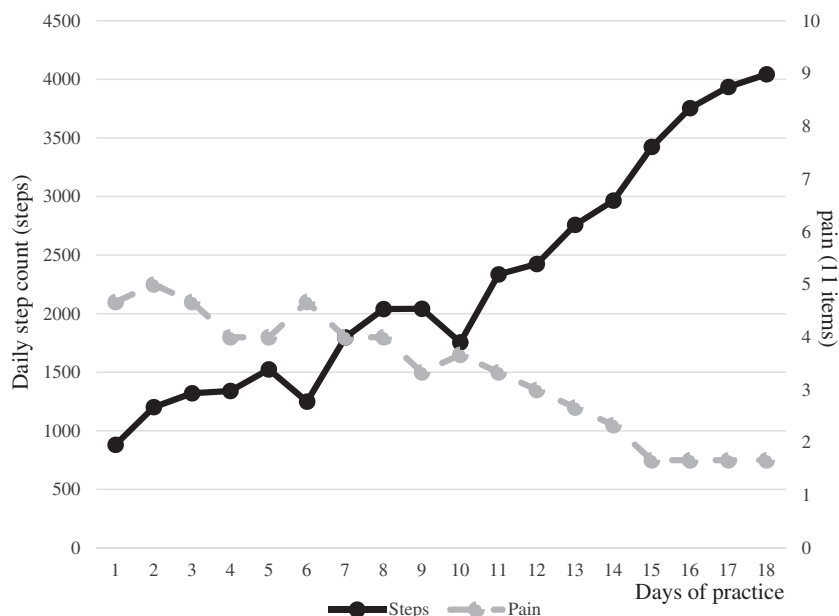


Figure 3. Record of OT using an activity diary. The combination graph shows the trends of mean step count and mean pain over 11 steps in the diary group.

Table 2. Pre- and post-OT outcomes, by group.

Variable	Diary group (n = 20)		Control group (n = 21)		Time-by-group interaction	
	Pre-OT	Post-OT	Pre-OT	Post-OT	F-value	p-value
COPM performance (points)	3.4 ± 2.4	8.6 ± 1.3	4.3 ± 2.3	6.3 ± 2.7	10.309	0.001
COPM satisfaction (points)	3.1 ± 2.2	8.3 ± 1.9	3.9 ± 2.3	6.1 ± 2.8	8.136	0.005
NRS rest pain (points)	2.9 ± 2.4	1.3 ± 0.4	2.8 ± 2.4	1.2 ± 0.4	0.001	0.965
NRS walk pain (points)	3.5 ± 2.3	1.3 ± 0.2	3.8 ± 2.7	3.2 ± 0.6	5.861	0.017
PCS total score (points)	27.5 ± 7.9	12.6 ± 6.8	25.5 ± 10.2	20.6 ± 13.7	5.018	0.027
Rumination score (points)	14.9 ± 2.9	6.6 ± 3.3	15.1 ± 4.7	10.1 ± 6.5	2.637	0.108
Helplessness score (points)	7.9 ± 4.7	3.7 ± 2.8	6.3 ± 5.0	6.0 ± 5.0	3.762	0.056
Magnification score (points)	4.6 ± 3.2	2.2 ± 2.0	4.0 ± 3.1	4.4 ± 3.3	4.351	0.040
HADS anxiety (points)	7.7 ± 3.4	1.7 ± 0.3	6.6 ± 3.1	4.4 ± 3.3	8.686	0.004
HADS depression (points)	6.9 ± 3.2	2.7 ± 2.5	5.0 ± 3.2	3.9 ± 3.5	4.320	0.040
PSEQ total score (points)	35.9 ± 13.1	44.8 ± 11.6	36.6 ± 16.4	37.7 ± 14.2	1.602	0.209
Daily step count (steps)	1069.5 ± 288.1	3580.5 ± 1545.2	902.7 ± 190.3	2088.4 ± 2008.3	3.909	0.041
Physical activity time (seconds)	831.2 ± 413.3	1741.4 ± 551.3	834.8 ± 306.1	731.8 ± 321.1	31.648	0.000

COPM: Canadian Occupational Performance Measure; HADS: Hospital Anxiety and Depression Scale; NRS: numeric rating scale; OT: occupational therapy; PCS: Pain Catastrophizing Scale; PSEQ: Pain Self-Efficacy Questionnaire.

Values are expressed as means ± standard deviation.

the diary group, the mean post-OT score improved over the pre-OT score ($p=0.001$). The mean HADS anxiety score post-OT was significantly better than for the diary group than for the control group (1.7 ± 0.3 versus 4.4 ± 3.3 ; $p=0.031$). Within the diary group, the mean post-OT score improved over the pre-OT value ($p=0.005$). The mean daily step counts and physical activity time post-OT were significantly better for the diary group than for the control group (daily step count: 3580.5 ± 1545.2 versus

2088.4 ± 2008.3 , $p=0.013$; physical activity time: 1741.4 ± 551.3 versus 731.8 ± 321.1 ; $p=0.000$). Within the diary group, the mean post-OT values improved over the pre-OT values ($p=0.000$).

Discussion

In this study, we examined the effects of using an activity diary during OT on pain, psychological factors, and physical activity after TKA. Post hoc tests in the diary

Table 3. Multiple comparisons of diary and control groups.

	Pre-OT	Post-OT	p-value	Mean difference	(95% CI)
COPM performance (points)					
Diary group (n=20)	3.4 ± 2.4	8.6 ± 1.3*	††	2.32	(0.95 to 3.69)
Control group (n=21)	4.3 ± 2.3	6.3 ± 2.7*	††		
COPM satisfaction (points)					
Diary group (n=20)	3.1 ± 2.2	8.3 ± 1.9*	††	2.19	(0.63 to 3.75)
Control group (n=21)	3.9 ± 2.3	6.1 ± 2.8*	††		
NRS walk pain (points)					
Diary group (n=20)	3.5 ± 2.3	1.3 ± 0.2*	†	-2.14	(-3.18 to -1.10)
Control group (n=21)	3.8 ± 2.7	3.2 ± 0.6*	†		
PCS total score (points)					
Diary group (n=20)	27.5 ± 7.9	12.6 ± 6.8*	†	-8.01	(-14.93 to -1.10)
Control group (n=21)	25.5 ± 10.2	20.6 ± 13.7*	†		
Magnification score (points)					
Diary group (n=20)	4.6 ± 3.2	2.2 ± 2.0*	†	-2.22	(-4.02 to -4.34)
Control group (n=21)	4.0 ± 3.1	4.4 ± 3.3*	†		
HADS anxiety (points)					
Diary group (n=20)	7.7 ± 3.4	1.7 ± 0.3*	†	-2.77	(-4.46 to -1.09)
Control group (n=21)	6.6 ± 3.1	4.4 ± 3.3*	†		
HADS depression (points)					
Diary group (n=20)	6.9 ± 3.2	2.7 ± 2.5	††	-2.52	(-4.31 to -0.73)
Control group (n=21)	5.0 ± 3.2	3.9 ± 3.5	††		
Daily step count (steps)					
Diary group (n=20)	1069.5 ± 288.1	3580.5 ± 1545.2*	††	1492.02	(326.41 to 2657.64)
Control group (n=21)	902.7 ± 190.3	2088.4 ± 2008.3*	††		
Physical activity time (seconds)					
Diary group (n=20)	831.2 ± 413.3	1741.4 ± 551.3*	†	1009.59	(726.26 to 1292.92)
Control group (n=21)	834.8 ± 306.1	731.8 ± 321.1*	†		

COPM: Canadian Occupational Performance Measure; HADS: Hospital Anxiety and Depression Scale; NRS: numeric rating scale; OT: occupational therapy; PCS: Pain Catastrophizing Scale.

Values are expressed as means ± standard deviation.

*Significant difference between post-OT results between groups ($p < 0.05$).

†Significant difference between pre-OT and post-OT results within the group ($p < 0.05$).

††Significant difference between pre-OT and post-OT results within the group ($p < 0.01$).

and control groups revealed within-group (diary group) and between-group improvements in COPM performance score, COPM satisfaction score, NRS walking score, HADS anxiety score, daily step counts, and physical activity time. Therefore, OT that included an activity diary was found to be beneficial for patients after TKA. It is also meaningful that the number of days in the diary group was shorter than that of the control group.

Harkin et al. (2016) reported on the use of an activity log and found that when goals were set and progress was recorded, achievement was increased and additional goals were formed. Furthermore, use of education incorporating self-management showed that length of stay in hospitals were reduced (Yoon et al., 2010). In addition, Seminowicz et al. (2013) reported that feedback resulted in improvement in positive emotion, pain catastrophizing, and mental health. Based on these studies, reporting negative comments such as stubborn pain in the comment section of an activity diary can

result in improvement of activity levels and achievement of goals. If consciousness changes from positive emotion to positive activity levels, improvement can be observed in the HADS anxiety score. Furthermore, the length of hospital stay was shortened. However, deterioration in physical activity was observed in the control group, which may be related to the possibility of falling, particularly these patients may have exhibited fear avoidance (Vlaeyen & Linton, 2000).

A previous study (Somers et al., 2012) demonstrated improvement in pain self-efficacy after education and pain self-management programme at 24 weeks postoperatively among knee osteoarthritis patients. The present study did not show any effects of activity diary use on pain self-efficacy. This is likely because the course of OT practice with the activity diary was limited to two weeks. However, use of the activity diary produced various significant effects within a relatively short period of time. This study directed patients in the

diary group to use the activity diary for self-management, in order to achieve an established goal in physical activity and pain management. We found that the performance score, satisfaction score, NRS walking score, HADS anxiety score, daily step counts, and physical activity time had been improved with use of the activity diary in the OT protocol.

The limitations of this study are that it was a longitudinal study with a non-randomised design. The long-term effects of using activity diary on activity limitation after chronic pain remain unknown as this study only examined short-term effects. Furthermore, the history effects of physical therapy and medication therapy were not considered, and future studies must investigate those factors.

Conclusion

Our OT programme was previously shown to be effective in improving psychological factors in Japanese TKA patients. Use of the activity diary in this study increased the effectiveness, reduced patients' pain, and prevented a decline in physical performance. The OT programme and activity diary were also well accepted by TKA patients in this study. We conclude that the use of an activity diary is an effective and feasible addition for TKA patients.

Acknowledgments

The authors thank all of the researchers who conducted trials involved in the study. We would like to thank Editage (www.editage.jp) for English language editing.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Yuki Hiraga  <https://orcid.org/0000-0003-3118-5987>

References

Ackerman, I. N., Graves, S. E., Wicks, I. P., Bennell, K. L., & Osborne, R. H. (2005). Severely compromised quality of life in women and those of lower socioeconomic status waiting for joint replacement surgery. *Arthritis Care & Research*, 53(5), 653–658.

Adachi, T., Nakae, A., Maruo, T., Shi, K., Shibata, M., Maeda, L., et al. (2014). Validation of the Japanese version of the Pain Self-Efficacy Questionnaire in Japanese

patients with chronic pain. *Pain Medicine*, 15(8), 1405–1417.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155–159.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39(2), 175–191.

Harkin, B., Webb, T. L., Chang, B. P., Prestwich, A., Conner, M., Kellar, I., et al. (2016). Does monitoring goal progress promote goal attainment? A meta-analysis of the experimental evidence. *Psychological Bulletin*, 142(2), 198–229.

Hiraga, Y., Hirakawa, Y., Hisano, S., & Shiota, M. (2015). Correlation between occupational performance and pain catastrophizing among patients after total knee arthroplasty: A pilot study. *Japanese Occupational Therapy Research*, 34(3), 299–306 (in Japanese).

Hiraga, Y., Hisano, S., Hirakawa, Y., & Nomiyama, K. (2016). Occupational therapy intervention using the Canadian Occupational Performance Measure in reducing pain-induced helplessness after total knee arthroplasty. *Japanese Occupational Therapy Research*, 35(5), 515–524 (in Japanese).

Hiraga, Y., Hisano, S., Hirakawa, Y., & Nomiyama, K. (2017). Improvement of self-efficacy through occupational therapy intervention using an activities diary after total knee arthroplasty: A case study. *Japanese Occupational Therapy Research*, 36(5), 327–333 (in Japanese).

Hirase, T., Kataoka, H., Nakano, J., Inokuchi, S., Sakamoto, J., & Okita, M. (2018). Effects of a psychosocial intervention programme combined with exercise in community-dwelling older adults with chronic pain: A randomized controlled trial. *European Journal of Pain*, 22(3), 592–600.

Jensen, M. P., Turner, J. A., & Romano, J. M. (1994). What is the maximum number of levels needed in pain intensity measurement? *Pain*, 58(3), 387–392.

Law, M., Baptiste, S., McColl, M., Opzoomer, A., Polatajko, H., & Pollock, N. (1990). The Canadian Occupational Performance Measure: An outcome measure for occupational therapy. *Canadian Journal of Occupational Therapy*, 57(2), 82–87.

McDonough, S. M., Tully, M. A., Boyd, A., O'Connor, S. R., Kerr, D. P., O'Neill, S. M., et al. (2013). Pedometer-driven walking for chronic low back pain: A feasibility randomized controlled trial. *The Clinical Journal of Pain*, 29(11), 972–981.

Nakamura, M., Nishiwaki, Y., Ushida, T., & Toyama, Y. (2014). Prevalence and characteristics of chronic musculoskeletal pain in Japan: A second survey of people with or without chronic pain. *Journal of Orthopaedic Science*, 19(2), 339–350.

Ohkawara, K., Oshima, Y., Hikihara, Y., Ishikawa-Takata, K., Tabata, I., & Tanaka, S. (2011). Real-time estimation of daily physical activity intensity by a triaxial accelerometer and a gravity-removal classification algorithm. *British Journal of Nutrition*, 105(11), 1681–1691.

Rhudy, M. B., & Mahoney, J. M. (2018). A comprehensive comparison of simple step counting techniques using wrist- and

- ankle-mounted accelerometer and gyroscope signals. *Journal of Medical Engineering Technology*, 42(3), 236–243.
- Seminowicz, D. A., Shpaner, M., Keaser, M. L., Krauthamer, G. M., Mantegna, J., Dumas, J. A., et al. (2013). Cognitive-behavioral therapy increases prefrontal cortex gray matter in patients with chronic pain. *The Journal of Pain*, 14(2), 1573–1584.
- Somers, T. J., Blumenthal, J. A., Guilak, F., Kraus, V. B., Schmitt, D. O., Babyak, M. A., et al. (2012). Pain coping skills training and lifestyle behavioral weight management in patients with knee osteoarthritis: A randomized controlled study. *Pain*, 153(6), 1199–1209.
- Sullivan, M. J. L., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: Development and validation. *Psychological Assessment*, 7(4), 524–532.
- Sullivan, M., Tanzer, M., Reardon, G., Amirault, D., Dunbar, M., & Stanish, W. (2011). The role of presurgical expectancies in predicting pain and function one year following total knee arthroplasty. *Pain*, 152(10), 2287–2293.
- van den Akker-Scheek, I., Stevens, M., Groothoff, J. W., Bulstra, S. K., & Zijlstra, W. (2007). Preoperative or postoperative self-efficacy: Which is a better predictor of outcome after total hip or knee arthroplasty? *Patient Education and Counseling*, 66(1), 92–99.
- Vlaeyen, J. W., & Linton, S. J. (2000). Fear-avoidance and its consequences in chronic musculoskeletal pain: A state of the art. *Pain*, 85(3), 317–332.
- Wylde, V., Dixon, S., & Blom, A. W. (2012). The role of preoperative self-efficacy in predicting outcome after total knee replacement. *Musculoskeletal Care*, 10(2), 110–118.
- Yoon, R. S., Nellans, K. W., Geller, J. A., Kim, A. D., Jacobs, M. R., & Macaulay, W. (2010). Patient education before hip or knee arthroplasty lowers length of stay. *The Journal of Arthroplasty*, 25(4), 547–551.
- Zigmond, A. S., & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica*, 67(6), 361–370.