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ORIGINAL RESEARCH

Effectiveness of an educational intervention on levels of pain, anxiety and self-efficacy for patients with musculoskeletal trauma

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Abstract

Title. Effectiveness of an educational intervention on levels of pain, anxiety and self-efficacy for patients with musculoskeletal trauma.

Aim. This paper is a report of a study of the effectiveness of a pain management educational intervention on level of pain, anxiety and self-efficacy among patients with musculoskeletal trauma and consequent orthopaedic surgery.

Background. Substantial evidence supports the use of preoperative education to improve patient outcomes. Educational interventions are common in preparing patients for orthopaedic surgery.

Methods. A pre- and post-test design (quasi-experimental) was employed in 2006 with patients assigned either to a control (usual care) or an experimental group (usual care plus educational intervention). The 30-minute educational intervention consisted of information about pain, coping strategies and breathing relaxation exercises. The outcome measures were scores for pain, anxiety, self-efficacy, analgesic use and length of hospital stay and these were measured before surgery and on day 2, day 4, day 7, 1 month and 3 months after surgery.

Results. A total of 125 patients completed the study (control, n = 63; experimental = 62). The experimental group reported statistically significantly lower levels of pain, less anxiety and better self-efficacy during hospitalization (before surgery to day 7), as compared to the control group. The experimental group had more requests for analgesics at day 2 only. There were no statistically significant effects on length of stay. At the 3-month evaluation, a statistically significant effect on anxiety level was found in favour of the experimental group.

Conclusion. Patients may benefit from this educational intervention in terms of relieving pain, anxiety and improving self-efficacy, and the educational intervention could be incorporated as part of routine care to prepare musculoskeletal trauma patients for surgery.

Keywords: anxiety, educational intervention, musculoskeletal trauma, nursing, pain, self-efficacy

Introduction

Musculoskeletal trauma is one of the most common causes of hospitalization. Fractures are very often caused by motor vehicle accidents, falls, sport injuries, for which orthopaedic surgery with internal fixation of surgical nails, screws, plates or wires to fix the limb fracture is the treatment, and this can be stressful for patients [Esser & McRae 2002, Ho & Chan 2003, Hospital Authority (HA) 2008]. Patients with traumatic limb fracture may experience intense pain and anxiety after unexpected injury and after undergoing surgery (Byrne & Heyman 1997; Calvin & Lane 1999, Coll *et al.* 2004a, Carr *et al.* 2005). Anxiety provoked by trauma is frequently beyond the patient's control, and could cause physical and psychological instability (Munafo & Stevenson 2001). Several studies (Ponzer *et al.* 2000, Scaf-Klomp *et al.* 2003, Carr *et al.* 2005) have confirmed that postoperative anxiety is a common consequence affecting patients' level of pain and recovery, specifically in studies of people with limb and hip fractures. Anxiety may be related to fears of engaging in activities that precipitate pain. As a result, patients may be inclined to avoid activity, physiotherapy, and even self-care. This may lead to delay in the rehabilitation process, and consequential muscle wasting, physical weakness with reduced physical endurance, anxiety and depression and even a decrease in quality of life (Melzack & Wall 2003, Mitchell 2003, Ilya & Yoram 2007). Thus, there is a need to help patients to overcome pain and anxiety after surgery.

Background

Anxiety is common among patients who have experienced musculoskeletal trauma and surgery (Ponzer *et al.* 2000, Carr *et al.* 2005, Johansson *et al.* 2005). Substantial evidence supports the fact that preoperative education is useful in improving physical and psychological outcomes (Sjolingm *et al.* 2003, Carr *et al.* 2005, Johansson *et al.* 2005, Lin & Wang 2005). The goals of preoperative educational intervention for orthopaedic surgery are to prepare patients for the surgery and to improve patient outcomes, including knowledge about the surgery and rehabilitation programme, pain control, anxiety reduction or even length of hospital stay (Shuldham 1999, Carr *et al.* 2005, Lin & Wang 2005). The methods of delivery in preoperative educational interventions vary widely, and include audio-taped or videotaped information (Daltroy *et al.* 1998; Heye *et al.* 2002), preoperative face-to-face sessions (Giraudet-Le *et al.* 2003), written materials (Butler *et al.* 1996; Johansson *et al.* 2004), and internet-based education (Katja *et al.* 2008).

Many previous studies have focused on enhancing knowledge of the surgery, possible complications, exercises, and rehabilitation programmes for patients undergoing planned surgery such as hip replacement or knee surgery (Giraudet-Le *et al.* 2003, Johansson *et al.* 2004, 2005). However, few researchers have reported the theoretical framework underpinning the intervention; hence, it is difficult to interpret the findings or replicate the study (Johansson *et al.* 2005, Katja *et al.* 2008). In the limited studies available, self-efficacy theory is commonly used to underpin the educational intervention for orthopaedic patients (Pellino *et al.* 1998, Heye *et al.* 2002, Yeh *et al.* 2005).

Self-efficacy refers to people's sense of confidence in their ability to perform a set of actions; the greater their confidence, the more likely it is that they will initiate and persist in the particular activity (Bandura 1986, 1997). The underlying assumption of this theory is that behavioural change and the maintenance of that behaviour are both a function of expectation of the person's ability to perform a certain behaviour (self-efficacy) and expectations of the outcomes. Self-efficacy is the mediator between knowledge and action. Enhancing appropriate knowledge in clients may provide them knowledge and skill to cope with the upcoming problems and decrease their anxiety. For example, Heye *et al.* (2002) incorporated self-efficacy theory into the development of a multimedia CD for patients having hip replacement surgery. Patients receiving the educational intervention demonstrated better self-efficacy scores and performed better in mobility. However, these interventions were designed for planned surgery such as hip and knee replacement and very few researchers have addressed the psychological well-being of acute musculoskeletal trauma patients; such patients would be stressed about the unexpected event and upcoming surgeries and their physical status and pain would not be appropriate for receiving a comprehensive educational programme. Very few studies have been carried out involving self-efficacy and pain management for Chinese patients, yet these patients are frequently reported to be stoical and reluctant to seek pain relief, even though they are suffered from cancer pain or postoperative pain (Wills & Wotton 1999, Chung & Lui 2003). An educational intervention based on self-efficacy theory may have potential to help patients with traumatic limb fracture to cope with the stressful events, leading to better adaptation to the rehabilitation process and outcomes (Gammon & Mulholland 1996, Pellino *et al.* 1998, Heye *et al.* 2002, Yeh *et al.* 2005).

Given that musculoskeletal trauma is the leading cause of hospital admissions globally and in Hong Kong (Maher *et al.* 2002, Simpson 2002, HA 2008), there is a need to develop interventions for this group of patients (Heye *et al.* 2002, Johansson *et al.* 2004, 2005, Yeh *et al.* 2005).

The study

Aim

The aim of this study was to examine the effectiveness of a pain management educational intervention on level of pain, anxiety and self-efficacy among patients with musculoskeletal trauma and consequent orthopaedic surgery.

Design

A pre- and post-test design (quasi-experimental) was employed.

Participants

The study was carried out at two of the largest regional public hospitals in Hong Kong. The hospitals provide acute care to a population of 1,600,000. Six orthopaedic and trauma wards of the two hospitals were randomized into experimental or control groups by drawing lots, with three wards in each group. These wards had similar patient profiles, staff mix, treatment protocol, and pain-management protocol as they are governed by the Hong Kong Hospital Authority.

During the study period, all eligible patients at the study venues who met the inclusion criteria were recruited. The inclusion criteria were: Chinese adult, able to communicate in Cantonese, ambulatory before injury, medically diagnosed as having musculoskeletal trauma of a single limb and undergoing orthopaedic surgery. Patients were excluded if they had a skull fracture, rib fracture, unstable hemodynamic state, past history of chronic pain, or cognitive and mental impairment.

Determination of the sample size was based on a previous review of similar nursing research, which reported small to medium effect size (d = 0·5) (Portney & Watkins 2000, Yeh *et al.* 2005). To detect a medium effect size for differences in study outcomes between the control and experimental groups at a 5% statistical significance level and a power of 0·80, 64 participants in each group were required (Cohen 1992). In this study, a total of 226 potential patients were assessed for eligibility and 125 consented and completed the study, with 62 in the experimental group and 63 in the control group.

Interventions

Intervention group

All participants in the experimental group received the usual care plus the educational intervention (EI). The framework of the EI was based on self-efficacy theory (Bandura 1986, 1997, DeGood & Shutty 1992), but the content was based on a previous qualitative study exploring Chinese patients' pain experiences and knowledge of pain management (Wong & Chan 2008), and self-efficacy theory (Bandura 1986, 1997, DeGood & Shutty 1992).

The aim of the 30-minute EI was to enhance patients' self-efficacy by providing them with knowledge about pain and the use of analgesics, and performing breathing relaxing exercises. The interventions were delivered 1 day before surgery by one of the researchers to ensure consistency in the method of delivery and intervention dosage. The incorporation of breathing relaxation exercises was aimed at enhancing patients' self-efficacy for pain management and anxiety reduction. When patients experience pain or anxiety, they should know how to cope with this, such as by seeking pain relief and practicing breathing relaxing exercises. Table 1 summarizes the objectives and content of the EI.

Control group

All participants in the control group received the usual care. This involved the standard care provided by healthcare professionals in terms of surgery type, wound care, physiotherapy, routine hemodynamic observations, pain assessment and management. Normally patients received extra intramuscular analgesics from surgery until discharge, the provision of which was reliant on their requests and oral agreement. Routine oral analgesics were given to all patients regularly four times a day when they could tolerate oral feeding.

Outcome measures

Pain level

Pain level was assessed using the visual analogue scale (VAS), which consists of a horizontal 100 mm line on a piece of paper with 'no pain' at one end and 'worst pain' at the other end. The VAS is a valid measure of pain and is sensitive to changes in pain perception (Coll *et al.* 2004a,b, Coll & Ameen 2006). It has been shown to have good psychometric properties, especially for those experiencing acute pain (Gift 1989, Kruger 1996, Wang *et al.* 1996, Coll *et al.* 2004b). Correlations between patients' score on numeric pain intensity scales and the VAS have been found to be high (r = 0·85–0·96), establishing instrument validity (Paice & Cohen 1997, Coll *et al.* 2004b).

Anxiety

The Chinese version of The State Scale of the State-Trait Anxiety Inventory (STAI) was used as a measure of anxiety. The instrument consists of 20 items, 10 anxiety-present and

Table 1 Educational intervention content

Time	Objectives	Contents covered
First 5 minutes	Build up rapport with the participant	Introduction
10 minutes	Enhance patients' knowledge on pain and pain management	State the key points of benefit of good pain management Good pain relief can improve capability of activities and speed up recovery Pain leads to all kinds of psychological discomfort, results in vicious circle of tension and more pain Option of pain relief available after surgery Measures to take when pain is present
10 minutes	To reduce anxiety and regain self-efficacy	Demonstration and re-demonstration of breathing relaxation exercises skill Sit up right or lie flat, fully breathe out by mouth (purse lip and blow air), breathe in by the nose and count to 4 simultaneously and slowly Hold your breath, count to 3 slowly, then count again to 4 slowly, breathe out through mouth in a relaxing manner. Finally, lower down your shoulder and relax, feel your tummy, it shrinks a bit, continue practising for 6 cycles Practise 4 times (6 cycles each time) a day, in the morning, afternoon, evening and before sleep; it helps to relax your body
5 minutes	Reinforcement of importance of self-efficacy	Encourage participant to have a positive attitude to manage pain and anxiety after surgery

10 anxiety-absent items, rated on a 4-point Likert scale of increasing intensity from 'not at all' to 'very much so'. The total score ranges from 20 to 80, with higher scores indicating higher anxiety levels. The coefficients of the 20-item scale in the present study ranged from 0·71 to 0·90 and were similar to previous reports (Shek 1988, 1991, 1993).

Self-efficacy

Self-efficacy for pain management was assessed by the Chinese Version of the Self-efficacy Scale (C-SES). This consists of 10 items and uses a 4-point Likert scale to assess the general sense of perceived self-efficacy in coping with stressful life events (Schwarzer & Jerusalem 1995). The sum of responses to the 10 items yields the final composite score, ranging from 10 to 40. High test-retest reliability and internal consistency have been established in many studies, with α coefficients higher than 0·80 (Zhang & Schwarzer 1995, Schwarzer & Born 1997). For the purpose of the current study, we added one item with a 4-point scale focusing on self pain-management to the original C-SES: 'I am confident that I can handle my pain at home'. The style of this item is similar to others in the C-SES. The α coefficients for the 11-item scale ranged from 0·71 to 0·88, and were similar to earlier reports (Zhang & Schwarzer 1995, Schwarzer & Born 1997).

Demographic and clinical data

Demographic data were collected on age, gender, marital status and educational level. Clinical data such as type of injury, type of operation, analgesic use were also collected. Frequency of performing the breathing relaxation exercises was collected from the experimental group. These data were retrieved either from medical records or from patients themselves.

Data collection

Data collection lasted for 12 months from January 2006. All eligible patients were approached by the research nurse to obtain written consent. Baseline data were then collected and an appointment was made for participants in the experimental group to receive the EI. Participants' general condition and comfort were ensured before conducting the intervention. All those in the experimental group received the usual care plus the EI, whereas those in the control group received only the usual care. All healthcare professionals working in the wards, such as doctors, nurses, and physiotherapists, were blinded to the grouping, and gave only usual care to all participants.

Measurements were taken at six intervals: all outcome variables at T0 (1 day before surgery), VAS, STAI, analgesic use at T1 (2 days after the surgery), T2 (4 days after the surgery), VAS, STAI, analgesic use, self-efficacy at T3 (7days after the surgery), (v) VAS, STAI, analgesic use, self-efficacy at T4 (1 month after the surgery) and T5 (3 months after the surgery).

Ethical considerations

Ethical Approval was obtained from university and hospital ethics committees. All participants were assured of

confidentiality and their right to withdraw from the study at any time without affecting the quality of their care. Further, before conducting the educational intervention, participants' general condition, such as blood pressure and pulse rate, were monitored to ensure that they were within normal ranges and that they were not suffering from dizziness or discomfort.

Data analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows version 15.0 (SPSS Inc, Chicago, IL, USA). Descriptive statistics, i.e. means, standard deviations, frequencies and percentages, were used to summarize the data. Chi-square statistics, independent *t*-tests and Mann–Whitney *U* tests were used to explore differences between the groups. Repeated measures ANOVA was used to determine which intervention was more effective in terms of pain level, anxiety level and self-efficacy from baseline to 3 months. The *post hoc* Tukey test with pairwise comparison was used to identify whether outcomes in specific time periods differed. In addition, the Mann–Whitney *U* test was used for sub-scale analysis for the extra item of C-SES. The intention-to-treat method was adopted (Engels & Diehr 2003, Polit & Beck 2008).

Results

A total of 125 participants consented to and completed the study, with 62 in the experimental group and 63 in the control group. A total of six participants could not be contacted for follow-up 1 month after surgery, while nine could not be contacted for follow-up at 3 months after surgery. The drop-out rate was 4·8% at 1 month and 7·2% at 3 months. There was no statistically significant difference between the experimental and control groups in terms of numbers, and the reasons for the drop-out were similar. The reasons for drop-out included 'moved to a nursing home', 'lived or worked in China', and 'lost contact, such as due to change contact number'. Figure 1 summarizes the recruitment status and study flow.

Demographic and clinical characteristics

Table 2 shows the demographic and clinical characteristics of the participants. The experimental and control groups were homogenous in terms of their demographic data and baseline clinical characteristics. The majority were male (68%), married (79%), full-time employed (47%), and had received secondary school education (52%), with a mean hospitalization of 8·96 days. All participants had musculoskeletal trauma with single-limb fractures, and their operations involved internal fixation with nails, pins and/or plates. The reasons for the injuries sustained were mainly falls (62%), vehicle accidents (10%), or sports injuries (10%). There was a strong relationship between the mechanism of injury and age. A majority of the older participants (> 60 years of age) had sustained a fracture due to a slip or fall, either at home or in a public area. The younger participants (< 60 years of age) had sustained a fracture as a result of a motor vehicle accident or a work-related or sports injury.

Pain level

Table 3 summarizes the outcome measured, with the means and standard deviations. Repeated measures ANOVAs were used to determine VAS pain levels across time and between groups. Over time, within subjects in the same group, VAS pain decreased and differed statistically significantly (from presurgery to 3 months), $F(5,119) = 132{\cdot}3$, $P < 0{\cdot}001$. For the between-subjects factor of group, there was no statistical significance between the experimental and control groups, $F(1,123) = 2{\cdot}26$, $P = 0{\cdot}14$. Analysis of the interaction between group and time showed that VAS pain across the six time periods did not differ statistically significantly between the groups, $F(5,119) = 1{\cdot}25$, $P = 0{\cdot}29$.

However, if the VAS pain score was compared during hospitalization only, analysis of the interaction between group and time showed that it differed statistically significantly between the groups across the four time periods (T0–T3), $F(3,121) = 4{\cdot}17$, $P = 0{\cdot}008$, partial eta square, 0·02. A *post hoc* Tukey test showed a significant statistical effect ($P < 0{\cdot}001$) between days 2 and 4 as well as between days 4 and 7. The results showed that there might be an intervention effect on pain outcomes between the experimental and control groups during hospitalization.

Anxiety level

Anxiety level decreased and differed statistically significantly from presurgery to 3-month follow-up, $F(5,119) = 71{\cdot}19$, $P < 0{\cdot}001$. For the between-subjects factor of group, there was a statistically significant difference between the experimental and control groups, $F(1,123) = 9{\cdot}79$, $P = 0{\cdot}002$. Analysis of the interaction between group and time showed that anxiety level across the six time periods differed statistically significantly between the groups, $F(5,119) = 3{\cdot}1$, $P = 0{\cdot}011$, partial eta square, 0·074.

Pair-wise comparison using the Tukey test showed a statistically significant effect ($P < 0{\cdot}001$) between days 2 and 4 as well as between days 4 and 7. The EI appeared to

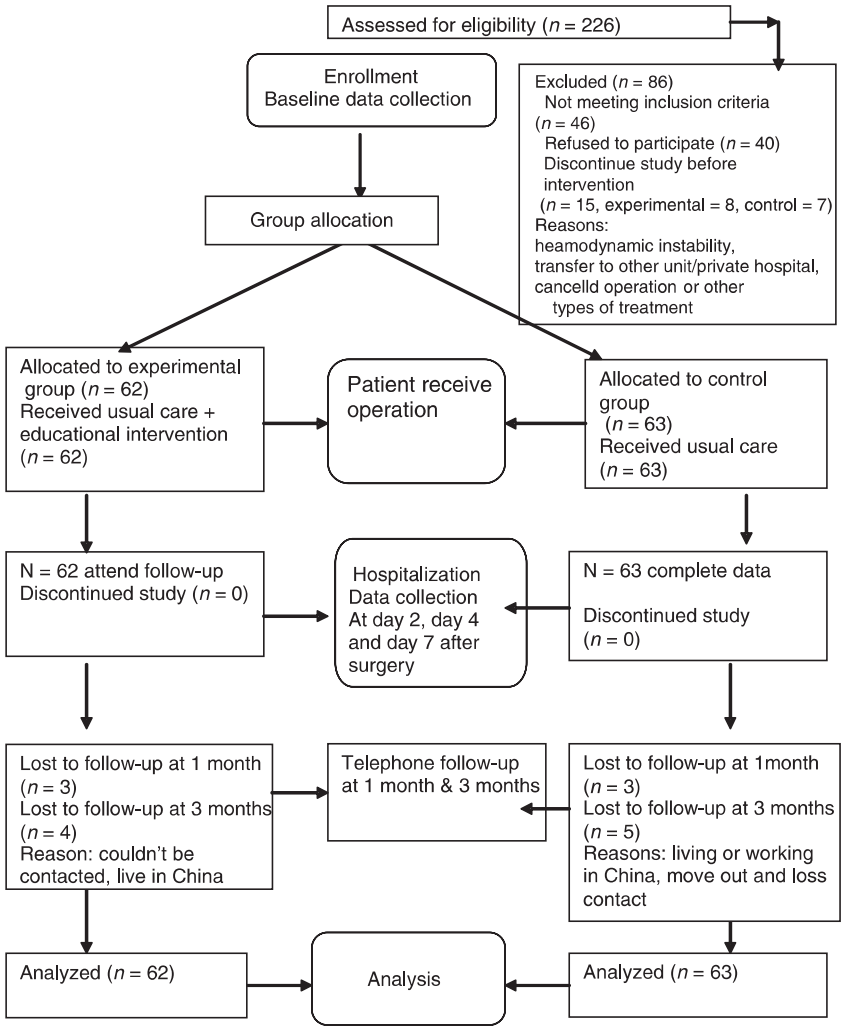

Figure 1 Flowchart of recruitment.

have a positive impact on the experimental group in reducing anxiety during hospitalization only. The standard effect size (partial eta square) was 0·074, and the observed power was 0·87. According to Cohen (1992), 0·074 suggests a moderate effect size.

Self-efficacy level

Table 3 shows the pattern of change in self-efficacy in each study group across four time points (presurgery, day 7, 1 month, and 3 months). There was a statistically significant difference between the experimental and control groups, $F(1,123) = 4{\cdot}25$, $P = 0{\cdot}048$. The experimental group had consistently increased self-efficacy over time, while the control group experienced decreased in self-efficacy from presurgery to 1 month and then increased in self-efficacy from 1 to 3 months. However, the within subjects factor of time and self-efficacy increased but not differed statistically significantly across 3 months, $F(3,121) = 1{\cdot}33$, $P = 0{\cdot}27$. Moreover, a statistically significant difference was found in the sub-scale analysis on day 7 in the item, *I am confident that I can handle my pain at home*, with $P = 0{\cdot}011$(Mann–Whitney test). The result indicated that participants from the experimental group had higher self-efficacy levels for pain management on discharge.

However, analysis of the interaction between group and time showed that self-efficacy across the T0–T5 did not differ statistically significantly between the groups, $F(3,121) = 0{\cdot}81$, $P = 0{\cdot}49$; thus, there was no intervention effect on the self-efficacy scale across 3 months.

Length of stay

There were no statistically significant differences between the two groups in total length of stay in hospital, although the mean length of stay was shorter in the experimental group (mean = 8·1 days, SD = 5·8) than in the control group (mean = 10·1 days, SD = 7·3).

Table 2 Participant demographics

	All participants (N = 125), n (%)	Experimental group (N = 62), n (%)	Control group (N = 63), n (%)	P-value
Age mean (SD)	54·4 (18)	51·69 (17·09)	57·08 (18·6)	0·095*
Gender				
Male	68 (54·4)	31 (50)	37 (58·7)	0·1#
Female	57 (45·6)	31 (50)	26 (41·3)	
Marital status				
Married	99 (79·2)	49 (79·0)	50 (79·4)	0·63#
Single	26 20·8)	13 (20·9)	13 (20·6)	
Education level				
Less than primary	29 (23·2)	10 (16·1)	19 (30·2)	0·24#
Primary level	26 (20·8)	13 (21·0)	13 (20·6)	
Secondary level	65 (52)	37 (59·7)	28 (44·4)	
University level or above	5 (4)	2 (3·2)	3 (4·8)	
Employment status				
Employed	59 (47·2)	39 (62·9)	28 (44·5)	0·095#
Retired	39 (31·2)	13 (21·0)	26 (41·3)	
Unemployed	3 (2·4)	2 (3·2)	1 (1·6)	
Employed	59 (47·2)	39 (62·9)	28 (44·5)	
Others	16 (12·8)	8 (12·9)	8 (12·6)	
Injury type				
Motor vehicle accident	13 (10·4)	5 (8·1)	8 (12·7)	0·69#
Industrial	11 (8·8)	4 (6·5)	7 (11·1)	
Sport	16 (12·8)	9 (14·5)	7 (11·1)	
Fall	78 (62·4)	42 (67·9)	36 (57·2)	
Others	6 (4·8)	2 (3·2)	4 (6·3)	
Injury site				
Upper limb	32 (26)	15 (12)	17 (13·6)	0·44#
Lower limb	93 (74)	47 (37·6)	46 (36·8)	

*Student's t-test; #Fisher's Exact test; chi-square test statistically significant at $P < 0·05$.

Breathing relaxation exercises

The frequency of performing breathing relaxation exercises was recorded only for the experimental group. From surgery up to T1 (day 2) after surgery, all participants in the experimental group completed the breathing relaxation exercise assignment (six cycles each time and three times per day). At T2 (day 4), 50 (80·6%) completed the assigned task. Five (8%) completed the exercise twice per day, while seven (11%) completed one cycle per day. At T3 (day 7), 75·8% (n = 47) participants completed the assigned task, eight (13%) completed it twice, and the remaining 11% (n = 7) completed breathing relaxation exercises once only.

Analgesic use

Overall, there was no statistically significant difference for both groups at T0 (presurgery), T2 (day 4), and T3 (day 7) (Chi-square test, P ranged from 0·1 to 0·3), when it came to analgesic use. However, at T1 (day 2 those in the experimental group made more requests for analgesia than those in the control group Chi-square test, $P < 0·001$).

Discussion

Study limitations

This study had several limitations. First, the results may not be generalized to non-Chinese ethnic trauma patients because the educational intervention was targeted at enhancing Chinese patients' pain knowledge and analgesic use. Another limitation was that we did not use a randomized clinical trial (RCT) with non-probability sampling for each subject. A quasi-experimental design was employed due to problems with blinding, control of extraneous variables, and limited resources. This limits the generalizability of the results, although the two groups were homogeneous in their demographic characteristics and baseline measures. Despite the similarities in treatment and pain protocol at the study venues, environmental factors such as light, noise, and ward setting might have confounded the outcomes.

In addition, the intervener or Hawthorne effect might have been present in the study. The participants might have been aware that they were participating in the experimental group

Table 3 All outcomes measured across 3 months

	Experimental group, $n = 62$						Control group, $n = 63$					
Outcomes mean (SD)	T0	T1	T2	T3	T4	T5	T0	T1	T2	T3	T4	T5	*P*-value
Pain Visual Analogue Scale (0–100)	55·8 (15)	46·00 (21)	29·8 (18)	22·7 (17)	32·7 (24·3)	19·00 (12·2)	61·10 (23)	34·10 (21·2)	47·70 (20·4)	30·8 (21·2)	32·7 (24·4)	17·90 (20·3)	0·29*
State-Trait Anxiety Inventory (40–80)	50·82 (10·9)	43·97 (8·8)	38·10 (8·6)	37·65 (7·42)	37·89 (9·41)	36·14 (11·08)	55·27 (15·63)	52·44 (17·34)	47·38 (14·96)	44·87 (14·53)	40·89 (11·9)	35·71 (10·55)	< 0·001*
Self-efficacy (11–44)	26·45 (6·7)			27·05 (5·4)	27·34 (5·98)	28·44 (6·2)	25·89 (6·38)			25·50 (5·37)	25·44 (5·3)	25·94 (5·83)	0·27*
Pain efficacy on self-management (1–4)	2·63 (0·75)			3·34 (0·83)	3·37 (0·71)	3·37 (0·79)	2·65 (0·79)			2·91 (0·69)	3·1 (0·86)	3·33 (0·78)	0·011†
Length of stay (days)						8·1 (5·80)						10·1 (7·30)	0·12‡

TO = 1 day before surgery, T1 = day 2 after surgery, T2 = day 4 after surgery, T3 = day 7 after surgery, T4 = 1 month after surgery, T5 = 3 months after surgery.
Statistically significant at $P < 0·05$.
*Repeated measure ANOVA (Interaction effect).
†Mann–Whitney *U* test.
‡*t*-test.

as other types of patients (i.e. elective surgery and spine surgery) in the same ward did not receive the EI.

There might have been other factors (in addition to the intervention) that could have influenced the outcomes of the surgery, such as individual health conditions, financial status, social support, and home environment, none of which we could control (Brooten & Naylor 1995). In this study, these factors were considered during data analysis. Finally, the study may have been under-powered, with its total sample size of 125 patients, especially in terms of the pain VAS analysis. In future studies a larger sample size would be needed to detect statistically significant differences in pain.

Baseline data

The majority of the participants were older adults who had had falls. They constituted a large proportion of those who had suffered a fractured femur or hip. This is similar to patterns observed both locally and globally (Tornetta *et al.* 1999, Simpson 2002, Bergh *et al.* 2005, HA 2008).

Overall pain levels at T0 (1 day before surgery) for both groups were high, with the mean VAS pain level (55·8 ± 15) indicating that almost all patients suffered from moderate to severe pain, although intramuscular analgesia was provided on request according to the pain protocol in the hospital. According to the WHO (1996), a VAS of 50–70 is regarded as moderate pain, while a score of 70–90 is regarded as severe pain. In this study, the baseline VAS level was consistent with the results from previous studies, in which patients reported severe pain during the early admission period after injury (Joy *et al.* 2000, Klofenstein *et al.* 2000, Chung & Lui 2003, Bergh *et al.* 2005).

The overall baseline anxiety level was also high for all participants, with a mean STAI of 50·82 ± 10·9. Similar to previous literature, patients who faced surgery were anxious and stressed (Munafo & Stevenson 2001, Carr *et al.* 2005, Ilya & Yoram 2007). Musculoskeletal trauma, such as a fractured limb and subsequent surgery, is often unexpected and beyond the patient's control, and the physical instability may provoke much anxiety (Byrne & Heyman 1997, Joy *et al.* 2000).

Pain control

The results of this study suggest that, during hospitalization, participants in the experimental group experienced better pain control than control group participants for the first 7 days after surgery. This finding is consistent with the results of previous studies, which show that educational intervention has a positive effect on pain management after orthopaedic surgery (McDonald *et al.* 2004, Johansson *et al.* 2005).

The better pain control observed in the experimental group could be related to the amount of analgesic used, which is influenced by the knowledge held by each individual. It can also be related to the practice of breathing and relaxation exercises. Our findings show that the frequency with which the breathing and relaxation exercises were practised was higher at T1 (day 2) than at T2 (day 4) or T3 (day 7), suggesting that those in the experimental group used breathing relaxation exercises to cope with their pain.

We found no statistically significant difference between the groups in terms of pain control after discharge. This might be due to the effect of the EI becoming diluted after discharge, as evident in the smaller number of participants regularly performing the breathing relaxation exercise. Furthermore, the pain level might have been reduced for both groups due to recovery, as the results showed no statistically significant difference between the groups in pain score after 3 months.

Anxiety reduction

All participants reported high anxiety levels, with a mean of 51 (on a scale of 20–80) at T0 (presurgery). Those in the experimental group perceived less anxiety than those in the control group both during hospitalization (T0–T3), as well as after discharge. In line with previous literature, an educational intervention can play an important role in enhancing patients' knowledge about pain and coping strategies. Such an intervention might therefore reduce anxiety among patients with orthopaedic trauma (McCarthy *et al.* 2003, Starr *et al.* 2004) and might help them regain their confidence in terms of ability to manage the pain themselves (Ersek *et al.* 2003). Carr *et al.* (2005) have suggested that preoperative anxiety is predictive of postoperative anxiety and pain, highlighting the importance of preoperative intervention.

The breathing relaxation exercises were an important component of the EI in this study. Their use is a common relaxation technique that helps decrease anxiety levels. The technique is easily learned and managed by patients (Seers & Carroll 2001, Kristine *et al.* 2006). If patients believed that they could exert control over their pain, the perception of threat would decrease, leading to a reduction in anxiety. Many studies (Barnason *et al.* 1995, Kristine *et al.* 2006, Leardi *et al.* 2007) have shown that breathing relaxation exercises, together with educational intervention, can have a positive effect by reducing anxiety. This is also supported by our study. According to the Agency for Health Care Policy and Research (AHCPR) (1992) guideline, non-pharmacological interventions such as breathing relaxation exercises should be used in conjunction with analgesics in managing pain. This is an approach that may benefit patients whose pain is only partially relieved after analgesics have been taken, and thus could be a useful supplementary intervention.

Self-efficacy

Those in the experimental group had statistically better self-efficacy than those in the control group during hospitalization. These findings are in line with the results in other studies (Pellino *et al.* 1998, Heye *et al.* 2002, Yeh *et al.* 2005), which show that self-efficacy may be improved with the help of an educational intervention. Those in the experimental group might have had more confidence in their ability to manage pain and felt more in control of it during hospitalization.

General self-efficacy serves as a personal resource for coping with different types of stress such as pain, employment problems, social problems, unexpected surgery, medical treatment, or even a strange environment (Jerusalem & Schwarzer 1992, Schwarzer 1992). There are many factors, such as financial status, social support, and home environment which may influence self-efficacy after patients' discharge. This may be why we did not find a statistically significant difference between the two groups in self-efficacy after discharge.

Length of stay

Length of stay is an indirect indicator of patient recovery and is often used to measure postoperative wellness in terms of orthopaedic surgery complications, such as chest infections, wound infections, and deep vein thrombosis (Maher *et al.* 2002). In this study, although participants in the experimental group stayed in hospital for a shorter period than those in the control group, the difference between the groups was not statistically significant. Previous studies (Daltroy *et al.* 1998, Dai *et al.* 2002, Giraudet-Le *et al.* 2003) suggest that the effect of an educational intervention on length of hospital stay is strongly associated with anxiety and the effect of the stress response. The stress response after musculoskeletal trauma can contribute to physiological changes associated with poor outcomes. A high stress response may cause vascular shunting and hypo-perfusion of vital organs, which can eventually affect the speed of recovery from injury and thus the length hospital stay (Bourdarne *et al.* 2002, Maher *et al.* 2002).

Conclusion

This study is the first of its kind with an Asian population with fractured limbs. It adds new evidence on the therapeutic

What is already known about this topic

- Patients experience pain and anxiety after unexpected injury and undergoing surgery.
- An educational intervention is a common intervention in preparing patients for orthopaedic surgery.
- Many different types of educational intervention have been designed for patients having elective surgery such as hip and knee replacement.

What this paper adds

- The educational intervention was effective in terms of relieving pain, anxiety and improving self-efficacy.
- The application of self-efficacy theory in the design of educational intervention appears to be effective in helping patients to cope with acute pain during hospitalization.
- Breathing relaxation exercises as part of the educational intervention appeared to be helpful in reducing anxiety and enhancing self-efficacy in pain management.

Implications for practice and/or policy

- The educational intervention using self-efficacy theory is feasible, safe and worth implementing by nurses, and is well accepted by patients.
- The educational intervention could be included in routine nursing care.

value of the EI for patients with fractured limbs and who are undergoing unexpected surgery. Similar interventions could be applied to other orthopaedic problems involving acute pain or other types of surgery, and the effects could be evaluated. An RCT with block randomization of weeks or months as a unit could be adopted for a similar study in the future. This design has the advantage of balancing the benefit of random sampling with that of controlling extraneous confounders, minimizing the chance of subject contamination.

Clinically, this study indicates that the EI is feasible and worth implementing by nurses and is likely to be well-accepted by patients. The total length of the educational sessions is only 30 minutes, making it feasible for incorporation in routine care. The EI can be used to promote positive patient outcomes and to achieve more effective use of nursing time. A study of the cost-effectiveness of the EI might be useful to attempt to confirm this.

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Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

EW, SC & SY were responsible for the study conception and design. EW performed the data collection. EW performed the data analysis. EW was responsible for the drafting of the manuscript. EW, SC & SY made critical revisions to the paper for important intellectual content. EW & SY provided statistical expertise. EW provided administrative, technical or material support. SC & SY supervised the study.

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