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Comparison of the Effects of Hand Massage Provided with Different Intervals and Periods on Pain and Sleep Disturbance after Orthopedic Surgery

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Purpose: The purpose of this study was to compare the effects of hand massage provided with different intervals and periods on pain and sleep disturbance after orthopedic surgery. **Methods:** A non-equivalent control group pre-test-posttest design was used. The subjects were admitted in an orthopedic hospital to get a surgery. They were divided into three groups. Group I (n=30) had hand massage every day. Group II (n=30) had hand massage every other day. Control group (n=31) had usual care. Data of all three groups were collected on the day before operation, POD (postoperative day) 6 and POD12. Hand massage was given for 2 and half minutes per hand. **Results:** Pain on POD6 of experimental group II was reduced more than those of control group. Pains on POD12 of both experimental groups were reduced more than those of control group. On POD6, only perceived sleep disturbance (PSD) was significantly different among groups. On POD12, PSD, total sleeping time, and sleep efficiency were more improved in the experimental groups. **Conclusion:** Hand massage was effective on the reduction of pain and sleep disturbance after orthopedic surgery. Applying hand massage on alternate day was effective enough. Also the effects were more obvious after 12 days.

Key Words: Hand massage, Pain, Sleep, Orthopedic surgery

INTRODUCTION

One of the most disturbing problems of postoperative patients are pain and subsequent sleep disturbance (Rosenberg, Rosenberg-Adamsen, & Kehlet, 1995). The patients who had orthopedic surgery are no exception. In spite of many interventions including analgesics have been implemented for these patients, pain and sleep disturbance are still distressing symptoms after orthopedic surgery (Wylde, Rooker, Haliday, & Blom, 2011). So the management of pain and sleep disturbance after orthopedic surgery is still significant challenge to health professionals including nurses.

Among non-pharmacological independent nursing interventions, hand massage is a traditional technique that has been used in clinical settings and reported its effectiveness on pain and sleep disturbance (Kim, Chung, & Suh, 2008). Tactile stimulation during hand massage results in relaxation response through activation of parasympathetic nervous system (Lindquist, Snyder & Tracy, 2014). When compressing and relaxing the muscle tissue during massage, blood and lymph circulation increases, which removes lactic acid between the muscle fibers, reduces fatigue and stress, and produce relaxation (Degirmen et al., 2010). Also it stimulates the mechanoreceptors that activate the "nonpainful" nerve fibers, preventing pain transmission from reaching consciousness (Wang & Keck, 2004). Reduction of pain and sleep disturbance is closely related with the production of relaxation response (Kwekkeboom, Cherwin, Lee, & Wanta, 2010). The patients with poor sleep quality had a higher pain score than the patients without sleep disturbance (Son et al., 2015). In a recent study to review the 23 studies to report the effects of hand massage in

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Korea (Kim & Cho, 2012), the effect size of pain and sleep disturbance was 0.4 and 0.3, respectively.

Above all, since hand massage is simple and easy, it is worth to study and use more widely as an independent nursing intervention (Lindquist et al., 2014). Especially, hand massage using just patients' hands might be particularly beneficial to the patients who had orthopedic surgery, since these patients faced unique status after surgery (ie, catheters, drains, infusion devices, cast, and bulky bandage) limiting other non-pharmacological interventions.

However the research to identify the effects of hand massage was limited, not to speak of postoperative pain and sleep disturbance for the patients who had orthopedic surgery, even these patients are increasing as the population ages (Degirmen, Ozerdogan, Sayiner, Kosgeroglu, & Ayranci, 2010). Moreover, we could not find any research to identify how often and how long it is necessary to improve pain and sleep disturbance after orthopedic surgery. Even though most of patients who had orthopedic surgery admitted over 2 weeks (Jeong et al., 2006) and complained pain after discharge, most researchers gave hand massage once or less than 1 week. Thus, the aim of this study was to compare the effects of hand massage provided with different interval and period on pain and sleep disturbance after orthopedic surgery. The findings from the study will provide the information of one of the useful independent nursing intervention being overlooked and the important implications for the development of a protocol of hand massage.

METHODS

1. Design

A non-equivalent control group pretest-posttest design was used. To compare the effects of hand massage provided with different interval and period, subjects were divided into three groups. Group I had hand massage every day. Another group had hand massage every other day. The control group had usual nursing care. Subjects were divided into three groups by the ward. Data were collected on 3 different times (before operation, POD6 and POD12). Hand massage was given to the Group I and II from POD1 (Figure 1).

2. Settings and Subjects

The subjects were admitted to have orthopedic surgery in an orthopedic hospital of D city in Korea. Under a significance level of 0.05, power equal to 0.08, group size of 3, and effect size of 0.40, twenty-six subjects per group are needed (Lee et al., 2009). Inclusion criteria were the inpatients who admitted to have orthopedic surgery, stayed for more than 2 weeks, had no problems to limit hand massage on hand, had usual pain control intervention with patient controlled analgesia until POD 2, could understand the aims of study and communicate, and agreed to participate the study. Exclusion criteria were the patients who were diagnosed with arteritis, unstable hypotension, aneurysm, emboli, arrhythmia, or cancer. Massage is contraindicated for these patients (Lindquist et al., 2014). Also the patients having hands with inflammation, unexplained lumps, bruises or open cuts were also excluded.

The content of the intervention was approved by the physicians and the director of the hospital in which the subjects were hospitalized. Participants were assured of the confidentiality and withdrawal right. All of them provided informed written consent.

3. Measurements

1) Pain

Participants were asked to rate the level of their average pain over the last 6 days and present pain. Pain was measured using a numeric rating scale from 0 to 10, anchored by word descriptors of "no pain" next to the

Group	Pre-op	POD1~POD6	POD6	POD7~POD12	POD12
Exp. I	Y1	X1	Y2	X1	Y3
Exp. II	Y1	X2	Y2	X2	Y3
Cont.	Y1				Y3

Exp.=experiment; Cont=control; POD=post operative day; X1=hand massage everyday; X2: hand massage every other day; Y1=measurement of demographic data, pain, and perceived sleep disturbance; Y2, Y3=measurement of pain, use of analgesics, and all variables of sleep disturbance.

Figure 1. Study design.

number 0 and "pain as bad as you can imagine" next to the number 10. The reliability and validity of this type of self-reported measure have been demonstrated (Ferraz et al., 1990). Number of analgesics additionally used was also measured on POD6 and POD12.

2) Sleep disturbance

Sleep disturbance was measured with two methods. One of them is perceived sleep disturbance measured with the Korean Sleep Scale A (KSS-A) (Oh, Song, & Kim, 1998). The KSS-A was comprised of 15 items, with 4 point Likert type scale. A score of 1 represented 'never', 2 represented 'sometimes', 3 represented 'often', and 4 represented 'always'. The scores could range from 15 to 60, with higher scores representing better sleep. Factor analysis showed 4 factors: sleep pattern, sleep evaluation, sleep result, and cause of sleep disturbance. The internal consistency of Cronbach's α were .75 (Oh et al., 1998) and .85 in this study.

Another data of sleep disturbance was measured with actigraphy. Actigraphy has been validated as a useful and sensitive method of measuring sleep status (Morgenthaler et al., 2007). Overall, sensitivity (0.965) and accuracy (0.863) of actigraphy were high (Marino et al., 2013). An ActiSleep+(ActiSleep+, ActiGraph, Fl, USA) was used. The ActiSleep+ looks like a watch and can be worn on the non-dominant wrist. All subjects wore it only at night from POD1 to POD12 and kept a sleep diary, in which they indicated the time of going to bed and getting up in the morning. Mean of sleep onset latency (SOL), total sleep time (TST), number of awakening (NOA) and sleep efficiency (SE) were used in the analysis.

3) Hand massage

One nurse who had a certificate of sports massage and trained hand massage applied hand massage to the participants in the experimental group I and II from POD1 to POD12. Hand massage was applied in the evening resting time after taking dinner. It was around from 7 pm to 8:30 pm. Before applying hand massage, patients were provided a comfortable and unconstrained sitting or lying position. Upon the technique provided by Lindquist et al., (2014), hand massage was applied to back, palm and fingers for 2 and half minutes per hand. Straight, stretching, and circular stroke, milking and lifting, squeezing, and gentle compression were used.

4. Data Analysis

SPSS 21.0 + was used to analyze the data. Descriptive statistics were used to show the demographic and clinical characteristics. ANOVA or x^2 test were used depending on the level of measurement to identify the differences among groups. Scheffé test was used for post-hoc test. Significance levels were set at .05.

RESULTS

1. Participants Characteristics and Homogeneity Test

The average age of the subjects in the experimental group I, II and control groups were 59.9, 61.0, and 59.8 years, respectively. The number of female patients (78.0 %) was larger than that of male patients (22.0%). In all groups, most subjects were married (70.3%) and lived with their spouse. The groups had no significant differences in age, gender, marital status, education level and job status (Table 1).

The type of operation was TKA (total knee arthroplasty), reconstruction, PLIF (posterior lumbar interbody fixation) or OR/IF (open reduction/internal fixation). Previous operation experience, number of chronic disease, and number of currently taking medicine measured as participants' clinical characteristics were not different among three groups.

2. Homogeneity Test for Pain and Sleep Disturbance

Before intervention, average pain was not different among groups. Present pain of experiment II group was the highest among groups (Table 2). Perceived sleep disturbance was not different among groups (Table 2).

3. Difference Test for Pain on POD6

On POD6, present pain were significantly different among groups. The differences of pain before operation and POD6 were significant among groups (average pain: F=6.67, p=.002; present pain: F=7.13, p=.001). Average and present pain of experimental groups were more reduced than those of control group. Amount of analgesics used during previous 6 days was not different among groups (F=0.35, p=.705)(Table 3; Figures 2, 3).

4. Difference Test for Pain on POD12

On POD12, similar results were observed. That is, the differences of pain before operation and POD12 were significantly different among groups (average pain: F=12.26, p<.001; present pain: F=12.27, p<.001). Average

Table 1. Homogeneity Test for Participants' Characteristics

Characteristics	Categories	Exp. I (n=30)	Exp. II (n=30)	Cont. (n=31)	Total (*N*=91)	x^2 or F	*p*
		n (%) or M±SD	n (%) or M±SD	n (%) or M±SD	n (%) or M±SD		
Age (year)		59.9±10.88	61.0±14.93	59.8±16.12	60.2±14.03	0.07	.936
Gender	Male	7 (23.3)	7 (23.3)	6 (19.4)	20 (22.0)	0.19	.910
	Female	23 (76.7)	23 (76.7)	25 (80.6)	71 (78.0)		
Marital status	Married	25 (83.3)	19 (63.3)	20 (64.5)	64 (70.3)	3.64	.162
	Others	5 (16.7)	11 (36.7)	11 (35.5)	27 (29.7)		
Education	<Elementary school	6 (20.0)	8 (26.7)	5 (16.1)	19 (20.9)	4.29	.830
	Elementary school	5 (16.7)	9 (30.0)	6 (19.4)	20 (22.0)		
	Middle school	6 (20.0)	4 (13.3)	8 (25.7)	18 (19.8)		
	High school	11 (36.6)	7 (23.3)	10 (32.3)	28 (30.8)		
	≥College	2 (6.7)	2 (6.7)	2 (6.5)	6 (6.7)		
Job	Yes	15 (50.0)	8 (26.7)	15 (48.4)	38 (41.8)	4.21	.122
	No	15 (50.0)	22 (73.3)	16 (51.6)	53 (58.2)		
OP name	TKA	8 (26.7)	9 (30.0)	8 (25.8)	25 (27.4)	0.59	.997
	Reconstruction	8 (26.7)	7 (23.3)	8 (25.8)	23 (25.3)		
	PLIF	7 (23.3)	7 (23.3)	6 (19.4)	20 (22.0)		
	OR/IF	7 (23.3)	7 (23.3)	9 (29.0)	23 (25.3)		
Operation experience	Yes	16 (64.8)	20 (66.7)	23 (74.2)	59 (64.8)	2.98	.226
	No	14 (35.2)	10 (33.3)	8 (25.8)	32 (35.2)		
No. of chronic disease		0.70±0.79	1.13±1.22	1.03±1.08	0.96±1.05	1.41	.251
No. of currently taking medicine		0.63±0.76	1.03±1.13	0.94±1.12	0.87±0.10	1.25	.291

Exp=experiment; Cont=control; No=number; TKA=total knee arthroplasty; PLIF=posterior lumbar interbody fixation; OR/IF=open reduction/internal fixation.

Table 2. Homogeneity Test for Pain and Sleep Disturbance before Operation

Variables	Exp. I (n=30)	Exp. II (n=30)	Cont. (n=31)	F	*p*
	M±SD	M±SD	M±SD		
Average pain	5.30±1.76	6.03±1.73	5.00±1.81	2.74	.070
Present pain	4.70±2.28	5.43±2.18	3.87±2.41	3.56	.033
Perceived sleep disturbance	43.43±8.61	37.70±9.56	39.84±10.13	2.81	.065

Exp=experiment; Cont=control; POD=postoperative day.

and present pain of the experimental groups were more reduced than those of control group. Amount of analgesics used during previous 6 days was not different among groups (F=0.25, *p*=.783)(Table 3; Figures 2, 3).

5. Difference Test for Sleep Disturbance on POD6

On POD6, only perceived sleep disturbance was significantly different among groups. It was more reduced in the experimental group I and II than the control group (F=3.80, *p*=.026).(Table 4, Figure 4).

6. Difference Test for Sleep Disturbance on POD12

On POD12, perceived sleep disturbance, total sleeping time, and sleep efficiency were significantly different among groups. Perceived sleep disturbance was more reduced in the experimental group I and II than the control group (F=7.50, *p*=.001). Total sleeping time, and sleep efficiency were more reduced in the experimental group II than control group (F=3.55, *p*=.034)(Table 4).

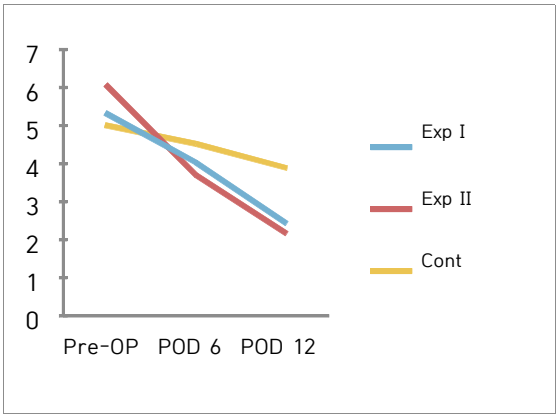
DISCUSSION

Hand massage was effective in reducing pain and sleep disturbance after orthopedic surgery. These results were consistent with the findings of previous researches which reported the effects of hand massage on pain and sleep disturbance (Chang, 2008; Lee, 2008). The effect size (Cohen's d) of pain based on F-value, means and

Table 3. Difference Test for Pain on POD6 & POD12

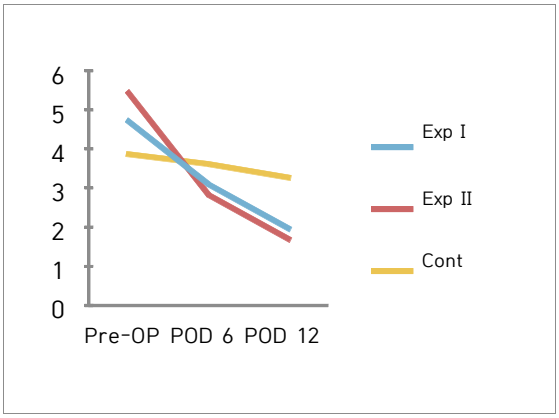
Variables	Categories	Exp. I M±SD	Exp. II M±SD	Cont. M±SD	F (*p*)	Post-hoc	Effect size
Average pain	Pre-OP	5.30±1.76	6.03±1.73	5.00±1.81			
	POD6	4.03±1.73	3.70±1.39	4.52±1.44			
	diff.	-1.27±2.02	-2.33±2.31	-0.48±1.57	6.67 (.002)	C>II	0.67
	POD12	2.47±1.41	2.20±1.03	3.90±1.95			
	diff.	-2.83±2.02	-3.83±2.09	-1.10±2.21	12.26 (<.001)	C<I, II	1.02
Present pain	Pre-OP	4.70±2.28	5.43±2.18	3.87±2.41			
	POD6	3.10±1.73	2.83±1.29	3.61±1.67			
	diff.	-1.60±2.19	-2.60±2.59	-0.26±2.49	7.13 (.001)	C>II	0.75
	POD12	1.97±1.10	1.70±1.06	3.27±2.21			
	diff.	-2.73±2.17	-3.73±2.39	-0.60±2.82	12.27 (<.001)	C<I, II	0.79
Use of analgesics	POD6	3.17±2.78	3.87±4.00	3.40±3.00	0.35 (.705)		
	POD12	0.60±1.16	0.67±1.52	0.83±1.29	0.25 (.783)		

Exp=experiment; Cont=control; diff=difference; Pre-OP=preoperative day; POD=postoperative day.



Exp=experiment; Cont=control; Pre-OP=preoperative day; POD=postoperative day.

Figure 2. Change of average pain.



Exp=experiment; Cont=control; Pre-OP=preoperative day; POD=postoperative day.

Figure 3. Change of present pain.

number of subjects was from 0.67 to 1.02. And the effect size of sleep disturbance in this study was from 0.47 to 0.84. These results support previous contention that hand massage induces relaxation response through activation of parasympathetic nervous system (Lindquist et al., 2014). Also these results confirmed the reduction of pain and sleep disturbance is closely related with the production of relaxation response (Kwekkeboom et al., 2010). To confirm this contention, data to show the activation of parasympathetic nervous system have to be collected in the future study.

Hand massage was more effective to reduce pain than sleep disturbance. It supported the work of Kim and Cho (2012) to review the 23 studies to report the effects of hand massage. They reported that the effect sizes of hand massage (including aroma hand massage) on pain and sleep disturbance were 0.37 and 0.27, respectively. While the effect sizes of hand massage alone (excluding aroma hand massage) on pain and sleep disturbance were 0.33 and 0.12, respectively.

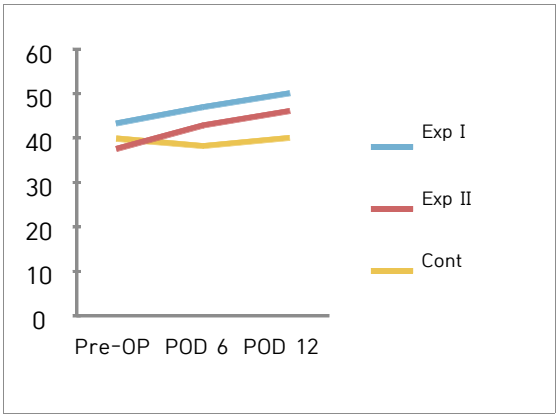
However the number of analgesics additionally used was not different among groups. It was still promising result since pain of experimental group was more reduced, even though the experimental group used analgesics as same as the control group.

In regard to the effects of hand massage with different interval and period which was the main interest of this study, hand massage applied on alternate day is enough

Table 4. Difference Test for Sleep Disturbance on POD6 & POD12

Variables	Categories	Exp. I	Exp. II	Cont.	F (*p*)	Post-hoc	Effect size
		M±SD	M±SD	M±SD			
Perceived sleep disturbance	Pre-OP	43.43±8.61	37.70±9.56	39.84±10.13			
	POD6	46.93±6.31	42.87±7.38	38.26±10.29			
	diff.	3.50±8.91	5.17±8.75	1.58±11.88	3.80 (.026)	C<I, II	0.54
	POD12	50.03±6.57	46.00±6.64	40.00±8.80			
	diff.	6.60±7.66	8.30±9.01	0.16±9.90	7.50 (.001)	C<I, II	0.84
Latency	POD6	15.79±20.65	14.77±12.80	16.86±9.85	0.13 (.875)		
	POD12	17.33±11.32	12.62±12.34	14.07±11.93	0.95 (.391)		
Total sleeping time	POD6	289.58±61.57	321.95±55.62	301.97±60.37	1.87 (.161)		
	POD12	306.11±53.17	331.83±60.79	278.54±88.92	3.55 (.034)	C<II	0.52
No. of Awakening	POD6	19.81±5.62	18.56±5.19	16.91±5.28	1.95 (.150)		
	POD12	19.90±5.32	19.27±5.00	16.81±6.24	2.17 (.121)		
Sleep efficiency	POD6	67.03±12.53	73.30±9.40	72.29±9.69	2.51 (.088)		
	POD12	71.14±11.32	75.95±9.72	66.59±17.13	3.05 (.054)	C<II	0.47

Exp=experiment; Cont=control; No=number; diff=difference; Pre-OP=preoperative day; POD=postoperative day.



Exp=experiment; Cont=control; Pre-OP=preoperative day; POD=postoperative day.

Figure 4. Change of perceived sleep disturbance.

to reduce pain and sleep disturbance. Since there are no reports to test how often hand massage was given to reduce pain and sleep disturbance, it is difficult to interpret the results. However, it is supposed that the effects of hand massage were not directly propositional to frequency. It was reported that hand and foot massage applied just one time was effective on reducing post-cesarean and postoperative pain (Degirmen et al., 2010; Wang & Keck, 2004). Chang (2008) showed that aroma hand massage applied everyday for 7 days was effective on pain for hospice patients. However, there were no reports to compare the effects of hand massage provided with different interval.

In terms of period, the effects on pain and sleep disturbance of POD12 were more consistent than those of POD6, although the effects appeared on POD6. That is, pain and sleep disturbance on POD12 were significantly reduced in both experimental groups, however, only the experimental group II was significantly different from the control group on POD6. And this result was more prominent in the effect of sleep disturbance. Kim and Cho (2012) also reported that hand massage over 60 minutes in total was necessary to improve sleep, while pain was improved in the studies which hand massage was applied for less than 10 minutes. The result of the previous study in which the effect size of sleep disturbance was the smallest was due to duration. All reports identified the effect of hand massage on the sleep disturbance were implemented for less than 6 days (Kim & Cho, 2012). Also hand massage applied just one time on POD1 was not effective to reduce postoperative pain of hysterectomy patients (Kim, 2003).

Unlike other full-body massage, special cautions are not much during hand massage. The hand with inflammation, unexplained lumps, bruises or open cuts have to be avoided. We excluded the patients who had these problems. While giving a massage, cover up any open cuts or scratches on hands with a plaster or other dressing (Lindquist et al., 2014).

It is encouraging that the effect of hand massage on sleep disturbance was measured with actigraph which gave objective data. Actigraph was reported as a good method to obtain objective sleep data (Morgenthaler et al., 2007). Furthermore, it is worth to use in clinical set-

tings, since it is easy to measure and score. However, it is necessary to be careful to use in sensitive or uncomfortable patients, since some participants reported the actigraph is somewhat uncomfortable to wear during sleep, which could cause or aggravate sleep disturbance.

A major limitation of this study was not using randomized clinical trial (RCT). We could not use RCT because of sampling problem and diffusion of treatment.

CONCLUSION

Hand massage was effective on the reduction of pain and sleep disturbance after orthopedic surgery. Applying on alternate day rather than everyday was effective enough. Also it was effective till 12 days after acute surgical pain somewhat relieved. Since hand massage was easy and simple, and need no additional equipment, it was recommended to use widely for surgical patients with confidence. Also more research was necessary to identify the effects of other symptoms as well as effective frequency and duration.

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