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Original Article

Effect of operating room nursing interventions on infection, stress response, and deep venous thrombosis of the lower extremity in patients with fracture surgery

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Abstract: Objective: This study aimed to evaluate the effect of nursing interventions in the operating room on infection, stress response, and deep venous thrombosis (DVT) of the lower extremity in patients with fracture surgery. Methods: 188 patients with lower extremity fractures were divided into the control group (conventional care) and the intervention group (operating room intervention nursing). The following scoring systems were used: postoperative wound healing rate, Barthel index of life quality scores, Artificial Total Hip Efficacy Score (Harris), Hamilton Anxiety Scale (HAMA), and Hamilton Depression Scale (HAMD). Postoperative care was given and patient satisfaction was observed. Results: The wound healing rate of the control group was significantly lower than that of the intervention group ($P<0.05$). The Harris score and Barthel index of the control group were lower than those of the intervention group (both $P<0.05$). The HAMA score and HAMD score of the control group were significantly higher than those of the intervention group (both $P<0.05$). The decreases in E, NE, and Cor levels were significantly greater in the intervention group than in the control group ($P<0.05$). The incidence of postoperative DVT and infection in the control group was significantly higher than that in the intervention group ($P<0.05$). The satisfaction with nursing care in the control group was significantly lower than that of the intervention group ($P<0.05$). Conclusion: Operating room nursing interventions is beneficial to the improvement of postoperative functional recovery, quality of life, daily living ability, and psychophysiological stress. Prevention of deep vein thrombosis after lower extremity fracture and improvement of nursing satisfaction should be emphasized.

Keywords: Fracture surgery, operating room care, incision infection, preventive effect, deep vein thrombosis of the lower extremity

Introduction

A surgical site infection is a complication that commonly occurs in postoperative patients, mainly due to the competition between the bacteria and the body's own immunity, and the presence of pathogens at the incision site [1]. Infection at the surgical site can lead to continuous elevation of the patient's body temperature, persistent pain at the incision site, multiple organ dysfunctions, and amputation [2]. In the meantime, patients are more likely to develop fear, anxiety, and depression. This greatly affects the postoperative treatment and prognosis of patients, increases length of hospital stay and financial burden [3]. DVT is caused by prolonged bed rest, causing a reflux disorder in the local vein, leading to the formation of a thrombus. Severe deep venous thrombosis (DVT) may be life-threatening and may extremely affect patients' quality of life. Preventing the occurrence of DVT has become an urgent problem among clinical health care workers [4].

Orthopedic patients develop a wide variety of diseases; most of them are mainly treated by surgery, and the most common surgical treatment is repair or reconstruction of the injured area [5]. The choice of perioperative care options is also particularly important due to the different surgical approaches. Studies have shown that the choice of nursing program has a certain impact on the surgical outcome of patients [6]. Operating room nursing interventions are performed as per the principles

of routine nursing. Studies have shown that operating room nursing interventions can reduce the incidence of lung infections, but whether it can reduce infection, stress response, and DVT in fracture patients remains unclear [7].

Therefore, this study served as a reference for the selection of clinical care programs by studying the effects of operating room nursing interventions on infection, stress response, and DVT in fracture surgery patients.

Methods and materials

Patients' clinical data

This study retrospectively analyzed 188 patients with lower extremity fractures who were treated in the Jiangxi Cancer Hospital from March 2016 to January 2018. They were divided into the control group and the intervention group according to the patient care plan. The study was approved by the Medical Ethics Committee of the hospital, and all family members were informed of the procedure of the study and signed an informed consent.

Inclusion and exclusion criteria

Patients were included in the study if they underwent hip arthroplasty, experienced bed rest after surgery, had no malignant tumors, had complete clinical data, and were followed up for treatment. By contrast, patients <18 years of age, with immune deficiency, congenital limb defects, memory disorders, autism, hearing disorders, abnormal blood coagulation, and/or liver and kidney dysfunction were excluded from the study.

Nursing care plan

The two groups of patients underwent routine blood tests, urine and blood coagulation tests, cardiopulmonary function tests, and kidney function tests. The patient's psychological condition was evaluated preoperatively, the surgical site was prepared the day before the operation to prevent infection, drug sensitivity test was performed, Postoperative vital signs were monitored, and blood pressure, respiration, and pulse were measured according to the anesthesia method until stable.

The following operating room nursing interventions were performed in the intervention group apart from routine nursing: 1) psychological interventions included enhancing patient's knowledge about their conditions, improving communication between patients and health care providers to better understand the patient's psychological situation, and improving patients' knowledge regarding the effects of surgery; 2) patients were given intravenous antibiotics 30 minutes before surgery to prevent infection; 3) skin preparation: the surgical site was prepared based on the position of the patient during surgery; if the position of the patient does not affect the performance of the procedure nor the adhesion of postoperative dressing, changing patient's surgical position is not required; the patient's surgical site was routinely disinfected; 4) disinfection of surgical items and evaluation of operating rooms.

Observation index

Main observation indicators: The Barthel index of life quality scores, total hip arthritis score (Harry), Hamilton Anxiety Scale (HAMA), and Hamilton Depression Scale (HAMD) were obtained [8, 9]. The Barthel index has a total score of 100 points. A higher score indicates an increased level of independence in performing activities of daily living. The Harris score has a total of 100 points. A higher score indicates better recovery. The HAMA has a total score of 56 points. A score of ≥ 29 indicates severe anxiety, a score of ≥ 21 obvious anxiety, a score of ≥ 14 mild anxiety, and a score of ≥ 7 no anxiety. The HAMD has a total score of 68 points. A score of ≥ 24 indicates severe depression, a score of ≥ 17 significant depression, a score of ≥ 7 mild depression, and a score of <7 no depression. Patients' serum epinephrine (E), norepinephrine (NE), and cortisol (Cor) levels were monitored 1 day and 1 week after operation, and the wound healing rate was observed. In patients with grade A healing, no obvious adverse reactions were observed in the incision site, and prognosis was better. In patients with grade B healing, no inflammatory reaction (including hematoma, suppuration, redness, etc.) occurred in the incision site. In patients with grade C healing, a purulent infection occurred in the incision site.

Table 1. Clinical data of both patient groups [n (%)]

Factor	Control group (n=88)	Intervention group (n=100)	X^2/t value	*P* value
Sex			0.584	0.445
Female	44 (52.38)	58 (58.00)		
Male	40 (47.62)	42 (42.00)		
Age (year)			0.120	0.729
>60	50 (65.50)	65 (65.00)		
≤60	30 (37.50)	35 (35.00)		
BMI (kg/m^2)			2.593	0.107
>23	32 (36.36)	48 (48.00)		
≤23	56 (63.64)	52 (52.00)		
History of hypertension			1.823	0.177
Yes	70 (79.55)	71 (71.00)		
No	18 (20.45)	29 (29.00)		
Diabetes history			2.004	0.157
Yes	52 (59.09)	69 (69.00)		
No	36 (40.91)	31 (31.00)		
Smoking history			0.584	0.445
Yes	44 (52.38)	58 (58.00)		
No	40 (47.62)	42 (42.00)		
History of alcoholism			1.342	0.247
Yes	12 (13.64)	20 (20.00)		
No	76 (86.36)	80 (80.00)		

Note: BMI denotes body mass index.

Table 2. Wound healing rate of both patient groups

Group	Grade A healing	Grade B healing	Grade C healing	X^2	*P* value
Control group (n=88)	22	48	18	5.675	0.017
Intervention group (n=100)	38	52	10		

In the secondary observation index, the patients were observed for the incidence of postoperative DVT and infection, and patient's level of satisfaction with postoperative care was evaluated (satisfaction = 1 - general number/total number * 100%).

Statistical method

In this study, we used SPSS20.0 (Sichuang Weida, China) software to perform statistical analysis on the collected data, and used GraphPad Prism 7 (Shenzhen Qi Rui Tian Soft) to draw pictures. Measurement data is expressed as mean ± standard deviation (mean ± SD). The normal distribution was analyzed using a t-test; the count data usage rate (%) was analyzed using a Chi-square test, and the grade count data were analyzed using a Wilcoxon signed-rank test. *P* value <0.05 was considered significant.

Results

Comparison of clinical data between the two patient groups

We compared the clinical data of the two groups and found that there were no statistical differences in gender, age, body mass index (BMI), history of hypertension, history of diabetes, history of smoking, history of alcohol abuse, and duration of surgery between the two groups (all P>0.05) (**Table 1**).

Wound healing rate in both groups

The wound healing rate of the two groups had a significant difference. In the control group, 22 patients had grade A healing, 48 had grade B healing, and 18 had grade C healing. In the intervention group, 38 patients had grade A healing, 52 had grade B healing, and 10 had grade C healing. By comparison, it was found that the healing rate of the control group was significantly lower than that of the intervention group (P<0.05) (**Table 2**).

Changes in Harris score and Barthel index between the two groups before and after nursing care

We compared the Harris score and Barthel index between the two groups and found that there was no difference in the Harris score and the Barthel index between the two groups before treatment (P>0.05). After nursing care, the Harris score and Barthel index of the two groups significantly increased (P<0.05). Moreover, the Harris score and Barthel index of the control group were lower than those of

Table 3. Changes in Harris score and Barthel index in the two groups before and after nursing care

Group	Harris score		Barthel index	
	Before nursing care	After nursing care	Before nursing care	After nursing care
Control group (n=88)	36.84±5.84	71.98±5.22*	15.35±4.89	48.69±5.22*
Intervention group (n=100)	35.99±6.53	78.52±5.95*	15.22±4.75	65.84±4.79*
t value	0.935	8.071	0.185	23.487
P value	0.351	0.000	0.854	0.000

Note: *The values were significantly different from those obtained prior to the provision of nursing care (P<0.05).

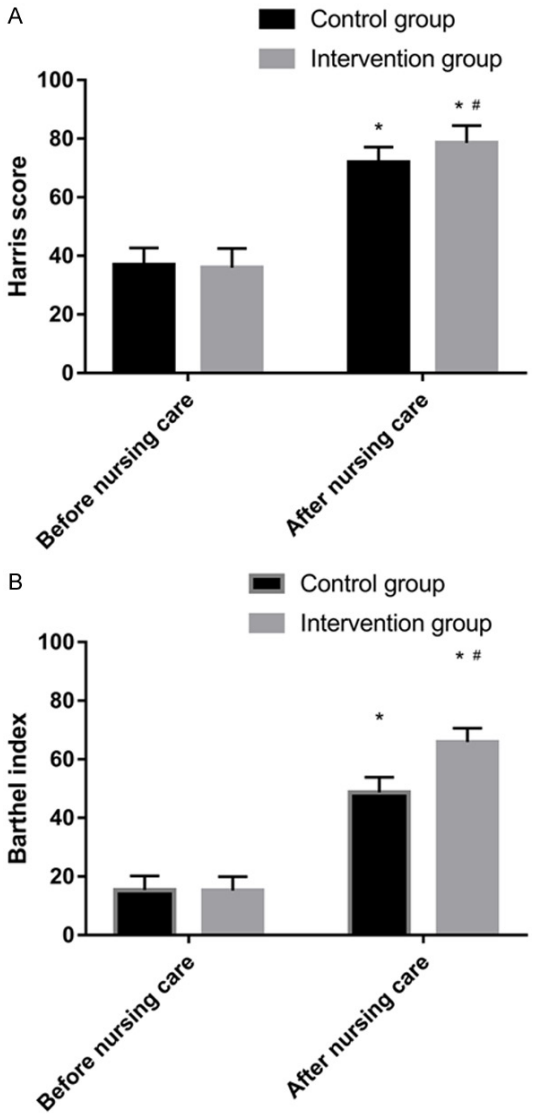

Figure 1. Changes in the Harris score and Barthel index of both groups before and after provision of nursing care. The Barthel index in the control group was significantly lower than that in the intervention group (P<0.05). *The significant difference was observed in the Harris score and Barthel index of both groups before and after provision of nursing care (P<0.05). Furthermore, there was significant difference in the Harris score and Barthel index in the control group before and after provision of nursing care (P<0.05).

the intervention group (P<0.05) (**Table 3** and **Figure 1**).

Changes in the level of anxiety and depression between the two groups before and after provision of nursing care

We compared the changes in HAMA and HAMD scores before and after treatment between the two groups. Results showed that there was no significant difference in the HAMA and HAMD scores between the two groups before treatment. After treatment, the HAMA score and HAMD score of the two groups were significantly lower than those before treatment (P<0.05), and the HAMA score and HAMD score of the control group were significantly higher than those of the intervention group (P<0.05) (**Table 4** and **Figure 2**).

Changes in E, NE, and Cor levels after treatment between the two patient groups

We found that there was no significant difference in the E, NE, and Cor levels between the two groups 1 day and 1 week after surgery (P>0.05). A week after provision of nursing care, the E, NE, and Cor levels of the two groups significantly decreased (P<0.05), and the reductions in the E, NE, and Cor index in the intervention group were significantly greater than those in the control group (P<0.05) (**Table 5** and **Figure 3**).

Incidence of postoperative DVT and infection in both patient groups

The incidence of postoperative DVT and infection in the two groups was calculated. Results showed that the incidence of postoperative DVT and infection in the control group was significantly higher than that in the intervention group (DVTX^2=8.010, DVTP=0.005; infection X^2=6.723, infection P=0.010) (**Table 6**).

Table 4. Changes in the level of anxiety and depression in the two groups before and after nursing care

Group	HAMA score		HAMD score	
	Before nursing care	After nursing care	Before nursing care	After nursing care
Control group (n=88)	21.88±1.86	14.27±1.62*	22.58±2.55	19.35±1.89*
Intervention group (n=100)	21.39±1.99	11.08±1.71*	22.96±2.31	16.57±1.93*
t value	1.737	13.081	1.072	9.951
P value	0.084	0.000	0.285	0.000

Note: *The values were significantly different from those obtained prior to provision of nursing care (P<0.05).

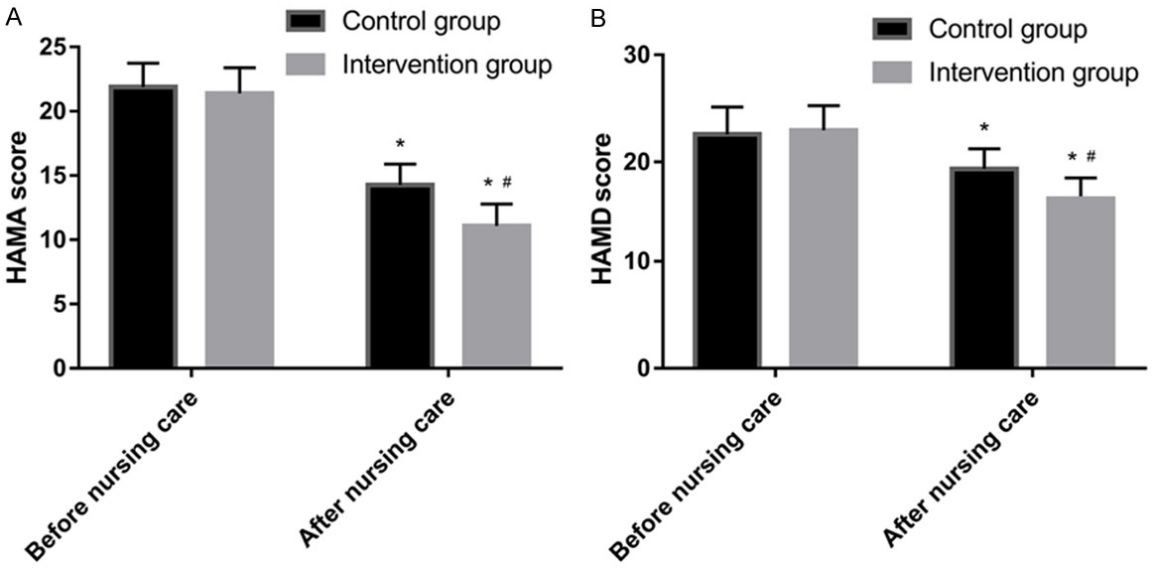

Figure 2. The difference in Hamilton Anxiety Scale (HAMA) score and Hamilton Depression Scale (HAMD) score between the two groups before and after nursing care. The difference was significantly higher in the intervention group (P<0.05). *There was a significant difference in the HAMA and HAMD score between the two groups before and after nursing care (P<0.05). Furthermore, there was a significant difference in the HAMA and HAMD score in the control group before and after nursing care (P<0.05).

Table 5. Changes in the E, NE, and Cor levels in the two groups after provision of nursing care

Group	E (μg/L)		NE (μg/L)		Cor (μg/L)	
	Nursing 1 day	Nursing 1 week	Nursing 1 day	Nursing 1 week	Nursing 1 day	Nursing 1 week
Control group (n=88)	0.35±0.09	0.19±0.05*	322.54±40.35	298.68±31.84*	255.84±33.88	228.63±22.62*
Intervention group (n=100)	0.34±0.08	0.14±0.04*	328.69±38.99	267.52±30.92*	259.82±32.54	189.52±25.88*
t value	0.807	7.609	1.062	6.799	0.821	10.962
P value	0.421	0.000	0.290	0.000	0.413	0.000

Note: *A significant difference was observed 1 day and 1 week after provision of nursing care (P<0.05).

Evaluation of nursing satisfaction in both groups

We calculated the level of patient care satisfaction and found that the level of nursing satisfaction of the control group was significantly lower than that of the intervention group (P< 0.05) (**Table 7**).

Discussion

Hip fracture is a type of fracture that commonly occurs in patients who experienced traffic accidents [10]. To date, surgery is considered as the primary treatment of hip fractures, but most hip fracture patients require artificial total hip arthroplasty. Infection of the patient's inci-

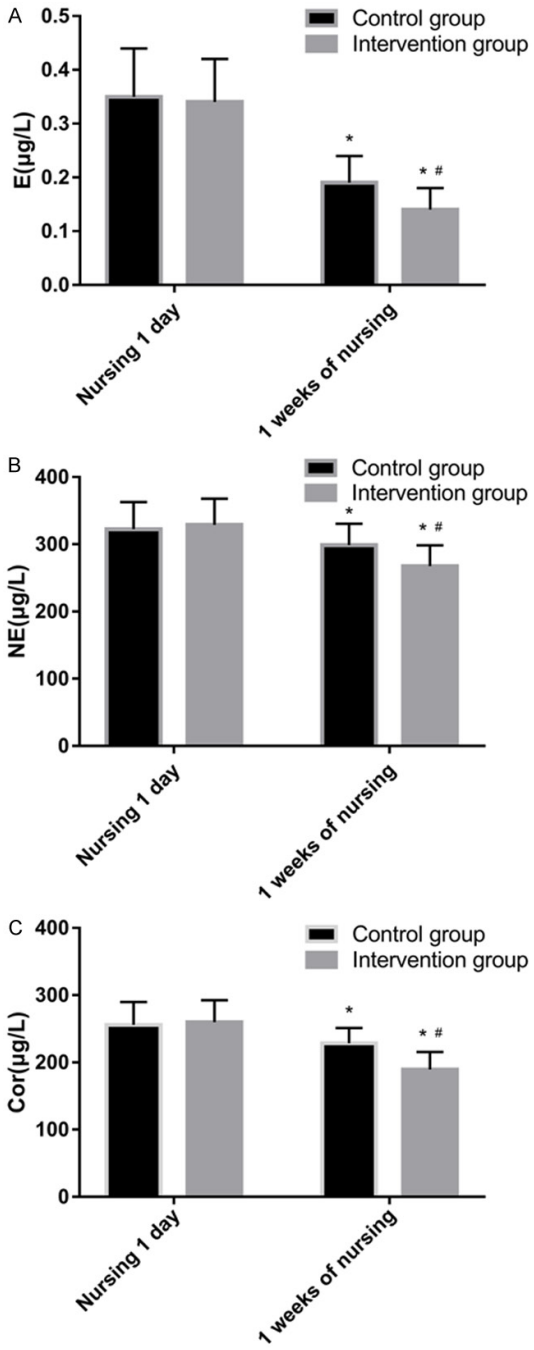

Figure 3. Difference in the epinephrine (E) levels between the two groups 1 day and 1 week after provision of nursing care. There was no significant difference in the cortisol (Cor) levels between the two groups 1 day after provision of nursing care (P>0.05). After 1 week of nursing care, the level of Cor in the two groups was significantly higher than that in the control group (P<0.05). The degree of reduction in the level of Cor in the intervention group was significantly higher than that in the control group (P<0.05). *There was a significant difference in the E and Cor levels between both groups before and after nursing care (P<0.05). There was a significant difference in the E and Cor levels in the control group before and after nursing care (P<0.05).

Table 6. Incidence of postoperative DVT and infection in both groups [n (%)]

Group	DVT	Infect
Control group (n=88)	20 (22.73)	16 (18.18)
Intervention group (n=100)	8 (8.00)	6 (6.00)
X^2	8.010	6.723
P	0.005	0.010

sion after surgery may result in systemic organ dysfunction, and severe septic shock [11, 12]. Furthermore, most patients develop fear and resistance to surgery, which affect their surgical treatment and prognosis.

Routine nursing is designed to meet the needs of surgical patients, it has obvious limitations [13, 14]. As a better quality care model extended from routine care, perioperative care needs strict control of the operating room environment and requires surgeons with more operational knowledge [15, 16]. Therefore, this study investigated the effects of operating room nursing interventions on infection, stress response, and DVT in patients with fracture surgery, and provided an alternative method for clinical care.

In this study, we evaluated the wound healing rate of the patients. Results showed that the healing rate of the control group was significantly lower than that of the intervention group, which indicates that the use of operating rooms can improve postoperative wound healing and facilitate postoperative recovery. We also analyzed the Harris score and the Barthel index before and after treatment in both groups. The Harris score and Barthel index were improved in the two groups, and the Harris score and Barthel index were significantly higher in the intervention group than in the control group. This indicates that routine care and operating room care have an effect on quality of life and postoperative recovery of patients. In addition, the quality of postoperative care and postoperative recovery was superior to that of conventional methods. In Sadat-Ali's study, the postoperative Harris score was improved by operating room care [17]. This finding is consistent with the results of our study. It is also a good indication that operating room care has a good effect on postoperative recovery. Furthermore, we conducted a statistical analysis on the HAMA score and the HAMD score before and after patient care. Results showed that both groups

Table 7. Evaluation of nursing satisfaction between the two groups [n (%)]

Group	Very satisfied	Satisfied	Same as	X^2 value	*P* value
Control group(n=88)	22 (25.00)	36 (40.91)	30 (34.09)	9.370	0.002
Intervention group(n=100)	37 (37.00)	48 (48.00)	15 (15.00)		

had lower HAMA and HAMD scores after provision of nursing care, and the magnitude of reduction in the intervention group was significantly higher than that in the control group, indicating the positive effects of operating room care. Nursing intervention can effectively alleviate anxiety and depression symptoms. Studies have shown that surgical stimulation and the use of anesthetics not only cause psychological stimulation, but also physiological responses [18]. Additionally, other studies have shown that there is an interaction between psychological stress response and physiological stress response [19]. To this end, we evaluated the patients' E, NE, and Cor levels. Results showed that the E, NE, and Cor levels of the control group and the intervention group significantly reduced after 1 week of care, and the magnitude of reduction in the intervention group was significantly higher than that in the control group. Studies have shown that when the body is traumatized, the LHPA axis is activated in the patient, resulting in elevated levels of E, NE, and Cor [20]. Moreover, we used the operating room nursing methods to psychologically guide the patient and avoid the feeling of nervousness, which is also beneficial to decrease in the occurrence of physiological stress, thus reducing the expression levels of E, NE, and Cor.

DVT is a venous thromboembolic disease that occurs after surgery in patients with lower extremity fractures. DVT mainly occurs in patients with lower extremity fractures who had been on long-term bed rest after surgery [21, 22]. However, we found that the incidence of DVT in the control group was significantly higher than that in the intervention group. The reason is that the wound healing of the intervention group accelerated after appropriate operation room care, which enabled the patient to ambulate early and perform rehabilitation training to reduce DVT. Moreover, we found that the infection rate of the control group was significantly higher than that of the intervention group. In Chen's study, the use of operating room care effectively reduced the risk of infection in patients. This finding was consistent with the results of our study [7]. At the end of the study, we found that the nursing satisfaction of the intervention group was significantly higher than that of the control group, which indicates that operating room care can improve the care relationship.

However, there were still some limitations in this study. We were not able to conduct a long-term follow-up of patients' postoperative recovery, and it is unclear whether the inclusion of the elderly in the patient group has certain influence on the results of our study. Therefore, in future research, we plan to conduct a long-term follow-up of patients and balance the age distribution of samples to verify the correctness of our results.

In summary, operating room nursing intervention can promote postoperative healing, which is beneficial to the improvement of postoperative functional recovery, quality of life, daily living ability, and psychophysiological stress. Prevention of DVT after lower extremity fracture and improvement of nursing satisfaction is worthy of clinical generalization.

Disclosure of conflict of interest

None.

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