

Original Article

Effect of a comprehensive rehabilitation nursing program on patients undergoing elbow arthrolysis

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Abstract: Objective: To investigate the effect of a comprehensive rehabilitation nursing program on patients undergoing elbow arthrolysis. Methods: Patients who received unilateral elbow arthrolysis in the Department of Orthopedics in Shanghai Sixth People's Hospital East Affiliated to Shanghai University of Medicine & Health Sciences from December 2016 to February 2017 were selected for the study and were randomized into two groups: experimental group and the control group. Patients in both groups received routine nursing care, while patients in the experimental group also received comprehensive rehabilitation nursing, which was a program after elbow arthrolysis including postoperative pain management, standardized management of postoperative drainage, application of cryotherapy, prevention of heterotopic ossification, and personalized functional training. The visual analogue scale (VAS) was used to assess patients' pain levels, and the elbow joint range of motion (ROM) was measured for evaluating the amount of movement around the joint. In addition, the Mayo elbow performance index (MEPI) was employed to assess patients' elbow joint function. A satisfaction survey was also conducted. Results: A total of 60 patients were included in the study and were assigned to either the experimental group or the control group (30 cases in each group). As compared with the control group, patients in the experimental group achieved better results in elbow joint ROM with greater improvement. Flexion, extension, pronation, supination and rotation angles in the experimental group were (131±8)°, (7±8)°, (69±17)°, (82±18)° and (151±33)° respectively, which were all better than those in the control group ((120±14)°, (16±16)°, (48±32)°, (63±31)° and (111±58)°, P=0.001, 0.009, 0.002, 0.006 and 0.002). The experimental group also had higher MEPI score (experimental group: 95±7, control group: 86±9, P=0.000), higher percentage of excellent result evaluated by MEPI (experimental group: 70%, control group: 43.3%, P=0.034), and lower VAS score between 2nd and 5th day after operation (P<0.001, 0.001, 0.001, and 0.001) as compared with those in control group. Additionally, the patient satisfaction in the experimental group was also greater (P=0.026). Conclusion: A comprehensive rehabilitation nursing program can help relieve pain, improve elbow joint ROM and promote recovery of the elbow joint function in patients who undergo elbow arthrolysis.

Keywords: Elbow arthrolysis, functional training, rehabilitation exercise, nursing care

Introduction

Elbow injuries, if not treated properly, can often lead to ankylosis and heterotopic ossification, which can cause elbow joint dysfunction and affect patient's quality of life. Currently, elbow arthrolysis serves as an effective treatment method [1-6]. The stiffness is most likely to occur in elbow joint among all the joints, and the pathogenesis of the elbow joint dysfunction is quite complicated. It is believed that the only comprehensive rehabilitation intervention would be necessary in the treatment of elbow joint dysfunction occurring after bone fracture repair

in upper limb, which can help improve joint range of motion (ROM) and activities of daily living (ADL) [4, 7-10]. The comprehensive rehabilitation nursing program refers to a set of scientific, humanized and comprehensive rehabilitation nursing plans designed on the basis of evidence-based medicine and according to patient's condition and need, so that patient can receive optimal, standardized, and effective nursing care for improving and accelerating the recovery [2-4, 11]. Therefore, in order to find ways to enhance the results of elbow arthrolysis, the study investigated the effect of comprehensive rehabilitation nursing program

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Table 1. Comparison of general information in two groups

	Control group		Experiment group		P value
	Mean ± SD, n	Range	Mean ± SD, n	Range	
Gender (male/female)	21/9		15/15		0.114 ^b
Age (year)	36.3±12.1	18-65	37.2±9.8	20-55	0.771 ^a
BMI (kg/m ²)	23.3±2.9		23.3±3.0		0.970 ^a
Dominant hand (yes/not)	20/10		15/15		0.190 ^b
Malfunction period (month)	18.4±10.8		16.9±11.4		0.603 ^a
Smoking or not (yes/not)	9/21		7/23		0.559 ^b
Flexion angle	72±28	25-125	78±21	35-110	0.349 ^a
Extension angle	37±16	10-80	45±22	15-95	0.106 ^a
ROM	35±27	0-85	33±30	0-90	0.786 ^a
Pronation angle in forearm	39±40	-80-75	48±17	0-75	0.267 ^a
Supination angle in forearm	58±35	0-90	72±27	0-90	0.082 ^a
Rotation angle in forearm	97±67	0-165	120±41	0-165	0.111 ^a
MEPI score	69±16	30-95	70±14	35-95	0.865 ^a
VAS score	1.6±2.2	0-7.8	1.2±1.9	0-7.6	0.426 ^a

Note: BMI: body mass index; ROM: range of motion; MEPI: Mayo elbow performance index; VAS: visual analogue scale; ^aindependent samples t test; ^bPearson's Chi-square test.

which was implemented in patients after the operation.

Materials and methods

Case selection and grouping

The study was approved by the Ethics Committee and informed consents were obtained. A total of 60 patients who underwent unilateral elbow arthrolysis in the department of orthopedics in Shanghai Sixth People's Hospital East Affiliated to Shanghai University of Medicine & Health Sciences from December 2016 until February 2017 were selected for the study. Participants were randomly assigned into either the experimental group or the control group (30 cases in each group).

Inclusion criteria: 1) Patients aged between 18 and 65 years; 2) Patients that had posttraumatic elbow ankylosis; 3) Patients that had never received elbow arthrolysis in the past; 4) Patients that were available for a long-term follow-up after operation (the follow-up period was no less than 6 months).

Exclusion criteria: 1) Patients that had chronic pain or pain in other parts; 2) Patients that had burn injury or traumatic brain injury; 3) Patients that were not willing to undergo cryotherapy; 4) Patients that were not available for a complete follow-up.

The comparison of patients' general information in two groups prior to the operation can be seen in **Table 1**.

Methods

Patients in both groups received routine nursing care after admission, and patients were operated by the same surgeon for the elbow arthrolysis.

After the operation, patients in experiment group received comprehensive rehabilitation nursing

in addition to the routine nursing care, which included postoperative pain management, standardized drainage management, prevention of heterotopic ossification, appropriate application of cryotherapy, and personalized functional training during early stage [2-4]. Details are as follows.

Postoperative pain management: Management was performed systematically for pain relief so that patients can participate in early functional training [12]. Pain was evaluated in a timely manner by nurse, and the pain relieving device and analgesics were appropriately used. Cryotherapy was also carried out during the exercise interval [4, 7-9, 13-15].

Standardized management of postoperative drainage: If both the anterior and posterior sides of the articular capsules were opened in the surgery, drainage tubes were placed in both sides of the joint to help with full drainage [1]. Placement of drainage tube was performed appropriately and the drainage was monitored closely. Removal of the tube was conducted in a timely manner. Proper hemostatic and postoperative cryotherapy were also applied [13].

Innovative application of cryotherapy: Cold compression or a cryotherapy device was used to reduce postoperative hemorrhage, joint effusion, and joint swelling, which was helpful for early exercise [1, 3, 9, 16, 17].

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Table 2. Injury type and treatment in two groups

Injury	Control group			Experiment group		
	Gypsum	ORIF	ORIF + gypsum	Gypsum	ORIF	ORIF + gypsum
Dislocation	1	1	0	3	0	1
Proximal ulna	1	1	5	0	1	4
Distal humerus	1	6	4	3	2	6
Radial head	0	3	1	0	0	3
Multiple fracture	0	3	3	0	4	3

Note: ORIF: open reduction and internal fixation; comparison of the injury type in two groups: $\chi^2=3.867$, $P=0.145$; comparison of the treatment methods in two groups: $\chi^2=1.220$, $P=0.875$.

Prevention of heterotopic ossification: Patients were given oral administration of celecoxib for relieving pain and prevention of heterotopic ossification after the operation [1, 18].

Personalized functional training: Patient's condition was well evaluated by nurse in order to determine the training time and training load correctly [19-21]. The training consisted of elbow flexion and extension exercise and elbow rotation exercise [13]. The timing for external fixator removal was well controlled, and the muscle training was also strengthened if possible [9]. The training lasted for six months. The next step plan was made based on the results of outpatient re-evaluation.

Outcome measures

Pain evaluation: Patient's pain level was evaluated by visual analogue scale (VAS) once a day for five days after surgery. A score of 0 was defined as no pain, whereas a score of 10 indicated unbearable pain [22]. The assessment was conducted within one hour following the functional training on that day.

Evaluation of elbow joint ROM: Elbow joint ROM was measured for detecting the amount of movement around the joint. The forearm was fixed in neutral position before and six months after the surgery. The flexion, extension, pronation and supination ROMs in elbow joints were measured by protractor [22].

Evaluation of elbow joint performance: Patients were followed up prior to and six months after the operation respectively. The recoveries of elbow joint performance in patients were assessed by Mayo elbow performance index (MEPI) [7], which analyzed the joint perfor-

mance through the pain level, ROM, stability, ADL and other aspects. The system is on a scale of 0-100 (score ≥ 90 : excellent; score 75-89: good; score 60-74: fair; score < 60 , poor). The MEPI scores in both groups and the percentage of excellent result (score ≥ 90) were calculated.

Patient satisfaction survey: The self-designed questionnaire consisted of 25 items, with 4 scores in each item. A score of 4 represented very satisfied, a score of 3 meant satisfied, a score of 2 meant neutral, and a score of 1 meant dissatisfied. The total score was 100, while a score ≥ 75 was classified as satisfied, and a score < 75 was classified as dissatisfied.

Statistical analysis

SPSS 22.0 was applied for data analysis. The measurement data are presented as mean \pm standard deviation; comparison between two groups was conducted using independent samples t test, and the before versus after comparison within the group was conducted by paired t test; the enumeration data were examined by Chi-square test. A value of $P < 0.05$ was considered as statistically significant.

Results

Comparison of general information in two groups

A total of 60 patients were enrolled in the study, including 35 males and 25 females, with age between 18-65 years (36.8 ± 11.0). No intergroup difference was found in sex, age, type of fracture, and other general information (all $P > 0.05$, **Tables 1 and 2**).

Comparison of treatment effects in two groups

After the implementation of comprehensive rehabilitation nursing program, patients in experiment group achieved better elbow joint ROMs with greater improvements than patients in control group (all $P < 0.05$). The MEPI score and percentage of excellent result evaluated by

Table 3. Comparison of treatment effects in two groups

	Control group		Experiment group		P value
	Mean \pm SD	Range	Mean \pm SD	Range	
Flexion angle	120 \pm 14	80-140	131 \pm 8	100-145	0.001 ^{a,**}
Extension angle	16 \pm 16	0-80	7 \pm 8	0-30	0.009 ^{a,**}
ROM	104 \pm 24	50-140	124 \pm 14	85-145	<0.001 ^{a,***}
Improvement in ROM	64 \pm 45	0-120	82 \pm 40	20-135	0.023 ^{a,*}
Pronation angle in forearm	48 \pm 32	-45-75	69 \pm 17	0-80	0.002 ^{a,**}
Supination angle in forearm	63 \pm 31	0-90	82 \pm 18	0-90	0.006 ^{a,**}
Rotation angle in forearm	111 \pm 58	0-165	151 \pm 33	0-170	0.002 ^{a,**}
MEPI score	86 \pm 9	75-100	95 \pm 7	80-100	<0.001 ^{a,***}
MEPI level (excellent/good)	13/17		21/9		0.034 ^{b,*}
VAS score					
1 st day	3.5 \pm 0.6		3.2 \pm 0.6		0.075 ^a
2 nd day	3.4 \pm 0.5		2.8 \pm 0.5		0.000 ^{a,***}
3 rd day	3.2 \pm 0.6		2.7 \pm 0.6		0.001 ^{a,**}
4 th day	2.7 \pm 0.4		2.3 \pm 0.4		0.001 ^{a,**}
5 th day	2.3 \pm 0.4		2.0 \pm 0.3		0.001 ^{a,**}
Patient satisfaction (satisfied/dissatisfied)	23/7		29/1		0.026 ^{c,*}

Note: ROM: range of motion; MEPI: Mayo elbow performance index; VAS: visual analogue scale; ^aindependent samples t test; ^bPearson's Chi-square test; ^cFisher's exact test; *P<0.05; **P<0.01; ***P<0.001.

MEPI in experiment group were also higher than those in control group (both P<0.05). VAS scores in both groups were similar on the 1st day of the nursing program, whereas between the 2nd and 5th day, the scores in experiment group were much lower (all P<0.05). In addition, patient satisfaction in the experimental group was also much greater (P<0.05) as shown in **Table 3**.

Discussion

The elbow joint is a type of composite hinge joint that consists of three joints. Its function can be affected even by slight injuries. The mechanism behind elbow joint dysfunction after bone fracture repair is still unclear, and scholars in the field of orthopedics are still exploring ways for the effective treatment of this condition [18]. Currently, arthrolysis serves as a surgical method for improving elbow joint performance, however, patient's involvement in functional training is also key to the recovery [19, 23].

The study found that the elbow joint ROM and its improvement in the experimental group were significantly better than those in the control group, indicating that the comprehensive rehabilitation nursing program can help im-

prove elbow joint ROM after arthrolysis, and enhance surgical effects. Some studies have reported that the rehabilitation nursing after operation can markedly increase the elbow joint ROM, which aligns with the results of our study [12]. Clinical practice has proven that functional training following the elbow joint surgery cannot be replaced by any alternatives. The exercises usually include a combination of muscle strength exercise and active exercise, such as elbow flexion and extension, and forearm pronation and supination. The combination of exercise can help achieve good synergistic effects. A personalized and active rehabilitation plan can significantly improve the elbow joint function [7]. The present study adopted a comprehensive rehabilitation nursing program featuring early functional training, in an effort to obtain optimal ROM and recovery of ADL. After nearly 6 months of functional treatment and training, the flexion and extension ROMs as well as rotation ROM in patients' injured elbows could reach the excellent level, which was consistent with other studies [24].

Our study showed that the MEPI score in the experimental group (95 \pm 7) was much better than that in the control group (86 \pm 9). The percentage of excellent results evaluated by using MEPI score in the experimental group was also

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significantly higher. These findings displayed that a comprehensive rehabilitation nursing program can improve the joint performance after elbow arthrolysis, enhance the surgical effects, and improve patient's quality of life. Some studies reported that the postoperative rehabilitation nursing could increase elbow joint MEPI scores from 49.5 ± 2.6 before operation to 85.5 ± 2.3 after operation [12]. In the present study, we reinforced the early functional training, in addition to the standardized management of joint drainage, prevention of heterotopic ossification, and appropriate cryotherapy, so that patient's elbow joint performance and ADL could be improved, which was similar to other research findings [8, 9].

In the study, we found that between 2nd and 5th day of the nursing program, the VAS score in the experimental group was significantly lower than those in the control group. This suggested that the pain management adopted in the program could effectively relieve pain in patients who underwent elbow arthrolysis. Since much attention was paid to the pain management in the study, various measures were taken for controlling the pain after evaluation, which included the use of pain relieving device after operation, administration of analgesics for cases of mild pain, intramuscular injection of analgesics for cases of severe pain, and the application of cryotherapy. These measures effectively controlled pain in patients and helped ensure compliance with functional training [14]. Since the pain after operation can negatively affect the early training, pain management acts as a key component in the nursing program. In the present study, standardized pain management was conducted and patients' pain was controlled effectively, which was conducive to the implementation of early functional training [13].

Since this study was a single-center study with a relatively small sample size, the results may not be applicable to all population. Hence, a multi-center study with a larger sample size would be necessary in the future, in order to support a wide application of the program.

In conclusion, a comprehensive rehabilitation nursing program can be recommended for clinical application, as it can effectively control the pain, improve elbow joint ROM and performance, and promote the recovery by carrying

out postoperative pain management, standardized drainage management, measures for the prevention of heterotopic ossification, appropriate cryotherapy, and early personalized functional training.

Disclosure of conflict of interest

None.

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