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Original Article

Effect of timeliness incentive nursing on postoperative rehabilitation in patients with cervical spondylotic myelopathy

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Abstract: Objective: To explore the effect of timeliness incentive nursing on postoperative rehabilitation of patients with cervical spondylotic myelopathy (CSM). Methods: a total of 104 CSM patients treated in our hospital were recruited, who were evenly divided into two groups according to a random number table method. The control group was given routine nursing, and the research group was given timeliness incentive nursing based on routine nursing. The out-of-bed activity time after surgery, the length of hospital stay, the visual analog scale (VAS) scores before and after intervention, the Japanese Orthopedic Association (JOA) scores, the cervical spine range of motion (ROM), changes of quality of life (QOL), complications, and nursing satisfaction were compared between the two groups. Results: After intervention, the out-of-bed activity time and length of hospital stay in the research group were significantly shorter than those of the control group (P<0.001). Compared with before intervention, VAS scores were significantly decreased, while JOA scores and ROM were both considerably increased after intervention in both groups (P<0.001). Of note, the improvement in the research group was more significant compared with the control group. The incidence of complications of the research group was remarkably lower than that of the control group (P<0.05). Compared with before intervention, physiological functions, physiological and emotional responsibilities, social function, mental health, energy, and overall health scores were all significantly increased after intervention in both groups, whereas the physical pain was significantly decreased (P<0.001), and these measures of the research group were higher than those of the control group. The nursing satisfaction in the research group was notably higher than that of the control group (P<0.05). Conclusion: Timeliness incentive nursing can effectively improve postoperative rehabilitation of patients with CSM, reduce the pain, decrease the incidence of complications, improve the QOL, and increase nursing satisfaction.

Keywords: Cervical spondylotic myelopathy, timeliness incentive nursing, complication, quality of life

Introduction

Cervical spondylotic myelopathy (CSM) accounts for approximately 10%-15% of all cervical spondylosis, which represents the most severe type of cervical disease. CSM results from long-term compression of the spinal cord due to the structural degeneration of the intervertebral connection of the cervical spine, causing the secondary chronic progressive damage of spinal cord function [1, 2]. Trauma is a common culprit of CSM, and the main clinical manifestations include neck pain, limb dysfunction, mobility restriction, incontinence, quadriplegia, and so forth. If not treated in time or treated improperly, it can easily develop into irreversible nerve damage [3-5]. Surgery can relieve the compression very fast and terminate irreversible damage to the spinal cord nerve, which is of great importance to restoring nerve function. However, surgery is not an all-round strategy. Patients are often accompanied by various complications and sequelae after surgery, such as local hematoma and paralysis [6]. Although irreversible factors result in spinal cord damage, reversible factors such as lack of complete postoperative rehabilitation training, supervision, and guidance also contribute to this damage. Studies have demonstrated that reasonable functional exercise after surgery can effectively improve the prognosis and promote the postoperative rehabilitation of patients with cervical spondylosis [7, 8]. However, studies have found that at the current

stage, rehabilitation training is mostly carried out independently, and the exercise method is limited, accompanied by randomness, blindness, or inertia [9]. Thus, patients haven't fully taken advantage of their potential to achieve the best functional recovery.

Timeliness incentive refers to giving patients effective encouragement at different times to fully activate patients' subjective initiative, which makes patients proactively participate in postoperative rehabilitation nursing and fully induces their potential through positive incentives. This method could eventually make patients' rehabilitation more valid and effective and help them to be discharged earlier [10]. In recent years, studies have been applying timeliness incentive nursing to early rehabilitation training for diseases such as cerebral infarction and diabetes, which have shown promising results [11]. However, there is no clinical research so far to apply this methodology to patients with cervical spondylosis after surgery. Therefore, this study aimed to investigate and have a deep understanding of the effect of timeliness incentive nursing on postoperative rehabilitation of 52 patients with CSM.

Materials and methods

General information

A total of 104 CSM patients treated in our hospital from March 2018 to February 2020 were selected and divided into two groups according to a random number table method, 52 patients in each group. This study was approved by the Ethics Committee of our hospital. All participants have signed the informed consent form.

Selection criteria

Inclusion criteria: Disease diagnosed in accordance with the diagnostic criteria of CSM in *SHIYONG GUKE XUE* 4th Edition; Arc compression in front of the spinal cord confirmed by MRI examination; Tendon hyperreflexia, increased muscle tension, decreased muscle strength, numbness in the limbs, poor coordination of lower limbs, unstable gait, and feeling of stepping on cotton when walking; Straight or disappeared cervical curvature, bone hyperplasia at posterior edge of vertebral bodies, and narrowing of diseased intervertebral disc verified by X-ray; No surgical contraindications [12]. Exclusion criteria: Patients with a history of neurological diseases; Patients with a history of cervical spine surgery or acute spinal cord injury; Patients with bone metabolic diseases or bone tumors; Patients with combined immune diseases; Patients with Alzheimer's disease or schizophrenia; Patients with severe insufficiency of heart, liver, and kidney function; Patients with coagulation dysfunction.

Methods

Control group: Routine rehabilitation nursing intervention was conducted. (1) Within 1-10 days after the surgery, patients were recommended to stay in bed, wear a collar to fix the neck, and perform some simple and easy exercises on the bed. First, patients need to adjust their body positions. After the surgery, a supine position and a thin pillow under the neck were suggested on the bed to avoid muscle soreness due to the suspension of the back of the neck, which affects wound healing. Every 2 h, patients were assisted to perform turn-over training, no need to purposely exert any power by patients. The nurse aligned the head, neck, and trunk on a horizontal line and turned over the body coaxially. Two days after the surgery, in order to avoid joint stiffness and atrophy, exercises of limbs and joints would be performed. According to patients' muscle strength, they were instructed to perform active, passive, and resistance exercises, such as finger splitting, flexion exercises, hardball rolling, paper clamping exercises, knee joint and hip joint extension and flexion, straight leg lift, knee flexion resistance, muscle contraction training, etc. via tools likes grippers and rubber bands. Massage of limbs could be done by tapping, pressing, and rubbing. Three days after surgery, patients were instructed to flex their legs and push the bed surface and perform turn-over training at the same time. Five days after surgery, patients can be assisted to move slowly to the side of the bed by raising the bed for sitting training. (2) From 11 days to 1 month after surgery, the neck still needs to be fixed with a collar, but patients can be trained to get out of the bed. On the 11th day post-surgery, legs were slowly moved to the edge or underneath of the bed, the body could be turned straight, and a walker was used to help to stand and walk. After getting used to it, patients can try to walk without the aid of a walker. Based on

the above functional exercises, washing, eating, and defecation training could be implemented. Twenty days post-surgery, the neck collar can be removed according to patients' recovery status, and neck rotation training like up and down, left and right could be performed, after which the neck collar should be re-worn. (3) One month after surgery, the neck collar was removed without putting it back, and neck training was continued following the direction as shown in the Chinese character 'Mi'. The angle of movement should be thorough but should not cause the pain. Then, neck muscle contraction training and resistance training were performed to enhance the stability of the cervical spine. Finally, the training of upper limb supination, abduction, adduction, rotation, and resistance can be performed. The aspects of training mentioned above were guided by the nurse, after which patients could do these exercises by themselves.

Research group: Based on the control group, timeliness incentive nursing was implemented, and an intervention team was established, which was composed of 3 nurses, 1 head nurse, and 1 doctor with a qualification of the national second-level psychological counselor. All the nursing staff were trained with psychological intervention and passed the examination before participating in the study. The head nurse was appointed as the team leader. Spiritual incentive: during patients' rehabilitation exercise, every subtle action was carefully observed. When patients' action or performance was good, praise should be given in time to establish positive psychological confidence for patients so as to allow them to establish active exercises and have the awareness that exercises can accelerate the rehabilitation process, which could strengthen exercise motivation and interest and stimulate patients for further exercises. Goal incentive: during the training process, a clear exercise goal should be set for the patient. For example, the amount of joint activity training should be maintained at 15 min, 2-3 times/d, which was utilized to encourage patients to keep exercising, strengthen their will, and make them follow the rules. Model incentive: cases of good postoperative rehabilitation training can be shared to influence patients' thoughts, emotions, and behaviors. Patients who have shown good results in the rehabilitation training during the same period could be leveraged to share their exercise experience and inspire the peers. At the same time, patients can encourage each other so that everyone would be influenced. Benefit incentive: patients were educated with the benefits of following the doctor's advice on rehabilitation training and the importance and necessity of postoperative rehabilitation training, which can make patients maintain correct cognition and finish the exercises they started with. It could also help to avoid all kinds of psychological interference during the exercise and hold on to the end. After patients were discharged from the hospital, a WeChat group was established, and the patients were supervised and guided in the group at 10 am and 3 pm every day. At the same time, an incentive strategy was used to encourage patients to persist in the rehabilitation training. For patients who did not follow the rehabilitation training, a return visit by phone call was required to know the reason for poor compliance, and a targeted psychological nursing intervention was given for 2 months.

Outcome measurements

Primary outcome measurements: (1) The out-of-bed activity time after surgery and the length of hospital stay were observed and recorded. (2) Pain level before intervention and 2 months after intervention: The latest version of the visual analog scale (VAS) was used to evaluate the pain level, 0 point indicated no pain; 1-3 points indicated mild pain, by which the daily life and work were slighted affected, the pain was acceptable, and sleep was basically unaffected; 4-6 points indicated severe pain, which affected part of daily life and work, and sleep was also affected; 7-10 points indicated unbearable pain, by which daily life and work were severely affected and patients cannot sleep [13]. (3) Cervical spine functional status before intervention and 2 months after intervention: The Japanese Orthopaedic Association assessment and treatment (JOA score) was used for the evaluation, including upper limb motor function, lower limb motor function, upper limb sensation, lower limb sensation, trunk sensation, bladder function, the total score was 17, a score of ≤8 points indicated severe, incontinence, complete loss of self-care ability, or patients had partial lower or upper limb motor functions, but the self-care ability was still poor

accompanied by incontinence; 9-12 points suggested moderate: patients' lower limbs or upper limbs were inflexible or weak, or had abnormal urine and stool, but can basically take care of themselves; 13-16 points suggested mild: although patients showed lower or upper limbs inflexible or weak, which, however, had no impact on their life, and they were qualified for normal work; 17 points represented asymptomatic, no clinical symptoms of spinal cord injury [14]. (4) The cervical spine range of motion (ROM) before intervention and 2 months after intervention: patients stayed in a sitting position with the head centered and were instructed to do some movements to measure the cervical ROM, including touching the chest with the chin (normal range: 35°-45°), tilting the head back as far as possible (normal range: 35°-45°), touching the left shoulder with the left ear, touching the right shoulder with the right ear (normal range: 45°), and touching the left and right shoulders with the chin, but without raising the shoulder (normal range: 60°-80°). At the same time, X-ray examination was used to measure the tangent angle of the posterior wall of the C_3 and C_7 vertebral bodies according to the Nishituzi method.

Secondary outcome measurements: (1) Quality of life (QOL) before intervention and 2 months the intervention: The short form health survey (SF-36) was used to evaluate the QOL [15]. The scale contained 8 dimensions and a total of 36 items, including physiological function, physical pain, physiological and emotional responsibilities, social function, mental health, energy, and overall health. The score ranged from 0 to 100 points, the higher the score, the higher the QOL. (2) Nursing satisfaction at the end of the rehabilitation: home-made questionnaire with Cronbach's α coefficient of 0.93 and the retest reliability of 0.89 by our hospital was leveraged. The questionnaire contained nursing attitude, nursing skills, communication skills, exercise skills, and health propagation and education, etc. Likert 5-point scale method was conducted to evaluate nursing satisfaction, which included strongly satisfied, satisfied, fair, unsatisfied, and strongly unsatisfied. The total score was 100 points, in which 90 points and above were strongly satisfied, 80-89 were satisfied, 70-79 were fair, 60-69 were dissatisfied, and below 60 were strongly dissatisfied. Satisfaction = (strongly satisfied + satisfied)/n ×100%. (3) Complications within 2 months after surgery: the incidence of complications such as wound edema, neck hematoma, deep vein thrombosis, and spastic paralysis were recorded. Complication rate = total number of complications/n ×100%.

Statistical analysis

SPSS 21.0 software was applied to analyze the data. Graphpad Prism 6.0 software was used to generate and design figures. The quantitative data was presented as ($\bar{x} \pm sd$). Independent sample t test was carried out for the comparison between two groups. Paired t test was conducted for comparison before and after intervention within the same group. Counting data was expressed as percentage and analyzed using χ^2 test. $P<0.05$ indicated a significant difference.

Results

General information

There was no statistically significant difference in terms of general data such as gender, age, course of disease, surgical segment, pathological location, and comorbidity between the two groups ($P>0.05$), indicating that the two sets of general data were comparable (**Table 1**).

Out-of-bed activity time and length of hospital stay

The out-of-bed time and length of hospital stay in the research group were significantly shorter than those in the control group ($P<0.001$), suggesting that timeliness incentive nursing can effectively shorten the out-of-bed time and length of hospital stay (**Figure 1**).

VAS score, JOA score, and ROM activity

Before intervention, there was no statistically significant difference in terms of VAS scores, JOA scores, and ROM activities between the two groups ($P>0.05$), whereas VAS scores were significantly decreased, and JOA scores and ROM activities were considerably increased after intervention in both groups ($P<0.001$), in which the improvement of the research group was more significant compared with the control group. These data demonstrated that timeliness incentive nursing can effectively relieve

Table 1. Comparison of general information between the two groups ($\bar{x} \pm sd$, n)

Group	Control group (n=52)	Research group (n=52)	t/χ^2	P
Gender (male/female)	30/22	32/20	χ^2=0.160	0.689
Age (years)	58.3±6.1	60.7±7.3	t=1.762	0.081
Course of disease (month)	8.4±3.4	8.6±3.5	t=0.296	0.768
Surgical duration (min)	65.96±11.05	66.31±11.62	t=0.157	0.875
Surgical route			χ^2=0.170	0.680
Anterior	35	33		
Posterior	17	19		
Surgical segment			χ^2=1.051	0.902
$C_{3/4}$	4	5		
$C_{4/5}$	8	9		
$C_{5/6}$	19	16		
$C_{6/7}$	7	5		
Comorbidity			χ^2=0.417	0.812
Combined multiple segments	14	17		
Diabetes	14	11		
Hypertension	20	21		
Hyperlipidemia	11	12		

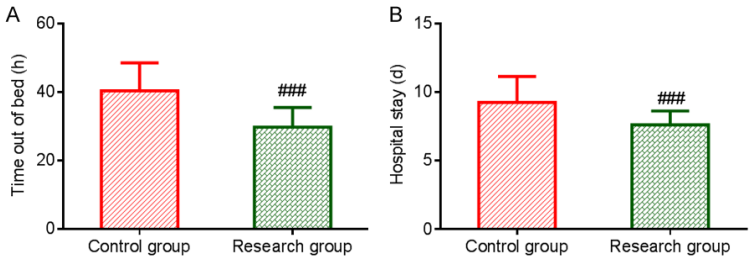

Figure 1. Comparison of the out-of-bed activity time and length of hospital stay between the two groups. A: Out-of-bed activity time (h); B: Length of hospital stay (d). Compared with the control group, ###P<0.001.

the postoperative pain, improve the cervical spine functional status, and enhance the cervical spine flexion and extension activity (**Figure 2**).

Complications

The incidence of complications in the research group was slightly but significantly lower than that of the control group (P<0.05), which indicated that the timeliness incentive nursing was beneficial to control the risk of complications to a certain extent (**Table 2**).

SF-36 score

Before intervention, there was no statistically significant difference regarding the SF-36 scores between the two groups (P>0.05); after intervention, physiological functions, physiological and emotional responsibilities, social function, mental health, energy, and overall health scores were all significantly increased in both groups, while the physical pain was significantly decreased (P<0.001), and these parameters in the research group were higher than those of the control group. These results indicated that the timeliness incentive nursing can effectively improve the QOL of patients after surgery (**Table 3**).

Nursing satisfaction

The nursing satisfaction in the research group was significantly higher than that of the control group (P<0.05), which revealed that the timeliness incentive nursing was more likely to be accepted by patients (**Table 4**).

Discussion

In the pathological change of cervical spondylotic myelopathy (CSM), ischemic necrosis of nerve tissue will occur. Although the degenera-

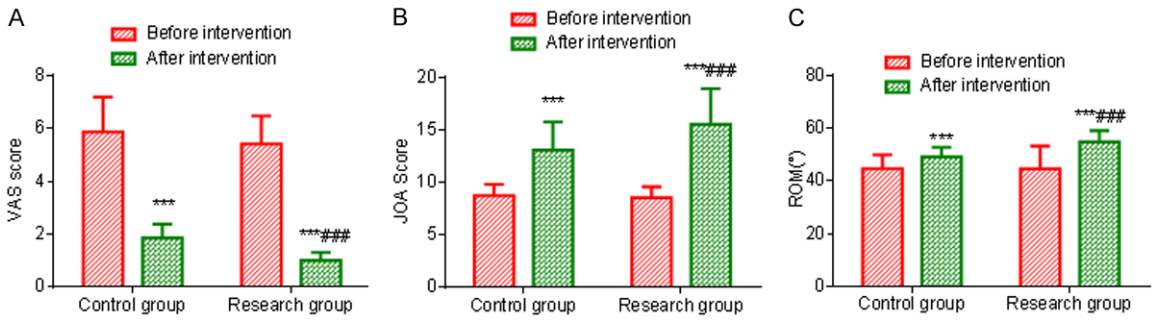

Figure 2. Comparison of VAS score, JOA score, and ROM activity between the two groups. A: VAS score (points); B: JOA score (points); C: ROM activity (°). Compared before intervention within the group, ***P<0.001; compared with the control group, ###P<0.001. VAS: visual analog scale; JOA: Japanese Orthopedic Association.

Table 2. Comparison of the incidence of complications between the two groups (n, %)

Group	Control group (n=52)	Research group (n=52)	X^2	P
Wound edema	3 (5.77)	1 (1.92)		
Neck hematoma	1 (1.92)	0 (0.00)		
Deep vein thrombosis	2 (3.85)	0 (0.00)		
Spastic paralysis	3 (5.77)	1 (1.92)		
Total incidence	9 (17.31)	2 (3.85)	4.981	0.026

tion and necrosis of nerve cells after surgery are irreversible, some nerve cells have only temporarily loss of function, which can be utilized to reconstruct the nervous system by stimulating the regeneration of nerve cells through exercises. Thus, suitable rehabilitation training can effectively promote the recovery of nerve function [16, 17]. Timeliness incentive nursing refers to the positive guidance and instruction to patients' specific physical and psychological conditions at the right time to stimulate patients' psychological motivation and encourage patients proactively to receive the rehabilitation training, leading to functional recovery [18, 19]. This theory pays more attention to the spiritual factors of patients. In the study, various incentive approaches such as spiritual incentive, goal incentive, model incentive, and interest incentive are used to meet the psychological needs of patients, which could fully motivate patients' enthusiasm for the rehabilitation exercise. According to the psychological analysis, the behavior of approval will psychologically imply that "what you say is right", which makes opinions more convincing and forces patients subconsciously to accept the conscious content. This appropriate recognition can eliminate the tension and anxiety and help patients establish an optimistic and positive attitude [20]. Wang et al. have reported that the application of timeliness incentive intervention to patients after cerebral hemorrhage can improve self-efficacy and exercise compliance, improve the quality of life (QOL), and promote neurological recovery [21]. However, currently, there is no report on the application of this nursing approach to CSM. Our study has shown that the out-of-bed activity time and length of hospital stay after intervention in the research group are significantly shorter than those of the control group. Compared with before intervention, visual analog scale (VAS) scores are significantly decreased, while Japanese Orthopedic Association (JOA) scores and range of motion (ROM) activities are notably increased after intervention in both groups. Additionally, the incidence of complications in the research group was much lower than that of the control group. Qu et al. have demonstrated that timeliness incentive nursing can significantly shorten the out-of-bed time, the time of first eating, and the length of hospitalization in patients with radical rectal cancer stoma, relieve their postoperative pain and negative emotions, improve self-management and compliance, and reduce the occurrence of postoperative complications, which are in line with the results of this study [22]. Our data suggest that the timeliness incentive nursing can effectively preserve the postoperative mobility of the cervical spine, reduce patients' pain, achieve early discharge, and control the risk of complica-

Table 3. Comparison of SF-36 scores between the two groups ($\bar{x} \pm sd$, score)

Group	Control group (n=52)	Research group (n=52)	t	P
Physiological function				
Before intervention	51.85±5.12	52.07±5.09	0.220	0.827
After intervention	72.45±7.46***	81.45±8.51***	5.735	<0.001
Physical pain				
Before intervention	51.75±7.47	53.06±7.38	0.900	0.370
After intervention	37.68±7.66***	27.14±7.84***	7.891	<0.001
Physiological responsibility				
Before intervention	73.79±6.56	74.53±6.47	0.579	0.564
After intervention	80.17±7.67***	89.87±8.28***	6.197	<0.001
Emotional responsibility				
Before intervention	62.45±7.63	62.34±7.76	0.073	0.942
After intervention	75.21±8.33***	86.54±9.21***	6.579	<0.001
Social function				
Before intervention	52.44±6.53	53.17±6.86	0.556	0.580
After intervention	72.84±8.51***	82.63±10.30***	5.284	<0.001
Mental health				
Before intervention	71.59±7.88	70.06±7.76	0.995	0.323
After intervention	80.86±8.23***	88.37±9.45***	3.082	<0.001
Energy				
Before intervention	56.48±6.56	55.32±6.21	0.854	0.343
After intervention	76.41±7.24***	83.53±8.76***	4.108	<0.001
Overall health				
Before intervention	55.59±6.47	54.44±6.36	0.985	0.328
After intervention	76.49±7.14***	85.33±9.19***	5.335	<0.001

Note: Compared before intervention within the group, ***P<0.001.

Table 4. Comparison of nursing satisfaction between the two groups (n (%))

Group	Control group (n=52)	Research group (n=52)	χ^2	P
Strongly satisfied	19 (36.54)	32 (61.54)	6.502	0.011
Satisfied	20 (38.46)	16 (30.77)		
Fair	11 (21.15)	2 (3.85)		
Dissatisfied	1 (1.92)	1 (1.92)		
Strongly dissatisfied	1 (1.92)	1 (1.92)		
Overall satisfaction	39 (75.00)	48 (92.31)	5.696	0.017

tions. Our results are also consistent with others' data that are mentioned above, showing positive results by the application of timeliness incentive nursing.

Through the application of a variety of incentive approaches, on one hand, patients can have a correct understanding of training, which induces proper exercise patterns by changes in thought, emotion, attitude, and behavior, thereby standardizing the rehabilitation treatment and reducing the unnecessary pain caused by wrong behaviors. For example, in the early stage of training, the surgical site is interfered due to excessive extension and flexion of the limbs, which causes pain and even surgical wound hematoma. On the other hand, controlling pain can not only be achieved by strengthening normal physiological activities. When people are under an anxious circumstance, a subtle stimulus can produce severe pain, but when in a state of excitement, it will notably inhibit pain [23]. The timeliness incentive nursing can effectively provide positive suggestions to patients by spiritually enriching patients, improve their desire for rehabilitation training, and reduce pain responses [24]. Furthermore, a clear exercise goal for patients can solve the problems of "how to do the rehabilitation training" and "how much for the training", which

could avoid randomness and blindness during the training. At the same time, this can also allow patients to make continuous efforts to complete the goal by targeted, selective, and systematic training step by step, which stimulates the re-organization and compensation of the nerve tissue, prevents and controls muscle spasms, and avoids spastic paralysis [25].

In addition, after a follow-up of patients for 2 months after surgery, our results have found that the QOL in the research group is significantly higher than that of the control group, indicating that the timeliness incentive nursing also has good effects on CSM patients after surgery. Rehabilitation in the early period after surgery is of great importance to improving the daily life of patients in the later stage. Wang et al. have reported that the application of timeliness incentive nursing to patients with cerebral infraction could effectively improve patients' compliance, living ability, and QOL, which are consistent with our conclusions [26]. This may be due to the fact that timeliness incentive nursing encourages patients at different times, fully motivates patients' subjective initiative, cooperates with rehabilitation nursing, exploits patients' potential, and eventually benefits their recovery. What's more, nursing satisfaction study has revealed that the nursing satisfaction in the research group is also significantly higher than that of the control group, which suggests that the timeliness incentive nursing is efficient and suitable and is easily accepted by patients. However, this study has some caveats. For example, due to the limitation of time, human resources, and budget, the sample size of this study is small, and the participants are all from the same hospital. Thus, large-scale, multi-center research is preferred. Our conclusion is also affected by individual differences such as patient subjectivity, pathologic condition, and the type of surgery. Additionally, different levels of exercise may bias the results. Therefore, more investigations are needed in the future to further elucidate the effect of this nursing method on postoperative rehabilitation of CSM.

In summary, the timeliness incentive nursing can effectively promote postoperative rehabilitation of patients with CSM, reduce the pain, control the risk of complications, improve the QOL, and increase nursing satisfaction.

Disclosure of conflict of interest

None.

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