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Original Article

Application value of an integrated treatment model of orthopedic rehabilitation in patients undergoing total knee arthroplasty

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Abstract: Objective: To investigate the therapeutic effect of an integrated treatment model (ITM) of orthopedic rehabilitation on patients undergoing total knee arthroplasty (TKA). Methods: A total of 100 patients undergoing TKA in Linyi People's Hospital from December 2015 to December 2017 were selected and randomly divided into two groups. Patients in the control group were treated with the conventional rehabilitation mode, while those in the observation group were treated with an ITM of orthopedic rehabilitation. Clinical efficacy was compared between the two groups of patients, and observation indexes included a numerical rating scale (NRS) score, an active range of motion (AROM) score, a hospital for special surgery (HSS) score, a SF-12 score, and an activities of daily living Barthel index. Results: There were no significant differences in NRS score, AROM score, HSS score, SF-12 score, and Barthel index between the two groups of patients before operation. After operation, NRS scores in both groups showed decreasing trends, while AROM scores, HSS scores, SF-12 scores and Barthel index showed increasing trends. Moreover, the NRS scores in the observation group at 4, 12, and 24 weeks after operation were lower than those in the control group (all $P<0.05$), while AROM scores, HSS scores, and SF-12 scores in the observation group at 12 and 24 weeks after operation were higher than those in the control group (all $P<0.05$). The Barthel index in observation group at 24 weeks after operation was remarkably higher than that in the control group ($P<0.05$). Conclusion: The ITM of orthopedic rehabilitation can improve the recovery rate of the joint, relieve the pain during treatment, and increase the quality of life of patients undergoing TKA, which has a high value in clinical treatment.

Keywords: Integrated orthopedic rehabilitation, total knee arthroplasty, therapeutic effect, score

Introduction

Arthroplasty is needed for patients with severe knee arthritis, among which artificial total knee arthroplasty (TKA) is used more and more widely. In TKA, an artificial knee prosthesis is implanted into the body to simulate motion of knee joint in the body [1, 2]. According to clinical statistics, the success rate of TKA is higher, but a series of adverse reactions will also occur, which may lead to long-term knee joint pain and affect the patient's mental and physical health if there is no good rehabilitation nursing intervention after operation [3-5]. There are still considerable deficiencies in the clinical routine nursing mode, thus it cannot give full play to its function [6-8].

To ensure the quality of life of patients after operation, the postoperative treatment should be strengthened, including the integrated treatment model (ITM) of orthopedic rehabilitation, a new bio-physio-social medical model. In this treatment model, the orthopedic treatment is combined organically with the rehabilitation, and the medical nursing staff and rehabilitation nursing staff develop the clinical therapeutic regimen simultaneously used jointly in the treatment before and after operation, so as to improve the therapeutic effect of patients [9, 10]. The ITM has not been widely applied and studied in clinical practice. In this study, therefore, a total of 100 patients undergoing TKA in Linyi People's Hospital from December 2015 to December 2017 were selected and treated with conventional nursing and ITM of orthopedic rehabilitation, respectively, so as to explore the nursing efficacy of the latter in TKA and provide a more scientific basis for the clinical nursing model in the future. It is now reported as follows.

Materials and methods

Cases enrolled

A total of 100 patients undergoing TKA in Linyi People's Hospital from December 2015 to December 2017 were selected and randomly divided into two groups. There were a total of 50 cases in control group, including 27 males and 23 females with an average age of (55.48 ± 4.94) years and body mass index (BMI) of (20.64 ± 3.31) kg/m^2. There were a total of 50 cases in observation group, including 26 males and 24 females with an average age of (56.54 ± 5.54) years and BMI of (20.08 ± 2.83) kg/m^2. There were no significant differences in general clinical data between the two groups of patients (all P>0.05), and data were comparable. All patients were informed of the clinical protocol before treatment, and signed the informed consent. The protocol was approved by the Ethics Committee of Linyi People's Hospital.

Inclusion criteria: 1) patients meeting diagnostic criteria of knee osteoarthritis confirmed via pathological diagnosis; 2) patients meeting the criteria for artificial TKA; 3) patients without mental disorders, who had good compliance and could cooperate with the medical staff; 4) patients who received TKA for the first time.

Exclusion criteria: 1) patients with other knee-joint diseases; 2) patients with severe injury in heart, liver, kidney or other vital organs; 3) patients with relative severe deep venous thrombosis of the low limbs.

Methods

Patients in the control group were treated with conventional nursing intervention before operation, during postoperative hospitalization and before discharge. Before operation, medical workers explained the preoperative precautions and preparations to the patients in detail, and introduced the operation procedures and treatment purpose in simple terms. In order to prevent patients from infection after operation, the anti-infective, anti-inflammatory, and other conventional therapies were administered to the patients. In case of severe pain in patients, sedatives were injected appropriately, and postoperative rehabilitation training was given regularly, so that patients were able to adapt to artificial knee joint as soon as possible. Before discharge, medical workers provided detailed guidance on the exercise method after discharge, informed patients of precautions at home, and reminded patients to be reviewed within the prescribed time after discharge.

Patients in the observation group were treated with the ITM of orthopedic rehabilitation based on the conventional nursing mode in control group, and they were instructed before operation, after operation and before discharge. 1) Orthopedic nursing staff and rehabilitation nursing staff discussed the protocol before operation, and developed the protocol through the patient's clinical vital signs and pathological diagnosis results. The patient's knee joint motion ability and psychological status were major reference indexes. Before operation, a few nursing staff explained the operation and possible complications during operation to patients and their families, and introduced the rehabilitation nursing model conducted after operation, so that patients could further understand the ITM of orthopedic rehabilitation, and enhance the trust of this treatment model. In order to ensure a positive rehabilitation state after operation, patients were advised to take related rehabilitation exercises before operation, such as ankle training, quadriceps training, gluteal muscle contraction training, as well as body position transfer training, and pulmonary function training. In the entire process of exercise, the conditions of patients were considered. The amount of exercise was reduced appropriately if the patients failed to bear the exercise intensity, and a walking aid was used during exercise. At the beginning of exercise, it was possible that the patients were not proficient in using the instruments and could not seize the point in exercise, thus producing negative and irritable moods. If so, psychological counseling was appropriately given to disperse the patient's attention and improve their motivation. 2) One day after the operation, in order to avoid the occurrence of deep venous thrombosis, patients was asked to perform proper exercises to ensure the smooth blood flow in lower extremities and reduce the incidence of thrombus. For example, two pillows could be put under the operated calf to raise the lower extremity, so that the operated knee joint was

Table 1. Comparison of clinical data between the two groups of patients

Clinical data	Observation group	Control group	t/χ²	P
Gender (male/female)	26/24	27/23	0.149	0.799
Age (years)	56.54 ± 5.54	55.48 ± 4.94	0.893	0.465
BMI (kg/m²)	20.08 ± 2.83	20.64 ± 3.31	1.543	0.843
Replacement side (unilateral/bilateral)	35/15	32/18	0.987	0.564

Note: BMI, body mass index.

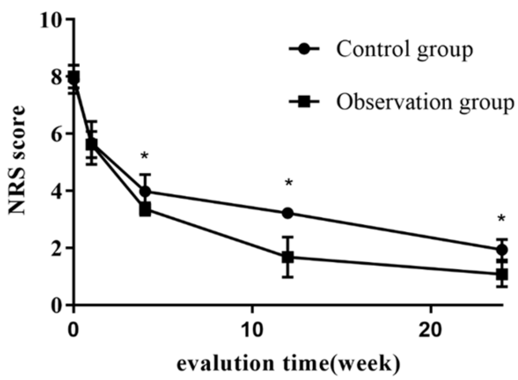

Figure 1. Trends in NRS score before and after operation between the two groups of patients. 0: before operation. *P<0.05. NRS, numerical rating scale.

in a hyperextension state and the blood circulation could be promoted. Rehabilitation nursing staff massaged the lower extremities and waist of patients, and paid particular attention to the massage strength during the process to avoid wound cracking. The wound was compressed by ice in dressing change within 1 week after operation, so as to relieve pain. Elastic socks were worn within 7 weeks after operation, and they were removed in advance if patients recovered well. In addition, the patella was taken up and rubbed to relax to avoid the impact on the wound. The patient remained from the lying position independently, got out of bed and sat on the chair, repeating for 3 days. To help patients adapt to the balancing pole as soon as possible within 3 days after the operation, they could practice walking with the help of walking aid early, but it would consume the patient's strength, so the energy was supplemented during training. After operation, the knee flexion was practiced under a supine position slowly until the full extension. 3) Before discharge, the patient's vital signs and physical conditions were scored, so as to develop the personalized exercise program. The main evaluation indexes included the motion of joint, balancing pole, walking ability, and adaptive ability to walking aid. Due to the artificial prosthesis implanted in the knee joint, strenuous activity was avoided to prevent infection and serious complications. Moreover, patients were told to be reviewed regularly in Linyi People's Hospital after discharge to check the implantation [11, 12].

Observation indexes and efficacy evaluation

Pain was compared between the two groups using the numerical rating scale (NRS) score. Recovery of knee joint function was compared between the two groups using the active range of motion (AROM) score. The functional status of the knee joint was compared between the two groups using the hospital for special surgery (HSS) score. Furthermore, the quality of life scale SF-12 was adopted to compare the physical component summary (PCS) and mental component summary (MCS) between the two groups. The Barthel index was used to compare the independent living ability between the two groups of patients. The above indexes were measured before operation (0), and at 1, 4, 12 and 24 weeks after operation.

Statistical processing

SPSS 19.0 software was used for the statistical analyses of data. Measurement data are presented as mean ± standard deviation ($\bar{x}$ ± sd), Chi-square test was used for quantitative data, and the t test was adopted for the intergroup comparisons of means. P<0.05 suggests that the difference is statistically significant.

Results

Comparisons of clinical data between the two groups of patients

There were no significant differences in general clinical data, such as gender, age, body mass index, and replacement side, between the two groups of patients (all P>0.05). In the observation group, there were 26 males and 24 females with an average age of (56.54 ± 5.54) years

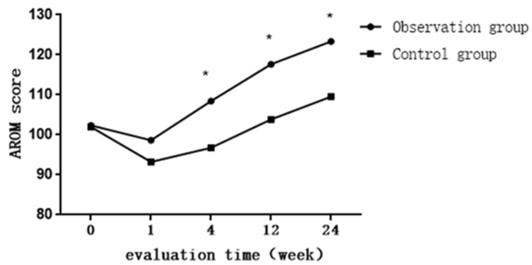

Figure 2. Trends in AROM score before and after operation between the two groups of patients. 0, before operation. *P<0.05. AROM, active range of motion.

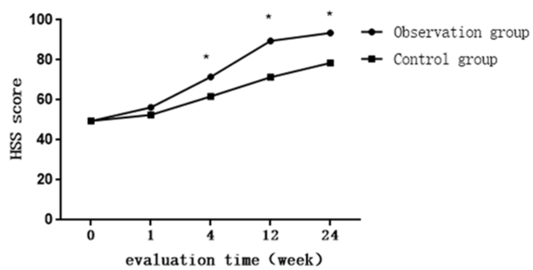

Figure 3. Trends in HSS score before and after operation between the two groups of patients. 0, before operation. *P<0.05. HSS, hospital for special surgery.

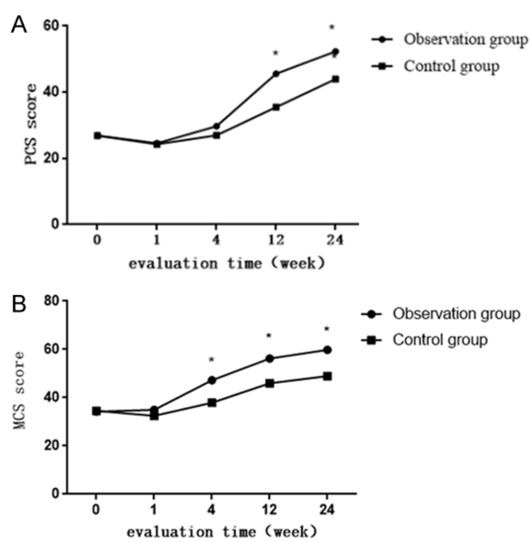

Figure 4. Comparisons of SF-12 score before and after operation between the two groups of patients. 0, before operation. *P<0.05. A: Trends in PCS score before and after operation between the two groups of patients. B: Trends in MCS score before and after operation between the two groups of patients. PCS, physical component summary; MCS, mental component summary.

and BMI of (20.08 ± 2.83) kg/m^2, including 35 cases of unilateral replacement and 15 cases of bilateral replacement. In the control group, there were 27 males and 23 females with an average age of (55.48 ± 4.94) years and BMI of (20.64 ± 3.31) kg/m^2, including 32 cases of unilateral replacement and 18 cases of bilateral replacement (**Table 1**).

Comparisons of NRS score before and after operation between the two groups of patients

There was no significant difference in the NRS scores before operation between the two groups of patients. After operation, NRS scores in both groups were decreased, and the degree of decline in the observation group was significantly higher than that in the control group. At 4, 12, and 24 weeks after operation, NRS scores in the observation group were significantly lower than those in the control group (all P<0.05), and differences were statistically significant (**Figure 1**).

Comparisons of AROM score before and after operation between the two groups of patients

The AROM score had no significant difference before operation between the two groups. It was decreased at 1 week after operation and increased at 4, 12, and 24 weeks after operation, and the degree of increase in the observation group was significantly higher than that in the control group. The AROM scores in the observation group were significantly higher than those in the control group (P<0.05), and the difference was statistically significant (**Figure 2**).

Comparisons of HSS score before and after operation between the two groups of patients

No difference was found in the HSS score before operation between the two groups of patients. HSS scores in both groups displayed increasing trends after operation, and the degree of increase in the observation group was higher than that in the control group. HSS scores in the observation group at 4, 12, and 24 weeks after operation were higher than those in the control group (all P<0.05), showing statistically significant differences (**Figure 3**).

Comparisons of SF-12 score before and after operation between the two groups of patients

PCS scores in both groups displayed increasing trends, and they were significantly higher in the

Table 2. Comparison of Barthel index between the two groups of patients

Group	Before operation	Twenty-four weeks after operation
Control group	75.44 ± 9.08	98.14 ± 5.97
Observation group	76.44 ± 9.74	118.05 ± 9.44
P	0.987	0.032

observation group at 12 and 24 weeks after operation than those in the control group (both P<0.05), showing statistically significant differences. There were no significant differences in the MCS score before operation and at 1 week after operation between the two groups. MCS scores in observation group at 4, 12, and 24 weeks after operation were remarkably higher than those in the control group (all P<0.05), and differences were statistically significant (**Figure 4**).

Comparison of Barthel index between the two groups of patients

The Barthel index in the observation group ((76.44 ± 9.74) points) was similar to that in the control group ((75.44 ± 9.08) points). At 24 weeks after operation, the Barthel index was (118.05 ± 9.44) points in the observation group and (98.14 ± 5.97) points in the control group, indicating that the Barthel index in the observation group at 24 weeks after operation was remarkably higher than that in the control group (P<0.05), and there was a statistically significant difference (**Table 2**).

Discussion

Knee osteoarthritis is more common in the elderly, causing great inconvenience to patients once it attacks. In addition to difficulty in mobility, severe pain will also be produced, so the treatment of disease is particularly important [13, 14]. Currently, TKA is applied, in which the prosthesis is implanted into the knee joint, thereby improving the knee lesion. However, a series of complications, such as infection, inflammation and arthrofibrosis, may occur after operation. Studies have demonstrated that the complication is mainly related to the joint motion before operation, individual differences of patients, and position of intraoperative prosthesis implantation, so perioperative nursing intervention plays a key role [15, 16].

Conventional treatment is mainly used in TKA nursing intervention, but the nursing efficacy is poor without better therapeutic effect, and the incidences of infection and inflammation are relative higher in patients. Currently, the ITM of orthopedic rehabilitation, a new treatment model, has begun to be applied in the treatment, and such a model consists of orthopedic nursing staff and rehabilitation nursing staff, thus avoiding the single treatment. Both orthopedic and rehabilitation nursing staff, as a treatment team, discuss the pathological symptoms of patients, so that the treatment concepts of not only orthopedics but also rehabilitation are adopted in the treatment. Reuter et al. developed sounder rehabilitation programs through combination of orthopedics and rehabilitation to improve the recovery of patients to the maximum degree [17, 18]. An ITM of orthopedic rehabilitation is performed before operation, after operation and before discharge, including health education and explanation of operation before operation, choices of body position during operation, rehabilitation training after operation, and follow-ups after discharge, thereby developing a detailed clinical protocol. Such a treatment model can raise the enthusiasm of patients for medical treatment, improve the functional recovery of knee joint and reduce the occurrence of complications.

Results of this study demonstrate that AROM scores in observation group at 12 and 24 weeks after operation are significantly higher than those in control group, indicating that the recovery of knee joint in observation group was significantly superior to that in control group. Muscle weakness in the lower extremity might occur in patients with knee arthritis, and the postoperative muscle strength in the lower extremity declined more seriously due to the influence of operation. Research suggested that the muscle strength was also related to the efficacy of rehabilitation nursing, and the timely and effective postoperative rehabilitation could help recover the muscle strength effectively. Results of this study also fully illustrated that the ITM of orthopedic rehabilitation could significantly improve the recovery of knee joint. Furthermore, the HSS scores in the observation group were also remarkably higher than those in the control group after operation, and the daily living ability in the observation group was significantly better than that in the control group, which might be related to the massage of ankle joint, knee joint and waist during rehabilitation. In addition, the correct body position training and translocation training could also improve the quality of life, which was consistent with the previous research [19].

The Barthel indexes in the observation group at 12 and 24 weeks after operation were remarkably higher than those in control group (both $P<0.05$), also fully illustrating the above conclusions. The findings in this study were similar to those in the previous research [20]. Furthermore, in this study, NRS scores in the observation group at 12 and 24 weeks after operation were obviously lower than those in the control group, suggesting that the ITM of orthopedic rehabilitation could significantly relieve the pain. Research suggested that severe pain would be generally produced in patients after TKA, thus reducing the satisfaction with surgical results. The postoperative pain was caused by several reasons, such as infection, improper location of prosthesis implantation, and knee lesions. The possible reason for the significantly higher scores in the observation group at 12 and 24 weeks after operation than those in the control group was related to the effective and correct rehabilitation training. Moreover, medical workers actively communicated with patients throughout the rehabilitation, so as to improve the patient's enthusiasm for treatment and reduce the patient's pain. The SF-12 scores in the observation group at 12 and 24 weeks after operation were obviously higher than those in the control group, which was also evidence for the above conclusions. However, comparative analysis was not conducted from the biochemical indexes related to knee joint and the molecular mechanism, so further in-depth research is still needed.

In conclusion, an ITM of orthopedic rehabilitation can remarkably improve the rehabilitation efficacy, relieve the pain during treatment, accelerate the functional recovery of knee joint and lower extremities, and increase the quality of life of patients undergoing TKA. Therefore, it is worthy of clinical promotion and application. In this study, the effect of ITM of orthopedic rehabilitation was discussed using multiple scoring scales.

Disclosure of conflict of interest

None.

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