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Original Article

Effects of rehabilitation training on joint function, self-care ability and quality of life of patients undergoing TKA

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Abstract: Objective: To analyze the effect of early rehabilitation training on restoration of knee function of patients undergoing total knee arthroplasty (TKA). Methods: Ninety patients undergoing TKA in our hospital from March 2016 to March 2017 were included, of which 40 patients received routine nursing care as the control group, and the remaining 50 patients received additional rehabilitation training as the study group. The hospital stay, fracture healing time, recovery of knee function, psychological status, quality of life (QL), visual analogue scale (VAS) score and patient satisfaction were compared between the two groups. Results: The hospital stay and fracture healing time in the study group were shorter than those in control group ($P < 0.05$). Besides, patients in study group were less anxious and showed enhanced knee function and self-care ability, higher QL, as well as higher VAS and satisfaction than those in control group ($P < 0.05$ for each comparison). Conclusion: Rehabilitation training promotes postoperative recovery and improves self-care ability and QL for patients undergoing TKA.

Keywords: Total knee arthroplasty, rehabilitation training, postoperative recovery

Introduction

Following the aging of the general population and the modern changes of life style, the prevalence of knee osteoarthritis (KOA) has been increasing annually in China, with over 20 million patients diagnosed so far [1]. It is conservatively estimated that there are 50,000 to 70,000 patients undergoing artificial joint replacements in China every year, and this number is on the rise [2, 3]. Owing to continuous progress in improving biomaterials and biomechanics, total knee arthroplasty (TKA) has become an effective method to treat knee joint diseases. It can solve joint pain and joint deformities, improve function of affected limbs, enhance quality of life (QL), and maximize the restoration of joint function [4-6]. Patients with severe joint pain and severe dysfunction have a potential need for artificial joint replacement. In addition, TKA is required for those with rheumatoid arthritis and other end-stage knee diseases [7]. TKA has been clinically confirmed to have a positive effect on patient's living ability, pain relief, and joint function [8, 9], and its implementation in major hospitals is also increasing annually. However, TKA may induce a long-term decrease in muscle strength around the knee joint [10], making typical orthopedic rehabilitation unable to meet patients' requirements for rehabilitation and QL improvement [11]. Rapid rehabilitation contributes to pain relief and shortening of hospital stay [12]. Pagnotta et al. reveal that rapid rehabilitation program not only evidently shortens the hospital stay, but also significantly accelerates functional recovery [13]. Stevens JE believes that a continuous weakness in the strength of the quadriceps femoris after surgery is directly related to a lag in rehabilitation measures [14]. Final outcomes of TKA are closely associated with postoperative rehabilitation. Correct and standardized rehabilitation measures can greatly restore function of pros-

Table 1. Comparison of recovery of patients (x ± sd)

Group	n	Hospital stay (d)	Fracture healing time (d)
Control group	40	9.53±1.78	120.63±17.61
Study group	50	7.86±1.24	103.42±14.74
t	-	5.236	5.047
P	-	< 0.001	< 0.001

thetic knee joints, reduce complications and improve postoperative efficacy, as well as solve the decline of muscle strength [15-17].

Therefore, in the present study, 90 patients undergoing TKA were enrolled, and the therapeutic effects of comprehensive rehabilitation measures and routine nursing care were compared.

Materials and methods

General data

Ninety patients who were diagnosed with OA, rheumatoid arthritis (RA) and traumatic arthritis (TA) who underwent primary unilateral TKA from March 2016 to March 2017 were included. Patients who received routine nursing care were allocated into a control group (n=40, 23 males and 17 females, age: (51.87±6.94) years, course of disease: (3.64±1.28) years). Those that received additional rehabilitation training were placed into a study group (n=50, 31 males and 19 females, age: (52.47±6.18) years, course of disease: (52.47±6.18) years). There was no significant in sex, age, course of disease and other general data between the two groups (P > 0.05). Diagnostic criteria for knee OA were developed by the American College of Rheumatology (ACR) in 2001 [18], and those for RA were proposed in 1987 [19]. The present study was approved by the ethics committee of our hospital. Inclusion criteria: patients met the diagnostic criteria of KOA, RA, TA and accorded with surgical indications of TKA; patients were treated by primary unilateral cemented TKA; patients were operated on by doctors of the same team, and had accurate implantation of prosthesis tested by comprehensive X-ray and CT examinations; patients did not suffer from serious internal diseases or neurosis before surgery, and actively participated in treatment and functional training after surgery; patients were 45-65 years old; all participants signed the informed consent form voluntarily. Exclusion criteria: patients with joint infection, tuberculosis, or osteomyelitis, as well as those with severe limitations in walking due to underlying diseases; patients with serious deformities and limited daily activities caused by diseases of the hip, ankle and other joints due to serious knee joint diseases and injuries; patients with mental illness.

Grouping and rehabilitation training

Patients were allocated into the study group and control group according to different rehabilitation measures. General training measures; included deep breathing and cough training, raising affected limbs, ice compression of affected knees, and centripetal massage, were carried out in the control group. Rehabilitation training was performed in the study group; range of motion (ROM) training, active limb flexion/extension and weight-bearing training, as well as intensive muscle strengthening were added in addition to the routine training. ROM training: continuous passive motion (CPM) devices were used for training from the 2nd day after surgery, twice a day for 40-60 min each. The ROM was controlled at 0°-30° first, and then increased by 10° daily. The angle of each training was 15°-25° lower than the previous one, then increased gradually until the knee joint reached 95-110° flexion and 0° extension. From slow to fast, the training intensity was kept within the tolerance of patients. After 3 days, active limb flexion/extension exercises were initiated for muscle strengthening. Weight-bearing training after one week: walker-assisted sitting exercises, adaptive standing exercises, and walking exercises were performed. Intensive muscle strengthening: isometric muscle strength of quadriceps femoris and hamstring muscles, progressive resistance exercises, isometric strength of triceps calf and anterior tibialis muscles, leg-press exercises, straight leg raising exercises were performed.

Efficacy assessment

Postoperative recovery of knee joints was evaluated with New York Hospital for Special Surgery (HSS) knee score [20] (one of the most commonly used rating scales after TKA with high reliability and validity). It comprises seven items and has a full score of 100: excel-

Table 2. Excellent + good rate assessed by HHS [n (%)]

Group	n	Excellent	Good	Fair	Poor	Excellent + good
Control group	40	10 (25.00)	15 (37.50)	11 (27.50)	4 (10.00)	25 (62.50)
Study group	50	16 (32.00)	25 (50.00)	7 (14.00)	2 (4.00)	41 (82.00)
χ^2	-	-	-	-	-	4.321
P	-	-	-	-	-	0.038

Table 3. Comparison of Functional Independence (x ± sd)

Group	n	Before intervention	Three months after intervention
Control group	40	51.70±8.72	69.67±7.25*
Study group	50	50.31±9.69	74.91±7.53*
t	-	0.707	3.335
P	-	0.482	0.001

Note: *P < 0.05 *vs.* same group before intervention.

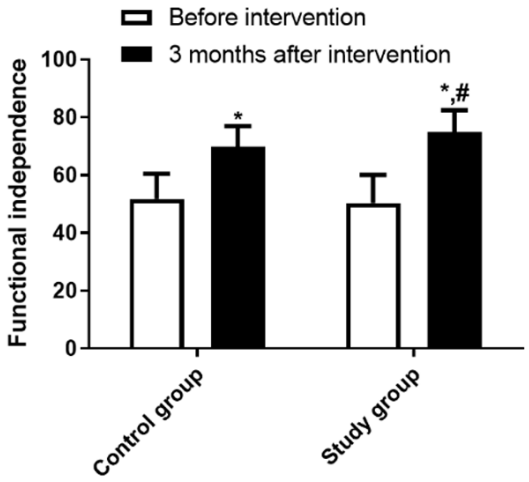

Figure 1. Comparison of functional independence. There was no significant difference in functional independence between the two groups before intervention (P > 0.05). After intervention, the functional independence in the two groups improved significantly (P < 0.05), and the score in the study group was higher than that in the control group (P < 0.05).

lent ≥ 85, good > 70-84, fair > 60-69, poor < 60. Excellent + good rate (%) = cases of (excellent + good)/total cases * 100%. The commonly used quality of life index (QL-Index) questionnaire [21] was used to evaluate the QL three months after surgery from 5 dimensions, activity, daily living, health, support and outlook. Each dimension was scored 0-2 points, and the total score was 10 points. The higher the score, the better the QL of patients. Function independent measure (FIM) [22] is an 18-item scale used to estimate the ability of independent living of patients three months after surgery. The scale includes two dimensions: motor (13 items, scored 13-91) and cognition (5 items, scored 5-35), and is graded by 7 levels (7 for complete independence and 1 for complete dependence). The scores range from 18 to 126, with 126-108 indicating moderate independence and 53-18 indicating moderate dependence. Visual analogue scale (VAS) was employed for pain evaluation, with scores ranging from 0 (no pain) to 10 (severe pain). Self-made satisfaction questionnaires were developed to compare the satisfaction of patients, including satisfaction scores, reasons and suggestions. Scores of 1-4 were considered to be highly satisfied, satisfied, moderately satisfied and dissatisfied, respectively. Total satisfaction = (cases of highly satisfied + satisfied)/total cases ×100%.

Statistical processing

SPSS 22.0 statistical software was used for data processing. Counting data were expressed in numbers and percentages, and the comparison was conducted by χ^2 test. Measurement data were expressed by "x ± sd" and analyzed by t test. Differences were statistically significant at P < 0.05.

Results

Comparison of recovery of patients after intervention

After intervention, patients in the study group showed shorter hospital stay and fracture healing time than those in the control group [(7.86±1.24 d *vs.* 9.53±1.78 d), (103.42±14.74 d *vs.* 120.63±17.61 d)] (P < 0.05 for each comparison) (**Table 1**).

Restoration of joint function

The excellent + good rate of joint function restoration in the study group was 82.00%,

Table 4. Comparison of SAS score (x ± sd)

Group	n	Anxiety	Depression	Interpersonal sensitivity
Control group	40	2.63±0.62	2.55±0.43	2.60±0.51
Study group	50	2.25±0.58	2.12±0.46	2.03±0.43
t	-	2.995	4.535	5.752
P	-	0.004	< 0.001	< 0.001

Table 5. Comparison of QL (x ± sd)

Group	n	Before intervention	Three months after intervention
Control group	40	4.52±1.12	5.34±1.45*
Study group	50	4.49±1.30	6.22±1.93*
t	-	0.116	2.393
P	-	0.908	0.019

Note: *P < 0.05 *vs.* same group before intervention.

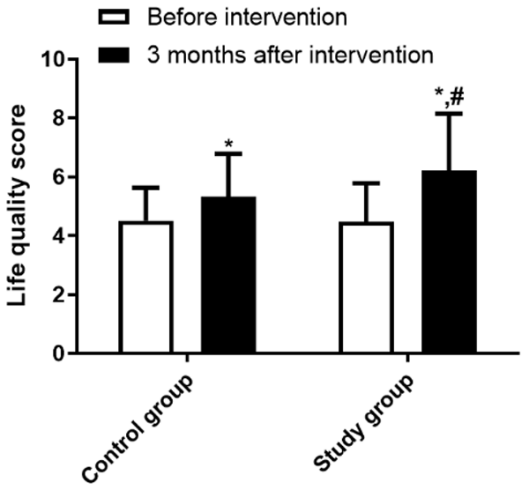

Figure 2. Comparison of quality of life. There was no significant difference between the two groups before intervention (P > 0.05). After intervention, the quality of life of the two groups of patients was significantly enhanced (P < 0.05), and the score in the study group was higher than that in the control group (P < 0.05).

remarkably higher than 62.50% in the control group (P < 0.05) (**Table 2**).

Comparison of functional independence

There was no significant difference in functional independence between the two groups before intervention (P > 0.05). Whereas after intervention, differences between groups over time were statistically significant (P < 0.05), indicating that the functional independence of patients improved over time. The FIM score in the study group was higher than that in the control group (**Table 3** and **Figure 1**).

Comparison of psychological status

Scores of anxiety, depression and interpersonal sensitivity in the study group were lower than those in the control group after intervention (P < 0.05) (**Table 4**).

Comparison of QL

The QL was found to have no significant difference between groups before intervention (P > 0.05). QL was enhanced after intervention, and the QL score in the study group was higher than that in the control group (P < 0.05) (**Table 5** and **Figure 2**).

Comparison of VAS score

The VAS score in both groups decreased after intervention, and the study group score was remarkably lower than the control group before discharge and one month after intervention (P < 0.05). There was no significant difference in VAS scores between the two groups 6 months after intervention (P > 0.05) (**Table 6**).

Comparison of patient satisfaction

In the study group, 30 patients were highly satisfied with the intervention, and 13 were satisfied, with a total satisfaction rate of 86.00%. Whereas 17 patients were highly satisfied and 9 were satisfied in the control group, with a total satisfaction rate of 65.00%. The patient satisfaction in the study group was higher than that in control group (P < 0.05) (**Table 7**).

Discussion

TKA is mainly adopted to treat severe joint pain and deformity, as well as patients with knee diseases who received ineffective conservative treatments [23]. With the aggravation of social aging and people's pursuit of higher QL, the number of patients requiring TKA has increased annually. Arthroplasties help patients with hip and knee dysfunctions to restore joint function, however, they are often accompanied by long term consequences in decreased muscle strength of the affected limbs [7, 24]. Patients undergoing TKA and total hip arthroplasty often suffer from pain, joint edema, decreased muscle strength and mobility. There-

Table 6. Comparison of VAS score (x ± sd)

Group	n	Before discharge	One month after intervention	Six months after intervention
Control group	40	6.33±1.30	4.01±1.13*	0.72±0.64*,#
Study group	50	4.92±0.70	2.74±0.75*	0.66±0.68*,#
t	-	6.575	6.385	0.427
P	-	< 0.001	< 0.001	0.671

Note: *P < 0.05 *vs.* same group before discharge; #P < 0.05 vs. same group 1 month after intervention.

Table 7. Comparison of patient satisfaction [n (%)]

Group	n	Highly satisfied	Satisfied	Moderately satisfied	Dissatisfied	Total satisfaction
Control group	40	17 (42.50)	9 (22.50)	13 (32.50)	1 (2.50)	26 (65.00)
Study group	50	30 (60.00)	13 (26.00)	6 (12.00)	1 (2.00)	43 (86.00)
t	-	-	-	-	-	5.478
P	-	-	-	-	-	0.019

fore, it is necessary to recover the muscle strength of patients as early as possible [25].

Systematic rehabilitation training is a comprehensive and targeted guidance for postoperative functional exercises, making the implementation and management of rehabilitation more standardized, comprehensive and effective. Moreover, it encourages patients to actively participate in the postoperative rehabilitation process, so as to better improve the self-care ability, and ultimately enhance the QL of patients [26-28]. In this study, we applied rehabilitation training to the postoperative rehabilitation of patients undergoing TKA. It turned out that the scores of joint function, independent ability and QL in the study group were remarkably higher than those in the control group, which suggests that rehabilitation training promotes the restoration of knee function and is beneficial to the improvement of postoperative QL. After rehabilitation exercises and muscle strengthening, the motor function of patients was evidently enhanced. In addition, the measures of CPM training, vital sign monitoring, timely communication, feeling exchanges, step-by-step exercises, detailed explanation of relevant knowledge, and exercise guidance enhanced patients' cognition of the disease and eliminated negative emotions, as well as increased their compliance with rehabilitation exercise and effectively promoted the recovery of joint motion function. The hospital stay and fracture healing time in the study group after training were shorter than those in the control group (P < 0.05). Similar to our conclusion, Berend et al. reveals that a rapid recovery protocol resulted in a significant reduction in hospital stay and hospitalization rates in patients with primary TKA [29]. Therefore, rapid rehabilitation training can effectively shorten the duration of postoperative rehabilitation. The possible reason may lie in the fact that it avoids a long healing time and insignificant effects of traditional treatments. Besides, fast and effective exercises speed up the postoperative rehabilitation process without weakening the therapeutic effects. Professional rehabilitation training is able to alleviate this kind of physical and mental discomfort induced by arthroplasties, as well as accelerate recovery, build a harmonious doctor-patient relationship, reduce nurse-patient conflicts, and improve patients' satisfaction with treatment. In this study, the total satisfaction in study group was higher than that in control group (86.00% *vs.* 65.00%) (P < 0.05). Although the pain score in the study group was not significantly different from that in control group 6 months after surgery, it was lower than control group before discharge and 1 month after surgery (P < 0.05). The scores of anxiety, depression and interpersonal sensitivity in the study group were decreased after intervention as well. Swank AM revealed that functional training based on lower limb muscle strength before TKA enhances limb function, relieves clinical symptoms and improves activities of daily living (ADL) ability [30]. Multiple exercise protocols including isotonic, isometric, isokinetic concentric, isokinetic eccentric exercises or their combinations are available in training.

All these indicate that professional rehabilitation training can relieve pain and promote the recovery of joint function. The application of rapid rehabilitation training for patients after TKA contributes to the reduction of complications and the alleviation of postoperative pain. It also enables patients to cooperate with postoperative treatment and rehabilitation exercise more actively, and improves their satisfaction with the treatment.

In summary, rehabilitation training promotes postoperative recovery and improves self-care ability and QL for patients undergoing TKA.

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Disclosure of conflict of interest

None.

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