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Effect of knee joint function training on joint functional rehabilitation after knee replacement

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Abstract

This retrospective study investigated the effect of knee joint function training (KJFT) on joint functional rehabilitation after knee replacement in Chinese patients with severe knee osteoarthritis (KOA).

Eighty-six eligible patients with severe KOA were included. Of those, 43 patients in the intervention group received KJFT and educational program, while the other 43 patients received educational program only. Primary outcome was measured by the Western Ontario and McMaster Universities Arthritis Index (WOMAC). Secondary outcomes were measured by the visual analogue scale (VAS), and Knee Injury and Osteoarthritis Outcome Score (KOOS). All outcomes were assessed at baseline, 1 week before and 3 months after the surgery.

Patients in the intervention group showed encouraging benefit neither at 1 week before nor 3 months after the surgery in all outcome measurements, including WOMAC, VAS, and KOOS, when compared with the patients in the control group.

The results of this study did not show promising effect of KJFT for joint functional rehabilitation in Chinese patients with KOA after KJR.

Abbreviations: JFR = joint functional rehabilitation, KJFT = knee joint function training, KJR = knee joint replacement, KOA = knee osteoarthritis, KOOS = Knee Injury and Osteoarthritis Outcome Score, OA = Osteoarthritis, VAS = visual analogue scale, WOMAC = Western Ontario and McMaster Universities Arthritis Index.

Keywords: joint functional rehabilitation, knee joint function training, knee joint replacement, knee osteoarthritis

1. Introduction

Osteoarthritis (OA) is the one of most common joint disorder with pain, function loss, and disability among the older population.[1,2] It is also the second most common reasons for the elderly to visit the doctor and ask for medical care.[3] Knee osteoarthritis (KOA) is the most common conditions of the OA disease. It is reported that KOA incidence is still increasing with the progression of population aging in China.[4,5] It has been estimated that more than 29.25% women and 24.71% men of the population over 70 years old still suffer from such condition.[4–6]

If KOA cannot be treated properly and effectively, it will result in severe condition.[7–9] Under such situation, patients often suffer from severe pain and disability, and poor function and quality of life.[10] The preferred treatment option for treating such condition is knee joint replacement (KJR).[11–13] However, some patients still suffer from severe knee pain and poor quality of life after KJR.[14,15]

It has been reported that knee joint function training (KJFT) on joint functional rehabilitation (JFR) after KJR may benefit the patients with severe KOA.[16–19] However, the results of other studies demonstrated that KJR did not show beneficial effects on postoperative functional recovery in patients with severe KOA.[20,21] Based on this inconsistent conclusion, and limited available data regarding the effect of KJFT on JFR after KJR among Chinese patients with severe KOA, this study tried to explore the effect of KJFT on JFR in severe KOA.

2. Methods and design

2.1. Design

This retrospective study was approved by the Ethical Committee of First Affiliated Hospital of Jiamusi University. All the patient cases were selected from January 2016 to December 2017 at this hospital. All patients had provided written informed consent.

This study included 86 eligible Chinese patients with severe KOA. All these patients were divided into an intervention group and a control group equally, and all of them received educational program before the surgery. In addition, patients in the intervention group also underwent KJFT before the KJR. All outcome data were analyzed and assessed 1 week before and 3 months after the surgery.

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S-cL and Z-lH contributed equally to this study.

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2.2. Patients

Patients with severe KOA waiting for KJR were included in this study. We included patients with following criteria: 50 to 85 years old; had severe KOA before the KJR. However, patients were excluded if they had cognitive problems; history of KJR before this study; planned moving to other cities within 1 month after eligible assessment; refused to accept training and/or educational program; could not walk at least 3 m; received KJFT before this study; and had insufficient data from the patient cases.

2.3. Treatment schedule

All patients in both groups received educational program before KJR. The educational program was taught by an experienced physical therapist, 2 sessions weekly for a total of 4 weeks before the KJR. It mainly introduced the patients about the anatomy of knee joint and its adjacent functional structures, as well as the pain management and rehabilitation care after the surgery.

Additionally, the patients in the intervention group also underwent KJFT on JFR after KJR. KJFT aimed to enhance the functional stability of the weight-bearing muscles of attached knee joint after the surgery. It was also trained by 2 experienced physical therapists.[22] This training program includes 3 parts with warming up, training sessions, and coiling down. The warming up part includes ergometer cycling for 15 minutes with workload increased gradually to warm up the knee joint. The training session part consists of training exercises of attached knee stability, muscle strength, and knee function. This session is performed 30 minutes daily, 3 sessions weekly for a total of 6 weeks before the surgery. The coiling down session comprises walking exercises for 10 minutes. In this session, patients were required to walk backward and forward, and also performed exercises of stretch and mobility for the attached knee muscles.

2.4. Outcome measurements

Primary outcome was measured by the Western Ontario and McMaster Universities Arthritis Index (WOMAC).[23] It was used to evaluate the pain (5 items, each item ranges from 0 [no pain] to 4 [extreme pain]), stiffness (2 items, each item ranges from 0 [no problem with stiffness] to 4 [extreme stiffness]), and function (17 items, each item ranges from 0 [no problem with functional activities] to 4 [extreme difficulty of functional activities]) of attacked knees.[23]

Secondary outcomes of pain intensity at knees were measured by 0 to 10 cm visual analogue scale (VAS), with 0 of no pain, and 10 of the severest pain.[24] Additionally, knee function and pain are also measured by the self-reported Knee Injury and Osteoarthritis Outcome Score (KOOS).[25] This tool consists of 5 subscales with a total of 42 items. Each subscale is transformed to a 0 to 100 scale, with 0, extreme knee problems and 100, no knee problems. All outcomes were measured at baseline (8 weeks before the surgery), 1 week before and 3 months after the surgery.

2.5. Statistical analysis

All baseline, primary, and secondary data were analyzed by a statistician using SPSS Statistics 17.0 (IBM Corp, Armonk, NY). The categorical data was analyzed by Chi-square test. The continuous data was analyzed by the Wilcoxon-Rank sum test. $P < .05$ was considered as the statistical significance.

Table 1

Characteristics of included patients.

Characteristics	Intervention group (n = 43)	Control group (n = 43)	*P* value
Mean age, y	72.1 (7.4)	73.3 (6.9)	.44
Gender			
Male	16 (37.2)	13 (30.2)	.49
Female	27 (62.8)	30 (69.8)	—
Race (Asian Chinese)	43 (100.0)	43 (100.0)	—
BMI, kg/m^2	27.0 (3.3)	26.8 (3.6)	.79
Duration of symptoms, y	15.8 (4.4)	16.4 (4.7)	.54
Time to surgery, y	8.2 (2.5)	8.3 (2.8)	.86
VAS scale	7.5 (1.8)	7.7 (1.6)	.59
WOMAC score			
Total	61.4 (10.9)	62.2 (11.1)	.74
Pain	14.3 (3.5)	15.1 (3.8)	.31
Stiffness	4.8 (1.4)	5.0 (1.7)	.55
Function	41.6 (9.3)	42.5 (8.9)	.65
KOOS score			
Pain	76.8 (9.7)	77.2 (10.2)	.85
Function in daily living	78.9 (14.7)	80.4 (16.0)	.65
Symptoms	73.8 (12.4)	74.6 (13.1)	.77
Sport and recreation	40.1 (10.7)	42.2 (9.9)	.34
Quality of life	50.3 (17.2)	52.7 (16.6)	.51
Previous treatment			
Medications	43 (100.0)	43 (100.0)	—
Physical therapy	20 (46.5)	24 (55.8)	.39
Exercise	10 (23.3)	12 (27.9)	.62
Acupuncture	19 (44.2)	15 (34.9)	.38

Note: Data are present as mean ± standard deviation or number (%); BMI = body mass index, KOOS = Knee Injury and Osteoarthritis Outcome Score, VAS = visual analogue scale, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

3. Results

The basic characteristics of 86 patients in both groups are showed in Table 1. No significant differences were found in each characteristic between 2 groups. These items consist of age, gender, body mass index, duration of symptoms, time to surgery, mean VAS, WOMAC, and KOOS scores, as well the previous treatment information.

One week before the surgery, no significant differences were found between 2 groups in VAS ($P = .50$), WOMAC (pain, $P = .49$; stiffness, $P = .68$; function, $P = .55$), and KOOS (pain, $P = .051$; function in daily living, $P = .37$; symptoms, $P = .39$; sport and recreation, $P = .64$; and quality of life, $P = .58$) scores (Tables 2 and 3).

Three months after the surgery, all outcomes in the intervention group did not show better outcomes than those in the control group, with VAS ($P = .47$), WOMAC (pain, $P = .25$; stiffness, $P = .44$; function, $P = .16$), and KOOS (pain, $P = .19$; function in daily living, $P = .28$; symptoms, $P = .22$; sport and recreation, $P = .31$; and quality of life, $P = .14$) (Tables 4–6).

4. Discussion

Previous related studies evaluated the effect of KJFT for patients with KOA. One study investigated physical training in rehabilitation programs in patients with hip and knee arthroplasty.[19] It found that physical training cannot benefit patients before hip or knee arthroplasty.[19] However, it may benefit patients after the total hip arthroplasty (THA).[19] The other study utilized a 6-week training intervention for patients with THA or total knee arthroplasty (TKA) prior to surgery.[20] The results showed that

Table 2

Change of WOMAC at 1-wk before surgery (change from baseline).

WOMAC	Intervention group (n = 43)	Control group (n = 43)	Difference	*P* value
Total	−5.4 (−7.3, −3.9)	−2.6 (−3.7, −1.8)	−2.8 (−3.3, −2.2)	.42
Pain	−1.9 (−3.0, −1.1)	−1.0 (−1.8, −0.4)	−0.9 (−1.4, −0.5)	.49
Stiffness	−0.5 (−0.9, −0.2)	−0.2 (−0.6, −0.1)	−0.3 (−0.5, −0.1)	.68
Function	−3.1 (−4.5, −2.2)	−1.4 (−2.9, −0.6)	−1.6 (−2.3, −1.1)	.55

Note: Data are present as mean ± standard deviation; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

Table 3

Change of KOOS score at 1-wk before surgery (change from baseline).

KOOS score	Intervention group (n = 43)	Control group (n = 43)	Difference	*P* value
Pain	−10.2 (−16.2, −6.3)	−5.6 (−8.4, −3.3)	−4.3 (−5.1, −4.0)	.51
Function in daily living	−6.4 (−8.9, −4.4)	−4.5 (−6.1, −3.0)	−1.8 (−2.7, −1.0)	.37
Symptoms	−5.7 (−7.6, −4.3)	−4.1 (−6.6, −2.7)	−1.6 (−2.4, −0.9)	.39
Sport and recreation	−4.9 (−6.0, −3.2)	−3.8 (−5.1, −2.4)	−1.1 (−2.0, −0.3)	.64
Quality of life	−5.3 (−7.1, −3.6)	−4.0 (−5.3, −2.8)	−1.3 (−2.2, −0.4)	.58

Note: Data are present as mean ± standard deviation; KOOS = Knee Injury and Osteoarthritis Outcome Score.

Table 4

Change of VAS at 1-wk before surgery and 3-mo after the surgery (change from baseline).

VAS	Intervention group (n = 43)	Control group (n = 43)	Difference	*P* value
1-wk before surgery	−1.1 (−2.0, −0.3)	−0.5 (−0.9, −0.2)	−0.6 (−1.0, −0.1)	.50
3-mo after the surgery	−5.2 (−6.5, −4.1)	−4.3 (−5.4, −3.0)	−0.9 (−1.6, −0.3)	.47

Note: Data are present as mean ± standard deviation; VAS = visual analogue scale.

Table 5

Change of WOMAC at 3-mo after the surgery (change from baseline).

WOMAC	Intervention group (n = 43)	Control group (n = 43)	Difference	*P* value
Total	−43.2 (−50.1, −34.6)	−36.7 (−45.9, −30.1)	−6.1 (−7.3, −5.0)	.21
Pain	−10.1 (−14.1, −7.9)	−8.3 (−11.6, −6.7)	−1.9 (−3.2, −1.1)	.25
Stiffness	−3.5 (−4.7, −2.6)	−2.6 (−3.9, −1.4)	−1.0 (−1.7, −0.4)	.44
Function	−30.9 (−39.5, −22.4)	−26.6 (−32.7, −19.8)	−4.2 (−5.1, −3.3)	.16

Note: Data are present as mean ± standard deviation; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

Table 6

Change of KOOS score at 3-mo after the surgery (change from baseline).

KOOS score	Intervention group (n = 43)	Control group (n = 43)	Difference	*P* value
Pain	−56.4 (−69.8, −42.1)	−47.2 (−62.9, −35.5)	−9.2 (−13.8, −7.6)	.19
Function in daily living	−53.8 (−61.7, −44.5)	−45.3 (−53.0, −38.7)	−8.5 (−10.2, −6.9)	.28
Symptoms	−59.3 (−67.5, −50.6)	−51.5 (−61.6, −43.8)	−8.3 (−8.6, −6.5)	.22
Sport and recreation	−29.7 (−37.7, −20.4)	−22.6 (−30.5, −14.7)	−7.2 (−8.2, −6.3)	.31
Quality of life	−37.9 (−48.2, −29.3)	−28.7 (−36.9, −20.3)	−9.1 (−10.5, −8.2)	.14

Note: Data are present as mean ± standard deviation; KOOS = Knee Injury and Osteoarthritis Outcome Score.

such intervention can safely enhance preoperative functional status and muscle strength levels in patients undergoing THA.[20] Another study found that preoperative therapeutic exercise for total joint replacement did not show beneficial effects on postoperative functional recovery.[21]

Although previous related studies have assessed the effect of KJFT for patients with KOA among other population, limit data is still available regarding the effect of KJFT on JFR after KJR in patients with severe KOA among Chinese population. In this study, we investigated the effect of KJFT on JFR in Chinese patients with severe KOA. The results of our study were partly consistent with the previous study.[21]

In this study, the patients in the intervention group did not exert better outcomes in VAS, WOMAC, and KOOS, compared

to the patients in the control group. Our results indicated that KJFT on the JFR may not benefit Chinese patients with severe KOA after KJR.

This retrospective study has its own advantage and limitations. All patients in this study were Chinese, which may decrease the variability in this study. As for limitations, the sample size in this study is relative small. In addition, the study did not include the specific evaluation tool for evaluating quality of life, such as 36-Item Short Form Health Survey. Furthermore, the outcome effects were the combined results of KJFT plus educational program, but not KJFT alone in this study. All these limitations may affect the results of this study.

5. Conclusion

The results of this study did not show better outcomes of KJFT on the JFR in Chinese patients with KOA after KJR.

Author contributions

QJ, SL, JY contributed to the conceptualization. QJ and SL contributed to data curation. QT, XQ, and JY did the investigation for the study. ZH contributed to the methodology of the study. QJ, XQ, and JY provided the resources. QJ and ZH were responsible for the software. QJ and QT supervised the study. SL and QT validated the study and contributed to the visualization. QJ, SL, and JY prepared the original draft. QJ, SL, ZH, QT, XQ, and JY reviewed and edited the manuscript.

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