DOI: https://doi.org/10.53350/pjmhs221611376

ORIGINAL ARTICLE

Effectiveness of Structured Rehabilitation Program on Pain and Function in Patients with Total Knee Replacement: A Randomized Controlled Trial

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ABSTRACT

Objective: To determine the effectiveness of the structured rehabilitation program on knee pain and function in patients with a total knee replacement.

Methodology: A randomized controlled trial conducted at Horizon Hospital Lahore. Twenty six patients were randomly allocated to experimental and control group. Experimental group was treated with structured rehabilitation program and conventional exercises while control group was treated with conventional exercises alone. Outcome measuring tools were numeric pain rating scale, Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and goniometer. All the patients received 16 sessions of treatment. Data was collected at baseline and at the end of 4th week.

Results: Outcome measures numeric pain rating scale, Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and goniometer showed significant results ($p<0.05$) after treatment in both groups but mean values showed more improvement in experimental group treated with structured rehabilitation program.

Conclusion: This study concluded that structured rehabilitation program had better effects on pain, function and range of motion in patients with knee arthroplasty.

Keywords: Arthroplasty, Replacement, Knee, Knee osteoarthritis, Range of motion, exercise therapy

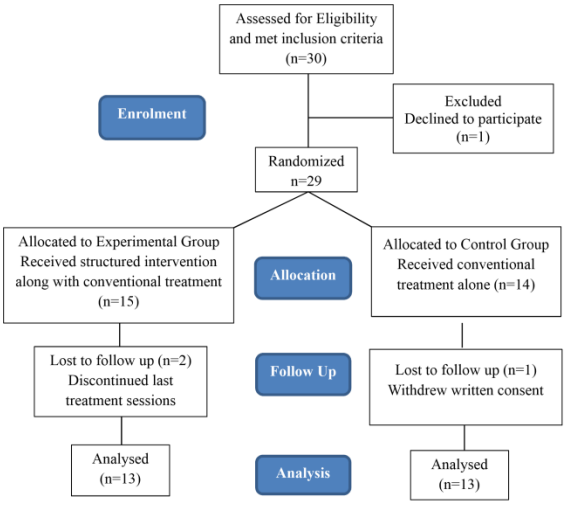
INTRODUCTION

Osteoarthritis (OA) is the most common joint disease among elderly population that causes pain, decreased joint function and leads to disability (1). Reportedly in the USA about 19% of women and 13% of men are diagnosed with knee osteoarthritis and about half of them received total knee replacement (TKR) (2). The major symptoms of knee OA include joint pain especially during movement, joint stiffness, and swelling. As the severity of the disease increases it can also impair the walking ability and ability to perform activities of daily livings (ADLs) (3). Weight loss, exercise, use of analgesics and proper patient education are considered conservative management of knee OA (4). In case of severe knee OA there is the failure of conservative treatment, and then total knee replacement is preferred to reduce the OA symptoms (5). Currently, TKR has been regarded as effective management of knee OA. Besides end-stage of OA some other indications for TKR include severe patellofemoral or tibiofemoral joint pain, loss of mobility of knee joint, and severe deformity of the knee (6). The average stay in hospital after TKR is almost 6 days. Bilateral TKR is mostly performed in a younger population. The elder population also suffers from different comorbidities so that unilateral TKR is recommended for such patients (7). Standard and minimally invasive are surgical approaches used for TKR. The minimally invasive technique is more preferred because it implies smaller incisions and there is less disruption of soft tissues which eventually improves postoperative pain and recovery. Mostly cemented implants are used by surgeons (8). The gold standard approach mostly used for TKR is medial parapatellar (9). Physiotherapy is a therapeutic approach in relieving symptoms and increasing function before and after knee replacement surgery (10). It is an important component of perioperative and post- operative care (11). Neuromuscular control and proprioception play an important role in maintaining the stability of the knee joint. Weakness of quadriceps occurs due to muscle atrophy, swelling, and arthrogenic muscle inhibition. So, the rehabilitation programs should also focus on strengthening quadriceps musculature to improve knee function (12). Most of the hospitals and rehabilitation centers provide post-operative therapies to TKR patients but an authentic rehabilitation program following all the protocols has not been established yet (13). A few studies regarding knee arthroplasty had given structured rehabilitation program with combination of conventional physiotherapy. Hence, the purpose of this study was to determine the effect of structured rehabilitation program on pain and function in patients with total knee replacement to improve their life style after knee arthroplasty. This trial provides a structured rehabilitation protocol to physiotherapists to achieve all goals in three phases is a protective phase, recovery phase, and activity phase.

METHODOLOGY

This study was a randomized controlled trial registered with ClinicalTrials.gov ID: NCT04694625. It was conducted in Horizon hospital Lahore within the time duration of six months after the approval of the synopsis from research

ethical committee REC/RCRS/20/1041. Sampling was done by consecutive sampling. Sample size was twenty six as calculated by online EPITOOL sample size calculator (14). Both male and female patients with age ranging from 50-75years having unilateral or bilateral total knee replacement through the medial parapatellar approach included in the study while patients awaiting revision TKR, post-traumatic patients planned for TKR, those with non-degenerative joint diseases and patients who got infected after the operation were excluded from the study. Once the above mentioned inclusion and exclusion criterion was taken into account, potential participants were requested to participate in the study. Written informed consent was taken. Participants were randomly allocated to experimental group and control group. Patients were blinded for their treatment group allocation. Experimental group was treated with structured rehabilitation program and conventional physiotherapy exercises while control group was treated with conventional physiotherapy exercises alone. Structured rehabilitation program included four phases. Early function phase (protective phase) 1st-week goals were patient education and motivation, ankle pumps, isometrics of quadriceps, gluteus tightening, good leg exercises, educate the patient about side-lying and position of the leg, commode or washroom training on 3rd post-op day, walk with walker 20 to 25 steps with full weight-bearing by using a knee immobilizer, active straight leg raising without external lag. Progressive function phase (recovery phase) 2nd and 3rd week, 2nd-week goals were continuation of protective phase exercises, icing to minimize swelling, start bending the knee to 70 degrees without external lag, walk without knee immobilizer, walk with walker 40 to 50 steps with full weight-bearing, sitting on the chair as per tolerance, patient education to sit on a high chair, commode and bed. 3rd-week goals were continuation of above mentioned exercises and icing. knee bending to 90 degrees without external lag, walk with the walker and start using a tetrapod stick, stairs training, climb stairs upward with a non-operated leg and down with an operated leg with the help of a railing or tetrapod stick, sitting on the chair as per tolerance. Advance function phase (activity phase) 4th-week goals were continuation of all exercises, knee bending to 120 degrees without external lag, walk with a tetrapod stick for 5 to 10 minutes and slowly increase the walking time, sitting 45 minutes to 1hour. Conventional physiotherapy exercises included rapid postoperative mobilization, range of motion exercises, passive extension by placing pillow underfoot, flexion-by dangling the leg over the side of the bed, muscle strengthening exercises and weight-bearing is allowed on 1st postoperative day. Outcome measuring tools were numeric pain rating scale, Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and goniometer. All the patients received total 16 sessions of treatment. Measurements were taken at baseline and at the end of 4th week. SPSS version 25 was used to analyze the data using statistical significance p=0.05. Shapiro-Wilk test was used to check the normality of data. Value of the Shapiro-Wilk Test was greater than 0.05, the data was normal and parametric tests of analysis were used. Paired samples t-test was used to show change of subjective as well as objective measurement overtime. Difference between the groups was measured by Independent samples t-test.



CONSORT Diagram of Study

RESULTS

A total number of twenty six patients were part of this study. They were divided into two groups; experimental group and control group. The maximum age of patients in the experimental group was 75 years whereas the minimum age was 50 years with a mean of (65.00 **±**8.77 years). Maximum BMI of experimental group was 17.20 while minimum BMI was 10.60 with a mean value of (14.33 **±**2.19). In the control group, the maximum age of the patients was 74 years whereas the minimum age was 52 years with a mean of (65.69 **±**7.9 years). Maximum BMI of control group was 44.98 whereas minimum BMI was 27.12 with a mean value of (38.60 **±**6.41). Pre-treatment mean values for the functional outcome on the NPRS score for the experimental group was 8.69 whereas the post-treatment mean was 1.46. The mean difference was ±7.230 with a p-value <0.001. Similarly, the pretreatment mean NPRS value of the control group was 8.92 whereas the post-treatment mean was 3.46. The mean difference was ±5.461 with a p- value <0.001. The p-values indicate that the results for both groups were statistically significant. Pre-treatment mean values for the WOMAC scale of the experimental group was 78.538 whereas the post-treatment mean was 6.7692. The mean difference was ±71.769 with a p-value <0.05. In the same way, the pretreatment mean WOMAC scale value of the control group was 77.615 whereas the post- treatment mean was 18.962. The mean difference was ±58.923 with a p-value <0.05. The p-values indicate that the results for both groups were statistically significant. The pre-treatment mean for knee flexion ROM of the experimental group was 65.0 whereas the post-treatment means was 106.5. The mean difference was 41.5 with a p-value <0.001. In the same way, the pretreatment mean for knee flexion ROM of the control group was 61.5 whereas the post-treatment mean was 95.7. The mean difference was 34.2 with a p-value <0.001. The p-values indicate that the results for both groups were statistically significant.

Table 1: Pairwise comparison of NPRS

	Experimental Group		Control Group	
Pre-treatment NPRS	8.69		8.92	
Post-treatment NPRS	1.46		3.46	
	Mean difference	p-value	Mean difference	p-value
Pre-treatment NPRS – Post-teatment NPRS	7.23	< 0.001	5.46	< 0.001

Table 2: Pairwise comparison of WOMAC

	Experimental Group		Control Group	
Pre-treatment WOMAC	78.538		77.615	
Post-treatment WOMAC	6.7692		18.962	
	Mean difference	p-value	Mean difference	p-value
Pre-treatment WOMAC– Post-treatment WOMAC	71.769	< 0.05	58.923	< 0.05

Table 3: Pairwise comparison of knee flexion ROM

	Experimental Group		Control Group	
Pre-treatment knee flexion ROM	65.0		61.5	
Post-treatment knee flexion ROM	106.5		95.7	
	Mean difference	p-value	Mean difference	p-value
Pre-treatment knee flexion ROM – Post-treatment knee flexion ROM	41.5	< 0.001	34.2	< 0.001

DISCUSSION

Many researches were carried out on this subject matter. Most of the evidence promotes the use of structured rehabilitation program after TKR (15, 16). Some researchers did not recommend the incorporation of this program (17). Remedios, et al. (2015) conducted a non-randomized trial to compare the effectiveness of hospital-based and home-based exercise plans for patients undergoing TKR. Both groups started physiotherapy protocol after 2nd postoperative day until they could start walking with a walker. Patients in the home-based group had their exercise sessions with respective physiotherapists. Functional exercises and gait training were included in the protocol. An exercise program under supervision was developed for patients in the hospital. Results of the study show that there was an improvement in knee function and activity in both groups (18). Current study also proved that structured rehabilitation program and conventional exercises alleviates knee pain and improve knee function. Aseer, et al. (2016) conducted RCT to explore the efficacy of structured rehabilitation protocol on knee functionality outcome of patients undergoing TKR. Eighty patients were randomly allocated to an experimental and control group. The experimental group followed a structured exercise program while the control group received standard hospital care. The structured rehabilitation program was divided into four stages. Stage 1: patient education about joint positioning, bed mobility and walker use, passive range of motion exercises. Stage 2: isometric exercises, active-assisted knee exercises, balance exercises with arm support. Stage 3: strengthening exercises for hamstrings and quadriceps, the progression of balanced exercises. Stage 4: closed chain exercises of the knee. Results showed that the experimental group shows notable improvement regarding pain severity, knee range of motion, and isometric strength of knee musculature. So structured rehabilitation program plays a dominant in improving knee functionality after TKR (11). The current trial also supports the role of a structured rehabilitation program after TKR. Antony, et al. (2019) carried out RCT to find which surgical approach of TKR is better in terms of knee function. Patients were randomly allocated to the mid-vastus approach group and medial parapatellar approach group. All participants performed structured rehabilitation protocol after surgery. The rehabilitation protocol was divided into 3 phases. Protective phase 1 starts from day 0 to 2 weeks. Recovery phase 2 lasts from 3rd week-6th week and Activity phase 3 starts from 7th week to 12th week. Phase 1 and part of phase 2 were done during a hospital stay and phase 3 was performed at home under supervision. Results of the study reveal that knee pain, knee flexion and extension, and isometric strength of quadriceps were improved in both groups. However mid-vastus approach group shows significant improvement as compared medial parapatellar approach group (8). The current study suggested that after TKR structured rehabilitation program should be a preferable treatment option for knee pain and function.

CONCLUSION

This study concluded that a structured rehabilitation program had better effects on pain, function and range of motion in patients with knee arthroplasty.

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