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PHYSIOTHERAPY REHABILITATION PROGRAM FOR PATIENTS OF KNEE OSTEOARTHRITIS: A COMPARATIVE STUDY AMONG PATIENTS WITH DIFFERENT PAIN INTENSITY

Physiotherapy

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ABSTRACT

Degenerative osteoarthritis (OA) is the most common form of arthritis and is a major cause of morbidity and functional limitation, especially in elderly patients. **METHODOLOGY:** In this study, 82 patients with moderate bilateral knee OA were identified as potential participants based on the orthopedic physical therapy clinic records. 8 patients did not meet the inclusion criteria, and another 4 subjects refused to participate in the study. **RESULTS**: Total 51 patients were included in the final analysis. There were 32 male and 19 female in the study population. The analysis was conducted based on three groups of pain scale, mild pain group, moderate pain group and severe pain group. **CONCLUSIONS: :** The effects of physiotherapy treatment programs might be optimized by identifying the grade of pain and subgroups of patients.

KEYWORDS

Physiotherapy rehabilitation , knee osteoarthritis

INTRODUCTION

Degenerative joint arthritis is the most common joint disorder that is caused by biomechanical stresses affecting both the articular cartilage and subchondral bone. Degenerative osteoarthritis (OA) is the most common form of arthritis and is a major cause of morbidity and functional limitation, especially in elderly patients. [1] The incidence of knee OA is expected to increase over the next decades. [2] Knee OA is directly related to disabilities due to pain, quadriceps dysfunction, and impaired proprioception. Moreover, knee OA is responsible for the impaired ability of the quadriceps muscle to control force in patients with OA. Nevertheless, exercise therapy is effective in reducing the pain and improving the function of patients with knee OA. [3]

Unlike many other pain conditions in which the underlying injury typically heals or resolves, OA is a disease that does not resolve. Thus, OA is typically accompanied by chronic pain. Whether, and to what degree, this ongoing chronic pain (i) plays an important nociceptive role, (ii) represents maladaptive pain, or (iii) reflects other aspects of the pain experience are not clear. [4]

Pain is one of the most commonly reported and prominent factors that are responsible for physical inactivity in patients with knee OA. [5] This impairment in physical activity associated with knee OA has important implications for aerobic power and cardiovascular health. Hence, patients with OA are at a particular risk of poor health outcomes. [6] Pain pattern and severity of knee OA as either absent, mild, moderate, severe, or very severe could affect the range of motion (ROM) that involves daily activities and quality of life. [7] Moreover, muscle weakness in knee OA usually results in joint stiffness and decreasing ROM that involves daily activities. [8] Quadriceps muscle impairment in knee OA is well documented in the literature. In addition, the differences in the magnitudes of muscle strength are caused by the differences in the subjects' characteristics, OA severity, pain severity, and definition of the control group. [9, 10, 11] Patients with knee OA experience chronic form of pain and show a declining ability to use their joints, which consequently weakens the muscles. Hence, these destabilize the joints and reduce the physical functions of patients; further, the motions required for the patients' daily activities become restricted. [12]

Prevalence of OA has been recorded to increase with increasing age. Less than half of those with OA underwent treatment. With a high prevalence of OA, there is need to spread awareness about the disease, its prevention, and rehabilitation in the community. Therefore, the aim of this study was to examine the effect of a physiotherapy treatment program on patients of moderate knee OA with different pain intensity.

METHODOLOGY

In this study, 82 patients with moderate bilateral knee OA were identified as potential participants based on the orthopedic physical therapy clinic records. 8 patients did not meet the inclusion criteria, and another 4 subjects refused to participate in the study. A total of 70 patients were recruited via convenience sampling. At the end of the 4-week treatment period, outcome data were available for 62 patients. Some participants withdrew from the study and some were lost to follow-up. Thus, 51 subjects (32 men and 19 women) participated in the current study. The intensity of knee pain was evaluated using the visual analogue scale (VAS) after the patients have remained in a weight-bearing state for 5 minutes (walking or standing). The pain level was rated by each patient from 0 to 10 cm, where 0 represented 'no pain', and 10 represented 'unbearable pain'. The pain was also graded as follows: 0 to 4 mm, no pain; 5 to 44 mm, mild pain; 45 to 74 mm, moderate pain; and 75 to 100 mm, severe pain. Based on these grades, the three groups of knee OA were created.

The inclusion criteria were as follows: age between 45 and 62 years, ≤grade 2 radiographic severity according to the Kellgren/Lawrence scale, diagnosis of moderate bilateral knee OA according to the American College of Rheumatology criteria, knee pain for more than 3 months in most days of the week, and patients are not obese. Conversely, the exclusion criteria were as follows: inflammatory knee disorders, metabolic bone disease, history of knee trauma, previous knee surgery, previous intra-joint injection, and use of analgesics in the past 3 months. Written informed consent was obtained from all subjects. Prior clearance from the Institutional Ethics Committee was obtained.

Measurement of active knee flexion ROM: While the patients were lying supine on an examination table, active knee flexion ROM was measured using a plastic universal goniometer with 25-cm arms, while the goniometer's pivot tip was placed on the femur's lateral epicondyle. The patients maintained maximum flexion of the knee joint with hip flexion. The angle between the maximum flexion and maximum extension was described as the excursion range. The range was measured thrice, and the mean value was calculated. [13]

The patients' disability was evaluated using the valid and reliable modified Western Ontario and McMaster Universities osteoarthritis index (WOMAC). [14] It is a questionnaire that evaluates disabilities in performing daily living activities. This method is relevant and appreciated for its simplicity and allows assessment of the patients' opinions of their functional disabilities.

The isometric quadriceps strength was measured using Jamar hydraulic dynamometer. The patients were instructed to sit on the side of the bed with their back flat, arms crossed, hip at 90° flexion, and knee at 30° flexion. After ensuring stabilisation in these steps, the therapist held the dynamometer between his hand and the patients' limb segment. The dynamometer was positioned two finger widths above the lateral malleolus on the anterior aspect of the tibia, and the

patients were then instructed to push the dynamometer with their maximum strength for 5 seconds. The mean value of the three repetitions with 2-minute intervals was calculated. [15]

In this study, the treatment program was firstly initiated for treating knee OA based on the Battecha and Soliman program. [16] All groups underwent a standard set of pulsed electromagnetic field (PEMF), ultrasound (US), and stretching and strengthening exercises. A PEMF was used to provide electromagnetic therapy. The pulse frequencies were 50 Hz for the solenoids and up to 100 Hz for the applicators. The solenoid encircled the target limb segment at the level of the knee. Each patient was exposed to low-intensity 15 GPMF (Gauss permagnetic field) with a frequency of 50 Hz for 30 minutes per session. Thereafter, a US device was used to provide deep heating therapy. Continuous US waves with a 1-MHz frequency and 1-watt/cm^2 power were applied using a 4-cm^2-diameter applicator. The US therapy lasted for 5 minutes per session. [17] Both PEMF therapy and US therapy were continued for three sessions weekly for 4 weeks. Immediately after PEMF and US application, each patient was asked to perform stretching exercises and strengthening exercises in the following fixed sequence: hamstrings muscle stretching and calf muscle stretching. The physical therapist repeated the passive stretching exercises thrice per session. Each stretch was sustained for 30 seconds, with 10-second rest interval. [18] After a rest period of 5 minutes, the patients were asked to perform the following: 1) isometric quadriceps contraction (quadriceps drill) in full knee extension maintained for 5 seconds, followed by a 5-second rest; the exercise was performed for 20 repetitions per session; [19] and 2) straight leg raising exercise in a crock lying position (the patients were asked to tense the quadriceps muscle, elevate the limb to 45° and maintain it for 6 seconds, and lower the limb slowly and then relax for 6 seconds; the exercise was performed for three sets of 10 repetitions per session). [18] Both stretching and strengthening exercises were performed for three sessions weekly for 4 weeks. The evaluation and treatment procedures were done for the patients by the same therapist before and after the treatment period. They were instructed to maintain their activity levels during the study period. [20]

Data were analysed using the Statistical Package for Social Sciences (IBM Corp.: Armonk, NY USA) version 20.0. A one-way analysis of variance was used to compare the effect of the physical therapy treatment on the VAS score, knee ROM, quadriceps strength, and WOMAC score. Score changes were also calculated. The level of significance was set at $p < 0.05$.

RESULTS

Total 51 patients were included in the final analysis. There were 32 male and 19 female in the study population. The analysis was conducted based on three groups of pain scale, mild pain group, moderate pain group and severe pain group. Three groups were formed for analysis purpose based on intensity of pain, mild, moderate and severe. Each group consisted of 17 patients each. The mean age was calculated to be 53.6 ± 4.6 in group 1, 54.7 ± 5.2 in 2nd group and 56.3 ± 5.6 in 3rd group.

Table showing effect of intervention on various attributes viz pain, ROM, quad strength and WOMAC on patients in different pain groups separately

Variable	Mild pain group			Moderate pain group			Severe pain group		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
Pain	3.2 ± 0.6	2.5 ± 0.5	- 0.7 ± 0.1	6.1 ± 0.5	4.7 ± 0.6	-1.4 ± 0.4	8.9 ± 0.4	7.8 ± 0.5	- 1.1 ± 0.3
ROM	109.7 ± 7.4	124.5 ± 8.8	14.8 ± 2.5	102.5 ± 7.8	117.4 ± 10.3	14.9 ± 4.2	95.3 ± 7.1	105.2 ± 8.3	9.9 ± 4.5
Quad strength	23.2 ± 6.1	27.3 ± 5.4	4.1 ± 1.3	21.3 ± 2.6	25.9 ± 3.2	4.6 ± 1.5	17.9 ± 3.1	22.6 ± 3.5	4.7 ± 1.3
WOMAC	27.4 ± 4.5	22.9 ± 4.5	-4.5 ± 1.5	45.8 ± 5.2	33.1 ± 5.3	- 12.7 ± 1.5	57.5 ± 5.2	52.4 ± 4.9	- 5.1 ± 1.3

The pre-intervention ROM of the mild pain group was greater than those of the moderate and severe pain groups (p=0.001), without a significant difference between the pre-intervention ROMs of the moderate and severe pain groups (p=0.066). There was a significant improvement in the ROM owing to the interventions in the three groups (p=0.001). The post-intervention ROM of the mild pain group was significantly greater than those of the moderate and severe pain groups (p=0.008 and 0.001, respectively); moreover, the post-intervention ROM of the moderate pain group was significantly greater than that of the severe pain group (p=0.002).

The pre-intervention isometric quadriceps strength of the mild pain group was greater than those of the moderate and severe pain groups (p=0.019 and 0.001, respectively), without a significant difference between the moderate and severe pain groups (p=0.137). There was a significant improvement in the quadriceps strength of the three groups (p=0.001, 0.001, and 0.004, respectively). There was no significant difference between the post-intervention quadriceps strength of the mild and moderate pain groups (p=0.087). The post-intervention quadriceps strength of the mild and moderate pain groups was significantly greater than that of the severe pain group (p=0.001 and 0.026, respectively).

The pre-intervention WOMAC score of the mild pain group was lower than those of the moderate and severe pain groups (p=0.001), and that of the moderate pain group was lower than that of the severe pain group (p=0.001). There were significant improvements in the WOMAC scores owing to the interventions in the three groups (p=0.001). The post-intervention WOMAC score of the mild pain group was significantly lower than those of the moderate and severe pain groups (p=0.001), and that of the moderate pain group was significantly lower than that of the severe pain group (p=0.010).

The VAS score, knee ROM, and WOMAC score changes in the moderate pain group were significantly greater than those in the mild and severe pain groups (p=0.001, 0.001, 0.026, 0.013, 0.016, and 0.001, respectively). In the same context, there was no a significant difference between the mild and severe pain groups (p=0.054, 0.676, and 0.132, respectively).

There was no significant difference in the quadriceps strength score changes among the mild, moderate, and severe pain groups (p=0.212, 0.276 and 0.231, respectively). However, the score change in the moderate pain group was significantly greater than that in the severe pain group (p=0.030).

DISCUSSION

In the pretreatment condition, it was observed that the patients with knee OA with moderate and severe pain showed significant declines in the knee ROM, isometric quadriceps strength, and level of functional performance, which may be due to the level of pain that resulted in the weakening of muscle strength, instability of the knee joint, and decreased physical function. [21] Moreover, the impairments of muscle activation are magnified in subjects with knee OA ranging from 8 to 25% in populations of varying disease severities. [22] Reduced voluntary activation of the muscles and decreased contractile rates are meaningful as these explain the strength decline and changes in muscle size, [23] which were experienced by the patients with knee OA with moderate and severe pain in the current study. However, a recent study discovered that pain did not influence the thigh muscle electromyogram (EMG) amplitudes or proprioceptive acuity in patients with mild and moderate knee OA during a stair climbing task. [24]

The rehabilitation program decreased the pain intensity and improved the knee ROM, isometric quadriceps strength, and level of functional performance in all knee OA groups. In addition, it was clear that the rehabilitation program had more drastic effects in the moderate pain group. Thus, the levels of improvement in the moderate pain group were superior to those in the other groups in all measurement outcomes. The compatibility of the results of the VAS and WOMAC is consistent with the findings of Riddle and Stratford who concluded that the WOMAC scores are most strongly associated with pain intensity in patients with unilateral and bilateral pain. [25]

The significant improvement in the muscle strength of the three groups might be explained by the findings of Lewek et al. who reported that the arthrogenic inhibition of the quadriceps muscles of patients with knee OA may be corrected using exercise training. [22]Moreover, the results of the current study are in line with the findings of Knoop et al. who reported that all grades of knee OA severity can achieve improvement in pain and functional performance after an exercise therapy program. [26] However, it should be noted that this study included an exercise program only, which was applied in patients with knee OA with different grades (mild, moderate, and advanced knee OA); conversely, the current study included patients with moderate knee OA only, and the rehabilitation program included stretching exercises, PEMF, and US. The difference in the intervention and

patient characteristics could explain the greater improvement in the moderate pain group than in the severe pain group.

The lesser improvement level in the severe pain group in all outcome measures may be explained by the greater inactivity caused by the higher pre-intervention pain levels experienced by the patients in this group, which had profound adverse effects on skeletal muscle function and metabolism in terms of weakness and atrophy. [27] In addition, the knee extensors have a prominent role in resisting gravity; they undergo a greater magnitude of weakness and atrophy than other groups of muscles during inactivity. [28]

Conversely, the findings of this study revealed a trend toward greater improvements in the moderate pain group, which can be explained by the greater reduction in the score change in the pain in this group. In the same circumstances, the reduction of pain can improve the level of function, ameliorate physical impairment, [29] and reduce the restriction of movements (knee ROM) as a protective mechanism in patients with knee OA. [30] In addition, the chronic form and level of pain can result in muscle weakness, and it seemed that the greater pain reduction and strengthening exercises in this group were responsible for improving the isometric quadriceps strength. [22]

This study has several limitations. Firstly, it did not have a control over the daily activities of the patients. Secondly, the long-term effects of this treatment were not identified. Thirdly, the outcome measures of the study did not involve functional tests, such as the 6-minute walk test. Further research studies with longer durations evaluating the effects of physiotherapy rehabilitation programs should be conducted on patients with knee OA, especially those with severe pain. Finally, further studies are needed to examine the effects of rehabilitation programs on the hip and ankle joints of patients with OA with different degrees of pain, since previous studies have reported that examination of the hips may be indicated in patients with knee OA. [31] Moreover, knee OA leads to weakness of the ankle joints, plantar flexors, and dorsiflexors [32] and deficits in ankle proprioception.

CONCLUSIONS:

In this study, all patients with moderate knee OA with different grades of pain can benefit from a physiotherapy rehabilitation program, which was shown to be highly effective in patients with moderate pain, although this effect might be reduced in patients with severe pain. Hence, the effects of physiotherapy treatment programs might be optimized by identifying the grade of pain and subgroups of patients.

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