Functional Outcomes of Physical Therapy Programs in Osteoarthritic Subjects

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ABSTRACT

Objective: *To determine the effectiveness of physical therapy programs for subjects with osteoarthritis (OA) of the knee referred for physiotherapy in terms of pain and physical dysfunction.* ***Methods****: After a baseline assessments, sixty-four subjects aged 56±10 yrs, body weight 82.7±9.3 kg and body mass index 28.4±3.8kg/m2 with symptoms and radiographic evidence of unilateral or bilateral knee OA were randomized into two groups: physical therapy (PT) group: 32 subjects received physical therapy sessions three times a week for 8 weeks and exercise (Ex) group: 32 subjects received only exercise program three times a week for 8 weeks.* ***OUTCOME MEASURES:*** *Using a visual analogue scale (VAS), patients assessed for pain, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), stiffness, pain and physical function. Objective measures of physical performance (Timed Up & Go, Gait speed and Stair test, range of motion) were assessed at baseline and post treatment.* ***RESULTS:*** *The two groups were homogenous regarding all parameters at baseline. Although both groups showed a significant improvement in all variables measured in (e.g. WOMAC, pain and physical function) at the post-treatment assessments, PT group demonstrated significant improvements over Ex group in mostly all variables measured.* ***Conclusions:*** *Physical therapy, either as an individually exercise program or in combination with physical modalities, is an effective intervention for patients with knee OA. Although all patients had improvement in pain and functional performance, physical therapy modalities in combination with exercise group were superior to exercise program group alone for improvements in functional performance of knee OA patients.*

Key wards: *Osteoarthritis, Physical therapy, objective physical function.*

INTRODUCTION

Knee Osteoarthritis (OA) constitutes a major social and health problem in older people[17], it is the single most important cause of musculoskeletal disability in the western world[8,14] imposing an increasingly heavy financial burden on the social welfare and health care system in modern societies[7, 17]. The pain of OA of the knee causes older adults to reduce their level of activity, and with this reduction, muscle strength diminishes and the knee receives less support. A downward spiral of pain, diminished activity, decreased strength, increased instability, and more pain occurs, and the frequency and duration of knee pain increases as the disease progresses[3].

The etiology of knee OA is not entirely clear, but it is a widespread, slowly developing disease. The primary complaints of patients suffering from OA are pain, stiffness, instability, and loss of function[24], and its incidence increases with age and in women. Obesity is a risk factor for the development and progression of knee OA and the need for total joint replacement. Underlying biomechanical factors also may predispose people to OA. The disability and pain associated with knee OA correlate with a loss of quadriceps femoris muscle strength (loss of force-generating capacity of muscle), coronary heart disease, and depression[7]. Røgind et al. (1998)[24] found that 80% of patients with knee OA reported problems related to muscular function i.e. muscle strength, endurance, and balance/coordination.

The treatment of OA is oriented primarily to relieve the pain and preserve joint function and includes both pharmacologic and nonpharmacologic treatment modalities[20,22]. The symptomatic treatment of OA focuses mainly on physical therapy, analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs) and intraarticular injections of corticosteroids[14].

The overall goals of the present study were to investigate the effectiveness physical therapy programs and to further establish the

relationship between physical therapy programs and functional outcomes.

PATIENTS AND METHOD

A total of 64 participants recruited for the study (42 women and 22 men); with a mean age of 56±10 y, body weight 82.7±9.3 kg and body mass index 28.4±3.8 kg/m^2 with knee OA of 159±15.2 month participated in this study. All subjects were referred from the outpatient department of orthopedic surgery Zagazig University Staff Hospital. Subject recruitment began on June 1, 2007 till end of July 2008. All patients had a thorough medical examination before the treatment, and only those who would not be subjected to a significant health risk during the maximal test were included in the study. In patients in whom both knees were symptomatic, the more painful knee, or when symptoms were similar bilaterally, the right knee was chosen as the target knee. Participants were randomly assigned into two groups. PT group: 32 subjects received physical therapy three times a week for a total of 24 sessions. Ex group: received only 2 months of the exercise program for a total of 24 sessions, both groups were followed up at baseline and 8 weeks. All participants will continue to receive the usual, normal routine care offered by their own orthopedic surgeon and other healthcare providers. Informed written consent to participate was obtained from all patients.

Inclusion criteria were based on the clinical criteria defined by the American College of Rheumatology (ACR) for knee OA as follows: (*a*) knee pain for more than 25 of the past 30 days, morning stiffness of less than 30 minutes, and crepitation in the knee or (*b*) osteophytes on *x* ray examination of the knees indicating knee OA, and a normal general physical examination. Further inclusion criteria were: radiologically verified OA of grade I-III according to Ahlbäck (1968)[1] (grade I=loss of more than 50% of joint space, but less than 100%; grade II=complete loss of joint space; grade III=additional loss of bone substance) estimated on the basis of an anteroposterior weight-bearing radiograph with a knee flexion angle of 10–15°.

The exclusion criteria were: bone attrition in either knee (Ahlbäck grade IV–V); previous intra-articular knee fracture, injections of steroids, hyaluronan or other invasive procedure (e.g. arthroscopy, arthrography, surgery), rheumatoid arthritis, or other inflammatory joint disease as defined by ACR criteria less than 6 months prior to inclusion, and any quadriceps exercise program within the last 4 months. Furthermore, patients were not included if they had a difficulty completing questionnaires.

Study design and assessment

Following baseline assessment, participants were randomized to receive either physical therapy modalities plus exercise or exercise therapy program alone. Patients received treatment according to a standardized protocol. The exercise program applied for all participants was tailored to the individual patient's needs, and consisted of both active and passive exercises and homework exercises.

Physical therapy

Physical therapy was applied to each patient in PT group and it consists of several strategies to facilitate resolution of symptoms and improve functional deficits, including range of motion exercises without resistance, strengthening exercise program, with a series of ice backs, pulsed ultrasound (US), with 1 MHz frequency and 1.5 w/cm^2 power were applied for 5 minutes to the target area with a 3 cm diameter applicator (Sonopuls 590 Enraf-Nonus), interferential therapy (IF) with RS-4i^R Stimulator (Vancouver, WA). Two channels employing four reusable 2 inch diameter cutaneous electrode pads were placed over the thigh and back of the leg. For channel 1, one pad was placed over the vastus lateralis (positive) and one over the vastus medialis (negative), and for channel 2, one pad was placed over the proximal hamstrings (negative) and one over the distal hamstrings (positive), for 15 min. IF stimulation had a base frequency of 5000 hertz (Hz) and a pre-modulated beat frequency sweeping between 1 and 150 Hz. Stimulation intensity was controlled by varying the pulse width, which in this study ranged between 3.39 ms and 102.2 ms.

Exercise program

The exercise program was an adaptation of the protocol of Van Baar et al. (2001)[28], and primarily consist of a multi-modal, supervised program of warm-up/aerobic, muscle strengthening, muscle stretching, and neuromuscular control exercises. Secondarily, additional exercise therapy interventions had been prescribed individually for each participant on the basis of the physical examination findings. Muscle strengthening was performed by doing progressive repetetive exercises for quadriceps, hip adductors, hip abductors, hamstrings, gluteus maximus muscles, erector spinae muscles, and abdominal muscles. Hip adductor and abductor muscle groups were strengthened by having the patient lie down on one side doing straight leg lifting for the adductors and then for the abductors. Then they changed sides, doing exactly the same lifting. Abdominal muscles were strengthened lying supine doing sit-ups. Hamstrings, gluteus maximus, and erector spinae muscles were all strengthened lying prone on a hard training pillow: hamstrings by lifting both legs straight holding on to the top of the pillow, gluteus maximus by lifting one leg at a time with the knee in flexion, and erector spinae by having the physiotherapist hold the legs while the patient lifted the upper body. Progression was achieved by increasing the number of repetitions (starting number was 10), and for the hip adductors and abductors by applying weight to the patient's ankles. The quadriceps muscle was trained in different ways. First: supine with a straight leg lifting, and then supine with a pillow under the knee placing it in approximately 15° flexion, from which the patient fully extended the knee.

Functional Capacity Measurements

Functional capacity was measured under standardized conditions by the following tests: Primary outcomes measures: the knee pain was assessed at baseline by an 11-point numeric rating scale (NRS) for pain severity (range: 0, no pain; 10, unbearable pain). Immediately post functional tests, the patients were asked to give an NRS rating of the knee pain they perceived during the functional capacity tests. Secondary outcomes physical functioning was determined in 2 ways: Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, Likert version 3.1 standardized with Arabic for an Arabian population and the functional performance tests. The WOMAC scores test pain, stiffness and physical functioning and consist of 24 items self-administrated questions that were answered for each item on a 5-point Likert scale (none, mild, moderate, severe and extreme): Five determine subjective global assessment of pain, two assess joint stiffness and 17 assess physical functioning. WOMAC scores were recorded on a Likert scale of 0-4, where 0 = no pain/limitation; 1 = mild pain/limitation; 2 = moderate pain/ limitation; 3 = severe pain/ limitation and 4 = very severe pain/ limitation[2].

Timed "Up & Go" Test. Participants were instructed to rise from a standard arm chair, walk at a safe and comfortable pace to a line 3 m away, cross the line, turn, and return to a sitting position in the chair. The stopwatch was started on the command, and stopped when the subject passed a pre-determined mark 3 m from the chair[21].

Gait speed test: Participants were timed as they walked an 8-m walkway at their habitual, self-selected pace. Participants were instructed to "walk at a pace that you consider to be normal" and each participant performed two practice trials followed by three walking trials. Using an electronic stopwatch, the time taken by the participants to cover the central 4 m was measured to eliminate the acceleration or deceleration effects from initiating and stopping the walk. Accordingly, gait speed was computed by dividing the distance (i.e., 4 m) by the time taken, and recorded in m/s. The habitual gait speed averaged over three trials was used for analysis[23].

Stair test: Stair climbing ability was assessed by the time taken to climb up and down six standardized stairs (step height, 18 cm; step depth, 30 cm), at both self-selected and fast pace. Handrails were on the right side of the stairs, and participants held them loosely for safety if they wished. For the self-paced timed stair test, participants were instructed to ascend and descend the stairs in their usual manner[15].

Prior to performance of the physical function tests, subjects were familiarized with the test procedures and purpose. The details of the tests' procedures were explained to the patients, and they were allowed to perform a few submaximal trials for familiarization. Adequate pauses between tests were allowed in order to avoid fatigue. Two trials with a 5-minute rest interval were performed for all functional tests, and the best performance was accepted as valid.

Range of motion (ROM): The active pain-free ROM of knee flexion was measured using goniometer according to Brosseau et al. (2001)[5]. The arms of the goniometer were placed in the longitudinal axis of the thigh and shin. The patient was asked to flex the knee until the moment he feels pain. The angle of the knee joint at that moment was recorded as the maximal pains free ROM. This measurement was performed twice, just before and at the end of the study.

Statistical Methods

SPSS for Windows software was used for data management and statistical analysis. To compare the groups concerning demographic measurements, the paired t test was used in group analyses. For statistical analysis, data of each parameter were transformed to a 'percent of change' formula such as end results-baseline values/baseline×100. Associations between pain, exercise and physical performance at the end of the study were evaluated by Pearson's correlation coefficients. The level of significance was set at 0.05 for all statistical tests.

Table (1): Demographic and baseline characteristics of all participants.

Variable	Physical Therapy G (N = 32)		Exercise G (N=32)		P* Value
	Mean	SD	Mean	SD	
Age (years)	56.3	9.8	55.8	10.2	NS
Weight (kg)	82.2	5.4	84.3	5.6	NS
Height cm	152.5	4.7	153.1	5.1	NS
Body mass index ($kg.m^{-2}$)	28.8	3.9	28.3	3.7	NS
Sex M/F	10/22	-	12/20	-	NS
Mean duration of symptoms, m*	162	15.6	157	14.9	NS
Bilateral symptoms %	35%	-	34%	-	NS
Medications use %	60%	-	56%	-	NS
Number (%) at each radiographic stage					
Grade 1	15 (42.5)	-	16 (50.5)	-	NS
Grade 2	13 (42.5)	-	13 (37.5)	-	NS
Grade 3	4 (15.0)	-	3 (12.5)	-	NS

m*: month

RESULTS

None of the subjects complained during the testing and were therefore able to complete the entire set of tests. They were well matched with respect to demographic data, duration of arthritis, baseline score on the visual analog scale, the concomitant use of analgesics, and radiographic stage table (1). The majority of patients were female in both groups (69% in the Pt group and 63% in the Ex group).

Basic functional tests: WOMAC scores improved in all domains in both study groups at a significant level. It showed 29.92% improvement within the PT group from 47.8±14.5 at baseline to 33.5±14.4 post treatment follow-up ($P<0.01$), corresponding to a 19.4% improvement at the Ex group from 46.9±15.2 at baseline to 37.8±15.1 post treatment ($P<0.05$) Table (2). Comparing both groups for the post-treatment evaluation there was a statistically significant difference for the PT group ($P<0.05$) table (3).

The TUG test showed a statistically significant improvements for both study groups, ($P<0.01$) for the PT group and

(P<0.05) for the Ex group, the PT group showed 23.6% improvement and the Ex group showed 15.1% respectively table (2). Comparing both groups for the post-treatment evaluation there was a statistically significant difference for the PT group (P<0.01) Table (3).

Walking speed showed statistically significant improvement within the PT group from 1.1±0.15 m/sec at baseline to 1.6±0.14 m/sec post treatment follow-up (P<0.01) corresponding to an improvement of the Ex group from 1.1±0.15 m/sec at baseline to 1.4±0.15 m/sec post treatment (P<0.01) Table (2). The PT group subjects were 45.45% faster in gait speed tests post treatment compared to 27.3% for the Ex group. Comparing both groups for the post-treatment evaluation there was a statistically significant difference for the PT group (P<0.01) table (3).

The Stair test stair ascending and descending showed 11.34% improvement within the PT group from 9.7±2.3 sec at baseline to 8.6±2.5 sec post treatment follow-up (P<0.01) corresponding to a 6.25% improvement at the Ex group from 9.6±2.4sec at baseline to 9.0±2.6 sec post treatment (P<0.05) table (2). Comparing both groups for the post-treatment evaluation there was a statistically significant difference for the PT group (P<0.01) table (3).

Table (2): Comparison between the Pre-to-post program measurements for both groups.

Variables	Groups	Pre-program		Post-program		Changed %
		mean	±SD	mean	±SD	
WOMAC: total	*Ph TH g*	47.8	14.5	33.5	14.4**	29.92
	Ex g	46.9	15.2	37.8	15.1*	19.4
Timed Up & Go (s)	*Ph TH g*	8.6	2.1	6.6	2.2**	23.26
	Ex g	8.6	2.1	7.3	2.4*	15.1
Gait speed m/s	*Ph TH g*	1.1	0.15	1.6	0.14**	45.45
	Ex g	1.1	0.15	1.4	0.15**	27.3
Stair test (s)	*Ph TH g*	9.7	2.3	8.6	2.5**	11.34
	Ex g	9.6	2.4	9.0	2.6*	6.25
NRS	*Ph TH g*	6.7	1.8	3.9	2.0**	41.79
	Ex g	6.6	1.5	4.1	2.2**	37.87
ROM^{o}	*Ph TH g*	127.2	12.3	136.3	10.4**	7.15
	Ex g	127.3	12.3	132.6	11.4*	4.16

** HS: Highly significant P<0. 01, * S: significant P<0.05, *Ph Th G: physical therapy group Ex g: exercise group, WOMAC S: Western Ontario and McMaster University osteoarthritis index scores, NRS: numeric rating scale, ROM ^{0}: range of motion*.

Patients in the group 1 were reported to have had significantly less pain for up to 6 weeks postoperative compared to the two other groups (P<0.05), and less pain during activity at all follow-up periods. Patients in the group 3 showed superior scores over the subjects of group 2 (P>0.05) Table (2).

Regarding subjective patient functional satisfaction patients in the group 1 were reported to have had significantly more satisfaction at the end of study (P<0.05), patients of group 3 showed also a significantly more satisfaction than subjects of group 2 (P<0.05). With constant patient evaluation and follow-up, clinically successful results have been achieved.

Regarding knee pain, both groups showed significant reduction following intervention (P<0.01). Pain reduction averaged 41.79% in the PT group and 37.87% in the Ex group table (2). Comparing both groups for the post-treatment evaluation there was a statistically significant difference for the PT group (P<0.05) table (3).

Table (3): Comparison between the post-program measurements of both groups.

Variables	PT Group		EX Group		P Value
	M	SD	M	SD	
WOMAC: total	33.5	14.4	37.8	15.1	P<0.05
Timed Up & Go (s)	6.6	2.2	7.3	2.4	P<0.01
Gait speed m/s	1.6	0.14	1.4	0.15	P<0.01
Stair test (s)	8.6	2.5	9.0	2.6	P<0.01
NRS	3.9	2.0	4.1	2.2	P<0.05
ROM^{o}	136.3	10.4	132.6	11.4	P<0.05

ROM showed statistically significant changes in both study groups, (P<0.01) for the PT group and (P<0.05) for the Ex group. PT group showed 7.15% while the Ex group showed 4.16% Table (2). Comparing both groups for the post-treatment evaluation there was a statistically significant difference for the PT group (P<0.05) Table (3). Although an overall improvement was noticeable in all parameters in both treatment groups, the PT group showed superior scores which showed statistically significant changes over the Ex group.

The correlation coefficients analysis reveals significant relationships between pain, exercise, ROM and physical performance P<0.01 at the end of study.

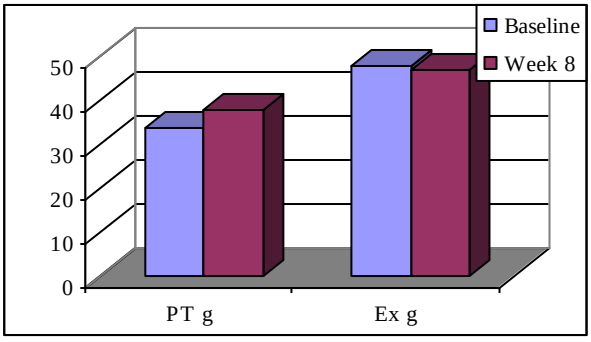

Fig. (1): Mean WOMAC for both groups.

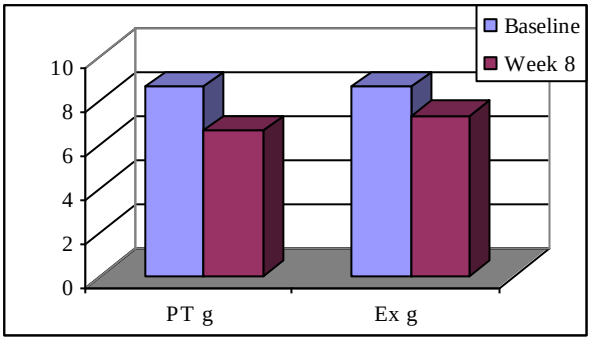

Fig (2): Mean Timed up and go (s) for both groups.

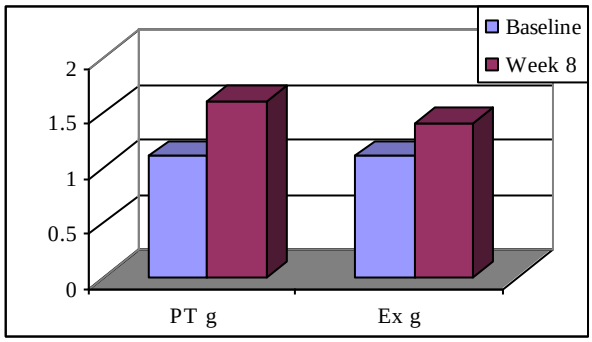

Fig (3): Mean Gait speed (m/s) for both groups.

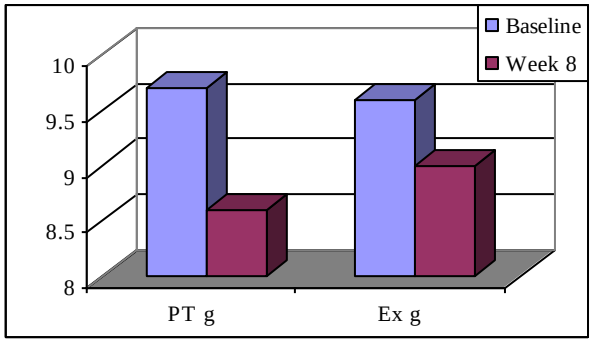

Fig. (4): Mean Stair test (s) for both groups.

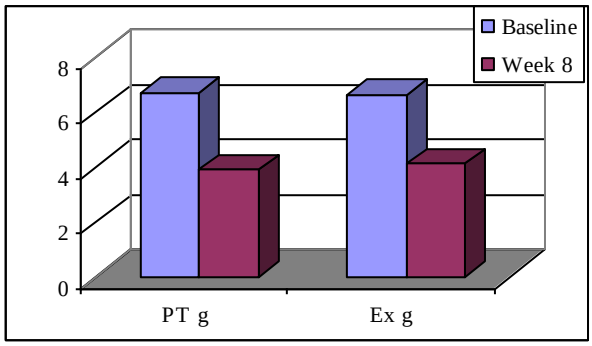

Fig. (5): Mean NRS for both groups.

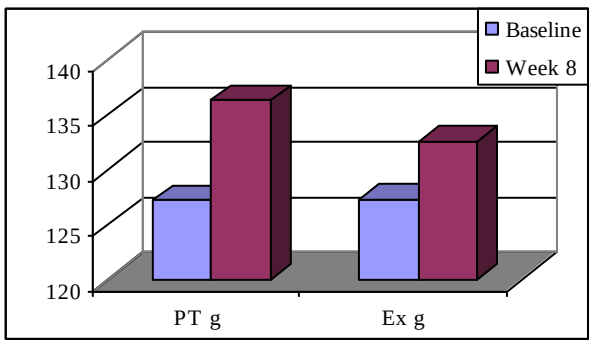

Fig. (6): Mean ROM for both groups.

DISCUSSION

The overall results of the present study revealed marked reduction of functional performance capacity observed at the baseline assessments. This is in agreement with those of Haxby et al. (2009)[10] who identified joint impairment as a predictor of disability, they added also that presence of an impaired ROM was one of the factors defining joint impairment in patients with knee OA, but other factors, such as tenderness, swelling and pain during motion, were also used in the assessment of joint impairment. Steultjens et al. (2000)[26] who found that restricted flexion of the hips and knees were strong risk factors for locomotor disability. They concluded that restricted joint mobility is an important component in the disability in patients suffering from knee OA. Røgind et al. (1998)[24] who found that in patients with knee OA, reduced balance, muscle strength, and flexibility predispose them to falls and impaired quality of life and further limits functional capacity. Ling and Bathon, (1998)[18] found that decreased quadriceps muscle strength has been associated with falls, loss of mobility, the ability to rise from a chair, and an overall decline in functional status. Gur and Gakan (2003)[9] reported that pain and physical disability are problems in patients with knee OA, and such patients have weak lower extremity muscles, particularly the quadriceps muscle, which correlates with the degree of knee pain and the degree of physical disability. Pua et al. (2009)[23] mentioned that knee OA is a leading cause of limitations of physical function, which in turn, are among the major reasons for total knee replacements among the older adults. Liikavainio et al. (2008)[17] reported that the patients with knee OA exhibited significantly poorer physical function and lower knee extension and flexion muscle strength which is serious risk factor for mobility limitation and impaired quality of life compared with age- and sex-matched control subjects. They claimed that to the weakness in the quadriceps femoris, and muscle strengthening in knee OA patients has improved their physical function. Kenneth (2003)[16] said that it is reasonable to consider that quadriceps weakness (or quadriceps strength) may be a surrogate marker for the progression of OA in some patients.

The primary purpose of this study was to investigate whether it is possible for patients with mild to moderate knees OA to undertake a physical therapy program to improve functional performance. Post-treatment evaluation revealed significant improvement in all variables measured. Previous work in this area has been reported by Haxby et al. (2009)[10] who reported that new developments in physiotherapy have demonstrated very promising improvements in pain and physical function in subjects with knee OA.

Results of the present study revealed a correlation between pain and physical performance. In this study, pain relief was observed as early as 4 weeks after PT program and became significant after 8 weeks, accompanied by increase in physical performance, this agreed with that of Ozgönenel et al. (2009)[20] who found that both pain and joint function improved after 10 sessions of US therapy spanning over 2 wk. Their patients showed statistically significant improvement in all pain measurements (VAS and WOMAC) and 50 meter walking time. Based on these results, they conclude that pain is correlated with physical performance. Miyaguchi et al. (2003)[19] have claimed the improved muscle strength and functional performance in patients with knee OA to the pain relief preceded the improvements. This is going with that obtained by Jordan et al. (1996)[13] study's result which demonstrates pain as a significant predictor of functional performance and the association of knee pain with diminished functional performance. They also showed that knee pain was significantly correlated with difficulty in performing daily tasks as measured with the Health Assessment Questionnaire. Also parallel to that results Van Baar et al. (2001)[28] who reported that exercise treatment in OA aims at reducing pain and disability through improvement of muscle strength, stability of joints ROM, and aerobic fitness, which are often impaired in patients with OA, presumably contributing to pain and disability. Improving these functions is assumed to reduce pain and disability. The significant improvement in the walking speed gained in the present study are supported by

those of Baker et al. (1999)[4] which revealed 18.4% improvement in the 6-minute walking distance by the aerobic exercise. This can be compared to a smaller improvement in walk time of 12% following resistance training. Also Røgind et al. (1998)[24] who evaluated the effects of an exercise regimen demonstrated diminished pain, increasing function, maximum weight lift, and endurance after 4 weeks of intervention, improved muscle strength by 35% and walking speed by 50% in men with knees OA. Also the results conside with those of Deyle et al. (2005)[7] and Topp et al. (2002)[27] who reported exercise, programs is effective in reducing chronic knee pain and improving function of older adults with knee OA. As exercise improves flexibility, improve muscle strength, diminish depression, and reduce fatigue. Improvements in any of these areas results in diminished pain. Deyle et al. (2005)[7] demonstrated a 52% improvement in self-reports of function, stiffness, and pain as measured by the WOMAC scale and a 12% improvement in 6-minute walk test scores in a manual therapy techniques and exercises group applied for 8 clinical visits.

During the present study the WOMAC was chosen to evaluate pain, stiffness and physical function. The effect of physical therapy modalities and exercise on function was measured through as physical functional performance by using a battery of validated tests that could be practically applied in general practice. The tests used required joint mobility, the strength of lower extremities, and balance and were intended to mimic normative daily activities. Performance was directly measured as the number of seconds needed to complete the task. These was in agreement with Haxby et al. (2009)[10] reported that WOMAC is a widely used validated instrument and responsive measure designed specifically for the assessment of lower extremity pain and function in knee or hip OA. Also Atamaz et al (2006)[3] who used the WOMAC scale for evaluation of physical therapy interventions in knee OA patients.

Application of pulsed US in the present study are supported by that of Huang et al. (2005)[11] who find that application of US treatment increased the effectiveness of isokinetic exercise and lead to functional improvement of knee OA patients. In their study, patients had better compliance than those in the group with only exercise therapy, which supports analgesic effect of physical therapy modalities. Also Ozgönenel et al. (2009)[20] claimed the improvement in stiffness, ROM of knee OA and walking time to the healing and thermal effects of US on periarticular structures of knee joint, which can produce a temporary increase in the extensibility of highly collagenous structures such as tendons, ligaments and joint capsule. Besides its thermal effects, nonthermal effects of US can modulate cell diffusion, fibroblast production, and collagen synthesis, alter extracellular matrix arrangement, break down adhesion and accelerate healing.

In the present study the application of IF were correlated to functional improvements, this was in consistent with those obtained by Burch et al (2008)[6] and Ruth et al. (2005)[25] who reported that IF current applied to the knee significantly reduced both chronic pain intensity and stiffness, and significantly increased pain-free ROM and pain threshold in the knee. Their results suggest that IF current is very effective treatment for chronic OA knee pain. They claimed the significant results of their study in part to IF stimulation, as it delivers current more deeply than conventional TENS. Consequently, they conclude that IF current may offers an effective and recommended treatment for OA pain.

Conclusion

Physical therapy programs proved to be a safe, effective and promising intervention for patients suffering from knee OA. The utilization of physical therapy modalities combined with exercise programs presents one of the most effective lines of treatment for relieving pain, decreasing stiffness and improving functional performance for knee OA.

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الملخص العربي

المخرجات الوظيفية لبرامج العلاج الطبيعي لحالات خشونة الركبة

تهدف هذه الدراسة إلي تحديد فعالية برامج العلاج الطبيعي علي الأداء الوظيفي للطرفين السفليين لحالات خشونة الركبة. ولقد إشتملت هذه الدراسة علي أربعة وستون شخص ممن يعانون من خشونة الركبة و تتراوح أعمارهم بين 56 ±10 أعوام ومتوسط وزن 82.7 ±9.3 كجم ومعدل مؤشر حجم الجسم 28.4 ±3.8 كجم/ م2 ودلالات إشعاعية لخشونة الركبة . تم تقسيم الحالات عشوائيا إلي مجموعتين، المجموعة الأولي: 32 مريض تلقوا برنامجا مكون من العلاج الطبيعي المصحوب ببرنامج من التمرينات العلاجية لمدة ثمانية أسابيع بمعدل ثلاث جلسات اسبوعيا، بينما تلقت المجموعة الثانية المكونة من 32 مريض برنامجا مكون من التمرينات العلاجية فقط لمدة ثمانية أسابيع بنفس المعدل. وتم متابعة الحالات قبل بدء البرنامج مباشرة وبعد ثمانية أسابيع من بدء البرنامج لكلتا المجموعتين. وقد تم إختيار إختبارات مقياس جامعتي ماك ماستر واونتاريو الغربية للألم والتيبس والوظائف البدنية إلي جانب الاختبارات الموضوعية مثل زمن القيام والمشي وسرعة المشي وسرعة صعود الدرج ومقياس الألم ومقياس المدى الحركي لمفصل الركبة. ، وقد أظهرت نتائج القياس القبلي تجانس المجموعتين. كما أظهرت نتائج هذه الدراسة تحسنا ذو دلالة إحصائية لكافة المشاركين بالدراسة في قياس نهاية البرنامج بالأسبوع الثامن إلا أن مجموعة برنامج العلاج الطبيعي المصحوب ببرنامج من التمرينات العلاجية قد أظهر تحسنا ذو فروق إحصائية عند نهاية البرنامج مقارنة بمجموعة التمرينات العلاجية فقط لحالات الخشونة المفصلية لكافة عناصر الاختبار. وقد خلصت هذه الدراسة إلي أن العلاج الطبيعي سواءا كبرنامج من التمرينات العلاجية المنفردة أو مصحوبا بوسائل العلاج الطبيعي المختلفة هو وسيلة فاعلة لعلاج المصابين بخشونة الركبة. وعلي الرغم من تحسن كافة المشاركين بالدراسة، فإن نتائج مجموعة العلاج الطبيعي بوسائله المختلفة المصحوب ببرنامج التمرينات العلاجية كانت أفضل من نتائج مجموعة التمرينات العلاجية فقط من حيث تحسن الألم والتيبس والمدى الحركي أو الوظائف البدنية وكذلك الأداء الوظيفي للمصابين بخشونة الركبة .