Effect of a Comprehensive Treatment Program in Improving Gait Parameters and Energy Expenditure in Patients with Unilateral Hip Osteoarthritis

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ABSTRACT

The purpose of this study was to examine the effect of two treatment programs, one involving all body segments and other applied only to the affected side of patients with unilateral hip osteoarthritis on their spatial gait parameters and energy expenditure. The study included 40 male patients, they were randomly assigned into two groups of equal number. Group 1 received a comprehensive physical therapy program for all body segments with special emphases on the affected limb while group 2 received localized treatment for affected side only. The study also included 20 healthy volunteers subjects for comparison. The measurement of gait parameters was conducted by using foot print method, while the oxygen consumption was measured by using the oxygen analyzer (Oxycon 3). The results showed that both treatment programs achieved significant improvement in the measured gait parameters. Oxygen consumption decreased significantly in both groups. However, comparison between the two groups after treatment showed significantdiference between the two groups in fevor of group1. That indicates that treatment programs which include all body parts are more effective in treating OA hip.
Keywords: *Hip joint, Gait, Oxygen consumption, Exercise, osteoarthritis.*

INTRODUCTION

The hip joint is the most important joint of the lower limb as it is the most proximal joint that provides stability and gross control in space for the remainder of the leg[28]. The primary function of the hip joint is to support the weight of the head, arms and trunk (HAT) both in static erect posture and in dynamic posture such as ambulation, running, and stair climbing. The hip joint also provides an essential pathway for the transmission of different kinds of stresses and forces from the upper body and the pelvis to the lower extremities and conversely the thrusting propulsive movements of the leg are transmitted to the body[25].

Pathology involving the hip joint always results in detrimental sequences on all its functions. The most common painful condition of the hip is due to deterioration of the articular cartilage and to subsequent related changes in articular tissues. This condition is known as osteoarthritis, degenerative arthritis or perhaps most appropriately as hip joint arthrosis[5]. Pathological condition of the hip such as osteoarthritis can create additional alteration in standing, in locomotor activities and other activities of daily living but may also results in adaptive changes at more proximal and distal joints such as in the spine and lower extremities[25].

Neumann and Cook[23] reported that regardless of the etiology pain is a symptom common to most hip pathologies, and itself

can affect hip mechanics. In such a circumstance the patient tends to assume postures that diminish the force through the joint. For example to avoid pain the patient tends to lean the body weight towards the affected side during walking to reduce the force upon the affected hip. This relatively extreme motions require high energy expenditure and in turn results in excessive wear and tear in the lumbar spine[25].

The degenerative changes already happened in osteoarthritis can not be cured or reversed but can be controlled with appropriate treatment[18]. Many authors reported various methods that can be used to control the progression of osteoarthritis. Soderberg[28] recommended that the use of an assistive device such as a cane or crutch held in the opposite hand can reduce significantly the muscular as well as the compressive forces acting on the affected hip joint. Other authors[5,8,9,21,22] advocated the use of manipulative procedures including stretching techniques to avoid capsular and ligamentous contractures, mobilizing techniques to conserve the range of motion and other therapeutic modalities involving electro and hydrotherapy for the control of pain.

Most of the treatment programs advocated by various clinicians or investigators emphasized their treatment protocol on the affected hip joint mainly and lower extremities to some extent. That, may ignore other body segments which could also be affected due to the abnormal pattern of activities the patient revert to in order to avoid pain. Therefore, the aim of this study is to design a comprehensive treatment program (including manipulative techniques) that would involve all body parts, and measure its effect on the walking ability and energy expenditure of the patient in comparison with a treatment program advocated mainly for the involved extremity. So the purpose of this study was to compare the effect of two treatment programs, one involving all body segments and one applied only to the affected side of patients with unilateral hip osteoarthritis on their spatial gait parameters and energy expenditure.

METHODS AND PROCEDURES

Forty male patients suffering from unilateral hip OA were selected among patients attending the orthopaedics outpatient's clinic of Kasr El-Einy University Hospital. Their age ranged between 40 and 60 years. They were randomly assigned into two groups of equal number One group received a specific training program involving all body segments (Group 1). Their average age was 54.3±4.3. ranging between 40 to 60 years) Their average weight was 88.7kg ± 9.1 and ranged between 75 kg to 103 kg. The height of this group ranged between 162 Cm to 182 cm with an average of cm 174 cm ± 0.5.

A second group received a treatment program emphasizing mainly on the segment of the affected side (Group 2). This group had an average age of 54.1 ± 4.9 years. Ranging from 41 to 59 years. Their average weight was 94.2Kg ± 14.5 ranged between 77 Kg and 102 Kg. Their height ranged between 160 cm and 180 cm and with on average of 172 cm ± 0.5.

A third group (Group 3) included 20 healthy volunteers matching in age to the above two groups of patients. They were selected as a control group for the purpose of comparison. The average age of the third group was 54.6 years ± 4. Their weight ranged between 71 Kg and 90 kg and average of 82.7± 5.5. Their average height was 172 cm ± 0.5 and ranged between 164 and 181cm.

All patients and subjects participated in this study were given an explanation of the study and the experimental protocol before being enrolled to participate. Also, all the patients were instructed not to receive any other form of physical therapy during the course of the study period.

Criteria of patients' selection

1-The arthritic changes were limited to one hip joint (unilateral) with no involvement of ankle, knee or trunk.
2- No previous history of surgery.
3- Rheumatoid arthritis patients were excluded from the study.
4- Patients with limb discrepancy more than 3 cm were excluded from the study.
5- Degree of disease falls between moderate and severe osteoarthritis.
6- Other than osteoarthritis of the hip, each patient has no other illness affecting his health and none has generalized neuromuscular problems or a systemic medical illness such as cardiopulmonary diseases, which might have impaired the walking ability.
7- All the patients have the ability to stand and walk without assistive device (crutch/cane) during the assessment.
8- Each subject had to be able to walk continuously at least for 10 minutes.

PROCEDURES

The personal data of each subject was recorded: age, height, weight and affected side as will the leg length. The leg length was measured with the subject standing (from the upper border of the greater trochanter to the floor bisecting the lateral maleolus). Determination of the severity of OA hip: after, the answer of the index of severity (adopted from lequesne and Samson-appendix) was given by each patient. The score was calculated and the degree of severity was determined from the following table.

Table-1: Determination of degree of severity of OA:

Point	Handicap
$\geq$ 14	Extremely severe
11,12,13	Very severe
8,9,10	Severe
5,6,7	Moderate
1-4	Minor

Ask the patient to mark any point throughout the VAS to represent the degree of pain. Each subject (including the control group) was asked to walk at his own normal walking free speed along a 10 meters walkway, which was covered by the absorbent paper twice, to accommodate him with the procedure. Afterward, the inked pads were adhered to the sole of his shoes and then he was asked to walk along the walkway. To eliminate the factor of acceleration and deceleration, the walkway was demarcated. So that one meter at the beginning and one meter at the end of the walkway was excluded. In this way only the parameters of 8 meters were considered. The time of traverse, stride length (the perpendicular distance from the heel strike of one foot to the next heel strike of the same foot), step length (the perpendicular distance from the heel strike of one foot to the next heel strike of the opposite foot). Speed was calculated by dividing the total walking distance in centimeters by the elapsed time recorded using a stopwatch. The cadence was calculated by dividing the number of steps taken in 8 meters of walking and then was converted into steps per minute.

Oxygen consumption was measured for each subject of the study (including control group: The subject was connected to the oxygen analyzer (oxygen-pro; Germany)

through the mouth piece. The subject was asked to breath from his mouth while applying a nose clip. So the expired air passes through the gas meter. This was followed by the following steps:

-The resting VO_2 was determined.

-The speed of the treadmill (Tentori: 797) was adjusted to permit the subject to walk at his natural walking speed. During this time no measurement for oxygen consumption was taken since the steady state period has not been reached yet.

- Once a steady state was reached (usually within three to four minutes after the exercise had started), oxygen consumption was measured over two minutes while the subject was walking on the treadmill.
- The difference between the VO_2/Kg value at the steady state and at the resting state was considered as the amount of oxygen consumption per kg per minute (VO_2/Kg/min).
- Assessment of walking and oxygen consumption was repeated 3 times with allowed period of rest about 15 minutes between each trial and the average was considered.

Treatment procedure

The patients of group I received a comprehensive exercise program for all body segments. This program include, (1)stretching of hip flexors, (2)stretching of hip adductors, (3)stretching of the hamstring, (4)long-axis distraction of the hip, (5)hip anterior glide, (6)hip posterior glide, (7)hip extension – abduction – internal rotation strengthening, (8)lumbar flexion active ROM, (9)lumbar rotation active ROM, (10)lumbar extension active ROM, (11)strengthening the abdominal muscles, (12)strengthening the back extensors and (13) proprioceptive exercise in form of two-foot standing balance on foam roller and rocker board.

The patients in-group 2 received treatment for the affected side only in the form of: Stretching of hip flexors, stretching of hip adductors, stretching of hamstrings, long axis distraction of the hip, hip anterior glide and hip posterior glide[21].

RESULTS

Comparison between the three groups before treatment

Table 4 and figure 38 show comparison using (ANOVA) between the measured parameters of the control group and the two groups of patients (G1 and Group 2) before treatment.

Analysis of variance showed that the patio-temporal parameters of walking were reduced significantly ($P<0.05$) in both patients group than normal control subjects. Also, the energy cost in patient groups were higher significantly ($P<0.05$) than control group.

Table-2: Results of one way analysis of variance ANOVA of selected parameters for the control group and the two patients groups (G1 and G2) before treatment.

Variables		Control	Group 1	Group 2	Probability level
Step length cm	Affected	62.3±3.9	54.6±3.4	53.2±5.4	P <0.05
	Sound	62.3±3.9	57.8±3.2	56.7±5	P<0.05
Stride length cm		121.7±9.1	113.1±4.4	112.5±7.3	P <0.05
Speed m/min		55.4±11.4	33.0±3.2	31.6±4.6	P<0.05
Cadence steps/min		81±14	57±7	53±7	P<0.05
O_2.cons. mL/Kg/min		5.9±5.5	8.4±0.7	9±0.8	P<0.05

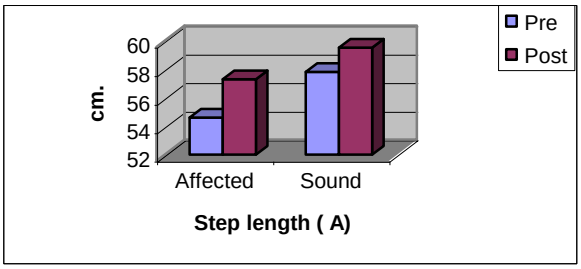
O_2.cons = Oxygen Consumption.

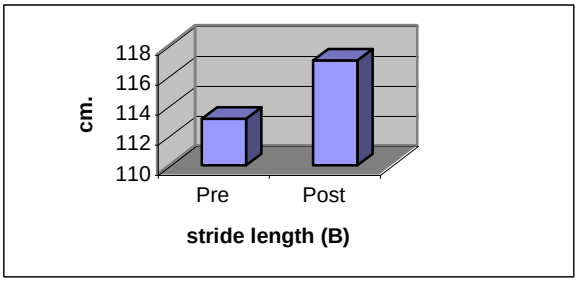
Statistical analysis between the two groups of patients (G1 and G2) was made using unpaired student t-test. Which reseal a non significant difference between studied groups before treatment.

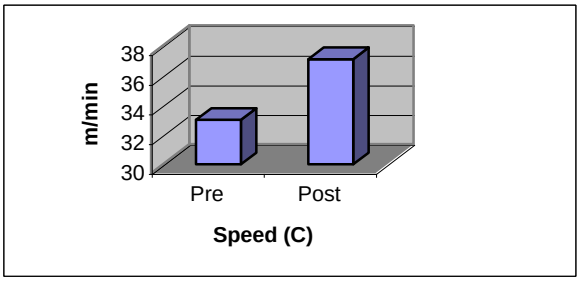
From the reported results, it can be observed in figure (1) that there was no significant difference in all parameters measured between the two groups.

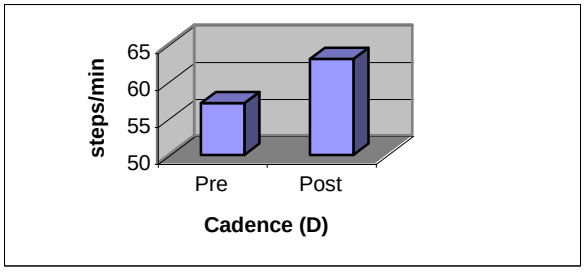
Results of treatment in each group:

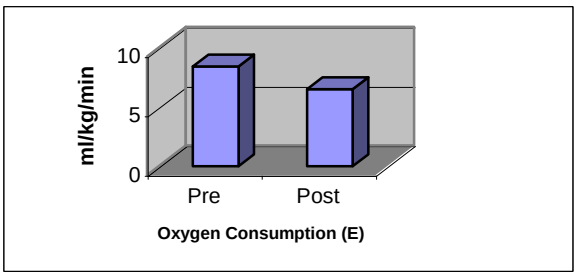
Comparison of the measured parameters before and after treatment in group 1 using paired t-test was made and shown in table 3. It demonstrated that the spatio-temporal parameters improved significantly ($P<0.05$) as well the 10s and VAS. The energy cost of walking was reduced significantly after treatment

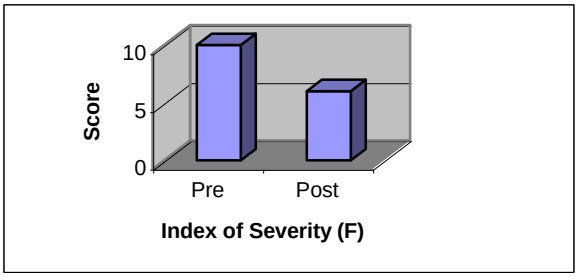












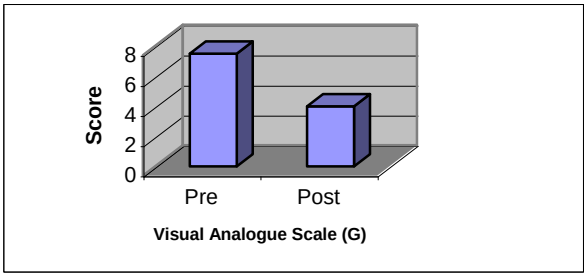


Fig. (1)(A-F): Multiple graphical presentation of the measured parameters in two patients groups (Group1 and Group2) before treatment

Table (3): Comparison of the measured parameters of group 1 pre and post treatment.

Variables		Pre	Post	Probability level
Step length cm	Affected	54.6±3.4	57.3±3.4	P<0.05
	Sound	57.8±3.2	59.5±3.2	P<0.05
Stride length cm		113.1±4.4	117±4.2	P<0.05
Speed m/min		33±3.2	37.1±3.1	P<0.05
Cadence steps/min		57±7	63±7	P<0.05
O_2 cons. mL/Kg/min		8.4±0.1	6.5±0.1	P<0.05
IoS		10±0.1	6±1.1	P<0.05
VAS		7.5±0.1	4±1	P<0.05

O_2 Cons. = Oxygen Consumption. IOS = Index of Severity. VAS = Visual Analogue Scale

Table-4 show comparison of the measured parameters in group 2 pre and post treatment using paired t-test. Comparison of steps length of the affected side pre and post treatment revealed a significant improvement in gait parameters. The treatment program resulted in significant (P<0.5) reduction of O_2 consumption during walking. Also, the LOS and VAS scors were reduced significantly (P<0.05).

Table (4): Comparison of the measured parameters of groups 2 pre and post treatment using paired t-test.

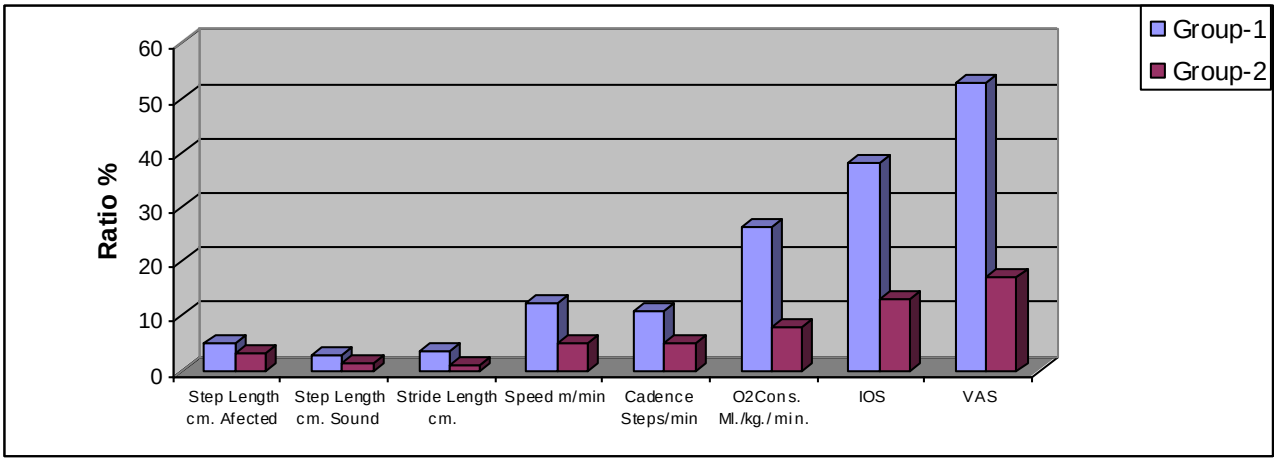
Variables		Pre	Post	Probability level
Step length cm	Affected	53.2±0.5	54.8±5.1	P<0.05
	Sound	56.7±0.1	57.3±5	P<0.05
Stride length cm		112.5±7.3	113.7±7.2	P<0.05
Speed m/min		31.6±4.6	33.2±4.5	P<0.05
Cadence steps/min		53±7	56±7	P<0.05
O_2 cons. mL/Kg/min		9±0.8	8±0.9	P<0.05
IOS		10±1	9±0.1	P<0.05
VAS		8±0.1	6±0.1	P<0.05

O_2 Cons. = Oxygen Consumption. IOS = Index of Severity. VAS = Visual Analogue Scale

Statistical analysis of relative changes in the measured parameters in group 1 and group 2 was made using unpaired student t-test. The purpose was to clarify the percentage of change of the parameters of each group in an attempt to determine which group has gained as a result of treatment. Comparison between the relative changes in group 1 andgroup 2 is represented in table 5 and figure (2), revealed the superiority of treatment results gain group 1, compared with group 2. Whom received localized treatment affected limb.

Table (5): Comparison between relative changes of the measured parameters in group 1 and group 2 using un paired student t-test.

Variables		Group 1	Group 2	Probability level
Step length cm	Affected	5±2.5	3.24±1.6	P<0.05
	Sound	2.9±1.5	1.21±0.1	P<0.05
Stride length cm		3.5±1.5	1.1±0.5	P<0.05
Speed m/min		12.4±2.4	4.99±1.3	P<0.05
Cadence steps/min		10.9±3.9	5.06±3.1	P<0.05
O_2 cons. mL/Kg/min		26.3±4.8	8.05±3.3	P<0.05
IOS		38.2±9.2	13.18±6.4	P<0.05
VAS		52.9±11.3	17±7	P<0.05



O_2 Cons. = Oxygen Consumption. IOS = Index of Severity. VAS = Visual Analogue Scale

Fig. (2): Multiple graphical presentation of the relative changes in the measured parameters in group 1 and group 2

DISCUSSION

The purpose of the current study was to investigate the efficiency of two treatment programs in the management of patients suffering from unilateral hip osteoarthritis (OA). Spatio-temporal parameters of walking; energy cost during walking; index of severity

(IOS) score; and perceived pain sensation (VAS) were stand as the outcome of the treatment program.

In addition, the potential difference between the effects of two physical therapy programs was investigated. The first treatment program (GI) involves dealing with all body segments. It consists of stretch, manual mobilization, strengthening exercises, mobilizing exercises, and proprioceptive (balance) exercises. The second treatment program (G2) emphasized the treatment only to the affected side. It is in the form of stretch and strengthening exercise, in addition manual mobilization.

Analysis of the results showed that the baselines of spatio-temporal parameters of walking (pre- treatment) of all patients were significantly less than that of normal age matched subjects (control group). Also, energy expenditure during walking was substantially greater in patients

With regards to the effectiveness of treatment, comparison of the before and after treatment parameters demonstrated that both treatment programs were effective in improving walking parameters; reducing energy cost, and reducing both IOS and VAS scores. However, comparison between the two programs outcome showed that comprehensive therapeutic program for all body segments is superior than that applied to the affected side only.

The decrease in gait parameters which was observed in the present study in the two groups of patients (pre treatment) in comparison to normal subjects is in agreement with other investigators[17,33]. Who also reported as was found in the present study that patients with hip OA take shorter steps with the involved limb than control subjects and demonstrated decreased velocity[2].

Also, the spatio- temporal parameters; reported by Watanabe et al.,[32] of gait for normal individuals were generally greater in values than that of the patients with hip disease. As well, Watelain et al.,[33] examined seventeen patients with diagnosed OA of the hip matched with 17 healthy subjects. Using video data obtained while subjects walked a 10 meter walkway twice and stepped across a force plate. Authors found that, cadence, speed, stride length, swing/stance ratio were decreased significantly than comparative data, which was reported from normal subjects.

The reduced values of spatio- temporal parameters observed in studied patients with hip OA may be attributed to perceived pain and to pathomechanical changes within the joint due to hip joint disorders. For instance, Hulet et al.,[17] found out that patients with hip OA showed significant reduction in step length. Patients who had severe hip pain walked with a decreased dynamic range of motion with a curve reversal as they extended the hip. Patients showed increased anterior pelvic tilt and lumbar lordosis. Allover, it could be deduced that patients with painful hip walked with a manner that was asymmetric. These gait modifications were related to hip limitation in passive motion and pain. Patients with flexion contracture adopted a compensatory gait mechanism.

In relevance to the same results, Hoeksma et al.,[16] suggested that the high intra articular pressure, due to restriction of the joint capsule in OA, is associated with pain. These pathological changes lead to reduced range of motion of the hip joint in OA patients. Similarly, variation in gait pattern in hip osteoarthritis from normal detected in the present study has been established with another clinical trial that aimed to study the compensatory gait mechanisms in patients

with early hip osteoarthritis. Subjects in the clinical group were characterized by a 12.4% slower walking speed. Besides, other changes not measured in the present study have been detected which pronounce that even at an early stage of hip OA, joint degeneration was compensated by an increase in pelvis motion and muscle power generation or absorption modifications in other lower limb joints[33].

Variation in gait parameters between hip OA patients and normal subjects has also been addressed in several earlier studies and all comes in accordance with findings of the current study, and in conformity with its interpretation and conclusion of the findings. For instance, Norkin and Levangie[25], explained the problems in patients with hip OA as follows; patients laterally lean towards the affected side to diminish the moment arm of the body weight relative to the center of rotation of the hip joint. This reduces the gravitational torque and consequently reduces the need for abductor counter torque. In addition, other study explained that the shorter steps observed in hip OA was attributed to diminished hip extension when either the involved and uninvolved limb was extended backwards during the latter part of each stance phase[2]. Cerny[6], reported that arthritic hip joint leads to limited hip extension range of motion and lack of extensibility of hip flexors predispose individuals to have an excessive anterior pelvic tilt in an attempt to displace the center of the head, arms and trunk anterior to the axis of motion of the hip joint

Many investigators[4,14,34] reported increase in oxygen cost during walking in patients with hip OA; similar to the finding of the present study. Gussoni et al.,[14] stated that energy cost of locomotion was in most patients increased by up to 50% and 70% during level-surface and uphill walking, respectively. While in the present study level of oxygen consumption in patients was higher than norms in level walking by approximately 30-35%.

It was suggested that pain felt during stance and/or swing phases would disturb the normal "heel strike to toe off" pattern. So, more muscular activity was required to maintain balance of different body segments[3,31]. This may explain the reported increase in oxygen cost of walking in studied patients when compared with normal matched group.

The results, also, showed that post experimental evaluation indicated improvement of measured gait parameters and oxygen consumption in both treatment groups, either group 1 using whole body exercise, or group 2 using local hip exercises. This indicates that exercises in general have positive effects on improving the restraints resulting from hip osteoarthritis. These positive effects are attributed to pain reduction and improved mechanical efficiency following treatment. This is a proposal supported by several authors. For instance, Kerrigan et al.,[20] concluded that an isolated and consistent reduction in hip extension during walking in the elderly, which is exaggerated in fallers, implies the presence of functionally significant hip tightness, which may limit walking performance. Authors, also, pointed out that overcoming hip tightness with specific stretching exercises can be considered as a simple intervention to improve walking performance and to prevent falls in the elderly. That is a conception that supports the results obtained in the current study indicating that stretching exercises, as a part of the exercise regimen has improved tightness of hip muscles. Consequently, functional performance of gait has been improved.

Positive effect of stretching used in improving hip flexion range of motion through hamstrings stretching has been demonstrated in a study by Cipriani et al.,[7] that aimed to compare the effect of two different protocols of stretching on hip flexion range. Results showed that both stretching protocols achieved improvement of hip flexion range; with a non-significant difference between the two protocols. The results of this study endorse the explanation of the results of the present study.

Considerable significant increase in hip range of motion both in flexion and extension has been shown in a recent clinical trial that investigated the effects of passive stretching on the passive range of motion of the hip joint, and reproducibility of passive range measurements[1]. This apparant improvement in the range of hip motion agrees with the present suggestion that stretching has a touchable effect in improving hip ranges, and excursions during gait cycle. It helps to improve measured gait parameters, and subsequently improved oxygen consumption.

Comparable improvement of hip flexion/ extension ranges and ankle plantar/ dorsiflexion ranges with stretching procedures has been recorded in an alternative clinical trial that aimed to investigate the overall effect of stretching on muscle performance parameters as isometric force, muscle activation, and jump power[26]. A lay down of findings that further supports the suggested mechanism about the influence of stretching in the present study.

The basic effect of stretching in the above suggested succession, namely improvement of joint range of motion, has been further supported by other review study. It has been concluded that regular stretching increases joint ROM (mean increase in ROM = 8 degrees; and range 6 degrees to 9 degrees) for more than one day after cessation of stretching and possibly that the effects of stretching are greater in muscle groups with limited extensibility[15].

In another related study, Willy et al.,[37] reported that it is generally accepted that stretching exercises result in an increase in ROM. In addition, the results of their study showed improvement of knee extension range following stretching exercises. These results further add to the suggested mechanism of contribution of stretching exercises to the current outcomes of this study.

In a clinical trial by Godges et al.,[13] whom aim was to investigate the effect of exercises on hip range of motion, trunk muscle performance, and gait economy. Their results revealed contradictory outcome than that of the present study. The authors concluded that training of isolated tasks, such as hip flexibility and trunk flexion exercises, did not produce the desired outcome in the economy of walking and running. The contradiction, basically, seems to arise from difference in subjects' sample. In the present study the subjects included in this study were relatively old aged hip arthritis patients. Unlike this study by Godges et al., where the results were obtained from a group of young athletic population whom possibly pocess high baseline of mechanical efficiency beforehand.

In addition, the results of these authors have raised another worthy debate concerning the effect of stretching exercises on range of motion. This is about how long can it last. As authors mentioned that improvement of range in their study has not been maintained when measured 4 weeks following cessation of stretching program. This contradictory has not been tested in the current study as measurements were taken immediately following program cessation.

Reported benefits of therapeutic exercises for hip osteoarthritis has been documented in a literature review study. Authors searched five different data bases for randomized clinical trials. Based on the data, therapeutic exercise was shown to reduce pain and improve physical function for people with OA[12]. This data supported using therapeutic exercises in the present study in attempt to improve patients' functional performance and oxygen consumption.

Another study report by Resnick[27]. Using exercises therapy to improve joint mobility and flexibility like is the case in the present study. It was reported that regular exercise is an important therapeutic intervention for all types of arthritis. Specifically, regular exercise can prevent deconditioning of the muscles, keep the joints stable, improve joint function and flexibility, decrease pain, enhance aerobic fitness, improve balance, and decrease falls. A comprehensive exercise program should include stretching exercises followed by a range-of-motion program for joints, muscle strengthening, and aerobic exercise.

Applied program[36] for inpatient rehabilitation intervention in patients with osteoarthritis (OA) of the hip or knee, has included strengthening exercise, flexibility training, endurance training, relaxation strategies, and consultations for preventive measures. Reported measures showed comprehensive inpatient rehabilitation of patients with OA of the hip or knee may improve pain and physical function in the mid-term and pain in the long term over a follow up period of 24 months). Exercises suggestions used by these authors have been close to considerations in constructing the present protocol of treatment where stretching and strengthening have been 2 integral components of present protocol aiming to reduce pain, improve range, and improve performance.

Considering incorporating joint mobilization techniques in present protocol has been based on their capacity to improve pain, and joint flexibility. This point of view has been justified by clinical trial that compared the effect of manual therapy (in the form of mobilization) and regular therapeutic exercises on pain, hip function and range of motion in patients suffering from hip osteoarthritis. Patients in the manual therapy group had significantly better outcomes on pain, stiffness, hip function, and range of motion. Effects of manual therapy on the improvement of pain, hip function, and range of motion endured after 29 weeks[16].

It was found that all spatial and temporal parameters of gait measured demonstrated good to excellent test- retest reliability in an adult population without pathology. Thus, changes observed in gait after treatment can be attributed to that treatment and not to test-retest variability[29]. Also, the walking energy expenditure in able- bodied or physically disabled was stable within and between days measures[19]. In spite of the fore mentioned; to compare between two programs applied in the present study, the percentage change from baseline were used as an outcome of each program. It was suggested that this design will minimize the influence of individual variation in response to therapeutic modality[30]. The comparison between studied groups showed superiority of comprehensive program applied to all body segments.

Training of the trunk muscles to stabilize the pelvis and allow the center of mass of the head, arms, and trunk remain in a position that could lessen pelvic compensatory movements seen in hip osteoarthritic patients during

walking, as a result an improvement in gait pattern is observed [13]. A finding that supports and explain the results obtained in the present study. Despite this agreement, the results of this above mentioned trial contradicts that of the present trial concerning improvement achieved in walking economy, suggesting that trunk exercises did not caused improved walking economy. Mostly the discrepancy arises from differences in target population.

Using an exercise program that consists of generalized lower limb and trunk exercises for osteoarthritis patients, Fisher and Pendergast[11], found out that improvement occurred that involves exercise capacity increment, reduction in submaximal heart rate, systolic blood pressure and oxygen consumption during gait. These findings confirm the results obtained in the present study that suggests higher improvement of oxygen consumption with comprehensive exercise program in comparison to local exercises only.

The importance of balance training in arthritic patients has been studied in bilateral knee osteoarthritis. Where balance deficits have been proven to occur. Results suggest the importance of balance training in this population[35] these results aids explanation of the present study results, as balance training, as a part of the comprehensive program added to the superiority of this program in comparison with the local exercises program.

However, in a study of the effect of aerobic versus resistive exercises in treatment of knee OA, no significant difference between both treatment protocols was detected[10]. This result contradicts the present study that shows higher improvement in gait parameters and oxygen consumption in the general training group over local training group. Such contradictory probably arises from difference in the nature of general training regimens where aerobic training would have not addressed faulty trunk posture and loss of trunk mobility, besides the difference in target population where knee OA was the target population in this study while hip OA is the present target population.

Conclusion

From the above results, it can be concluded that a comprehensive program which included all body segments is more effective than localized program in treating of patients with unilateral hip OA. Greater improvement in mechanical efficiency and index of severity were attained from comprehensive program intervention.

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الملخص العربى

تأثير برنامج علاجى شامل على مقومات حركة المشى واستهلاك الاكسجين فى المرضى المصابين بالتهاب عظمى مفصلى فى أحد مفصلى الفخذ.

أجريت هذه الدراسة بهدف بيان تأثير برنامج علاجى شامل يشمل جميع أجزاء الجسم على مقومات حركة المشى واستهلاك الأكسجين فى المرضى المصابين بالتهاب عظمى مفصلى فى أحد مفصلى الفخذ ومقارنته مع برنامج آخر لعلاج الجزء المصاب فقط، وقد اقتصرت الدراسة على 40 مريضا تم تقسيمهم الى مجموعتين : مجموعة 1 (برنامج شامل لجميع اجزاء الجسم) ومجموعة 2 (برنامج للجزء المصاب فقط) كما اشتملت الدراسة على 20 شخصاً من الأصحاء. وتراوحت أعمار المرضى والأصحاء من 40 إلى 60 عاماً وقد تم قياس بعض مقومات حركة المشى باستخدام طريقة طابع القدم وقياس كمية استهلاك الأكسجين باستخدام جهاز سير المشى وجهاز قياس الأكسجين وقد أسفرت النتائج عن زيادة إيجابية فى بعض مقومات حركة المشى وقلة استهلاك الأكسجين فى مجموعة 1 ومجموعة 2 والتحسن الايجابى فى مجموعة 1 أكثر من مجموعة 2. مما يدل على أن استخدام برنامج علاجى يشمل جميع أجزاء الجسم يفضل فى علاج المرضى المصابين بالتهاب عظمى مفصلى فى أحد مفصلى الفخذ.