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Original Article

Exercise Therapy Program in Rehabilitation of Patients with Primary Hip Osteoarthritis

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Abstract
The distresses of the hip represent a wide chapter of interest in medical rehabilitation pathology. Also, by the increase in the average age population, hip osteoarthritis has become a common degenerative restrictive disease to the "third age" patient.
The aim of the current study was to determine whether an 8-weeks intervention program comprising of a patient group based on medication, exercise therapy and electrotherapy is more efficacious in terms of effects on pain, functional performance and health status in individuals with primary hip osteoarthritis compared to participants treated only with medication and electrotherapy.
The purpose of this study was to describe and demonstrate the use of an 8-weeks intervention program consisting of exercise therapy and electrotherapy in patients with primary hip osteoarthritis compared to participants treated only with medication and electrotherapy.
The results of this study are encouraging, suggesting that the application of an exercise therapy program associated with classic physiotherapy treatment can lead to better and persistent outcomes in patients with primary hip OA. We consider that the combined therapy can be a better option in the hip OA rehabilitation management and that randomized clinical trials must be extended in the future, regarding exercise therapy and its effects. Eventually this combined therapy can be used on larger groups of patients to further confirm our obtained results and to promote the utility of therapeutic exercise program.
Key words: hip, osteoarthritis, exercise therapy, rehabilitation

Introduction

The distresses of the hip represent a wide chapter of interest in the medical rehabilitation pathology. Also, by the increase in the average age population, hip osteoarthritis has become a common degenerative restrict disease to the third age patient.

Hip osteoarthritis (HOA) is a pathological entity having a bilateral higher prevalence in most of the cases with monthly or yearly gaps between the clinical expressions from one hip to another.
Rheumatic degenerative diseases can be located at any joints of the inferior limb and have sometimes a disabling impact for the ambulation or orthostatic position. By changing the biomechanical alignments, in time, all this rheumatic diseases can also affect the hip joints. Due to the impairment of the functional status and the decrease of the joint mobility, the disease can generate temporary or permanent loss of work capacity. For the same reasons, HOA has a negative impact on social activities, being an important source of stress because it isolates and restraints the patient's activity.

The muscles surrounding the arthritic hip frequently become weak and atrophied. There is often a reduction in the reflexive inhibition and maximal force output of the muscles around the hip as well. The sensitivity of the muscles' proprioceptors is also reduced, decreasing the ability to detect and report information to the brain. The hip's stability then becomes compromised, as the muscles become less able to react in response to changes in stimuli. These changes finally result in a significant restriction in activity and mobility, which affects the patients' quality of life.

This condition is responsible for many different clinical manifestations but, at the same time explains the key clinical manifestations that are common for all the clinical forms of hip osteoarthritis: *pain* and *impairment of joint mob*ility. Hip joint pain generates relatively fast functional impairment and as a consequence the patient comes to see the doctor. The specialist needs to decide on the therapy that can be conservative, rehabilitative or a surgical intervention.

The accuracy of the therapeutically behaviour depends, first of all, on the accuracy of the therapeutically objectives that will be given according to the age of the patient, their profession, the level of their physical activity and daily activities, the moment when the symptomatology occurred and also the type and

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complexity of the disorders. Taking into account the clinical particularities of each case it can be a choice between conservative or surgery treatment.

The objective of conservative treatment is to relieve pain, maintaining a normal functional joint mobility, obtaining a good hip stability, and prevention of postural disorders. Regular exercise can increase physiological impairments associated with osteoarthritis including muscle strength, range of joint motion, balance, proprioception, and aerobic conditioning.

As a conclusion, from our point of view and our experience, regular exercises and electrotherapy, are appropriate and essential options for healthy joints and for rehabilitation.

The aim of the current study was to determine whether an 8-weeks intervention program comprising of a patients group based on medication, exercises therapy and electrotherapy are more efficacious in terms of effects on pain, functional performance and health status in individuals with primary hip osteoarthritis compared to participants treated only with medication and electrotherapy.

We hypothesized that the efficacy of the exercise therapy program applied to the exercise therapy group (ETG) is superior to the efficacy of the control group (CG) intervention consisting of electrotherapy and medication.

Methodology

Setting and sample method. This is an observational quasi-experimental, prospective analytical study on two groups of patients diagnosed with hip OA and treated in our clinics for 8 weeks with physical therapy and with a 6 month follow up. We used this type of non-equivalent group design to describe our clinical experience in adult subjects who utilized physiotherapy health services between September 2010 and August 2012 in two Rehabilitation Clinics in Craiova.

A total of *73 patients* with established and radiographically verified unilateral or bilateral hip OA were treated in this period. The selection of the subjects for this study was made by their own free choice of therapy (according medical indications and time to spend on rehabilitation). For patients with bilateral hip OA (n = 23), the most painful hip was selected for analysis. Data collection was made with the consent obtained from the head of the Rehabilitation Clinics.

The hip study participant *main eligibility criteria* consisted of continuous presence in physical therapy over a period of 8 weeks and the final assessment at 6 months. *Inclusion criteria* were: aged ≥ 50 years with clinical evidence of hip OA (hip internal rotation ≥ 15°, pain with internal rotation of the hip, morning stiffness of the hip for ≤ 60 minutes, or hip internal rotation < 15° and hip flexion of ≤ 115°, which has a sensitivity of 86% and a specificity of 75%) [18,19]; reported pain on most days in one or both hips; duration of symptoms of less than 3 months; moderate level of interference in activities of daily living; radiographic measurement of joint space width < 2.00 mm or side difference > 10%. Potential participants were *excluded* if they had: significant comorbidities, or others conditions which prevent safe participation in an exercise program (peripheral vascular disease, insulin-dependent diabetes, angina pectoris, blood pressure, or respiratory conditions); systemic arthritis conditions such as rheumatoid arthritis; neurological condition such as Parkinson's disease, Multiple sclerosis or stroke; problems of the lower limbs that could interfere with an exercise program; low back pain dominating over the hip symptoms; an inability to walk without an assistive device; indication for hip joint replacement surgery within the next 6 months.

After applying the mentioned criterion, a number of *38 patients* were selected; depending on the type of therapy were divided into: exercise therapy group (n=20, ETG, patients receiving an intervention therapy based on physical exercises, electrotherapy and medication) and control group (n=18, CG, treated only with medication and electrotherapy).

Exercise therapy (ET) protocol. Subjects participated in 60 minute physical therapy sessions, three times weekly for 8-weeks period, in our centre under the close surveillance of a physical therapist. *The general aims* of the exercise program were to increase functioning and improve levels of activity. *Individual aims* consisted of reducing pain, improving muscle strength, active joint stability, joint mobility, balance and functional activities. Exercise therapy comprised of a supervised program based on: walking on a treadmill for warm-up and aerobic conditioning, muscle strengthening, muscle stretching, functional exercises and activities to improve balance and gait stability.

Each exercise therapy session initiated with a warm-up session of 5-10 minutes walking on a treadmill. The intensity of the warm-up was established from 12 to 13 on the Borg Rating of Perceived Exertion Scale. The participants were instructed to walk symmetrically, maintaining a pace equal during ambulation and to extend the hip in the push-off phase of gait as patients diagnosed with hip osteoarthritis appear to modify their gait pattern, likely because of pain and altered joint loading.

Stiffness and vicious installed position of the hip have echoed in the superjacent and subjacent joint segments of the hip. Thus in lower extremity kinetic chain can develop damage simultaneously and gradually through the compensatory overload in the lumbosacral spine, on the homolateral knee, but also in the contra lateral hip and knee. Most OA patients have some degree of inflexibility due to muscle shortening and intrinsic joint restriction.

Hip extension and external rotation are associated with a high degree of disability, too. For these reasons, one of the goals of the exercise program is to maintain sufficient hip ROM to perform activities of daily living. To achieve this goal we included in our program mobility exercises based on static stretches to increase flexibility of the hip, pelvis and lumbosacral spine joints. These exercises were the hip flexor stretch, piriformis stretch, single knee to chest stretch, hamstring stretch, hip internal and external rotation stretch. Each stretch should be maintained for 20-30 seconds for each direction.

To enhance the physical independence we introduced strengthening exercises for hip and core muscles like: supine gluteal sets, bridging with two legged support and unilateral bridging, standing hip extension, extended supporting leg and supine pelvic tilt with gradually progressions and crunches were executed lying supine with hip and knees partially flexed. Hip abductor strengthening exercises were performed initially in supine position and then progressed through, side lying and standing wall press. For hip external rotators we chose clamshell exercises performed initially without resistance and progressive with resisted clamshells, and standing wall press. The patient was asked to perform three sets of 8 repetitions for each exercise.

To improve the strength of quadriceps muscle the patients performed resistance band knee extensions in sitting, sit to stand, ½ squats and partial wall squats. This exercise was performed in 3 sets with 10 repetitions. For the gastrocnemius muscle strengthening heel-raise exercises in orthostatic position holding a dumbbell in each hand were performed. When the subjects could tolerate more than 8 repetitions, the effort intensity was increased gradually by increasing the exercises resistance.

Many of our patients with OA also complain about frequent limitations in performing daily activities such as maintaining orthostatic position, walking up and down stairs, rising from a sitting position, etc. Single leg standing is an important part of the gait cycle and many functional activities such as stair climbing or clearing an obstacle during walking. For this reason each balance training session included exercises incorporating static or dynamic balance while standing on a hard or unstable surface. Others exercises that we introduced in the rehabilitation program were the following: lateral and tandem stance and weight shifting, side steps, crossover stepping, shuttle walking and stairs.

Electrotherapy was realised with BTL-5000 professional medical devices (which combine up to four therapies in a single unit: electrotherapy, ultrasound therapy, laser therapy, magneto therapy). We used pre-set protocols to relieve the pain and stiffness, to accelerate healing process and tissue repair. The applied on hip electrotherapy forms and protocols were: interferential P2157 or P5806; ultrasound 0025; laser therapy P0727 and P0728; magneto therapy as a focused magnetic field M0011.

Outcome measures and data collection. Measurements have been taken at baseline (T1 moment, initial examination), after 8 weeks of rehabilitation (T2 moment), and at a 6-month follow-up (T3). Physical examination procedures included range of motion (ROM) measurements and functional tests.

The passive range of motion ROM for hip flexion, extension, abduction, internal rotation and external rotation, were obtained using a universal goniometer, which has been demonstrated to be a sufficiently reliable tool for measuring hip ROM [1]. For all measured values, two trials were performed and the mean was used in analysis.

The hip pain has been self-assessed by his numeric pain rating scale (NPRS). Subjects quantify their pain intensity on a scale ranging from 0 (no pain) to 10 (pain as bad as it can be) [2].

To add information about the potential effectiveness of the intervention, participants were assessed using a range of standardized, self-report measures that included:

Hip disability and osteoarthritis outcome score HOOS is developed as an instrument to assess the patients' opinion about their hip and associated problems. HOOS consists of 5 subscales; Pain, other Symptoms, Function in daily living (ADL), Function in sport and recreation (Sport/Rec) and hip related Quality of life (QOL). The last week is taken into consideration when answering the questions. Standardized answer options are given (5 Likert boxes) and each question gets a score from 0 to 4. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale. The result can be plotted as an outcome profile. HOOS is patient-administered, the format is user friendly, and takes about 10 minutes to fill out [3].

The Lower Extremity Functional Scale (LEFS) is a self-report, 20-item, uni-dimensional, region-specific measure that quantifies the perceived difficulty of a variety of activities. Each item is scored on a 5-point scale (0-4). Item scores are summed to yield a total score [4] ranging from 0 to 80, with higher scores representing better functional status [5].

Several functional tests were included.

Stair climb test. For the stair climb test, we assessed the time taken to climb up and down 6 standardized stairs (step height 18 cm, step depth 30 cm) at the participant's self-selected pace. Handrails were on the sides of the stairs, and participants held them loosely for safety if necessary. No practice trial was given for this test.

The 'timed up and go' test TUG was used to measure functional mobility of people with musculoskeletal conditions [6]. It is also used frequently to assess patients in rehabilitation because it is simple and easy to administer in a clinical setting. The test consists of measuring the time it takes for an individual to get up from a chair, walk to a 3-m mark, return to the chair, and sit down.

The 6-minute walk test (6 MWT) is a functional test developed to measure functional status [7]. The test provides information about gait speed and functional and endurance capacity. The primary outcome is the total distance walked. The 6 MWT measures the distance in metres walked indoors at a comfortable speed for 6 minutes, and is considered an adequate measure of physical functioning in subjects with hip OA. The patients walked along a 40-metrer corridor for 6 minutes.

Results

Between September 2010 and August 2012 we selected and evaluated *38 patients* diagnosed with hip primary OA; depending on the type of therapy, they were divided into: exercise therapy group (n=20, ETG, patients receiving an intervention therapy based on, physical exercises, electrotherapy and medication) and control group (n=18, CG, treated only with medication and electrotherapy). The total study sample comprises of 23 women and 15 men, aged 54–72 years old, with a mean age of 64.1 years old (95% CI 62.6-65.6 years old).

The patient's baseline characteristics are shown in Table 1. There were no statistically relevant differences between the two groups at the beginning of the study T1.

Table 1. Characteristic and the initial parameters for the research groups

Characteristics T1	ETG* (n =20)	CG* (n = 18)	*P* Value
Age	63.8 ± 5.3	64.4 ± 3.8	*> 0.05*
Sex (women/men), *n*	12/8	11/7	-
Duration of pain (y)	3.15 ± 1.2	3 ± 1.4	*> 0.05*
Bilateral/unilateral (n)	7/13	6/12	-
Hip pain (NPRS)	5.7 ± 1.2	5.6 ± 1.4	*> 0.05*
HOOS	47.03 ± 9.36	47.14 ±9.51	*> 0.05*
LEFS	42.6 ± 10.43	43.78 ± 9.94	*> 0.05*
Hip flexion	122.75 ± 11.64	122.5 ± 12.16	*> 0.05*
Hip extension	5.25 ± 3.79	5.56 ± 4.82	*> 0.05*
Hip abduction	32.25 ± 11.41	33.06 ± 10.59	*> 0.05*
Hip adduction	17.25 ± 4.86	17.64 ± 4.81	*> 0.05*
Hip external rotation	26.5 ± 6.9	26.94 ± 8.77	*> 0.05*
Hip internal rotation	29.75 ± 8.65	29.72 ± 8.31	*> 0.05*

Abbreviations: ETG-exercise therapy group, CG-control group, T1-initial examination, NPRS-numeric pain rating scale, HOOS-Hip disability and osteoarthritis outcome score, LEFS-Lower Extremity Functional Scale.
**Data presented as mean ± SD.*

Both groups with hip OA had significantly lower hip pain level at T2 - after 8 weeks of rehabilitation (ETG: mean 2.3, 95%CI 1.98-2.62; CG: mean 2.72, 95%CI 2.17-3.26, *p<0.05* when comparing with T1), but with insignificant differences between groups, *p>0.05*. The pain decreasing was found to be greater at T3 - 6-month follow-up for the exercise therapy group ETG (mean 1.45, 95%CI 1.11-1.78) than for CG (mean 2.11, 95%CI 1.8-2.42), *p=0.003* (figure 1).

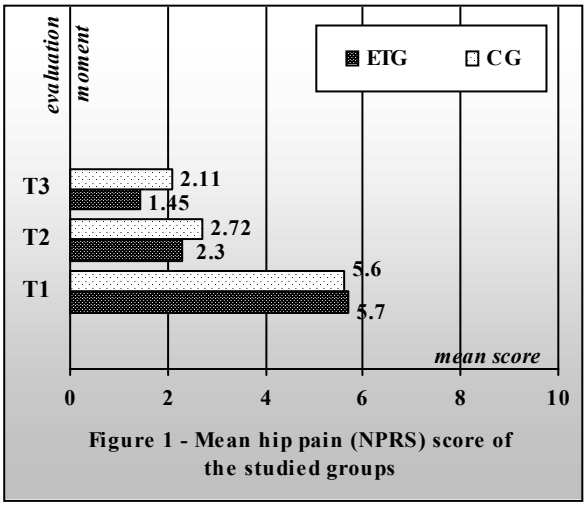

Figure.1- Mean hip pain (NPRS) score of the studied groups

Both groups improved from baseline to T2 (after 8 weeks of therapy) on most of the outcome measures (but particularly significant for 6-minute walk test, p=0.04) and on all outcome measures at T3 - 6-month follow-

up for the exercise therapy group ETG when comparing with CG (Table 2). At 6-month follow-up (T3) the patients with hip OA treated with combined therapy (physiotherapy plus exercises for 8 weeks) in our study covered a significantly longer distance during the 6MWT (500.8 versus 434.3 m) compared to the controls.

Table 2. Hip functional evaluation for patients with exercise therapy and controls

	ETG* (n =20)			CG* (n = 18)			*P* Value (ETG:CG)		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
Stair climb test (n)	9.9 ± 3.24	4.6 ± 0.75	5.8 ± 1.67	9.67 ± 3.83	5.17 ± 1.69	7.5 ± 3.26	*>0.05*	*>0.05*	*=0.02*
'Timed up and go' test, TUG (s)	11.1 ± 2.47	4.5 ± 1.19	5.7 ± 1.69	10.8 ± 3.38	5.2 ± 1.48	8.4 ± 3.42	*>0.05*	*>0.05*	*=0.002*
6-minute walk test, 6 MWT (m)	428.7 ± 95.86	524.9 ± 92.13	500.8 ± 93.92	429.2 ± 93.91	476.8 ± 77.46	434.3 ± 89.01	*>0.05*	*=0.04*	*=0.01*
	Mean Difference T2/T1			**Mean Difference T2/T1**			***P* Value (ETG:CG)**		
Stair climb test (n)	5.3 ± 2.66 (95%CI 4.07-6.53)			4.5 ± 2.38 (95%CI 3.4-5.6)			*>0.05*		
'Timed up and go' test, TUG (s)	6.6 ± 1.47 (95%CI 5.92-7.28)			5.6 ± 2.06 (95%CI 4.66-6.56)			*=0.04*		
6-minute walk test, 6 MWT (m)	96.2 ± 26.26 (95%CI 80.07-108.33)			47.7 ± 37.43 (95%CI 30.37-64.96)			*p<0.001*		

Abbreviations: n-number, s-seconds, m-meters, ETG-exercise therapy group, CG-control group, T1-initial examination, T2- after 8 weeks of rehabilitation, T3- at a 6-month follow-up.
**Data presented as mean ± SD.*

Compared with T1 baseline scores, the exercise therapy group had a statistically significant larger increase at T2 evaluation on the 6MWT (ETG mean difference T2-T1 96.2 ± 26.26, CG 47.7 ± 37.43, *p<0.001*), for the decrease on TUG test (ETG mean difference T2-T1 6.6 ± 1.47, CG 5.6 ± 2.06, *p=0.04*), but with insignificant differences between groups for the Stair climb test, *p>0.05* (Table 2). There were no adverse events registered in the exercise therapy group at T2 after 8 weeks of rehabilitation.

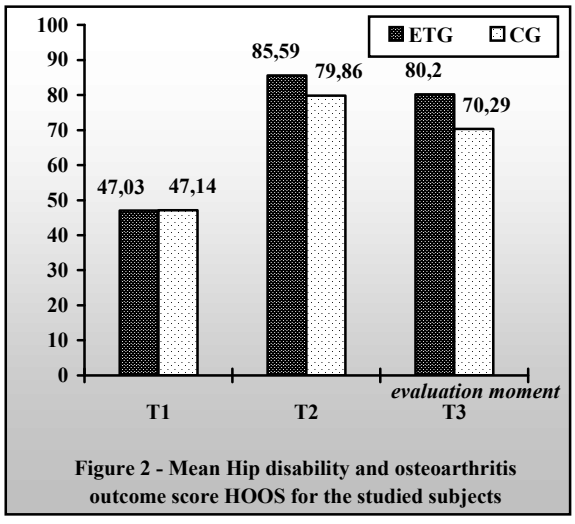

Figure 2 - Mean Hip disability and osteoarthritis outcome score HOOS for the studied subjects

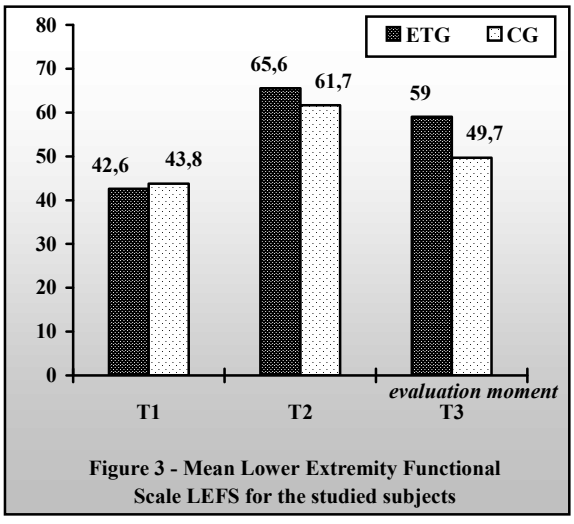

Figure 3 - Mean Lower Extremity Functional Scale LEFS for the studied subjects

Figure 2 Mean HOOS score

Figure. 3 Mean LEF Scale

The patients with exercise therapy in our study showed a significantly improvement on the Hip disability and osteoarthritis outcome score HOOS at all evaluation moments (T2 mean score 85.59 versus 79.86, T3 80.2 versus 70.29, *p<0.05* at both evaluations) compared to the controls (figure 2).
Compared with the baseline score, the LEFS showed a higher score after 8 weeks of rehabilitation (ETG: mean 65.6, CG: mean 61.7, *p<0.05* when comparing with T1), but with insignificant differences between groups,

p>0.05; a statistically significant improvement for LEFS score was noticed at 6-month follow-up (T3): ETG:mean 59, CG mean 49.7, *p=0.004* (figure 3).

Discussion

The purpose of this study was to describe and demonstrate the use of an 8-weeks intervention program consisting of exercises therapy and electrotherapy in patients with primary hip osteoarthritis compared to participants treated only with medication and electrotherapy.

The patients completed the physical therapy with no complications and there were no adverse events registered in the exercise therapy group after 8 weeks of rehabilitation. The ET included different types of exercises aimed to reduce pain, improve muscle strength, active joint stability, joint mobility, balance, to increase functioning and improve levels of activity.

There were no statistically relevant differences between the two groups at the beginning of the study. After completing the 8-weeks exercises program, the ETG had better scores than the control group on performance-based and self-reported physical functioning, pain, and self-efficacy scores, but particularly greater for 6-minute walk test, 'Timed up and go' test and HOOS. At 6-month follow-up we noticed statistically significant differences between the groups in favour of ETG on all self-report measures (pain, HOOS, LEFS) and functional tests (stair climb test, TUG, 6 MWT).

Our results suggest that the exercise therapy program served its purpose, as all outcome measures have improved more in the ETG group than in the control group after the 8-weeks period. Despite the fact that both groups improved after the intervention, the ETG group kept its advantage above the control group at 6 month reassessment.

As a result of our study, the substantial and maintained effects of our exercise training program with no adverse events are promising. Therefore we recommend that the physical therapist should provide information about the benefits of exercise and to adjust exercise intensity according to pain level, the physiotherapist's supervision and guidance being an important integrated part of the rehabilitation program for patients with hip OA. However, the study has to be replicated to determine whether these effects are clinically worthwhile and could define conclusions about its effectiveness.

Conclusions

The results of this study are encouraging, suggesting that the application of an exercise therapy program associated with a classic physiotherapy treatment can lead to better and persistent outcomes in patients with primary hip OA. We consider that the combined therapy can be a better option in the hip OA rehabilitation management, and that randomized clinical trials must be extended in the future regarding exercise therapy and its effects, eventually on larger groups of patients for further confirmation of our obtained results and to promote the utility of therapeutic exercise program.

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