Physical Therapy Program after Hip Fractures in Geriatric patient

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ABSTRACT

This study was aiming to design a simple physical therapy program to improve quadriceps strength, postural control and gait velocity after hip fractures in geriatric patient. The actual participants of this study were 20 patients (65 to 70 years of age). Subjects were recruited on average 5 months after a fall-related hip fracture. They were subdivided into control and intervention groups (n=10 each). Both groups were well matched in terms of medical conditions, medication use, disability, and activity level. The intervention group received the described physical therapy program for two months. The main outcome measures included quadriceps strength, postural sway, functional reach, weight bearing ability and walking velocity. The subject undertook these assessments at the begining and at the end of the study. The obtained results showed a significant improvement in both gait velocity and cadence of the intervention group. The mean changes of gait velocity and cadence for the intervention group were +130.80 (2.4) m/sec and +7.9 (6.8) steps/min, respectively, while the mean changes of gait velocity and cadence for the control group were 5.66 (7.8) m/sec and 2.1 (7.4) steps/min, respectively. Also, the strength of the quadriceps muscle of the intervention group showed a greater improvement than that of the control group (the mean change of quadriceps strength of the exercised group was +53.1 (5.2) kg; while it was +11.6 (33.8) kg for the control group). Improvement of postural control of the exercised group was also recorded while swaying on floor, on foam and functional reach. The findings of this study can be helpful for falls prevention for older people. Also, the described exercise program is beneficial in improving muscular strength, especially after hip fractures of the elderly subjects.
***Key words:** Hip fractures, gait velocity, muscular strength and postural control.*

INTRODUCTION

Hip fractures in older people are problems of major public health significance[3]. It has been estimated that about one third of people over the age of 65 years experience one or more falls a year[4] and that 50 year old women have a 16% life time risk of hip fracture[5].

Falls are a major cause of hip fractures in older people who is suffering mostly of osteoporosis[9]. Hip fractures may be extra or interacapsular, the latter has a much more worse prognosis.

The disorder after changes in the lifestyle of an ambulatory person to one who becomes bedridden. Physical and mental deterioration may follow and in some instances the patient may die within 6 month

after the traumatic incident[18]. Therefor, the major goal in treating elderly people who have suffered from hip fracture is early mobilization to avoid complications of bedridden. To promote early ambulation, the fracture is either subjected to some form of internal pining or prosthetic replacement of the proximal end of the femur. Half of these patients admitted to the primary hospitals are discharged to a rehabilitation service. Unfortunately, rehabilitation after fracture neck of femur is relatively poor, studies indicated a success rate varying from 25% to 51%[1]. This may be due to lack of adequate home exercises program and inadequate re-assessment procedures. The most appropriate gait retraining method for those patients was described by Baker et al (1991). The authors reported that subjects participated in the treadmill gait retraining program had significantly better mobility outcomes as measured by temporal distance gait parameters and mobility level. Furthermore, treadmill gait retraining after the neck of femur has been fractured will result in gait parameters close to normal and a higher rate to pre-fracture mobility, than conventional gait retraining program.

Reduced quadriceps strength, postural sway, and slow walking velocity have been identified as important risk factors in community-dwelling populations. Fortunately, there is now strong evidence that exercise programs can improve fall-related risk factors including strength and sway[15].

The different types of fracture neck of femur is treated mostly by open reduction and internal fixation or hemiarthroplasty of the hip joint. Post-surgical interference physical therapy should be given twice a day[7]. This may include coughing and breathing exercises, ankle range of motion exercise, bed mobility exercises and lower limb strengthening by using isotonic exercises for the sound limb and isometric for the musculature of the affected limb. This physical therapy program includes also, gradual gait training by using a suitable walking device till the patient is discharged.

This study aimed to design a simple physical therapy program to improve quadriceps strength, postural control and gait velocity after hip fracture in geriatric patients. Through this program, the patient can return to near normal function and his falling risk factors can be reduced.

METHODS

Patient criteria

The medical records of 25 patients, 65-70 years of age who had been admitted to the orthopedic department of Kaser El Eni hospital were reviewed to identity eligible subjects. The eligibility criteria included: age 65 plus/years, fracture resulting from a fall, occruing within the last 3 months and discharged from Kaser El Eni hospital. Of the 25 patients who met the study inclusion criteria, 3 patients had severe cognitive impairments or were too ill and/or immobile to participate. The raimining 20 agreed to participate and were randomly allocated to treatment and control groups.

The included patients were then visited at their place of residence, and an interviewed physical assessment lasting approximately 50 minutes was conducted by a single investigator after informed consent was obtained.

The mean time from hospital admission to test was one month for both the intervention and control groups. The interview consisted of questions regarding activities of daily living, general health, joint limitation, physical activities levels, balance, fall risk and medical conditions. Functional status was assessed using the functional ambulation category[10],

functional independence measure for locomotion[21] and stair climing and descending. After the interviews, two patients were excluded because of poor general health and lack of co-operation. The final sample included 20 patients (ten in each group). They were living independently in the community. The mean age of the intervention group was (range 65 to 70 SD, 8.5), which was not significantly different from the mean age of the control group. There was, however, a higher proportion of women in the intervention group compared with the control group. Table (1) shows the number and proportion in each group with regard to presence and/or history of medical conditions, cognitive impairment, disability, mobility problems, falls, instability and reduced activity. There was no significant difference between both the control and intervention groups.

Table (1): General health assessment.

	Intervention N %	Control N %
- Medical conditions and cognitive status:		
Cardiovascular disorders	3 (15)	2 (9)
Osteorarthritis	5 (12)	4 (9)
Diabetes	1 (4.5)	2 (8.5)
Severly impaired cognition	1 (4.5)	1 (4.5)
- Activities of daily living:		
Requires assistance for:		
Indoor mobility	1 (4.8)	0 (0.0)
Toiletting	2 (9.5)	1 (4.5)
Showering	5 (22.3)	7 (21.4)
Street mobility	7 (33.3)	4 (13.3)
Cooking	8 (38.1)	5 (20.2)
Cleaning	7 (33.3)	6 (28.9)
Shopping	7 (33.3)	5 (20.2)
- Mobility and activity:		
Uses walker	4 (19.1)	4 (21.9)
Uses crutches	3 (14.3)	5
Uses cane	3 (14.3)	1
- Instability:		
Two + falls in last year	4 (19.5)	0 (0.00)
Self reported giddiness on standing	3 (14.3)	2 (9.5)

* $P < 0.05$

Physical Assessment

This included assessment of gait, muscular strength and postural control.

1- Gait: Subjects were timed (using a hand-held stopwatch), while they are walking at a comfortable speed with their usually walking aid over the longest available indoor distance (e.g. diagonally across a room or along a hall way). This distance was quantified using a measuring wheel. The mean distance walked were 5.0 meters for both the intervention and control groups. Steps were also counted and cadence (Steps per minute) was calculated for both groups.

2- Knee extension torque: It was measured with a Cybex II dynamometer. Patients were seated with the trunk stabilized against a backboard reclined 20°, and the knee flexed to 15° from full extension. The

dynamometer was aligned so that the axis of the lever arm matched the knee joint axis during the test. The cuff of the dynamometer arm was placed at the supramalleolar area of the ankle. The obtained quadriceps forces were recorded on analonge tape and printed on light sensitive paper with a light galvanometer. The forces in kilograms (of force) were multiplied by the hand-measured lever arms to produce torques in kg. meters (Kgm). The larger torque of two trials was used for data analysis. A test retest reliability coefficient of 92 has been reported.

3- The patients ability to generate extensor force in both lower limbs was tested by using a "weight-bearing exercise"[16],. In standing position with both feet adjacent, the patient placed one foot on a wooden block and attempted to lift the contralateral leg off the ground by extending the hip and knee of the leg on the block. The ability to perform this exercise was assessed for each leg using both a 5.5 cm and a 10.5 cm block. Subjects performance was graded using a five point scale: 1) not capable of lifting the contralateral leg; 2) required help from investigator; 3) needed to support themselves with both hands; 4) needed to support themselves with one hand 5) did not require any kind of support,Nugent et al. (1994).

4- Postural control. This was measured by sway meter as described by Lord et al., 1996[14]. The device, as shown in Figure (1), consisted of a rod attached to the patients waist by a firm belt. A pen mounted vertically at the end of the rod recorded the subject on a sheet of graph paper (with a millimeter square grid) that was fastened to the top of an adjustable high table. The subject was instructed to stand with feet comfortably apart on a firm base, as motionless as possible for a period of 30 seconds. The test procedure was then repeated with the subject standing on high density foam rubber (70 cm by 62 cm by 15 cm thick), again with eyes open. Shoes worn corded and kept consistent between the trials for the same patient.

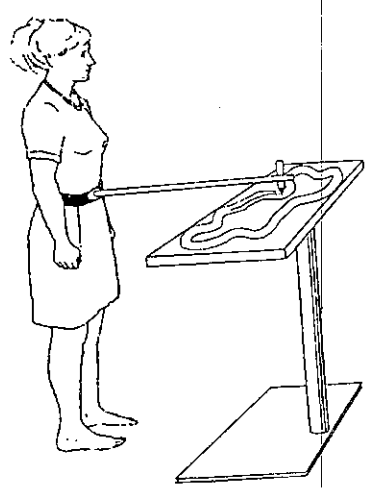

Fig. (1): Assessment of postural control..

Description of the exercise program

The exercise group included 10 patients. They practised the described exercise program for two months. This program included.

1- The weight bearing exercises: The patient stood with the affected leg on a wooden block with a minimum height of 5 cm and a maximum height of 12 cm, i.e, approximately one third the height of a standard house steps. Assistance was provided to achieve this position if required. The patient then lifted his non affected leg from the floor by extending his

affected hip and knee without using his non affected leg to achieve foot clearance or permitting the affected knee to hyperextend. If necessary, manual guidance was used to prevent hyperextension of the affected knee. Patients were instructed to undertake this exercise at least once a day and encourged to slowly increase the number of repetitions they were doing. The number of repetition initially prescribed ranged from 5 to 50 (mean 19.7 SD ± 10.1).

2- Knee extension exercise (Three sets) performed to fatigue while the patient in a semireclining position. This position allows the rectus femoris to be in a greater length and can make a greater contribution to knee extension torque. Patients rested for two minutes between sets.

3- Balance exercises: This included T'ai Chi postural alignment exercises, shifting weight laterally from one foot to the other foot, and anterior posterior weight shifts performed in a position similar to a fencing position. This simple T'ai Chi movements were performed for five to ten minutes[12].

4- The previously described program included also a cardiorespiratory component in the form of planned walking. The walking program was graded in terms of both duration (walking time) and intensity (walking speed). This component is usually done outdoors except in inclement weather.

5- Exercises to improve flexibility of the involved limb:These exercises begin by standing calf and hamstring stretches followed by stretching the hip abductors while the patient was in supine position.

6- The included patients were advised to practice the previously described therapeutic program regularly. They practiced 1 hour exercise sessions twice weekly for one month, then they were reassessed by the same physical therapist. The involved home exercise program was continued for another month where re-assessment is repeated again.

Statistical Analysis

Outcome measures were knee extension strength (1 RM and isokinetic), gait velocity, weight bearing test, postural control, and flexibility. Analysis of variance (ANOVA) were used for comparison between both groups. For the ordinary scaled weight-bearing exercise test, the Mann-Whitney U test was used to compare test retest changes between both groups.

Finally, within the intervention group, Spearman correlation was used to assess whether there was any improvements at the end of the study. The data were analyzed using the SPSS computer program.

RESULTS

The obtained results were summarized in the following items:

1- Gait. There was a significant improvement in both velocity and cadence of the intervention group. The mean changes of gait velocity and cadence for the exercised group were +13.80 (2.4) m/sec and +7.9 (6.8) steps/min respectively. The mean changes of gait velocity and cadence for the control group were -5.66 (7.8) m/sec and -2.1 (7.4) steps/min respectively as shown in table (2) and figure (2).

Table (2): Gait assessment for the exercised and control groups.

Group	Pre-test Mean (SD)	Post-test Mean (SD)	% Change Mean (SD)
Intervention			
Velocity (m/sec)	0.54 (.22)	0.60 (.33)	+ 13.80 (2.4)
Cadence (step/min)	78.0 (20.1)	85.2 (27.2)	+ 7.9 (6.8)
Control			
Velocity (m/sec)	.60 (.33)	.45 (.33)	-5.66 (7.8)
Cadence (step/min)	90.2 (32.1)	73.2 (41.2)	-2.1 (7.4)

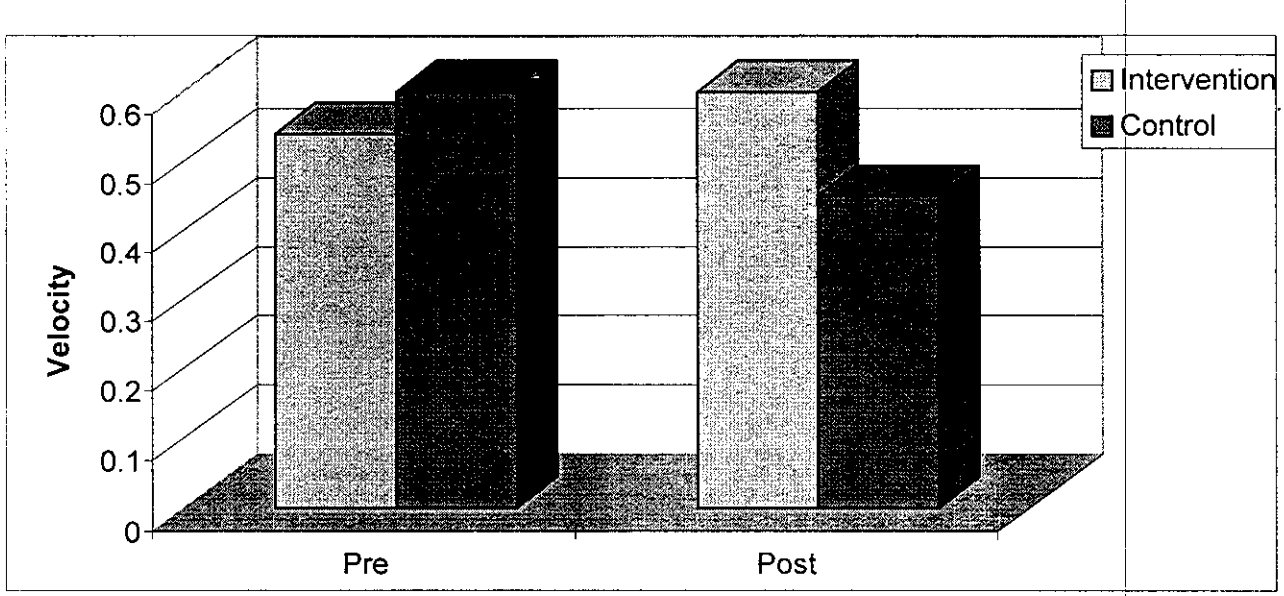

Fig. (2): Gait velocity assessment of both the exercised and control groups.

2- Quadriceps strength. The exercised group showed greater quadriceps strength at post-test assessment than the control group. The mean change of quadriceps strength of the exercised group was + 53.1 (5.2) kg; while it was + 11.6 (33.8) kg for the control group as shown in table (3) and fig. (3). There was also a trend ($P<0.1$) indicating that quadriceps strength in the non affected leg also improved.

Table (3): Assessment of the quadriceps strength of the intervention and control groups.

Group	Pre-test Mean (SD)	Post-test Mean (SD)	% Change Mean (SD)
Intervention	6.4 (6.2)	9.4 (3.8)	+ 53.1 (5.2)
Control	5.7 (2.7)	7.2 (2.4)	+ 11.6 (33.8)

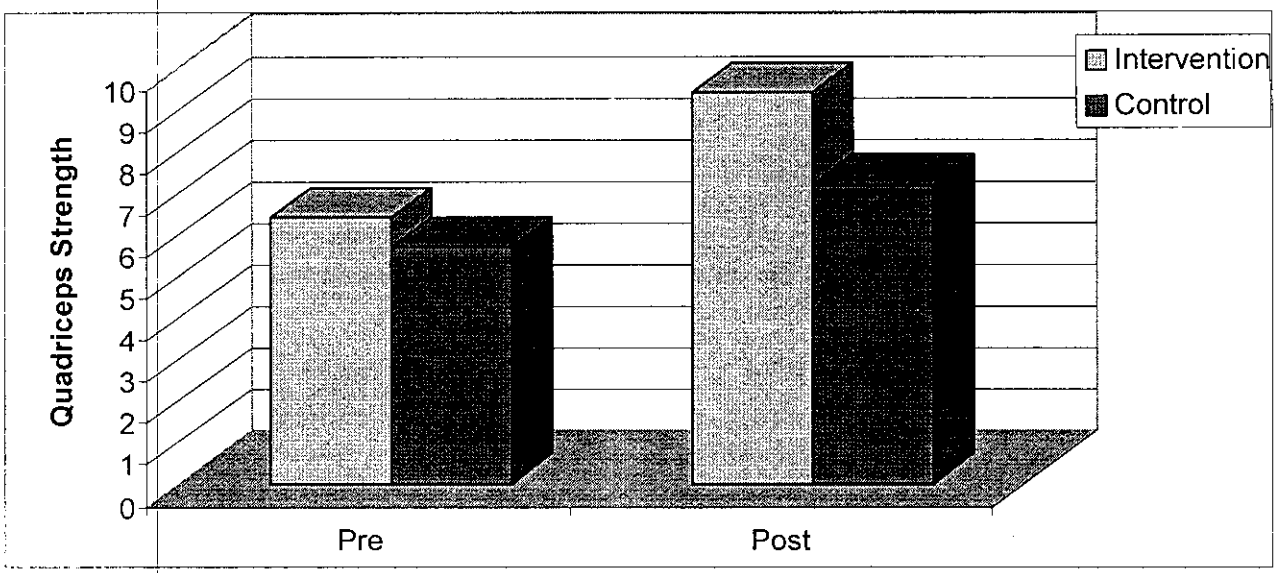

Fig. (3): Pre and post test assessment of the quadriceps strength of the intervention and control groups.

3- Postural control. There was a significant improvement of balance in the intervention group. Sway on floor change for the intervention group was -1.5 (54.2) mm while it was 8.7 (51.8) mm for the control group. Swayon foam changed by -21.1 (38.2) mm in the intervention group and -4.1 (36.11) mm in the control group. Also, the functional reach change of the intervention group was -9.9 (40.7) cm and -7.2 (31.2) cm for the control group as shown in table (4).

Table (4): Postural control assessment of the exercised and control groups.

Group	Pre-test Mean (SD)	Post-test Mean (SD)	% Change Mean (SD)
Intervention			
Sway on floor (mm)	151 (33.4)	101 (56)	+ 1.5 (54.2)
Sway on foam (mm)	340 (38.6)	235 (151)	+ 21.1 (38.2)
Functional reach (cm)	13.5 (4.6)	14.7 (6.8)	+ 9.9 (40.7)
Control			
Sway on floor (mm)	120 (5.3)	130 (80)	8.7 (51.8)
Sway on foam (mm)	250 (16.4)	280 (15.2)	-4.1 (36.1)
Functional reach (cm)	14.6 (5.8)	15.9 (7.7)	-7.2 (31.2)

DISCUSSION

The findings of this study suggest that a 2-month of weight-bearing exercise program significantly increased lower limb strength and walking velocity in a post hip fractures of geriatric patients. Thus, it seems that the stimulus intensity of the program was sufficient to induce improvements in a relatively short period.

The specific strength-training program was designed to improve extensor strength for walking and improvements were significant when strength was assessed in a weight bearing position similar to the manner of the training. The significant association between quadriceps strength and gait velocity suggests that increased walking velocity was mediated, at least in part, by improved lower limb strength. This finding is in accord with lord et al (1996)[14], who found that following a 6-months exercise trial, improvements in gait parameters such as stride length and cadence were associated with increasing in hip extension and ankle dorsiflextion strength in older community dwelling women, and with other studies that have found strength in lower limb muscle groups to be associated with gait speed[10,11].

If gait velocity predicts functional independence, as found in cross-sectional study[10], it is likely that intervention like the program used in the present study will maintain or improve mobility-related functional status in order subjects. Because gait velocity declines at a rate of 12% to 16% per decade after age 60[8], the rate of improvement in the present study is clinically significant.

The findings of significant improvements in postural control after the exercise program is in contrast to 2 recent studies[6,13] that found that exercise programs result in little or no improvement in postural control. This may be caused by differences in the intensity of the exercise program, compliance of the exercise program and to sample differences. Our study group (X age 60 yrs) was considerably younger than the samples studied by Cirlly and Colleagues (19967)[6], (X age, 85 yrs).

CONCLUSION

It appears that the study findings have implications for falls prevention strategies for older people. The described exercise program also is beneficial in improving muscular strength, gait velocity and postural control for older subjects especially after hip fractures.

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الملخص العربي

برنامج العلاج الطبيعي بعد كسور مفصل الفخذ المختلفة للمرضى المسنين

تتعرض نسبة كبيرة من المسنين لكسور الفخذ المختلفة وذلك نتيجة لأنهم يعانون من هشاشةالعظام وفقد نسبي للتوازن مما يعرضهم للسقوط على الأرض بسهولة مما ينتج عنه كسور مختلفة في منطقة مفصل الفخذ لذا استهدفت هذه الدراسة تصميم برنامج تأهيلي يهدف إلى تحسين مستوى التوازن وقوة العضلات التى تلعب دوراً هاما فى المشي وتؤثر أيضا في سرعته مما يقلل نسبة تعرض هؤلاء المرضى للسقوط والتعرض للكسور المختلفة واشتملت هذه الدراسة على حوالى عشرون مريضا يعانون من كسور سابقة فى مفصل الفخذ وتتراوح أعمارهم بين ٥٥ ، ٦٥ سنة تقريبا . تم تقسيمهم إلى مجموعتين كل مجموعة تشتمل على عشرة مرضى . تم تقيمهم إكلينيكيا وفيزيائيا بواسطة اخصائى العلاج الطبيعى وقد تلقت مجموعة واحدة منهم برنامج العلاج الطبيعى والذي يستهدف إلى تحسين قوة العضلة الرباعية بالفخذ وتحسين التوازن وسرعة المشي عند المريض واستمر العلاج لمدة شهرين ولقد تم تقييم المرضى مرة أخرى في نهاية البرنامج العلاجي . أثبتت النتائج تحسن سرعة المشى بنسبة ملحوظة وأيضا تحسين قوة العضلة الرباعية للفخذ بالمقارنة بالمجموعة التى لم تتلقى العلاج كما سجلت النتائج أيضا تحسن ملحوظ فى معدل التوازن للمرضى مما يثبت أهمية هذا البرنامج وإمكانية الاستفادة منة خاصة فى حالات المرضى المسنين الذين يعانون من كسور سابقة بمفصل الفخذ .