

The effect of individualized muscle strengthening and dietary assessment in quality of life in women with osteoporotic hip fractures

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Abstract

The purpose of this study was to evaluate the influence of a personal training program and dietary assessment on quality of life in women with osteoporotic hip fractures.

Fifty women with osteoporotic hip fractures, aged 57-89 years, were randomized in an experimental group (n=25) and a control group (n=25). The experimental group participated in a 12-week muscle strengthening training program. The controls were instructed to continue with their routine daily activities. Specific questionnaires (regarding osteoporosis and diet) were used to assess quality of life in both groups, before and after the intervention.

Both descriptive and inferential statistics were used for analyses. For descriptive analyses, mean values, standard deviations and occurrence frequencies were estimated and they are represented here. Our main investigational hypothesis was analyzed by 2-way ANOVA with repeated measures.

Our results show that the muscle strengthening program benefited the experimental group of women with osteoporotic hip fracture and improved their quality of life.

In conclusion, considering that women with osteoporotic fractures show a tendency for deterioration of their mobility and ambulatory ability starting from about the fourth decade of age, due to natural aging processes (decreased strength, endurance), and changes related to osteoporosis (fractures, reduced mobility, confidence, independence, social life, pain), participation in similar programs may considerably enhance them in their daily activities and prevent deterioration in body composition. Diet had a positive effect on these women using specific dietary instructions.

Key words: osteoporotic fractures, women, exercise, quality of life, diet, muscle strengthening program.

Introduction

In osteoporosis, bone density is decreased below a critical limit and then numerous consequences appear, such as reduction of height, back pain, increased fragility of the bones and fracture risk (Saag et al, 2005). Osteoporotic fractures lead to reduction of mobility, negative influence on social life, mood and cognition of the individual, pain, disability, depression, and loss of independence, sequelae that are all crucial components of quality of life (Picavet et al, 2004).

This impairment is commonly observed mostly in individuals with vertebral or hip fractures compared with fractures in other body areas and it is never completely restored (Hagino et al, 2008). Although physical activity and normal diet have positive effects on body function, research assessing both parameters is relatively scarce. Our results, using specific questionnaires of quality of life before the occurrence of any fracture, may have an important role in development of future prevention strategies aiming in crucial and considerable improvement of health in the aged (Rohde et al, 2008).

Methods

Fifty women aged 57-89 years participated in our study. All participants had been diagnosed with osteoporotic hip fracture, after their admission to the Orthopaedic Department of Hippokraton General Hospital of Thessaloniki. Subjects were randomly allocated in 2 groups; experimental group and control group. The experimental (n=25) and control (n=25) groups had a mean age and weight of 77.04 years, 78.36 Kg, 80.56 years and 78.64 kg, respectively. All subjects provided an informed consent for their participation in this study. The quality of life was assessed twice, preoperatively and postoperatively for their hip fracture, by specifically designed questionnaires (for osteoporosis and for diet), in both groups. The experimental group participated in a muscle strengthening program. The osteoporosis questionnaire included 41 items and it was based on the relative literature review and on the judgment of the experts that created it. For convenient use, its items are grouped in 7 domains (pain, activities of daily life, domestic work, mobility, leisure time, perception of health and cognitive function). Each activity is scored with 3-5 points (1-2-3-4-5) using a Likert-type scale (Adachi et al, 2001, Lips P et al, 1997, Lips P et al, 2005, Tsauo et al, 2005). This questionnaire has been widely used and it has been evaluated for its reliability and validity by the International Osteoporosis Foundation. The diet questionnaire included 55 items grouped in 6 domains (consumption of meat, breakfast, fruits, vegetables, various foods and cereals including bread). Each food category is scored with 0-7 points (0-1-2-3-4-5-6-7), representing the weekly frequency of consumption of each food, using a Likert-type scale (From Aston University, WHO 2005, WHO 2007, IOF 2008).

An individual muscle strengthening program was

initially implemented to both groups but after their discharge from hospital (15 days) only the experimental group continued it, while the control group continued with routine daily activities and use of low intensity exercises (mild walking, dish-washing, cooking).

The muscle strengthening program was based on various studies and guidelines from international societies (Chan et al, 2003, Hauer et al, 2002, Gardner et al, 2005, Malliou et al, 2004, Sherrington et al, 2003, Fleck et al, 2006, Young et al, 2005, ACSM, 1998). It includes recording of the exercise type that was applied (weight-bearing, resistance, warm up and full recovery) the frequency in days per week, the duration of each exercise in minutes, the intensity (always moderate) and sets, repetitions and relax time in every type of exercise. At the end of the total duration of the program, the progress in frequency and duration of each exercise was recorded as well. The program of the experimental group was completed in 8-12 weeks, depending on case, with active participation of all women. In some cases, it was interrupted earlier (before completion of 12 weeks) due to pain intensity or fatigue. It included weight-bearing exercises (stairs climbing, vigorous walking) and resistance exercises (light weight lifting, own body elevation by elastic bandage). The frequency was 4-5 days/week either initially, increasing gradually to 6-7 days/week or constantly, depending on case. The duration of exercises varied between 10-15min per exercise with a progressive increase to 15-30min per exercise, depending on case. The intensity of all exercises was invariably moderate, because of the osteoporosis. Resistance exercises included 2 sets of 6-8 repetitions per case with a resting interval of 2-3min. Warming up and full recovery was implemented before and after the main program, respectively, including circles with the hands, initially in sitting and subsequently in standing position. The duration was 10-15s with a progressive increase to 20-25s. The intensity included 5 repetitions with a progressive increase to 10-15 repetitions. Finally, the intensity of pain was recorded three times, by measurements at the start, at the middle and at the end

TABLE 1. Mean values (SD) of weight-bearing and resistance exercises

	Pre-interventional	Post-interventional
WB Duration	25.00 (2.04)	38.40 (3.74)1*
WB Frequency	2.60 (.58)	3.24 (.43)2*
RE Duration	17.60 (2.55)	27.60 (2.54)1*
RE Intensity	13.12 (1.83)	14.56 (1.96)1*
RE Frequency	2.12 (.33)	2.96 (.20)2*

1. Comparison is based on the paired t-test. 2. This difference is based on Wilcoxon Signed Ranks test.

* $p < 0.01$

WB, weight-bearing; RE, resistance.

TABLE 2. Osteoporosis Questionnaire

Mean values (SD) of groups and measurements				
	Experimental group		Control group	
	1st measurement	2nd measurement	1st measurement	2nd measurement
Pain	17.24 (1.64)	13.84 (1.34)	18.76 (1.87)	18.04 (.93)
Activities	12.28 (1.99)	10.24 (1.92)	14.64 (1.29)	12.76 (1.01)
Household activity	17.84 (2.62)	15.04 (2.37)	20.40 (2.02)	18.68 (1.21)
Mobility	31.88 (3.87)	27.52 (2.96)	32.64 (3.01)	30.60 (2.02)
Leisure time	21.24 (1.94)	18.40 (2.16)	21.23 (1.74)	20.28 (1.54)
Health perception	12.28 (.84)	11.12 (1.27)	12.54 (.88)	11.72 (1.06)
Cognitive function	29.16 (2.44)	30.20 (1.50)	30.32 (1.55)	30.44 (1.56)

of the program. The control group program included routine daily activities (shopping, floor-sweeping, dish-washing clothes-washing, ironing and gardening) with exercises of low intensity (slow walking, stairs-climbing or stairs-descending 2-3 times/week, and physiotherapy with mainly passive exercises of the lower body).

Statistical Analysis

Both descriptive and inferential statistics were used for analyses. For descriptive analyses, mean values, standard deviations and occurrence frequencies were estimated and they are represented here. Our main investigational hypothesis was analyzed by 2-way ANOVA with repeated measures. The seven domains of the osteoporosis questionnaire and the six domains of the diet questionnaire were dependent variables. The assigned group, with two levels, experimental and control, was our independent variable. The measurement, with two levels, initial and final, was the second factor. Differences in a level for p below 0.05 were considered as significant. In case where a significant interaction was found, we proceeded in simple main effect analysis. The advantage of this method is that all possible comparisons are performed under the same type I error.

Results

Effectiveness of the intervention program

According to the paired t-test, all parameters of the exercise program were significantly improved. The changes were noticed in the duration of weight-bearing exercises as well as in the duration and intensity of resistance exercises. In table 1, mean values and standard

deviations of those variables are shown. Wilcoxon Singed Ranks test revealed that both the frequency of the weight-bearing exercises and the frequency of resistance exercises were significantly increased (p<0.05) (Table 1).

Discussion

An individual muscle-strengthening program improved strength and resistance in women with osteoporotic hip fractures. This improvement is very important because of the tendency these women show for a progressive worsening in their mobility status and in their ambulation, due to the lack of sufficient mobilisation and physical activity. It has been reported that the consequent complications lead to institutionalization and social isolation (Bakas E, 2001). The role of specific exercises (weight-bearing or strengthening) is important in increasing bone mass and maintaining bone strength. The benefits from exercising are not limited only to muscular strengthening but they extend to a normal resocialisation and de-institutionalization (Iwamoto et al, 2001). Previous research especially in women with hip fractures as showed that the role of exercise after surgery is imperative regarding the level of rehabilitation (Malmros et al, 1998). Our study confirms the benefits of exercise and the effectiveness of a well-planned personal training program, in women with osteoporotic hip fracture. All women in both groups showed improvement, which was significant in the experimental group.

A combination of physical exercise and proper diet in children and adolescents is essential for a better quality of life in older age (Khan et al, 2000, Swanenburg et al, 2007). Our results are very encouraging and they confirm

TABLE 3. Effect of dietary directions

Meat - protein consumption	Increase in both groups
Breakfast consumption	No essential change in both groups
Vegetables consumption	Trend for increase in the experimental group
Fruits consumption	Trend for increase in the experimental group
Other foods consumption	Trend for increase in the experimental group
Cereals and bread consumption	Reduction in the experimental group by the end of intervention

TABLE 4. Intervention Program

Type of Exercise	Frequency	Duration	Intensity	Progress
Weight-bearing exercises (climbing – descending stairs, vigorous walking)	Days per week			Increase in days per week
Resistance exercises	Days per week		Sets Repetitions Rest	
Warm up/Full recovery (circles with the hands in sitting position)				

ACSM's position stand on osteoporosis and exercise. *Med Sc Sp Ex*, 1998, 27: 4.

all previous studies on the role of diet. We showed explicit both physical and mental improvement, increase in energy, and faster healing of the surgical trauma without serious complications or additional disease burden. This improvement was a result of many factors; well designed intervention program; constant adherence of the patients; exercising in a familiar place; keeping a pleasant atmosphere; attention and devotion of all of the members of our scientific team; right behaviour and understanding of the specific problems of osteoporotic women with precise implementing of dietary recommendations.

Conclusions

A muscle-strengthening program in combination with appropriate dietary recommendations in osteoporotic women can improve both their muscle strength and endurance and their general quality of life. Given the important role of daily physical activity starting from younger age and of the understanding of the ideal features of exercising for increase of bone density; prevention programs could be designed to substantially improve quality of life in postmenopausal women. Acknowledgments I would like to thank Mr. Christos Dimitriou, Director of Orthopaedic Department in Hippokraton Hospital of Thessaloniki, Greece,, for his precious help in the research process.

References

- Adachi JD, Ioannidis G, Berger C, Joseph L, Papaioannou A, 2001. The influence of osteoporotic fractures on health-related quality of life in community-dwelling men and women across Canada. *Ost Int*, 12: 903-908.
- American College of Sports Medicine, 1998. ACSM's position stand on osteoporosis and exercise. *Medicine and Science in Sports and Exercise*, 27: 4.
- Bakas E, 2001. Osteoporosis. Prevention, Treatment, Rehabilitation, 2nd Edition
- Chan KM, Anderson M, MacLau E, 2003. Exercise interventions. Defusing the world's osteoporosis time bomb. *Bull w org*, 81: 827-830
- Fleck S, Kraemer J, 2006. Resistance Exercise Planning
- Gardner M, R.Brophy, D.Demetrakopoulos, J. Koob, R.Hong, 2005. Interventions to improve osteoporosis treatment following lower limb fracture. *JBJS (American)*, 87: 3-7.
- Hagino H, Nakamura T, Fujiwara S, Oeki M, Okano T, 2008. Sequential change in quality of life for patients with incident clinical fractures:

- a prospective study. *Int Ost F*
- Hauer K, Specht N, Schuler M, Bartch P, Oster P, 2002. Intensive physical training in geriatric patients after severe falls and hip surgery. *Age A*, 31: 49-57.
- IOF. Nutrition, 2008, (www.iof.org).
- Iwamoto J, Takeda T, Ichimura S, 2001. Effect of exercise training and detraining on bone mineral density in postmenopausal women with osteoporosis. *JOS*, 6, 128-132.
- Khan K, McKay HA, Haapasalo H, 2000. Does childhood and adolescence provide a unique opportunity for exercise to strengthen the skeleton? *J Sci Med Sport*, 3:150.
- Lips P, Cooper C, Agnusdei D, Cautin F, Egger P, 1997. Quality of life as outcome in the treatment of osteoporosis: the development of a questionnaire for quality of life by the European Foundation for Osteoporosis. *Ost Int*, 7: 36-38
- Lips P, van Schoor NM, 2005. Quality of life in patients with osteoporosis. *Ost Int*, 16: 447-55
- Malliou P, Giouftsidou A, Delaporta A, Godolias G, 2004. Osteoporosis and Physical training. *Inq Sp Ph Ed*, 2: 173-183
- Malmros B, Mortensen L, Jensen MB, Charles P, 1998. Positive effects of physiotherapy on chronic pain and performance in osteoporosis. *Ost Int*, 8: 215-221.
- Picavet H, Hoeymans N, 2004. Health related quality of life in multiple musculoskeletal fractures. *An Rh Dis*, 723-729
- Rohde G, Hangeberg G, Mengshoel AM, Moum T, Wahl AK, 2008. Is global quality of life reduced before fracture in patients with low-energy wrist or lower limb fracture? A comparison with matched controls. *H Qual L O*, 6: 90
- Saag KG, Morgan SL, Coa X, 2005. Bone health and disease. A textbook of Rheumatology. 15th ed. Philadelphia, Pa: Lippincott Williams & Wilkings: 2487
- Sherrington C, Lord SR, Herbert RD, 2003. A randomised trial of weight-bearing versus non-weight-bearing exercise for improving physical ability in inpatients after lower limb fracture. *Aust J Phys*, 49, 15-22.
- Swanenburg J, Douwe de Bruin E, Stauffacher M, Mulder T, Uebelhart D, 2007. Effects of exercise and nutrition on postural balance and risk of falling in elderly people with decreased bone mineral density: randomized controlled trial pilot study. *Cl R Vol*. 21,6, 523-534.
- Tsauo JY, Leu WS, Chen YT, Yang RS, 2005. Effects on function and quality of life of postoperative home-based physical therapy for patients with lower limb fracture. *Arch. Phys Med Reh*, 86, 1953-7.
- WHO, 2005. The treatment and management of Severe Protein-Energy Malnutrition, (www.who.com)
- WHO, 2007. The health aspects of food and nutrition, (www.who.com)
- Young A, Dinan S, 2005. Activity in later life. *BMJ*, 330: 189-191.

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