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Case Report

Effect of Three-year Multi-Component Exercise Training on Bone Mineral Density and Content in a Postmenopausal Woman with Osteoporosis: A Case Report

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Abstract

The purpose of the present study was to examine the effect of 3-years of moderate multi-component exercise training on bone mineral density and bone mineral content in a female subject with osteoporosis. A 57-year-old postmenopausal woman, a known case of osteoporosis following an accident, participated in this study. Bone mineral density and bone mineral content was measured in the femoral neck area and the lumbar spine by dual energy X-ray absorptiometry. The measurements lasted four years, first year without any exercise training and three succeeding years with exercise intervention. After three years of exercise training, bone mineral density and bone mineral content were improved in both regions, despite the increase in age and decrease in weight. This case highlights the importance of exercise training in maintaining and increasing bone mineral density and bone mineral content of the spine and hip in postmenopausal women. Considering its positive effects, regular and lifelong exercise training must be incorporated into peoples' life due to the chronic nature of bone loss in aging process.

Keywords: Osteoporosis, Bone mineral, Postmenopause, Exercise training

Introduction

Osteoporosis is a systemic disorder characterized by low bone mass and microarchitectural deterioration of bone tissue, which predisposed old people to bone fragility and fracture risk, is known as the second widespread public health problem after cardiovascular diseases (1). This pathology is more often related to old age, especially among women maybe due to hormonal changes (2) and a decline in physical activity level (3). Around half of males and 70% of females over 50 years old, experience the ill effects of osteoporosis or osteopenia in Iran and is likely to increase due to the ageing of the populations (4). "Approximately 2.5 million Iranian post-menopausal women out of 5 million are apparently at risk of osteoporosis" (5). This health problem is believed to be a cause of a large number of fractures, which ends in heavy burden on society (6-8). Osteoporosis-associated costs were about US$ 13 million and its mortality rate was estimated to be at least 5000 patients annually in Iran (5). Disease prevention is the least complex way for restricting the probable smashing economical load caused by the very disease. Physical activity is beneficial in many physiological processes like bone turnover (9). Although exercise training has been reported as one of the best non-pharmacological ways to improve bone mass during life, there is no clinical guideline for the most

practical activities regarding type, intensity and duration to prevent bone loss. Not all exercises have positive effects on improvement of osteoporosis and there are some important factors such as type, severity and duration of exercise, which affect this improvement (10).

This study aimed at investigating whether long-term moderate multi-component exercise training that can be done easily, prevents expected bone loss, improve bone mineral density, and bone mineral content in postmenopausal woman with osteoporosis.

Case Report

A 57-year-old woman, a case whose osteoporosis disease was diagnosed after an accident, took part in this study voluntarily. She was 154 cm and 62 kilos. She was not physically active throughout her life and had been taking Calcium and vitamin D supplements after her accident.

Her areal bone mineral density and bone mineral content were measured on the lumbar spine and the proximal femur with dual-energy X-ray absorptiometry (DXA) (Norland XR-26, WI, USA) in the Orthopedic Diagnostic Centre at the Motahari Hospital, Shiraz. Her femoral neck, trochanter and Ward's triangle of the hip, and vertebras L2–L4 were analyzed separately. These measurements were performed three times, first immediately after an accident, second, after one year of sedentary lifestyle and last after three years of exercise training.

After the first year of the study along which the subject had no exercise training, the bone mineral density of the anteroposterior spine measured at the L_2-L_4 region indicated that the bone density was 48% less than the BMD of young normal density and -3.23 SD below the young normal reference. The bone mineral density of the hip measured at the neck of femur also indicated that the bone density was 37% less than BMD of young normal density and represented -3.08 SD below the young normal reference. Although the subject had been taking Calcium and vitamin D supplements during this year, her disease was not healed much.

Having no improvements over her disease the case was suggested to participate in the exercise training sessions in PAD institute, lasted for three succeeding years. The training sessions were carried out two or three times a week for three years (235 sessions). All training sessions were supervised by a physical trainer instructor and were done accompanied by music and lasted for 70 to 90 min. Each session began with 15 minutes of warm-up including static and dynamic stretching. Then, 30 minutes of aerobic exercises using fitness ball, steps, light dumbbells (1 to 2 kg), light bar and elastic resistant tube for the arms and legs were conducted. After that, 15 to 35 minutes of exercise was done with machines including treadmill (walking and slow running without any steep), recumbent bike (with no or little resistance) and elliptical trainer.

Table 1: Bone mineral density after one year with no exercise training and three following years with exercise training

	Bone Mineral Density (g/cm²)				
	2008		**2009**	**2010**	**2013**
	Base line				
L2	0.552	With no exercise	0.597	Three years of exercise	0.649
L3	0.580	training	0.570	training	0.665
L4	0.598		0.602		0.745
L2-L4	0.578		0.591		0.687
Femoral neck	0.627		0.631		0.666
Trochanter	0.577		0.561		0.581
Ward's Triangle	0.532		0.520		0.536

Finally, it ended in a 10 minute of cooling down exercises mainly including static stretching. The type and intensity of training was changed per month. The training program was well tolerated by the subject.

After three years of exercise intervention, her height remained the same but her weight decreased by 7 kilos. Furthermore, her bone density of the anteroposterior spine which was 48% changed to 38% and her bone density of her hip turned to be 33% (-2.56 SD and -2.47 SD below the young normal reference, respectively) less than that of young people which was 37% before. Bone mineral contents increased in both regions particularly in spine. This data indicates that the bone improved, especially in spine region (Table 1 and 2).

Table 2: Bone mineral content after one year with no exercise training and three years after onset of exercise training

	Bone Mineral Content (g)				
	2008 Base line		**2009**	**2010**	**2013**
L2	6.67	With no exercise	7	Three years of exercise	7.94
L3	7.38	training	7.05	training	9.27
L4	9.24		10.34		9.82
L2-L4	23.31		24.40		27.04
Femoral neck	3.13		2.06		3.13
Trochanter	5.45		5.47		5.55
Ward's Triangle	0.53		.52		.536

Discussion

Although osteoporosis increases as a person grows aged (11), a part of this bone loss observed in the elderly is because of lack of physical activity not the aging itself (12). Most patients and health care providers think that calcium and vitamin D alone are able to prevent bone loss and reduce fracture but the results of the study revealed that there was little improvement after one year of medication therapy.

Meta-analyses of exercise studies have confirmed that physical exercise has a positive effect on bone mass and density. However, the differences observed are due to kind, duration, intensity of exercise and subjects' ages that could potentially affect the bone metabolism (13).

By the end of the training program, the subject was 3 years older and she had lost some weights but her bone mineral density and bone mineral content were both improved in anteroposterior spine and hip, although the increase in age and weight loss has adverse consequences on bone mass density and aggravates osteoporosis.

Although strength exercises seem to be a powerful stimulus for improving and maintaining bone mass during the ageing process but middle-aged women are less willing to participate in such exercises because of their difficulty.

Conclusion

The results might state the fact that multi-component long-term moderate physical training in which risks of injuries are minor and can be done easily by women, especially the postmenopausal ones, would be so beneficial for their bone health and can reverse the osteoporosis process in these patients despite the intensity of problem.

Ethical considerations

Ethical issues (including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy) have been completely observed by the authors.

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The authors declare that there is no conflict of interests.

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