

Short-term effect of back extensor strengthening exercises on the quality of life of patients with primary osteoporosis

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Abstract: In addition to acute and chronic pain due to fractures, many negative effects of osteoporosis on quality of life are associated with kyphotic posture, balance disturbance and physical, mental and social side effects of falling and fear of fall. The purpose of this study was to evaluate the short term effect of back extensor strengthening exercise on quality of life of women with primary osteoporosis. In this semi experimental clinical trial with available sampling method, 90 women between the ages of 55 to 75 with primary osteoporosis and 45 to 60-degree kyphosis who were admitted to physical medicine and rehabilitation clinic of Shahid Modarres university hospital in Tehran were included. Each patient fulfilled the Persian version of SF36 quality of life questionnaire. Patients were categorized randomly in case and control groups. All of the participants were treated with pharmacotherapy, weight bearing and balance training exercises. Patients in the case group also taught to perform back extensor strengthening exercises at home including 10 contractions of back extensors without increasing the lordosis based on prof. Sinaki's program in Mayo clinic (Sinaki 2007). 8 weeks after the initiation of treatment, patients fulfilled the quality of life questionnaire once again and the results were compared. At the end of study in the case group, scores of physical function, bodily pain, general health, social functioning, role emotional and role physical improved significantly but no significant difference was seen in mental health variable ($p=0.06$) and vitality variable ($p=0.06$). No significant differences were seen between case and control groups in variables of physical function ($p=0.72$), bodily pain ($p=0.85$), general health ($p=0.47$), social functioning ($p=0.42$) and mental health ($p=0.07$) also role physical ($p=0.80$) role emotional ($p=0.70$) and vitality ($p=0.61$). In this study total QOL was improved significantly, whether in patients under pharmacotherapy and weight-bearing and balance training exercises (control group) or in patients who performed back extensor strengthening exercises in addition to the aforementioned treatments (case group), but in short term there was no meaningful difference between groups after intervention.

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1. Introduction

Osteoporosis, the most common bone metabolic disease, is a well-known threat to public health, especially in the geriatric population (1, 2). Negative effects of osteoporosis (OP) on quality of life (QOL) seem to be more related to physical characteristics of the disease rather than bone mineral density (3). Among the neuromuscular problems associated with OP are spinal deformities such as kyphosis. Kyphotic posture changes cause the most devastating physical and mental effects in osteoporotic patients (4). Stooped posture develops with increasing age and disturbs individual's stability by shifting the center of gravity (5). Therefore, kyphotic posture not only causes chronic back pain, but also increases the risk of fall (4). Although kyphosis (which is the common result of fractures in

the vertebral bodies) disturbs the activities of daily living (3), women with kyphosis experience more problems in their daily living than women who suffer from vertebral fractures without kyphosis (3, 6). Furthermore, in long term fear of falling reduces physical, mental and functional capabilities of people with history of falling, and that per se can have obvious effects on QOL and health of such people (7). Prevention from fall, by influencing QOL and decreasing health costs, is a priority in medical interventions (8). On the basis of clinical studies one third of falls and consequent injuries are preventable (7). Evidences show that exercise training by decreasing the risk of fractures (due to maintaining bone density) and more importantly through improving postural stability decreases the risk of fall. In fact, improving stability and decreasing kyphosis

could become targets for prevention of fall (8). On the other hand, prevention from fall may influence QOL through different mechanisms such as maintaining functional capabilities and social activities (7).

Different studies have been performed on osteoporotic patients encompassing no intervention (9, 10) medical intervention, physical therapy (11), exercise training (1, 12, and 13) and bracing (14-17). Effects of these interventions on different aspects also have been measured such as; muscles strength (18), bone mineral density, pain intensity (5), spinal range of motion, kyphosis measure, incidence of falls (19), and more importantly balance (12, 19-21), postural stability (16, 22) and QOL (3, 6, 23, 24).

Among interventions performed for improving spinal posture, balance and prevention from fall, there is lack of special consideration to QOL, which is the ultimate goal of all interventions. In the study of Sinaki, application of weighted kypho orthosis accompanied by back extensor strengthening exercises showed to reduce the rate of kyphosis progression and the risk of fall (5). However, the effects of such exercises on the QOL of patients with osteoporosis and vertebral fractures have not been studied yet. The goal of this study was to assess the effects of back extensor strengthening exercises on QOL of kyphotic women with primary osteoporosis.

2. Material and Methods

In this semi-experimental clinical trial with available sampling method, 90 women between the ages of 55 to 75 with primary osteoporosis (documented by DEXA bone densitometry) and 45 to 60-degree kyphosis (documented by lateral view thoracic spine x-ray graphs) who were admitted to physical medicine and rehabilitation clinic of Shahid Modarres hospital in Tehran were included. Excluding criteria were presence of secondary osteoporosis (based on history and Z score), history of vertebral fracture in last 6 months, history of arthroplasty of the lower limb and concomitant neuromuscular diseases. Each patient fulfilled the Persian version of SF36 quality of life questionnaire – which validity and reliability was confirmed by Jahad-e-Daneshgahi health science research center – and consent form confirmed by Shahid Beheshti Medical University committee of medical ethics (25). Patients were categorized randomly in case and control groups. All of the participants were treated with pharmacotherapy, weight-bearing and balance training exercises. Pharmacotherapy included 1000 milligrams of calcium and 400 IU of vitamin D daily and 70 milligrams of sodium Alendronate weekly. All of the participants were recommended to walk 30 minutes daily 5 times a week. Patients in the case

group were also taught to perform back extensor strengthening exercises at home (including 10 contractions of back extensors without increasing the low back lordosis) based on professor Sinaki program in Mayo clinic (Sinaki 2007) as follow:

1. In supine position, the patient flexes the knees and then abducts and adducts the shoulders while the elbows are extended and upper limbs are in contact with the floor.
2. In the supine position, the patient flexes the knees and put hands over the head. By contracting abdominal muscles the patient tries to draw the low back to the floor and keep this position for 10 seconds.
3. In the prone position, the patient puts a pillow under the lower abdomen and raises the head and shoulders gently from the floor as much as possible and keeps this position for 10 seconds.
4. The patient sits on a chair and puts the hands behind the head. Then he/she moves the elbows behind the head while inhaling. The patient will do the opposite while exhaling.
5. Sit on a chair, the patient flexes the elbows while keeping the arms near to the trunk and then moves the arms back to reduce thoracic kyphosis.

All of the exercise programs were taught by an experienced physical therapist. In addition, an illustrated paper describing each exercise was presented to each participant. Besides, each patient was given a paper with a table and was asked to specify every day if he/she would do the exercises and bring it on follow up visits. The patients were called by the educating physical therapist every 2 weeks (totally thrice) to assess exercise performance and associated problems. After 8 weeks, quality of life questionnaire was fulfilled once again by the participants and the results were compared.

Quality of life questionnaire (SF-36) is a tool for assessing quality of life and is categorized in three levels including: 1) Questions 2) Eight measures (physical function, physical role functioning, bodily pain, general health, vitality, social function, role emotional and mental health) each obtains from a combination of 2-10 questions 3) Two brief measurements obtaining from combination of measures as follow: a) physical health (physical function + role physical+ bodily pain + mental health) b) Mental health (social function + role emotional + mental health + vitality). Data were analyzed by SPSS version 16. After evaluating the normal distribution of the variables with Kolmogorov-Smirnov test, variables of physical functioning, bodily pain, general health, social functioning and mental health were analyzed by independent t-test (for comparing two groups) and paired t-test (for comparing each group before and

after treatment). Variables of role physical, role emotional and vitality were analyzed by Man-Whitney test (for comparing two groups) and Wilcoxon test (for comparing each group before and after treatment). In all of the mentioned tests the meaningful level was considered ($\alpha=0.05$).

3. Results

Forty six patients were included in the case group and 44 patients were included in the control group. Five patients in the case group and 6 patients in the control group were excluded due to not

participating in the follow up assessment. Variables of height, physical function, bodily pain, vitality, general health, social function and mental health before the intervention and variables of height, physical function, bodily pain, general health, social function and mental health after the intervention have normal distribution in the case group ($p>0.05$). In the control group, all of the variables except emotional role function before and after intervention and physical role function after intervention have normal distribution.

Table 1. Comparison between the mean values of the variables physical functioning, bodily pain, general health, social functioning, mental health and total quality of life in case and control groups at the end of study

Variable	Group	Mean	Standard deviation	Probability value
Physical function	Control	55.13	23.11	0.72
	Case	62.07	23.74	
Bodily pain	Control	58.15	20.77	0.85
	Case	60.73	21.14	
General health	Control	54.63	19.21	0.47
	Case	55.62	16.76	
Social function	Control	68.75	21.69	0.42
	Case	69.81	19.95	
Mental health	Control	71.15	13.98	0.07
	Case	71.41	11.71	
Total QOL	Control	523.91	125.80	0.68
	Case	532.21	133.69	

Based on the above table, after the intervention there were no significant differences in studied variables between two groups ($p>=0.05$)

Mean age was 63 ± 4.37 years and 62.31 ± 4.23 years in the case and control group, respectively and there was no significant difference between two groups in this sense ($p=0.48$). Before intervention in both groups, dependent t-test demonstrated that variables of physical function ($p=0.87$), bodily pain ($p=0.81$), general health ($p=0.97$) and social function ($p=0.44$) were not statistically different, but mental health had meaningful difference between two groups ($p=0.02$). At the end of study in the case group, scores of physical function, bodily pain, general health and

social functioning improved significantly ($p=0.00$) but no significant difference was seen in mental health variable ($p=0.06$). In the control group, all of the mentioned variables (including mental health) improved significantly ($p=0.00$). Using dependent t-test after the intervention, no significant differences were seen between two groups in variables of physical function ($p=0.72$), bodily pain ($p=0.85$), general health ($p=0.47$), social functioning ($p=0.42$) and mental health ($p=0.07$) (table 1).

At the end of study in the case group, scores of physical function, bodily pain, general health and

social functioning improved significantly ($p=0.00$) but no significant difference was seen in mental health variable ($p=0.06$). Using dependent t-test after the intervention, no significant differences were seen between two case and control groups in variables of physical function, bodily pain, general health, social functioning and mental health (table 1). At the beginning of the study there were no significant differences in nonparametric variables of physical role functioning ($p=0.95$), role emotional ($p=0.86$) and vitality ($p=0.46$) between two groups using Mann-Whitney test. There were also no significant differences in such variables after the intervention (role physical with $p=0.80$, role emotional with $p=0.70$ and vitality with $p=0.61$) (Table 2). By using Wilcoxon test in the case group, there were significant differences between role emotional ($p=0.03$) and role physical ($p=0.00$) before and after intervention, but not in the vitality variable ($p=0.06$).

Table 2. Comparison between case and control groups in variables of physical role functioning, emotional role functioning and vitality at the end of study

Variable	Group	Row average	Probability value
Role physical	Control	39.07	0.70
	Case	40.87	
Role emotional	Control	38.67	0.61
	case	41.23	
Vitality	Control	39.37	0.80
	Case	40.59	

After the intervention there were no significant differences in studied variables between two groups ($p \geq 0.05$).

4. Discussions

In this study total QOL was improved significantly, whether in patients under pharmacotherapy and weight-bearing and balance training exercises (control group) or in patients who performed back extensor strengthening exercises in addition to the aforementioned treatments (case group), but there was no meaningful difference between groups after intervention. All of the components of the quality of life (including physical functioning, physical role functioning, bodily pain, mental health, social functioning, emotional role functioning, general health and vitality) were

improved in the case group. In the control group, all the mentioned variables were improved except mental health and vitality. Improvement in QOL following back exercise was consistent with the study of Hongo et al. (13), in which the effect of low-intensity training program was assessed on QOL and back muscle strength of osteoporotic women. Such exercises were shown to be useful for enhancing back muscle strength and improving QOL of osteoporotic women. In the study of Sinaki et al. (26) in 2002, although patients who only performed back extensor strengthening exercises for 4 weeks had lower pain values and increased levels of physical activity, but had lower dynamic posturography scores comparing to those who used weighted kypho orthosis in addition to performing proprioceptive exercises.

Gunendi et al. showed in 2008 that a 4-week aerobic exercise program was useful in improving static and dynamic balance of osteoporotic women (12). In the study of Madureira et al. in 2007, balance training program in a 12-month period was shown to be useful in improving static and functional balance, increasing mobility and decreasing the number of falls in osteoporotic women (8)

One explanation for improvement of QOL in the control group is the implementation of pharmacotherapy and weight-bearing exercises (which are a kind of aerobic exercise). According to ethical considerations, it was impossible to omit intervening interventions such as weight-bearing and balance training exercises and pharmacotherapy. Although these variables were identical in both groups, their presence may dilute the effects of back extensor strengthening exercises.

One reason for explaining the failure of the case group to be significantly superior to the control group could be the duration of back extensor strengthening exercises. While in some studies emphasis was on increasing the duration of such exercises, perhaps 8 weeks were not enough to show the real difference between the groups. For example, improvement in QOL was obtained 4 months in Hongo study (13) and 6 months in Papaianou study (27) after exercises.

Renno et al. (1) evaluated the effect of training program on respiratory function, posture and QOL in 14 osteoporotic women in 2005. Quality of life was assessed using OPAQ questionnaire. Eight weeks after performing the program, no significant change occurred in QOL. In fact, they contributed their failure to obtain positive results to low sensitivity of the questionnaire and low sample size. Although Muller (28) stated that at least 6 weeks of training is necessary to increase muscle strength (which indeed is less than the time in our study), perhaps this minimal improvement in muscle strength

is not enough to affect QOL. Thus, longer training time is needed to obtain the maximal effect from strengthening exercises.

Despite follow up calls in order to encourage the participants to perform the exercises regularly, as the back extensor muscle strength was not measured objectively, the relationship between the increase in muscle strength and QOL cannot be evaluated with certainty. In some studies, presence of osteoporotic fractures, their number and location were contributed to total QOL. In 2005 Fechtenbaum et al. (29) showed that the greater the number of fractures, the more the QOL would be impressed. They also realized that persons with greater deformities (more severe fractures) had lower levels of QOL. Papaianou et al. (27) evaluated the effects of 6-month home-based exercise training on the QOL of osteoporotic women with at least one vertebral fracture using OQOL questionnaire and found that QOL and balance were improved in participants. Miyakoshi et al. (6) concluded that QOL in osteoporotic patients is affected by postural deformities, especially whole kyphosis, and there is direct relationship between spine range of motion and QOL. In our study, only the angle of kyphosis was evaluated and patients were not categorized based on the location and number of fractures, therefore this could be a confounding factor per se. Our findings were consistent with Renno's study (1) in which 8 weeks of exercise did not lead to significant change in QOL. Since there is no questionnaire specifically designed for osteoporotic patients in Iran with approved validity and reliability, we used SF-36 questionnaire which is the main questionnaire in the field of QOL. Although using this questionnaire gave this study strength (due to its expansion and inclusion), but we should keep in mind that this is a general questionnaire, not specific for osteoporotic patients. Therefore, general questions in this form may dilute the effects of interventions in total improvement of osteoporotic patients.

Finally, nonparametric statistical findings in three non-normal variables were consistent with other variable findings. In intragroup comparison, QOL variables in both groups also showed significant improvement after intervention, except mental health in control group. Since two groups had significant difference in this variable before the intervention began, we could not stress on this exception as it could have been affected by one or more confounding factor(s).

An important limitation of this study was difficulty in finding osteoporotic patients consistent with our study criteria. We ensured regular performance of exercises by using a daily table and regular calls for reminding and encouraging

participants; however, there was no supervision in this regard. Age range of patients was so wide and as age could affect individual's QOL, this wide range could impress our findings. Due to limited sources and time, follow up duration was only 8 weeks, and longer assessment was not possible. There was also lack of objective measurement of back extensor muscle strength with dynamometer. Patients were not categorized based on intensity and number of fractures. Furthermore we lacked a questionnaire specifically designed for assessing the QOL of osteoporotic patients with approved validity and reliability in Iran.

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