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The importance of physical therapy and occupational therapy on the quality of life and bone health in patients with osteoporosis

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Abstract: This study aims to evaluate. in the course of one year. the role of physical therapy and occupational therapy intervention. in association of specific drug therapy versus only drug therapy. in patients with osteoporosis. The study was carried out between April 2022 and June 2024, on 94 patients with osteoporosis. selected from the Clinical Rehabilitation Hospital in Băile Felix. All subjects signed an informed consent form 46 subjects followed drug therapy, physical therapy and occupational therapy (study group) and 46 subjects had only drug therapy (control group). The following parameters were assessed: the decrease in height. bone mineral density (BMD) - the T score and the Qualeffo test for the quality of life. Between groups analysis showed that in the study group. The post-test values of the total Qualeffo score decrease significantly and showed a smaller decrease in height compared to control group. Regarding BMD there is no significant difference between the study group compared to control group. The results of the study suggest that a specific physiotherapy can cause significant improvements both of quality of life and vertebral static disorders. As far as BMD is concerned rehabilitation has only a limiting effect of braking its decrease.

Keywords: physiotherapy, bone mineral density, body posture

1. Introduction

Osteoporosis is a bone condition characterized by a decrease in bone strength. highlighted both by qualitative parameters: bone microarchitecture. the disposition of bone trabeculae and quantitative ones represented by bone mineral density (BMD) and the decrease in trabeculae [1]. The consequence of the decrease in bone strength is increased bone fragility and the risk of fractures. BMD is a quantitative parameter of bone composition and has age-dependent dynamics: it increases from childhood until the age of 25-30 years, when it is maximum. Then it goes through a plateau until 45-50 years. after which it starts to decrease by 0 .5-1% per year. The decrease in BMD is more pronounced in post-menopausal states. when due to the fall in estrogen levels. bone mineralization suddenly decreases and. consequently. a drop in BMD greater than 1% may occur [2, 3].

To evaluate the degree of bone mineralization. the T score is used. It represents the comparison between the patient's BMD and the ideal BMD i.e. the average of young people aged 25-30. When the bone capital is maximum, this score is expressed in

standard deviation (SD) from the average. The diagnosis of osteoporosis is made in a patient with a T-score lower than - 2.5 SD or in a patient with a T-score higher than - 2.5 SD but presenting a fragility fracture [4]. Osteoporosis is also called the "silent disease" it does not have specific symptomatology patients are not aware of the presence of the condition until a fracture accompanied by pain occurs. The name "silent" disease also refers to the fact that osteoporosis has received limited attention despite its serious physical and psychosocial consequences [5]. Vertebral fractures are the most common type of fracture in osteoporosis.

These fractures are due. first of all. to the fact that osteoporotic vertebrae have a lower bone mass. which means that the stress distribution is on a smaller surface than in a normal vertebra; resulting in higher local stresses and an increased risk of fracture. Secondly. the osteoporotic vertebrae also present an altered microarchitecture. an aspect that contributes to the production of vertebral fractures. The narrowing of the dorsal vertebral bodies leads to the severe rounded back ("the dowager's hump"). the decrease in height and hunching of the patients. with the protrusion and reduction of the abdomen. with ileus and consecutive postprandial bloating and also the reduction of the ribcage volume. with consecutive dyspnea [6].

The complete cure of osteoporosis is still a challenge. The specialized treatment of osteoporosis includes both drug therapy (DT) and physical therapy (PT). DT improves the evolution of the pathology. but does not cure the disease. Skeletal damage resumes sooner or later when a drug is discontinued. and problems that interfere with the effectiveness of DT in clinical practice. such as poor adherence to therapy and safety in long-term treatment. also arise.

Physical therapy is of great importance in patients with osteoporosis because it contributes to improving the quality of life (QoL) and increasing their level of independence and functionality. The physical therapy (PT) and occupational therapy (OT) are essential rehabilitation methods. because they have no adverse effects and can be performed for an indefinite period [7, 8]. PT has a very important role because. according to studies. it can not only prevent osteoporosis. but even improve it when it has set in [9, 10]. In patients with osteoporosis (OP). the PT program learned in the hospital must be followed by the patients after discharge. at least four times a week. The level of exercise intensity at the beginning of the program depends on the physical capacity of the patients and their intensity is increased by increasing the number of repetitions and resistance to movement [11].

Also. OT is of particular importance. having as main objectives the increase of body stability and the reduction of the risk of falling [12]. Within the OT. are included both the adaptive changes and the development of specific strategies that the patient with osteoporosis must respect. Currently. in everyday medical practice there is no standard protocol for rehabilitation: as far as PT is concerned. there are only objectives that the exercises should pursue and OT is considered to be a recovery method that could only improve the quality of life in patients with osteoporosis.

The main objective of this study was to highlight the effectiveness of the association of drug therapy with physiotherapy and occupational therapy. versus only specific drug therapy. in patients with osteoporosis. on a period of one year. We also propose the implementation of therapeutic approach that will help establish a standard protocol regarding the detection and treatment of primary osteoporosis.

2. Results

The data analysis involves the intergroup and within group comparison of study group and control group. The comparison analysis of initial values aims to observe whether or not the groups are homogeneous before the treatment. The final values allowed us to compare the effectiveness of the two types of treatment followed in the study: only specific medication for osteoporosis versus medication associated

with a rehabilitation program. The comparison between initial and final values for each group. we highlighted the therapeutic impact on the parameters studied.

In order to describe the characteristics of the two groups. the following parameters were taken into account: gender. age and the environment of origin (table 1). From the point of view of the characteristics. there are no significant differences between the two groups (p>0.05).

Table 1. Demographic characteristics of the study group (n=46) and control group (n=48).

Demographic characteristics		Mean ± SD	p
Age (years)	Group A	61.85 ± 5.40	0.241
	Group B	63.40 ± 6.50	
Gender	Group A	F/B: 61.10%/ 39.90%	0.753
	Group B	F/B: 60.84%/ 39.16%	
Environment	Group A	U/R: 67.23%/ 32.77%	0.329
	Group B	U/R: 65.71%/ 34.29%	

Group A= study group (drug therapy. physical therapy. occupational therapy). Group B = control group (only drug therapy) p= statistical significance. SD=standard deviation.

The initial comparison between the two groups. showed that there are no significant differences regarding the different sections of the Qualeffo score and the T score ($p > 0.05$) (table 2). This aspect highlights the fact that study group and control group were homogeneous at the beginning of the treatment in terms of quality of life and bone mineral density.

Table 2. Baseline scores comparison of Qualeffo test sections and T score between the group A (n=46) and group B (n=48).

Parameter	Group A	Group B	p	95% CI
Qualeffo-pain	15.61±2.7	16.32±3.38	0.3001	−1.223/0.690
Qualeffo-daily activities	10.89±1.71	10.3488±1.212	0.0958	−2.783/0.450
Qualeffo- daily activities	13.71±2.22	14.55±2.38	0.1038	−2.852/0.391
Qualeffo-mobility	23.35±2.54	22.86±2.74	0.3984	−1.120/0.980
Qualeffo-leisure time	18.77±3	19.63±3.1	0.2065	−1.852/0.591
Qualeffo-health status	9.82±1.27	9.30±1.24	0.0664	−2.413/0.510
Qualeffo-mental health	19.89±3.37	20.81±2.55	0.1668	−1.653/0.274
Qualeffo-total	112.09±14.75	114.78±14.22	0.4031	−1.346/0.570
T score	-3.175±0.364	-3.183±0.370	0.752	−1.546/0.380

Group A= study group (drug therapy. physical therapy. occupational therapy). Group B = control group (only drug therapy) p= statistical significance.

The homogeneity of the 2 groups allowed the evaluation of the difference in therapeutic efficiency during one year. between the association of medication for osteoporosis associated with rehabilitation intervention compared to only drug therapy. in terms of quality of life and bone mineral density. Intergroup analysis of the final Qualeffo test scores found that there are statistically significant differences ($p < 0.05$) both between the total Qualeffo values and for the section values: pain. daily activities. leisure activities and mental function. In study group. Qualeffo total score and the sections mentioned

above have significantly higher values compared to the values at control group. No statistical differences were found between the two groups for the sections: household chores. mobility and state of health (p > 0.05) (table 3).

Table 3. Intragroup and intergroup analysis of Qualeffo sections scores and T score (IC 95%).

	Group A (n=46) (mean ± SD)		Group B (n=48) (mean ± SD)		Inter-action	Effect size	Group A changes		Group B changes	
	Baseline	Post	Baseline	Post	p	p	p	95% CI Lower/Upper	p	95% CI Lower/Upper
Qf-P	15.61±2.7	13.58±3.85	16.32±3.38	15.27±3.6	0.0436	0.076	< 0.001	3.862/5.158	<0.001	4.115/6.228
Qf-DA	10.89±1.71	8.71±2.37	10.34±1.21	9.79±1.45	0.0147	0.046	< 0.001	4.965/6.169	<0.001	6.115/8.239-
Qf-HC	13.71±2.22	12.51±3.5	14.55±2.38	13.55±2.59	0.1261	0.003	< 0.001	7.996/11.671	<0.001	6.889/10.981
Qf-M	23.35±2.54	21.05±5.04	22.86±2.74	21.88±3.75	0.3962	0.002	< 0.001	8.291/10.963	0.001	9.341/11.233
Qf-Lt	18.77±3	16.65±3.95	20.55±4.84	19.63±3.1	0.0003	0.457	< 0.001	6.837/9.143	0.1645	6.727/7.297
Qf-HS	9.82±1.27	8.28±1.94	9.3±1.24	7.95±1.78	0.4276	0.002	< 0.001	5.167/7.563	<0.001	6.237/8.303
Qf-MH	19.89±3.37	18.41±4.05	20.81±2.55	20.09±3.23	< 0.005	0.376	< 0.001	8.117/9.996	0.001	9.156/10.796
Qf-T	112.09±14.75	99.24±22.96	114.78±14.22	108.27±16.45	< 0.005	0.296	< 0.001	14.347/19.613	0.012	15.347/17.293
T score	-3.175±0.364	-3.182±0.375	-3.183±0.370	-3.200±0.449	0.221	0.006	0.863	−1.781/−0.685	0.471	−1.901/−0.545

Group A= study group (drug therapy. physical therapy. occupational therapy). Group B = control group (only drug therapy) p= statistical significance. Qf-P= Qualeffo-Pain. Qf-DA=Qualeffo- Daily activities. Qf-HC=Qualeffo-Home Chores. QF-M=Qualeffo-Mobility. Qualeffo- Leasure time. Qf-HS=Qualeffo- Heatph Status. Qf-MH= Qualeffo- Mental Health. Qf-T = Qualeffo total score. CI = confidence interval.

The intergroup analysis of the final scores. showed significant differences in quality of life between subjects from study group versus subjects from control group. This improvement was achieved by reducing pain. making it easier to carry out daily and leisure activities. as well as by increasing confidence in one's own state of well-being. Regarding the Qualeffo test values. in study group. we observed statistically significant differences between the final and initial scores for Qualeffo test sections and also for the total Qualeffo score (p < 0.001).

In control group. there are also statistically significant differences between the final and initial scores in all sections of the Qualeffo test (p < 0.001). except for the free time activities section (p > 0.05). Analysing the evolution of the total Qualeffo score during the study. we found a statistically significant change (p=0.012. <0.05). Comparison between initial and final values of the T score. in the two groups. it was found that there were no significant differences statistically between study and control group. Compared to the initial values. in both subjects from study and control group. the T score decreased insignificantly at the final assessment (-3.175 vs -3.182 p=0.863. respectively -3.183 vs -3.200 p=0.471). as can be seen in table III. Comparison between groups showed that both at the initial and at the final evaluation. the T score was insignificantly higher in study group compared to control group (-3.175 vs -3.183 with p=0.752 respectively -3.182 vs -3.200 with p=0.387).

After one year of treatment. comparing the differences regarding the decrease in height of the patients from the two groups. we found the existence of a statistically significant difference (independent t-Student test: p=0.014 < 0.05) in favor of the patients from control group. who does not comply with rehabilitation at home (table 4).

Tabel 4. Final comparison regarding the decreasing in height between the study group (n-46) and control group (n=48).

Decrease in height	Group A Mean ± SD	Group B Mean ± SD	p	Effect size
Final	1.019±0.342	1.683±0.782	0.014	0.242

Group A= study group (drug therapy. physical therapy. occupational therapy). Group B = control group (only drug therapy) p= statistical significance

3. Discussion

Osteoporosis is perceived by patients as a disease that can lead to severe functional limitations or even disability; this disease affects different aspects of personal life with a variety of unwanted effects such as: chronic pain. reduced physical capacity. limited social activity. decreased good mood or even depression. According to Bianchi [13] patients diagnosed with osteoporosis have a great fear of losing their functional and social independence. The consequence is a decrease in quality of life. this aspect is observed even in the absence of fragility fractures. It is known that. in patients with osteoporosis. chronic pains do not only cause postural changes. they also limit the activities of everyday life. induce depressive states. decrease physical capacity and overall QoL [14]. In patients study group. we observed. after one year of specific medication associated with rehabilitation program. a significant decrease in pain. compared to patients from control group. The results of our study highlight the positive impact of Pt and OT on the quality of life (for sections pain. daily activities. leisure activities and mental function and for total Qualeffo). Our results are consistent with the results of other specialized studies that also support that a specific physical exercise program performed regularly will cause an increase of the quality of life in patients with primary osteoporosis [15, 16].

According to studies [17] the improvement of chronic pain from osteoporosis is naturally followed by the easier performance of daily and leisure activities. as well as an increase in self-confidence. The fact that the mobility. household chores and health status sections do not show statistically significant changes in patients from study group compared to control. can be explained by the fact that in study group there is a predominance of patients from an urban environment and older than 60 years. with an increased degree of sedentarism and with an associated pathology.

In our study. the benefits of rehabilitation on the quality of life for people with osteoporosis were highlighted by analysing individuals over the course of a year. In study group. after one year of treatment. we observed a strongly statistically significant improvement ($p < 0.001$) in all sections of the Qualeffo score. Also, the total Qualeffo score presented a strongly statistically significant improvement. Compared to control group. in the free time activities section, we did not find a statistically significant change and the total Qualeffo score showed only a statistically significant improvement. A superior improvement in the quality of life for patients from study group. compared with control group. is therefore observed.

The decrease in height with age is a natural phenomenon. but a significant loss in height. is a warning sign for a potential diagnosis of osteoporosis [7, 18]. In the elderly. there are two major causes that cause the decrease in height. The first is represented by the degenerative changes of the intervertebral discs. With age. they lose their elasticity. dehydrate. they compress. becoming less tall. The other major cause of the decrease in height with age consists of vertebral fractures due to osteoporosis. which are accompanied by pain in the spine and kyphotic changes of the spine [19, 20]. In patients with osteoporosis. height loss may indicate a vertebral fracture. the accuracy of height information is relevant to clinical practice [21]. Mumtaz considers that the periodic monitoring of the height at the PO is mandatory. it can highlight early the occurrence of osteoporotic fractures [22]. A significant decrease in height also has a diagnostic value. raising the suspicion of osteoporosis. especially in the absence of clinical symptoms.

In order to get a clearer picture of the impact that PT and OT have on people with osteoporosis. we compared the decreasing in height between the two groups. We also compared the patient's height at the beginning and at the end of the study. The results highlight the impact of PT and OT on bone fracture's fragility. The patients from study group. due to the fact that they followed a daily home rehabilitation program. showed a smaller decrease in height and therefore a more correct body posture compared to the control group.

The result of the study is in agreement with other studies [23, 24] which highlight the benefits of PT and OT for correcting the body posture in patients with osteoporosis.

Specific physical exercises have an important role in increasing bone strength. this being highlighted by the fact that lack of physical activity is followed by a decrease in BMD and thinning of the cortical bone in the diaphysis area [25]. In order to have an osteogenic effect. physical exercises must cause muscle contractions intense enough to cause dynamic stresses on the bone [26]. In the specialized literature. there is no consensus regarding the effectiveness of the combination of physical therapy and drug therapy on BMD in patients with osteoporosis. Lespessailles claims that research studies on the effects of this association in animals have more promising results compared to human studies that have mixed results [27].

Comparison analysis between groups. shows that. from the point of view of bone mineral density. there is no significant difference neither between the baseline scores. nor between the final scores of the two groups. According to our results, confirmed by other studies [28, 29] in primary osteoporosis drug therapy and rehabilitation will not cause a statistically significant improvement in BMD compared to only specific medication. At the end of the study. lower values are recorded compared to the beginning of the study. but there is no significant difference in any of the two groups. Thus, in the study group an average bone loss of 0.22% was found during the study and in control group. an 0.53% average bone loss of was found. Therefore PT and OT has a limiting effect on BMD reduction. an aspect that was also highlighted by Korpelainen in his study [30].

An explanation in this regard is the fact that if medication for osteoporosis has an antiresorptive effect preventing bone resorption by osteoclasts. PT and OT has an osteogenic effect on osteoblasts and osteocytes. However. the osteogenic effect of PT and OT is inversely related to age. i.e. the older the patient. the more limited is the effect of rehabilitation exercises due to cellular changes following senescence: the number and activity of osteoblasts and osteoclasts decreases. It turns out that physical therapy in primary osteoporosis has only a braking effect on the decrease in BMD.

Zehnacker claims that the duration of exercise program should be at least one year to cause changes in BMD. The duration of PT is important. because the total time of formation of a basic multicellular unit for bone is 4-6 months. the duration of specific physical exercises to be effective on BMD should be at least 2-3 times longer than this period. i.e. 12 - 18 months [31].

This study was limited by the relatively small number of patients and the short duration of the study. Our findings may stimulate further research with longer follow-up periods and larger patient groups.

4. Materials and Methods

Based on subjective and objective anamnestic criteria. a number of 94 patients admitted to the Rehabilitation Hospital in Băile Felix. aged between 56-69 years and who expressed their written consent to participate. were taken into the study. Initially. there were 100 participants. but 6 were excluded during the research. for various reasons. Our study took place over two years. between April 2022 and June 2024.

The inclusion criteria in the clinical study were: hospitalization at the Rehabilitation Hospital in Băile-Felix. the diagnosis of primary osteoporosis confirmed by DEXA. the compliance with the recommended medication during the study; the following of a 2 weeks rehabilitation treatment; the compliance with the initial and final assessment.

The exclusion criteria were: the refuse to participate; the alteration of the patient's general condition during the study regardless of the cause; any type of infectious complications. neoplasms. debilitating co-morbidities or mental illnesses; body mass index (BMI) < 20 kg\m2. a BMI < 20 kg\m2 is a significant risk factor in osteoporosis [32]; the presence of a TM for osteoporosis prior to our study.

All the 94 patients in our study followed a two weeks rehabilitation program at the Clinical Rehabilitation Hospital in Băile Felix. consisting of drug therapy and physical therapy. The medication used was: medication for osteoporosis; Ca / vitamin D supplements and pain killers and drugs necessary for pathologies that can cause imbalance in walking and static. if needed.

The rehabilitation therapy included for all study subjects specific physical exercises; analgesic electrotherapy (TENS; aquatic therapy) and occupational therapy. including measures to prevent falls and increase postural stability.

Characteristic for patient with osteoporosis. is that the rehabilitation program. including PT and TO. must not be interrupted once the patient is discharged. It must be continued at home for the entire life. From medical discipline reasons. some of the patients from this study did not respected this indication. Therefore. according to this criteria. the study subjects were divided into two groups:

1. the study group (group A) - 46 subjects with osteoporosis medication. who followed continuous PT. OT for one year;

2. the control group (group B) - 48 subjects with osteoporosis medication who did not followed the above mentioned rehabilitation program.

Assessment tools

In order to highlight the therapeutic efficiency of the medication for osteoporosis associated with rehabilitation exercises versus only drug therapy. in the treatment of osteoporosis, we followed. in both the two groups of subjects included in the study. the evolution of the following parameters. over the course of one year:

- the decrease in patient's height during the study - the assessment was carried out using a standard thalometer, common for all patients;

- the T score value expressing BMD. obtained by DEXA examination at admission and after 1 year of treatment;

- the value of the Quallefo test. a useful tool in the overall assessment of osteoporosis patients. through which their quality of life is evaluated [33]; the Qualeffo test includes 41 questions divided into 7 sections (pain. daily activities. daily activities. mobility. leisure time. health status. mental health).

Intervention

After discharged. all the patients from study group performed 5 weekly PT and OT sessions at home. monitored by the physiotherapists and volunteer doctors from this study.

PT was structured as follows: warm-up (5 to 7 min). exercise program (30 to 35 min). and recovery (5 min). The OT sessions were adapted individually according to each patient.

All PT exercises were aerobic and their intensity level. at the beginning of the program. depended on the physical capacity of each individual patient. The benefits of PT exercises on the skeleton are limited to the stimulated anatomical area. Therefore, special importance was given to exercises to stimulate bone remodeling in the forearm. hip and lumbar spine. the areas most susceptible to osteoporotic fractures. In this sense. exercises with small weights were performed for the flexor and supinator-pronator muscles of the seated fist. Also. exercises with bags attached to the ankles for hip flexion and abduction from standing and sitting with support from the back of a chair.

The goal was to improve balance and tone the muscles of the lower limbs. especially the quadriceps. The exercises to strengthen the abdominal and paravertebral muscles were performed only from the supine and ventral positions. Exercises to improve balance also included improving proprioception and the function of the vestibular system. The necessary exercises for the re-education of abdominal and diaphragmatic breathing were also carried out. Exercises and activities involving excessive flexion of the thoracic and

lumbar spine were avoided because it increases the risk of vertebral compression fractures.

Within the OT a safe ADL improvement program was initiated. including transfers. sitting and standing. household activities. pedaling and gardening. Also, within the OT adaptive changes were made at home and the workplace to avoid falls and injuries: the elimination of thresholds. obstacles and slippery surfaces. the installation of support bars.

Statistical analysis

For data analysis. we used the Statistical Package for Evaluation in Social Sciences (SPSS) version 15.0. issued by IBM SPSS Statistic. Oradea. Romania. For the quantitative analysis of numerical variables. we used mean and standard deviation. and for categorical variables we used percentage and mean. We analysed the normality of data distribution using the Kolmogorov-Smirnov test. For the intergroup analysis of baseline values. we used the Independent samples T-test because we had a normal distribution of the data (Kolmogorov–Smirnov test. $p \geq 0.05$). The chi-square test for homogeneity was performed to explore whether the frequency counts were identically distributed between the two patient groups. with respect to gender and environment. To test whether there was a significant difference between the two groups for baseline and final outcomes. we used one-way ANOVA between patients. as we had a normal distribution of data (Kolmogorov-Smirnov test. $p \geq 0.05$). For the pretest - post-test analysis of the two groups. we used one-way ANOVA with repeated measures. To measure effect size for both between-subjects one-way ANOVA and repeated-measures one-way ANOVA. partial Eta squared was used. Overall. 95% confidence intervals (CI) were reported as appropriate.

5. Conclusions

Patients with osteoporosis. who during one year. undertakes drug therapy with physiotherapy and occupational therapy. compared to those who only take medication for osteoporosis. have the following advantages: the quality of life and mental tone improvement. and significant decrease in pain; slowing down the decrease in height. with postural improvement; slowing down the decrease in bone mineral density: PT and OT have a braking effect on the decrease in bone mineral density.

Our study proposes a therapeutic protocol for PO that includes: annual monitoring of patients' height; the inclusion of occupational therapy within the rehabilitation management; compliance with an individual program adapted by a physiotherapist performed 5 times a week.

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