Chłystek Joanna, Pietsch Julia, Golus Anna, Abramczyk Agata, Łakomski Mateusz. Review of physiotherapeutic methods used in patients with osteoporosis. Journal of Education, Health and Sport. 2018;8(9):1058-1066 eISNN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.1420053
http://ojs.ukw.edu.pl/index.php/johs/article/view/6004
https://pbn.nauka.gov.pl/sedno-webapp/works/877731

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part b item 1223 (26/01/2017).
1223 Journal of Education, Health and Sport eissn 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 02.08.2018. Revised: 18.08.2018. Accepted: 15.09.2018.

Review of physiotherapeutic methods used in patients with osteoporosis

Joanna Chłystek, Julia Pietsch, Anna Golus, Agata Abramczyk, Mateusz Łakomski

Department and Clinic of Geriatrics, Collegium Medicum in Bydgoszcz, University of Nicolaus Copernicus in Torun

Abstract

This article is a review of current literature about physiotherapeutic methods used in osteoporosis including physical activity and physical therapy. Osteoporosis is a systemic disease classified as a civilization disease, which is significantly associated with gender, age, low body weight, and lifestyle. Most often it concerns older adults and is also characteristic for postmenopausal women. The research presented in this article suggests the positive influence of physiotherapy (i.e. aerobic exercises and resistance training and also physical therapy) on osteogenic processes, bone mineral density, pain and decrease the risk of falls.

Keywords: Osteoporosis, Physiotherapeutic methods

Introduction

Osteoporosis is a systemic disease characterized by a decrease in bone mass and disturbances in the bone structure. Initially, it runs asymptomatically, and often its first noticeable symptom is an osteoporotic fracture, resulting from an inadequate event, such as a fall from the height of one's own body. Therefore, one of the basic goals of osteoporosis management is to prevent fractures that are the cause of disability of older people, as well as a serious economic challenge due to the huge costs associated with both treatment and rehabilitation after fracture. In addition to preventing falls, the goal of physiotherapy is to reduce pain and maintain functional capacity. These goals can be obtained by non-pharmacological treatment consisting mainly of the use of appropriate physical activity and diet. Movement activity supported by a proper diet gives much better results and is recommended as an adjuvant treatment in the treatment of osteoporosis [1, 2].

Effect of physical activity on bone tissue metabolism

Movement activity prevents the loss of bone mass in the elderly, favorably affects the bone structure, contributing to its strengthening and thus prevents fractures. There is also an increase in the range of joint mobility and elasticity of periarticular structures. However, in the muscular system, the changes that take place depend on the nature of the effort, as well as on its duration, intensity and frequency with which it is taken.

Stillness always leads to rapid muscular atrophy [3]. Despite the fact that patients are aware of the fact that osteoporosis is a disease and that physical activity and diet are important aspects of prophylaxis, social awareness on the subject is still too small [4].

Bones have the ability to adapt to the mechanical forces acting on them, including by changing the structure and mass in places subject to the highest loads.

Due to the vertical position of the body, vertical bars are subjected to loads more often than bars horizontally arranged. For this reason, horizontal bars undergo resorption, while vertical bars maintain their volume [5]. Stimulating the bone tissue with the load, including the load on one's own body, we contribute to increasing its strength. If these forces do not work, the risk of osteoporosis increases [6].

Hormones also affect bone metabolism. Physical effort stimulates the secretion of growth hormone, which causes an anabolic effect, while insulin-like growth factor 1 - IGF-1, secreted by osteoblasts, stimulates the synthesis of DNA and collagen [7]. Women who used hormonal therapy, and in addition participated in training including stretching, equivalent exercises and

intense aerobic exercises show a much better response to treatment than those who do not exercise [8]. Bone mineral density (BMD) allows to measure densitometry [9].

Exercises that contribute to increasing bone mass are well defined. Physical exercise is more dynamic than static, and intensity, although individually adjusted to the patient, should exceed a certain threshold. Exercises stimulating osteogenic processes are those that trigger mechanical loads other than those exerted on a daily basis [10]. The increase in bone mass is greater if high stresses will work at different angles and from different sides, which is why the activities in which alternately we load the limbs or at the same time we take off both from the ground, stimulate the best bone formation. Activities during which forces operate in different directions include ball games, dancing, aerobics are suitable for people who are at high risk of fracture and cannot exercise vigorous, heavy exercise. Walking or running, on the other hand, exert a force greater than the body weight, but they are applied at the same angle. Endurance sports such as swimming or cycling do not favor the prevention of bone loss, but because they favorably affect the cardiovascular system, they should also be part of the training plan [6, 8, 11].

The role of physical activity in osteoporosis

Walking plays an important role, among others in postmenopausal women, as it has beneficial effects on BMD of the femoral neck, however, these beneficial effects cannot be seen in the spine BMD [12]. The use of walking as the only form of activity, without other exercises, will not significantly affect the bone mineral density in women around menopausal age, with the exception of BMD of the femoral neck. The research shows that the beneficial effect on the mineral density of the femoral neck is noticeable after 6 months [11]. Beneficial results in the value of bone mineral density in the lumbar spine and femur in postmenopausal women have a training program during which, except for a 30 minute treadmill walk with an intensity of 70% VO2max, women performed 10-minute exercises using the steppe. These results were noticed after 24 weeks, with the frequency of training three times a week [13]. The effectiveness of walking is confirmed by numerous tests, but the appropriate length of these walks is equally important. It has been shown that post-menopausal women who overcome 12 km per week have better BMD results in the spine and lower limbs than women who have traveled less than 1.6 km for a week [2].

70 women with postmenopausal osteoporosis were assigned to two groups to assess whether the Pilates exercise program (twice a week for one year), or chest extension exercises give better

effects on pain, functional capacity and quality of life. Better effects of therapy were noted in the Pilates exercise group [14].

In osteoporosis, strength training is also recommended, in which the muscles have to overcome the external weight. During these exercises, muscles exert force on the bones, stimulating osteogenic processes. Strength training in postmenopausal women and patients with osteoporosis may contribute to an increase in BMD in the lumbar spine and hip joint if its intensity is at least medium (70-90% of the maximum weight) and the number of repetitions is from 8 to 12 in each three series for a given exercise. Exercises should take place two or three times a week for a year [15]. Sinaki et al. Observed that by increasing the muscle strength of the extensor muscles in postmenopausal women, the number of osteoporotic fractures in the spine significantly decreased. This is because resistance exercises help to prevent bone loss and have a positive effect on balance and reduce the risk of falls that are the cause of fractures [11]. It is important to strengthen the muscles of the back, gluteus and abdomen, as well as to eliminate contractures of breast muscles, stretching the muscles in the lumbar region of the spine, as well as flexors of the hip joint.

There are many contradictions in the literature about water exercises for patients with osteoporosis, however, studies conducted on 34 post-menopausal women who took part in pool activities by performing lower and upper limbs movements with an intensity of 70-90% of maximum heart rate indicate that that both training with additional load and without causes an increase in muscle strength, and in addition, the water environment favors the strengthening of balance, because the waves of water arising from the movements of the exercisers change the center of gravity, stimulating the torso muscles to work in order to maintain balance. Women exercised twice a week for 12 weeks [11].

Apart from low BMD, in people with osteoporosis, falls are a dangerous factor increasing the risk of fracture. In addition to endurance and resistance exercises, patients should be introduced to improve the balance, coordination, flexibility and cardiovascular function [16].

Vibration training and other methods

Vibration training is a method that uses mechanical vibrations and their impact on the body of a person who doing a movement tasks on a vibration platform. Maintaining a static position allows involvement of appropriate muscles [2].

Half of the 116 postmenopausal patients who had osteoporosis were treated with vibration training with a 30 Hz vibration frequency. Vibration training was applied 5 times a week for 10 minutes. In the remaining half, no intervention was used. In patients treated by

vibration training, after 3 months of therapy there was an increase in bone mineral density in the lumbar region and in the femoral neck, there was also a reduction in chronic back pain [17]. Benefit of using vibration training was also demonstrated by Gusi N. et al. who examined 28 postmenopausal women. The women were divided into 2 groups to determine whether vibration training (vibrations with a frequency of 12.6 Hz) or walks (55 minutes of walk and 5 minutes of stretching) show better results in bone mineral density (measured in the lumbar and hip region) and balance. After 8 months, during which the sessions which took place three times a week, it was noticed that BMD in the femoral neck, in the group with which vibratory therapy was applied, increased by 4.3% compared to the walking group. BMD values in the lumbar spine did not change in both groups. In the group treated by vibration training, the balance improved by 29%, while in the group that walked, there was no improvement in the balance [18]. A significant improvement was found in studies using frequencies from 12.5 to 20 Hz. Vibration training is potentially useful not only in the prevention of osteoporosis, but also in sarcopenia [19].

There were also examined the effect of high intensity laser therapy (HILT) on quality of life, risk of falls and pain level combined with and without exercise, in a randomized, single-blind trial in patients over 50 years old with osteoporosis or osteopenia. Participants were subjected to three sessions of therapy during the week, over the 12-week duration of the program. They were divided into four groups, the first of them participated in laser therapy exercises and treatments, the second in exercises and placebo treatments instead of laser therapy, the third in laser therapy alone, while the fourth group was subject to only placebo treatments instead of laser therapy. Laser therapy treatments were performed using the scanner method on the lower back and the proximal part of the thigh. Exercises included aerobic and resistance training, stretching and balance training. Pain was assessed with the VAS visual-analogue scale, the group subjected to HILT and exercises recorded the greatest decrease, which correlated with the increased in quality of life. The decrease in pain level was greater than in the group subjected to exercises without HILT and the group subjected to laser therapy alone, without exercise [20].

In the prevention of BMD loss is also used a magnetotherapy. A study in a group of 30 COPD patients (Chronic Obstructive Pulmonary Disease) showed that in the magnetotherapy group the density of bone tissue increased, despite the use of steroids in the treatment of COPD. The control group consisted of 15 patients who did not participate in magnetotherapy. The sinusoidal shape of the magnetic field was used, frequency 50 Hz, field strength 2.5 m T. Magnetotherapy took place every day for 20 days, then for 3 months (2x a

week 20 times), and after their completion were repeated after three months (2 series a year). Patients were followed by an observation lasting one year and an increase in bone density of 1.75% was noted in the study group, with no improvement in the control group [21].

Physiotherapy in alleviating the effects of osteoporosis's complications

Vertebral fractures are the most common fractures in postmenopausal osteoporosis. In the acute phase (first 3 weeks), breathing exercises and isometric exercises are performed in lying on the back. In addition, the time of uprightness is increased, and from the second week the patient may sit down. However, it should be remembered that the verticalization is performed in a corset, but resting in a lying position without a corset. In the acute phase pharmacotherapy and physiotherapeutic treatments giving analgesic effect are invaluable. For this purpose, electrotherapy (DD, IF, TENS), pulsed electromagnetic field or Low Level Laser Therapy (LLLT) are used. In phase II, bone healing, which lasts 10 weeks, isometric exercises of stabilizing muscles are performed, free active and resistance exercises for limb, and synergistic exercises performed with maximum resistance. In this phase exercises are implemented to relax the paraspinal muscles, or balance exercises. Physical therapy treatments in this phase are less importance, but in addition, heat and cold treatments can be used to relax the paraspinal muscles. In the third phase after fracture, pain relief in the lumbar region is used, which is achieved by using "intermittent rest in the supine position" and physiotherapeutic procedures such as in the second phase [22].

In the skeletal system, unstimulated by gravitational forces, bone mineral density expressed in BMD units decreases. Even in people who aren't at risk for osteoporosis but have immobilized BDM decreased. Young men who underwent 17-week immobilisation, BDM in the femoral neck and lumbar spine have decreased by 4%. With minimal stimulation by gravitational forces, the monthly drop of BDM may be 2% [23].

The most dangerous problem associated with osteoporosis are fractures in the proximal femur. They are associated with many complications and increased the risk of death. The risk of these fracture increases with the number of falls, that occur most often among older adults. These types of fractures are treated surgically, but after the procedure comprehensive rehabilitation should be started as soon as possible. This procedure includes not only increased the functional efficiency after the surgery, but is aimed at reducing the risk of falls in the future. The procedure begins already on the first day after the surgery, performing breathing, anticoagulant and isometric exercises of the operated limb. It should be remembered that contralateral exercises are important in the postoperative period. When the general condition of

the patient is good, verticalization should be started as soon as possible. During exercises in the operated limb are contraindicated rotational movements, while adherence in the hip joint cannot exceed the zero position. Physical treatments use electromagnetic field and laser bio stimulation, because these treatments can be used after surgery with metal implantation [22].

In patients who had surgery, the physiotherapy should be continued until the end of their life, with particular emphasis on kinesitherapy procedures. They should include active exercises in relief, which can be additionally carried out with resistance, both within the operated limb and the remaining ones. It is also important to conduct balance exercises, together with the lesson of controlled, safe falling, to overcome the fear of falling, learning the techniques of assurance, and education of getting up after the fall [22].

Summary

In patients suffering from osteoporosis, physiotherapeutic treatment is an important part of both comprehensive treatment and preventive measures. It influence on both the density of bone tissue and decreases the risk of fractures, of which a serious risk among older adults are falls. Physiotherapy also support the treatment of already occurring fractures.

In the presented studies, a correlation between physical activity and bone mineral density are a positive relationship. The increase in bone mineral density at best was influenced by activity during which gravity works, e.g. walking, running, gymnastics or team games, but the best effects for osteogenesis had exercises, during which on bones was applied loads in different directions.

Also resistance training gave many benefits, which outside the improvement in muscle strength improved also the increased BMD areas, where the muscle was better trained. Physical activity for patients with osteoporosis should also include coordination and balance exercises, because of the risk of falls in these people. The best exercise program, which will be focused on the increasing of bone strength should consist of all of the mentioned activities.

In the treatment of osteoporosis is also used a physical therapy. Both vibrational therapy, high energy laser therapy and other physical methods have a beneficial effect on bone mineral density and pain.

Physiotherapy is also an integral part in the treatment of fractures.

References:

1. Tkaczuk-Włach J, Sobstyl M, Jakiel G. Osteoporoza - obraz kliniczny, czynniki ryzyka i diagnostyka. Przegląd Menopauzalny, 2010, 2, 113-117
2. Weber-Rajek M, Ciechanowska K. Postępowanie fizykalne w osteoporozie pomenopauzalnej – przegląd badań. GinPolMedProject 1 (35) 2015; 53-58
3. Kasperczyk T. aktywność fizyczna seniorów warunkiem zdrowia i dobrej jakości życia. Journal of Clincal Healthcare, 2014 (1), 8-15
4. Srokowska A, Zawadzka E, Lewandowski A, et al. Ocena stanu wiedzy pacjentów na temat profilaktyki osteoporozy. Journal of Education, Health and Sport. 2015; 5(12): 503-520
5. Czerwiński E. Osteoporoza problem interdyscyplinarny. PZWL, Warszawa 2015, 13-23, 59-71, 117-130
6. Hingorojo MR, Syed S, Qureshi M. Role of exercise in osteoprosis prevention, J Pak Med Assoc, 2008, 58/2, 78-81
7. Melo Ocarion N, Serakides R. Effect of the physical activity on normal bone and the osteoprosis prevention and treatment. Rev Bras Med Esporte, 2006, 12/3, 149-152
8. Lirani-Gavaldo AP, Lazaretti-Castro M. Physical approach for prevention and treatment of osteoprosis. Arq Bras Endocrinal Metab. 2010; 54/2, 171-178
9. Czerwiński E, Badurski JE, Marcinowska-Suchowierska E, Osieleniec J. Współczesne rozumienie osteoporozy w świetle stanowiska World Health Organization (WHO) i International Osteoporosis Foundation (IOF). Ortopedia Traumatologia Rehabilitacja© MEDSPORTPRESS, 2007; 4(6); Vol. 9, 337-356
10. Borer KT. Physical activity in the prevention and amelioration of osteoprosis in women: interacion of mechanical, hormonal and dietary factors, Sports Med. 2005 35(9); 2629-41
11. Fernandes Moreira LD, Longo de Oliviera M, Lirani-galvano AP. Physical exercise and osteoporosis: effect of different types of exercises on bone and physical unction of postmenopausal women, Arq Bras Endocrinal Metab. 2014; 58/5: 514-522
12. Martyn-St JM, Caroll S. Meta-analysis of walking for preservation of bone mineral density in postmenopausal women, Bone, 2008, 43(3): 521-31
13. Chien MY Wu YT, Hsu AT, Yang RS, Lai JS. Effiacy of a 24-week aerobic exercise program for osteopenic postmenopausal women, Calcif Tissue Int., 2000; 67(6):443-8 42 42:312403
14. Kucukcakir N, Altan L, Korkmaz N. Effects of Pilates exercises on pain, functional status and quality of life in women with postmenopausal osteoporosis. J Bodyw Mov Ther 2012;17(2):204-211

15. Zehnhacker CH, Bermis-Dougherty A. Effect of weigted exercises on bone mineral women in postmenopausal women a systematic review, J GeriatrPhys Ther, 2007; 30(20):79-88

16. Roczniak W, Babuśka-Roczniak M, Roczniak A. Diagnostyka i farmakoterapia osteoporozy. Lekarz 2010; 12: 14-22

17. Ruan XY, Jin FY, Liu YL, et al. Effects of vibration therapy on bone mineral density in postmenopausal women with osteoporosis. Chinese Medical Journal 2008, 121(13): 1155-1158

18. Gusi N, Raimundo A, Leal A. Low-frequency vibratory exercise reduces the risk of bone fracture more than walking: a randomized controlled trial. BMC Musculoskelet Disord 2006;30,7:92

19. Fratini A, Bonci T, Bull AMJ. Whole Body Vibration Treatments in Postmenopausal Women Can Improve Bone Mineral Density: Results of a Stimulus Focussed Meta-Analysis. PLoS ONE 11(12): e0166774. doi:10.1371/journal.pone.0166774

20. Alayat MSM, Abdel-Kafy EM, Elsoudany AM, et al. Efficacy of high intensity laser therapy in the treatment of male with osteopenia orosteoporosis: a randomized placebo-controlled trial. J Phys Ther Sci. 2017; 29(9): 1675-1679

21. Kuliński W. Medycyna fizykalna w profilaktyce zdrowia. Studia Medyczne 2008; 10: 17-20

22. Jasiak-Tyrkalska B, Czerwiński E. Postępowanie fizjoterapeutyczne po złamaniach osteoporotycznych, Ortopedia Traumatologia Rehabilitacja, MEDSPORTPRESS, 2006; 4(6); Vol. 8, 388-394

23. Nordström A, Tervo T, Högström M. The effect of physical activity on bone accrual, osteoprosis and fracture prevention, The Open Bone Journal, 2011, 3, 11-21