

Osteoporosis and osteoarthritis: similarities and differences

Dijana Avdić

Faculty of Health Studies, University of Sarajevo, Bolnička 25, Sarajevo, Bosnia and Herzegovina

Abstract

Osteoporosis and *osteoarthritis* are two different medical conditions, which beside the first part of their name „oste“, have very little in common. Osteoporosis is a disorder which influences bones in terms of reduction of quality and quantity, which can easily result in bone fracture. Clinical signs of osteoporosis show no pain or other symptoms which could point to changes in bone structure, unless a bone fracture is diagnosed. Osteoarthritis is a disease which influences joints and its surrounding tissues. Seeing through clinical signs, changes could be verified in terms of pain and limitations of movement and the cause of pain and way of its treatment are numerous. A person can suffer from osteoporosis and osteoarthritis at the same time. Although these medical conditions are more frequent in female than in male population, mechanisms which lead to them may interfere. Osteoporosis and osteoarthritis are muscular-bone disorders with significant morbidity and mortality, but clinical experiences and epidemiological studies have shown their negative correlation.

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Introduction

Although osteoporosis and osteoarthritis, as medical disorders, have different etiology, pathology as well as clinical signs and symptoms, having similar name often leads to a confusion between patients and doctors. Beside the same first part of the name of these two medical disorders, „oste“, osteoporosis and osteoarthritis have very little in common. Osteoporosis is a disease which influences bones in terms of reduction of quality and quantity, which can easily result in bone fracture. Clinical signs of osteoporosis show no pain or other symptoms which could point to changes in bone structure, unless a bone fracture is diagnosed. Osteoarthritis is a disease which influences joints and surrounding tissues of a body. Seeing through clinical signs, changes could be verified in terms of pain and limitations of movement and the cause of pain and way of its treatment are numerous. Osteoporosis is commonly accepted as

a bone disorder while osteoarthritis is generally considered as a joint' cartilage disorder. The causes which are included in the pathophysiology of osteoporosis can also be included in the pathophysiology of osteoarthritis of the subchondral bone. The treatment is available for both medical disorders and it can help in reduction of medical disorder' symptoms and improve the quality of life (1,2). If the person suffers from osteoporosis and osteoarthritis at the same time, specifically planned program of treatment should be applied in terms of changes' control in both disorders. This situation requires management of both disorders in terms of determination of proper and adequate physical activity. The recommended program of treatment for osteoporosis includes regular physical activity and the same can be extremely hard to follow if the patient has significant osteoarthritic degenerative changes verified in hip or knee joint. Therefore the physical activity program should be adapted to one and another degenerative disorder.

What is osteoporosis?

According to the definition of the World Health Organization (WHO) osteoporosis is a disease which appears as a consequence of bone mass re-

* Corresponding author: Dijana Avdić,
Faculty of Health Studies, University of Sarajevo,
Bolnička 25, Sarajevo, Bosnia and Herzegovina
Phone: +387 62 83 80 37
E-mail: dijana2007@gmail.com

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duction and bone morphology disorder. Therefore bone fractures become more often. According to the WHO' data, osteoporosis is the most frequent bone metabolic disorder (3,4). Nowadays, it is even more present than ever and the most frequent cause of it is modern way of living and extended life expectancy. Osteoporosis is a condition of reduced quantity (mass) of the bone below the limits necessary to preserve the integrity of the skeleton. The leading symptom is loss of bone mass, which results in brittle bones easily. The cells in bones are constantly renewed, but with the bone age it is becoming less valuable mechanically so as to maintain the mechanical quality, it is being remodeled. Osteoporosis is characterized by low bone mass due to an imbalance in favor of bone resorption, leading to changes in bone remodeling. Osteoporosis represents changes in bone density as well as in bone quality, including not only changes in the microarchitecture, but also changes in bone remodeling, remodeling and mineralization of microcracks (5). The remodeling process takes 3-4 months, and the same amount of bone that was destroyed is being renewed. The complete reconstruction of the bone takes 10 years. In the process of osteoporosis the destroyed bone is not restored completely and bone mass decreases. The bones become hollow and crumbling at the least shock (1). Pathogenesis and pathophysiology of osteoporosis is multifactorial: genetics, age, a lack of estrogen, diet and insufficient physical activity. Osteoporosis is followed by reduced mobility, pain in bones and joints, cramps and muscle weakness, a decrease in body height, an increased risk of bone fractures, and even spontaneous fractures. More than 90% of hip and spine fractures are caused by osteoporosis, and osteoporotic fractures constitute of 45% of vertebral fractures, 16% of the upper femur (hip), 16% of distal forearm and 20-25% are other fracture localization (pelvis, upper arm, ribs) (1).

What is osteoarthritis?

Osteoarthritis is the most common rheumatic disease that affects the joints, although various extra-articular structures can be affected. Approximately 10% of the population in general has problems due to osteoarthritis. This disease particularly affects older people and it is estimated that more than 60% of people aged above

35 years suffer from osteoarthritis. About 55% of people with osteoarthritis have difficulty in performing activities of daily living, and about 25% of them do not perform these activities. Only osteoarthritis of knee joint causes disability as chronic heart and lung disease combined (5). Pathogenesis and pathophysiology of osteoarthritis is multifactorial: being overweight, the aging process, joint injury or stress, heredity, muscle weakness. Osteoarthritis often develops in the joints in which vicinity were fractured bones. It often affects cervical or lumbar spine, hip and knee. Cartilage damage in osteoarthritis is the result of an imbalance of enzymes that are released from the cells of articular cartilage (matrix metalloproteinases, aggrecanases and other enzymes). When the enzymes that destroy and build cartilage are produced in equal amounts, cartilage naturally regenerates, and when enzymes of degradation are over-produced, cartilage damage occurs.

Differential characteristics of reduction of muscle fibers in osteoporosis and osteoarthritis

Osteoporosis is associated with the presence of type II muscle fibers in the stage of decrease in muscle mass, bone mineral density and with reduced levels of AKT (protein kinase B - PKB), as the main regulator of muscle mass. Osteoarthritis is connected with the muscle reduction which is expressed to a lesser extent, but in direct relation with disease duration and severity. Osteoarthritis and osteoporosis are associated with reduced muscle mass and muscle strength, but still there are no morphological studies on the reduction of muscle tissue, so the basic mechanisms of reduction of muscle mass are not yet known. The aim of the study *Terracciano C. et al.* was to assess the relationship osteoporosis - osteoarthritis with a reduction in muscle mass and correlation with disease severity. Muscle protein levels of AKT, specifically a component IGF-1/PI3K/Akt pathway is a major regulator of muscle mass. AKT is known as protein kinase B (PKB); it is the serine / threonine-specific protein kinase that plays a key role in several cellular processes such as glucose metabolism, apoptosis, cell proliferation, transcription and cell migration. Muscle biopsy was performed in 15 women with osteoporosis and in 15 women with

osteoarthritis (age range, 60-85 years). According to statistical analysis, type II fibers are decreased in muscle mass which correlates with bone mineral density (BMD) in the group of women with osteoporosis and Harris Hip Score (HHS), and duration of illness in a group of women with osteoarthritis. HHS is a tool for assessing the functionality after hip arthroplasty. The results showed that in women with osteoporosis, type II muscular fiber atrophy correlates inversely with BMD. In the group of women with osteoarthritis, muscle atrophy was noticed to a lesser extent, and there was homogeneity among the types of fiber related to duration of disease and HHS. Within a group of women with osteoporosis, the level of AKT was significantly reduced compared to the muscles in the group of women with osteoarthritis. This study shows that osteoporosis is connected with frequent diffuse type II muscle fiber atrophy, in proportion to the degree of bone loss, whereas in osteoarthritis, muscle atrophy is associated with functional impairment caused by disease (7). Osteoarthritis and osteoporosis clinical and research evidence of inverse relationship Osteoporosis and osteoarthritis, as serious medical conditions, have two characteristics in common; both are associated with aging and multifactorial. Although the relationship between osteoporosis and osteoarthritis is especially important, as the inverse relationship, the two diseases are studied for the last 30 years, and yet their relationship is controversial and stimulating for further study. Regarding the anthropometric characteristics of patients with osteoarthritis compared to people with osteoporosis, following are well established. People who have osteoarthritis have a stronger body structure and more obesity, and increased BMD. This increase in BMD was also linked to higher values of bone mass. With aging, bone loss in osteoarthritis is lower unless when measured in the vicinity of the affected joints (hand, hip, knee). A small degree of bone loss with aging is explained by lower degree of bone resorption. People with osteoarthritis in effective have higher bone density, but wider measures of skeletal geometry, the diameter of long bones and trabeculae, which positively contributes to better strength and lower bone fragility. Osteoarthritis is characterized with an increased content of

growth factors such as IGF and TGF beta, which are required for the regeneration of bone. Experimental evidence show that osteoclasts have metalloproteinase that directly or indirectly from the matrix creates a precondition for a deterioration of a medical finding of cartilage. The capacity of osteoblastic bone regeneration in osteoporosis is compromised in comparison with osteoarthritis. The claim that drugs which suppress bone transport in osteoporosis may be useful for osteoarthritis, such as bisphosphonates, is incorrect (8).

Differences in the distribution of adaptive mechanisms of femoral neck in osteoarthritis and osteoporotic fracture

Study of *Rubinacci A. et al.* refers to diversity of adaptive mechanisms in the distribution of femoral neck in osteoarthritis and osteoporotic fracture. It was done by comparative analysis of peripheral quantitative computed tomography (pQCT) of femoral bone in 32 postmenopausal women which were undertaken the hip arthroplasty due to osteoarthritis or osteoporotic femoral fracture. Adaptive mechanisms that are present on the wrist, which is affected by osteoarthritis, lead to a reduction in fracture risk, despite the presence of osteoporosis, low bone density and bone mass. It was found that the cortical bone volume and trabecular thickness is significantly ($p < 0.05$) higher in the group of women with osteoarthritis than in the group with fractures. This study confirms the presence of compensatory mechanisms in osteoarthritis in the preservation of the mechanical ability of bone structure, regardless of low bone density, bone mass and lower fracture risk (9).

Conclusion

Osteoporosis and osteoarthritis are two major health problems of modern society, and can affect the quality of life in different ways. Since both diseases are part of the aging process, one should take all preventive measures and identify any joint pain, and bone density test should be done in particular age in order to check whether there are changes that would indicate to osteoporosis. Both diseases are complex disorders of the musculoskeletal system, although they show effect on different tissues, both are affecting the bones. A person may have osteoporosis and osteoarthritis at the same

time. Although these disorders are more present in women than men, the mechanisms that lead to them may overlap. Osteoarthritis and osteoporosis are senile musculoskeletal disorders with significant morbidity and mortality, and clinical ex-

perience and epidemiological studies have shown that there is a negative correlation between them.

Conflict of interest

None to declare.

References

- [1] Avdić D, Buljugić E.: Kako spriječiti, kako liječiti osteoporozu. Tuzla: Off-set, 2008.
- [2] Lajeunes se D, Pelletier J-P, Martel-Pelletier J. Osteoporosis and osteoarthritis: bone is the common battleground. *Medicographia*. 2010;32:391-398
- [3] Rizzoli R, Bruyere O, Cannata-Andia JB, Devogelaer J-P, Lyritis G, Ringe JD, et al. Management of osteoporosis in the elderly. *Curr Med Res Opin* 2009;25(10):2373-2387. PubMed PMID: 19650751. doi: 10.1185/03007990903169262.
- [4] Watts NB, Lewiecki EM, Miller PD, Baim S. National Osteoporosis Foundation 2008 Clinician's Guide to Prevention and Treatment of Osteoporosis and the World Health Organization Fracture Risk Assessment Tool (FRAX): what they mean to the bone densitometrist and bone technologist. *J Clin Densitom* 2008;11(4):473-477. PubMed PMID: 18562228. doi: 10.1016/j.jocd.2008.04.003.
- [5] Jang IG, Kim IY. Computational simulation of simultaneous cortical and trabecular bone change in human proximal femur during bone remodeling. *J Biomech* 2009;43(2):294-301. PubMed PMID: 19762027. doi: 10.1016/j.jbiomech.2009.08.012.
- [6] Sluka KA. Osteoarthritis and rheumatoid arthritis. In: Sluka KA, editor. *Mechanisms and management of pain for the physical therapist*. Seattle: IASP Press; 2009.
- [7] Terracciano C, Celi M, Lecce D, Baldi J, Rastelli E, Lena E, et al. Differential features of muscle fiber atrophy in osteoporosis and osteoarthritis. *Osteoporos Int* 2012 Apr. PubMed PMID: 22535191. doi: 10.1007/s00198-012-1990-1.
- [8] Dequeker J, Aerssens J, Luyten FP. Osteoarthritis and osteoporosis: clinical and research evidence of inverse relationship. *Aging Clin Exp Res* 2003;15(5):426-439. PubMed PMID: 14703009.
- [9] Rubinacci A, Tresoldi D, Scalco E, Villa I, Adorni F, Moro GL, et al. Comparative high-resolution pQCT analysis of femoral neck indicates different bone mass distribution in osteoporosis and osteoarthritis. *Osteoporos Int*. 2012 Jul;23(7): 1967-75. Epub 2011;23(7):1967-75. PubMed PMID: 21947103. doi: 10.1007/s00198-011-1795-7.