

## Physiotherapy in the prevention and treatment of osteoporosis in elderly patients

### Medycyna fizykalna w profilaktyce i leczeniu osteoporozy u osób w wieku podeszłym

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#### Abstract

**Introduction.** Physiotherapy is one of the oldest areas of medicine. Its methods are used both in the treatment and prevention of disease. Osteoporosis is one of the most common diseases of modern civilisation. An analysis of the incidence of osteoporotic fractures in different countries suggests that the development of civilisation contributes to this problem. In Poland, 25% of women and 15% of men over the age of 50 have osteoporosis. Osteoporosis is a chronic and progressive disease, which is why its treatment is long-term and multidirectional. Consequently, it is crucial to introduce preventive measures, health education, physical activity and physiotherapy. **Aim.** To assess the usefulness and efficiency of low-frequency alternating magnetic fields (LFAMF) in the prevention of bone mass loss in patients with chronic spinal pain. **Material and methods.** The study group consisted of 50 men with chronic spinal pain (mean age was 66.5 years) treated with a series of LFAMF procedures. Bone density (densitometer) and pain intensity (Laitinen scale) were assessed. Treatment schedule: exposure time was 12 minutes for thoracic spine and 10 minutes for lumbosacral spine. In total, the patients underwent 40 procedures: at first they were treated once a day for 20 days (20 procedures) and then twice a week for 3 months. The procedures were repeated after 3 months (two series of treatment per year). **Results.** After 1 year of follow-up the patient's bone density was increased by 1.75%. **Conclusions.** 1. Good therapeutic effects in all patients treated with LFAMF confirm the usefulness of this method in osteoporosis prevention. 2. This method should be used in the prevention of bone loss more widely as it is effective, easy to use and has no adverse effects. (Gerontol Pol 2016, 24, 214-218)

**Key words:** physiotherapy, health prophylaxis

#### Streszczenie

**Wstęp.** Medycyna fizykalna jest najstarszą dziedziną wśród specjalności lekarskich, a stosowane metody wykorzystywane są zarówno w celach leczniczych, jak i profilaktycznych. Jedną z głównych chorób współczesnej cywilizacji jest osteoporoza. Analiza częstości występowania złamań osteoporotycznych w różnych krajach wskazuje na negatywny wpływ rozwoju cywilizacji na występowanie tej choroby. W Polsce osteoporozę stwierdza się u 25% kobiet i 15% mężczyzn po 50 roku życia. Leczenie osteoporozy, schorzenia mającego charakter przewlekły i postępujący jest długotrwałe i wielokierunkowe. Najistotniejsze jest więc wdrożenie metod mających charakter profilaktyczny, edukacja zdrowotna, właściwa aktywność ruchowa i stosowanie metod fizykalnych. **Cel pracy.** Ocena przydatności i skuteczności zmiennego pola magnetycznego niskiej częstotliwości (zpmncz) w profilaktyce utraty masy kostnej u chorych leczonych z powodu zespołów bólowych kręgosłupa. **Materiał i metody.** Badaną grupę stanowiło 50 mężczyzn (średnia wieku 66,5 lat) z przewlekłym zespołem bólowym kręgosłupa. Oceniono gęstość kości i nasilenie bólu w skali Laitinena. Wprowadzono w leczeniu zmienne pole magnetyczne n. częstotliwości. Metodyka wykonywania zabiegów – czas ekspozycji 12 minut na odcinek piersiowy, 10 minut na odcinek L-S, seria 20 zabiegów codziennie i 20 zabiegów 2x w tygodniu przez 3 miesiące. Zabiegi powtórzono po 3 miesiącach - 2 serie w ciągu roku. **Wyniki.** W grupie badanej po rocznej obserwacji stwierdzono zwiększenie gęstości tkanki kostnej o 1,75%. **Wnioski.** 1. Korzystne efekty terapeutyczne uzyskane u wszystkich leczonych zpmncz potwierdzają celowość stosowania tej metody w profilaktyce osteoporozy. 2. Wykazane działanie, łatwość wykonania zabiegów, brak objawów ubocznych przemawiają za szerszym wdrożeniem tej metody w profilaktyce utraty masy kostnej. (Gerontol Pol 2016, 24, 214-218)

**Słowa kluczowe:** medycyna fizykalna, profilaktyka zdrowia

## Introduction

Osteoporosis is one of the main diseases of our modern civilization. More than 25% of women and 10% of men over the age of 60 are diagnosed with osteoporosis. An analysis of the prevalence of osteoporotic fractures in various countries suggests that the development of civilization contributes to this problem [1-3].

Our lives are dominated by:

- low physical activity,
- inappropriate diet,
- too much animal fats,
- too much carbohydrates and salt,
- too little calcium,
- too little fresh fruit.

We have too much:

- alcohol, tobacco, coffee,
- stress,
- and too little exposure to sunlight.

In Poland, osteoporosis is found in 25% of women and 15% of men over the age of 50. In the fifth decade of life the spine starts to undergo involutional changes. At first, cortical bone loss does not exceed 0.3-0.5% per year. Annual lamellar bone loss reaches 0.6-2.4% in women and 1-2% in men.

Aging processes are always accompanied by the limitation of mobility and physical activity to a necessary minimum while the bones lose their natural stimulator of osteogenesis. Women develop age-related osteoporosis 2 times more often than men [4,5].

The use of new methods of measuring bone density (SPA, DEXA, QCT) and biochemical markers of bone turnover allows for early diagnosis and determining the degree of metabolic disturbances of the bone tissue as well as its density.

The treatment of osteoporosis, which is a chronic and progressive disorder, is long and multidimensional. Apart from pharmacological treatment, it is vital to introduce preventive measures:

- health education and elimination of risk factors,
- appropriate diet,
- appropriate physical activity,
- use of physical therapy,
- health resort treatment.

Health education is extremely important, especially in patients with risk factors for osteoporosis. It is often necessary to change one's lifestyle as well as dietary habits and introduce appropriate physical activity. Moreover, in the case of advanced osteoporosis the patient's environment has to be altered in order to reduce the risk of fractures [6-12].

The measures aimed at preventing osteoporosis should be introduced at an early age, that is in the period of the bone mass increase, so as to achieve a high peak value of bone mass at the age of 30-35 years. The higher the bone mass at the age of 30, the lower the risk of fractures due to physiological ageing in old age [11,12].

The education is best conducted during a stay at a health resort. Everyday contact with the doctor and the staff helps educate the patients, who can also attend talks given by doctors, rehabilitation specialists, and dietitians. In addition, this place allows the patients to exchange experience [4,6,9].

An appropriate diet is a basic element of osteoporosis prevention. It is crucial to convince the patient that it is necessary to follow the instructions concerning the diet, which should be rich in calcium and vitamins while containing limited amounts of protein, salt, and alcohol.

Apart from the diet, physical exercise is the other basic part of osteoporosis prevention and treatment.

During skeletal growth, proper loading of the skeleton influences the development of a large bone mass and strong high-quality bone while proper spinal loading can slow down the osteoporotic processes during the involutional period [13,14].

It is recommended to use exercise improving the range of motion in the joints, coordination, and general physical function and gradually introduce resistance exercises. The most important part of the treatment consists in the proper selection of exercises and loads, depending on the severity of osteoporosis, and adapting them to the patient's general physical performance [14,15].

The treatment and prevention of osteoporosis involve light therapy and phototherapy using UV light which stimulates the production of vitamin D<sub>3</sub> in the skin. It is recommended to use ultraviolet-B wavelengths ranging from 280 to 315 nm.

Sunlight is the best stimulator of vitamin D synthesis, but in our climate zone there is too little sunlight during the 5-7 colder months of the year. Consequently, in the autumn and winter it is advised to use even a simple quartz lamp as a preventive measure. Irradiation at a dose of 1 MED, which is then gradually increased by 1 MED every two days, is applied from a distance of 1 m.

A physical therapy method which directly stimulates the improvement of bone density is the use of low frequency alternating magnetic fields (LFAMF). Studies have confirmed that it accelerates bone union and facilitates the treatment of nonunion. Some publications report improved bone mineralization in osteoporotic patients.

In the case of osteoporosis, it is recommended to use triangular LFAMF (15 mT, 10 Hz) at the site of bone

defects for 12 minutes 3 times a day for more than ten weeks.

Low- and medium-frequency electrical currents can play a supportive role in reducing the pain and inflammation caused by osteoporosis, which allows the patient to follow the rehabilitation programme and take up physical exercise. Iontophoresis with calcium chloride is routinely recommended in local osteoporosis. The procedure involves the use of 1-2% calcium chloride (CaCl<sub>2</sub>) from the positive electrode [14,15].

Systemic cryotherapy is also recommended in osteoporotic patients. It has an analgesic and anti-inflammatory effect and relaxes the muscles. When combined with kinesiotherapy, it indirectly improves the range of mobility and increases muscle mass [14,15].

Recommended balneological procedures include therapeutic mud compresses on the spine and peripheral joints. Therapeutic mud components have a positive effect on the musculoskeletal system.

Kinesiotherapy procedures in brine pools allow for performing exercises with no loading; consequently, the patients are able to ambulate freely soon after musculoskeletal injuries or surgeries and can perform resistance exercises which strengthen the skeletal system and accelerate the metabolism of bone formation.

Therapy with natural potable mineral calcium, fluoride, and magnesium waters can be helpful in the treatment of osteoporosis as it constitutes an additional source of calcium. These waters include fluoride waters in Cieplice and Łądek Zdrój as well as hydrogen carbonate and magnesium waters in Krynica, Polanica, Szczawno, and Duszniki. Brine from Ciechocinek contains calcium and magnesium ions [14,15].

The aim of the study was to assess the therapeutic usefulness and efficacy of low frequency alternating magnetic fields (LFAMF) in bone loss prevention in patients with chronic spinal pain.

Biophysical mechanisms and biological effects of LFAMF

- influence on uncompensated magnetic spins of paramagnetic elements and free radicals as well as diamagnetic molecules,
- influence on liquid crystals, especially cell membrane elements with liquid crystal properties,
- displacement of moving electrical charges,
- inducing potentials in spaces filled with an electrolyte,
- influence on depolarization of cells with their own automatism,
- influence on structures with piezoelectric and magnetostrictive properties,

- intensifying the process of oxygen utilization and tissue respiration,
- vasodilatatory and angiogenic properties,
- increase in soft tissue regeneration processes,
- accelerated bone union,
- anti-inflammatory and anti-oedema effect,
- analgesic effect.

Benefits of magnetic therapy

- low level of stimuli – may be used in acute cases,
- magnetic field penetrates all body parts evenly,
- procedures may be conducted through: clothes, cast, bandages,
- metal implants and foreign bodies are not contraindications to LFAMF treatment (apart from electronic implants supporting organ function, such as cardiac pacemakers),
- effectively influences the connective (bone) tissue,
- no adverse effects with long-term application.

## Material and methods

The study group consisted of 50 men (mean age was 66.5) with chronic spinal and peripheral joint pain. This group of patients underwent 3-week physical therapy (diadynamic currents, laser therapy, massage) which did not improve their health status. Additional densitometry showed extensive osteopenic changes in the patients. The subjective health status of the patients was assessed with the Laitinen questionnaire. Low frequency alternating magnetic fields were introduced into the treatment.

Parameters of the magnetic field used and the methods of conducting the procedure:

- sinusoidal magnetic field (bipolar)
- frequency 50 Hz
- field strength 2.5 mT
- exposure time: 12 min. on the thoracic section + 10 min. on the L-S section
- series of 20 procedures daily (20 days) and 20 procedures 2 times a week (3 months)
- procedures were repeated after 3 months (2 series per year).

The data was analysed with elements of descriptive statistics, such as arithmetic mean and median as well as minimum and maximum values. Statistical significance of the results was assessed with Student's t-test. The significance level was set at  $p < 0.05$ .

**Table I. Densitometry results and Laitinen score at 1 year of follow-up**

	L2-L4 densitometry				Symptom severity according to Laitinen questionnaire	
	BMD g/cm <sup>2</sup>		T-Score		Before treatment	After treatment
	Before treatment	After treatment	Before treatment	After treatment		
Mean (SD)	1.069 ± 0.061	1.191 ± 0.068	-1.32 ± 0.27	-0.71 ± 0.23	5.9 ± 2.5	3.0 ± 1.5
p-value	< 0.001		< 0.001		< 0.001	

## Results

The procedures had a very beneficial influence on the results of subjective and objective assessment of the patient's health status.

The treatment eliminated or significantly reduced pain and resulted in an improved functional status. Follow-up densitometry performed at 1 year showed decreased progression of osteopenia with a clear trend towards higher bone mineral density. There was a very beneficial influence on the patient's subjective status as assessed with the Laitinen questionnaire. The results are presented in Table I.

## Discussion

Osteoporosis is characterised by a progressive loss of bone mass, weakening of the spatial bone structure and a higher risk of fractures. Elderly patients have lower bone mass and impaired microarchitecture of the osseous tissue, resulting in bone which is fragile and prone to fractures. Age-related limitation of physical activity leads to osteoporotic changes. Early stages of the disease are asymptomatic; patients suffer from pain in the spine and long bones caused by loading. The prevention and treatment of osteoporosis is aimed at preventing bone fractures, which is achieved through increasing bone mass, preventing bone loss and improving the internal structure of the bone tissue.

Patients at risk of osteoporosis should undergo preventive management. Moreover, factors contributing to osteoporosis should be minimised and supplementation should be implemented in case of calcium, vitamin D and protein deficiency. Physical activity should always be increased: the patients should be recommended to take up physical exercise in order to strengthen the muscles and bones responsible for postural stability. Elderly patients presenting to the Department of Rehabilitation with chronic spinal and peripheral joint pain should un-

dergo densitometry which will determine their bone mineral density and facilitate the diagnosis.

Treatment of such patients diagnosed with osteopenic changes includes physical therapy aimed at reducing pain, electrotherapy and light therapy, which stimulates the production of vitamin D<sub>3</sub> in the skin. We recommend ultraviolet-B wavelengths ranging from 280 to 315 nm. Bone growth is directly stimulated by the physical therapy method consisting in the use of low frequency alternating magnetic fields. Two 3-month treatments with alternating magnetic fields were used in our patients. The patients underwent follow-up densitometry at 1 year, which confirmed beneficial effects of the therapy; the progression of osteopenia was inhibited and bone mineral density increased. The subjective assessment of the patient's health significantly improved due to a radical reduction in pain. Patients should undergo focused kinesiotherapy including active non-weight bearing exercises, careful resistance exercises, closed chain exercises, postural muscle exercises, and education concerning normal posture. Physical therapy and rehabilitation should be more widely used in everyday practice of family doctors and geriatricians in the prevention and treatment of osteoporosis.

## Conclusions

1. Beneficial therapeutic effects achieved in all the patients treated with LFAMF confirm the efficacy of the method in the prevention of osteoporosis.
2. The analgesic effect of LFAMF, its ability to inhibit the process of bone tissue destruction, easily conducted procedures and no adverse effects suggest that this method should be widely used in osteoporosis prevention.

## Conflict of interest

None

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