Osteoporosis is recognized as a common skeletal disorder characterized by low bone mass and microarchitectural deterioration. Osteoporosis also affects maxillary bones where alveolar processes suffer resorption. Prosthetic rehabilitation supported by endoosseous implants is the only oral rehabilitation that preserves the residual alveolar ridge from atrophy. The objective of this study is to evaluate the effect of strontium ranelate on maxillary bone density for patients with osteoporosis candidates for implant therapy. The study included a number of 54 patients with osteoporosis, divided in two groups: group A where patients took 2 grams of strontium ranelate orally daily during one year and group B where osteoporotic patients did not receive strontium ranelate. Maxillary bone density was assessed for both groups at one year interval. The results show that strontium ranelate is associated with increased maxillary bone density.

**Keywords:** osteoporosis, bone density, strontium ranelate

Osteoporosis is recognized as a common skeletal disorder characterized by low bone mass and microarchitectural deterioration leading to higher fragility and consequently to an increased fracture risk [1] which affected more than 75 million people in the United States, Europe and Japan [2]. Osteoporosis also affects maxillary bones and both alveolar processes and periodontal tissues can undergo silent resorption which progresses without clear symptoms. Dental osteopenia (inadequate bone mass) is a condition associated with loss of teeth and poorly fitting dentures [3]. Maxillary osteoporosis leads to greater residual ridge resorption in denture wearers [4]. Studies show that osteoporotic patients have a greater risk of tooth loss [5] and osteoporosis is significantly associated with severe alveolar crestal bone loss and the prevalence of periodontitis cases in postmenopausal women [6]. However, it is not clear whether the quality and quantity of maxillary and mandibular bones decrease parallel with those of other bones or not [7], but more severe manifestation of edentulous jaw bone resorption is observed in patients with diminished bone mineral density [8]. In some patients there is a correlation between low bone mineral density and a decrease of mandibular bone mass and tooth loss [9], but this correlation could not be established with maxillary bone mass.

Diagnostic criteria for osteoporosis are based on the measurement of bone mineral density (BMD), but the BMD of the jaws was not correlated with femoral BMD or panoramic radiomorphometric indices [10]. Also there is no correlation between BMD and the areas of the jaws where dental implants may be placed [11].

Prosthetic rehabilitation supported by endoosseous implants is the only oral rehabilitation that preserves the residual alveolar ridge from atrophy, because implants conserve bones [12, 13] and hydroxyapatite coatings of implants seems to stimulate bone growth [14, 15]. Recent studies revealed no association between systemic BMD status, mandibular BMD status, bone quality, and implant loss [16]. The quality and quantity of jaw bones are local factors in decision-making for placement and success rate of implants and studies have shown that the risk of implant failure in areas with low bone density (type IV) increases compared to other bone types [17].

**Experimental part**

Current treatment of osteoporosis comprises lifestyle approaches and pharmacological interventions. Pharmacological options include bisphosphonate [18] and, in case of severe osteoporosis with high risk of fracture, strontium ranelate. Strontium ranelate increases deposition of new bone by osteoblasts and reduces resorption of bone by osteoclasts which is available in Europe from 2004 [19].

Strontium ranelate, with chemical formula distriontrium 5-[bis(2-oxido-2-oxoethyl)amino]-4-cyano-3-(2-oxido-2-oxoethyl)thiophene-2-carboxylate (fig. 1). Strontium ranelate comprises two atoms of stable strontium and one molecule of ranelic acid. Strontium ranelate dissociates at the gastrointestinal level. Strontium is a caption chemically and physiologically closely related to calcium. Ranelic acid is organic, highly polar molecule without pharmacological activity [20].

![Fig. 1. Chemical structure of strontium ranelate](image)

Strontium ranelate is a strontium salt of ranelic acid and and studies related with endoosseous implants show that strontium ranelate increases mechanical fixation of implant [21, 22].

The objective of this study is to evaluate the effect of strontium ranelate on maxillary bone density for patients with osteoporosis candidate for implant therapy.

The study included a number of 54 patients (age range 50-75 years) with osteoporosis candidate for dental implants. Diagnosis of osteoporosis was established by endocrinologist based on dual-energy X-ray absorptiometry.
Group A (33 women and 4 men) contains patients with severe osteoporosis (with BMD value below the -2.5 SDS of T-score). Group B includes 17 patients (women) with osteoporosis, but with BMD value over the -2.5 SDS of T-score.

Patients from group A took 2 grams of strontium ranelate orally daily during one year. Patients from group B did not receive strontium ranelate. All patients, group A and B, took calcium and vitamin D supplements before and during the study.

Maxillary bone density was assessed for both groups at one year interval.

In the bones of the skull, the degree of osteoporosis has been evaluated using single-photon absorptiometry, dual-photon absorptiometry (DPA), dual-energy X-ray absorptiometry (DEXA), quantitative computed tomography (qCT), digital subtraction radiography and clinical observations, but its importance regarding treatment remains unclear [23]. Computer tomography has many applications in dentistry [24, 25] and for subject candidate to dental implants is the best method to determine quantity and quality of remaining bone [26]. In this study maxillary bone density was assessed with special software SimPlant Master Crystal® (Materialize Dental, Belgium) after recording data from computer tomography.

Jaw bone quality was assessed based on Lekholm and Zarb [27] classification for edentulous sites, rating the distribution of cortical and cancellous bone (table 1).

**Results and discussions**

The result of maxillary bone density assessment before treatment with strontium ranelate is shown in table 2. The result of maxillary bone density assessment after one year treatment with strontium ranelate is shown in table 3.

34 patients from 37 (91.89%) shown increased maxillary bone density after one year treatment with 2 g of strontium ranelate in association with calcium and vitamin D supplement. Patients from group B, who took only calcium and vitamin D supplement, had no improvement of bone density. Bone type II and III is favorable for placement of endosseous implants.

The majority of patients had low bone maxillary density type IV and III. Bone type II and III was found at only 4 men present in this study. All women with osteoporosis have bone type IV. Research confirmed that bone type IV, with thin cortex and low-density trabeculae, is typical bone quality found in patients with osteoporosis [28].

An implant placed in poor-quality bone, like type IV has a higher chance of failure compared with the other types of bones. This type of bone is more frequently found in the posterior maxilla and studies report higher implant failure rates in this region [11]. Surveys have shown that implant therapy in the maxilla has a higher clinical failure rate than that in the mandible, and BMD may be partly responsible [29].

In current international flow of data, there are no records about the effect of strontium ranelate on maxillary bone density. Studies indicate that oral daily intake of 2 g of strontium ranelate increased BMD with 2.97% annually [30] and long-term treatment with strontium ranelate is associated with sustained increases in BMD over 10 years [31]. Also daily intake of 2 g of strontium ranelate reduces the risk of vertebral fracture in postmenopausal women [32] and has beneficial effect on knee osteoarthritis [33].

**Conclusions**

This study proves that low body mass density measured in osteoporosis is associated with low bone maxillary density (type IV).
One year treatment with strontium ranelate is associated with increased maxillary bone density in case of patients with severe osteoporosis. Calcium and vitamin D supplement intake without strontium ranelate had no improvement in maxillary bone density.

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References