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EVALUATION OF THE EFFICACY OF ALENDRONIC ACID IN DENTAL IMPLANTATION (literature review)

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Abstract

Normal functioning of bone tissue is ensured by a balance between the interrelated processes of bone resorption and bone formation, neogenesis. Bone remodelling depends on the balanced work of osteoclasts and osteoblasts, adequate mineralisation, and is controlled by many factors, both at the systemic level and locally, such as hormones, cytokines, and growth factors. Disturbance of bone tissue metabolism, predominance of the resorption process leads to the formation of osteopenia and osteoporosis, which is accompanied by the loss of support, protective and depositing functions of bone tissue

Key words: *alendronic acid, dental implantation.*

Normal functioning of bone tissue is especially important for rapid bone regeneration and osseointegration of dental implants, their effective functioning. Therefore, the question is often raised about the need for so-called pharmacological support of dental implantation, i.e. the use of drugs that provide accelerated bone tissue regeneration and osseointegration, improving bone quality, especially in patients with the presence of osteoporosis or its increased risk [2]. Experimental studies convincingly argue the legitimacy of using various regulators of bone metabolism to increase the efficiency of implantation. At the same time, clinical studies are rather scarce.

There are many pharmacological agents that provide inhibition of bone resorption (calcitonin, bisphosphonates), activate mineralisation (calcium salts), bone formation (fluorides), or have a polymodal effect on bone resorption and bone formation (vitamin D, ossein-hydroxyapatite complexes). Most of them are effectively used as part of osteoporosis pharmacotherapy and for prophylactic purposes [10]. The elements of the system "denture-implant- surrounding tissue" are: denture, implant, bone tissue and oral mucosa.

Bone atrophy is a process characterised by a decrease in the volume, size and total bone mass of a bone organ. Atrophy is caused not only by pathological conditions, but also by the natural processes of aging of the body.

Increased rate of atrophy is a pathology caused by exo- or endogenous factors that disturb the balance between resorption and osteogenesis in the process of bone structural remodelling. Endogenous factors of accelerated jaw atrophy (up to 0.4 mm per year) may be changes in hormonal background and metabolic disorders. Exogenous factors are: acute and chronic periodontal diseases, occlusal disorders and functional overload of the periodontium, adentia, irrational prosthetics, use of removable dentures [3].

Osteoporosis is a decrease in the amount of bone tissue in a unit of bone volume by 30^40% in relation to normal values of indicators [5]. Osteoporosis is more a response of the bone system to the impact of various exo- and endogenous factors than an independent disease [4]. There are two main forms of osteoporosis - systemic and local (regional) [6].

In systemic osteoporosis, changes are usually observed in the spine, radius and femur bones [10]. The development of the bony structures of the jaws is subordinated mainly to the functional load of mastication, so the main cause of osteoporosis is adentia [8].

Thus, a decrease in mechanical stress in bone tissue causes its atrophy and regional osteoporosis; an increase leads to a disruption of the physiological bone regeneration process, resulting in bone resorption.

From the biological point of view, several variants of implant engraftment in the bone are possible. In each case a different contact layer is formed between its surface and the bone, which can be formed by scar, fibrous, fibrocostal or new bone tissue. What is new in the morphogenesis of dental implantation is the discovery of the possibility to achieve bone-implant fusion by means of dense connective tissue or direct connection to the bone. The stages of bone wound healing after implant placement correspond to the general patterns of osseointegration of the jaw bone during fractures [5]. In the final stage (regeneration stage) the tissue that differs little from the initial one can be formed or connective tissue of a more dense structure can be formed. This process is most pronounced in bone, where bone resorption and remodelling occurs as a response to implant insertion and bone recession [12]. In the process of osseointegration, osteoblasts play a major role in bone formation [7]. Parallel to the surface of the titanium implant, matrices rich in phosphate and calcium ions, alkaline phosphatase and phospholipase enzymes are formed. Osteocytes are noted near and directly on the implant surface.

The question of the completion of osseointegration is a complex one, and precise and specific criteria have not yet been developed. Undoubtedly, the quality of bone at the implantation site has a very important role for the engraftment (osseointegration) of dental implants. Osteointegration is directly dependent on adequate bone metabolism, and the possibility of its pharmacological support can improve this process and reduce the risk of possible complications. Bone tissue provides extremely important physiological functions: it forms the skeleton of the body, protects vital organs, is a depot of mineral substances, primarily calcium and phosphorus.

The inorganic part of bone tissue is hydroxyapatite crystals - bicarbonates, fluorides and chlorides of magnesium, potassium, sodium; the organic non-cellular "compartment" of bone

consists of 90% of type I collagen and non-collagen proteins - proteoglycans, osteocalcin, osteonectin, bone sialoproteins, fibronectin, morphogenetic proteins (BMP) and so on.

Cellular components of bone are represented by osteoblasts, derivatives of pluripotent bone marrow stromal cells, which are then transformed into osteocytes, as well as cells of macrophage origin - osteoclasts.

The processes of bone resorption and subsequent bone formation are called remodelling. This process is clearly controlled both at the systemic and local level. Factors regulating remodelling are hormones, cytokines and growth factors, prostanoids, nitric oxide, reactive oxygen intermediates . The main stimulus inducing remodelling is considered to be mechanical stress, a change in the load on the bone, as a result of which osteocytes produce a number of biologically active substances initiating remodelling [8].

The process of bone resorption in the so-called "resorption lacuna" is associated with the production by osteoclasts of hydrogen ions (H+) that ensure demineralisation and proteases that dissolve protein matrix. H+ generation is carried out by cytoplasmic type II carboanhydrase localised near the caecal margin [Gay G., 2016], and their transmembrane transport is carried out by a special ATP-dependent proton pump [10].

The formation of new bone is the result of a whole chain of events including proliferation of primitive mesenchymal cells, their differentiation into osteoblasts, maturation of osteoblasts, formation of matrix by them, and its mineralisation. Proliferation and differentiation of osteoblasts and, subsequently, their synthetic and mineralising activity, are controlled autocrinally and paracrine by various factors, including TGF-ß, IGF-I, IGF-II, PDGF, OGF, FGF, bone morphogenetic proteins (BMP), which also belong to the TGF-ß superfamily. Currently, there are about

15 BMPs that are potent inducers of osteoblast maturation. There are specific receptors on osteoblasts for morphogenetic proteins (BMPR-1 and BMPR-1) [4].

The process of osseointegration during dental implantation requires adequate and functionally complete bone metabolism and bone remodelling [6]; therefore, implantation in so-called "compromised" patients is of particular interest to researchers [3]. Systemic disturbance of bone tissue metabolism, for example, in diabetes, impairs the process of osseointegration in both patients and animals with experimental diabetes [9]. Clinical and experimental observations show delayed osteointegration of dental implants in postmenopausal osteoporosis and in ovariectomised animals when corticosteroids are administered [2].

Conclusions: Thus, it should be noted that osseointegration of the implant is possible even in osteoporosis, but further functioning of the implant may be impaired.

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