

POSSIBILITIES FOR THE APPLICATION OF NANOMATERIALS IN VARIOUS AREAS OF DENTISTRY

Rolik-Attia S., Piminov O., Shevchenko V., Faizullin O.

National University of Pharmacy, Kharkiv, Ukraine

sweetrol@ukr.net

Today nanotechnologies are developing rapidly and find their application in many branches of modern medicine and pharmacy. Dentistry did not become an exception, where nanotechnology is used in areas such as local anesthesia, nanodiagnosics, for restoration of teeth with nanocomposite materials during caries and generalized abrasion, for elimination of increased sensitivity of enamel with nanomaterials, and preventive restoration of dental hard tissues in children and adults with initial caries (biomimetic regeneration), the use of nanoparticles for coating dental implants, nano-restoration bone cements, nano-imprints materials.

Nanotechnology is applicable to any field of dentistry: radiography, orthodontics, surgery and therapy. Due to the tiny size of the nanoparticles, they are able to easily penetrate and fill tissues and fight against pathogens. Today, at the same time, a lot of research is underway, considering various ways of using nanoparticles for various dental purposes. The most perspectives nanotechnologies that can be introduced into clinical practice in the near future are can be considered the following.

Durable restoration materials. Scientists are conducted experiments to improve the flexibility and strength of restoration materials by adding nanoparticles. So, in one work, they came to the conclusion that composite materials with the addition of quartz and silicon dioxide nanoparticles have greater flexibility and strength than conventional composites. Another investigation reported that hydroxyapatite particles have biological compatibility and can be used to enhance the properties of glass ionomer cements.

Dental prostheses for the prevention of infections. Nanoparticles of certain substances possess antimicrobial and antibacterial properties, exerting a depressing effect on the formation of bacterial films. In particular, it was suggested that silver nanoparticles could be used for the targeted transport of medicines. Besides, the addition of silver nanoparticles to the composition of the polymer for the dental prostheses base or a remedy for relocation and conditioning of tissues showed positive results in the treatment of stomatitis associated with wearing prostheses. In this regard, scientists came to the conclusion that the addition of silver nanoparticles to dentures has the effect of preventing infections of the mucous tissue.

Effective targeted drug delivery. Not only silver nanoparticles, but also gold were suitable for transporting medicines and combating the activity of pathogenic microorganisms. Gold particles have antimicrobial, antibacterial and antifungal properties. Nanoparticles are able to penetrate the mucosa and even its cellular composition, disrupting the membrane layer in small areas, thereby starting the process of regeneration and renewal. As a result, the resistance, durability of organs and structures of the oral cavity to inflammatory and destructive processes increases, and with the existing inflammation, the healing process accelerates. They can be used

in dentistry and medicine, for example, for treating wounds, applying a protective coating, applying adhesive bandages.

Chitosan nanoparticles are able to slowly release chlorhexidine over 4 hours, and polymer and chitosan nanoparticles release chlorhexidine within 4 weeks. Calcium fluoride nanoparticles can be used to transfer fluoride to tooth tissue. One study reported that calcium fluoride nanoparticles have enhanced chemical activity and solubility compared to larger particles. Therefore, calcium fluoride nanoparticles contribute to better absorption of fluorine with dentin hypersensitivity.

More informative diagnostic shots. Nanoparticles can be used not only for therapeutic purposes, but also to improve the quality of diagnostic images. Some types can be applied to the surface of the teeth to increase the contrast between them and the gums in an x-ray photographs. For example, in one work it was shown that applying gold nanoparticles to dental structures helps to visualize them in flat and three-dimensional images. Another investigation was reported that using iron oxide nanoparticles increases the contrast of images taken using with help of computed tomography.

High quality of implants. Nanoparticles are added to the protective coating for dental implants. This technique proves the prevention of formation bacterial films and contributes better integration of the implant and bone. Nanoparticles of silver, iron oxide and copper possess antibacterial properties and are suitable for the protective coating of implants. Gold nanoparticles, in addition, stimulate the division of osteoblasts, and in the future they can be used as part of preparations for bone tissue restoration.

Enamel restorative toothpastes. The most promising use of nanoparticles is associated with their ability to remineralize enamel. For example, nanoparticles of hydroxyapatite with quartz and nanoparticles of silicon dioxide contribute to the remineralization of the collagen matrix of dentin, after placing the sample in a solution of artificial saliva, they can recover the mineralization level of enamel to 20% of the initial phosphate level in enamel. Additionally, a combination of these nanoparticles reduces the rate of leaching of minerals; in the future, development can be used to create restorative toothpastes. A comparative in vitro experiments showed that a paste with hydroxyapatite nanoparticles more effectively restores the mineralization of enamel, compared with a paste with aminofluoride. Therefore, scientists came to the conclusion that hydroxyapatite nanoparticles promote enamel remineralization and reduces dentin hypersensitivity.

In this way, we can make conclude that nanostomatology is the beginning of a new era of treating patients without pain, almost perfect professional hygiene through the applying of various nanomaterials, nanorobots and biotechnologies, allowing to restore hard tooth tissues at the microscopic level. All this will make it possible to change approaches in the diagnostics and treatment of many dental diseases and will make the services of a dentist doctor more preventive than therapeutic and require interventions.