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Editorial

Bioactive Coatings in Dentistry—What Is the Future?

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Bioactive coatings are widely used and understood materials in engineering. The use of coatings modifying the properties of various elements to change their interactions with living matter can be found in agriculture [1], bioengineering [2], and medicine [3]. Bioactive coatings can prevent the adverse effects of microbes [1,4], create better conditions for cell culture [2], and support bone cell growth or angiogenesis (for example, in a transplant recipient).

The effect of such an action may be an increase in yields, creating new possibilities in the field of cell engineering [2], such as increasing the likelihood of receiving a transplant and reducing the likelihood of postoperative complications [1–6].

The human oral environment poses major challenges for clinicians and manufacturers of dental materials in terms of mechanical properties and biocompatibility. It is characterized by a wide range of temperature and pH variability, the presence of a large number of microorganisms, and the possibility of the interaction of various chemical substances contained in food and oral hygiene products [7]. An additional problem that should be considered is the need to maintain appropriate aesthetics—as in the case of prosthetic restorations and orthodontic appliances.

Due to such high environmental requirements, research on the surface properties of the materials used mainly in implant surgery or orthodontics has long been at the center of interest for many researchers and producers of these materials. This has resulted in many original studies and systematic reviews summarizing the achievements in this field [8–10].

An increasingly strengthening cooperation between researchers in the field of dentistry, materials engineering, bioengineering, chemistry, microbiology, immunology, and the dentists themselves continues to result in rapid developments in the field of improving the surface properties of various types of elements used in the oral cavity environment.

In dental surgery, research in the field of surface modification towards its bioactive effect is particularly strong. The change in the properties of the implant surface may take place as a result of physical, chemical, or biological processes [11].

Research on modification via chemical interactions was particularly intense in the second decade of the 20th century and many of the researchers have provided very promising results [12–14]. This research consisted mainly of the application of hydroxyapatite, magnesium compounds, silver, calcium phosphates, sol-gel coatings, fluorine, and anodic oxidation.

Changes made by physical methods can modify the structure on the micro and nano scale.

Modifications to the surface of implants smaller than 1 µm seem to be particularly promising, as they may have a positive effect on osseointegration and reduce the adhesion of bacterial biofilm. In order to achieve these effects, researchers are trying to use laser ablation and cover the surface of implants with nanocomposites [15–19]. Many of these experiments yield positive results in in vitro and animal studies, but in this area, there are still opportunities for research investigating both the direct mechanisms of these interactions and the applicability of some of these methods to humans.

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Biological methods include covering the implant surface with various factors regulating bone metabolism and possessing antibacterial properties. They have been the focus of researchers in recent years due to the very promising results related to the promotion of bone reconstruction and the strength of bone–implant bonding, as well as the acceleration of post-operative tissue healing. The most promising substances include sclerostin-antibody, collagen-binding promoting peptides, osteocyte adhesion promoting peptides, osteoblast and fibroblast growth factors, antibiotics, bisphosphonates, and statins [14].

In the field of orthodontics, research aimed at modifying the surface of orthodontic wires and brackets to increase their antibacterial and antifungal properties is particularly interesting. Promising results were presented after the use of long-chain polyethylene glycol, 1,3,5-triacryloylhexahydro-1,3,5-triazine, bioglass with niobium phosphate, methacryloyloxydodecylpyridinium, and polymethyl methacrylate resins. Research on the use of nanoparticles seems particularly promising. The best results were achieved with coatings containing titanium dioxide (TiO_2), gold (Au), silver (Ag), copper (Cu/CuO), silica (SiO_2) and zinc oxide (ZnO), or curcumin [10,20]. In the case of the covering elements of the fixed appliances, an additional difficulty is the necessity for maintaining an appropriate coefficient of friction for the modified surfaces and their resistance to sliding and bending. However, in this context, an additional benefit of using orthodontic wire coatings may be to increase their resistance. The influence of the oral cavity environment, which can, in the course of treatment, significantly change the mechanical properties of wires, especially nickel-titanium wires, is also a critical research topic [10,21].

An analysis of the achievements of recent years shows that further research is needed to develop methods for modifying the surface of the elements used in the oral cavity. Surfaces that are modified to achieve a bioactive effect enable better therapeutic results and minimize the risk of complications. Therefore, the cooperation between specialists in various branches of dentistry, medicine, and material science specialists is very promising.

This Special Issue aims to provide a forum for scientists to share current developments and promote further research into the behavior of bioactive coatings in the challenging oral environment. We invite you to publish original research conducted in-vivo, in-vitro, in-silico; theoretical calculations; systematic reviews; and meta-analyses.

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