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Editorial

Advanced Biomaterials, Coatings, and Techniques: Applications in Medicine and Dentistry

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The field of biomaterials is very extensive, encompassing both the materials themselves and the manufacturing methods, which are constantly developing. Biomaterials, natural or synthetic, alive or lifeless, due to their biological interactions, are frequently used in medical or oral applications to augment or replace a natural function [1].

A biomaterial for medical or oral applications has been defined as a natural or synthetic material that can be inserted into live tissues without developing an immune reaction [2]. As a consequence of the close proximity with human tissues, their use implies specific issues related to properties such as biocompatibility, bio-integration, antimicrobial action, corrosion resistance, and long-term performance. Based on biocompatibility, they are classified as bioactive, biotolerant, biodegradable, or bioinert [3].

The wide range of biomaterial applications in medicine and dentistry include both hard and soft tissue regeneration [4,5]. The basic characteristics of biomaterials for tissue engineering have constantly improved due to the advancements in the field, being characterized by corrosion resistance, non-toxicity and non-carcinogenic properties, bioactivity, and proper mechanical strength, depending on the surrounding tissue type [2,6].

Starting with medical devices or grafts, regenerative medicine has improved the field of tissue engineering, with the aid of biomaterials. Natural or synthetic biomaterial scaffolds have been developed to induce replacement of the missing tissue by means of generating specific regenerative cell responses, through bioactive molecules. Once placed into a specific tissue, the biomaterial surface initiates the interaction with the surrounding cells, inducing the charging of its surface energy and resulting in an adequate matrix for biomolecule adhesion [2,7–9].

Scaffolds promote cell growth and differentiation, resulting in tissue healing. Based on their type, scaffold biomaterials can be categorized in natural-based and synthetic-based polymers, ceramics, hydrogels, and bioactive glasses [9,10].

The latest generation of scaffolds can induce specific cellular responses: adhesion, differentiation, and proliferation. In order to improve tissue response and intensify the regenerative capability scaffolds were combined with growth factors and bioactive molecules. They are used to provide an extracellular matrix, an attachment site, or 3D support for regenerative cells, as well as a template for tissue regeneration [1,2,11].

Smart scaffolds, which incorporate bioactive molecules and nanoparticles, with tailored physical and chemical properties, aim to improve the interactions with cells by enhancing the osteogenic differentiation and generate a better response to the surrounding environment. Providing a proper microenvironment that ensures cell adhesion and differentiation is the ultimate goal [12–14].

Platelet-rich fibrin is a biomaterial scaffold with trapped platelets and leukocytes aimed to accelerate musculoskeletal tissue recovery by providing a binding site for platelets

and growth factors [15,16]. It promotes tissue regeneration and reduces healing time by increasing the local concentration of growth factors, and has been frequently used in combination with bone graft materials in maxillofacial and orthopaedic surgery and sports-related injuries [17–23]. It has excellent handling characteristics, and can be firmly sutured in an anatomically desired location during open surgery [24–26].

The additive manufacturing (3D printing) of biomaterials launched a new perspective for the field of biomedical engineering, considering its patient-specific clinical applications. Scaffolds are now being fabricated using 3D bioprinting methods and progress has been made in 3D printing of biocompatible materials, seed cells, and supporting components into functional living tissue [1,2,27].

Based on layer-by-layer precise positioning of biological constituents, biochemicals and living cells, this novel technology facilitates the printing of cells, tissues, and organs for regenerative medicine purposes, enabling the manufacturing of tissue-engineered constructs with tailored structures and properties [1,28–32].

Coatings play an important role in achieving the most crucial properties of biomaterials by surface modification, making them suitable for medical and oral applications. The application of coatings onto medical devices is quite vast, ranging from implantable to non-implantable medical devices, from orthopedic prostheses to dental implants, including hydroxyapatite (which enhances cell attachment onto orthopaedic implants), antimicrobial silver coatings on catheters, drug-eluting coatings on stents, and blood-compatible coatings (such as heparin). The protective medical coating of prosthetic device surfaces results in healing stimulation; meanwhile, porous bioactive coatings make implants far better suited to bone tissue interaction. The coating of scaffolds with stem or differentiated cells is a complex and novel method used in the field of regenerative medicine [2,33].

Among the different methods used to deposit coatings, plasma spraying, dipping, and spin coating are quite usual. Meanwhile, recently developed techniques such as laser, low-temperature atmospheric plasmas, and microblasting have been used for the deposition of bioactive coatings [34–36].

This Special Issue aims to provide a forum for researchers to share current research findings to promote further research and provide an updated outlook on the applications of biomaterials and coatings in medicine and dentistry, as well as presenting innovative manufacturing technologies.

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