

Biomaterials for dental implants: current and future trends

Donatella Duraccio¹ · Federico Mussano² · Maria Giulia Faga¹

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Abstract The urge to replace missing teeth dates back to the origin of medicine. Along history, organic materials, metals, alloys, polymers, glasses, and carbon were used to substitute teeth, but only in the past thirty years was a truly scientific approach implemented introducing the concept of osseointegration. This review aims at recapitulating the materials of choice, the surface modifications, and the most updated research advancements in the field of oral osseointegrated implants. As the accepted clinical standard, commercially pure Titanium, Ti–6Al–4V and, to a lesser extent, zirconium dioxide will be described from the perspective of physical, mechanical, and biological features, together with *in vitro*, *in vivo*, and clinical assessment of biocompatibility. Outlines of the researches that are presently conducted in an endeavor to limit the drawbacks of the current technology are also provided. Novel Titanium alloys such as Ti–Zr and Ti–20Nb–10Zr–5Ta, Zr61Ti2Cu25Al12, innovative production methods for non metallic materials as well as ceramic composites will be considered as possible promising candidates for future dental implants.

What is a dental implant?

Introduction

The goal of modern dentistry is to restore the patient to normal function, speech, health and esthetics, regardless to the atrophy, disease, or injury of the stomatognathic system. Replacing single missing teeth, especially in the anterior region, has always been a challenge for dentists. With increasing patient demands, removable partial dentures have become less acceptable and many patients now oppose the preparation of intact teeth for the fabrication of a fixed partial denture.

Among various dental materials and their successful applications, a dental implant is a good example of the integrated system of science and technology involved in multiple disciplines including surface chemistry and physics, biomechanics from macro-scale to nanoscale manufacturing technologies, and surface engineering.

Dental implant materials encompass a variety of materials with different degrees of interaction with the human body. Immediately after insertion of the implant, this contact provides primary stability through friction and mechanical interlocking between the implant thread surface and the bone trabeculae. During the following weeks, the peri-implant bone is remodeled and replaced by newly formed bone [1, 2]. The major part of the final bone-implant contact is thus based on newly formed bone that originates from the adjacent peri-implant bone and is laid down on the implant surface in an osteoconductive manner [3, 4].

In the past 30 years, the number of dental implant procedures has increased steadily worldwide, reaching about one million dental implantations per year. The clinical

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