

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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Biomaterials For Dental Implants Current And Future Trends

**Ajay Kumar, Namrata
Dogra, Sarita, Surbhi Bhatia, M S Sidhu**

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Nanostructured Biomaterials for Cranio-Maxillofacial and Oral Applications Júlio C. M. Souza, Dachamir Hotza, Bruno Henriques, Aldo R. Boccaccini, 2018-01-10 Nanostructured Biomaterials for Cranio maxillofacial and Oral Applications examines the combined impact of materials science biomedical and chemical engineering and biology to provide enhanced biomaterials for applications in maxillo facial rehabilitation and implantology With a strong focus on a variety of material classes it examines material processing and characterization techniques to decrease mechanical and biological failure in the human body After an introduction to the field the most commonly used materials for cranio facial applications including ceramics polymers and glass ceramics are presented The book then looks at nanostructured surfaces functionally graded biomaterials and the manufacturing of nanostructured materials via 3 D printing This book is a valuable resource for scientists researchers and clinicians wishing to broaden their knowledge in this important and developing field Explores the techniques used to apply nanotechnology to biomaterials for cranio maxillofacial and oral applications Bridges the gap between fundamental materials science and medicine Shows how nanostructured biomaterials respond when implanted in the human body

Biomaterial Mechanics Heather N. Hayenga, Helim Aranda-Espinoza, 2017-05-23 This book describes the fundamental knowledge of mechanics and its application to biomaterials An overview of computer modeling in biomaterials is offered and multiple fields where biomaterials are used are reviewed with emphasis to the importance of the mechanical properties of biomaterials The reader will obtain a better understanding of the current techniques to synthesize characterize and integrate biomaterials into the human body

Handbook of Intelligent and Sustainable Smart Dentistry Ajay Kumar, Namrata Dogra, Sarita, Surbhi Bhatia, M S Sidhu, 2024-08-05 With the exponential growth of science and technology the delivery of dental care has shifted from conventional methods to intelligent techniques In addition to adapting intelligent techniques sustainable dental practice is of the utmost importance Eco friendly dentistry sustainable dentistry or green dentistry are approaches that reduce the environmental impact of dental practice and help safeguard planetary and community well being This handbook provides the latest and most comprehensive evidence based guidance on intelligent and sustainable approaches in dentistry Handbook of Intelligent and Sustainable Smart Dentistry Nature and Bio Inspired Approaches Processes Materials and Manufacturing highlights how Dentistry 4 0 has come to the rescue after COVID 19 and how it has helped in providing needed e healthcare This handbook bridges the gap between research and development in the field of smart dentistry for professionals and clinicians Intelligent materials equipment instrumentation and the latest behavior management techniques and how these techniques provide superior care and treatment to society are explored in detail The scope of nature inspired techniques and procession along with green solutions are also discussed in this one of a kind handbook This valuable handbook is a single stop solution for practitioners researchers scholars students academicians and clinicians interested in updating their knowledge on intelligent and sustainable dentistry The handbook

will bestow the readers with not only theoretical knowledge but will equip them with clinical skills as well Translational Research in Biomedical Sciences: Recent Progress and Future Prospects Krupakar Parthasarathy,Radhakrishnan Manikkam,2024-08-29 The main objective of translational health science is to concentrate on discovering healthcare products for all people where care gaps exist This book examines the applications of translational research identifies its difficulties outlines its essential characteristics considers healthcare management strategies and examines the public s perspectives today This book assists aspiring implementation scientists in researching this area because the discipline is still relatively young for the wide range of researchers tackling the challenge of clinical and translational science a field dedicated to examining human health and disease interventions and outcomes to develop new treatment approaches devices and modalities to improve health This book Edition is the most authoritative and timely resource that introduces new physiological and therapeutic processes to engage the fastest growing scientific outcomes from academic and industrial research The chapters in this book give insights into perspectives on the field of clinical and translational science and discuss artificial intelligence in drug development and conventional and novel clinical trial designs There is a lot of hope that using artificial intelligence AI will significantly advance all facets of healthcare from diagnosis to therapy AI is prepared to assist medical staff with various duties including administrative workflow clinical documentation patient outreach and specialist support like image analysis medical device automation and patient monitoring Some of the most important uses of AI in healthcare will be covered in this book by eminent Scientists Academicians and Industrial persons from both clinical and non clinical fields **From Current to Future Trends in Pharmaceutical Technology** Natassa Pippa,Costas Demetzos,Maria Chountoulesi,2023-11-30 From Current to Future Trends in Pharmaceutical Technology explores the current trends of this field and creates a multi aspect framework for the reader The book covers topics on pharmaceuticals pharmaceutical engineering pre formulation protocols techniques innovative excipients bio printing techniques scale up based on formulas on a chip and regulatory aspects based on new scientific achievements Modified dosage forms new aspects on the compatibility of drug excipients interactions and drug release by various dosage forms are included Physical pharmacy physical and biological stability of dosage forms innovative excipients patents on innovative formulations and regulatory issues related to the approval process of medicines are also discussed The book is a valuable resource for a wide audience of academics industrial researchers and professionals working in this field as the development of efficient and safe medicines is critical to future needs Includes innovative excipients advanced materials in pharmaceuticals Covers modified release delivery platforms Explores new elements of drug development **Endosteal Dental Implants** Ralph V. McKinney,1991 **Restorative Dental Materials** Robert George Craig,John M. Powers,2002 This resource provides thorough up to date coverage of the latest dental materials and backs it with fundamental information needed to correctly use dental materials in the clinic and dental laboratory A problem solving approach is emphasized throughout this book especially when applying

new information to practical situations Additionally it incorporates case studies throughout to illustrate concepts in the chapters The scientific basis for technical procedures and manipulation of materials is provided and at the end of chapters students have the opportunity to work through selected problems and verify their solutions This edition features major revisions of core concepts such as cements esthetic materials and bonding as well as new chapters on preventive materials and impression materials Spanish version of 10th edition also available ISBN 84 8174 287 2

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