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# Biomimetics in dental applications.

The phrase biomimetic was coined by biomedical Engineer Otto Schmitt in the 1950's and refers to the study of multi disciplinary mechanism and biologically produced materials to design novel products to mimic nature. Biomemetric is derived from Latin word 'bio' meaning life, and 'mimetric' is related to the imitation biochemical process with inspiration from nature. Novel approaches have produced hierarchal structures by accumulating inorganic ion in a coordinated manner along with organic protien molecules analogous to biomineralization Therefore, the understanding of emerging biomimetics approaches has involved the conception of multiple ideas from biology, chemistry, materials science, and bioengineering. In addition numerous innovations of materials using nanoscale have accentuated a major push in the fabrication of biomimetic materials using nanotechnology - It is encouraging to witness the emergence of biomimetic courses in Educational sectors of robotic Engineering, inter disciplinary teaching, biomaterials, and industrial design for undergraduate as well as postgraduate students. In this regard, claymond discussed the concepts and real examples of biomimetic principles and tools for the development of new materials, new improved design and fabrication strategies and innovation methodologies used for students in a "biomimicry" course

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Biomimetic approaches were extensively explored across various disciplines including dentistry. Contemporary dentistry involves the minimal invasive dental management of defective or diseased tissue with bioinspired materials to achieve remineralization. The instrumental role of floride to control incidence and in prevention of dental caries has been widely reported in the literature for over a quater of a century. More recently, a variety of bioactive formulation such as micro and nano-hydroxyapatite, tricalcium phosphate, mineral trioxide caesin-phosphate have been advocate due to their excellent biocompatibility, biomimcry, bioactivity and remineralization potenials.

In clinical dentistry, biomimetics refers to the repair of affected ~~defin~~ dentition mimicking the characteristics of a natural tooth in terms of appearence, biomechnical and functional competences. For example, adhesive restorative materials have demonstrated tooth and esthetics mimicking natural tooth. Similarly biomimetic dental implant. Coating of calcium phosphate (CAP) and HA have been investigated to improve osseointegration of dental implants to achieve therapeutic benefits. In addition, tissue-engineering approaches have reported promising results in regeneration of oral tissues

Biomimetic endodontic regeneration includes the formation of dentin barrier by pulp capping agent, root formation during apexogenesis and apexification, apical healing by root-end fillings and pulp regeneration by cell homing strategies. The aim of the present article is to review various biomimetic approaches used to replace lost or damaged dental issues by means of restorative biomaterials and tissue-engineering technique. In addition tooth structure and various biomimetic properties of dental restorative materials and tissue engineering scaffold materials.

## Biomimetics in bone applications

The bone microenvironment is characterized by an intricate interplay between cellular and noncellular component which controls bone remodeling and repair. Its highly hierarchical architecture and dynamic composition provide a unique microenvironment as source of inspiration for the design of a wide variety of bone tissue engineering strategies. To overcome current limitation associated with gold standard for the treatment of bone fractures and defects, bioengineered bone micro-environment have the potential to orchestrate the process of bone regeneration in a self regulated manner.

However, successful approaches require a strategic combination of osteogenic, vasculogenic and immunomodulatory factors through a synergic coordination between bone cells, bone forming factors and biomaterials. There are various strategies range from simple to highly complex aiming to recreate the architecture and spatial organization of cell-cell, cell-matrix and cell-soluble factor interaction resembling the in vivo microenvironment. While several bone microenvironment-mimicking strategies with biophysical and biochemical cues have been proposed, approaches that exploit the ability of the cells to self-organize into microenvironments with a high regenerative capacity should become a top priority in the design of strategies towards bone regeneration. These miniaturized bone platforms may recapitulate key characteristics of the bone regenerative process and hold great promise to provide new treatment concepts for the next generation of bone implants.

The self healing capacity of bone can become significantly comprised in the case of eg. large bone defects, patient comorbidities, ageing and inflammatory disorders. These factors complicate the natural process of bone regeneration.

Consequently, osseous reconstructive surgery is often still a major clinical challenge for the treatment of severe fractures and / or large bone defects. Even the gold standard treatment i.e the use of autologous bone grafts has been associated with poor bone regeneration, infections, and limited availability. Aiming to circumvent the limitations of those conventional medical procedures bone tissue engineering (BTE) and cell based therapies have emerged as an alternative to engineer bone tissue for implantation. In fact, one of the most promising strategies entails mimicry of the human bone microenvironment under in vitro conditions to provide cells the structural, biochemical and/or instructive signals that positively influence bone tissue regeneration and healing after implantation. Presently, the ever-increasing knowledge of the physiology, architecture, composition, marco/microscopic properties mechanism of formation and repair of bone has inspired the design of a plethora of biomimetic bone microenvironment ranging from simplest to advanced approaches. The multifaced spatial organisation cell-cell, cell-matrix and cell soluble factor interactions resembling the vivo bone microenvironment has been recreated in a three-dimensional (3D) manner.