Biomaterials in Endodontics

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Introduction

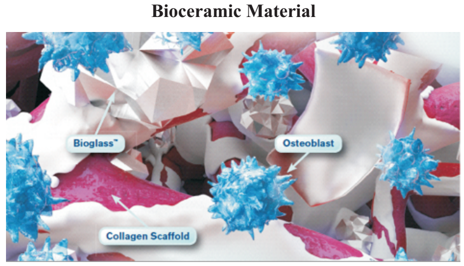
The potential use of dental biomaterials in endodontic therapy is an active area of research. Biocompatibility of hydroxyapatite is closely related to its chemical composition, similar to dental and bony tissues. However, inferior mechanical properties limit the use of hydroxyapatite as an endodontic material. Recent studies have focused on new and modified formulations of calcium-phosphate-based biomaterials with improved mechanical and maintained favourable biological properties (Huan & Chang 2009, Damas et al. 2011, Khashaba et al. 2011, Modareszadeh et al. 2012, Chen et al. 2013, Hakki et al. 2013. The class of ceramics used for repair and replacement of diseased and damaged parts of musculoskeletal systems are termed bioceramics. Bioceramics have become a diverse class of biomaterials presently including three basic types: bioinert high strength ceramics, bioactive ceramics which form direct chemical bonds with bone or even with soft tissue of a living organism; various bioresorbable ceramics that actively participate in the metabolic processes of an organism with the predictable results.

Evaluation

Studies have shown odontogenic molecules expression within the dental pulp repaired by Biomaterials. Double immunofiuorescent staining reveals colocalized with fibrous actin (phalloidine) in the dental pulp capped with endodontic biomaterials. Endodontic biomaterials have excellent cytocompatibility. Bioglass based biomaterials are interesting versatile class of materials and structurally all silica-based glasses have the same basic building block - SiO_4^{4-}. Glasses of various compositions can be obtained and they show very different properties. These bioglasses are embedded in a biomaterial support to form prosthetics for hard tissues.Evidence for the lack of toxicity of various bioglass formulations was deduced from studies carried out both in vivo and in vitro set up.Bioactive glass ceramic materials were the first to actively interact with tissues and induce their intrinsic repair and regenerative potential which involves control over the cell cycle, molecular frame work that controls cell proliferation and differentiation. Depending upon the rate of resorption and release of ions they can create chemical gradients with specific biological actions over cells and tissues. Glass ceramic biomaterials has a primary wallastonite crystal phase and a secondary apatite crystal phase. The glass ceramic has superior mechanical properties, good biocompatibility, bioactivity and no toxicity .The bioactive glass ceramic containing two main crystal phases, mica and apatite, developed by Hoeland et al., showed a calcium phosphate rich interface layer with apatite crystals grown on solid state reaction between glass ceramic and hard tissue. The interface reaction was interpreted as a chemical process, which includes a slight solubility of the glass ceramic and a solidstate reaction between the stable apatite crystals in the glass ceramic and the hard tissue. Hydroxyapatite is the most stable phase of various calcium phosphates. It is stable in body fluid and in dry or moist air upto 1200°C and does not decompose and has shown to be bioactive due to its resorbablebehaviour. Multiple techniques have been used for preparation of Hydroxyapatite based biomaterials.

The biomaterials are not only replacing missing or damaged tissues but also promoting regeneration. There are many areas of research that biomaterials and were used. They offer potential for tissue regeneration in dentin, periodontal ligament, dental pulp, and even enamel. In this issue, some researches related to MTA or Biodentine were accepted which have capability to stimulate tertiary dentin formation. However, as the cellular mechanisms behind successful tertiary dentin formation are largely unknown, few materials have been rationally designed to induce regeneration of root-like structures. Still a considerable amount of research is required for explanation of unravelling cellular mechanisms behind dentin formation by pulp-derived stem cells, and, by this way, some other researcher may apply this knowledge to design novel biomaterials aimed at stimulating dentin formation by pulp-derived stem cells.

Bioceramic Material



Bioglass and Hard tissue Interface

Conclusion

Biomaterials are now widely used in endodontics. It starts from biomaterials used as therapeutic to pulp capping agents, root end filling materials(to promote healing of cystic cavity) to syringe based system for sealing of the entire root canal system (bioceramic root canal sealer). They show promising result but still further research and follow up is required.

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