Biomimetic materials are the materials fabricated by Biomimetics techniques, i.e., based on natural processes found in biological systems. These materials are said to produce results that replicate the form, function, and other characteristics of natural teeth and oral tissues— in terms of biologic process, strength, physical characteristics etc. Biomimetics provides a new strategy that translates our knowledge of biological structures and functions and creates new synthetic pathways to mimic biological processes.

**KEYWORDS**

Biomimetic, Form, Function, Strength
The main component of the powder is a tricalcium silicate, with the addition to the powder of CaCO₃ and ZrO₂. The liquid is a solution of CaCl₂ with a water content of 2 g. As cement, the setting reaction leads to a gel structure, which allows possible ionic exchange. The reaction of the powder with the liquid leads to the setting and hardening of the cement. The hydration of the tricalcium silicate (3CaO·SiO₂) leads to the formation of a hydrated calcium silicate gel (CSH gel) and calcium hydroxide (Ca(OH)₂). The cement is placed in the inter- and peri-apical areas with a level of calcite (CaCO₃) content.

Compared to other Ca-based cements, this material presents two advantages: Faster setting time of about 12 minutes and higher mechanical properties.

**DIAROOTBIOAGGREGATE/I-ROOT BIOAGGREGATE:**
BioAggregate Root Canal Repair Material is a biocompatible pure white powder composed of ceramic nano-particles. Upon mixing powder with BioA Liquid, the hydrophilic BioAggregate powder promotes cementogenesis and forms a hermetic seal inside the root canal. Its effectiveness to clinically block off bacterial infection, ease of material manipulation and superior quality make BioAggregate the most innovative and unique root canal repair material.

**COMPOSITION:**
Powder: Tricalcium silicate, Dicalcium silicate, Tantulum pentoxide, Calcium phosphate monobasic, Amorphous silicon oxide

**Liquid:** Deionized water

DirootBioaggregate vs MTA

**PROPERTIES:**
1. MTA has a pH of 10.2 initially and a pH of 12.5, 3 hours after mixing. This may impart some antimicrobial properties.
2. The material has low solubility.
3. It has a radio-opacity slightly greater than that of dentin.
4. Biocompatibility: nonmutagenic, shown to be less cytotoxic than SuperEBA and IRM. In animal studies, MTA was the only material studied that allowed cementum overgrowth. In vitro studies of human osteoblasts showed that MTA stimulated cytokine release and interleukin production. These studies suggest that MTA is not just an inert material but may actively promote hard tissue formation.

**MINERAL TRIOXIDE AGGREGATE:**
MTA is a powder consisting of fine hydrophilic particles of tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide. It also contains small amounts of other mineral oxides, which modify its chemical and physical properties. Hydration of the powder results in a colloidal gel that solidifies in approximately three hours. Bismuth oxide powder has been added to make the aggregate radiopaque. Electron probe microanalysis of MTA powder showed that calcium and phosphorus are the main ions present.

**AMORPHOUS CALCIUM PHOSPHATE (ACP):**
It is the initial solid phase that precipitates from a highly supersaturated calcium phosphate solution, and can convert readily to stable crystalline phases such as octocalcium phosphate or apatitic products. Its morphological form, structural model and X-ray diffraction patterns are typical for noncrystalline substances with short-range periodic regularity. ACP has been demonstrated to have better in vivo osteoconductivity than hydroxyapatite (HAP), better biodegradability than tricalcium phosphate, good bioactivity but no cytotoxicity. These excellent biological properties make ACP widely used in dentistry, orthopaedics and medicine.

**BIOACTIVE GLASS:**
The material Bioactive glass was invented by American Professor Larry Hench during the Vietnam War. Tasked by the US Government to develop a material which could be used to repair large bone injuries suffered by Servicemen during the war, Professor Hench used silica (glass) as a carried or host material which could be combined with other ingredients such as calcium in a powdered form to pack between bone fragments to fuse shattered bones.

Bioactive glasses (BAGs), as opposed to most technical glasses, are characterized by the materials reactivity in water and in aqueous liquids. The bioactivity of BAGs is derived from their reactions with tissue fluids, resulting in the formation of a hydroxyapatite or calcium hydroxide layer on the glass.

**The Bioactive Glass formulas given by Clark et al. in 1996 were:**
A58: 58% SiO₂, 38% CaO, 4% P₂O₅
A68: 68% SiO₂, 28% CaO, 4% P₂O₅

**BONE REPLACEMENT GRAFT:**
Bone replacement grafts can promote tissue/bone regeneration through a variety of mechanisms. Some grafts actually contain cells that
lay down bone matrix, ultimately resulting in new bone formation. These grafts are referred to as having osteogenic properties. Other grafts release growth factors and other mediators that signal the host to produce native bone. These grafts are considered osteoinductive. Furthermore, other graft materials might simply act as a scaffold on which host bone might grow. This property is referred to as osteoconductive. In general, grafts can be categorized into autogenous, allograft, allotransplant, xenograft sources.\(^1\)

**PLATELET RICH PLASMA:**

The use of autologous products with high platelet concentrations such as Platelet rich plasma (PRP), Platelet concentrates (PC) and platelet gels developed to combine the fibrin sealant properties with growth factor effects of platelets- providing an ideal growth factor delivery system at the site of injury. The scientific rationale behind the use of these preparations lies in the fact that growth factors (GFs) are known to play a crucial role in hard and soft tissue repair mechanisms. These GFs exhibit chemotactic and mitogenic properties that promote and modulate cellular functions involved in tissue healing, regeneration and cell proliferation.

**PLATELET RICH FIBRIN:**

Platelet rich fibrin (PRF) was first developed in France by Choukroun et al in 2001. This second generation platelet concentrate eliminates the risk associated with the use of bovine thrombin.

The PRF protocol is very simple: A blood sample is taken without anticoagulant in 10-ml tube which is immediately centrifuged in a table centrifuge at 3000 rpm (approximately 400g) for 10 minutes.

**PROPERTIES OF PRF:**

1. The biochemical analysis of the PRF composition indicates that this biomaterial consists of an intimate assembly of cytokines, glycanic chains, structural glycoproteins emmeshed within a slowly polymerized fibrin network. These biochemical components have well known synergetic effects on healing processes.

2. PRF is not only a platelet concentrate but also an immune node able to stimulate defense mechanisms. It is likely that the significant inflammatory regulation noted on surgical sites treated with PRF is the outcome of retro control effects from cytokines trapped in the fibrin network and released during the remodeling of this initial matrix.

3. Role of fibrin matrix of PRF: Fibrin is the natural guide of angiogenesis. Fibrin constitutes a natural support to community, Fibrin and wound coverage: Fibrin matrix guides the coverage of injured tissues, affecting the metabolism of epithelial cells and fibroblasts.\(^1\)

**CONCLUSION:**

Biomimetic dentistry remains a very active area of research. By its nature, it is interdisciplinary, and it has tremendous potential for transforming everyday dental practice. “The future of biomimetics in dentistry is indeed very promising, but we are not there yet”\(^2\) Tay emphasizes. “Only tight collaborations between engineers, chemists, tissue engineers, material scientists, and biologists will make these ‘next-generation’ materials become a reality.”

**REFERENCES:**


