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Clinical Applications Of Chitosan In Dentistry- A Review
Chitosan In Dentistry

Rajendran Vikash[1], Suresh Mitthra[2], Ramachandran Tamilselvi[3], Paramasivam Vivekanandhan[4]

[1]B.D.S., First yr Postgraduate student Department of Conservative Dentistry and Endodontics, Sree Balaji Dental College and Hospital, Bharath Institute of Higher Education and Research, Narayanapuram, Pallikaranai, Chennai-600 100. Tamilnadu – 603 203 India.
[2]M.D.S, Reader Department of Conservative Dentistry and Endodontics, Sree Balaji Dental College and Hospital, Bharath Institute of Higher Education and Research, Narayanapuram, Pallikaranai, Chennai-600 100. Tamilnadu – 603 203 India.
[3]M.D.S, Reader Department of Conservative Dentistry and Endodontics, Sree Balaji Dental College and Hospital, Bharath Institute of Higher Education and Research, Narayanapuram, Pallikaranai, Chennai-600 100.Tamilnadu – 603 203 India.
[4]M.D.S, Professor Department of Conservative Dentistry and Endodontics, Sree Balaji Dental College and Hospital, Bharath Institute of Higher Education and Research, Narayanapuram, Pallikaranai, Chennai-600 100.Tamilnadu – 603 203 India

E mail id: [1]rvikash97@gmail.com, [2]malu.dr2008@yahoo.com, [3]drtamilchandran@yahoo.co.in, [4]endovivek@gmail.com

ABSTRACT: Chitosan, a multipurpose hydrophilic polysaccharide derived from chitin (derivative of glucose), has betterbiocompatibility, anti-inflammatory property and hasbroad antimicrobial spectrum (gram-negative, gram-positive bacteria as well as fungi).The unique properties of Chitosan have concerned scientists around the globe to explore it for bio-dental applications. Main aim of this review paper is to discuss the application of chitosan biomaterial in the field of dentistry.

Keywords: Chitosan, biopolymer, bio polysaccharide, chitin

1. INTRODUCTION

Chitosan, is a bio polymeric material obtained from the alkaline deacetylation of chitin it's comprised of N-acetylglucosamine and glucosamine copolymer units.[1] The copolymer obtained has excellent biocompatibility, selective permeability, polyelectrolyte action, antimicrobial activity, anti-inflammatory and wound healing properties.[2] These unique properties have led to newer opportunities in the field of bioengineering and tissue regeneration. Chitosan has been already used in the field of hard tissue and soft tissue repairs. All through this review our aim is to discuss potential applications of chitosan in dentistry, including the advantages and further prospects.

Chitosan Composition

Chitosan is the most abundant biopolymer and is structurally similar to glucose. Term chitosan usually signifies cationic copolymers consisting of 2-amino-2-deoxy-β-D-glucose

(60-100%) and 2-acetamino -2-deoxy-β-D-glucoside (0-50%), bound together by ß (1→4) bonds.[3-4] Chitosan is soluble in soluble in dilute acids but it's solubility depends on degree of deacetylation, molar mass, concentration of acid and biopolymer and ionic strength.[5] Chitosan has been used in several areas in the field of dentistry due to its properties such as biodegradability, biocompatibility, hydrophilicity, antibacterial properties, bioactivity, chelation ability and ability to form processed such as gel, pastes, film, membranes and solution.

Properties Of Chitosan Pertinent To Dentistry

Five important properties of chitosan relevant to field of dentistry are, anti-inflammatory, wound healing, bioactivity, haemostasis and hard tissue (bone) repair.

Anti-inflammatory

Inflammation is natural process of body expressed against physical, chemical and biological factors.Studies have revealed that chitosan and its derivatives are able to stimulus this process in many different ways. It is associated with the presence of N-acetyl-D-glucosamine, which stimulates inflammatory cells such as macrophages, PMN neutrophils and fibroblasts.[6]

Bioactivity

Relationship between chitosan and calcium-phosphate mineral hold out a high degree of bioactivity, which appears to be favoured by the functional and structural versatility of chitosan.[7]

Wound healing and hemostasis

Bleeding is the most common problem encountered after performing any invasive procedure. It is important to achieve proper haemostasis to promote wound healing. The most common method to control bleeding is to use hemostatic agent. Chitosan release -acetylglucosaminidase N, a product of hidrolitic and enzymatic degradation, increases the biosynthesis of hyaluronic acid and extra cellular components related with scarring formation. Chitosan aids in the release of increased number of collagen and osteopontin and a substantial infiltration of polymorphonuclear leucocytes (PMN). [8]

Hard Tissue Repair

Chitosan has been introduced in to the field of bioengineering and tissue regeneration due to its superior biocompatibility and biodegradable property. Many studies have revealed that chitosan scaffold triggers osteoblastic activity and could increase osteogenesis.[9]

APPLICATION OF CHITOSAN IN DENTISTRY

Oral Drug Delivery

Chitosan as nano-particles and resorbable film can be used to deliver antibiotics to periodontal tissues in situ [10], against fungal infections [11] and oral mucositis. These nanoparticles have higher surface area and reactivity to facilitate the drug release. [12,13] Chitosan nanoparticles possess bacteriostatic and bactericidal actions against a variety of oral microorganisms. They have low toxicity and superior biodegradability property. In dentistry, Chitosan has displayed effective plaque control by inhibiting specific dental plaque pathogens.[14,15]

Dentifrices

Dentifrices/toothpaste plays a major role in oral hygiene maintenance. Many dentifrice/ toothpaste with diverse formulation has been introduced and studied over the years. Formulation includes 5% KNO_3 [16–18] ,SnF_2[19,20]and nanohydroxyapatite, with the intention of complementing the action of sodium fluoride towards remineralisation and re-mineralization of enamel. Ganss et al. stated the commercially obtainable chitosan-based dentifrice (Chitodent® (B&F)), is a non-fluoride formulation, and highlighted a significant reduction of tissue loss. [21]

Guided Tissue Regeneration

Periodontitis is defined as a chronic inflammatory disease resulting in inflammation within the supporting tissues of the tooth leading to progressive destruction periodontal ligament and alveolar bone loss. [22] Clinicians and researchers showed immense interest in developing regenerative periodontal therapeutic strategies in the concept of guided tissue regeneration (GTR) or guided bone regeneration (GBR). This membrane acts as a physical barrier and allows cellular infiltration into the osseous defects, thereby encouraging osseous regeneration and providing spaces for fibrous tissue proliferation simultaneously.[23] Membrane should be bio-degradable, osseoconductive and biocompatible, chitosan poses all the characteristics mentioned above and acts as a favourable substrate material for periodontal tissue regeneration. Some investigators have worked on chitosan membranes coated with bioactive materials such as hydroxyapatite and tricalcium phosphate.

Regeneration of Enamel

Enamel is the hardest tissue in the human body devoid of vascular supply hence the regeneration or repair of enamel is challenging process.Chitosan-based restorative formulations have been explored over the years and are under consideration for accomplishing human enamel regeneration through successful delivery of organic amelogenin at the site of enamel defects. Ruan et al evaluated chitosan-based hydrogel as a delivery medium for amelogenin for repairing or regenerating the enamel defects[24] that also prevented the occurrence of secondary caries.

Coating for Dental Implants

Success of dental implant depends on the osseointegration and deposition of alveolar bone around the implant surface. To improve the osseointegration property of the dental implant chitosan coating has been used recently.[25] The chitosan coating may affect the implant surface and bone interface by altering biological, mechanical and morphological properties. Chitosan coatings are used to deliver several medicaments such as antibiotics, locally around the implant surface area.

Collagen stabilization

Chitosan used for pretreatment of the etched enamel and dentin has shown to enhance collagen stabilization and thereby provide increase bond strength while restoring with composite resin restorations. Dentin collagen pretreated with chitosan resists degradation, by the formation of ionic complexes between carboxymethyl-chitosan (CMCS) and collagen mediated by intermolecular interactions between positive and negative units. [26]

2. CONCLUSION

Dental application of chitosan as a biomaterial ranges from restorative material to tissue regeneration. Though it as few limitation further studies has to be done to explore the uses of chitosan in the field of dentistry.

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