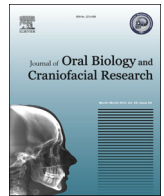




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Nanoparticles used in dentistry: A review

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ABSTRACT

Nanotechnology is widely used in our day to day life including its use in medicine. Using nanotechnology, it is easy to analyze and manipulate atoms, chemical bonds and molecules present between various compounds. Nanotechnology is used in the dental field as nano dentistry. While choosing the nanoparticle for the use in the field of nano dentistry its chemical, physical, along with the biological aspect of nanostructures are taken into account. Often various atoms or molecules are added to form the functional structure. Nanostructures are used in innovations or diagnosis of dentistry. Some nanoparticles are used for oral disease preventive drugs, prostheses and for teeth implantation. Nanomaterials further deliver oral fluid or drugs, preventing and curing some oral disease (oral cancer) and maintain oral health care up to a high extent. This review summarises the use of various widely used nanoparticle in the field of dentistry.

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1. Introduction

Teeth are present within the oral cavity and include various parts like dentin, enamel, cementum, pulp, and periodontal ligament. The function of teeth is to cut and crush the food to make it easy for swallowing and digesting.¹ Besides that tooth enhances self-confidence and improve the quality of life. Thus the

loss of teeth due to disease or decay affect eating pattern, speaking, or laughing to certain extent.² Thus a lot of effort has given to protect the teeth in the field of dentistry.

Various compounds are used in the field of dentistry to protect the teeth (Fig. 1). For filling of teeth amalgam having good mechanical properties is used. The amalgam composite is used to seal crowns and bridges.³ The sealing was permanently hardened by a polymerization lamp inserted into the oral cavity. Glass ionomers are used for temporary filling of deciduous teeth. It gives well tolerance capacity and permanently seals crowns and

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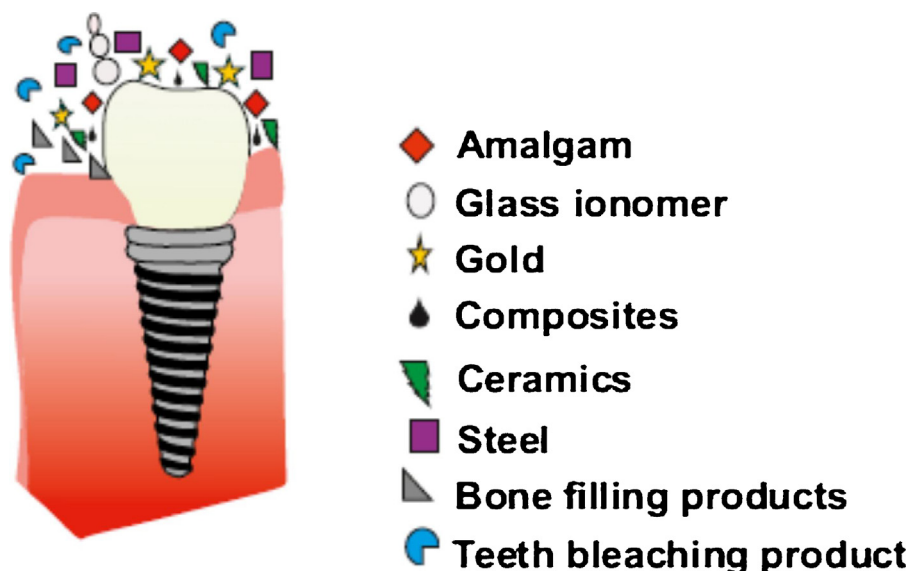


Fig. 1. Conventional materials used in dentistry.

bridges.⁴ For prosthesis, gold is an ideal material as it is harmless, precision, and rigid.⁵ Ceramics are used in fixed prosthetics (crowns and bridges).⁶ Steel is used for framework and clasps in removable prosthetics.⁷ For bleaching the yellow coloured tooth, “carbamide peroxide” gels⁸ and hydrogen peroxide derivatives⁹ are used. Hg replaces heterogeneous and homogeneous transplants. Although these methods are used in the field of dentistry, they have some disadvantages too (Table 1). For example, the main flaw of amalgam is that it contains mercury which is harmful to our body.¹⁰ Composite fillings are hypersensitive¹¹ towards cold. Ceramics can sometimes fracture and extremely hard in nature.¹² Taking these disadvantages into account nanoparticles are introduced in dentistry.

Nanotechnology¹³, a technology which deals objects of nanometer size and the particles are called as nanoparticles

(NPs). Silver is the frequently used NPs, used in various products in different form,¹⁴ which is followed by carbon and ion oxides (TiO₂).¹⁵ The nanoparticle can improve the quality of the products by adding many functional groups to it.¹⁶ Thus nano products are widely used in various industrial sectors,¹⁵ medicine and in the field of dentistry.¹⁷

Hybrid bionanomaterials are used to build electronic and memory devices.¹⁸ The dental implant formed of biocompatible materials like hydroxyapatite and titanium embedded into the alveolar bone along with an artificial tooth is available for implantation.¹⁹ This implant, mainly, forms a periodontium and that varies from the structure of the original tissue. It may cause dental ankyloses when alveolar bone directly contacts the dental implant.²⁰ Nanoporous anodic alumina (NAA), porous silicon (pSi) and Titania nanotubes (TNTs) are used for development of drug-

Table 1
Advantages and disadvantages of conventional materials used in dentistry.

Conventional Materials	Advantages	Disadvantages
Amalgam	Durable, provide great resistance to surface corrosion, easy to manipulate, needs less time to get placed than other materials; prevention of bacterial leakage, lasts long when placed under controlled conditions, money saving.	Disruption of the tooth tissue, reduced aesthetic qualities, local allergic responses may occur, mercury which is component may have toxic effects.
Nickel or cobalt chrome alloys	Good resistance to further decay, long term effectivity, shows no fracture issues in stress conditions, does not decay in the mouth, and needs removal of the minimum tooth, resistance against leakage.	Dark silver metal colored, may irritate sensitivity tooth as it conducts heat and cold, costly.
Glass Ionomer	Provide aesthetic beauty, prevents decay by fluoride release, needs removal of the minimum tooth, low tooth sensitivity.	Usage is limited, the material becomes rough as time goes and can increase the accumulation of plaque resulting in periodontal disease. It is colored yellow, may result in tooth sensitivity, high cost.
Gold alloy	Good resistance to decay, durable, shows no fracture in stress, resists leakage because of good fitting, needs removal of the minimum tooth.	
Ceramics	Provide excellent resistance to further decay, resistant to surface wear, resistant to leakage, very minimal or no tooth sensitivity.	The weak material, which can break under biting forces, not suggested for molar teeth, costly material.
Ceramics fused to metals	Resistance to decay, very durable, no sensitivity of tooth, resists leakage.	More tooth needs to be removed than ceramics, higher cost.
Resin ionomer	Very good aesthetics, act against decay by releasing fluoride, needs removal of the minimum tooth, well usable for non-biting surfaces, can be used for the primary restoration of teeth, better than glass ionomers, provide resistance against leakage, low rate of dental sensitivity.	Cost is similar to the composite resin, limited use wears faster than composite and amalgam.
Composite resin	Strong and durable, tooth colored, break free, preservation of maximum tooth, the low hazard of leakage, do not undergo decay and provide good resistance to the biting forces.	Moderate tooth sensitivity occurs, more costly, shrinks when it hardened which could lead to temperature sensitivity, may leak over time.

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