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Review Article

Review of Nanotechnology in dentistry

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ABSTRACT:
Nanotechnology creates functional structures by controlling atoms and molecules on a one-by-one basis. This concept will allow many developments in the medical sciences as well as in materials science, bio-technology, electronic and computer technology, aviation, and space exploration. This article evaluates the current status and the possible clinical applications of nanotechnology in dentistry.
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INTRODUCTION

Prof Keric E Dexler, an specialist in the field of nanotechnology, coined the term nanotechnology. It is considered as manipulation of matter on the molecular and atomic levels. The word nano initiated from the Greek word "dwarf"[1,2]. The concept of nanotechnology was first introduced in 1959 by Richard Feynman, a Nobel Prize winning physicist, in a lecture titled, "There's plenty of room at the bottom". He concluded that "this is a development which I think cannot be avoided"[3]. Nanotechnology refers to the science that manipulates matter at molecular and atomic levels, and studies matter at the nanoscale level to detect and exploit the useful properties that derive from these dimensions; materials with components less than 100 nm in at least one dimension are called nanomaterials. Nanomaterial properties vary from other materials owing to two reasons: the increase in surface area and quantum effects[2]. The purpose of this article is to review application of nanotechnology in dentistry in the present scenario, as well as in the time to come.

APPLICATION OF NANOTECHNOLOGY IN DENTISTRY

1. HYPERSENSITIVITY CURE

Dentin hypersensitivity is major problem where nanorobots may bring into play. Nanorobots with combination of local organic materials result in effective occlusion of particular tubules cause quick and steady treatment[3].

2. NANOROBOTIC DENTIFRICE

The nanorobots present in the toothpastes or mouthwashes which monitors all gingival surfaces regularly. They would also break down harmful materials into harmless substances and undertake constant calculus removal.

3. TOOTH REPOSITIONING

Nanorobots involved in orthodontic treatment. All the periodontal tissues like gingiva, periodontal ligament, cementum and alveolar bone are influenced by orthodontic nanorobots which lead to speedy and painless orthodontic movements[4].

4. ORTHODONTIC WIRES

In order to minimize the frictional forces between the orthodontic wire and brackets has the potential to increase the desired tooth movement and therefore result in reduced treatment time. Redlich *et al*[5] coated stainless steel wire with nickel– phosphorous electroless film impregnated with inorganic fullerene-like nanoparticles of tungsten disulfide (IF-WS2) by inserting stainless steel (SS) wires into electroless solutions of nickel–phosphorus (Ni–P) and IF-

WS2.Friction tests replicate arch wire functioning of the coated and uncoated wires were approved out by an Instron machine and SEM/EDS analysis of the coated wires showed that clear impregnation of the IF-WS2 nanoparticles in the Ni–P matrix. The friction forces was measured on the coated wire and reduced to 54%[5].

5. NANOPARTICLE DELIVERY FROM ELASTOMERIC LIGATURE

Elastomeric ligatures can provide as a carrier scaffold for delivery of nanoparticles The properties are anti cariogenic, anti inflammatory and antibiotic drug molecules embedded in the elastomeric matrix. The release of anti cariogenic fluoride from elastomeric ligatures has been reported in the literature previously[6-8].

6. NANO LIPUS DEVICES

Low–intensity pulsed US (LIPUS) has been accounted to be effective in liberating preformed fibroblast growth factors from a macrophage-like cell line (U937), and it improve angiogenesis during wound healing . Also, LIPUS has been reported to improve bone growth into titanium porous–coated implants and bone healing after fracture and after distraction osteogenesis[9]

7. IMPRESSION MATERIAL

Conventional vinyl polysiloxanes have included with nanofillers, which create a distinctive material with better flow, enhanced hydrophilic properties and superior detail precision[10].

8. NANO-COMPOSITE DENTURE TEETH

In order to overcome disadvantage of denture teeth,porcelain is highly wear resistant, although it is breakable, not have bonding ability to the denture base, and is not simple to polish. Other side,Acrylic undergo undue wear. Nanocomposite denture teeth are made of polymethylmethacrylate (pmma) and homogeneously distributed nanofillers. Main benefit are excellent polishing ability and stain-resistant, excellent esthetics and improved wear resistance and surface hardness[11].

9. OSSEOUS GROWTH

Newer material called calcium sulphate based composite has been expanded by Dr Ricci, Bone Gen –TR. The conventional calcium sulphate has been used to stop small osseous defects like in post extraction sockets and periodontal bone defects and bone graft material. It breaks down more gradually and regenerates bone efficiently[12].

10. LASER PLASMA APPLICATION

The application of nanosizedtitania particle emulsion on human skin go after by laser irradiation, direct to the disintegration of the particles along with other results like shock waves, microabrasion of hard tissues and it stimulus to construct collagen[11]

11. NANO LIGHT-CURING GLASS IONOMER RESTORATIVE

Nanotechnology at first developed for Filtek ™ Supreme Universal Restorative with fluoralumino silicate technology[11].Other advantages are excellent polish,esthetics and improved wear resistance. The clinical implication are primary teeth restoration,transitional restoration,small Class I restoration ,sandwich restoration,class III and V restoration and core build-up.

12. NANO STERILIZING SOLUTION

Gandly Enterprises Inc Florida ,A concept of new sterilizing solution following nanoemulsion has been developed .Nanosized oil droplets attack and destroy the pathogens[13]. E.g.: Eco Tru Disinfectant. Main advantages are broad spectrum,hypoallergic,noncoroding,does not stain fabric,require no protective clothing,environment friendly and compatible with various impression materials.

13. LOCAL ANESTHESIA

The use of nanorod has been reported in efficiently delivering LA and achieving continuous release of LA. Changyou et al they reported a phototriggerable formulation capable of repeated and on demand anaesthesia with reduced toxicity in vivo. Briefly gold nanorods (GNRs) that are capable of converting near-infrared (NIR) light into heat were coupled to liposomes (Lip-GNRs) enabling light-triggered phase transition of their lipid bilayers with a resultant release of payload. The irradiation with an 808 nm continuous wave NIR laser produced on-demand and constant infiltration anaesthesia in the rat footpad in proportion to the irradiance, with reduced toxicity[14].

CONCLUSION

Different biomaterials (nanoparticles, liposomes, nanospheres, nanocapsules, nanorod, cyclodextrins and hydrogels) have successfully been developed through the knowledge of nanotechnology.The future employment of the advantages of nanotechnology will aid in improvements of oral health.

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