

Nanovative Dentistry: A Review of Literature

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ABSTRACT

Dentistry is providing reliable and comfortable therapeutic options for the patients. Recently nanotechnology has emerged as a new science exploiting specific phenomena and direct manipulation of materials on the nano-scale. This paper highlights the role of nanotechnology as an innovation in dentistry.

KEYWORDS: Nanotechnology, Nanorobotics.

INTRODUCTION

The word nano originates from the Greek word "dwarf". The nanotechnology was first elaborated in 1959 by Richard Feynman, a Nobel Prize winning physicist, in a lecture titled, "There's plenty of room at the bottom". He concluded the lecture "this is a development which that think cannot be avoided", and dentistry is facing revolutions in order to provide most reliable options for the patients.¹ Currently nanotechnology has emerged as a new science presenting specific phenomena and direct manipulation of objects and materials on the nanoscale. Since then, nanotechnology has found use in the applications including diagnosis, dental material and therapeutics.²

Prof Keric Eric Dexler, coined the term nanotechnology. It is the manipulation of matter on the molecular and atomic levels.^{3,4}

NANO DENTISTRY

Two types of approaches

BOTTOM-UP APPROACHES⁵

Assembly of small components into compound structures.

TOP-DOWN APPROACHES⁶

Creation of small structures by using bigger ones in guiding their assembly.

DENTAL NANOROBOTICS

Bottom-Up Approach

Local Nanoanaesthesia.

A colloidal suspension containing millions of anesthetic dental nanorobots would be used to induce local anesthesia. Deposited on the gingival tissue, on reaching the pulp, the analgesic robots may close down all sensation in the tooth. This technique is advantageous as it reduces apprehension.^{1,6}

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Hypersensitivity Cure

Nanorobots, using organic materials, could result in effective occlusion of particular tubules, resulting in rapid and stable treatment.^{1,6}

Tooth Repositioning

All the periodontal tissues, namely the gingiva, periodontal ligament, cementum and alveolar bone, may be directed by orthodontic nanorobots leading to swift and pain free corrective movements.⁷

Nanorobotic Dentifrice (Dentifrobots)

Toothpastes or mouthwashes could contain the robots which would then survey all gingival surfaces regularly. They break down harmful materials into harmless substances and undertake constant calculus removal.^{1,7}

Dental Durability And Cosmetics

Changing the superficial enamel layer with materials like sapphire or diamond may enhance the toughness and appearance of teeth as these materials have 20-100 times the hardness of enamel. However, diamond and sapphire are brittle, but can be made tougher by their inclusion as part of a nanostructured composite.^{8,9}

Nanodiagnostics (Photosensitizers & carriers)

Quantum dots may also play the role of a photosensitizer and carrier. They attach the antibody to the target cell and on stimulation by UV light, result in the formation of reactive oxygen species which destroy the target cells. another role of nanotechnology may lie in overcoming some drawbacks of biochip technology.¹⁰

Therapeutic aid in oral diseases

- Nanotherapeutics / Drug delivery
- Gene Therapy
- Diagnosis of oral cancer¹¹
- Treatment of oral cancer¹²

DENTAL NANOMATERIALS**Top-Down Approach*****Nanocomposites***

These filler particles are very minute, higher proportions can be achieved, and result indistinctive physical, mechanical, and optical properties.¹³ Beun et al compared the physical properties of nanofilled, universal hybrid and microfilled composites, and observed a higher elastic modulus with the nanofilled composites than most of the hybrids tested.¹⁴

Nanosolution (Nanoadhesives)

Nanosolutions are constituted by dispersible nanoparticles, which lead to homogenous and perfectly mixed adhesive consistently.¹⁵

Nano Light-curing glass ionomer restorative

This blends Nanotechnology initially developed for FiltekTM Supreme Universal Restorative with fluoralumino silicate technology.⁷

Impression materials

Incorporated of nanofillers may produce a distinctive material with improved flow, enhanced hydrophilic properties and superior detail precision.¹⁵

Nano-composite denture teeth

Conventional denture teeth have their own inherent disadvantage. Porcelain is brittle, lacks bonding ability to the denture base, and is not easy to polish. Acrylic on the other hand undergoes undue wear. Nanocomposite denture teeth are made of Polymethylmethacrylate (PMMA) and homogeneously distributed nanofillers.^{12,15}

Dentifrices

These are mainly made up of nanosized hydroxyapatite molecules. They will result in protective shell on tooth surface and may even repair damaged areas. Micro brite dentifrice has microhydrin (1-5 nanometers) which breaks down the organic food particles.¹⁶

Orthodontic Wires

Orthodontic wires may be drawn from a novel stainless steel material along with excellent deformability, corrosion resistance and fine surface finish.

REGENERATIVE NANOTECHNOLOGY

Bio-Mimicry

Dentition Renaturalization

This technique may revolutionaries' cosmetic dentistry. Initially, old amalgams restorations may be removed and the teeth remodelled with natural materials.¹⁷

Dentition replacement therapy (Major tooth repair)

Nanotechnology may utilize genetic engineering, tissue engineering and tissue regeneration initially, followed by growing whole new teeth in vitro and their installation. Eventually, production and installation of an autologous tooth may become possible in a single office visit.¹⁸

CONCLUSION

Great changes come out with great challenges. Nanotechnology will bring enormous changes into the fields of dentistry. However, as with all developments, it may also pose a risk for misuse and abuse. Time, newer developments, economical and technical resources, and human needs will determine which of the applications are realized first.

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