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RESEARCH ARTICLE

Nano Dentistry

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ABSTRACT

Speed advancements are being made in the field of nanotechnology from its theoretical foundations into real-world practice. There are now many available products demonstrating that the technology is applicable, and its capacity for further application is promising. Dentistry, along with the scientific world is facing a major revolution in terms of ongoing technological developments and has already been targeted directly with nano-related advances in modern practice. This article reviews some applications of nanotechnology as well as future applications in this field.

Keywords: Dentistry, Nano Dentistry, Nanomedicine, Review.

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1. Introduction

"Nano" is stem from a Greek word for dwarf. Nanotechnology is the development of materials, and devices that start showing different physical, chemical, and biological characteristics compared to those of a larger scale [1]. NanBioScience has attracted lots of interest in today's science. Nanotechnology has many applications in dentistry which is so-called "nano dentistry". These include nano local anesthesia, restorative-like nanocomposites, nanoceramics, nano glass ionomers, and nanometals [2]. Nanotechnology has provided solutions to several dentistry problems. Traditional dental materials have some challenges, which adversely affect the success of dental treatment and might lead to treatment failure.

2. The Benefit of Nanomaterials in Dentistry

Nanotechnology helps improve newer materials with better properties. Using some types of equipment to create mechanical nanoscale nanoproducts, atomic elements can be built up to make nano products. To elaborate, the quality of different fibers can be improved using nanotechnology developing fibers with diameters in the nanometer range. These novel fibers demonstrate a larger surface area per unit mass which in turn allows more convenient addition of surface functionalities compared to the conventional polymer microfibers. In this regard, it has been proposed that polymer nanofiber can work as scaffolds for filters, tissue engineering, and drug delivery systems. Nanometer dimensions Carbon fibers have selectively revealed an increase in osteoblast adhesion. This is necessary for successful orthopedic and dental implants since a higher degree of nanometer surface roughness can be provided [3]–[5].

3. Oral Health

Several nano enzymes have been designed to treat oral ulcers, caries, and periodontitis. These enzymes have anti-inflammatory, antibacterial, and immunomodulatory capabilities and can be used in oral health [6] in this regard it has been proposed that dental caries, periodontal diseases, oral infections or malignancies can be treated with the use of targeting directly to the diseased area Local therapy rather than systemic drug administration, while minimizing systemic side effects [2], [3]. However, inadequately are still concerns about their stability and high costs, and less relaxed storage conditions. These issues will be solved soon and with growing evidence, we predict that these nano enzymes will be widely used in oral health [6]–[8].

Also, developing nano materials used as anti-caries, especially nano-adhesive and nano-composite resins have been improved during the past years. Also, Inorganic

nanoparticles (NPs) have been proposed as a novel material in dental applications. These materials inhibit bacterial metabolism in terms of biofilm development by inducing oxidative stress and releasing metal ions as well as non-oxidative activities. So far, anti caries agents such as zinc, copper titanium, silver, and calcium ions have been applied. In addition, fluoride functionalized inorganic NPs have also been used to improve remineralization and restrain demineralization through increasing apatite formation [9].

Remarkably, Antimicrobial photodynamic therapy (aPDT) has been suggested as a novel treatment to eliminate the infectious pathogens. It utilizes the light of a specific wavelength that is applicable for oral biofilm destruction with methylene blue dye (photosensitizer). It is encapsulated within poly (D, L-lactide-co-glycolide) (PLGA) nanoparticles which are 150 nm to 200 nm in diameters. Indocyanine green (ICG) is a novel photosensitizer with PDT-like effect which is shown to function as probable photodynamic periodontal therapy. It works as nanospheres when activated with 805-nm wavelength by a diode laser [10].

4. Drug Delivery

Some controlled nanomaterials are being used for drug delivery. These include core-shell structures, hollow spheres, nanotubes, and nanocomposite. Drugs are incorporated into nanospheres of a biodegradable polymer which enhances prolonged release of the drug. In terms of periodontal inflammation, Triclosan-loaded nanoparticles which are made by poly(d,l-lactide-coglycolide), poly(d, l-lactide), and cellulose acetate phthalate are found to be effective. Microspheres containing tetracycline are offered for controlled drug delivery into the periodontal pocket [10]. An in-vivo study in rats showed that 8.5% doxycycline gel nanostructured could preserve the periodontal surface following experimentally induced periodontal diseases.

5. Nanorobots

Nanorobots are made of carbon materials in the form of diamond or fullerene. These components are sized from 1–100 nanometers with a diameter of about 0.5–3 microns. Nanorobots could probably help clinicians to execute fine procedures at the cellular and molecular levels in the field of dentistry in terms of aiding natural immunity and repairing cellular damage [11], It's been proposed that in the future by using a computer to direct these tiny components, dental nanorobots can be designed to overcome caries-causing bacteria or to repair tooth blemishes with decay dental nanorobots will be programed to use specific motility mechanisms to move through human tissue to sense and manipulate their surroundings, and to u apply any of the multitude of techniques to monitor, or change individual nerve cells in real time [12].

6. Nano Diagnostic Tools for Cancer Diagnosis in Dentistry

There are some nano technology approaches for diagnosis in dentistry. Optical Nano biosensors are fiberoptic-based nano biosensors that can analyze the intracellular components and proteins. Nevertheless, the procedure is minimally invasive. Nanoscale cantilevers are flexible beams of divided boards that are attached to the cancer-associated molecules. Nanopores act as filters for DNA allowing the passage of single strands DNA for an efficient DNA sequencing. Quantum dots can detect cancer cells when illuminated by ultraviolet light binding to cancer cells proteins. Interestingly Nanotubes are about half the diameter of a DNA molecule. This helps detect the exact location of transformed genes. Nano Electromechanical Systems (NEMS) are kinds of biosensors that are used to convert (bio)chemical to electrical signa for detecting cancer cells. Likewise, Oral fluid nano sensor test (OFNASET) helps detecting the salivary biomarkers to detect some types of oral cancers with high sensitivity and specificity. This works through self-assembled microfluidics, and amplification of monolayers (SAM) of cyclic enzymatic to detect the salivary biomarkers. These biomarkers include salivary mRNA biomarkers (SAT, ODZ, IL-8, and IL-1b), and proteomic biomarkers (thioredoxin and IL-8) Finally, lab-on-a-chip have different laboratory functions on one single chip with the silicon wafers performing the analysis on chemically activated beads embedded. This method includes a small sample requirement, short analysis time, thus reduced cost. In dentistry, we can assess the levels of matrix metalloproteinase-8 (MMP-8), interleukin-1 beta (IL-1ß), and C-reactive protein (CRP), in the saliva. These biomarkers are used for evaluating the severity and extent of periodontitis [13]–[16].

7. Anesthesia

Regarding local anesthesia, Nanorobots enter dentinal tubules 1–4-micron holes and they reach the pulp through a combination of temperature differentials, chemical gradients, and positional navigation, These procedures are all under the control of the nano computer directed by an expert dentist [17].

8. Tooth Repair

The nanorobotic installation of a biologically autologous total replacement tooth incorporates both mineral and cellular components. In this way, fabricating the new tooth might become feasible within the time and economic constraints of using an affordable desktop manufacturing facility [18].

9. Conclusion

Nanotechnology has shown advancements in different aspects of science. Although challenging, nanotechnology might hold promise in the field of dentistry.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

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