

NANOTECHNOLOGY: IMMINENT IN DENTISTRY

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ABSTRACT:

Nanotechnology, is the management of a substance on the grounds of molecular as well as of the atomic levels. It has the capability in making mammoth variations in the field of dentistry. There will be a time when nanodentistry will flourish in sustaining the oral well-being with the assistance of nanorobotics, nanomaterials and biotechnology. Nevertheless, through all the advances, it may also cause a menace for mismanagement. Time, cost-effectiveness, mechanical assets, and necessities of the humans will define and govern the path of this transfiguring improvement. This article reviews the contemporary eminence and the probable experimental solicitations of nanotechnology, nanomedicine and nanodentistry.

Keywords: Nanoparticle; Biomaterials; Nanodentistry; Nanofillers



INTRODUCTION:

Nanotechnology era is fast approaching which was unheard two decades ago. All disciplines of human life will be impacted by advances in nanotechnology in the near future. The growing curiosity in this field is giving advent to a newfangled field called Nanomedicine, a science & technology of analyzing, treating & preventing, and preserving & refining human health, using nanoscale structured materials. This article provides an early glimpse of nanodentistry solicitations to elucidate their potentially far-reaching impressions on clinical dental practice.^[1]

Slants in Nanotechnology:

The fields of science and technology have perceived the building of numerous nanoparticles that we have been coming across and using in everyday lives, though many times not understanding that it is portion of the forthcoming uprising. The several nanoparticles are nano pores, nanotubes, quantum dots, nanoshells, dendrimers, liposomes, nanorods, fullerenes, nanospheres, nanowires, nanobelts, nanorings, nanocapsules^[2,3]

Dentistry and Nanotechnology

Nanodentistry will make the preservation of almost perfect oral health possible by the routine of nanomaterials, biotechnology and nanorobotics.^[4]

Various Applications Of Nanotechnology in Dentistry

1) Diagnosis

The Nanotechnology will support in the primary diagnosis of disease and its credentials by using the nanodevices at the molecular and the cellular level. Nanomedicine can aid in enhancing the adeptness and trustworthiness of tissue sections or humanoid liquids grounded diagnostic procedures that employ the nanodevices. Diagnostic measures inside the patient's oral cavity for early identification of disease presence, tumor cells can be done with devices advanced by the nanotechnology. The Technology such as the Nano-electrochemical methods and the girder array radars could be forthcoming approaches for cancer, bacteria, fungi and viruses recognition.^[4,5,6]

2) Oral Anaesthesia and Nano

For persuading the oral anesthesia in the epoch of nanodentistry, dentist will impart a colloidal suspension comprising of millions of dynamic analgesic micrometer sized dental nanorobots

'particles' on the patient's gingivae. After communicating the surface of the crown mucosa, the ambulating nanorobots reach the dentin by wandering into the gingival sulcus and ephemeral painlessly through the lamina propria or 1-3 micrometer thick stratum of loose tissue at the cemento-dentinal junction. On attainment to the dentin, the nanorobots go in the dentinal tubule holes which are 1 to 2 micrometer in diameter and ensue towards the pulp, channeled by a permutation of chemical gradients, temperature disparities and also the positional triangulation; all beneath the govern of the on-board nanocomputer as focused by the dentist. There are countless pathways to choose from. Tubule diameter upsurges near the pulp, which may enable nanorobots' crusade; though circumpulpal tubule openings vary in number and size.

As soon as stationary in the pulp, these robots may be padlocked all sensitivity in any precise tooth which is requiring the management. After the completion of the procedure, manipulation of these nanorobots may be done for reinstating all sensation and renounce regulation of nerve circulation and outlet from the tooth by parallel means used for access.^[4,6]

3) Orthodontic Treatment and Nano

Unnecessary force application may lead to resorption of the root and loss of anchorage. Redlich et al (2008) observed that by covering the

orthodontic wire with sedentary fullerene-like tungsten disulfide nanoparticles acknowledged for their outstanding dry lubrication properties, a lessening in this resistance. In forthcoming days, these nanorobots might unswervingly manipulate the periodontal tissues thus consenting a swift, unproblematic straightening of the tooth, rotating, vertical repositioning within minutes to hours.^[7]

4) Prosthodontics and Nano

There is assimilated of the nanofillers into the vinyl poly siloxanes, thereby generating exceptional adding of silicone impression materials. This material is thus appealed to have improved properties such as flow, adhesiveness. It also has upgraded hydrophilic properties henceforth less vacuums at margin, enhanced model pouring and enriched features meticulousness.

Inadequate formation of bone nearby the biomaterial nearly after implantation is the most common cause of failure of implant, with veneering of nanoparticles above the dental implants, adhesion and integration to neighboring tissues is enhanced. ^[1] The surface of the implant which may be 'macro', 'micro' or 'Nano' arranged, plays a key and serious role in biocompatibility determination and bio integration since it is in straight connection with the tissues. Nanostructured materials can

reveal superior mechanical, electrical, magnetic, optical properties associated with the cautious micron-scale or macro –scale complements.^[8]

5) Periodontics and Nano

Hypersensitivity: Usually, the normal hypersensitive teeth have eight times greater surface density of dentinal tubules and diameter twice as large as the non-sensitive teeth. Dental nanorobots could particularly seal these tubules in minutes and thus gives the patient a swift and perpetual treatment.^[6] These nanorobots extent upto the dentinal tubules and continues towards the pulp, channeled by chemical gradients, temperature variances, all underneath the control of nanocomputer. In almost 100 seconds, they can reach the pulp, thus providing a speedy liberation of sensitivity.^[9,10,11]

Delivery of Drug: Periodontal therapy necessitates the local delivery of drugs for more foreseeable outcomes of cure. The drug delivery systems grounded on triclosan assimilated nanoparticles have been established. Pinon-segundo et al, created triclosan-loaded nanoparticles by the procedure of emulsification-diffusion, in an endeavor to gain a innovative delivery system for the treating the periodontal disease. Tetracycline grounded microspheres are also being estimated for employment into the periodontal pockets.^[12]

6) Nano in Conservative dentistry & Endodontics

Tooth strength and look: Toughness and look of the tooth can be improvised by the replacement of the layers of enamel with covalently bonded synthetic constituents like diamond and sapphire. They exhibit 20 times more stiffness and failure strength than those of the conformist ones and also are biocompatible. Nanorobotic dentifrice (dentifrobots) provided by the mouth wash or the tooth paste might avert the gathering of supragingival and subgingival calculus, also metabolizing the entombed organic matter into unscented, anodyne fumes and helps in the debridement of calculus. They measure 1-10 micron and also may have the ability to disengage them if absorbed.^[1]

Nanocomposite resins: Non-agglomerated distinct nanoparticles that are unvaryingly dispersed in resins or coatings to create nanocomposites. The nanofiller used: Aluminosilicate powder by a mean particle size of 80 ran 1:4 M ratio of alumina to silica and a refractive index of 1.508. These nanocomposites have greater stiffness, flexural strength, modulus of elasticity, reduced polymerization shrinkage and also have outstanding handling properties . Xu et al assessed the acclimatization of nanosized CaPO₄ particles into resin based-composites, with a resulting augmentation in stress bearing aptitude as well as ion

discharge that could hinder dental caries.^[13,14]

Disinfection of the Root Canal System: Recently, the effectiveness of nanoparticles to fumigate root canals has gained admiration This has been accredited to the broad spectrum of antibacterial activity. The nano particles assessed in the field of endodontics include Chitosan, zinc oxide and silver. Effectiveness of chitosan and zinc oxide nanoparticles against *Enterococcus faecalis* has been accredited to their capability of interrupting the cell wall. In addition, these nanoparticles are also capable enough to cause degeneration of the biofilms present inside the root canal system. There has been assessment of the silver nanoparticles for their usage as root canal disinfecting agents. It has been revealed that 0.02% silver nanoparticle gel is capable to eradicate and dislocate *Enterococcus faecalis* biofilm from the root canal system. Ground-breaking introduction in the field of endodontics, the eventual core of which lies in nanotechnology, is bioactive glass (SiO₂-Na₂O-CaO-P₂O₅). The usage of SiO₂-Na₂O-CaO-P₂O₅ has been endorsed for the disinfection of the root canal system¹³. Antimicrobial result of bioactive glass is because of its capability of maintaining an alkaline atmosphere over an epoch of time^{14,15}. Effectiveness of 45S5 bioactive suspension – nanometric/micrometric hybrid as an antimicrobial agent exhibited that a ten-fold rise in silica release and 3 units of pH progression

originated with the nanometric bioactive glass. [15-25]

compatibility matters and the skill in detailed placing and procedure. [15]

NANODENTISTRY & TRIALS

Nanotechnology is prophesied to cause modification of the well-being maintenance by helping as a novel method for diagnosis and preclusion of the disease, delivery of the drug and gene remedy. Though nanotechnology seems to exist as a newfangled and innovative system and strategies in the field of dentistry, there are certain hesitations also. These encompass of the cost-effective nanorobot form production method, moral matters and well-being of the human, biological

CONCLUSION:

Nanotechnology will revolutionize the health care, especially dentistry, more overwhelmingly than many other past developments. It has the potential to bring out noteworthy reimbursements, such as amended health. However, as with any other technology, it also carries a prospective for misapplication and exploitation. The evolution of nanotechnology will benefit dentists with more meticulousness made materials, medications and equipments by which both the well-being and patient acquiescence are enriched.

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