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Research Paper

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Nanotechnology in dentistry- Future ahead..

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Declaration

The Declaration of the authors for publication of Research Paper in Asian Journal of Modern and Ayurvedic Medical Science (ISSN 2279-0772) . Dr. Ankita Singh and Dr. Rajul Vivek,the authors of the research paper entitled Nanotechnology in dentistry- Future ahead entities described in ayurveda declare that , We take the responsibility of the content and material of our paper as We ourself have written it and also have read the manuscript of our paper carefully. Also, We hereby give our consent to publish our paper in ajmams , This research paper is our original work and no part of it or it's similar version is published or has been sent for publication anywhere else.We authorise the Editorial Board of the Journal to modify and edit the manuscript. We also give our consent to the publisher of ajmams to own the copyright of our research paper.

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Abstract

Nanotechnology is being predicted to bring revolution in various scientific and technological fields as it would enable the control over material properties at ultrafine scales and the sensitivity of tools and devices applied in these areas. This review focus on the influence nanotechnology in the field of dentistry. Nanotechnology can favour our understanding of dental tissues at the nanoscale and enable the design of materials with ultrafine architecture. There is a prospect that probing thestructure of dental tissues at ever finer size scales and using the dynamic resolution capabilities of advanced nano tools will give us answers to some of the puzzles that occupy dental researchers of the day.

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Keyword : Nanodentistry, Nanotechnology, Nanorobots

Introduction

Nanotechnology is a rapidly emerging concept having tremendous potential to manipulate and control a particle to create novel structures with unique properties and advances in medicine and dentistry. Prof. Kerie E. Drexler, lecturer and researcher of nanotechnology coined the term "nanotechnology". "Nano" derived its meaning from the Greek word "dwarf". Nanotechnology is the science of manipulating matter measured in the nanometer, roughly the size of 2 or 3 atoms.1 Genesis of the concept was based on the thought that microstructures or tiny nanorobots can be manufactured and utilized in human body for treatment of various diseases by restoring cellular functioning at molecular level.First speculated by the late Nobel Prize winning

physicist Richard P. Feynman in 1959 as the potential of nanosize devices he concluded his historic lecture by saying, "this is a development which I think cannot be avoided."2 Feynman discussed the using of microscopic machine tools all the way down to the atomic level. Therefore, nanotechnology was proposed to be the utilization of these nanomachine tools, nanodevices, and nanorobots to

and ultimately dental robotics",nanotechnology derives its concept by utilizing atoms and molecules to build functional structures. These functional structures can be constructed by various methods including "top-down" and "bottom-up" techniques. Molecular components which assemble themselves chemically by principles of molecular recognition is the basis of the in the „bottom-up approach". Fabrication of nano objects from large entities without atomic level-control represents the „top-down" approach. 3

Nanotechnology and diagnostics

Nanodevices can be utilized for the early identification or predisposition of disease at cellular and molecular level. Diagnosis by using human fluids or tissues samples **in-vitro** with selective nanodevices to make multiple analyses at subcellular scale could increase the efficiency and reliability of the result. In **in vivo** diagnostics, nanomedicine could develop devices able to work inside the human body in order to identify the early presence of a disease, to identify and quantify toxic molecules, tumor cells.5,6

Nanodentistry

Application of nanotechnology to dentistry has been a novel area of interest since some years now and has lead to the materialization of a new field called nanodentistry. Preservation and

Nanoporous silica filled composite is a fairly new material still in experimental form, proven to increase wear resistance

develop a wide range of atomically precise microscopic instrumentation and manufacturing tools.

Fundamental Concept

Defined by Robert A. Frietas as "the science and technology that will make possible the maintenance of comprehensive oral health by employing use of nanomaterials, biotechnology

The various nanoparticles are 2, 4

1. Nanopores
2. Nanotubes
3. Quantum dots
4. Nanoshells
5. Dendrimers
6. Liposomes
7. Nanorods
8. Fullerenes
9. Nanospheres
10. Nanowires
11. Nanobelts
12. Nanorings
13. Nanocapsules

maintenance of oral health utilizingnanodentistry will be made possible by employing nanomaterials, including tissue engineering, and ultimately, dental nanorobots.

Nanorobots guided and controlled by nanocomputers may execute preprogrammed instructions in response to local sensor stimuli. Nanorobots might use specific motility mechanisms to travel through human tissues with navigational precision gaining energy and sensing their surroundings. After achieving cytopenetration, they will be guided to use any of the multitude techniques to monitor, interrupt, or alter nerve impulse traffic in individual nerve cells in real time.4,5

Application of Nanotechnology in Dentistry

1. Material science

in posterior applications. These non-agglomerated discrete nanoparticles that are homogeneously distributed in resins or coatings to produce nanocomposites. The

nanofiller used include an aluminosilicate powder having a mean particle size of 80 ran and a 1:4 M ratio of alumina to silica and a refractive index of 1.508.6

2. Local anaesthesia

Nanodentistry will play a role in application of local anesthesia by introduction of millions of active analgesic micron-size dental robots in the form of a colloidal suspension administered on the patient"s gingiva. When in contact with the surface of crown or mucosa, these ambulating nanorobots will reach the pulp via the gingival sulcus, lamina propria and dentinal tubules. Further, these nanorobots may be controlled and commanded by the dentist to shut down all sensitivity in any particular tooth that requires treatment. After oral procedures are completed, the dentist orders the nanorobots to restore all sensation and move out from the tooth by similar pathways used for gaining entry.5,8,9,10,11,12 The advantage of this application of nanodentistry will include greater patient comfort, diminished anxiety, no needles required, greater selectivity and control over analgesia, fast and completely reversible and no side-effects and complications.

3.Periodontal disease

Nanorobotic dentifrice (dentifrobots) delivered by mouthwash or toothpaste could remove all the harmful bacteria and maintain the required microflora for positive health of the oral environment. These dentifrobots will ambulate on all supragingival and subgingival surfaces at least once a day removing trapped organic matter like food particles and tartar so that they can be rinsed away. Continuous calculus debridement and caries prevention will further prevent occurrence of halitosis.

4. Tooth durability and appearance

Tooth durability and appearance may be improved by replacing upper enamel layers with covalently bonded artificial materials such as sapphire or diamond, which have 20 to 100 times the hardness and failure strength of natural enamel, or contemporary ceramic veneers as well as good biocompatibility. Pure sapphire and diamond are brittle and prone to fracture resistant as part of a nanostructure composite material that possibly includesembedded carbon nanotubes.13

5. Dentin hypersensitivity

Reconstructive dental nanorobots, using native biological materials, could selectively and precisely occlude specific tubules within minutes, offering patients a quick and permanent cure.5, 12, 45, 15 On reaching the dentin, the nanorobots enter dentinal tubular holes that are 1to 4 µm in diameter and proceed toward the pulp, guided by a combination of chemical gradients, temperature differentials and even position ofnavigation, all under the control of the onboard nanocomputer as directed by the dentist. As nanorobots pass through the journey of enamel, dentin reaches into pulp. Once installed in the pulp, having established control over nerve impulse traffic, the analgesic dental nanorobots may be commanded by the dentist to shut down all sensitivity in selected tooth that requires treatment. After the oral procedure are completed, the dentist orders the nanorobots via the same acoustic data links to restore all sensation, to relinquish control the nerve traffic and to retrieve from the tooth via similar path. This analgesic technique is patient friendly as it reduces anxiety, needle phobia, and most important one is quick and completely reversible action. 5,12, 16

6. Orthodontic treatment

Orthodontic nanorobots could directly manipulate the periodontal tissues, allowing rapid and painless tooth straightening, rotating and vertical repositioning within minutes to hours.5

7. Nanosolution.

Nanosolutions produce unique and dispersible nanoparticles, which can be

used in bonding agents. This ensures homogeneity and ensures that the adhesive is perfectly mixed everytime

8.Impression materials.

Nanofillers are integrated in vinylpolysiloxanes, producing a unique addition of siloxane impression materials. The material has better flow, improved hydrophilic properties and enhanced detail precision.

9.Nanoencapsulation.

SWRI [South West Research Institute] has developed targeted release systems thatbencompass nanocapsules including novel vaccines, antibiotics and drug delivery with reduced side effects. At present, targeted delivery of genes and drugs to human liver has been developed

electronic industry such as lithography, ionic implantation, anodization, and radio frequency plasma treatments may be applied to the surfaces of dental implants to produce controlled features at the nanometer scale.

11. Photosensitizers and Carriers

Quantum dots can be used as photosensitizers and acrriers. They can bind to the antibody present on the surface of the target cell and when stibulated by UV light, they can give rise to reactive oxygen species and thus will be lethal to the target cell.19

12. Diagnosis of Oral Cancer

Nano Electromechanical Systems (NEMS)

Nanotechnology based NEMS biosensors that exhibit exquisite sensitivity and specificity for analyte detection, down to

protein to the process which produces cellular energy and is well-known as the protein involved in apoptosis, or programmed cell death. 22

Conclusion

Nanotechnologies are on the verge of initiating extraordinary advances in biological and biomedical sciences improving healthcare and human life profoundly with better utilizing the natural by Osaka University in Japan 2003. Engineered Hepatitis B virus envelope L particles were allowed to form hollow nanoparticles displaying a peptide that is indispensable for liver-specific entry by the virus in humans. Future specialized nanoparticles could be engineered to target oral tissues, including cells derived from the periodontium [Yamada et al, 2003].

10. Nanodentistry and Implants

Nanotechnologies may produce surfaces with controlled topography and chemistry that would help understanding biological interactions and developing novel implant surfaces with predictable tissue-integrative properties.17, 18Various processing methods derived from the single molecule level are being developed. They convert (bio) chemical to electrical signal.20

Oral Fluid NanoSensor Test (OFNASET)

The Oral Fluid NanoSensor Test (OFNASET) technology is used for multiplex detection of salivary biomarkers for oral cancer. It has been demonstrated that the combination of two salivary proteomic biomarkers (thioredoxin and IL-8) and four salivary mRNA biomarkers (SAT, ODZ, IL-8, and IL-1b) can detect oral cancer with high specificity and sensitivity.21

Optical Nanobiosensor

The nanobiosensor is a unique fiber optics-based tool which allows the minimally invasive analysis of intracellular components such as cytochrome c, which is a very important resources and reduced environmental pollution. These would be associated with both providing the tools for improved understanding of fundamental building blocks of materials and tissues at the nanoscale and designing technologies for probing, analyzing and reconstructing them. Although nanodentistry has tremendous potential, but social issues of public acceptance, ethics, regulation, and humansafety must be addressed before

molecular nanotechnology can be seen as the possibility of providing high quality dental care.

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