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Best Things Comes-Small Packages Applications Nanotechnology Medicine -Dentistry

[1]Dr. K. Malathi, [2]Dr. N. Srividya, [3]Dr. G. Sandhya
[1,2]Department of Periodontics, [3]Department of Periodontics and Implantology
Tamilnadu Government Dental College and Hospital, Chennai

***Corresponding Author:**
Dr. G. Sandhya
Department of Periodontics and Implantology, Tamilnadu Government Dental College and Hospital, Chennai

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Abstract

Nanotechnology is the science of manipulating matter measured in the billionth of meter or nanometer. "Nano" is derived from Greek word 'dwarf'. The basic thought of nanotechnology is to employ individual atoms and molecules to construct functional structures. Feyman in 1959 speculated the potential of nanosized device and said that it is the development of science which can't be avoided. Achieving nanotechnology – in producing goods has 3 objectives: 1) to manipulate individual atoms 2) to develop nanoscopic machines called assemblers, 3) to create enough assemblers to build consumer goods, replicator, where the assemblers and replicators will work together to automatically construct products. This review on nanotechnology discusses its role in dentistry and its application in periodontics

Keywords: Nanotechnology, nanometer, assemblers, replicators

Introduction

Nanotechnology which is the fast-developing field in our profession today to improve the oral health while overcoming both extrinsic and intrinsic factors which adversely affects the progress towards achieving this goal [1]. It is also known as molecular nanotechnology or molecular engineering [2]. This involves the production of functional materials and structures in the range of 0.1 to 100 nanometres- the nanoscale- by various physical and chemical methods. Nano comes from the Greek word for "dwarf". The term nanotechnology was coined by professor Kerie E. Drexler, a lecturer and researcher of nanotechnology. Nanotechnology is defined as the research and development of materials, devices and systems exhibiting physical, chemical and biological properties that are difficult from those found on the large scale. It is an engineering at the atomic and molecular scale or macromolecular levels. Nanotechnology applied to dentistry will bring significant advances in the diagnosis and treatment and prevention of disease [3]. Nanotechnology is the science of manipulating matter measured in the billionth of meter, roughly the size of 2 to 3 atoms [4]. There are 2 concepts employed the first signifies any techniques smaller than micro technology and the later stands for the technology to program and manipulate matter to scale it to 3D products of arbitrary size [5].

The concepts of nanotechnology are: Bottom-Up approach and Top-Down approach. Bottom- up approach-1) begins with designing and synthesizing custom-made molecules that have the ability to self-replicate. 2) the structure of molecules is then organized into higher macro-scale. 3) the molecules self-replicate upon the change in specific physical and chemical property that triggers the self-replication. Top-Down approach -1) begins with taking a macroscopic material i.e. (the finished product) and then incorporating smaller scale details into them. 2) the molecules are rearranged to get the desired property. Development of nano advanced

means of delivering medications at therapeutic levels to specific sites is an important clinical issue, and this technology should be able to target specific cells in a patient suffering from cancer or other life-threatening conditions. Toxic drugs used to fight these illnesses would become much more direct and consequently less harmful to the body. Dental nanorobots are the most exciting and challenging approach to nano dentistry. Applications in dentistry are nano solution, nanocomposites, inducing anaesthesia, tooth positioning, to treat hypersensitivity, photosensitiser carriers.

The science of bioengineering at the molecular level within thought properties which will pave the way to future periodontal engineering and drug delivery in periodontics which is the basic concept of nanotechnology in this speciality. Nanopores, nanofibers, nano shells, dendrimers and quantum dots are different nano spur used in periodontics. Nanotechnology is introduced in 1959 by late Nobel Physicist Richard P Feymann. Nanomachines, nanorobots and nanodevices in the end could be used to develop a wide range of automatically precise microscopic instrumentation and manufacturing tools. Nanotechnology aims to manipulate and control particle to create novel stimuli with unique possessions and promises advances in medicine and dentistry. Broadly it consists of 3 mutually overlapping and progressing more powerful molecular technology to achieve nano-technically produced goods. Steps involved are: 1) To manipulate individual atoms 2) To develop nanoscopic machines called assemblers. 3) To create replicators which will be programmed to build more assemblers [6].

Types Of Nanotechnology:

1. **Nanoscale:** Structured materials and devices that can be made-up for advanced diagnostics and biosensors, targeted delivery and smart drugs.
2. **Molecular Medicine:** This is via genomics, proteomics and artificial bodies (microbial robots). Nanomedicine can be defined as 'science and technology of diagnosis, treating and preventing diseases and traumatic injury in order to relieve pain, preserve and improve human health through the use of nanoscale structured material, biotechnology and genetic engineering, eventually complex molecular machine system and nanorobots [7].
3. **Molecular Machine System:** Medical nano robots allows instant pathogen diagnosis and extermination, efficient intensification and improvement of natural physiological function [8]

Nanorobots

They are theoretical microscopic devices measured on the scale of nanometers (1nm equals one millionth of 1mm). Since nanorobots would be microscopic in size, it would probably be required for very large members of them to work together to perform microscopic and macroscopic tasks. Carbon will likely be the principal element comprising the bulk of a medical nanorobots, probably in the form of diamond or diamondoid/ fullerine nanocomposites [9]. Light elements such as hydrogen, sulphur, oxygen, nitrogen, fluorine, silica etc., will be used for special purposes in nanoscale gears and other components. The smooth and more flawless the diamond surface, the lesser is the leukocytic activity and fibrinogen absorption. The capacity to design, build and deploy large number of medical nanorobots into the human body would make possible the swift elimination of diseases and the effective and relatively painless recovery from trauma.

Medical Nanorobots:

It can be of great importance in easy and accurate correction of genetic defects, and helps to ensure a greatly expanded health span. The typical size of a blood borne medical nanorobots will be 0.5-3 micrometres as it is the maximum size that can be permitted due to capillary passage requirement.

Bulk Teflon, carbon powder and nanocrystal sapphire are the different nano pyrogenic nanorobots used [10]. The pyrogenic pathway is controlled by in vivo medical nanorobots and the pyrogenic nanorobots are alumina, silica and trace elements like copper and zinc. Nanorobots may release inhibitors, opponent or down regulators and to selectively absorb the endogenous pyrogens, chemically modify them and they release them back into the body in a harmless inactivated form. Painful slow strategic decisions, sub-optimal funding, lack of engagement of private enterprises and problems of retention of trained man

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power are the main difficulties noted in doing research in nanotechnology.

Nanomedicine:

Rising curiosity in the future medical applications of nanotechnology is principal to the advent of a new field of 'NANOMEDICINE'. Development of nanotechnology has become the most highly thrilled discipline in science and technology.

Applicationof Nanotechnology In Medicine:[11]

1.In Pharmacological Research:

Advanced drug delivery systems aims to improve the bioavailability, pharmacokinetics of pharmaceuticals and to replace invasive by non-invasive routes of administration.

2. In Clinical Diagnosis:

Nanodiagnostics:

It is the use of nanodevices for early disease identification and predisposition at cellular and molecular level, in vivo and invitro.

IN INVITRO diagnostics: By using selective nanodevices, nanomedicine could increase efficiency and reliability of the analysis using human fluids or tissue samples, to make multiple analyses at subcellular scale etc.

IN INVIVO diagnostics: Nanomedicine could develop devices which are able to work privately in human body. They are used in order to recognize the early presence of disease and in order to identify and quantify the toxic molecular cancer cells.

1. Nanomaterials for brachytherapy, Brachy SiLTM delivers 32P- clinical trail
2. Drug delivery transversely the blood brain barrier of more active – treatment of brain tumours, Alzheimer's, Parkinson's disease in expansion.
3. Nano vectors for gene therapy: non-viral gene

3. Detection And Treatment Of Oral Cancer:

Nanoscale Cantilevers:

Uncovering and therapy of oral cancers are done by nanoscale cantilevers. These are flexible beams approaching a row of diving boards which can be plotted to bind to the molecules associated with cancer. They may bind to altered DNA sequences/proteins that are present in certain types of cancer.

Diagnosis Of Cancer:

1. NEMS –it converts (bio)chemical to electric signals, centi level array sensors.
2. **Ultrasensitivemass Detection Technology:**
   - i. Picogram - (10-12) bacterium
   - ii. Femtogram – (10-15) virus
   - iii. Atto-gram – (10-18) DNA

Treatment Of Oral Cancer:

Multifunctional dendrimers and nano shells are highly precise tools for cancer therapy. Property of dendrimers are:

i. High grade of branching
ii. Multivalues
iii. Globular structure
iv. Well defined molecular weight

These possessions make them promising in cancer therapies.

4.Nanopores:

1. These are minute holes that allow DNA to pass over one strand at a time, will make DNA sequencing more efficient.

2. As the DNA passes through nanopores, scientist can observe the shape and electrical properties of each base, or letter on the strand.

5.Nanotubes:

These are carbon rods about half the diameter of molecules of DNA can detect the presence of altered gene and may help the researchers pinpoint the exact place of these changes.

6.Quantum Dots:

Semiconductor nanoparticles have exclusive optical and electrical properties are known as quantum dots. They flow very luminously when illumined by ultraviolet light. Quantum dots can be injected into the cells or attached to proteins in order to track, label or recognize specific biomolecules and they offer decisive detection sensitivity.

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7.Dendrimers:

Highly branched supermolecules with a controlled 3-dimensional architecture makes it possible to attach other molecules like drugs and contrast agents to the surface [12].

8.Nanoshells:

Nano shells are infinitesimal beads coated with gold with a core of silica and a metallic outer layer designed to harvest concentrated heat in absorbing specific wavelength of radiation that can be used for selective eradication of cancer cells, leaving aside integral, adjacent normal cells and hence, used in the treatment of cancer.

a) **Respirocyte**: They are the first theoretical design study of a complete medical nanorobot. It improves the respiratory capacity. It is a imaginary artificial, mechanical red blood cell which would deliver 236times more oxygen to body tissues per unit volume than natural red blood cells and would manage carbonic acidity, controlled by gas concentration sensors and an onboard nano computer.

b) Atherosclerosis: Nanorobots can be made to eradicate the yellow fat deposits on the inner side of blood vessels.

Hemostasis: Clot inducing medical nanorobots with fully developed netting are capable of embedding growing clot with the red blood cells and fibrin strands. This concept is called clotocyte concept.

Nanodentistry:[13]

Nano dentistry is defined as science and technology of diagnosing, treating and preventing oral and dental disease, relieving pain and of preserving and improving dental health, using nanoscale structured materials [14]. It was first introduced in the year 2000 by research scientist Robert A. Freitas. It will make possible maintenance of comprehensive oral health by applying biomaterials, tissue engineering and dental nano robots [15].

Nanodentistry Top-Down Approach:

Nanocomposites: [16]

Nanoproducts corporation has successfully manufactured non agglomerated discrete nanoparticles that are homogeneously dispersed in resin or coatings to produce nanocomposites. The nanofiller used includes an alumina- silica powder having a mean particle size of 80nm and a 1:4 ratio of aluminate silica and a refractive index of 1.508. High Filler loading, greater hardness, flexible forte, modulus of elasticity, high translucency, aesthetic appeal, good colour, density, high polish with good retention,50% reduction in filing shrinkage and excellent handling properties are the advantages of nanocomposites. The trade name is Filtek O Supreme, Universal Restorative Pure Nano O.

Nanosolutions:

Dispersible nanoparticles can be added to various solvents, paints and polymers in which they are dispersed unvaryingly and ensure that the adhesives are perfectly mixed every time. Nanofiller are integrated in the vinyl siloxanes, producing a exclusive addition of siloxane impression material. Advantages includes better flow, improved hydrophilic properties, better model pouring and enhanced detailed precision. These solutions produce the dispersible nanoparticles that can be used in bonding agent with better performance and no shaking of the bottle is required. The trade name is Ad per O single Bond Plus Adhesive, Single Bond.

Nanoimpression Material:

Advantages are better flow, improved hydrophilic properties with few voids and better model pouring. Nano impressions are available with nanofillers collective in the polyvinyl siloxane producing a unique addition of siloxane impression material [17]. The trade name is Nano Tech Elite H-D

Nano- Encapsulation:

SWRI (South West Research Institute) developed target release systems with nano capsule including novel vaccine, antibiotics and drug delivery with reduced side effects. Osaka in japan has developed a targeted delivery of generic drugs to human liver. Engineered hepatitis B virus envelope L particle were allowed to form 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. Other products produced by SWRI

a) Productive clothing using antipathogenic nano emulsion and nanoparticles.

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b) Medical appendages for curing - biodegradable nano fibres, wound dressings with silk nanofibers, nanocrystalline silver particles with antimicrobial properties on wound dressing (Acti-coat^{TM}UK)

c) Bone targeting nanocarriers: Calcium phosphate-based biomaterials has been developed which provisions development of cartilage and bone cells. This bone biomaterials are easily flowable, mouldable paste that interdigitates with host bone.

Nanoneedels:

Scientists have performed a delicate surgical operation on a solitary living cell using a needle that is just a few billionth of meter wide. Sandvick Bio line, RK 91^{TM} needle – are suture needles incorporating nano sized stainless steel. Nano tweezers are also under development which will make the cell surgery conceivable in the future.

New Electrochemical Process For Coating Implants:

Endosseous implant surfaces exaggerates with nanoscale topography comes under recent trends in dental implant therapy. Nano modification of titanium endosseous implant surface can alter cellular and tissue response that profit analysis and cure. Three nanostructured implant coatings in use are diamond, hydroxyapatite and graded metalloceramic etc. Diamond coating implants possess improved hardness, toughness and low friction. Hydroxyapatite coating possess increased osteoblast adhesion, proliferation, mineralization properties and graded metalloceramic, have ability to overcome adhesion problems. The length of the treatment for an implant is determined by osseointegration. These implants use nanometre scale calcium phosphate to create complex topography that has proven to expediate osseointegration by 150%, thereby, decreasing the time period from 1-3months.

Materials To Induce Bone Growth:

Calcium sulphate is used to fill small vacuums those found in periodontal defect and post-extraction socket. It is a long-lasting bone graft material. Calcium sulphate destined composite was formulated by Dr. Ricci. Bone Gen -TR resorbs much slowly and regenerate bone more consistently [18].

Bone Replacement Material:

These materials adopt itself well to the size and shape characteristics of healthy bone and act on the genes in the cells while answering well to internal as well as environmental stresses. This smart material assists in the repair and rejuvenation of cellular tissue in the bone. Creating nano enamel smart tissue for bone tissue additional is a tremendous challenge. Hydroxyapatite nanoparticles had to treat bone defects are:

i. Ostim – HA

ii. VITOSSO – (Orthovita– USA)

iii. HA+TCP – Nan OSSTM

Nanodentistry- Bottom-Up Approach: [19]

Local Anaesthetics

In Nano dentistry, a colloidal suspension containing millions of active analgesic micron size dental robots will be instilled on the patient's gingiva. After contacting the surface, ambulatory nanorobots reaches the pulp via, gingival sulcus, lamina propria and dentinal tubules. Once installed into the pulp the dental robots may be commanded by the dentist to shut down all the sensitivity which requires treatment. The dentists order the nanorobots to restore all the function once the oral procedures are completed [20].

Permanent Hypersensitivity Cure

The hypersensitivity teeth have 8-times higher surface density of dentinal tubules and tubules with diameter twice as large as non-sensitive teeth. Dental nanorobots would selectively and precisely occlude the selected tubules in minutes offering patients a quick and permanent cure [21].

Nanorobotics Dentrifice (Dentifrobots):

They are delivered by mouth wash or tooth paste. This can remove subgingival and supragingival calculus and can be used once a day. It metabolizes trapped matter into harmless and odourless vapour and performing continuous calculus debridement. Dentifrobots could identify and destroy pathogenic bacteria residing in the plaque and elsewhere, while allowing harmless oral microflora to flourish in the healthy ecosystem [22]. Since bacterial putrefaction is central metabolic process involved in halitosis, Dentifrobots would provide a continuous barrier to

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halitosis. Conventional tooth decay and gingival disease will disappear with daily dental care available from an early age with dentifrobots. These invisibly small Dentifrobots (1-10micron) crawling at 1-10microns /sec, would be inexpensive and purely mechanical device that would be programmed with strict occlusal avoidance protocol.

Durability And Cosmetics:

Tooth durability and appearance may be improved by using pure sapphire and diamond which have 20 to100 times hardness and the strength of the natural enamel. The sapphire is somewhat susceptible to aid corrosion but can be manufactured on any colour.

Complete Orthodontic Readjustment During Single Visit:

Continuous oral health maintenance using mechanical dental robots. Dental nanorobots might use specific motility mechanism to crawl or swim through human tissue with navigational precision, acquire energy, sense and manipulate their surroundings and achieve safe cytopenetration and use any of the technology to monitor, interrupt or alter nerve impulse transmission in individual nerve cells in real time. Future of nanorobots may be controlled by an on-board nano computer that exhibit pre-programmed instructions in response to local sensor stimuli via acoustic signals or other means that t dentists may issue strategic instructions by transmitting orders to in vivo nanorobot. This would eliminate the need of cumbersome and dreaded braces. Orthodontic nanobots could directly manipulate the periodontal tissues, allowing rapid and painless tooth straightening, rotating and vertical repositioning within minutes to hours. Sandrik Nanoflex is a new stainless steel which allows ultra-high strength combined with good deformability, corrosion resistance and a good surface finish.

Biomimetics

Nanotechnology can be applied to synthesize both mineral and cellular components of tooth and used for tooth repair. The central theme is to mimic the nature using the more efficient nanotechnology. This involves the cooperative interaction between self-assembled nanosphere of the proline rich protein amelogenin and the formation of directional orientation of the hydroxyapatite crystals. Complete dentition replacement therapy would become feasible and with the proper understanding of the nanoscale biological processes involved in tooth formation, nanorobotic manufacturing and installation of a biologically autologous whole replacement tooth can be done [23].

Photosensitizer And Carriers:

Quantum dots can be used as a photosensitizer and carrier. They can bind to antibody surface of target cell and when stimulated by UV light, they give rise to reactive oxygen species which are lethal to the target cells.

Diagnosis Of Oral Cancer:

Multi-plexing modality: Sensing large numbers of different biomolecules simultaneously in real time.

Applications Of Nanodentistry In Clinical Medicine: [24]

- To diagnose diabetes mellitus (multiple periodontal abscess) and cancer
- To detect bacteria, fungi and viruses.

Other Applications:

1. **Nanotherapeutics:** These are highly specific and targeted drug delivery systems. Nanotechnology in therapeutics will help to solve the solubility problems, reduce the drug dosage and minimize the side effects.[25]
2. **Nanoadhesive:** They produce unique and dispensable nanoparticles which prevent agglomeration. Higher dentin and enamel bond strength, high stress absorption, longer shelf life, durable marginal seal and fluoride release. No separate etching is required.
3. **Nano Sterilizing Solution:** It is based on super science of nano emulsion technology. It uses nanosized emulsified droplets of oil that bombards the pathogens. The advantages are broad spectrum, hypoallergic, non-corroding, does not stain fabric, compatible with various impression materials and environment friendly. Eg: Eco Tru Disinfectant
4. **Dentinal Renaturalisation.** This procedure provides perfect treatment methods for aesthetic dentistry. In patients who desires to have their old dental amalgam, crown and others are removed and denaturalised with

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native biological materials to become indistinguishable from original teeth.

Applications In Periodontics: [26]

Nanofibers: Nanofibers have been used for drug delivery systems and tissue engineering scaffolds.

Drug Delivery:

Nanomaterials including hollow spheres, cone-shell structures, nanotubes and nano composite have been widely explained for controlled drug release. Drugs incorporated into nanosphere composed of a biodegradable polymer allows timed release of the drug as the atmosphere mortify and this allows for site specific drug delivery. For example, development of Arestin in which tetracycline is incorporated into microspheres for drug delivery by local means to a periodontal pocket.

Tissue Engineering:

Utilization of synthetic scaffolds for cell delivery offers promise, it is very likely that the next generation of materials will rely heavily on nanotechnology and its potential to produce new biologic self-assembling system for tissue engineering purpose. It is possible to construct systems on nano, micro or even macro scale using the principle of self-assembling system for biologic systems.

The clinical utility of these nano- constructed self-assembling materials is their capacity to be developed into nanosphere leading to unique nano building blocks with nano control and nano delivering capabilities. The potential of nanotechnology is limited only by our imagination and polymer scaffolds for cell seeding; growth factor delivery and tissue engineering purposes may well be manipulated via nanodevices implanted to site of tissue damage. Minerals formed biologically different in structure and properties from lab formed materials is termed as nano-biomineralization for example that in bone. Crystals are manipulated at nano level and embedded into collagen fibres to create an organic - inorganic composite with unique mechanical properties. To construct a synthesis of bone graft substitute with a nano structured architecture that resembles a bone. Bone features and structures are analysed at the nano level.

A novel biodegradable nanocomposite porous scaffold consists of Beta Tri Calcium Phosphate (β - TCP) matrix and hydroxy apatite nano fibres was developed in which hydroxy apatite nanofibers were prepared with a bio mimetic precipitation method. Combining the gel casting and polymer sponge technique the composite scaffolds were prepared. Inclusion of hydroxy apatite nanofibers as a second phase in β-TCP showed significantly improved porous scaffolds with improved mechanical properties than the scaffolds of single phase calcium phosphate preparation. Promising approach for treatment of defective and lost bone includes bone tissue engineering.

Discussion:

Nanotechnology is a part of the foreseen future in which the periodontal practices may become more high-tech and more effective in controlling the battle decay, where it begins with bacteria, microscopic entities to be tasks performed that are now done by hand /equipment, this concept is known as nanotechnology. Tiny machines known as nano assemblers which are controlled by computers are used to perform specialized jobs. Nano assemblers are smaller than the nucleus of the cell so that they fit into the places where it is hard to reach. We dentist will ask the patient to rinse with the solution containing millions of microscopic machines called nanoassemblers [27]. Social issues of acceptance by the public acceptance, ethics, guidelines, human safety protocol, precise positioning, assembling the molecular scale part and biocompatibility are certain challenges faced by the nanotechnology [28]. The basic idea of nanotechnology is to employ individual atoms and molecules to construct functional structures.

The history of nanotechnology remains uncertain. Some scientists say it is a new form of scientific evolution which was not developed till late 1980s or early 1990s, but the history of nanotechnology can be traced back to the year 1959. Some of the unique notions in nanotechnology were showed by James Clarke Maxwell in 1867. The first remark and size measurement of nano particles was made during the first decade of 20th century by Richard Adolf Zsigmondy, who made a detailed study of gold sols and other nanomaterials with sizes down to 10nm and less. Nanoparticles must be assessed individually

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with greater concern and all the nano assets must be taken into account. The skin, lungs or digestive tract shows increased rate of absorption which might cause unwanted effects to the lungs, as well as other parts.

The Swedish Karolinska Institute studies about nanoparticles on human lung epithelial cells were out in 2008. It showed that the iron oxide nanoparticles caused little DNA damage and were non-toxic. Titanium dioxides caused DNA damage and zinc oxide were slightly worse. DNA damage caused by carbon nanotubes was at lower level. Copper oxide was the only nanomaterial identified by researches as a clear health risk and found to be the worst offender [29].

The National institute of occupational safety and health conducted a research on interaction of nanoparticles with the body's system and its pathogens. With research, nanotechnology will become progressive practice in future. Developments are expected to accelerate pointedly through the governmental and private sectors ingenuities. Biological approaches such as tissue and genetic engineering will yield a new investigative and healing approaches. Development of innovative restorative resources and new medicaments and pharmacologic approach will continue to expand dental care. With progression of nanotechnology, there will be enhanced attention on specific diagnostic and treatment modalities and preventive methods will reduce the need for curative and restorative communications.

Understanding the pathogenicity of other ailment process will make deterrence a practical method for most population. Analysis and therapy will be tailored to match the predilections and heredities of each patient. Dentist will have best technical capabilities, professional decision making and strong social skills that will bring revolution into the field of dentistry. Nanotechnology has the potential to an enhanced health, healthier use of natural resources and compact environmental pollution [30].

Conclusion:

Nanotechnology may be doubtful, unbelievable or unpredictable. It is hoped that dental nanorobots will make rapid , trouble-free and precision dentistry a reality. At the same time conventional methods and the expansion of progressive approaches will improve dental care. Nanotechnology will alter dentistry, healthcare and human life more intensely. Nanotechnology holds promises for advanced analysis, targeted drug delivery and biosensors making health care more effectual and reasonable. Primary of all the 21st century, medicine and dentistry, molecular technology is intended to become a core technology [31].

References:

1. Preeti Sateesh Kumar et al. Nanodentistry : A Paradigm Shift from Fiction to Reality. J. Indian Prosthodont. Soc. (Jan-March 2011) 11 (1) : 1-6.
2. Sumita B, Mitra , Dong WU and Brain N Holmes. An application of Nanotechnology in advanced dental materials. JADA, J Am Dent. Assoc. 2003; 134 ; 1382-1390.
3. Schulz W. Crafting a national nanotechnology effort. Chem. Eng. News. 2000. 78 ; 150: 39-42.
4. Kaehler T. Nanotechnology: Basic Concepts and Definition, Clinical Chemistry. 40(9) ; 1797-1799 ,1994.
5. Gordijn B. MedizinischeUtopien. Eineethische. Betrachtung, Gottingen, Vandenhoeck and Ruprecht, 2004,169-180.
6. Drexler K.E. Nanosystems : Molecular Machinery, Manufacturing and Computation, New York : Reinhold ; 282-296,196.
7. FeritasJr R.A. Nanodentistry Journal of American Dental Asso. 2000 , 131 : 1559-65.
8. Drexler K.E: Nanosystem, Molecular Machinery, Manufacturing and Computation; New York; John Wiley and Sons, 990-99 ,1992.
9. Abhilash M. Nanorobots– International Jounal of Pharma and Bio Sciences, volume VI (1) ,2010.
10. Joy B; Why the future does'nt need us. 804-810,2000. http://www.wired.com/wired/archive/8.04/Joy.html.

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11. Ajay R et al. Nanotechnology and its application in dentistry and medicine. J Oro fac Sci, 2 (1), 2010.
12. Tumors get selective with nanoparticles. Nano today. 2007 ; 2 (5); 35.
13. Hemant Asrani. Nanodentistry- A nd its Applications. JIDA,vol.5,no.1. Jan 2011.
14. Robert.A.Feritas Jr. Nanodentistry. Journal of American Dental Association . Vol-131, Nov-2000 ; 1559-65.
15. Javier da la Fuente Hermandez et al. Use of new technologies in dentistry.RevistaOdontologica Mexicana. Vol.15, no.3, July- Sept. 2011;158-163.
16. Titus L. Schleyer. Nanodentistry, JADA, vol-131, Nov.2000; 1567-8.
17. Jhavar H.M and Balaji ; Nanoechnology : The future of dentistry, 2005 ,5 :15-17,.
18. Simone E, Hieber et al. Future Dental Medicine – Nanodentistry. 17th Swiss Conference on Biomaterials. May 4th, 2011, Yverdonles-Bains, Switzerland.
19. Herzog A, Of Genomics, Cyborgs and Nanotechnology : A look into the future of Medicine, Connecticut: Medicine. 2002; 66 (1): 53-54.
20. Saravana kumar R, Vijayalakhmi R. Naotechnology in dentistry. Ind. J. Dent . Research. 17(2): 62-65, 2006.
21. Sujatha V et al. Nanorobotics- A Futuristic Approach. SRM University. Journal of Dental Science. Vol 1(1): 86-90; July 2010.
22. Harsna RR, Ramay M. Zhang, Biphasic calcium phosphate nanocomposite porous scaffolds for load bearing bone tissue engineering. Biomaterials 2004; 25: 5171-5180.
23. Shivani Sharma et al. Nanocharacterization in Dentistry. Int.J.Mol.Sci. 2010,11,2523-2545.
24. Jyoti Gupta. Nanotechnology application in Medicine and Dentistry. Journal of Investigations of Clinical Dentistry. (2011) , 2 : 81-88.
25. Kubik T, Boguina K.K. et al. Nanotechnology on duty in Medical applications. Current Pharmaceutical Biotechnology. 2005;17:33.
26. Sahitya Reddy.S. forwarded by CD Dwarakanath and Vandana KL. Essentials of Periodontology, Recent Advances in Periodontics. Chapter 71, page 745-746.
27. Saravana kumar R, Vijayalakshmi R. Nanotechnology in Dentistry. Ind.J .Dent. Res. 17(2):62-5,2006.
28. Rudra Pratap. Engaging Private Enterprise in Nanotechnology Research in India. ICS, Trieste, February 2005, 675-680.
29. Toxicol 2008. Chem. Res. Nanoparticles on epithelial cells. (2008)
30. Singla Gorav et al. Nanodentistry– The Future Ahead. BFUDJ, vol-1 (1):July 2010; 43-5.
31. Dr.Sanyuktha Shetty, Dr.Nitin Shetty, Prof. Aravind Shetty and Dr.Devanand Shetty. Nanodentistry: Fiction to Reality. Indian Dentist Research and Review. Page 26-31.

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