

NANO ANESTHESIA AND NANO DRUG DELIVERY- A REVIEW ARTICLE

ABSTRACT:

Nano Technology is present since the late 1950's and is currently getting highlighted more in the field of dentistry. Nano Technology is grounded on conception of creating active structure by holding atoms and molecules on one by one base. The arrivals of nanotechnology demand the implementation of nano robots in varied angles of dentistry like local anesthesia, dentition, re-naturalization and permanent hypersensitiveness cure. Nano medication delivery systems give a new medication delivery approach for treatment of varied dental ailments. Nano material similarly appeals to experimenters in the fields of cancer diagnosis and bio- marker discovery. The ongoing review presents an updated summary of recent advancements in the field of Nano Dentistry in the conformation of Nano medicine delivery systems and Nano anesthesia, therefore enhancing the effectiveness of new and old medications.

Keywords: Nano Dentistry, Nano anesthesia, Nano drug delivery, Nano technology.

INTRODUCTION:

The word "Nano" is procured from Greek word for "dwarf". Nano constitute of one billion of any unit of measure.¹ It means that, one "nanometer" equals to 2 – 3 atoms or one million of a meter (10⁻⁹ meters).^{2,3} "Nano Technology, a field that includes study and evolution of the manipulation and manufacture of materials and devices measured on the nanometer scale". □ "Nano Dentistry is one of the forthcoming content in Dentistry which may be outlined as the enhancement and conservation of oral health through the use of nano materials and biotechnology, involving tissue engineering and Nano robotics". □ Nano Dentistry includes numerous holdings which are Nano robotic dentifrice, Nano impression, Nano encapsulation, Nano composites, Nano solutions, Nano adhesives, Nano diagnostics, Nano anesthesia and Nano drug delivery system, etc. Nowadays, the field of Dentistry is utilizing nano patches for implantation, drug delivery for caries treatment and precautionary care. □ Nano materials display better performances than the usual standard materials in terms of raised stiffness, durability, clearness, defiance to heat, solvent and bruise. □ The objective of this paper is to reconsider the operations, current status of Nano Dentistry and concentrate on the desirable characteristics for prosperous Nano particle based drug delivery systems as well as the varied affection states in which these nanoparticle systems have exhibited promise and also to give a brief understanding of use of Nano anesthesia in Dentistry.

MATERIALS AND METHODS:

The present review of literature search was done using online and offline mode. EBSCO, Google scholar databases were used. Available journals were checked. The keywords searched were as follows "Nano Dentistry", "Nano technologies and Nano Dentistry", "Nano Dentistry and Nano anesthesia", "Nano Dentistry and Nano drug delivery". The

only literature from English language was selected. No patient was involved in the present review. All articles from year 2000 were selected which contained information about Nano Dentistry, the articles which had information about Nano anesthesia and Nano drug delivery were included and articles which had information about Nano Impression, Nano Composites, Nano solutions and Nano encapsulation were excluded. All articles were read thoroughly by all the author's with the objective to understand Nano anesthesia and Nano drug delivery system in the field of Dentistry and then it was summarized.

NANO ANESTHESIA:

"Anesthetic injections are generally employed in dental processes and can create discomfort and numerous associated complications, particularly in pediatric cases. The application of nanotechnology in anesthesia includes release of an analgesic colloidal suspension bearing numerous functional micron- sized dental nanorobot molecules into the patient's gingival mucosa. Upon contact with the gingival mucosa, the portable nanorobots resettle through the gingival sulcus, transfer easily through the lamina propria or the layer of loose tissue on the cemento- dental connection, and penetrate into the pulp where they control nerve impulses by blocking the nerve endings".¹

"Upon completion of dental treatment, the dentist stimulates the nanorobots to restore all nerve impulses and leave the tooth in a analogous manner. This is succeeded by aspiration of the tooth. Nanorobotic anesthetics offer higher patient relief, precise selectivity of analgesic effect, less side effects and complications, minimum patient anxiousness and controllability and entire reversibility of the analgesic effect".¹ "Nano anesthesia is a bottom up approach which seeks to settle lower elements into more complicate assemblies, the covalent bonds of which are extremely strong". □

Possible advances of Nanotechnology in Anesthesia:

Nano Local Anesthesia- "Lidocaine- laded poly(capro- lactone)- poly(ethylene glycol)- poly(capro- lactone)(PCL- PEG- PCL) Nano patches in hydrogel was prepped of size 200 nm. This has been exhibited to be haughty in terms of onset of anesthesia and effectiveness. Once medicine is worked in, it's channeled through Nano- computer to the peculiar point where feat is needed. It's kept at that point for required time and shrugged off from core when not needed". □

Nano General Anesthesia- "At Canary isles, Automatic governed anesthesia network was evolved which detects hypnotic state grounded on Electroencephalographic recordings & Bispectral Index and supplies appropriate dose of anesthetic. It's a computer software agenda which saves time, an aesthetic medicine and their medications. Samples contain Nano articulated medicines like anesthetic medicines and diclofenac, Biosensor for watching depth of anesthesia, Nanotube capnograph detector, True time non invasive glucose and electrolyte monitoring". □

Nano Regional Anesthesia- "With nanotechnology, an cure to bupivacaine overdose is achievable. There's a conformation of pi- pi establishments between bupivacaine and a pi- electron-rich injectable nanoparticle. This establishment would be void of clinical goods of bupivacaine and would therefore render poisonous bupivacaine safe. Nano anesthesia could avoid high spinal life hanging complication which is generally associated with epidural anesthesia". □

Nano syringes- "It's the top down approach, it seeks to produce lower devices by using larger ones in attaining perfection in structure and assembly". □ Suture syringes with nano sized pristine steel crystals have been evolved. The characteristics in overall can be stated to be a combination of properties of unexceptional austenitic pristine and low alloyed ferritic steels. This means that properties similar as modulus of elasticity, mechanical properties and thermal expansion are similar to ferritic steels, while properties similar as corrosion resistance is more similar to austenitic pristine steels. □

NANO DRUG DELIVERY:

Conventional medications like solution, suspension or admixture undergo from unspecified boundaries like high dosage and low accessibility, first pass effect, intolerance, unstableness, and they flash inconsistencies in plasma medicine statuses and don't give sustained result, thus there's a want for some novel vehicles which could meet ideal demand of medicine discharge network. ¹ □ "The nano granule- based medicine discharge system can overcome numerous of the drawbacks that conventional medicine delivery systems face. For example, chemotherapeutic means employed in cancer treatment are traditionally allotted non-specifically, damaging both healthy cells and cancer cells, resulting in low effectiveness and high toxicities. Nanoparticle grounded medicine delivery systems would be excellent vehicles for chemotherapeutic agents, leading the chemotherapeutic agents to the tumor site therefore raising the medicine concentration in cancer cells and preventing toxin in normal cells". ¹¹ Nanoparticle grounded medicine delivery systems can also be used as a prevention system for multiple conditions of the mouth, involving the treatment of oral cancer and gingivitis, bone replacement, stem cell imaging, and tracking are among others. □

Presently, the medical field is using Nano particle technology as a curative treatment for medicine delivery on a cellular position. Nanoparticles are a type of colloidal medicine delivery system consisting granules with a size range from 10 to 1000 nm in girth. Mesoporous silica nano granules(MSN) shows a great capability in the course of medicine delivery. The basal structure of MSN consists of silica precursor, a surfactant, and a catalyst. The mesopores can be loaded with different medicines, DNA, RNA, proteins, stains, and metal nano particles. □

MSN have been loaded with anti-cancer, anti-seditious, antibacterial, antidepressant, osteogenic, antioxidant, and hypoglycemic medicines. These include ibuprofen(anti-inflammatory), erythromycin(antibiotic), doxorubicin(chemotherapy), and numerous other. □ The primary aims for exploration of nano-bio-technologies in medicine delivery includes: More precise medicine targeting and delivery, reduction in toxin while preserving curative goods, higher safety, biocompatibility, and quick development of new safe drugs. ¹² One of the major difficulty in current drug is the non-effective delivery system. This can be overruled by the use of suitable Nano delivery systems which are as follows:

Nano- Capsules- One of the significant improvements in the Field of dental science is the obtainability of the nano- caps. Nano- caps have been intertwined in the providence of medicines by forming a cocoon like edifice. Also, the nano caps can be regulated to be unlocked at a precise point at a regulated rate. ¹³

Nano- scaffolds- Utility of nano- scaffold was first allocated for the thrust of hormone discharge. Still, the operation can be extended to target any distinct position in the body for efficient discharge of any medicine. In dental drug, uses includes regeneration of varied tissues in the oral cavity involving periodontal ligament and alveolar bone. □

Nano- Quantum Dots- "Quantum dots would be the most innovative and effective system for the spotting of oral malignancy. Once the covered quantum dots with unique substances are delivered, they will fix themselves to cancer

precise cells and effuses ultra-violet spectrum. The light which is emitted has a distant wavelength which is altered by the crystal size".¹ □

Nano drug delivery can be used in the following:

Hypersensitivity Cure- "Dental nano robots could specifically and precisely block selected tubules in minutes using native biological materials, offering cases a quick and endless cure for sensitiveness caused by the fluctuations in pressure transferred hydro- dynamically to the pulp".¹ □ "Natural hypersensitive teeth possess eight times advanced surface density of dentinal tubules and periphery with double as larger than nano sensitive teeth". □ "Reconstructive dental robots using native biological materials could specifically and precisely block specific tubules within twinkles, extending a quick and endless cure". □ "An in- vitro study carried out with a toothpaste bearing nano sized carbonate apatite displayed that dentin tubules were effectively sealed, which is important for sustained treatment of dentin sensitiveness".²

Treatment of oral cancer- "Nanotechnology in field of cancer curatives has provided largely specific tools in the form of multifunctional dendrimers and nanoshells. The distinctive property of dendrimers, like their high degree of branching, multivalence, spherical edifice and well- outlined molecular weight make them promising in cancer curatives. Nanoshells are miniscule globules with metallic external layers designed to produce intense heat by soaking precise wavelengths of radiations that can be used for particular destruction of cancer cells leaving away intact and adjoining normal cells". □ "Nano materials for brachytherapy, medicine delivery across the blood- brain barricade is more efficient treatment for brain tumors, Alzheimer's, Parkinson's in development, Nano vectors can be used in gene therapeutic and Non-viral gene delivery systems".¹ □

Periodontal conditions- The various nano particles that are being employed for medicine delivery in the regulation of periodontal conditions involve nano spheres, nano caps, nano fibres, nano gels, nano composites, dendrimers and liposomes.³ "Experimenters have tried to create an efficacious and satisfactory medicine delivery system for the treatment of periodontal conditions by producing nano particles impregnated with triclosan. It was concluded that the usage of triclosan particles into the test area eased inflammation". □ "Although this study researched only periodontal therapeutic, it indicated that targeted medicine delivery with nano materials is possible for other treatments. The best sample of the coming use of this technology is a procedure called Arestin, in which microspheres containing tetracycline are placed into periodontal pockets and tetracycline is administered locally". □

Dentifrobots- Nano robotic dentifrice(dentifrobots) delivered by mouthwash or dentifrice command all supragingival and sub gingival surfaces minimal once a day metabolizing entrapped organic matter into innocuous and odourless vapours, performing continual calculus debridement and linking and destroying pathogenic bacteria living in the plaque and elsewhere, while allowing the 500 species of innocuous oral microflora to flourish in a healthy ecosystem. □

Advantages of Nano anesthesia and Nano drug delivery:

"It includes controlled release characteristics, enhanced stability and dissolution in aqueous medium, increased transportation across the cell membrane which reduces clearance and enhances bioavailability, improved drug loading ability due to increased surface area per unit mass and higher surface reactivity, size simulating and biomimicking natural tissue and thus better tissue tolerance".³ "Nano anesthesia offers greater

patient comfort, reduces anxiety, no needles, greater selectivity, controllability of analgesic effect; fast and completely reversible action; avoidance of side effects and complications".^{1 7}

Disadvantages of Nano anesthesia and Nano drug delivery:

It includes high expenditure, complex fabrication, toxin, practical performance and uncontrolled self replicating nanorobots will consume earthly resource. ¹³ Nanotechnology may not exist faultless. " The lower the particles, the further poisonous they get, " tests have exhibited that nanotechnology can act as toxic to the communities we reside in and nano particles are understood to bio-magnify in creature organs. Scientists are alike covered about soil and plant life. Nano particles can result lung damages. By leveling its threat and advantage, we can maximize usages in drug without damaging the public wellness and surroundings. ¹□

Challenges Faced by Nano dentistry:

"It requires proper assembling of the molecules to build a functional unit, requires financial constraints for mass production of nano robots, biocompatibility, difficulty in coordinating the activities of nano sized nano robots, public acceptance is questionable, ethics and regulations have to be formulated, human safety issues, etc. due to this it requires further research".^{1 6}

Conclusion:

Nanotechnology is a quite new, fast evolving field of science that has great capability in the efficient growth of new devices and nanomaterials that can be used in the operation of human health. This likewise includes the field of dentistry, where nanotechnology is previously existing related for the growth of novel nanomaterials, better diagnostic and treatment strategies, and tissue regeneration for the enhancement and conservation of oral health. However, despite fast growths in this field, it's quiet in its earliest phase and, thus, requires farther study and clinical researches.

REFERENCES:

1. Kasimoglu Y, Tabakcilar D, Guclu Z, Yamamoto-Nemoto S. Nanomaterials and nanorobotics in dentistry: A review. *Journal of Dentistry Indonesia*. 2020;27(2):77-84.
2. Ozak S, Ozkan P. Nanotechnology and dentistry. *European journal of dentistry*. 2013 Jan;7:145-151.
3. Yadalam P, Arumuganainar D, Kasipandian R, Varatharajan K. Nanodrug delivery systems in periodontics. *International Journal of Pharmaceutical Investigation*. 2021 Mar;11(1):5-9.
4. Gordon S, Shaddox L. Nanoparticles in Dentistry: Evidence and Future. *American Journal of Biomedical Science & Research*. 2020 Apr;8(4)321-323.
5. Li Z, Tan S, Li S, Shen Q. Cancer drug delivery in the nano era: An overview and perspectives. *Oncology reports*. 2017 Aug;38(2):611-624.
6. Rajan S, Acharya S, Saraswathi V. Nanodentistry. *Indian Journal of Scientific Research*. 2013;4(2):233-238.

7. Dalai D, Gupta D, Bhaskar D, Singh N. Nanorobot: A Revolutionary Tool in Dentistry for Next Generation. *J Contemp Dent*. 2014;4(2):106-112.
8. Das S, Gates A, Abdu H, Rose G, Picconatto C. Designs for Ultra-Tiny, Special-Purpose Nanoelectronic Circuits. *IEEE Transactions on Circuits and Systems*. 2007 Nov;54(11):2528-2540.
9. Sheety N, Swati P, David K. Nanorobots: Future in dentistry. *The Saudi Dental Journal*. 2012 dec;25:49-52.
10. Mudshinge S, Deore A, Patil S, Bhalgat C. Nanoparticles: Emerging carriers for drug delivery. *Saudi Pharmaceutical Journal*. 2011 Apr;19:129-141.
11. Dang Y, Guan J. Nanoparticle-based drug delivery systems for cancer therapy. *Smart Materials in Medicine*. 2020 Apr;1:10-19.
12. Jong W, Borm P. Drug delivery and nanoparticles: Applications and hazards. *International Journal of Nanomedicine*. 2008;3(2):133-149.
13. Kumar M, Goel M, Gandhi A, kalra S. Nanotechnology in Anesthesia and Pain- A Review. *Theranostics Brain,Spine & Neural Disorders*. 2018 Oct;4(1)555627.
14. Raval C, Vyas K, Gandhi U, Patel B, Patel P. Nanotechnology in dentistry: A review. *Journal of Advanced Medical and Dental Sciences Research*. 2016 May;4(3):51-53.
15. Kumar S, Vijayalakshmi R. Nanotechnology in dentistry. *Indian Journal Dental Research*. 2006 Apr;17(2):62-5.
16. Sasalawad S, Naik S, Shashibhushan K, Poornima P. Nanodentistry: The next big thing is small. *International Journal of Contemporary Dental and Medical Reviews*. 2014 Dec; 101114.
17. Bumb S, Bhaskar D, Punia H. Nanorobots and challenges faced by nanodentistry. *Guident*. 2013 Sep;6(10):67-9.