

Nano Dentistry : A Peep into Future

Dr. Naresh Sharma

Reader

Dr. Diksha Saini

Intern

Dept. of Pedodontics & Preventive Dentistry
Manav Rachna Dental College, Faridabad, INDIA**Address for Correspondence**Dr. Naresh Sharma
1204, Sector-37, Shashi Kant Enclave, Noida-201303
naresh.mrdc@mrei.ac.in, nareshsharma-274@yahoo.co.in**Abstract**

Nano technology is invading in almost all aspects of science and its scope knowing no boundaries, we have with us a power which can be utilized to provide many benefits to mankind in many limitless ways. This is just a beginning of nano era in science. Let's find out what future holds for all of us.

- No bad teeth, worn-out jaws, and other skeletal maladies
- Will be an era of oral robotic tooth-flosser and cleaner
- Implants and dentures will exist only in museums
- A new era in dentistry.

Keywords: Ribosomes, Nanometers, Topoisomerase, Renaturalization, Flagellar.**Introduction**

- 'Nano' derived from Greek word for dwarf.
- Nanotechnology is defined in terms of linear scale.
- It describes materials, systems & devices with characteristic dimensions in the range 1-100 nanometres.

History

- 5000 BC: Democritus postulates atoms to be the fundamental building blocks of the visible world: 'atom', 'not cleavable'.
- 1974: Norio Taniguchi conceives the word 'nanotechnology'
- 1981: Binnig & Rohrer build first scanning tunnelling microscope (STM).
- 1989: Eigler writes IBM company logo using Xe atoms placed in position using a STM.
- April 2000, Bill Joy (co-founder of Sun Microsystems) stated that research into nanotechnology should stop immediately, as developments in the wrong hands could end life, as we know it!

Scope

- Biology has evolved nano-components and systems that exhibit motor, memory, sensor, signal processing, catalysis, synthesis, circulatory, and delivery functions.
- Mimicking the precision and efficiency already present in biological systems is likely to yield the greatest results - the starting position being components and processes that have been perfected through millions of years of evolution under diverse environmental conditions.

Nanotechnology and Nature

Flagellar Motor: A highly structured aggregate of proteins anchored in the membrane of many bacterial cells, providing the rotary motion that turns the flagella (whip-like 'propeller'). This motor uses the decomposition of ATP to cause changes in the shape of the molecules, making the protein shaft revolve.

- Biochemical motors
- Ribosome's make proteins in an assembly-line like (sequential) process.
- Topoisomerase unwinds double-stranded DNA when it becomes too tightly bound.
- Not all nanotechnology is new (nano-sized carbon black particles have been used as a reinforcing agent in car tyres for the last 80 years), while some ancient glazes derive their colour from nanoparticles...and almost the same technology is being used in nano-composites used in dentistry.

Nano Robots

- Devices ranging in size from 0.1-10 micrometers and constructed of Nan scale or molecular components.
- As no artificial non-biological nano robots have so far been created, they remain a hypothetical concept at this time.
- Nano robots when injected into the patient will be expected to perform their treatment at the cellular level

Dental Anesthesia

- Dentinal tubule number density is typically 22,000 mm⁻² near the DEJ,

- 37,000 mm⁻² midway between the junction and the pulpal wall, and
- 48,000 mm⁻² close to the pulp in coronal dentin.
- Low in no. in the Root and around the CEJ ~13,000 mm⁻².
- Tubule diameter increases nearer the pulp which may facilitate Nan robot movement, although circum-pulpal tubule openings vary in number and size.

Tooth Regeneration

- Genetic engineering.
- Tissue engineering: stem cells.
- Nano robotic manufacture and installation of a biologically autologous whole-replacement tooth that includes both mineral and cellular components-that is, complete dentition replacement therapy.
- Within the time and economic constraints of a typical office visit, through the use of an affordable desktop manufacturing facility, which would fabricate the new tooth, in the dentist's office?

Conservative Dentistry: New Face

- Dentition Renaturalization procedures.
- Getting rid of amalgams and composites.
- Teeth remanufactured with native biological materials.
- Teeth remanufactured will become indistinguishable from the original teeth.

Dentinal Hypersensitivity

- Most probably caused by changes in pressure transmitted hydro dynamically to the pulp.
- Occluding the dentinal tubules by nano robots.
- Relief within seconds.

Orthodontic Nano Robots

- Would directly restructure the periodontium to facilitate tooth movement.
- Will facilitate rapid and painless tooth repositioning.

Oral Surgery

- Hybrid Implant for facial/peripheral nerve regeneration.
- University of Heidelberg: Work on nano robots for various Cranio-maxillofacial osteotomies.
- Tissue Engineering.
- Protein based Biosensor for the detection of Oral Cancer from Saliva of patient.
- DNA and Protein Chips.
- Single DNA strand immobilised on array sites (synthesised or spotted).
- Complementary strand can attach.
- Detection via fluorescent markers and/or electrical detection.

Nanodentistry: Achievements**1. Nanocomposites**

- Superior hardness;
 - superior flexural strength;
 - superior modulus of elasticity;
 - superior translucency and esthetic appeal, excellent color density, high polish and polish retention;
 - about 50% reduction in filling shrinkage;
 - Excellent handling properties.
- All these characteristics make nano-

composites superior to the conventional composites and blend with natural tooth structure much better.

2. Nano-adhesive solutions

- Higher dentine bond strength and better performance.
- No shaking of bottle required since the nanoparticles are stable, neither do they cluster nor do they settle out of dispersion (in contrast, larger fillers tend to settle out of solution and such adhesives require routine shaking before use.

Thus, the use of nanotechnology in bonding agents ensures homogeneity and so the operator can now have total confidence that the adhesive is perfectly mixed every time.

3. Impression Materials

- Nanofillers are integrated in the vinylpoly-siloxanes, producing a unique addition siloxane impression material.
- Better flow,
- Improved hydrophilic properties hence fewer voids at margin and better model pouring,
- Enhanced detail precision.

Nanobots: Some Challenges

- Assume one exists Assembling an object at the rate of one bond per ns (10⁹ bonds/s), this nano robot would require almost 1 million years to make 1 gram of something.
- It would therefore make sense for the nano robot to first make copies of itself.
- Nanobots: Self-Replication.
- Assume one nano robot contains 10⁹ atoms in some complex structure.
- At the one bond per nanosecond rate assumed above, the nanobot would need only 1 sec to create a copy of itself.
- After 60 sec of cloning, there would be 10¹⁸ nanobots.
- These could produce 50 kg of 'something' per sec.
- Such nanobots would inevitably randomly mutate.
- We would then loose control of at least some mutants, and they would then simply take whatever material they desired to reproduce themselves or some other arbitrary structure ('grey goo' scenario).

Conclusion and Future

With nano technology invading almost all aspects of science and its scope knowing no boundaries, we have with us a power which can be utilized to provide many benefits to mankind in many limitless ways. This is beginning of nano era in science. Let's find out what future holds for all of us.

- No bad teeth, worn-out jaws, and other skeletal maladies.
- Will be an era of oral robotic tooth-flosser and cleaner.
- Implants and dentures will exist only in museums.

References

References are available on request at editor@healtalkht.com

