

EDITORIAL

NANODENTISTRY: THE STORY SO FAR

Rakesh N.

Reader, Department of Oral Medicine and Radiology, Faculty of Dental Sciences
M.S. Ramaiah University of Applied Sciences, Bengaluru - 560054

Nanotechnology refers to the applied research and development of molecular engineering and manufacturing at atomic or molecular level. The word 'Nano' means "dwarf" in Greek and it implies one-billionth (10^{-9}) of standard unit. It was Professor Richard Feynman, an American Physicist, in his lecture titled "there is plenty of room at the bottom" at Caltech in 1959, who inspired the idea of nanoscience to the scientific world. The term 'nanotechnology' was coined by Prof. Kevie E. Drexler in his book titled Engines of Creation: The Coming Era of Nanotechnology.

Over the past three decades' nanomedicine has sparked much attention in various medical fields like pharmacological research, clinical diagnosis, supplementing immune system, cryogenic storage of biological tissues, detection of proteins, probing of DNA structure, tissue engineering, tumor destruction hyperthermia separation and purification of biological molecules and cells, Magnetic Resonance Imaging (MRI) contrast enhancement, etc. This is possible because of the development of various nanoparticles which include nanopores, nanotubes, quantum dots, nanoshells, nanospheres, nanowires, nanocapsules, dendrimers, nanorods, liposomes and so on.

For example studies have shown its use in clinical diagnosis, where Magnetic and Gold nanoparticles tagged with antibody or DNA, can be used to accurately detect microorganisms or gene sequences. Quantum dots are semiconductor nanoparticles that have unique optical and electrical properties. Multicolour optical coding for biological assays has been achieved by embedding different-sized quantum dots into

polymeric microbeads. Also, quantum dots can be injected into cells or attached to proteins in order to track, label, or identify specific biomolecules, and these offer ultimate detection sensitivity.

Other examples include: a) nanoparticles which can be used for drug delivery to the specific target site reducing the chances of adverse effects b) biomimetic nanoparticles and bioactive nanoparticles which can induce tissue regeneration and repair c) nanorobots which can be used for advanced microsurgery with the help of femtolasers and d) nanorobots which can track and diagnose tumour cells and selectively modify the genetic structure. Hence the nanomedicine as discipline is continuing to evolve and discovering new potentials for the application of nanotechnology.

It was only a matter of time until which these developments in nanomedicine triggered the inquisitive minds of many researchers for its applications in dentistry. This led to formation of the field of 'Nanodentistry' – a discipline solely focused on research and development and application of nanotechnology in various aspects of dentistry, from diagnosis to therapy. Although many nanomedicine applications are valid and can be successfully applied in dentistry, certain dentistry specific innovations are also under development. These include local anaesthesia, dentition renaturalization, permanent cure of hypersensitivity, complete orthodontic realignment during a single office visit, covalently bonded diamondized enamel and continuous oral health maintenance with the help of mechanical dentifrobots (nanorobotic



dentifrice) that destroy caries-causing bacteria and even repair blemishes on the teeth where decay has set in. Basically, approaches of nanotechnology in dentistry has been classified into two:

a) Bottom up approaches, where the smaller components are arranged into more complex assemblies

b) Top down approaches, where smaller devices are created using larger ones to direct their assembly

Bottom up approaches includes applications like Inducing anesthesia, Major Tooth Repair, Hypersensitivity Cure, Dental Durability and Cosmetics, Nanorobotic Dentifrice (dentifrobots), Tooth repositioning, Local drug delivery, Nanodiagnostics, Therapeutic aid in oral diseases etc.

Top down approaches include Nano Light, Curing Glass Ionomer Restorative, Nano Impression Materials, Nano-Composite Denture Teeth, Nanosolutions, Nanoencapsulation, Plasma Laser application, Prosthetic Implants, Nanoneedles and Bone replacement materials. Hence, with research in nanodentistry picking up at exponential rates, soon nanoparticles will be used in our everyday dental practice.

As with any new scientific development, nanotechnology also raises social, ethical, economical and safety concerns regarding its universal use. One aspect that is most threatening is the potential misuse and abuse of this technology especially in bioterrorism which can cause catastrophic events on a worldwide scale. Therefore, there is a need for further research, weighing both the factors of use and misuse of nanotechnology in the field of medicine and dentistry, before launching it as a breakthrough technology for diagnosis and therapy.

