The U.S. National Nanotechnology Initiative defines nanotechnology as: "The science, engineering, and technology related to the understanding and control of matter at the length scale of approximately 1 to 100 nanometers. However, nanotechnology is not merely working with matter at the nanoscale, but also research and development of materials, devices, and systems that have novel properties and functions due to their nanoscale dimensions or components."

Present Application Of Nanotechnology In Orthodontics:
Bonding Agents: 'G Bond' one bottle system is manufactured making use of nanotechnology principles. The interface formed by G-bond is totally different from that of the interface formed by earlier bonding materials. Nano Interaction Zone (NIZ), or a reacted layer is formed at the "nano" level leading to stronger and more durable bond. It has adhesive strength of more than 40 MPa, which is comparable to the adhesion of two-step systems to dentin & also satisfactory initial adhesive strength. 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.

Impression Materials
Impression materials are available with nanotechnology application. Nanofillers are integrated in the vinylpolysiloxanes, producing a unique addition siloxane impression material.

Advantages
- better flow,
- improved hydrophilic properties hence fewer voids at margin and bettermodelpouring,
- enhanced detail precision.
- E.g. NanoTech Elite H-D+

Applications Of Nanotechnology In Orthodontics: A Review 01
Vol4, Issue1  CODS-Feb20
Application Of Nanotech For Improvement In Anchorage:

Nano-Implants: Nano-technology offers new biocompatible nano materials and coatings that should increase the adhesion, durability and lifespan of orthodontic implants. E.g. Calcium phosphate apatite (CPA) and Hydroxyapatite (HAP) coatings over the implant surface.

Bone Replacement Materials: Hydroxyapatite nanoparticles used to treat bone defects are
- Ostim® (Osartis GmbH, Germany) HA
- VITOSS® (Orthovita, Inc., USA) HA + TCP
- NanOss™ (Angstrom Medica, USA) HA

These bone replacement materials have improved properties than conventional bone grafts. In cases where bone support has been lost and orthodontic tooth movement is not possible, these materials can be helpful in treatment with help of periodontists.

Tooth Movement By Nanorobots

Orthodontic nanorobots could directly manipulate the periodontal tissues, including gingivae, periodontal ligament, cementum & alveolar bone, allowing rapid and painless tooth straightening, rotating, and vertical repositioning within minutes to hours.

Tooth Renaturalisation

In this, teeth are remanufactured with native biological materials using nanobots that may correct tooth malformations e.g. Peg shaped laterals. This will enhance the final results of orthodontic treatment.

New Diagnostic Systems Using Nano Transducers:

A novel approach mimicking malocclusions using a three-dimensional setup with nanotechnology transducers appearsto have great potential to help us understand the complexity of intra-arch biomechanics and its impact on frictional resistance among other mechanical aspects of orthodontics. This has helped to understand frictional resistances of different orthodontic bracket systems. The same approach will make diagnosis and selection of appliance system easy for orthodontists.
Applications Of Nanotechnology In Orthodontics: A Review

Fig. 7. Mimicking mal occlusion using nano transducers

Nanoparticles Coated Arch Wires

Coatings of nanoparticles like Titanium over the archwires and brackets will improve their mechanical properties, decrease friction. Also coatings of some other nanoparticles will improve their biological properties so that their plaque retention is reduced.

Fig. 8. Nano particles coating over archwires

Electrically Powered Orthodontic Brackets & Bonding

Orthodontic brackets with integral light sources in the mesh surface will make bonding easy to perform. One example may be blue CyberLites from Kopin Corporation (Taunton, Mass.) which are made using nanotechnology and are smaller than a grain of sand.

Silica Coated Retainers:

Nano particles of silica can be coated over the acrylic part of Hawley’s retainers to avoid oral thrush in susceptible individuals.

Conclusion:

Application of Nanotechnology may sound like science fiction now. But Stephen Hawking has rightly said, “Today’s science fiction is often tomorrow’s science fact.” So, we can expect nanotechnology to revolutionize the field of orthodontics making our life easy.

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