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Periodontal Diseases and Recently Applied Nano-Technology: A Review Article

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Abstract

Nowadays, nano-technology is a promising option for scientists to enhance dental conditions and provide new techniques to offer a more reliable and comfortable therapeutic pickups. In this regard, there are different methods to manufacture novel nano-structured dental materials, and also modern drug delivery techniques. In this review article, all our efforts are based on the recently nano-dental approaches closely linked to treat or prevent some common dental diseases including tooth erosion, tooth sensitivity, periodontal disease, oral cancer, and so on. All the data and articles putted in this survey are gathered from Google Scholar, PubMed, and some dental databases.

Keywords

Dental Diseases, Nano-Technology, Nano Particles, Drug Delivery, Dental Implant

1. Introduction

Nano-technology is commonly attributed for the technologies leading to produce nano-scaled materials (10 - 9 m) at nanometer dimension. This feather of nano-particles provides a larger surface space per unit mass than those which are not in nano size [1].

To create nano-structured materials there are two commonly routine techniques including, top-down technique and bottom-up technique, which their main difference is based on the size of primary entities applied to build nano components with or without atomic level control [2].

Reportedly, nano-composite resins were the first dentistry products utilized which showed greater mechanical, physical, and chemical characterizations such

as, better color density, surface brightness and less roughness, and superior potential to attach to the tissues, it should be declared that self-assembly of nano-structured compounds is a very impressive aspect. After this achievement, many efforts have been done to manufacture new nano-materials to improve mechanical fortification, aesthetic feathers, and control oral hygiene and diseases by adding antibiotics or creating new drug delivery systems, in this regard [3].

Taking nano-dentistry into close consideration as a promising development to improve dental conditions and hygiene, it has made researchers to find new methods which expand their knowledge and techniques to manufacture modern dental nano-materials and drug delivery systems. Usage of nano-technology in dentistry is mostly described as these three categories including nanorobotics, nanodiagnostics, nanomaterials which each of them has specific applications (as can be seen in **Figure 1**) [4]. Due to these developments, many oral and dental problems are putted in the better conditions from dental disease diagnosis to the more efficient treatments. Accordingly, there are specific descriptions for each group. In the term of nano materials, it should be declared that there are various type of nano-particles in different dimensional nano structures (zero-, one-, two-, and three-dimension), such as, nanopores, nanotubes, quantum dots, nanoshells, nanofibres, nanorings, nanocapsules, metal nano-particles [5] [6]. In the nanodiagnostics category, there are different applications mostly applied to diagnose some oral cancer & other dental diseases (**Figure 1**). Nanorobotics is a definition for application of many microscopic nanorobots together probably in many dental fields such as, local anaesthesia, hypersensitivity cure, dental biomimetics, dental durability and cosmetics, orthodontic treatment, dentifrobots, and renaturalization procedures [4].

2. Dental Diseases and Nano-Technology

In terms of using nano technologies in dentistry, it should be declared that many efforts have been carried out to detect, prevent and also treat variety different dental issues (oral bacteria, biofilms) and diseases such as periodontal problems, oral cancer, tooth erosion and sensitivities in many ways. Furthermore, many new dental nano-products have been produced and examined to achieve these goals. To clarify these efforts, designing new dentifrice and toothpaste containing nano-particles or nano drugs, using nano particles as a part of the basic implant materials and suggesting new nano-drug delivery systems in dentistry could be suitable examples.

3. Nano-Drug Delivery in Dentistry

Using Anti cancer nano particles have always considered as a promising drug delivery strategy to target specific regions in the body to obtain the better results with fewer side effects and more specificity; therefore many investigations have taken place to riche a more effective method. Hence, oral diseases have been the encouraging challenges for drug delivery purposes. Up to now, many endeavors have been performed to manufacture novel dental products, implants or

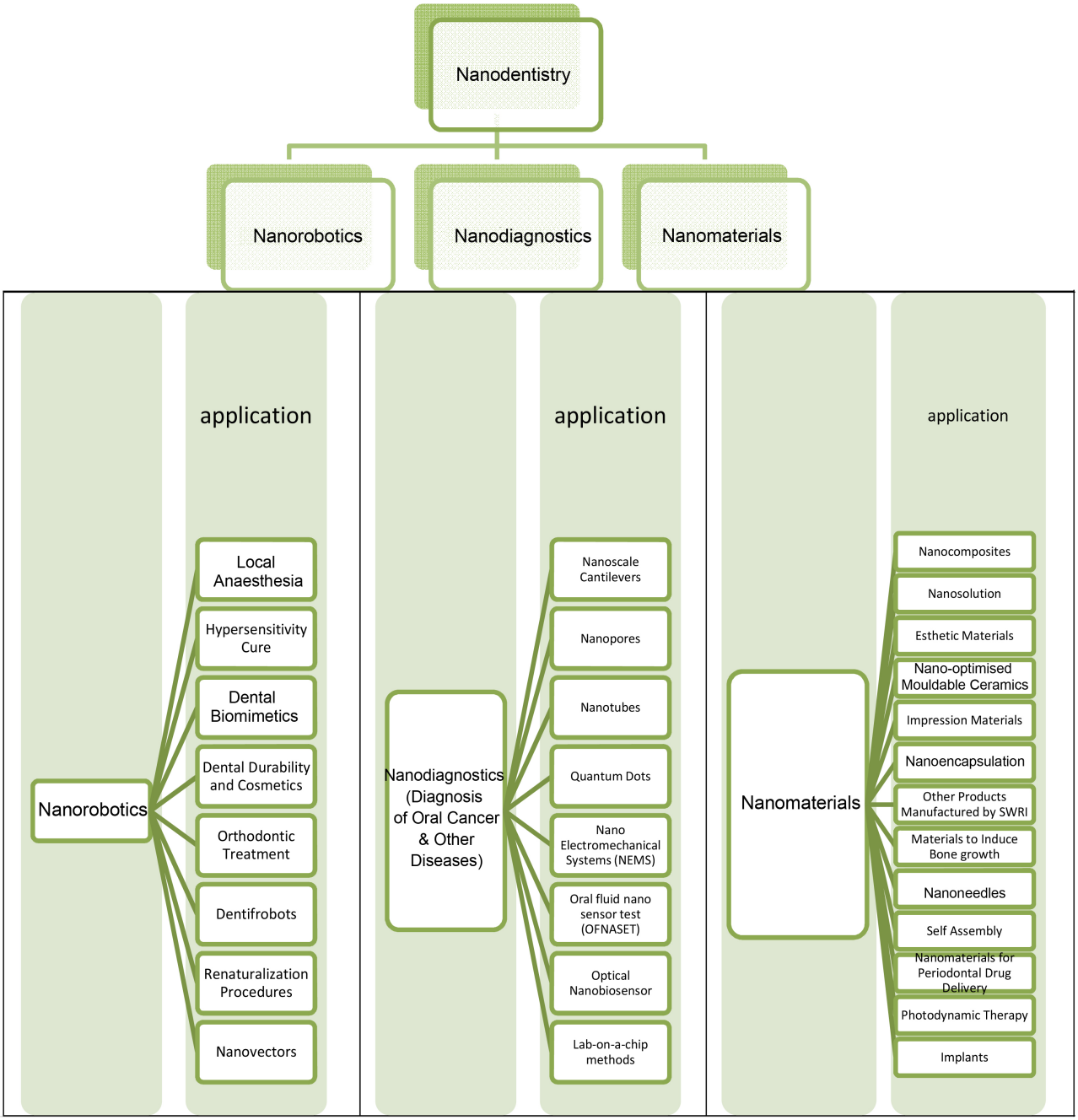

Figure 1. Utilization of nano-technology in dentistry today [23].

techniques utilized nano-technology. Below there are some recently approaches in this field.

Recently, many studies related to applying nano-technology in cancer detection and screening have been reported which indicate the greater improvement in diagnosis of oral cancer. Application of nano-bio-chip sensor platform [7] and exfoliative cytology and paper-based Surface-enhanced Raman scattering (SERS) of plasmonic gold nanorods (GNRs) [8] are two recent tangible endeavor with promising clinical potential.

Among many researches surrounding enhancement of the properties of dental

products such as toothpaste, the survey carried out by Nakashima S, *et al.* in 2009 is considerable, accordingly, the remineralization effect of nano-sized calcium carbonate added to dentifrice was evaluated and compared on enamel lesions [9].

4. Some Recently Nano-Drug Delivery and Dental Disease

Yang K, *et al.* in 2001, tried to provide an effective way to target cervical lymph nodes by the peri-cancer submucosal injection of Cucurbitacin BE polylactic acid nano-particles [10], then in following investigation in 2014, they evaluate its Acute toxicity and local stimulate compared with Cucurbitacin BE polylactic acid which illustrate the lower toxicity and local simiulation of nano-sized Cucurbitacin BE polylactic acid [11]. In the same year, nasopharyngeal carcinoma (NPC) have picked out as a target of drug delivery of Functionalized Lipid Nanoparticles linked to a amphipathic α-helical peptide (α-NTP-LNs), subsequently, the results increased the therapeutic efficacy of α-NTP-LNs in contrast to NPC [12].

5. Recently Nano-Drug Delivery and Dental Implants

A dental implant through a surgical osseointegration is placing into bone to support a dental prosthesis. The pros and cons associated with dental implants materials lead scientists to invent and examine new methods to improve its properties from different aspects. Covering implants by different medical and non-medical materials such as nano-particles has been a remarkable attempt to improve its biomedical application. there are many recently publications showing significant researches relatively, Improving osteoblast functions, osteoconductivity, osteogenesis, and bone regeneration and formation mainly have been subjected to many implant surface-nano-modifications; some of previous studied in 2015, 2014 and 2013 are good examples of many, BMP-2 preloaded on bone substitute or hydrogel [13], implant with Bioresorbable zinc hydroxyapatite [14], N-acetyl cysteine-loaded nanotube titanium dental implant [15], Gene delivery of c-myb transcription factor associated with titanium [16], revealed bon regeneration.

Delivery of some compounds inducing bone regeneration are also reported, druge delivery od of bone morphogenetic protein-2 by La WG, *et al.* is a good example of this kind [17].

6. Periodontal Disease and Recently Used Nano-Technology

Based on a review article provided by pela Zupan, *et al.* in 2015, the application of drug delivery systems and nano particles, nano-crystals, dendrimers, and nanofibers in treatment of Periodontal Disease, as a dental chronic inflammation are highlighted [18]. Furthermore, recently, there are also other benefits of nano-technology recently used in the case of screening periodontal disease, such as the assay performed to monitor human periodontal ligament stem cell response to extracellular matrix [19]. Moreover, evaluation of Antimicrobial properties of

green synthesized drug blended silver nanoparticles against periodontal disease should be mentioned as other endeavors [20].

7. Tooth Sensitivity and Nano-Technology

Tooth or dentin sensitivity is categorized as a dental disease, up to now, many studies and investigations have been done to reduce its symptoms. Applying modern nano-technology has been an encouraging option for researchers to deal with it, three-year follow up and evaluation dental composite based on sort of stress decreasing resin technology in 2014 is a recent instant of these efforts [21]. In another survey, Gordon LM and Joester D have emphasized that nano-scale chemical tomography would have effective influence to evaluate dental biomaterials and synthetic composites [22]. The significant assessment role of nano-hydroxyapatite on dentinal tubules has been declared in 2009 [23].

8. Conclusion

It is utterly clear that, modern developments in the field of nano-technology and drug delivery systems have shown substantially great impacts on diagnoses and cure some oral and dental diseases and also quality and aesthetic feathers of tooth products and components. It seems that nano-technology in future has promising perspective to every aspects of dentistry.

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