

ASSESSMENT OF KNOWLEDGE OF ENDODONTISTS ON NANOTECHNOLOGY IN ENDODONTICS- AN INNOVATIVE RESEARCH

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Abstract

Background: The advances in nanotechnology may lead to a new era of translational applications of nanoparticles in endodontic treatment.

Aim of the study: The purpose of the study is to understand and assess the knowledge of Nanotechnology used in Endodontics and how they can be helpful in ensuring proper prevention and treatment of endodontic cases.

Methodology: A questionnaire-based survey was conducted amongst 50 Endodontists who had more than a year of clinical experience. The questions were based on usage of Nanoparticles as well as its contribution in the field of dentistry particularly in case of Endodontics.

Results: Out of all the survey endodontists around 65 % felt that nanotechnology is the future in dentistry. Around 90 % endodontists believe that a lot of expertise might be required in using nanotechnology.

Conclusion: Nanoparticles may be developed for a variety of purposes in endodontics, such as disinfection strategies, photodynamic therapy, obturation materials and regenerative procedures. Thus, the increasing interest in this field warrants sound research based on scientific and clinical collaborations to emphasize the future potential of nanoparticles in clinical endodontics.

Keywords: Nano Particles, Nanotechnology, disinfectant, nanobioparticles, endodontics.

INTRODUCTION

Nanotechnology, also called molecular manufacturing, is an interdisciplinary science concerning the tiniest of particles in the molecular inter and intracellular level. It has revolutionized various fields such as engineering, physics, chemistry, biology, material science, medicine, and information technology, thereby transporting humanity to a new era. One of the branches of dentistry that deals with the morphology and physiology of the endodontium is endodontics. It combines such aspects of this field as etiology, pathology, epidemiology, prophylaxis and, above all, treatment of endodontic and periapical diseases. In recent years, nanomaterials have become increasingly present in medicine, especially in dentistry. Their characteristics are proving to be very useful in clinical cases. Due to the intense research in the field of biomaterials and nanotechnology, the efficacy and possibilities of dental procedures have immensely expanded over the years. In the field of endodontics, the nanomaterials are focused on steps that would improve mechanical integrity, antimicrobial of previously diseased tissue regeneration, and dentin matrix. Therefore, the aim of the study. 1-5 Bioceramic-based nanoparticles incorporated into endodontic sealers have revolutionized obturation by gaining access into irregular dentinal surface. Quaternary ammonium polyethyleneimine (QPEI) nanoparticles in the same provides excellent antimicrobial properties. 6-10 The purpose of the study is to understand and assess the knowledge of Nanotechnology used in Endodontics and how they can be helpful in ensuring proper prevention and treatment of endodontic cases.

METHODOLOGY

A questionnaire survey was conducted amongst 50 Endodontists who had more than a year of clinical experience. The survey comprised of questions which were in an open-ended format and in English language. These were sent to survey participants via Email and their responses were recorded on a Microsoft Excel sheet and then analyzed with the help of descriptive statistics. The questions were based on usage of Nanoparticles as well as its contribution in the field of Endodontics.

RESULTS

The survey participants included were 50 endodontists. Out of all the survey endodontists around 65 % felt that nanotechnology is the future in dentistry. Around 43 % believed that adding nanoparticles to biomaterials especially used in restoration of teeth would prove helpful as these would increase the flexural strength as well as improve the abrasion resistance and around 70 % believed that adding nanoparticles specially to composite restorative material reduced polymerization shrinkage considerably. 47 % showed increased strength in restoration materials and 40 % felt that nanotechnology will have better disinfectants for root canal irrigation as shown in Table 1. Around 90 % endodontists believe that a lot of expertise might be required in using nanotechnology as shown in Table 2.

Table 1- Advantages of Nanotechnology in Dentistry especially Endodontics according to survey participants.

Increased strength in restoration materials	43 %
Better disinfectants for root canal irrigation	40 %
Better flexural strength in cements	20 %
Increased abrasion resistance 45%	52 %
Reduction polymerization shrinkage of resin restorative materials	70 %
Prevent sealer leakage in root canal therapy	11 %

Table 2- Problems faced with Nano-dentistry according to survey Endodontists.

Increased cost	85%
Biocompatibility issues	12%
Ethical concerns	9%
Complicated procedures	15%
More training/expertise required	90 %

DISCUSSION

Nanotechnology provides the possibility of decreasing the size of devices and increasing the strength of materials, which makes tools more appropriate for utilization in medical devices.¹⁹ Most of the nanoparticles were tested for root canal disinfection depends on time-dependent and contact mediated antibacterial activity. Adding of various nanoparticles into root filling materials sealers or significantly improved the antibacterial efficacy by inhibition of biofilm formation on the surface as well as the resin-dentin interface.⁴ The nanometric BAG used by Dandelon et al. were amorphous in nature, ranging from 20 to 60 nm in size. ¹⁴ In vitro root canal disinfection studies showed a significantly less antibacterial effect of BAG compared with calcium hydroxide in preventing residual bacterial growth. Another popular nanoparticle Chitosan, has excellent antiviral, antibacterial, and antifungal properties. Other types of nano particles have been used as sealer to prevent leakage in the procedure of root canal therapy.¹⁹ In another study, Sondi et al. utilized nano- zinc oxide nano-powder and compared its leakage

with AH26 and micro size zinc oxide eugenol sealer. Their results indicated that zinc oxide nano-powders had the lowest micro-leakage among the investigated sealers. 15 Nanotechnology is able to enhance the mechanical strength of various materials. This ability can be applied in order to enhance mechanical properties of the materials utilized in root canal therapy. In addition to enhancement in mechanical properties of materials used in endodontics, nanotechnology has been employed in order to decrease setting time of endodontics materials. Although nanotechnology appears to introduce ground breaking techniques and devices in the dental field, there are some concerns as well. These include economical nanorobot mass production technique, ethical issues and human safety, biocompatibility issues and the expertise in precise positioning and technique. Nanotechnology is foreseen to change health care in a fundamental way by providing novel methods for disease diagnosis and prevention, therapeutics selection, tailored to the patient's profile, drug delivery and gene therapy.¹¹⁻¹⁵ Nanodentistry constitutes one of the most novel applications of nanotechnology. In this area, Nano Particles (NPs) focused on dentistry and, more specifically, in dental disinfections, constitute an important area that still needs to be explored. Nanomaterials offer a platform towards the specific delivery of active compounds, being able to penetrate through the root canals and fight against biofilm resistance. Specifically, biodegradable NPs have demonstrated biocompatibility and reduced toxicity. Further novel therapies in order to increase the success rates of endodontic disinfection constitute an unmet medical need. Among them, NPs are advocated as an innovative and effective tool in order to overcome the complicated dental tubules anatomy and deliver active compounds to the target site. Among several NPs types, metal NPs, especially silver NPs, are one of the most currently studied due to their suitable antibacterial effects. However, they pose serious concerns due to their toxic effects on human health and towards the environment. Therefore, efforts are being directed either to decrease the toxicity of silver NPs using functionalization or coating strategies, or towards the study and development of biodegradable NPs, such as chitosan-based NPs that possess a positive surface charge and intrinsic antibacterial capacity. Lipid NPs also offer an alternative that might be worth exploring in order to deliver active compounds in a directed manner, using natural compounds that are safe for human use.

CONCLUSION

The advances in nanotechnology may lead to a new era of translational applications of nanoparticles in endodontic treatment. Nanoparticles may be developed for a variety of purposes in endodontics, such as disinfection strategies, photodynamic therapy, obturation materials and regenerative procedures. Nonetheless, nanoparticles should not be applied with a "one size fits all" approach, given that different materials, formulations and combinations will generate different properties, both beneficial and adverse. Thus, nanoparticle applications in endodontics have a lot of potential but there is still some way to go before the basic research translates to clinical studies. Endodontists can keep themselves updated with the latest research on usage of Nanotechnology and Nano Particles in the field of Dentistry and Endodontics.

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