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Role Of Nanotics In Restorative Dentistry And Endodontics: A Review Study

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Abstract:
Background: *The era of science and technology has evolved to such an extent that the use of dental materials tends to miniaturised itself in the past few decades and rest to come. From macromolecules to micromolecules and thereafter nanomolecules has proved to dictate the evolution of dental materials and technology an everlasting phenomenon. The present paper dictates the role of nanotechnology by using miniaturised forms such as nanofibers, nanorobotics, nanodrugs delivery systems, nanoparicles and how it acts at a nanolevel which proves to be advantageous in different conditions. At this way certain challenges which has been faced previously can now be resolved at a nanolevel.*
Keywords: *Microorganism, local drug delivery, nanofibers, nanorobotics*

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I. Introduction

Nanotics is the technology which operates at a nanoscale in the range of 0.1 to 100 nanometers by either physical or chemical modes.[1] Tissue engineering, dental nanorobotics, local anaesthesia, dentition renaturalisation, permanent hypersensitivity cure, covalently bonded diamondised enamel and continous oral health maintenance using mechanical dentifrobots. Their applications has been widely accepted due to high surface area, high activity, catalytic surface, high adsorbent, prone to agglomeration, range of chemistries, natural and synthetic modes.[2]

Electrospun nanofibers and antibiotics containing aliquots have shown wide range of efficacy by acting on Actinomyces naeslundii, Enterococcus faecalis, Aggregatibacter actinomycetemcomitans and Fusobacterium nucleatum.[3] Biomaterial is transferred to the target site using a specifically designed micro/nanosized local drug delivery system which acts in a controlled and sustained pattern on the remaining dental pulp and stimulates hard tissue formation.[4]

II. Review

The newly futuristic approach is looking forward to define ongoing advancements in the field of restorative dentistry and endodontics. The applications of nanomaterials introduced in various forms i.e., natural, adventitious or engineered have been used in wide areas.[5] Nanostructured surface modifications are important in order to enhance efficacy of dental materials.[6] Enhanced physical properties such as compressive, tensile, biaxial flexural strength are improved by addition of nanohydroxyapatite crystals to restorative materials.[7,8] The Lava™ ultimate resin nano ceramic blocks manufactured by 3M™ESPE reveals superior characteristic features such as desirable aesthetics, durability and fracture resistance.[9]Several studies proved that superior properties has been revealed by nano ceramics and resin hybrid materials.

In restorative dentistry, nano amporphous calcium phosphate is a rechargeable composite resin which improves remineralising properties and maintains Ca and Phosphorous level by continuous recharge and release phenomenon.[10] Also known as smart materials as it shows the ability to neutralise bacterial acids by releasing Ca and Phosphorous ions and thereby, preventing secondary caries.[11] There were several studies which proved that incorporation of nACP in certain restorative materials such as luting cements and bonding agents showed better results in terms of prevention of caries. Such kind of specific technique is effective upto 3 weeks without the alteration of dentine bond strength.[12]

Several other forms of modification in order to prevent secondary caries is lactose modified chitosan (Chitlac) coated with silver nanoparticles (nAg).[13]Confocal Laser Scanning Microscope (CLSM) is used to examine alteration of the morphology of biofilm. Along with addition of QPEI i.e., cross-linked quaternised polyethyleneimine (QPEI) nanoparticles are effective against certain microorganisms and have shown several beneficial properties such as antibacterial effect, stable within the matrix and completely capsulated.[14] Calcium

peroxide nanoparticles gain the tendency to penetrate deeper into the tooth structure by different ways such as different forms of cracks; micro and nanocracks and hence increasing the effectiveness of whitening agents with the help of micro or macroparrticles.[15]

In the field of endodontics, there are certain forms of nanoparticles such as bioceramic nanoparticles e.g., bioglass, zirconia and glass ceramics in endodontic sealers. They are helpful in easy adaptation to micro irregularities and nano irregularities and improves dimensional stability, insoluble in tissue fluid, chemically bond to the tooth structure and osseoconductivity.[16] Due it's novel property, it tend to effective against endodontic biofilm, bond strength to dentin and ion release of calcium and phosphate ions in the form of endodontic sealer.[17] Silver nanoparticles incorporated in intracanal medicament i.e., calcium hydroxide in order to be effective against Enterococcus faecalis.[18] In a gel matrix, incorporation of nano silver particles in root canal sealer but found to be less effective against Chlorhexidine and Triple antibiotic paste.[19] There are different modes of local drug delivery systems such as microparticles (microspheres, liposomes, nanoparticles), hydrogels, fibers and other secondary modes such as cements, core-shell nanostructures, nanowires and filling materials, quantum dots.[20] Forms of nanoparticles such as nanodiamond particles are incorporated in gutta percha in order to increase it's efficacy.[21]

III. Conclusion:

In accordance with the above review, it is concluded that in order to improve the efficacy of restorative or endodontic treatment incorporation of nanoparticles is important. This aids in achieving the effectiveness of treatment at a nanoscale level.

Conflicts of Interest:
The authors declare no conflicts of interest regarding the publication of this paper.

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References

[1] Narayanan Mba, Kumar Sgr, Jayanthi D. Nanodentistry-An Overview. Jiaphd. 2011(18):278-81
[2] Kong Lx, Peng Z, Li Sd, Bartold Pm. Nanotechnology And It's Role In The Management Of Periodontal Diseases. Periodontology. 2000;40:184-196
[3] Karczewski A, Feitosa Sa, Hamer Ei, Pankajakshan D, Gregory Rl, Spolnik Kj, Bottino Mc. Clindamycin Modified Triple Antibiotic Nanofibers-A Stain Free Antimicrobial Intracanal Drug Delivery System. J Endod. 2018 January; 44(1):155-162
[4] Parhizkar A, Asgary S. Local Drug Delivery Systems For Vital Pulp Therapy: A New Hope. Hindawi. 2021:1-9
[5] Park B. Current And Future Applications Of Nanotechnology. Issues In Environmental Science And Technology. 2007;24:1-18
[6] Roszek B, Jong Wh, Geertsma Re. Nanotechnology In Medical Applications; State Of The Art In Materials And Devices. Rivm Report 2005.
[7] Moshaverinia A, Ansari S, Moshaverinia M, Roohpour N. Effect Of Incorporation Of Hydroxyapatite And Fluorapatite Nanobioceramics Into Conventional Glass Ionomer Cements. 2008;4(2):432-40
[8] M.E. L Ucas, K.Arita, M.Nishino. Toughness, Bonding And Fluoride Release Properties Of Hydroxyapatite Added Glass Ionomer Cement. Biomaterials. 2003;24(21):3787-3794
[9] Chen C, Trindade Fz, De Jager N, Kleverlaan C.J, Feilzer A.J.The Fracture Resistance Of A Cad/Cam Resin Nano Ceramic (Rnc) And A Cad Ceramic At A Different Thickness. Dental Mater.2012;30(9):954-962
[10] X.Xie, L.Wang.D.Xing, D.D.Arola, M.D.Weir, Y.Bai Et Al. Protein- Repellent And Antibacterial Functions Of A Calcium Phosphate Rechargeable Nanocomposite. J.Dentistry. 2016;52:15-22
[11] J.Wu, H.Zhou, M.D.Weir, M.A.S.Melo, E.D.Levine, H.H. Xu. Effect Of Dimethylaminohexadecyl Methacrylate Mass Fraction On Fracture Toughness And Antibacterial Properties Of Cap Nanocomposite. J.Dentistry. 2015;43(12):1539-1546
[12] L.Zhang, M.D.Weir, G.Hack, A.F. Fouad, H.H.Xu. Rechargeable Dental Adhesive With Calcium Phosphate Nanoparticles For Long Term Ion Release. J.Dentistry. 2015;43(12):1587-1595
[13] A.Ionescu, E. Brambilla, A.Travan, E.Marsich, I.Donati, P.Gobbi. Silver Polysaccharideantimicrobial Nanocomposite Coating For Methacrylic Surfaces Reduces Streptococcus Mutans Biofilm Formation In-Vitro. J.Dentistry.2015;43(12):1483-1490
[14] D.K.Shvero, N.Zatlsman, R.Hazan, E.I.Weiss, N.Beyth. Characterisation Of The Antibacterial Effect Of Polyethyleneimine Nanoparticles In Relation To Particle Distribution In Resin Composite. J.Dentistry.2015;43(12):287-294
[15] Velkoborsky V. 2010
[16] S.Utneja, R.R.Nawal, S.Talwar, M.Verma. Current Perspectives Of Bioceramic Technology In Endodontics:Calcium Enriched Mixture Cement-Review Of It's Composition, Properties And Applications. Restorative Dentistry Endod. 2015;40(1):1-13
[17] L.Wang, X.Xie, C.Li, H.Liu, K.Zhang, Y.Zhou, Et Al. Novel Bioactive Root Canal Sealer To Inhibit Endodontic Multispecies Biofilms With Remineralising Calcium Phosphate Ions. J.Dentistry. 2017
[18] F.Afkhami, S.J.Pourhashemi, M.Sadegh, Y.Salehi, M.J.K.Fard. Antibiofilm Efficacy Of Silver Nanoparticles As A Vehicle For Calcium Hydroxide Medicament Against Enterococcus Faecalis. J.Dentistry. 2015;43(12):1573-1579
[19] M.A.Mozayeni, A.Haeri, O.Dianat, A.R.Jafari. Antimicrobial Effects Of Four Intracanal Medicamentson Enterococcus Faecalis:An In Vitro Study. Iranian Endod J.2014;9(3):195-198
[20] Shahri F, Parhizkar A. Pivotal Local Drug Delivery Systems In Endodontics; A Review Of Literature.Iranian Endod J.17 May 2020;15(2): 65-78
[21] D K Lee, Sv Kim, A N Limansubroto, A Yen, A Soundia, C Y Wang, Et Al. Nanodiamond Gutta Percha Composite Biomaterials For Root Canal Therapy. 2015;9(11):11490-11501