J Oral Res
oral and craniofacial sciences

Perspective

Dentistry facing the biotechnological advances of the 21st century.

Carmen de la Luz Ayala Escandón[1] & Juan Manuel Cortes Ramírez.[2]

Affiliations: [1]Especialidad de Odontopedria, Universidad Autónoma de Zacatecas. Zacatecas, Mexico. [2]Ciencias de la Salud, Universidad Autónoma de Zacatecas. Zacatecas, Mexico.

Corresponding author: Carmen Ayala. Calle 1ª de Mayo # 426-3. Centro Histórico. Zacatecas, Zacatecas, México. Phone: (51-492) 9250940. E-mail: claescandon@yahoo.com

Conflict of interests: The authors declare no conflicts of interest.

Acknowledgements: None.

Cite as: Ayala Escandón CL & Cortes Ramírez JM. Dentistry facing the biotechnological advances of the 21st century. J Oral Res 2018;7(7):276-278.
doi:10.17126/joralres.2018.061

The 21st century has brought important biotechnological advances in the field of medical science research, such as the application of knowledge and new biological techniques to improve human health. Biotechnology is essential in dentistry to replace the artificial materials that are used today by biological materials based on stem cells, which have the ability to mimic replicas of a tooth or another stomatognathic system tissue. Stem cells have the capacity for continuous renewal and can differentiate into many cell types. Recently, the following stem cells have been identified: dental pulp stem cells (DPSCs), periodontal ligament stem cells (PDLSCs), apical papilla stem cells (SCAPs), stem cells from human exfoliated deciduous teeth (SHED), periapical follicle stem cells (PAFSCs), mesenchymal stem cells derived from adipose tissue (AD-MSCs), and bone marrow mesenchymal stem cells (BMSC).[1]

Dentistry incorporates genomic advances at a slower pace, but is today immersed in this effervescence mainly due to the applications of stem cells. The information generated is enormous and is key for identifying and isolating genes of interest, and interpreting the biological processes in molecular terms. Research on biotechnology includes bioactive and molecular materials and substances, and incorporates new bioactive materials and molecules that have a wide application in dentistry, such as probiotics and synbiotics.

Probiotics act in the mouth as a coating for oral tissues producing a biofilm preventing oral diseases. This biofilm ensures bacterial pathogens remain outside the oral tissues by coating a substrate that the pathogens would modify in the absence of such biofilm, and that would interact with cariogenic bacteria and also support the growth of periodontal pathogens. Probiotics can be a valuable tool in the prevention of oral diseases.[2] The probiotics role is through the modification of the microbiota and passive prevention of dental caries.[2]

Although the importance of genetic factors in susceptibility to dental caries has been demonstrated, no progress has been made in the identification of biomarkers, which would be useful for the early detection of individuals at higher risk of suffering from the disease. Currently saliva is recognized as a tool with a high potential for the analysis of biomarkers of various types of cancer, including oral and oropharyngeal.

 ISSN Online 0719-2479 - www.joralres.com © 2018

Biotechnology uses nanotechnology combined with genomic information, and nanorobotics creates nanomaterials, guiding clinical decision making in personalized dentistry. Dentistry has been progressively incorporating new advances in biotechnology, allowing the identification of numerous genes that cause diseases.[3]

Currently the use of biomaterials based on native or synthetic polymers are of great importance for the repair of teeth and pulp therapy (*e.g.* added mineral trioxide aggregate (MTA), classified as a bioceramic) in the field of dentistry and in the administration of drugs.[4] MTA is a bioactive material that is used to preserve the pulp and vitality of the periodontal tissue as part of the procedures to repair perforation and coating of the pulp.[5]

Currently there is work aiming to generate completely new teeth, recreating healthy and functional tissues and organs, in order to replace diseased, incurable or dead tissue; this is done under the principles of genetic engineering, using cellular and mineral components and tissue engineering for regenerating tissues at a nanoscale level. Through the use of nanostructures, it has been possible to replicate dental enamel the hardest tissue of the human body, utilizing calcium hydroxyapatite crystals, thus mimicking a natural process of biomineralization. The dentist can place a synthetic crown, in conjunction with a bioengineered root, and thus restore the damaged dental organ.[6]

For dental regeneration, the closest form of reconstruction of the root-periodontal complex is hybrid tissue engineering, where stem cells, the use of biomaterials and crown restoration are integrated. A root-periodontal complex is formed when the stem cells of the apical papilla and the periodontal tissues are combined with a matrix of tricalcium phosphate/hydroxyapatite, which can support a zirconium crown and thus provide masticatory and aesthetic functionality.[4]

There is current work with nano-hybrid resins, nanofillers and nano-adhesives, which when operated at nano levels result in the amplification of their chemical, mechanical and physical properties. There are nanoresins of photopolymerizable glass ionomer combined with nanotechnology fluoroaluminosilicate (FAS) in the market, which offer excellent aesthetics, improved resistance to wear and improved polishing.[5]

Diagnostic imaging

The most developed area is the manufacture of nanodetectors that allow for lower radiation doses to be used without loss of image resolution. Using nanotechnology, new contrast media is being developed using biologically designed nanoparticles for use in detection in photoacoustic imaging, computed tomography (CT), fluorescence tomography, tomography with upconversion, Cherenkov luminescence imaging, and positron emission tomography (PET).[7] Polarization-sensitive optical coherence tomography (PS-OCT) allows the detection of early carious lesions and the evaluation of the lesion over time by obtaining images with high resolution providing a better delimitation of caries.

Nano-dentistry involves the use of nanorobotics, nano-diagnosis and nanomaterials and will facilitate comprehensive oral health through the use biotechnology and tissue engineering. Nanorobotics can be used to perform local anesthesia in dental practice, where the dentistry professionals will generate an analgesic colloid suspension containing millions of "nanorobots particles" in the gum of the patient.

Nano-diagnosis uses nano-devices to identify early stages of disease or predisposition to disease at the cellular and molecular level. In in vitro diagnostics, nanotechnology may increase the efficiency and sensitivity of diagnostic methods, using fluids such as saliva or tissue samples where selective nanodevices may perform multiple subcellular analyzes in order to determine the early stage of a disease, identify and quantify toxic molecules, tumor cells or infectious agents.[8]

Future prospects of nanobiotechnology in dentistry

Nanobiotechnology may influence the choice of several biomaterials and new devices useful in the field of dentistry. Its importance will show in diverse biomedical applications ranging from the administration of drugs and gene therapy to obtaining molecular images, biomarkers and biosensors. Biomedicine is destined to revolutionize everyday dentistry. However, as with all technologies, nanotechnology has significant potential for misuse and abuse on a great scale and scope if it is not properly controlled and managed.

REFERENCES.

1. Wan M, Du W, Zhou X, Xu X, Zheng L. Stem Cell-based Tooth Engineering and their Potential in Dental Medicine. Curr Stem Cell Res Ther. 2015;10(5):443–9.
2. Fierro-Monti C, Aguayo-Saldías C, Lillo-Climent F, Riveros-Figueroa F. Rol de los Probióticos como bacterioterapia en Odontología. Revisión de la literatura. Odontoestomatología. 2017;19(30):4–13.
3. Pilmer CM, Kirsh JA, Hildebrandt D, Krahn AD, Gow RM. Sudden cardiac death in children and adolescents between 1 and 19 years of age. Heart Rhythm. 2014;11(2):239–45.
4. Camilleri J, Sorrentino F, Damidot D. Investigation of the hydration and bioactivity of radiopacified tricalcium silicate cement, Biodentine and MTA Angelus. Dent Mater. 2013;29(5):580–93.
5. Soliman MG, Pelaz B, Parak WJ, del Pino P. Phase Transfer and Polymer Coating Methods toward Improving the Stability of Metallic Nanoparticles for Biological Applications. Chem Mater. 2015;27(3):990–7.
6. Babannavar R, Shenoy A. Evaluation of shear bond strength of silorane resin to conventional, resin-modified glass ionomers and nano-ionomer cements. J Investig Clin Dent. 2014;5(23):295–300.
7. Sun X, Cai W, Chen X. Positron emission tomography imaging using radiolabeled inorganic nanomaterials. Acc Chem Res. 2015;48(2):286–94.
8. Abiodun-Solanke I, Ajayi D, Arigbede A. Nanotechnology and its application in dentistry. Ann Med Health Sci Res. 2014;4(Suppl 3):S171–7.