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JOURNAL OF INDIAN DENTAL ASSOCIATION - KOCHI

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Chief Editors Message

Happy Vishu Greetings!!!

As we bring you the first edition of JIDAK 2020-21, my heart goes out to the hard work of the previous editorial team who have put the wonderful systems in place. Indeed, the words 'Sow the seeds of hard work and you will reap the fruits of success' have stood the test of time.

The need and importance of a branch journal as this has been pondering in my mind. In this age where information is at fingertips, isn't it a bit out of place to have a printed version of JIDAK? Every now and then these questions arise. However all these queries were put to rest when I spoke to few senior members. I understand that there are many members who cherish reading our publication.

It is heartening to note that we have received articles from neighbouring states as well. The co editors and reviewers have played their roles well. The support from the President, secretary and executive committee has been paramount and vital in this endeavour.

Wishing everyone an enjoyable read.

Dr Vidhya Parameswaran
Chief Editor- JIDAK
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REVIEW ARTICLE

CLINICAL APPLICATIONS OF VARIOUS STEM CELLS IN DENTISTRY: A LITERATURE REVIEW

Authors:

Dr. Sandeep Kour[1]*
Dr. Mehak[2]
Dr. Radhika Singhal[3]
Dr. Kunal Singla[4]
Dr. Ekta Parmar[5]
Dr. Kriti Sareen[6]

[1]Senior Lecturer
Dept. of Periodontics and Oral Implantology
Himachal Institute of Dental Sciences
Paonta Sahib, Himachal Pradesh

[2]PG Student
Dept. of Conservative Dentistry and Endodontics
RUHS College of Dental Sciences
Jaipur, Rajasthan

[3]Senior Lecturer
Dept. of Periodontics and Oral Implantology
J.N. Kapoor DAV (C) Dental College
Yamuna Nagar, Haryana

[4]Consultant Dental Surgeon
Panipat, Haryana

[5]Resident Medical Officer
Nesco Covid Center, Goregaon, Mumbai

[6]Senior Lecturer
Dept. of Oral Medicine and Radiology
Rayat Bahra Dental College, Mohali, Punjab

Correspondence Address:
Dr. Sandeeep Kour, Senior Lecture
Dept. of Periodontics and Oral Implantology
Himachal Institute of Dental Sciences
Paonta Sahib, Himachal Pradesh
Email: sandeep31kaur@gmail.com
Mob. No: +91-7889851104

ABSTRACT

Regenerative dentistry plays a major role in treatment planning of various dental diseases. Teeth are the most natural, noninvasive source of stem cells. Dental stem cells, which are easy, convenient and affordable to collect, hold promise for a range of very potential therapeutic applications. Present review article discusses history of stem cells, different stem cells relevant for dentistry, their isolation approaches, collection, and preservation of dental stem cells along with the current status of dental and medical applications.

Keywords: Dental Pulp, Regeneration, SHED, Stem Cells, Transplantation

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INTRODUCTION

Stem cells are undifferentiated biological cells that can differentiate into specialized cells and can divide (through mitosis) to produce extra stem cells.[1] Stem cells are the master cells of the body that meet the two conditions of self-replication and the ability to differentiate into at least two different type of cells. The term stem cell was proposed for scientific use by Russian histologist Alexander Maksimov in1908.[2] Therapeutic application of stem cells has created an increasing interest in the study of undifferentiated cell types that constitute the ability to proliferate and differentiate into various tissues. They have the capacity to renew themselves by cell division even after long periods of inactivity.[3] In present scenario various studies concentrate on the regenerative ability of cells as various tissues in the body (such as blood, skin, and gastrointestinal tract) undergo rapid renewal and have regenerative ability which form an important part of treatment plan.[4]

DISCUSSION

Types of stem cells

Two main types of stem cells are being investigated for their use in medicine research. They differ in the ability to self-renew and their degree of differentiation.[5]

- Embryonic Stem Cells
- Adult Stem Cells

Dental Stem Cells

In dentistry, interest in tissue engineering researches on different types of dental stem cells done in vivo and in vitro, increased rapidly among researchers and institutes.[6] Various types of tooth derived stem cells have been utilized in the field of regeneration medicine.[7]

Dental sources of adult stem cells[2]

- Dental pulp dental pulp stem cells (DPSCs)
- Exfoliated deciduous teeth- SHED
- Dental follicle progenitor cells- DFPCs
- Stem cells from root apical papilla- SCAP
- Periodontal ligament stem cells- (PDLSCs)

Dental Pulp Stem Cells (DPSCs)

These are the highly proliferative and clonogenic cells that have been derived from enzymatically disaggregated adult human dental pulp, that form sporadic, but densely calcified nodules in vitro.[8]

The applications related to oral health care included regeneration of an immature tooth with extensive coronal and pulp damage, regeneration of resorbed roots, cervical or apical dentin, whole tooth regeneration, repair and replacement of bone in craniofacial defects can facilitate restoring the physiologic structural integrity.[9] Suitable stem cells for tissue engineering should be able to differentiate into the target tissue/organ and should be easily collected and prepared to provide a further benefit to ensure the safety of the patient. DPSCs hold great clinical procedure due to their differentiation capacity and easy accessibility.[10]

1) De novo pulp regeneration: When the entire pulptissue is lost, regeneration requires the de novo creation of pulp. To create functional pulp for clinical application, three issues must be considered: first, regenerated pulp tissue must be vascularised; second, newly differentiated odontoblasts should form on the existing dentinal wall of the root canal space; finally, new dentin must be produced by differentiated odontoblasts on the existing dentin.[5]

2) Tooth reconstruction: It may be possible to generate a method to biologically replace lost teeth with the help of stem cells. A functional biological replacement tooth must include generation of a root and periodontal ligament with nerve and blood supplies. The crown, is less important since replacement of crowns with synthetic functioning is possible.[10]

Stem Cells From Human Exfoliated Deciduous Teeth (SHED)

Dr. Songtao Shi, isolated stem cells using the deciduous teeth of his 6 year - old daughter and named them as stem cells from human exfoliated deciduous teeth (SHED).[11] These cells have the ability of high proliferation potency and are multipotent mesenchymal stem cells. These cells not only differentiate into dental pulp-

related cells, but also, other cell types such as osteoblasts, adipocytes, neuronal-like cells and endothelial cells.[12]

Applications in Dentistry

Based on the basic tissue engineering principles, Peter Murray et al. identified several major areas of research that might have applications in the development of these techniques.

Root canal revascularization via blood clotting: Revascularization of the necrotic root canal systems by disinfection followed by establishing bleeding into the canal system via over instrumentation. Use of intracanal irrigants (NaOCl and chlorhexdine) along with the placement of antibiotics (e.g., a mixture of ciprofloxacin, metronidazole, and minocycline paste), for several weeks, is a critical step, as it effectively disinfects the root canal systems and increases revascularization of the avulsed and necrotic teeth. The revascularization process offers negligible chances of immune rejection and pathogen transmission, as regeneration of the tissue takes place by the patient's own blood cells.[13]

Postnatal stem cell therapy: The process comprises of postnatal stem cells (derived from skin, buccal mucosa, fat, and bone) being injected into disinfected root canal systems after the apex is opened. This process has many advantages like the harvesting and delivery of autogenous stem cells by syringe, being relatively easy; and the potential of these cells to induce new pulp regeneration. However, there are several disadvantages, like the cells may have a low survival rate and they may migrate to different locations within the body. Instead, all three elements (cells, growth factors, and scaffold) must be considered, to maximize the potential for success of pulp regeneration.[11]

Pulp implantataion: The pulp cells can be grown on biodegradable membrane filters to transform two dimensional into three dimensional cell cultures. The ease of growing these cells on filters in the laboratory, for evaluation of cytotoxicity of test materials, is recognized as the main advantage of this delivery system. Specialized procedures for proper adherance to the root canal walls is required, which is the major problem associated with implantation. As sheets of cells lack vascularity, only the apical portion of the canal systems will receive these cellular constructs, with coronal canal systems filled with scaffolds capable of supporting cellular proliferation.[14]

Scaffold implantation and delivery: A scaffold should contain growth factors, Bone Morphogenic Protein (BMP), fibroblast growth factors, and Vascular endothelial growth factors, to aid stem cell proliferation and differentiation, apart from having nutrients promoting cell survival and growth as well as antibiotics to prevent any bacterial in growth in the canal systems. The scaffold materials may be natural or synthetic, biodegradable or permanent. The synthetic materials like polylactic acid, polyglycolic acid and polycaprolactone degrade within the human body and have been succesfully used for tissue engineering purposes. Limitations consist of difficulties of obtaining high porosity and regular pore size.[11]

Three-dimensional printing: The three dimensional cell printing technique can be used to precisely position cells so that they have the potential to create tissue constructs that mimic the natural tooth pulp tissue structure. Careful orientation of the pulp tissue construct during placement into the cleaned and shaped root canal systems in accordance with its apical and coronal asymmetry is the prime requisite for the success of the technique.[15]

Huang, et al. explored in mice that pulp-like tissue can be regenerated de novo in an emptied root canal space by stem cells from apical papilla and dental pulp that give rise to odontoblast-like cells, producing dentin-like tissue on the existing dentinal walls via stem/progenitor cell-based approaches and tissue engineering technologies.[16]

Periodontal Ligament Stem Cells (PDLSCs)

The concept that stem cells reside in periodontal tissues was first proposed by Melcher.[6] PDLSCs in defined culture conditions differentiate into cementoblasts, adipocytes and collagen forming cells. These cells when transplanted generate a cementum/ PDL-like

structure that contribute periodontal tissue repair.17 However, PDLSCs obtained from mature periodontal ligaments possess stem cell properties similar to MSCs rather than neural crest cells.[18]

Osteogenic Potential of PDLSC

PDLSC are shown to have osteogenic potential. PDLSC isolates to have lower osteogenic potential than BMSC and also dental pulp derived stem cells. Kim et al, who reported new bone formation by PDLSC in a periimplant defect model, albeit at lower levels than BMSC. Although the potential use of PDLSC for generating graft biomaterials for bone tissue engineering in regenerative dentistry can be envisioned, as these cells are more routinely accessible, it is however necessary to delineate more refined isolates of pluripotent progenitors using genomic and proteomic marker characterization.[19]

Periodontal Regeneration by PDLSC

Seo et al. demonstrated a cementum/PDL-like complex generated in surgically created periodontal defects by transplanting in vitro expanded human PDLSCs in a ceramic particle scaffold. Porcine model study reports transplanting autologous swine PDLSCs, which lead to the generation of a root/periodontal complex capable of supporting a porcelain crown, resulting in normal tooth function.[19] Cementum and PDL- like structures adjacent to the surface of scaffolds is formed due to subcutaneous injection of PDLSC with hydroxyapetite or beta- tricalcium phosphate scaffolds. Besides periodontal regeneration, another potential application of PDLSCs is in the area of hybrid tooth engineering in combination with other stem and progenitor cell populations and scaffolds.[20]

Stem Cells From Apical Papilla (SCAP)

A population of stem cells isolated from human teeth was found at the tooth root apex. These cells are called stem cells from apical papilla (SCAP).[21] SCAPs were initially isolated from third molars and incisors of swine by Sonoyama et al. and obtained from humans in 2008.[22]

Clinical Applications of SCAP

Continued Root Formation: Root apical papilla is likely to play a pivotal role in root formation. Despite the fact that pulp tissue is intact root development is halted as apical papilla is removed surgically at an early stage. Further research is needed to verify that this halted root development was not due to damage of Hertwig's epithelial root sheath (HERS) during the removal of the apical papilla of that particular root apex.[23]

Pulp Healing and Regeneration: Immature teeth that presented with radiolucent lesions and non- vital pulp underwent remarkable apexogenesis after conservative treatment suggest that vital pulp tissue must have remained in the canals. Periapical disease can occur while the pulp is only partially necrotic and infected as open apex provided a good communication from the pulp space to the periapical tissues. Along the same line of reasoning, stem cells in pulp tissue and in apical papilla may also have survived the infection and allowed regeneration of pulp and root maturation to occur.[23]

Replantation and Transplantation: Changes in pulp tissue after replantation showed that various hard tissues including dentin, cementum, and bone may form in the pulp space depending on the level of pulp recovery. If pulp and apical papilla are totally lost, then the root canal space may be occupied by cementum, PDL and bone.

Autotransplantation is one of the clinical treatment options for missing teeth. The process often involves extraction of a supernumerary tooth or third molar and implantation into a recipient site. Based on current available information, it is likely that odonto blast lineages are derived from stem cells in pulp tissue or apical papilla. Both SCAP and HERS appear to be important for the continued root development after transplantation. SCAP are also highly probable to survive after transplantation because minimal vascularity is found in apical papilla based on preliminary findings. The reason that transplanting a tooth with little or no root formation results in almost no further root development is unclear.[5]

Bioroot Engineering: Dental implants have recently gained momentum as a preferred option for replacing missing teeth instead of bridges or removable dentures but it requires a direct integration with bone onto its surface as the prerequisite for success. Due to lack of natural contours and its structural interaction with the alveolar bone make dental implants a temporary option until a better alternative is available. SCAP and PDLSCs form a bioroot. Using a minipig model, autologous SCAP and PDLSCs were loaded onto HA/TCP and gelfoam scaffolds, respectively, and implanted into sockets of the lower jaw. A post channel was precreated to leave space for post insertion. Three months later, the bioroot was exposed, and a porcelain crown was inserted. This approach is relatively a quick way of creating a root onto which an artificial crown can be installed. The bioroot is different from a natural root in that the root structure is developed by SCAP in a random manner. Nevertheless, the bioroot is encircled with periodontal ligament tissue and appears to have a natural relationship with the surrounding bone. The mechanical strength of the bioroot, which is approximately two thirds of a natural tooth.[23]

Dental Follicle Progenitor Cells (DFPCs)

Several studies have reported the isolation of progenitor/stem cells from Dental Follicle in different species, using an enzymatic digestion of the Dental Follicle to release cells, followed by a culture of the cells in a stem cell growth medium.[24] In 2005 & 2007, Morsczeck et al. and Kemoun et al., respectively have identified unique undifferentiated lineage committed cells possessing mesenchymal progenitor features in the human dental follicle The cells were referred to as 'dental follicle precursor cells'(DFPCs).[25]

Clinical Applications of DFPCs[5,26]

Periodontal Regeneration: Dental follicle stem cells (DFSCs) have been developed to regenerate periodontium), which could become an alternative cell source for periodontal regeneration therapy. It is also confirmed by Hasegawa et al 2005, that periodontal defects can be managed by reimplantation of these cells.

Repair of Craniofacial defects: Craniofacial defects results from post-cancer ablative surgery, craniofacial osseous deficiencies can also arise from infection, trauma, congenital malformations and progressively deforming skeletal diseases. Although autologous bone graft is considered the best option, it has the limitation of donor sites. Stem cells can be used to treat degenerative bone diseases including TMJ defects. Cells from various sources like articular cartilage cells, fibroblasts, mesenchymal stem cells have been used to reconstruct TMJ. Bone tissue engineering endeavours to repair large bone losses using three dimensional scaffolds to deliver vital cells to the defective site.

Gingival Mesenchymal Stem Cells (GMSCs)

The mesenchymal stem/progenitor cells (MSC) isolated from the gingival lamina propria have been termed variously researchers including GMSCs, gingival tissue derived SCs, gingival multipotent PCs and gingival margin derived stem/PCs human oral mucosa SCs and oral mucosa lamina propria PCs.[27]

Clinical Applications of GMCs

These cells can gain numerous applications in cell and regenerative therapies. Possible areas being aimed to include skin wound repair, tendon regeneration, bone defect regeneration, periodontal regeneration, peri implanatitis, antitumor effect, oral mucositis, collagen-induced arthritis and contact hypersensitivity.[27]

Potental clinical applications in the Orofacial complex

Craniofacial tissue engineering promises the regeneration or de novo formation of dental, oral and craniofacial structures lost due to congenital anomalies, trauma and diseases. Virtually all the craniofacial structures are the derivatives of mesenchymal stem cells. Cells with characteristics of adult stem cells have been isolated from the dental pulp, the deciduous tooth and the periodontium. Mesenchymal cells are used for regeneration of several craniofacial structures such as mandibular condyle, calvarial bone, cranial suture and subcutaneous adipose tissue.[28]

Alveolar Ridge Augmentation: Restoration of

alveolar ridge height is of utmost concern to dentists in trying to prevent the loss of a tooth due to bone destruction induced by periodontal disease and in maintaining the ability of edentulous patients to wear dentures.[29] Appropriate ridge height is also essential for the placement and long-term retention of dental implants. Standard practice involves the use of autologous or allogenic bone grafts oe ceramics, both with and without growth factors, but the outcomes are variable. In animal models, BMSCs are used in conjuction with HA/TCP. They have successful in building alveolar bone[30] and a number of small studies in human patients have used BMSCs along with allogenic bone fragments or with platelet-rich plasma, with another ceramic scaffold, beta-calcium phosphate etc. With further refinement, these types of procedures would mark a major advancement in dental reconstruction.[31]

Tissue Engineering of Temporomandibular Joint from the Stem Cells: Temporomandibular disorders (TMD) manifest as pain, myalgia, headaches and structural destruction collectively known as degenerative joint disease (Okeson1996).[32] The temporomandibular joint (TMJ) like other synovial joints is also prone to rheumatoid arthritis, injuries and congenital anomalies (Stohler 1999).33 The severe form of TMJ disorders necessitates surgical replacement of the mandibular condyle (Sarnat and Lakin, 1992).[34]

In the past few years, we have reported the tissue engineering of a mandibular condyle exhibiting the shape and dimensions of a human cadaver TMJ. The engineered mandibular condyle had stratified layers of cartilage and bone from a single population of bone-marrow derived mesenchymal stem cells (MSCs) and was moulded into the shape and dimensions of a human cadaver mandibular condyle.[34]

Challenges

Stem cell research has undergone huge advancements in the past couple of years. This does not mean, however, that researchers have not faced their share of problems. It has proved particularly challenging for scientists to ensure the long term proliferative ability and pluripotency of embryonic stem and germ cells. These are important characteristics to maintain, as accurate models are necessary to understand the unique genetic and molecular basis by which these cells are able to replicate indefinitely. In addition to providing accurate models, culturing stem cells in vitro is also necessary in order to ensure that sufficient quantities of stem cells are available to treat specific diseases.[35] Teratoma formation has also produced a hurdle that needs to be overcome. Formation of these tumor like masses of cells at injection sites significantly limit the therapeutic potential applications of embryonic stem cells.36Immune challenges also prove a significant barrier to the application of stem cell therapies. If the stem cells are recognized as non-self, they will be rejected and destroyed.[35]

SUMMARY AND CONCLUSION

Due to advancements in the prevention, diagnosis and treatment of human diseases, the inability of most tissues and organs, to repair and regenerate after damage is a problem that needs to be solved. Stem cell research is being pursued in the hope of achieving major medical breakthroughs. Scientists are striving to create therapies that rebuild or replace damaged cells with tissues grown from stem cells and offer hope to people suffering from various ailments.

REFERENCES

1. Singh H, Bhaskar JD, Rehman R, Jain CD, Khan M.Stem Cells: An Emerging Future in Dentistry. Int J Adv Health Sci 2014;1(2): 17-23.
2. Kohli A, Katiyar A, Gupta K, Singh G, Singh D, Sahani S. Stem cells - hope or hype. Rama Univ J Dent Sci 2015;2(1):34-41.
3. Mandal S, Ganguly BB, Kadam NN.Exfoliated Deciduous Tooth as the Source of Stem Cells : A Technique for Proliferation and Chromosome Analysis In Vitro. MOJ Cell Sci Rep 2017;4(5): 1-3.
4. Bianco P, Robey PG.Stem Cells in Tissue Engineering. Nature; 414: 118-121.
5. Jindal L, Dua P, Mnagla R, Gupta K, Vyas D, Bhat N. Stem cells- the tiny procreators: a review article. Asian Pac J Health Sci 2019;6(1): 118-23.

6. Fouad SAA.Dental Stem Cells:A Perspective Area in Dentistry Int J Dent Sci and Res 2015;3(2A): 15-25.

7. Park YJ, Cha S, Park YS.Regenerative Applications Using Tooth Derived Stem Cells in Other than Tooth Regenration : A Literature Review. Stem Cells Int 2016: 1-12.

8. Krebsbach PH, Gehron P, Goel R. Dental and Skeletal Stem Cells: Potential Cellular Therapeutics for Craniofacial Regeneration. J Dent Edu 2002;66 (6):766-773.

9. Pushpalatha C, Nimbal A, Jain S, Tammannavar P. Dental Pulp Stem Cells Scope in Dentistry: A Review. IOSR J Dent Med Sci 2013;8(1): 38-41.

10. Saito MT, Silverio KG, Casati MZ, Sallum EA.Tooth derived Stem Cells : Update and Perspectives. World J Stem Cells 2015;7(2): 399-407.

11. Jindal L, Bhat N, Vyas D, Thakur K, Neha, Mehta S. Stem Cells from Human Exfoliated Deciduous Teeth (SHED) –Turning Useless into Miracle: A Review Article. Acta Sci Dent Sci 2019;3(10): 49-54.

12. Sukarawan W, Osathanon T. "Stem Cells from Human Exfoliated Deciduous Teeth: Biology and Therapeutic Potential".Intech Open (2017): 55-76.

13. Rai S, Kaur M, Kaur S.Applications of Stem cells in Interdisciplinary Dentistry and Beyond : An Overview. Ann Med Health Sci Res 2013;3(2): 245-254.

14. Barron JA., et al. "Laser printing of single cells: Statistical analysis, cell viability, and stress". Annals of Biomedical Engineering 33.2 (2005): 121-130.

15. Gronthos S, Mankani M, Brahim J, Robey PG, Shi S.Postnatal Human Dental Pulp Stem Cells (DPSCs) in vitro and in vivo. Proc Nat Acad Sci 2000; 97(25): 13625-13630.

16. Young CS et al.Tissue Engineering of Complex Tooth Structures on Biodegradable Polymer Scaffolds. J Dent Res 2002;81(10): 695-700.

17. Upadhyay RK. Use of Stem Cells in Dental Implants and Enamel Regenerative Therapies. Insights in Stem Cells 2016;2(9): 1-12.

18. Zhu W, Liang M.Periodontal Ligament Stem Cells: Current Status, Concerns and Future Prospects. Stem Cells Int 2015: 1-12.

19. Acharya A, Shetty S, Deshmukh V. Periodontal Ligament Stem Cells: An Overview. J Oral Biosci 2010;52(3): 275-282.

20. Tomokiyo A, Wada N, Hamano S, Hasegawa D, Sugii H, Yoshida S. Periodontal Ligament Stem Cells in Regenerative Dentistry for Periodontal Tissues. J Stem Cell Res Ther 2016;1(3): 1-3.

21. Estrela C, Alencar AH, Kitten GT, Vencio EF, Gava E. Mesenchymal Stem Cells in the Dental Tissues: Perspectives for Tissue Regeneration. Brazz Dent J 2011;22(2): 91-98.

22. Almeida PN, Cunha KS.Dental Stem Cells and their application in Dentistry: A Literature Review. Rev Bras Odontol 2016; 73(4): 331-335.

23. George T, Huang J, Sonoyama W, Liu Y, Liu H, Shi S.The Hidden Treasure in Apical Papilla: The Potential Role in Pulp/Dentin Regeneration and Bioroot Engineering. J Endod 2008;34(6): 645-651.

24. Rad MR. Characteristics of Dental Follicle Stem Cells and their Potential Application for Treatment of Craniofacial Defects. Tehran Univ Med Sci 2007: 1-130.

25. Karamzadeh R, Eslaminejad MB. Dental-Related Stem Cells and their Potential in Regenerative Medicine. Regen Med Tiss Eng 2013 Chapter-4: 95-116.

26. Gopal SK, Padma M. Stem Cell Regenerative Therapy in Oral and Maxillofacial Region: A Systematic Review. Int J Adv Res 2017;5(3): 1631-1643.

27. Venkatesh D, Kumar KPM, Alur JB. Gingival Mesenchymal Stem Cells. J Oral Maxillofac Pathol 2017;21: 296-298.

28. Krebsbach PH, Gehron P, Goel R. Dental and Skeletal Stem Cells : Potential Cellular

Therapeutics for Craniofacial Regeneration. J Dent Edu 2002; 66 (6): 766-773.

29. Robey PG, Bianco P. The use of Adult Stem Cells in rebuilding the human face. J Amer Dent Assoc 2006;137: 961-972.
30. De Kok IJ, Peter SJ, Archambault M. Investigation of allogenic Mesenchymal Stem Cell based alveolar bone formation: preliminary findings. Clin Oral Implants Res 2003;14(4): 481-489.
31. Krzymanski G, Jedrzejczzak W. Autologous Bone-Marrow derived stromal fibroblastoid cells grown in vitro for the treatment of defects of mandibular bones. Transplant Proc 1996;28(6): 3528-3530.
32. Okeson JP. Orofacial pain: Guidelines for assessment, diagnosis and management. Carol Stream IL: Quintessence Publishing Co. Inc 1996; 1-15.
33. Christian S. Stohler. Muscle-Related Temporomandibular Disorders. J Orofac Pan 1999;13: 273-284.
34. Sarnat BG, Laskin DM. The Temporomandibular Joint: A biological basis for clinical practice.Philadelphia, PA, WB Saunders Publ 1992: 43-57.
35. Chapman AR, Frankel MS, Garfinkle MS. Stem Cell Research and Applications Monitoring the Frontiers of Biomedical Research. Ameri Assoc Adv Sci 199: 1-51.
36. Kim JH, Auerbach JM, Gomez R. Dopamine neurons derived from Embryonic Stem Cells function in an animal model of Parkinson disease. Nature 2002;418: 50-56.

REVIEW ARTICLE

AI IN RADIOLOGY AND PATHOLOGY: A BRIEF INTRODUCTION AND ETHICAL CONSIDERATIONS

Author:

Dr. Nithin Thomas BDS, MDS

Consultant
Oral Medicine and Radiologist
Maxillofacial Diagnostics, Cochin
nith.thomas@gmail.com

ABSTRACT

Artificial intelligence is perhaps one of the most debated science and technology topics of this generation. In this era of digital revolution, it is no longer a fantasy and we are already using AI systems in our routine life. Its applications in the practice of medicine have shown promising results and it may be not long before we see its use in our day-to-day clinical practice. This article focuses on a brief introduction to AI and its applications in health and medicine, how it's being used in various specialties medicine. The possible ethical issues and ways to address it have also been discussed at the end.

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INTRODUCTION

For centuries, the human brain has been entitled to be the pinnacle of mother nature's marvellous creations, with the brain of no other living organism capable of coming near to its raw power. But over the last century, which has seen mankind's best and worse time periods, thanks to the industrial revolution, the various advancements in science and technology, humans have this elusive dream of creating a 'super-intelligent machine'. A machine that can outsmart, outmatch the thinking, reasoning and grasping power of a human brain. Though this idea was thought to be an impossible fantasy that existed only in books and movies, things soon started take shape in the real world starting with early algorithms like The Turing Test, developed by Dr Alan Turing during the world war in 1942[1]. Decades later after much research and several "AI winters", the word AI (common abbreviation for Artificial Intelligence) as of today, sparks both excitement and fear in the hearts of many. As computational and manufacturing power grew exponentially complex "virtual brains" which can mimic certain human tasks without supervision became a reality. From IBM's WATSON, which can read analyze and interpret and give suggestions about various input images to AlphaGo, which can outsmart human players at the most complex board game Go[2] and many more of such examples, it is evident that AI is here to stay will soon become a norm in our lives forward. In fact, with the current smart phone revolution, AI has already become a part of our routine life, from AI-based personal assistants (Google, Siri, Cortana), intelligent apps like Facebook, Instagram curating our social life to the most used online taxi service app in the world, Uber, which uses AI to assign drivers near your location[3].

Not surprisingly, AI soon found its way to the medical science. Healthcare professionals and researchers were mesmerized by the thought using AI to help monitor, classify, predict and even give treatment suggestions for all kinds of disease conditions. The goal of this paper is to brush upon the basics of AI, its current developments in health and medicine and to discuss the possible ethical issues of AI systems replacing human doctors.

AI and how it works

The English Oxford Living Dictionary defines Artificial Intelligence or AI as "The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages." Simply put it's the ability of a computer or a set of computers to mimic human intelligent behavior. It does this by using a set of mathematical algorithms to identify a common pattern from the given input data and form a set of rules which can thereby be used to "teach" the machine to identify, classify and extract information. This forms the basic purpose of every AI system created and based on the complexity of algorithms and volume of data it uses for the task assigned they can be sub classified into:

1)Machine Learning - Machine learning (ML) is a subfield of AI that provides machines the ability to learn from data without being explicitly programmed[4]. ML systems use algorithms that can be used to extract features from a given set of data. The advantage of ML is that it evolves over time as it's exposed to more and more input data[5]. The most common ML algorithms used in medicine are Support Vector Machine (SVM), Neural Networks and Discrimination analysis[6]. A simple ML system can be trained to classify inpatient traits like age, sex and other demographic data to detecting abnormal lung nodules from a set of normal and abnormal chest radiographs.

2) Neural networks - Neural network is an advanced machine learning algorithm inspired by the functional organization of the human brain. Similar to the brain the neural network system contains individual functional units like neurons called nodes. Several nodes are arranged layer by layer called 'hidden layers', which collects the input data and filters it through different layers of nodes to give the final output data.[7]

3) Deep learning - Deep learning systems are aimed at becoming the true AI brain which are capable of handling high volume and high dimensional data through feature extraction, classification, text to speech conversion. Based on the method of AI learning its classified into

supervised learning and unsupervised learning. Supervised deep learning techniques are further classified into Convoluted neural network (CNN) and Recurrent neural network (RNN). CNN has brought about breakthroughs in processing images, video, speech, and audio, whereas RNN has shone light on sequential data such as text and speech.[8]

AI in Medicine

The use of AI in medicine has been on the rise over the past few years. With the help of Machine Learning and Deep Learning algorithms, AI can be used to identify, classify give treatment suggestion from millions of radiographic, clinical and pathological images. Traditionally physicians rely on their experience, judgment, and problem-solving skills to diagnose each individual case but this a time and energy-consuming process[9]. At the end of the day when physical and mental fatigue sets in, the efficiency of the physicians obviously tends to reduce. The major advantage of Deep learning AI is that the algorithm evolves itself and improves its accuracy as more and more images are analyzed[10].Although most of the studies based on AI and medicine done with the help of analyzing radiological and pathological images other specialties like ophthalmology, cardiology, etc have used images from specific diagnostic equipment to train AI systems. For example, using retinal fundoscopy images many neural networks and deep learning algorithms have been developed to detect diabetic retinopathy[11-13], congenital cataracts[14], macular degeneration[15,16] and most studies have found high ccuracy of these algorithms ranging from 88% to 92%. In cardiology, ECG and echo cardiography images have been used to train deep learning algorithms to detect heart attacks[17], arrhythmias[18], hypertrophic cardiomyopathy, cardiac amyloid and pulmonary hypertension[19]. Similarly, in gastro enterology, colonoscopy images were analyzed to detect small and sessile polyps which are usually difficult to identify by a real-life gastroenterologist and was detected by the algorithm with an accuracy of 94%[20,21]. And off late in dentistry to a few studies have been reported where Machine learning and Deep learning neural networks have been used to classify dental diseases[22], for assessing risk factors for periodontitis[23] and assess risk factors for oral cancer in a population-based study[24]. As with general radiology and general pathology, it is evident that AI algorithms can be used in the fields of Maxillofacial radiology and pathology also. Below are few examples which has shown the potential of AI in different medical specialties.

1) Radiology

Perhaps no other specialty has received such great attention in integrating AI systems into their daily practice as Radiology does. With the advent of digital radiology and computed tomography from the last few decades, the amount of diagnostic data that can be obtained from a single digital image has increased tremendously, opening the eyes of many radiologists worldwide. But when it comes to imaging a region with a lot of complex morphological/anatomical variations, like the head and neck region, diagnostic features can at times be missed or misinterpreted due to the sheer volume of data. AI can help in managing these large volumes of data analyze and augment the findings of a radiologist to achieve better precision.

Deep learning methods have been used successfully for image segmentation of anatomical and pathological structures, for example, segmentation of the lungs[25], tumors and other structures in the brain[26,27], tibial cartilage, bone tissue[29]. The progress of AI applications in radiology has been rapid and has shown significant accuracy when compared to real-life radiologists. Wang, X. et al. conducted to study to test the accuracy of a Convoluted Neural Network algorithm in detecting different lung diseases in over 108,948 frontal view X-ray images of 32,717 unique patients with the text mined eight disease image labels (where each image can have multi-labels), from the associated radiological reports using natural language processing and found promising results pledging more extensive research to improve it further[30]. In another validation study, deep-learning-based automatic detection algorithm was found to be more accurate than 17-18 physicians included in the study[31]. In fact, currently there are more than 10 AI systems that US FDA

approved for analyzing CT and MRI images, with "Arterys" being the first AI system to achieve FDA approval in 2017 for use in radiology[32]. Current generation DICOM viewers software's used for CT, CBCT, and MRI are already equipped with AI-based automatic segmentation and registration features. Thus, it is evident that AI and radiology will coexist become a norm in the very near future.

2) Pathology

Just as in the case of digital radiology, digital pathology created a revolution among pathologists improving their diagnostic efficiency. This also allowed the storage of large amounts of pathological images on a local hard drive or cloud server. But soon pathology labs became loaded with a high volume of data that needed to be stored and analyzed within a short period of time. This is where AI and Deep Learning algorithms stepped in and many researchers have successfully developed algorithms that can analyze millions of histological images, classify different lesions and even stage malignant changes all within one-third of the time it usually takes real-life pathologist to achieve. In a study conducted to assess the performance of several automated deep learning algorithms at detecting metastases in hematoxylin and eosin-stained tissue sections of lymph nodes of women with breast cancer and comparing it with pathologists', it was found that out of the 32 algorithms, 7 outperformed a panel of 11 well-experienced pathologist with an accuracy over 90%[33]. Litjens G et al assessed the use of'deep learning' as a technique to improve the objectivity and efficiency of histopathologic slide analysis found more than 90% accuracy in a convolutional neural network algorithm for the detection of prostate cancer and sentinel lymph node of breast cancer in H&E-stained whole slide biopsy specimens[34].Many publications such as above exist which shows significant accuracy of Deep learning algorithms in detecting lung cancer[35], brain tumors[36], breast cancer metastases[37,38]. Recently FDA granted Breakthrough Device designation to AI system known as Paige. AI developed by a start-up company in New York for its outstanding performance in diagnosis of life-threatening and debilitating diseases[39].

Ethical issues: AI vs Human touch[40]

So, with all the talk about the exciting potential of AI and its use in health and medicine a few rather pressing questions comes to the mind of any reader like perhaps the most important question of all - does this mean doctors, specialists and super specialists are going out of jobs? Is AI going to change the entire medical landscape as we know it? To answer these questions, one must understand the very core idea that goes into developing an AI system - to augment and increase the efficiency of existing systems. As of today, AI has its limitation in a clinical setting. Even the most efficient unsupervised algorithms cannot make decisions of an unprecedented event as good and quick as well experienced clinician. We should always remember that, no matter how technologically advanced medical science gets, it is us doctors who are treating the patients and it is our human touch that gives them comfort in their ailments and not an AI bot. Doctors must certainly embrace and integrate AI into their daily practice to improve their diagnostic and therapeutic workflow but should never become dependent on it and leave his or her clinical experience at the doorstep. Effective guidelines must be put into place before AI has approved for regular clinical use. Doctors and patients must be made aware of the advantages and limitations of AI and its abilities. And furthermore, even after successful deputation of AI systems they must be continuously monitored and evaluated for their effectiveness in a particular clinical setting. With such measures, we can ensure going forward our patients are well cared for with all the best possible tools at our disposal.

CONCLUSION

The fields of medicine and technology and have always grown hand in hand ensuring faster, more reliable and precise diagnosis and treatment of our patients. With advent of AI, we are taking the next big step towards a better future where healthcare systems are more customized and patient-centred instead of an empirical approach that is prevalent today.

REFERENCES

1. French, Robert M. "The Turing Test: the first 50 years." Trends in cognitive sciences 4.3 (2000): 115-122.
2. Castro, Daniel, and Joshua New. "The promise of artificial intelligence." Center for Data Innovation, October (2016).
3. https://novatiosolutions.com/uber-lyft-taking-artificial-intelligence-along-ride/
4. Samuel, Arthur L. "Some Studies in Machine Learning Using the Game of Checkers. II-Recent Progress." Computer Games I. Springer, New York, NY, 1988. 366-400.
5. Tang, An, et al. "Canadian Association of Radiologists white paper on artificial intelligence in radiology." Canadian Association of Radiologists Journal 69.2 (2018): 120-135.
6. Jiang, Fei, et al. "Artificial intelligence in healthcare: past, present and future." Stroke and vascular neurology 2.4 (2017): 230-243.
7. Johnson, Kipp W., et al. "Artificial intelligence in cardiology." Journal of the American College of Cardiology 71.23 (2018): 2668-2679.
8. LeCun, Yann, YoshuaBengio, and Geoffrey Hinton. "Deep learning." nature 521.7553 (2015): 436.
9. BertalanMesko (2017) The role of artificial intelligence in precision medicine, Expert Review of Precision Medicine and Drug Development, 2:5, 239-241
10. Jha, Saurabh, and Eric J. Topol. "Adapting to artificial intelligence: radiologists and pathologists as information specialists." Jama 316.22 (2016): 2353-2354.
11. Gulshan, V. et al. Development and validation of a deep learning algorithm for detection of diabetic retinopathy in retinal fundus photographs. JAMA 316, 2402–2410 (2016).
12. Abramoff, M. et al. Pivotal trial of an autonomous AI-based diagnostic system for detection of diabetic retinopathy in primary care offices. NPJ Digit. Med. 1, 39 (2018).
13. Kanagasingam, Y. et al. Evaluation of artificial intelligence–based grading of diabetic retinopathy in primary care. JAMA Netw. Open 1, e182665 (2018).
14. Long, E. et al. An artificial intelligence platform for the multihospital collaborative management of congenital cataracts. Nat. Biomed. Eng. 1, 1-8 (2017).
15. Burlina, P. M. et al. Automated grading of age-related macular degeneration from color fundus images using deep convolutional neural networks. JAMA Ophthalmol. 135, 1170-1176 (2017).
16. Kermany, D. S. et al. Identifying medical diagnoses and treatable diseases by image-based deep learning. Cell 172, 1122–1131.e1129 (2018).
17. Strodthoff, N. &Strodthoff, C. Detecting and interpreting myocardial infarctions using fully convolutional neural networks. Preprint at https://arxiv.org/abs/1806.07385 (2018).
18. Rajpurkar, P. et al. Cardiologist-level arrhythmia detection with convolutional neural networks. Preprint at https://arxiv.org/abs/1707.01836 (2017).
19. Zhang, J. et al. Fully automated echocardiogram interpretation in clinical practice feasibility and diagnostic accuracy. Circulation 138, 1623–1635 (2018).
20. Mori, Y. et al. Real-time use of artificial intelligence in identification of diminutive polyps during colonoscopy. Ann. Intern. Med. 169, 357–366 (2018).
21. Wang, P. et al. Development and validation of a deep-learning algorithm for the detection of polyps during colonoscopy. Nat. Biomed. Eng. 2, 741–748 (2018).
22. Prajapati, Shreyansh A., R. Nagaraj, and Suman Mitra. "Classification of dental diseases using CNN and transfer learning." 2017 5th International Symposium on Computational and Business Intelligence (ISCBI). IEEE, 2017.

23. Shankarapillai, Rajesh, et al. "Periodontitis risk assessment using two artificial neural networks-a pilot study." International Journal of Dental Clinics 2.4 (2010).
24. Rosmai, Mohd Dom, et al. "The use of artificial intelligence to identify people at risk of oral cancer: empirical evidence in Malaysian University." International Journal of Scientific Research in Education 3.1 (2010): 10-20.
25. Middleton I, Damper RI. Segmentation of magnetic resonance images using a combination of neural networks and active contour models. Med EngPhys 2004;26:71-86
26. Pereira S, Pinto A, Alves V, Silva CA. Brain tumor segmentation using convolutional neural networks in MRI images. IEEE Trans Med Imaging 2016;35:1240-1251
27. Moeskops P, Viergever MA, Mendrik AM, de Vries LS, Benders MJ, Isgum I. Automatic segmentation of MR brain images with a convolutional neural network. IEEE Trans Med Imaging 2016;35:1252-1261
28. Prasoon A, Petersen K, Igel C, Lauze F, Dam E, Nielsen M. Deep feature learning for knee cartilage segmentation using a triplanar convolutional neural network. Med Image ComputComput Assist Interv 2013;16(Pt 2):246-253
29. Glavan CC, Holban S. Segmentation of bone structure in X-ray images using convolutional neural network. AdvElectrComputEng 2013;13:87-94
30. Wang, Xiaosong, et al. "Chestx-ray8: Hospital-scale chest x-ray database and benchmarks on weakly-supervised classification and localization of common thorax diseases." Proceedings of the IEEE conference on computer vision and pattern recognition. 2017.
31. Nam, Ju Gang, et al. "Development and validation of deep learning–based automatic detection algorithm for malignant pulmonary nodules on chest radiographs." Radiology 290.1 (2018): 218-228.
32. Bluemke, David A. "Radiology in 2018: are you working with AI or being replaced by AI?." Radiology 287.2 (2018): 365-366.
33. Bejnordi, BabakEhteshami, et al. "Diagnostic assessment of deep learning algorithms for detection of lymph node metastases in women with breast cancer." Jama 318.22 (2017): 2199-2210.
34. Litjens, Geert, et al. "Deep learning as a tool for increased accuracy and efficiency of histopathological diagnosis." Scientific reports 6 (2016): 26286.
35. Coudray, N. et al. Classification and mutation prediction from non-small cell lung cancer histopathology images using deep learning. Nat. Med. 24, 1559–1567 (2018).
36. Capper, D. et al. DNA methylation–based classification of central nervous system tumours. Nature 555, 469–474 (2018).
37. Steiner, D. F., et al. Impact of Deep Learning Assistance on the Histopathologic Review of Lymph Nodes for Metastatic Breast Cancer. Am. J. Surg. Pathol. 42, 1636–1646 (2018).
38. Liu, Y. et al. Artificial intelligence–based breast cancer nodal metastasis detection. Arch. Pathol. Lab. Med. OA (2018).
39. https://www.businesswire.com/news /home/20190307005205/en/FDA-Grants-Breakthrough-Designation-Paige.AI
40. Char, Danton S., Nigam H. Shah, and David Magnus. "Implementing machine learning in health care-addressing ethical challenges." The New England journal of medicine 378.11 (2018): 981.

REVIEW ARTICLE

E- LEARNING DURING COVID-19: AN IRIDESCENT STEP INTO THE FUTURE OF DENTAL EDUCATION?

ABSTRACT

COVID-19 has brought a great range of changes to the world, dental education proved no different. There has been a boom in e-learning over the past one year or so as measures to ensure social distancing and prevention of the spread of the virus have been put into place. In this narrative review, the authors aimed at reviewing various e-learning modalities employed in dental education and how knowledge of the same can help us improve dental learning as practised today. A search of the PubMed database was conducted in November 2020, with no date limits, using the search terms "COVID-19", "SARS", "medical education" and "dental education", "Flipped class rooms", " Learning management systems", " Augmented reality" and "Problem based learning" and the results were screened for relevance to the review topic. Additional searches were done in Google Scholar for categories that yielded few results in PubMed. There are an array of tools at our disposal, one amongst the many and certainly the most popular being video conferencing. Home environments might not be the most conducive for education for various reasons. Assessments are to be done at regular intervals. We as educators must actively revise and review our teaching strategy and maintain a continuum in ways that are feasible and appropriate for our institutions respectively as well as effective for students.

Key words: Dental Education, E-Learning, COVID-19, Remote learning, Medical education, Dentistry, Online learning.

Authors:

Dr. Gayathri Rajeev[1]*
Dr. Mohamed Imranulla[2]
Dr. Prashant G.M.[3]
Dr. Sushanth V.H.[4]
Dr. Allama Prabhu C.R.[5]
Dr. Vivek H.P.[6]

[1]Postgraduate Student
College of Dental Sciences, Davanagere

[2,4]Professor
College of Dental Sciences, Davanagere

[3]Professor and HOD
College of Dental Sciences, Davanagere

[5,6]Reader
College of Dental Sciences, Davanagere

Corresponding Author:
Dr. Gayathri Rajeev
Postgraduate Student
College of Dental Sciences
Davanagere, Karnataka, India
Ph. : 7022870383, 9449271994
Email: gayathri_rajeev@ymail.com

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INTRODUCTION

COVID-19 emerged in Wuhan of Hubei Province of China in December of 2019 and has spread throughout the world, causing great concern.[1] To control COVID-19 transmission, various governments world over have implemented strict domestic quarantine and social isolation policies. Dentistry despite being a very practise centred profession, has firm roots in theory classes. This, enables the temporary shifting of the dental curriculum to one that is remote . Thus, keeping students in touch with the subject matter, ensuring their safety as well as engaging them thus alleviating fear, discomfort and uncertainty caused by the pandemic.

Dental colleges in India have been working to transform pedagogy by reducing lectures using technology, implementing active self-directed individualized learning and inter-professional education for more than a decade.[2,3] The advent of COVID-19 has led dental education into a new phase in India. Measures to ensure social distancing have included closure or partial functioning of medical and dental schools and working from home for both educators as well as students. Though the situation might seem as if learning may take a back seat, institutions and organizations have gone to great lengths to keep the learning going thus, providing an impetus to e-learning. This transition has been easy for some who had already incorporated e-learning in their system and a bit difficult for others who are completely new to this system. In a situation where remote learning is the need of the hour and the lack of a review summarizing the same, this article is aimed at reviewing the various modalities employed in facilitating remote learning in Dental Colleges during such unprecedented times.

Search Methods :

As this is a narrative review, we did not conduct a systematic literature search. However, a search of the PubMed database was conducted in November 2020, with no date limits, using the search terms "COVID-19" ,"SARS", "medical education" and "dental education", "Flipped class rooms", " Learning management systems", " Augmented reality" and "Problem based learning" and the results were screened for relevance to the review topic. Additional searches were done in Google Scholar for categories that yielded few results in PubMed.

Online learning:

According to Moore, Dickson-Deane, & Galyen online learning is learning that uses internet networks with accessibility, connectivity, flexibility, and the ability to bring up various types of learning interactions.[4]

A learning style can be described as a set of cognitive, emotional and physiological features that can be used as indicators of how a person can learn.[5]

There are certain types of learning one can employ in online education.

- **Asynchronous learning** - Literature states that this method works best in the digital format. Teachers need not deliver material at a fixed time, it can be posted online for access. While it gives respite for students and teachers, such learning tools are to be moderated by experienced faculty in order to be effective.

- **Synchronous learning** - Synchronous learning refers to that circumstance where a group of students are learning at the same time. Thus, it is preferred tool of choice where peer interactions are deemed necessary and appropriate.

- **Blended learning** - It can be used for integrated content and clinical scenarios where both synchronous and asynchronous elements may be effective.[6]

The success of e-learning depends on the attitudes and interactive teaching styles of the faculty, as well as on the experience and attitudes of students with regard to technology.

Students' characteristics refers to their general attitudes and behaviours towards achieving certain learning goals.[7] Student characteristics that define the success or failure of online learning are many and varied. Computer anxiety due to sense of inadequacy, lack of technological experience, computer self-efficacy (self-assessment of one's ability to apply and use the computer to accomplish a task), self-discipline, social interactions, motivation, extent of active learning are key factors.

Studies state that students in more advanced years of learning tend to perform better that than those in the initial years of the course most commonly due to better exposure and thus resultant familiarity with the tools.[8]

Educator Factors/ Instructor factors include, instructor attitude, teaching style, instructor

practise and online responsiveness.

These times are, in a great number of ways unprecedented for many of us. There are an array of tools at our disposal.

Tools of Online Education

Technology has advanced a great deal over the years. The tools of online learning available at our disposal are many and varied. We attempted to discuss a few through the course of this article.

Video conferencing - A common cost-effective tool for accomplishing synchronous learning.

Video conferencing is an accommodative tool for disparate learning styles, helps diversify the reach of education and compares positively with traditional teaching methods.

These days many conferences and workshops are also conducted on such platforms, eliminating need to travel and making it more accessible to many.[9] The most familiar tools used include Zoom, Skype, Google meet, Jio meet.

Flipped classrooms: The flipped classroom is a teaching model that changes most of the teacher-centered learning to more student-centered learning activities. It was originally introduced due to the ineffectiveness of traditional lectures in retaining students' attention and encourages active learning. This method seems to offer promising ways to engage students in a more effective, supportive and a motivating manner especially for low achievers and students that may struggle with traditional lectures. It is a mode of education which has mixed reviews based on the circumstance in which it is implemented. The evidence tips slightly towards the positive benefits especially if the student preparation is assessed.[10]

Learning management systems (LMS)/ Content Management Systems (CMS) / Virtual Learning Environment (VLE): which provides educators tools to create a course web site. They maybe cloud based or open source. Open Source LMS has an open source code that you can access for free, and customize it according to your specific requirements. Cloud LMS is a web-based LMS hosted on the servers of the service provider (vendor). A few examples of the same include Google classrooms, Moodle, Medwiz, Canavas, Edume, Edumodo. The use of such systems require the user to educate themselves in the process of using the same.[11]

Augmented reality/ Virtual reality- Augmented reality forms a useful tool especially for training and workshops in situations which need to be made genuinely authentic . It helps in developing participatory environments and activities, teaching tasks involving manual dexterity or physical movement. It can be used where it is essential to make learning more interesting and fun. It can assist in understanding clinical scenarios where mistakes made by the learner or trainee using the real thing could be devastating and/or demoralizing to the learner, harmful to the environment, capable of causing unintended property or equipment damage or is costly.[12] It also saves students from not being able to see demonstrations due to hampered visibility.

Paper cases/ clinical case scenarios- It helps students to understand the art of diagnosis better .

Gamification of learning-Gamification refers to the application of game design elements to non-game activities, such as education. Points, levels, badges, leader boards, prizes and rewards, progress bars, storyline and feedback are key determinants in the level of engagement provided and thus the success of the game.[13,14]

Problem based learning (PBL) - It is often suggested in psychological research that learning content as well as improvement in thinking strategies occurs through problem based learning. Groups of students engage in self-directed learning and the teacher is a mere facilitator of this process. It encourages students to apply new knowledge to problems, solve problems with multiple answers, reflect on what they have learned and essentially asses the effectiveness of the strategies employed. It ingrains in them intrinsic motivation, effective collaborative skills and flexible understanding and lifelong learning skills[15].

Open online resources- Giving students links, webpages, videos to learn from and assessing them based on the same helps them build upon already existing knowledge.

Social media- Social media can be used as an adjunct with other mediums to pass on information . Such as the use of blogs where study material is often discussed and reviewed. Blogging has been used commonly in various health care sectors, as a time intensive teaching tools. The use of other social media platforms such as facebook through closed groups which permit the students to interact the experts, eliminate doubts as well as discuss cases where deemed appropriate.

Integrating virtual education into the curriculum would largely eliminate issues that students may have regarding class timings, inability to see demonstrations in large classrooms as well as hear the speaker/teacher during lectures. It has mediums for all types of learners whether visual, tactile or audio based and ensures a greater level of learner satisfaction. It also helps those with low attention span or those who are slow learners because they have the option to repeat the material provided to them multiple times unlike real time lectures where some students may not be able to absorb the complete essence of the topic under discussion.

Causes of concern

There is a great deal of fear with regard to making e-learning as effective and engaging as offline learning. This may be overcome using good visually esthetic and creative presentations along with voice modulation to keep the students interested as well as engaged. A common issue faced when teaching online is the inability to know whether students are learning. Interaction is key to the success of the virtual classroom.

Assessing the level of a class is important so that the level of difficulty is set at an optimum. One cannot be sure if students comprehend the content that is provided to them till assessments are done to ensure the same in the form of quizzes/ polls, games, reflection, interactive and thought provoking assignments. 'Polleverywhere,''Kahoot', 'Socrative', 'Answer garden' are a few assessment tools .

Over the last year many universities adopted a range of measures to ensure the safety of the students, as well as the patients involved. Most universities conducted some form of virtual practical exams, making use of paper cases, and virtual vivas. Dentistry per se is a practical oriented subject and despite the availability of such tools, they only act as a supplement to what clinical experience one may gain from a patient. A very important fact we would like to emphasis here is the educational experience of the student must not be disrupted for a longer duration of time. These tools help one ensure that.

Students' mental health is often greatly affected when faced with a public health emergency. The dental students today are facing a unique situation, where social distancing is the norm and thus their mental state and quality of life is at risk. The environment one is in, as well as social interactions one has play a key role in ensuring good mental health thus setting the ideal tone for a good academic life. Home environment should be conducive for academic achievement. The size of the study site, the amount of light and even the color of the environment often influence the quality of learning.[16]

Educational institutions and government must help those students are unsupportive and whose home environments are not conducive to study to financial as well as other reasons. Studying at home is not easy for many, especially for children with low motivation.[17,18] Other disadvantages include network issues (lack of good band width), technical issues and lack of access to e-learning in remote areas. Constructive feedback helps both teachers and students function better on multiple fronts.

CONCLUSION

Students learn better when they connect newly learned knowledge and skills to previous knowledge. Schools and colleges are creating opportunities for engagement through collaborative, team-based, and inter-professional projects that support learners, with tailored resources within and outside of the classroom.19 Encouraging a learn from anywhere approach and bridging divides will be critical in overall results.20

Due to the constraints experienced by the world economies, dental colleges are also under great amount of strain to provide an effective education that is feasible, here e-learning comes to the rescue. Yet the effectiveness of the same for the practical aspects of dentistry as a specialty is yet to be evaluated. The extraordinary circumstances we are in demand

a balance between protecting students from the exposure of COVID-19 and saving resources to achieving an effective learning experience.

The present situation we are in has taught us a great deal, the stage for change has been set, we must continue to keep the ball rolling in a positive direction for dental instruction through the implementation of efficient changes that apply current and emerging information in novel ways that are found appropriate for our system.

REFERENCES

1. Silva PG, de Oliveira CA, Borges MM, Moreira DM, Alencar PN, Avelar RL et al. Distance learning during social seclusion by COVID-19: improving the quality of life of undergraduate dentistry students. European Journal of Dental Education. 2021 Feb;25(1):124-34.
2. Irby DM, Cooke M, O'Brien BC. Calls for reform of medical education by the Carnegie Foundation for the Advancement of Teaching: 1910 and 2010. Academic Medicine. 2010 Feb 1;85(2):220-7.
3. Skochelak SE, Stack SJ. Creating the medical schools of the future. Academic Medicine. 2017 Jan 1;92(1):16-9.
4. Pragholapati A. COVID-19 IMPACT ON STUDENTS. 2020.
5. DALMOLIN AC, MACKEIVICZ GA, POCHAPSKI MT, PILATTI GL, SANTOS FA. Learning styles preferences and e-learning experience of undergraduate dental students. Revista de Odontologia da UNESP. 2018 Jun;47(3):175-82.
6. Daniel J. Education and the COVID-19 pandemic. Prospects. 2020 Oct;49(1):91-6.
7. Iyer P, Aziz K, Ojcius DM. Impact of COVID-19 on dental education in the United States. Journal of dental education. 2020 Jun;84(6):718-22.
8. Khalil MK, Abdel Meguid EM, Elkhider IA. Teaching of anatomical sciences: A blended learning approach. Clinical Anatomy. 2018 Apr;31(3):323-9.
9. Saeed SG, Bain J, Khoo E, Siqueira WL. COVID-19: Finding silver linings for dental education. Journal of Dental Education. 2020 Oct 1.
10. Låg T, Sæle RG. Does the flipped classroom improve student learning and satisfaction? A systematic review and meta-analysis. AERA open. 2019 Aug;5(3):2332858419870489.
11. Ghazal S, Al-Samarraie H, Aldowah H. "I am still learning": Modeling LMS critical success factors for promoting students' experience and satisfaction in a blended learning environment. IEEE Access. 2018 Nov 5;6:77179-201.
12. Pantelidis VS. Reasons to use virtual reality in education and training courses and a model to determine when to use virtual reality. Themes in Science and Technology Education. 2010 Oct 29;2(1-2):59-70.
13. Nah FF, Zeng Q, Telaprolu VR, Ayyappa AP, Eschenbrenner B. Gamification of education: a review of literature. In International conference on hci in business 2014 Jun 22 (pp. 401-409). Springer, Cham..
14. Kiesler S, Kraut RE, Koedinger KR, Aleven V, Mclaren BM. Gamification in education: What, how, why bother. Academic exchange quarterly. 2011 Jan;15(2):1-5.
15. Hmelo-Silver CE. Problem-based learning: What and how do students learn?. Educational psychology review. 2004 Sep 1;16(3):235-66.
16. Khodabakhshi-koolaee A. Living in home quarantine: analyzing psychological experiences of college students during Covid-19 pandemic. Journal of Military Medicine. 2020 Feb;22(2):130-8.
17. Bao W. COVID-19 and online teaching in higher education: A case study of Peking University. Human Behavior and Emerging Technologies. 2020 Apr;2(2):113-5.
18. Al-Taweel FB, Abdulkareem AA, Gul SS, Alshami ML. Evaluation of technology-based learning by dental students during the pandemic outbreak of coronavirus disease 2019. European Journal of Dental Education. 2021 Feb;25(1):183-90.
19. Sullivan L, Magaña L, Galea S. Peering into the future of public health teaching. The Lancet Public Health. 2018 Jun 1;3(6):e268.
20. Sullivan LM, Velez AA, Galea S. Graduate public health education in the post-COVID-19 era. The Lancet Public Health. 2020 Sep1;5(9):e473.

NANO DENTISTRY: A REVIEW

Authors:

Dr. Archith Mannan[1]*
Dr. Mathew John[2]
Dr. Bindu Rachel Thomas[3]
Dr. Sabari Chandramohan[4]
Dr. Nitha Syam[5]
Dr. Aswathy S[6]
Dr. Revu Das[7]
Dr. Aijin A. Mohan[8]

Second Year PG[1,8]
Dept. of Periodontics
Sri Sankara Dental College

Head of Department[2]
Dept. of Periodontics
Sri Sankara Dental College

Professor[3]
Dept. of Periodontics
Sri Sankara Dental College

Reader[4,5]
Dept. of Periodontics
Sri Sankara Dental College

Lecturer[6]
Dept. of Periodontics
Sri Sankara Dental College

Senior Lecturer[7]
Dept. of Periodontics
Sri Sankara Dental College

Corresponding Author:
Dr. Archith Mannan
Second Year PG
Dept. of Periodontics
Sri Sankara Dental College
Mob: 9495606783
Email: archithmannan@gmail.com

ABSTRACT

Nanotechnology is the manipulation of matter on the molecular and atomic levels. It has the potential to bring enormous changes into the fields of medicine and dentistry. The new era of dentistry will encompass precisely regulated analgesia, tooth renaturalization, complete cure for hypersensitivity and rapid orthodontic treatment. A day may soon come when nanodentistry will succeed in maintaining near-perfect oral health through the aid of Nano robotics, nanomaterials and biotechnology. This review article provides an insight about the importance and possible applications of nanotechnology in the field of dentistry.

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INTRODUCTION

'Nano' is derived from the Greek word, which means 'dwarf'. The concept nanotechnology was set up by physicist Dr Richard Feynman in 1959 and he is known to be Father of nanotechnology. The term nanotechnology was coined by Japanese scientist Dr. Nori Taniguchi in 1974 Nanotechnology can be defined as the science and engineering involved in the design, synthesis, characterization, and application of materials and devices whose smallest functional organization in at least one dimension is on the nanometer scale1 (one-billionth of a meter). It is the control of matter at the nanoscale at dimensions between 1 to 100 nm[1].

'Nanotechnology is widely used in medicine in areas such as drug development, and imaging. Furthermore, the targeted delivery of drugs to diseased cells, such as cancer cells, is an effective, and safer way of treating a disease.[2] The potential applications of nanotechnology are very vast; however, one of the greatest values of nanotechnology will be in the development of new and effective medical treatments. With the application of nanotechnology in dentistry a new stream of nanodentistry is rising. Nanodentistry has a potential to improve oral health by providing the sophisticated preventive, diagnostic, and therapeutic measures using the nanomaterials, biotechnology, and nanorobots.[3] Current research in dentistry includes the use of Nanoparticles, which are being used in resin-based composite (RBC) restorations and in preventive dentistry specifically in control and management of bacterial biofilms. Nanotechnology is also an upcoming tool in the field of implant dentistry. There is a strong belief that nanoscale materials will produce a new generation of implant materials with high efficiency, low cost, and high volume.

Nanostructures used in Dentistry

Commonly explored nanostructures, which can show promising results in dentistry are as follows:

- Nanoparticles
- Nanorods
- Nanospheres
- Nanotubes
- Nanofibers
- Dendrimers
- Nanopores
- Nanoshells

Nanorobotic analgesics

- Nanotechnology uses millions of active analgesic nanometer sized dental nanorobots in colloidal suspension for local anaesthesia.
- Nanorobotic analgesics offer greater patient comfort, reduced anxiety, no-needle, greater selectivity, and control ability of the analgesic effect, fast and completely reversible action and avoidance of most of the side-effects and complications.
- On reaching the dentin nanorobots, within 100 secs, are said to enter dentinal tubules(1 to 4 µm) in diameter.
- Proceed toward the pulp, guided by a combination of chemical gradients, temperature differentials and even position of navigation all under the control of the onboard nanocomputer as directed by the dentist[4].
- Once installed in the pulp, the analgesic dental robots may be commanded by the dentist to shut down all sensitivity in any particular tooth that requires treatment. After sensation, to relinquish control of nerve traffic and to egress from the tooth by similar pathways used for ingress[4,5].

Major Tooth Repair

Nanodental techniques for major tooth repair may evolve through several stages of technological development, first using genetic engineering, tissue engineering and tissue regeneration, and later involving the growth of whole new teeth in vitro and their installation.

There are many substances which help in teeth repair and regeneration process. These are

I. Hydroxyapatite as a Biomaterial for Dental Restoration

Hydroxyapatite particle (HAp) is a naturally occurring mineral form of calcium apatite, which is predominately obtained in mineralized tissue. It is also one of the major components of dentin. These bioactive nanomaterials can be used as an injectable matrix for periodontal regeneration and bone regrowth.

Overall, HAp-reinforced nanocomposites [Fig.1.] or surface coating improves mechanical stiffness and bioactivity of implants and can be used for dental restoration.

II. Bioinert Zirconia Nanoparticle

Zirconia (or zirconium dioxide)[Fig .2.] is a polycrystalline biocompatible ceramic with low reactivity, high wear resistance and good optical properties. This nano filled zirconia particles promote bone bonding, mineralization and dental tissue repair.

III. Dentin Hypersensitivity

For the treatment of hypersensitivity nano particles of BAG is used.

This technology is known as NovaMin®, Sensodyne [Fig 3.]technically described as an inorganic amorphous calcium sodium phosphosilicate (CSPS) material that was designed based on a class of materials known as bioactive glasses. It comprises 45% SiO2, 24.5% Na2O, 24.5% CaO and 6% P2O[5].

IV. Nanorobotic Dentifrice (dentirobots)

Nanorobotic dentifrice (dentirobots) delivered by mouthwash or toothpaste [Fig.4.]could patrol all supragingival and subgingival surfaces at least once a day metabolizing trapped organic matter into harmless and odourless vapours and performing continuous calculus debridement[8].

Properly configured dentirobots could identify and destroy pathogenic bacteria residing in the plaque and elsewhere, while allowing the 500 species of harmless oral microflora to flourish in a healthy ecosystem.

V. Nano-filled Light Curing Varnish

Application of nanotechnology in GIC is the development of a nano-filled light curing varnish (G-CoatPlus,GC Europe)[Fig .5.], which is applied onto the surface of a highly viscous GIC (Fuji IX GP Extra, GC Europe)[7]. This combination has been commercially branded as EQUIA ('Easy-Quick-Unique-Intelligent-Aesthetic'). The main purpose is to provide surface protection in the early maturation phase of the cement to avoid both water uptake and dehydration. This will lead to improved mechanical properties

VI. IMPRESSION MATERIALS

Nanosilica fillers like Elite HD [Fig.6.] are integrated in vinylpolysiloxanes, producing a unique edition of siloxane impression material.

The material has a

1. Better Flow.

2. Improved Hydrophilic Properties.

3. Tear Strength.

4. Enhanced Detail Precision

The presence of the nanostructure increases the fluidity of the material, especially when pressure is applied.[6]

CONCLUSION

Nanotechnology is such a new, exciting and emerging field with a significant potential to yield new generation of technologically advanced clinical tools and devices for oral health-care. Nano-enabled technologies thus provides an alternative and superior approach to assess the onset or progression of diseases, to identify targets for treatment interventions as well as the ability to design more biocompatible, microbe resistant dental materials, and implants.

For all these things to happen, nanodentistry needs to overcome the various barriers or challenges for its application and yield more effective therapies and preventive properties. Nanotechnology also carries a significant potential for misuse and abuse on a scale and scope never seen before. Nanotechnology might cause adverse effects to human health and environment that are poorly understood. A successful future of nanotechnology will only be achieved through open sharing of ideas, research findings, testing, and forthright discussions.

Research to improve upon existing nanomaterials is still ongoing, with future directions towards more efficient and cost effective in new oral drug delivery systems to disrupt biofilm formation and reduce the incidence of caries and periodontal disease. Although the science behind nanotechnology has lack of long term clinical evidence addressing their clinical performance restricts their wide clinical use.

REFERENCES

1. Kaehler T. Nanotechnology: Basic concepts and definitions. ClinChem 1994;40:1797-9
2. Shaffer C. Nanomedicine transforms drug delivery. Drug Discov Today 2005;10:1581-2.
3. Subramani K, Ahmed W. Emerging nanotechnologies in dentistry: Processes, materials and applications. Waltham, MA: Elsevie Inc.;2012.
4. Freitas RA Jr. Nanodentistry. J Am Dent Assoc 2000;131:1559-65.
5. Subramani K, Ahmed W. Emerging nanotechnologies in dentistry:, materials and applications. Waltham, MA: Elsevier Inc.; 2012.
6. Verma SK, Prabhat KC, Goyal L, Rani M, Jain A. A critical review of the implication of nanotechnology in modern dental practice. NatlJMaxillofacSurg 2010; 1:41-4.
7. Efes BG, Dörter C, Gömeç Y, Koray F. Two-year clinical evaluation of ormocer and nanofill composite with and without a flowableliner.JAdhes Dent 2006;8:119-26
8. Emerich DF. Nanomedicine – Prospective therapeutic and diagnostic applications. Expert OpinBiolTher 2005;5:1-5.

LASER EXCISION OF PYOGENIC GRANULOMA: A CASE REPORT

Authors:

Dr. Sruthi V.G.[1]*

Dr. Harish Kumar V.V.[2]

III Yr Postgraduate[1]
Department of Periodontology
KMCT Dental College
Mukkam, Calicut

Professor and HOD[2]
Department of Periodontology
KMCT Dental College
Mukkam, Calicut

Corresponding Author:
Dr. Sruthi V.G.
Third Year Postgraduate
Department of Periodontology
KMCT Dental College
Manassery P.O., Mukkam
Calicut, Pin 673602
Mobile: 9497310415
Mail: sruthivg25@gmail.com

ABSTRACT

Pyogenic granuloma is a commonly occurring inflammatory hyperplasia of the skin and oral mucosa in females. It is a relatively common benign mucocutaneous lesion. The term is a misnomer as the lesion does not contain pus nor it is granulomatous. This tumor like growth is considered to be non neoplastic in nature and has a varied clinical presentation. Etiology of the lesions is unknown, but predisposing factors that have been reported include pregnancy, trauma, vascular malformation and chronic inflammation. The most common treatment of pyogenic granuloma is surgical excision but alternative approaches such as laser excision have also been proposed. Here present one such case of pyogenic granuloma, which was excised with diode laser.

Key words: Pyogenic granuloma, hyperplasia, diode laser.

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INTRODUCTION

Pyogenic granuloma is a common inflammatory hyperplastic lesion also known as Crocker and Hartzell's disease, granuloma pyogenicum, granuloma pediculatumbenignum, benign vascular tumor, and during pregnancy as granuloma gravidarum[1]. It was first described by Hullihen in 1844. And was originally described in 1897 by two French surgeons, Poncet and Dor[2], and the term pyogenic granuloma or granuloma pyogenicum was introduced by Hartzell in 1904[3]. It is considered as a capillary haemangioma of lobular subtype as suggested by Mills, Cooper, and Fechner, which is the reason they are often quite prone to bleeding[2]. The most common intraoral site is marginal gingiva, but lesions have been reported on palate, buccal mucosa, tongue, and lips. Extra oral sites commonly involve the skin of face, neck, upper and lower extremities, and mucous membrane of nose and eyelid[4]. Trauma, poor oral hygiene, low-grade local irritation, or certain kinds of drugs precipitate the hyperplastic response. It is common in females and may be associated with high levels of steroid hormones[1].

CASE HISTORY

A 34-year old woman presented to our department with a chief complaint of a painless swelling on the right maxillary buccal gingiva between 15 and 16 since eight months. She gave a history of a pea-sized swelling initially, which gradually increased to the present size and was associated with bleeding while brushing. She did not recollect any history of trauma or was not under gestation. General physical examination revealed no other abnormalities, and there was no generalized lymph adenopathy. On clinical examination, a single, well-defined pale red, roughly spherical gingival growth of 2.5x4 cm size was seen arising from the gingiva of 15,16 (Figure 1). The surface was smooth without ulceration. On palpation, it was found to be sessile, soft to firm in consistency, non-tender, but not reducible or fluctuant.

On the basis of history and clinical findings, a provisional diagnosis of pyogenic granuloma was made, and a differential diagnosis of peripheral ossifying fibroma, fibroma, and peripheral giant cell granuloma was considered. Excisional biopsy with diode laser was planned. After local anaesthesia, the lesion was excised with a diode laser using an initiated tip in continuous mode. It was ensured that the lesion was completely excised by trimming up the remnants of the soft tissue adjacent to the tooth to prevent recurrence of the lesion. There present a hidden recession of approximately 2mm in relation[16]. The diode laser provided an optimum combination of clean cutting of the tissue and hemostasis (Figure 2).Then the excised area was covered with a resorbable GTR membrane (Figure 3). Lastly periodontal pack was placed(Figure 4).

The excised tissue was sent for histopathologic examination, which shows stratified squamous keratinized epithelium and underlying connective tissue. The connective tissue is densely collagenous with numerous budding blood capillaries. Endothelial lined vascular channels engorged with RBCs and extravasated RBCs are also seen. Dense chronic inflammatory cell infiltrate predominately lymphocytes and plasma cells are also evident. The characteristics confirmed the diagnosis of pyogenic

granuloma. The patient was recalled after 10 days, and herpostoperative healing was uneventful (Figure 5).Then the patient was recalled after 2months, the surgical site was healing well, with no evidence or recurrence of the lesion (Figure 6).

DISCUSSION

Although pyogenic granuloma may appear at any age, 60% cases are observed between the ages of 10 and 40; incidence peaks during the third decade of life and women are twice as likely to be affected[5], due to the increased levels of circulating hormones, estrogen and progesterone[1]. It is more common in children and young adults[5].

Clinically, it presents as an elevated, smooth or exophytic, lobulated, sessile, or pedunculated growth that may show ulcerations or may be covered by yellow fibrinous membrane. Gingiva, especially the marginal gingiva, is affected more than the alveolar part[6]. Gingival irritation and inflammation that result from poor oral hygiene may be a precipitating factor in many patients[7]. Lips, tongue, or buccal mucosa may also be affected. Its size varies from a few millimetres to several centimetres, and it is usually slow growing, asymptomatic, and painless, but at times it grows rapidly6, reach its maximum size, and remain static8. They may typically begin as small, red papules that rapidly enlarge to become pedunculated raspberry-like nodules. Rarely, patient may develop multiple satellite angiomatous lesions after excision of a solitary pyogenic granuloma[2].The colour varies from red, reddish purple to pink depending on the vascularity of the growth[6].

Differential diagnosis of pyogenic granuloma includes peripheral giant cell granuloma, peripheral ossifying fibroma, fibroma, peripheral odontogenic fibroma, hemangioma, conventional granulation tissue, hyper plastic gingival inflammation, Kaposi's sarcoma, bacillary angiomatosis, angiosarcoma, and non-Hodgkin's lymphoma. Histologically, pyogenic granuloma shows prominent capillary growth within a granulomatous mass.

Although the conventional treatment for pyogenic granuloma is surgical excision, a recurrence rate of 16% has been reported[1]. There are also reports of the lesion being eliminated with electric scalpelor cryosurgery[9]. Other methods used by various workers include cauterization with silver nitrate, sclero therapy with sodium tetra decyl sulfate and monoethanolamineoleate[10], ligation, absolute ethanolinjection dye[11], Nd:YAG and CO2 laser[12] shave excision, and laser photocoagulation[13].

Laser therapy using continuous and pulsed CO2 and Nd: YAG systems have been used for a variety of intraoral soft tissue lesions such as haemangioma, lymphangioma, squamous papilloma, lichen planus, focal melanosis, andpyogenic granuloma, because they carry the advantage of being less invasive and sutureless procedures that produce only minimal postoperative pain. Rapid healing can be observed within a few days of treatment, and as blood vessels are sealed, there present improved haemostas is and coagulation. It also depolarizes nerves, thus reducing post-operative pain, and also destroys many bacteria and viral colonies that may potentially cause infection. Reduced post-operative discomfort, oedema, scarring, and shrinkage have all been associated with its use[13].

Powell et al applied Nd: YAG laser for excision of Pyogenic granuloma. Lower risk of bleeding compared to other surgical techniques and superior coagulation characteristics over CO2 laser was observed[14]. White et al also proposed that CO2 and Nd: YAG lasers are successful surgical options when performing excision of benign intraoral lesions[15].Flash lamp pulsed dye laser was used by Maffert et al for excision of a mass of granulation tissue which did not respond to the usual treatment methods[16]. Rai et al introduced laser as a powerful tool for treatment of pyogenic granuloma. They proposed laser therapy, since it has the advantage of being less invasive, limitation of hemorrhage during surgery, a better field of view for the surgeon and sutureless procedure with minimal post operative discomfort[2].

CONCLUSION

Diode laser can be effectively used for the excision of pyogenic granuloma to minimize discomfort during and after surgery.The use of diode laser offers a new tool that can change the way in which existing treatments are performed.

REFERENCES

1. Bansal V, Konidena A, Mann AK, Farooq F. Diode laser excision of pyogenic granuloma: A case report. Journal of Dental Lasers. 2019;13(2):52.
2. Rai S, Kaur M, Bhatnagar P. Laser: a powerful tool for treatment of pyogenic granuloma. Journal of cutaneous and aesthetic surgery. 2011;4(2):144.
3. Asnaashari M, Mehdipour M, MoradiAbbasabadi F, Azari-Marhabi S. Expedited removal of pyogenic granuloma by diode laser in a pediatric patient. Journal of lasers in medical sciences. 2015;6(1):40.
4. Parrulli R, Franco S, Petruzzi M, Maiorano E, Favia G. Pyogenic granuloma: surgical treatment with diode laser. Annali di stomatologia. 2013;4(2):35.
5. Nthumba PM. Giant pyogenic granuloma of the thigh: a case report. Journal of medical case reports. 2008;2(1):1-3.
6. Bhaskar SN, Jacoway JR. Pyogenic granuloma–clinical features, incidence, histology, and result of treatment: report of 242 cases. Journal of oral surgery (American Dental Association: 1965). 1966;24(5):391-8.
7. Burket LW, Greenberg M, Click M. Burket's oral medicine 11th ed. BC Decker Inc. 2008;214-5.
8. Neville BW, Damm DD, Allen CM, Chi AC. Oral and maxillofacial pathology. Elsevier Health Sciences; 2015.
9. Gupta R, Gupta S. Cryo-therapy in granuloma pyogenicum. Indian Journal of Dermatology, Venereology, and Leprology. 2007;73(2):141.
10. Matsumoto K, Nakanishi H, Seike T, Koizumi Y, Mihara K, Kubo Y. Treatment of pyogenic granuloma with a sclerosing agent. Dermatologic surgery. 2001;27(6):521–3.
11. Ichimiya M, Yoshikawa Y, Hamamoto Y, Muto M. Successful treatment of pyogenic

granuloma with injection of absolute ethanol. The Journal of dermatology. 2004;31(4):342-4.

12. Raulin C, Greve B, Hammes S. The combined continuous-wave/pulsed carbon dioxide laser for treatment of pyogenic granuloma. Archives of dermatology. 2002;138(1):33–7.
13. Kirschner RE, Low DW. Treatment of pyogenic granuloma by shave excision and laser photocoagulation. Plastic and reconstructive surgery. 1999;104(5):1346-9.
14. Powell JL, Bailey CL, Coopland AT, Otis CN, Frank JL, Meyer I. Nd: YAG laser excision of a giant gingival pyogenic granuloma of pregnancy. Lasers in Surgery and Medicine: The Official Journal of the American Society for Laser Medicine and Surgery. 1994;14(2):178-83.
15. White JM, Chaudhry SI, Kudler JJ, Sekandari N, Schoelch ML, Silverman Jr S. Nd: YAG and CO2 laser therapy of oral mucosal lesions. Journal of clinical laser medicine & surgery. 1998;16(6):299–304.
16. Meffert JJ, Cagna DR, Meffert RM. Treatment of oral granulation tissue with the flashlamp pulsed dye laser. Dermatologic surgery. 1998;24(8):845-8.
17. Rodriguez IA, Selders GS, Fetz AE, Gehrmann CJ, Stein SH, Evensky JA, et al. Barrier membranes for dental applications: A review and sweet advancement in membrane developments. Mouth Teeth. 2018;2(1):1-9.

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