

Recent Advances In Dental Science - A Brief Review

Running title:Recent advances in dental science

Type of manuscript:Review

S.Ragul Prasath

Saveetha Dental College,
Saveetha Institute of Medical and Technical Sciences (SIMATS)
Saveetha University, Chennai
Email ID:151901074.sdc@saveetha.com.

Jothi Priya.A

Assistant Professor, Department of Physiology
Saveetha Dental College,
Saveetha Institute of Medical and Technical Sciences (SIMATS)
Saveetha University, Chennai
Email ID:jothipriya.sdc@saveetha.com.

Corresponding Author

Jothi Priya.A

Assistant Professor, Department of Physiology
Saveetha Dental College,
Saveetha Institute of Medical and Technical Sciences (SIMATS)
Saveetha University, Chennai
Email ID:jothipriya.sdc@saveetha.com.

ABSTRACT:

The most important goal in dentistry is to provide best dental care to the patients. However, this may be attained with the help of a skilled dental professional and its team. As time passes by, several advances in science, especially in medicine, are leading humanity towards a new era of dentistry. Professionals and clinical experts with decades of experience or a dental student can look back at the advancement made in dentistry and can say clearly that the dental profession has experienced an exciting amount of technological growth. But in comparison to medicine, biomedical engineering, automotive and aeronautics, drugs and others, dentistry appears to be more than a decade behind in adopting or integrating new technologies on a widespread basis. Dentistry has witnessed tremendous advances in all its branches over the past three decades. Starting from the simple intra-oral periapical X-rays to advanced imaging techniques like CT Scans (computed tomography), cone beam computed tomography, MRI scans (magnetic resonance imaging) and ultrasound techniques have also found place in modern dentistry. This significant shift from analogue to digital radiography has not only made the procedures simpler and faster but also made image storage, manipulation like image, brightness/contrast, cropping, etc. and retrieval easier. This review article focuses on the various future perspectives of dentistry and their clinical applications. With the development of new technologies in three-

dimension and computer-aided design/computer-aided manufacturing (CAD/CAM) customized implants can be used as an alternative to conventional implant designs

Key Words:Imaging technologies,Nanodentistry,Topical Anaesthesia,Dental Implants,Dental Sculptures.

INTRODUCTION:

In the early 1900's, dental decay was considered "gangrene" of the teeth, which mandated nothing less than extraction. This basic procedure was replaced by the extension for prevention restorative concept introduced by Dr. Black and it was followed by others throughout the twentieth century as the microbiological model of dental disease took hold. This was earlier Known as macro-dentistry, it basically promoted the complete removal of all carious tooth structure without regard for structural or biological implications. Patients throughout the world are showing an emerging with regard to their function and aesthetic appearance [1]. Nevertheless, in some situations, the destruction of tooth structure is inevitable and teeth have to be restored or replaced. Hence, dental restorative endodontic treatment are still in demand, even today. The spectrum of dental restorations ranges from small restorations such as inlays and veneers to large restorations such as dental crowns and bridges. Also, Today's Vision is the Tomorrow's Reality. We are already experiencing immense changes, and the 21st Century will excel even in the immediate past for remarkable advances in the human condition [2]. The digital and biological information revolutions are rapidly converging with clinical dentistry as they are in close association with medicine and pharmacy. The dental profession is at the threshold of new discoveries. Restorative dentistry is conventionally one of the most fundamental aspects of dental treatment. Developments in materials, equipment, and techniques have transformed both the art and science of restorative dentistry, and future advancements will certainly continue the evolution of this discipline. Dental amalgam, a restorative material that contains mercury, has been widely used for almost 150 years. In the recent years, the awareness and recognition of the environmental implications of mercury have increased and alternative filling materials have become increasingly more favoured [[3]. Technologies which may be practical for clinical application in the near future are mainly Establishment of stem cell banks which are readily accessible can make stem cell therapy a clinical probability, Procedures involving the implant storage banks and respective biological pulp implants, Mainstream tissue engineering specifically related to tissue regeneration in dentistry. This may include cell printing and assembly on biological templates, Advanced and practical scaffold and growth factor delivery techniques and Amenable advances in biological micro-scale and nano-scale technologies. [4] Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade [5–29].

METHODOLOGY:

This review was done based on the articles obtained from various platforms like PubMed, PubMed central and google scholar. They were collected with a restriction in time basis

from 1970-2020. The inclusion were original research papers, in vitro studies among various conditions and articles that contain pros cons. Exclusion criteria came into account for review articles, retracted articles and articles of other languages. All the articles were selected based on advances in dental science.

They are determined by article title, abstract and complete article. When article holder websites were analysed on the topic of advances in dental science, more than 2000 articles and based articles were found, when it was shortlisted based on inclusion and exclusion criteria, the number of articles were lowered to 130 articles. When timeline and other factors were quoted only 31 articles came into play. This article is reviewed from the 39 articles collected. Quality of articles used was assessed using a quality assessment tool and graded as strong, moderate and weak is shown in table 1.

Table 1: Quality analysis of studies referred

S.NO	AUTHOR	YEAR	TAKEN FROM	QUALITY OF RESEARCH
1	Blatz MB et al	2019	Pubmed	Strong
2	Dubin NL et al	1974	Google scholar	Strong
3	Chung J et al	2019	Pubmed	Weak
4	Pophale H et al	2007	Pubmed	weak
5	Policichio P et al	2012	Pubmed	Moderate
6	Qahtani et al	2018	Google scholar	Moderate
7	Jingarwar et al	2014	Pubmed	Strong
8	Torvi S et al	2014	Pubmed	Strong
9	Deshmukh S et al	2018	Google scholar	Moderate
10	Dawood A et al	2019	Pubmed	Weak
11	Rajasekhar VK et al	2009	Pubmed	Moderate
12	Vaderhobli RM et al	2011	Pubmed	Strong

13	Khurshid Z et al	2015	Google scholar	Strong
14	Thostenson ET et al	2001	Pubmed	weak
15	Tani moto Y et al	2015	Pubmed	Strong
16	Brunski JB et al	1992	Google scholar	Strong
17	Beuer F et al	2008	Pubmed	Moderate
18	Messer PF et al	2010	Pubmed	Strong
19	Anusavice KJ et al	1993	Google scholar	Strong
20	Seltzer S et al	1971	Pubmed	Moderate
21	Strub Jr et al	2006	Pubmed	Strong

NANODENTISTRY:

Nanotechnology has made its way to become one of the most favourable technologies, and one which will change the application of materials in different fields. Nanotechnology is a branch of science that focuses on the study of handling matter on an atomic and molecular scale. The quality of dental biomaterials has been boosted by the emergence of nanotechnology [30]. This technology manufactures materials with much better properties or by improving the properties of existing materials [31]. Nanotechnology engages the characterization and supervision of materials at the atomic or molecular level. The first is Top-down approach which is based on solid state processing of materials: classic examples of top down processes are approaches like chemical vapor deposition (CVD), monolithic processing, wet and plasma etching we used to fabricate functional structures at micro and nano-scales. The second one is bottom up approach implicates the fabrication of materials via edifice of particles by harvesting atomic elements. Bottom-up processing is based on highly organized chemical synthesis and growth of materials [32]. Current dental research involves gradual ingress into the preventive, diagnostic, reconstructive, regenerative, restorative, and rehabilitative domains. A classic oral hygiene will be possible through the aid of nano-robotics, nano materials and biotechnology. A Colloidal suspension carrying millions of anesthetic dental nano-robots would be able to induce local anaesthesia before starting the dental treatment. The nano- robots get deposited on the gingival tissues [33]. The dentists guide these nano-robots by moving toward and the pulp via the dentinal tubules using nano-Computer through the chemical differentials, temperature gradients, and positional steering and assist them to reach the inner

layer of tooth mainly dentin. As soon as they reach the pulp, the analgesic robots close down all sensation in the tooth. After the completion of the treatment procedure, the nanorobots may be instructed to restore all sensation and to exit from the tooth. This technique is advantageous as it is fast and totally reversible. Rapid and stable treatment for dentin hypersensitivity is possible by using dental Nanorobots [34]. Nano composite denture teeth are made up of Polymethyl methacrylate are nanofillers that are homogeneously distributed with excellent polishing ability, stain-resistant, have surface hardness with enhanced wear resistance and are superb aesthetics [35].

IMAGING TECHNOLOGIES:

The initial system that was introduced in the field of imaging technologies and digital radiography in dentistry was Radio- visio graphy Digital radiograph refers to a method of capturing a radiographic image using a solid state technology sensor, which breaks into electronic pieces and presents and hence stored the image using a computer. There are currently three types of digital radiography systems available for use in dental imaging. They are CCD-charge-coupled device (direct system); and CMOS- Complementary metal oxide semiconductor (direct system); psp- photo-stimulable phosphor (indirect system) [36], [37].

Intraoral radiograph examination is the backbone of imaging for the general dental practitioner. It comprises positions of three categories; periapical, bitewing and occlusal

The periapical radiograph is a classical radiograph that provides detailed information about the teeth and the surrounding tissues and structures that is mainly utilized for assessment of pulp and root canal morphology, supporting alveolar bone status in the interdental region, detection of periapical pathology and crown / root fractures. It is especially useful for endodontics treatment that is for pre-treatment assessment of roots and root canal morphology, calcifications, fractures, periapical lesions, working angle determination quality and extent of root canal obturation and monitoring healing after treatment [38]. An occlusal radiograph mainly focuses the occlusal aspect of the oral cavity and displays a large segment of a dental arch that cannot be viewed on a periapical radiograph, such as a cyst. It helps to locate Supernumerary / impacted teeth and foreign bodies in the jaws and stones in the ducts of submandibular glands. Bitewing or interproximal radiographs are taken to evaluate inter- proximal surfaces of 3-4 Upper and lower teeth simultaneously [39]. The film has a flap on which the patient bites to keep the film in place against the crowns of upper and lower teeth simultaneously (hence called bitewing x ray) Bitewing or interproximal radiographs are particularly valuable for detecting interproximal caries in the early stages of development before it manifests clinically [40].

COMPOSITE DENTAL RESTORATIVE MATERIALS:

Composite dental restorations are widely used in endodontic treatment and represents a unique class of biomaterials with severe restrictions on biocompatibility, curing behaviour, aesthetics, and Ultimate material properties [41]. Restorative materials are presently limited by shrinkage and polymerization induced shrinkage stress, limited toughness, the presence of unreacted

monomers that remain following polymerization, and several other factors. Fortunately, composite restorative materials have been the great focus of interest in recent decades with the goal of improving restoration performance by changing the initiation System, monomers, and fillers and their coupling agents and by developing novel polymerization strategies. Here, we reviewed the general characteristics of the polymerization reaction. Some of the restorative techniques aiming at stress magnitude seems to be impractical. Also, their efficiency varies depending upon the materials employed [42].

THEORY AND MECHANISM OF ADHESIVE RESIN BONDING TO DENTIN:

Adhesion to tooth has been a subject of a considerable research interest for several decades. Because of poor adhesion of Restorative materials to prepared teeth, early attempts to restore teeth emphasized surgical removal of sound tissue by preparing Cavity to provide mechanical retention through the Such features as dovetails, grooves, undercuts, Sharp angles and so forth [43].

Most priming agents interact with either the exposed collagen fibrils or the intact dentin tissue forming hybrid layers. They are, therefore, critical ingredients in the formulations that promote tissue. Adhesive interactions. Because of the importance of priming Step in dentin bonding, the morphological and analytical aspects of primer tissue interaction, have been explored extensively. However, the nature of. these interactions remain uncertain, and " are not fully understood [44]. The nature of micromechanical bonding was invoked by Nakabayashi et al to explain the permeation of an adhesive monomer 4- methacryloyl long ethyl trimellitate anhydride (4-META) into the porous collagen scaffold on the etched surface of dentin, and the encapsulation and enlargement of the Collagen network by a polymer network formed by the polymerisation of the infiltrated monomer. Although the permeation of the monomer into the collagen scaled should be viewed as a micromechanical phenomenon, atomic level interactions potentially play a critical role in the overall adhesion process [45] .

DENTAL IMPLANTS:

Dental implants are a common treatment for the loss of teeth. The most common cause of teeth loss is periodontitis, and other causes include dental caries, trauma, developmental defects and genetic disorders. Short implants are considered to be simpler and more efficient by reducing the chances of various complications patient discomfort, procedure costs , and procedure time in rehabilitation of the atrophic alveolar ridge [46]. Implant Companies have recently offered short implants of less than 8 mm. From the previous studies comparing Standard implants with short implants and a bone graft, the survival rate ranged from 91.7 to 100% . There was also a statistically significant higher incidence of complications in the group with a standard implant with a bone graft [47]. Sinus augmentation , in other words, sinus lifting was first described as a surgical technique for creating a bone window in the vestibular wall of the sinus. After that the sinus epithelium was generally raised to create a Space for bone grafting . Rothe harvesting was performed in the iliac crest area and then placed in the prepared space [48], [49]. The healing

period took about 6 months before implantation . The use of autogenous bone, allograft and alloplastic material for bone grafting during sinus augmentation was Suggested.The one stage approach was demonstrated, in which sinus augmentation and implantation are performed on one surgery while the two-stage approach had the implantation taking place after several months of sinus augmentation [50].

Custom implant using three dimensional printing (3DP) was first used in the fields of rapid tooling and rapid prototyping. Initially, a specifically single, personalised Subjects were manufactured by 30p in Restorative dentistry. By combining oval scanning with a CAD CAM design and using 30p, dental labs can produce dental prostheses(Crowns, bridges) and plaster stone models more rapidly, and with excellent.precision than most traditional procedures performed by lab technicians. In addition to the usage of 3 DP cand CAD / CAM in the making of prosthesis- related components, some have presented concepts of Utilizing this advanced technology in the planning phase of Implantation. The use of core beam computed tomography(CRCT) Combined with CAD/CAM was suggested to produce a surgical guide for implant placement. [51].

DENTAL PULP TISSUE ENGINEERING:

The dental pulp is a highly specialized mesenchymal tissue characterised by the presence of odontoblasts and by the fact that it is Surrounded by a rigid mineralized tissue. The dental pulp is infiltrated by a network of blood vessels and nerve bundles emanating from the apical region.The possibility of pulp tissue regeneration is restricted by several factors. Due to anatomical arrangement of the pulp chamber, the dental pulp has minimal collateral blood supply, impairing the ability of the immune system to fight infections [52]. Furthermore, odontoblasts are post-mitotic cells that have limited (or no) ability to proliferate. The booth reparative competence is Observed when superficial Carious lesions stimulate Odontoblastic cells to increase their secretion activity [53]. Dentine presents a tubular structure that keeps it in an intimate relationship with the popp fissure through the odontoblastic process. Nevertheless, when teeth suffer injuries, such as trauma, deep cavity preparation or severe caries lesions the odontoblasts May succumb, possibly leading the dental pulp to irreversible pulpitis of necrosis . Responsive cells are generally stem cells [54]. They are undifferentiated cells with varying degrees of potency and plastically capable of self-renewal and multilineage differentiation.There are two basic Categories of stem cells classified according to their potential of differentiation;Embryonic Stem cells (ESC) and Somatic stem cells also called as adult stem cells of mesenchymal (Stem cells) .While the use of Esc is limited by ethical issues, somatic stem cells constitute a more favourable cellular source of to be brain, skin,hair follicles, skeletal muscles, bone marrow and dental tissue and five types of dental MSC were isolated and characterized; the dental pulp stem cells (DPSC) from pulp of permanent teeth,stem cells of human exfoliated teeth, (SHED) and immature dental stem cells [55]. Morphogenetic signalling molecules are proteins that bind to specific cell membrane receptors and induce a cascade of processes that results in the generation of a new tissue.There are several Growth factors which controls the activity of stem cells,cell and

its division by regulating the rate of proliferation, inducing differentiation into another Cell type, or by inducing the stimulation of cells to synthesize mineralizable matrices. such molecules play a key role in the formation and repair of dentin and pulp [56]. The formation of a mineralised barrier at sites of pulp exposure after direct pulp capping is an example of the potential of a dental pulp repair. Notably, the dentin matrix is a reservoir of growth factors capable of stimulating tissue response after being mobilized [57].

TOPICAL ANESTHESIA:

Topical anesthetics alter pain thresholds by controlling pain sensations through a blockade of signal that are transmitted from the peripheral sensory nerve fibres. Cocaine has been used as a topical anaesthetic agent in the past for its potent anesthetic effect and local vasoconstrictive properties, but its use is currently very limited because of high toxicity and risk of acute addiction [58]. Topical anesthetic products are in the form of sprays, solution, gels and ointments, There is a wide range of indications for topical anesthesia in dentistry and a specific agent should be chosen in accordance with purpose of its use. Generally, topical anesthesia is applied by after drying the mucous membrane or skin, where the anesthesia will be administered and spraying of Using a cotton swab to apply the minimal amount required to produce an adequate effect. Since the duration of action of the topical anesthetic is about 10 minutes, the subsequent procedure should be performed in approximately two minutes after administration. Methods of use vary for each product [59]. Traditional topical anesthetic agents with benzocaine and lidocaine as active ingredients are available in various forms and products, topical anesthetic can induce allergic reactions of side effects.

DENTAL MATERIALS:

The use of materials to rehabilitate tooth Structures is constantly changing to benefit the patient and clinician. In the recent times, newer materials processing techniques and technologies have significantly improved the dependability and predictability of dental material for clinicians [60]. The greatest obstacle, however, is in choosing the right combination for continued success. Finding predictable approaches for successful restorative procedures has been the goal of clinical and material scientists [61]. Any dental material like restorative materials used in the oral cavity must satisfy some basic prerequisites; they must be similar to tooth structures in their physical and mechanical properties, resist masticatory forces, and possess an appearance similar to natural dentin and enamel. Pit and fissure sealants: It consists of dimethacrylate monomers with sodium fluoride and poly (methyl methacrylate - co methacrylic) fluoride. The addition of fluoride did not alter the retention properties of the sealant [62].

DENTAL SCULPTURE:

CAD/CAM for dental manufacturing is growing at a fast pace. The laboratory profession has discovered timely on what clinicians are slower to recognize CAD/CAM works. It is quicker ,

more economical, predictable, consistent [63]. Merits of CAD/ CAM technology is designs, fabricates and places all ceramic restorations in a single patient visit.

Restorations have demonstrated excellent fit, Strength and longevity. Using CAD/ CAM technology a number of steps are simplified. In the currently available CAD / CAM systems using the shape design by the CAP/ CAM Systems without considering contact sliding movements of the upper and lower teeth, and technicians perform manual adjustments to the model after milling with the CAM [64]. Our institution is passionate about high quality evidence based research and has excelled in various fields ([65–75]

CONCLUSION:

The next generation of regenerative treatment techniques may involve the synthesis and assembly of bio proteins by the nano robots. When these nanorobots and entities are simply injected to the targeted location, they weave up the collagen framework onto which the proteins are assembled, also are the possibilities where dental tissues are grown to specific requirements and transplanted on a regular basis. The possibilities are infinite and coveting.

There ground breaking strategies may provide an innovative and novel biology based strategy new generation of clinical treatments for dental diseases. No one can know for certain what the future of dentistry will have. In the near future, we will see an integration of dentistry into comprehensive health care and an increased focus on the link between oral health & overall health as we enter the 21st century computer assisted technology for diagnosis and treatment, and gene-mediated therapeutics, which alters the genetic structure of teeth to make them impervious to decay will likely play an important role in the future of dentistry.

ACKNOWLEDGEMENT:

I thank saveetha dental college for their constant support and encouragement to carry out this work and finish the work on time.

CONFLICT OF INTEREST:

No conflict of interest indeed.

REFERENCES:

1. Blatz MB, Chiche G, Bahat O, Roblee R, Coachman C, Heymann HO. Evolution of Aesthetic Dentistry. J Dent Res. 2019 Nov;98(12):1294–304.
2. Dubin NL. Advances in restorative dentistry [Internet]. Vol. 14, The Journal of Prosthetic Dentistry. 1964. p. 949–54. Available from: [http://dx.doi.org/10.1016/0022-3913\(64\)90025-3](http://dx.doi.org/10.1016/0022-3913(64)90025-3)
3. Chung J. Delivering Mobile Dentistry to the Geriatric Population—The Future of Dentistry [Internet]. Vol. 7, Dentistry Journal. 2019. p. 62. Available from:

<http://dx.doi.org/10.3390/dj7020062>

4. Pophale H. Future of Dentistry [Internet]. Textbook of Medical Dentistry. 2007. p. 237–237. Available from: http://dx.doi.org/10.5005/jp/books/10918_31
5. Duraisamy R, Krishnan CS, Ramasubramanian H, Sampathkumar J, Mariappan S, Navarasampatti Sivaprakasam A. Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments. *Implant Dent*. 2019 Jun;28(3):289–95.
6. Ariga P, Nallaswamy D, Jain AR, Ganapathy DM. Determination of correlation of width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A systematic review. *World J Dent*. 2018 Feb;9(1):68–75.
7. Kannan A, Venugopalan S. A systematic review on the effect of use of impregnated retraction cords on gingiva. *J Adv Pharm Technol Res*. 2018;11(5):2121.
8. Basha FYS, Ganapathy D, Venugopalan S. Oral hygiene status among pregnant women. *J Adv Pharm Technol Res*. 2018;11(7):3099.
9. Rajakeerthi, Ms N. Natural Product as the Storage medium for an avulsed tooth – A Systematic Review. *Cumhur Üniv Diş Hekim Fak derg*. 2019 Jun 11;22(2):249–56.
10. Teja KV, Ramesh S, Priya V. Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study. *J Conserv Dent*. 2018 Nov;21(6):592–6.
11. Menon S, Ks SD, R S, S R, S VK. Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism. *Colloids Surf B Biointerfaces*. 2018 Oct 1;170:280–92.
12. Siddique R, Sureshbabu NM, Somasundaram J, Jacob B, Selvam D. Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi. *J Conserv Dent*. 2019 Jan;22(1):40–7.
13. Nandakumar M, Nasim I. Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis. *J Conserv Dent*. 2018 Sep;21(5):516–20.
14. Manohar MP, Sharma S. A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists. *Indian J Dent Res*. 2018 Nov;29(6):716–20.
15. Hema Shree K, Ramani P, Sherlin H, Sukumaran G, Jeyaraj G, Don KR, et al. Saliva as a

Diagnostic Tool in Oral Squamous Cell Carcinoma - a Systematic Review with Meta Analysis. *Pathol Oncol Res.* 2019 Apr;25(2):447–53.

16. Rajendran R, Kunjusankaran RN, Sandhya R, Anilkumar A, Santhosh R, Patil SR. Comparative evaluation of remineralizing potential of a paste containing bioactive glass and a topical cream containing casein phosphopeptide-amorphous calcium phosphate: An in vitro study. *Pesqui Bras Odontopediatria Clin Integr.* 2019;19(1):1–10.
17. Gheena S, Ezhilarasan D. Syringic acid triggers reactive oxygen species-mediated cytotoxicity in HepG2 cells. *Hum Exp Toxicol.* 2019 Jun;38(6):694–702.
18. Hussainy SN, Nasim I, Thomas T, Ranjan M. Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up. *J Conserv Dent.* 2018 Sep;21(5):510–5.
19. Hannah R, Ramani P, Herald. J. Sherlin, Ranjith G, Ramasubramanian A, Jayaraj G, et al. Awareness about the use, ethics and scope of dental photography among undergraduate dental students dentist behind the lens. *J Adv Pharm Technol Res.* 2018;11(3):1012.
20. Sharma P, Mehta M, Dhanjal DS, Kaur S, Gupta G, Singh H, et al. Emerging trends in the novel drug delivery approaches for the treatment of lung cancer. *Chem Biol Interact.* 2019 Aug 25;309:108720.
21. Ravinthar K, Jayalakshmi. Recent advancements in laminates and veneers in dentistry. *J Adv Pharm Technol Res.* 2018;11(2):785.
22. Jose J, Ajitha, Subbaiyan H. Different treatment modalities followed by dental practitioners for Ellis class 2 fracture – A questionnaire-based survey. *Open Dent J.* 2020 Feb 18;14(1):59–65.
23. Sharma, V., Bansal, K., Reddy, K.R.C., Gautam, D.N.S., Singh, N.K., Rai, H. Comparative evaluation of anti-inflammatory activity of Manahshila Realgar(2019) *Journal of Complementary Medicine Research*, 10 (1), pp. 1-12.
24. Kumar D, Antony SDP. Calcified canal and negotiation-A review. *J Adv Pharm Technol Res.* 2018;11(8):3727.
25. Johnson J, Lakshmanan G, M B, R M V, Kalimuthu K, Sekar D. Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH. *Hypertens Res.* 2020 Apr;43(4):360–2.
26. Janani K, Palanivelu A, Sandhya R. Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp

- vitality: an in vivo study. *Braz Dent Sci* [Internet]. 2020 Jan 31;23(1). Available from: <https://bds.ict.unesp.br/index.php/cob/article/view/1805>
27. Seppan P, Muhammed I, Mohanraj KG, Lakshmanan G, Premavathy D, Muthu SJ, et al. Therapeutic potential of *Mucuna pruriens* (Linn.) on ageing induced damage in dorsal nerve of the penis and its implication on erectile function: an experimental study using albino rats. *Aging Male*. 2018 Feb 15;1–14.
 28. Jeevanandan G, Govindaraju L. Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: a double blinded randomised clinical trial. *Eur Arch Paediatr Dent*. 2018 Aug;19(4):273–8.
 29. Nandhini JST, Babu KY, Mohanraj KG. Size, shape, prominence and localization of gerdy's tubercle in dry human tibial bones. *J Adv Pharm Technol Res*. 2018;11(8):3604.
 30. Timothy CN, Gayatri Devi R, Jothi Priya A. Evaluation of Peak Expiratory Flow Rate (PEFR) in Pet Owners [Internet]. Vol. 10, *Indian Journal of Public Health Research & Development*. 2019. p. 803. Available from: <http://dx.doi.org/10.5958/0976-5506.2019.01989.2>
 31. Policichio P. Oral Physician: The Future Relationship between Dentistry and Medicine [Internet]. Vol. 2, *International Journal of Experimental Dental Science*. 2012. p. 0–0. Available from: <http://dx.doi.org/10.5005/ijeds-2-1-v>
 32. Qahtani WMSA, Al Qahtani WMS, Yousief SA, El-Anwar MI. Recent Advances in Material and Geometrical Modelling in Dental Applications [Internet]. Vol. 6, *Open Access Macedonian Journal of Medical Sciences*. 2018. p. 1138–44. Available from: <http://dx.doi.org/10.3889/oamjms.2018.254>
 33. Fathima F, Preetha P. EVALUATION OF THYROID FUNCTION TEST IN OBESE PATIENTS [Internet]. Vol. 9, *Asian Journal of Pharmaceutical and Clinical Research*. 2016. p. 353. Available from: <http://dx.doi.org/10.22159/ajpcr.2016.v9s3.12959>
 34. Mm J, Jingrwar MM. Minimal Intervention Dentistry – A New Frontier in Clinical Dentistry [Internet]. *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*. 2014. Available from: <http://dx.doi.org/10.7860/jcdr/2014/9128.4583>
 35. Torvi S, Munniswamy K. Regenerative dentistry: Current and future perspectives to rejuvenate and reclaim dental tissues [Internet]. Vol. 6, *Journal of the International Clinical Dental Research Organization*. 2014. p. 112. Available from: <http://dx.doi.org/10.4103/2231-0754.143496>
 36. Deshmukh S. Indian dentistry: Today and tomorrow [Internet]. Vol. 10, *Journal of the*

- International Clinical Dental Research Organization. 2018. p. 1. Available from: http://dx.doi.org/10.4103/jicdro.jicdro_7_18
37. Iyer PK, Gayatri Devi R, Jothi Priya A. A Survey Study on Causes, Treatment and Prevention of Onychocryptosis [Internet]. Vol. 10, Indian Journal of Public Health Research & Development. 2019. p. 807. Available from: <http://dx.doi.org/10.5958/0976-5506.2019.01990.9>
 38. Dave PH, Preetha. Pathogenesis and Novel Drug for Treatment of Asthma-A Review [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1519. Available from: <http://dx.doi.org/10.5958/0974-360x.2016.00297.3>
 39. R GD, Sethu G. EVALUATION OF ADENOIDS BY ORONASAL AND NASAL SPIROMETRY [Internet]. Vol. 11, Asian Journal of Pharmaceutical and Clinical Research. 2018. p. 272. Available from: <http://dx.doi.org/10.22159/ajpcr.2018.v11i10.27365>
 40. Dawood A, Marti Marti B, Sauret-Jackson V, Darwood A. 3D printing in dentistry [Internet]. Vol. 219, British Dental Journal. 2015. p. 521–9. Available from: <http://dx.doi.org/10.1038/sj.bdj.2015.914>
 41. Rj I, R GD. Role of environmental factors on sleep patterns of different age groups [Internet]. Vol. 9, Asian Journal of Pharmaceutical and Clinical Research. 2016. p. 124. Available from: <http://dx.doi.org/10.22159/ajpcr.2016.v9i6.13832>
 42. Rajasekhar VK. Regulatory Networks in Stem Cells. Springer Science & Business Media; 2009. 601 p.
 43. Vaderhobli RM. Advances in Dental Materials [Internet]. Vol. 55, Dental Clinics of North America. 2011. p. 619–25. Available from: <http://dx.doi.org/10.1016/j.cden.2011.02.015>
 44. Shruthi M, Preetha S. Effect of Simple Tongue Exercises in Habitual Snorers [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 3614. Available from: <http://dx.doi.org/10.5958/0974-360x.2018.00665.0>
 45. Khurshid Z, Zafar M, Qasim S, Shahab S, Naseem M, AbuReqaiba A. Advances in Nanotechnology for Restorative Dentistry [Internet]. Vol. 8, Materials. 2015. p. 717–31. Available from: <http://dx.doi.org/10.3390/ma8020717>
 46. Harsha L, Priya J, Shah KK, Reshmi B. Systemic Approach to Management of Neonatal Jaundice and Prevention of Kernicterus [Internet]. Vol. 8, Research Journal of Pharmacy and Technology. 2015. p. 1087. Available from: <http://dx.doi.org/10.5958/0974-360x.2015.00189.4>

47. Castro T del C, del Castillo Castro T, Mónica M, Ortega C, Evelia D, Félix R, et al. Nanocomposite Hydrogels as Drug Delivery Systems [Internet]. Functional Hydrogels in Drug Delivery. 2017. p. 24–51. Available from: <http://dx.doi.org/10.4324/9781315152271-2>
48. Renuka S, Sethu G. Regeneration after Myocardial Infarction [Internet]. Vol. 8, Research Journal of Pharmacy and Technology. 2015. p. 738. Available from: <http://dx.doi.org/10.5958/0974-360x.2015.00117.1>
49. Samuel AR, Devi MG. Geographical distribution and occurrence of Endemic Goitre [Internet]. Vol. 8, Research Journal of Pharmacy and Technology. 2015. p. 973. Available from: <http://dx.doi.org/10.5958/0974-360x.2015.00162.6>
50. Thostenson ET, Ren Z, Chou T-W. Advances in the science and technology of carbon nanotubes and their composites: a review [Internet]. Vol. 61, Composites Science and Technology. 2001. p. 1899–912. Available from: [http://dx.doi.org/10.1016/s0266-3538\(01\)00094-x](http://dx.doi.org/10.1016/s0266-3538(01)00094-x)
51. Renugalakshmi A, Vinothkumar TS, Kandaswamy D. Nanodrug Delivery Systems in Dentistry: A Review on Current Status and Future Perspectives [Internet]. Vol. 8, Current Drug Delivery. 2011. p. 586–94. Available from: <http://dx.doi.org/10.2174/156720111796642336>
52. Mungara J, Philip J, Joseph E, Rajendran S, Elangovan A, Selvaraju G. Comparative evaluation of fluoride release and recharge of pre-reacted glass ionomer composite and nano-ionomeric glass ionomer with daily fluoride exposure: an in vitro study. J Indian Soc Pedod Prev Dent. 2013 Oct;31(4):234–9.
53. Tanimoto Y. Dental materials used for metal-free restorations: Recent advances and future challenges [Internet]. Vol. 59, Journal of Prosthodontic Research. 2015. p. 213–5. Available from: <http://dx.doi.org/10.1016/j.jpor.2015.07.003>
54. Choudhari S, Jothipriya MA. Non-alcoholic fatty liver disease [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1782. Available from: <http://dx.doi.org/10.5958/0974-360x.2016.00360.7>
55. Brunski JB. Biomechanical factors affecting the bone-dental implant interface [Internet]. Vol. 10, Clinical Materials. 1992. p. 153–201. Available from: [http://dx.doi.org/10.1016/0267-6605\(92\)90049-y](http://dx.doi.org/10.1016/0267-6605(92)90049-y)
56. Abigail, Abigail, Priya J, Devi G. Evaluation of Muscular Endurance among Dentists [Internet]. Vol. 10, Indian Journal of Public Health Research & Development. 2019. p. 258. Available from: <http://dx.doi.org/10.5958/0976-5506.2019.02808.0>

57. Beuer F, Schweiger J, Edelhoff D. Digital dentistry: an overview of recent developments for CAD/CAM generated restorations [Internet]. Vol. 204, British Dental Journal. 2008. p. 505–11. Available from: <http://dx.doi.org/10.1038/sj.bdj.2008.350>
58. Messer PF, Piddock V, Lloyd CH. The strength of dental ceramics [Internet]. Vol. 19, Journal of Dentistry. 1991. p. 51–5. Available from: [http://dx.doi.org/10.1016/0300-5712\(91\)90040-6](http://dx.doi.org/10.1016/0300-5712(91)90040-6)
59. Anusavice KJ. Recent Developments in Restorative Dental Ceramics [Internet]. Vol. 124, The Journal of the American Dental Association. 1993. p. 72–84. Available from: <http://dx.doi.org/10.14219/jada.archive.1993.0031>
60. Baheerati MM, Gayatri Devi R. Obesity in relation to Infertility [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 3183. Available from: <http://dx.doi.org/10.5958/0974-360x.2018.00585.1>
61. Swathy S, Gowri Sethu V. Acupuncture and lower back pain [Internet]. Vol. 8, Research Journal of Pharmacy and Technology. 2015. p. 991. Available from: <http://dx.doi.org/10.5958/0974-360x.2015.00165.1>
62. Seltzer S. Advances in biology of the human dental pulp [Internet]. Vol. 32, Oral Surgery, Oral Medicine, Oral Pathology. 1971. p. 454–60. Available from: [http://dx.doi.org/10.1016/0030-4220\(71\)90207-6](http://dx.doi.org/10.1016/0030-4220(71)90207-6)
63. David, David, Jothi Priya A, Devi G. Physical Fitness among the Dental Physician, Dental Undergraduates and Postgraduates Students [Internet]. Vol. 10, Indian Journal of Public Health Research & Development. 2019. p. 223. Available from: <http://dx.doi.org/10.5958/0976-5506.2019.02801.8>
64. Strub JR, Dianne Rekow E, Witkowski S. Computer-aided design and fabrication of dental restorations [Internet]. Vol. 137, The Journal of the American Dental Association. 2006. p. 1289–96. Available from: <http://dx.doi.org/10.14219/jada.archive.2006.0389>
65. Vijayashree Priyadharsini J. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019 Dec;90(12):1441–8.
66. Pc J, Marimuthu T, Devadoss P. Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study. Clin Implant Dent Relat Res [Internet]. 2018; Available from: <https://europepmc.org/article/med/29624863>
67. Ramesh A, Varghese S, Jayakumar ND, Malaiappan S. Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control

- study. *J Periodontol.* 2018 Oct;89(10):1241–8.
68. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJL. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. *Clin Oral Investig.* 2019 Sep;23(9):3543–50.
 69. Sridharan G, Ramani P, Patankar S, Vijayaraghavan R. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. *J Oral Pathol Med.* 2019 Apr;48(4):299–306.
 70. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. *J Oral Pathol Med.* 2019 Feb;48(2):115–21.
 71. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial. *Clin Oral Investig.* 2020;1–6.
 72. Samuel SR. Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life? *Int J Paediatr Dent.* 2021 Mar;31(2):285–6.
 73. R H, Hannah R, Ramani P, Ramanathan A, R JM, Gheena S, et al. CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene [Internet]. Vol. 130, *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*. 2020. p. 306–12. Available from: <http://dx.doi.org/10.1016/j.oooo.2020.06.021>
 74. Chandrasekar R, Chandrasekhar S, Sundari KKS, Ravi P. Development and validation of a formula for objective assessment of cervical vertebral bone age. *Prog Orthod.* 2020 Oct 12;21(1):38.
 75. Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen *A. baumannii* and related species. *Arch Oral Biol.* 2018 Oct;94:93–8.