Nat. Volatiles & Essent. Oils, 2021; 8(4): 7140-7152

Awareness On Genotoxicity Induced By Implants Among Dental Students.

Umayal S[1] , Dhanraj Ganapathy[2*]

[1]Undergraduate student, Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical science, Saveetha University, 162, PH Road, Chennai - 600077, Tamil Nadu, India. Email ID :151701057.sdc@saveetha.com Contact number : +91-9500633759.

[2*]Professor & Head, Department of Prosthodontics, Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical science, Saveetha University, 162, PH Road, Chennai - 600077, Tamil Nadu, India. Email Id: dhanraj@saveetha.com Contact number: +91 9841504523

Abstract

The implant dentistry area has expanded rapidly in recent years. Genotoxicity has gained widespread acceptance as an important and useful indicator of carcinogenicity. A variety of assays can assess genotoxicity, including those that assess genetic damage, DNA repair capacity, metaphase chromosomal aberrations, micronuclei, and sister chromatid exchanges.The purpose of this study was to provide an awareness and to analyse about genotoxicity induced by dental implants among various dental students.A Questionnaire was prepared and circulated among Dental students among various dental colleges. There were about 300 dental students who attended the survey. The data was collected and analysed and evaluated.About 89% of the students were aware about the genotoxicity induced by implants.Majority of the students were about the genotoxicity induced by implants.

Keywords Genotoxicity, Implants, Dentistry,Toxicity.

INTRODUCTION

In recent years, the field of implant dentistry has grown quickly. A great number of studies were based on the realisation that oral implants may achieve high success rates. The discovery that titanium is a biocompatible material prompted some researchers to investigate its surface features, including chemical composition, micro- and macrostructure, contamination, cleanliness, and surface aspects of biomolecule interaction.(1),(2)

Although titanium is preferable to previously utilised implant materials, titanium implants emit metal ions into surrounding tissues that can produce a corrosion zone limiting direct bone to implant

contact(3,4). These disadvantages reduce the clinical success rate of pure titanium implants and highlight the need for further improvement (5). Furthermore, metal release from titanium devices to neighbouring tissues such as bone, muscles, and soft tissue, as well as increased metal concentration in parenchymal organs such as the lungs, liver, and spleen, are causes for concern.(6).

However, due to the lack of clinical evidence for cytotoxicity in most investigations and the accumulation of metal concentration in the organism, this condition is ascribed only a minor biological significance.(7,8). As a result, further biocompatibility evidence is required to assess all of these chemicals' dangers. Indeed, the limited data on titanium devices' genotoxicity appears to be insufficient.

In addition to the basic biocompatibility testing, genotoxicity assays are of particular significance, as genotoxicity has acquired widespread acceptance as an essential and valuable indicator of carcinogenicity . This is due to the fact that these assays can detect a cancer triggering event. Genetic damage, DNA repair capability, metaphase chromosomal abnormalities, micronuclei, and sister chromatid exchanges are among the techniques that can currently be used to measure genotoxicity.(9)

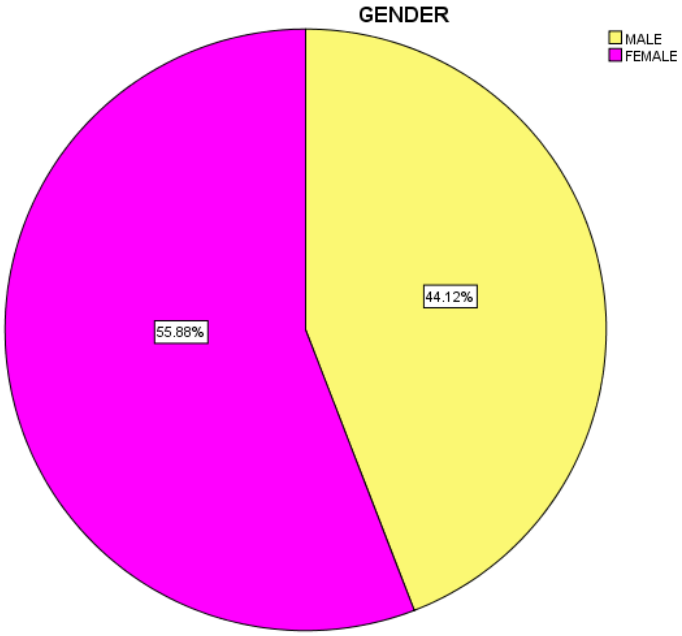
Genotoxicity is the capacity of an agent to produce damage in the DNA molecule. Considering the strong evidence for a relationship between genetic damage and carcinogenesis, evaluation of genotoxicity induced by dental materials is necessary for elucidating the true health risks to patients and professionals (10–12). Our team has extensive knowledge and research experience that has translate into high quality publications(13–24).The purpose of this study was to provide an awareness and to analyse about genotoxicity induced by dental implants among various dental students.

MATERIALS AND METHODS

This study was done by circulating a Questionnaire with 15 questions. It was Circulated among dental students of various dental colleges. The study population included patients with age ranging between 17 - 25years. The study sample included both male and female gender, predominantly south indians. The study population was 300 Dental students.. The necessary data such as age, gender, was recorded. Incomplete filled Survey records were excluded. Data was recorded in Microsoft Excel and exported to the statistical package of social science for windows (SPSS) and subjected to statistical analysis. Chi square tests are used for comparison of groups.

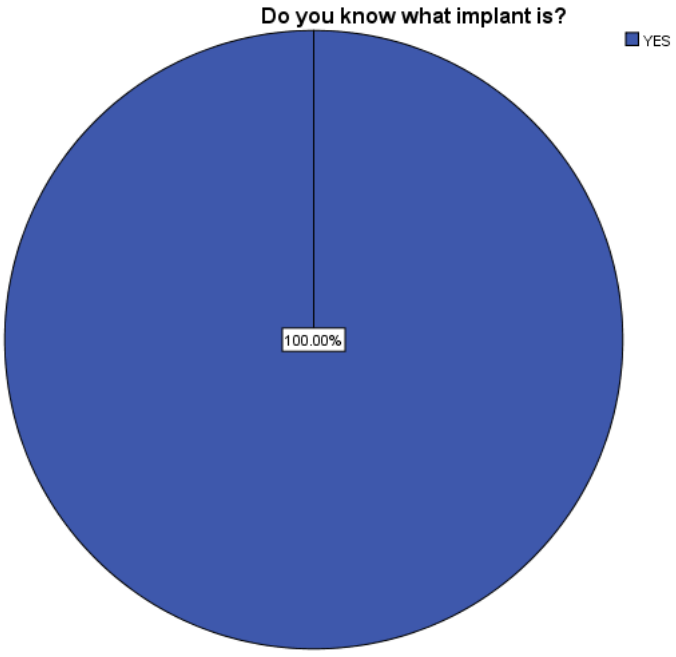
RESULTS

Graph 1



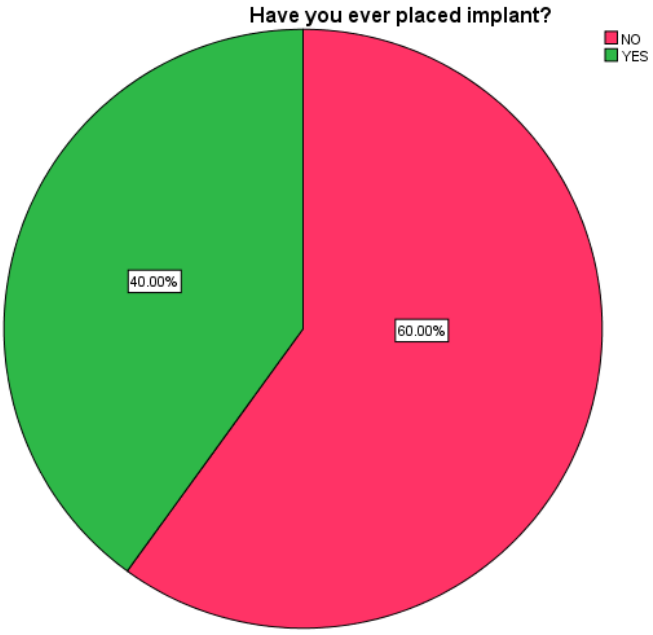
Graph 1 : Represents the Gender population among the dental students. Pink represents the percentage of females, yellow represents the percentage of males. Here there are about 55.8% females and 44.1% males.

Graph 2 :



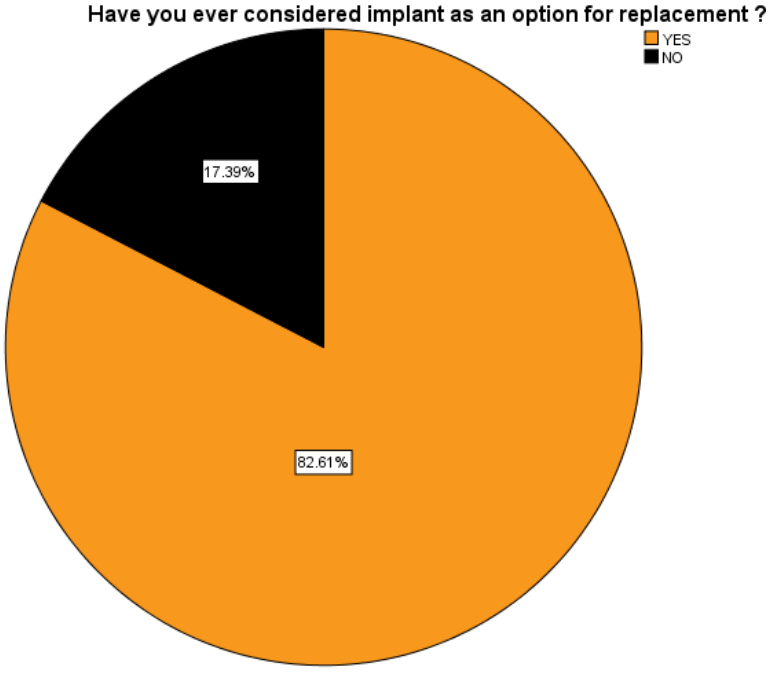
Graph 2 shows the percentage of students who are aware about the term implant. In the graph, blue represents awareness of implants. Here 100% of the population are aware of the term implant.

Graph 3 :



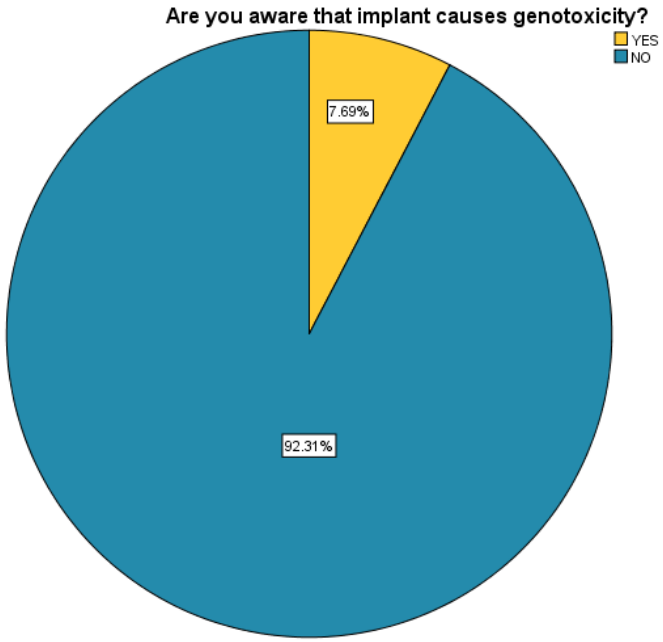
Graph 3 : Represents how many dental students have placed implants. Here green represents yes that they have placed and pink represents they have not placed implants yet. From the graph it is seen that 40% of the students have placed and 60% of the students have not placed.

Graph 4:

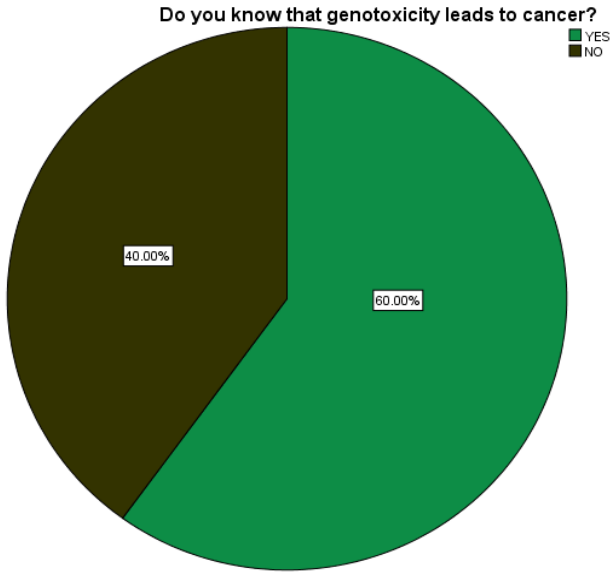


Graph 4 shows how many have considered or suggested implant as an option for replacement. It shows that 82.6% of students have considered and only 17% have not. Here yellow represents they have and black represents they have not suggested implant as an option.

Graph 5 : Shows how many are aware about the side effects of genotoxicity due to implants. Here 92.31% are aware that it causes harm and 7.8% say it does not cause any side effects.

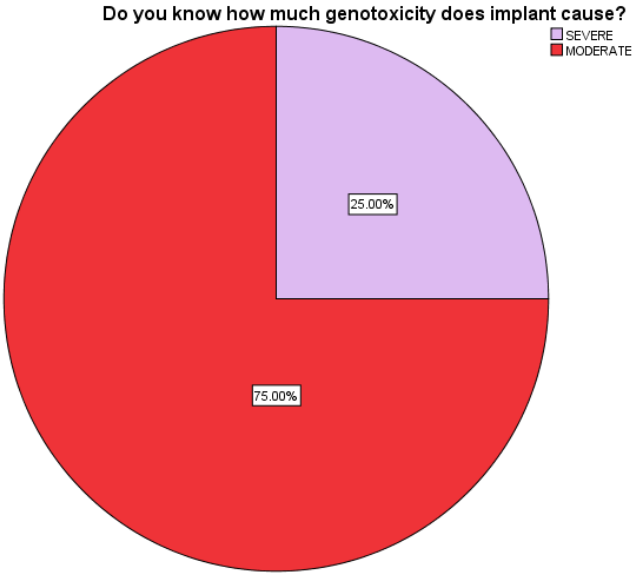


Graph 6 :



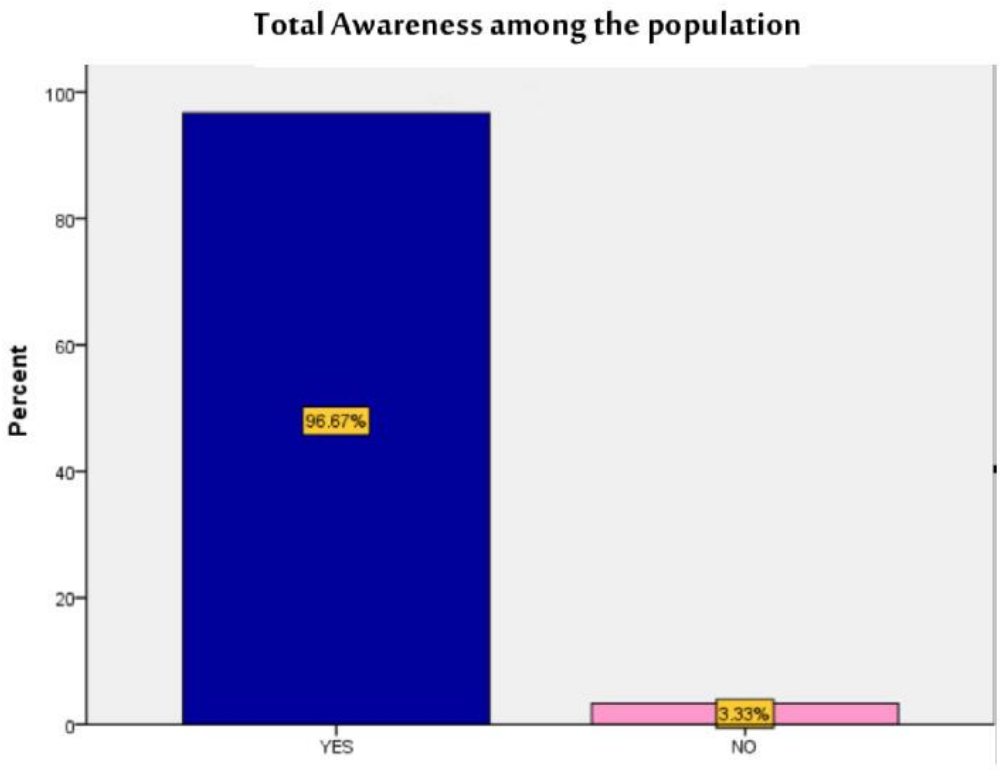
Graph 6 : represents how many dental students are aware that genotoxicity leads to cancer. Here green represents awareness and black no awareness. From the graph it is seen 60% of the students are aware and 40% are not aware.

Graph 7 :



Graph 7 : Represents how many are aware that genotoxicity induced implants leads to cancer. It shows that 75% of the dental students are aware and 25% of the dental students are not aware. Red shows awareness and pink shows no awareness.

Graph 8 :



Graph 8 : Shows the total awareness on genotoxicity induced implants. It shows that 96.6% of the population are aware and 3.3% are not aware.Here blue indicates awareness and pink represents no awareness.

The above given results show the awareness of the students about the genotoxicity induced by implants. On statistical analysis it was found that there were about 55.8% females and 44.1% males (Graph 1). 100% of the population are aware about the term implant (graph 2). 40% of the population have placed implants and 60% have not placed implants (graph 3). 82.6% of them have considered implants as the best option for replacement and 17.3% have not considered (graph 4). The majority of the population (92.3%) are aware that implant causes genotoxicity and 7.69% are not aware of it (graph 5). 60% of the population are aware that genotoxicity leads to cancer and 40% were not aware (graph 6). 25% of the population knows that genotoxicity induced implant causes severe effects and 75% knows that it is moderate (graph 7). After the total analysis with several questions it is statistically found that 96.67% of the population are aware about the genotoxicity induced by implants and only 3.33% are not aware of it (graph 8).

DISCUSSION :

The ability of an agent to cause harm to the DNA molecule is known as genotoxicity. Given the significant evidence for a link between genetic harm and carcinogenesis, determining the genuine health hazards to patients and professionals requires a thorough examination of genotoxicity caused by dental materials. There was some evidence of genotoxicity in all published data, particularly in relation to tooth bleaching, restorative materials, and endodontic chemicals.(25).

Titanium (Ti) is the most extensively utilised material for dental implants at the moment. Changes in the surface of commercial pure Ti can influence the functional response of cells, making it a crucial aspect in the implant's success. Untreated titanium causes DNA damage, chromosomal aberration, and micronuclei, according to certain research, leading to genotoxicity. Increased surface roughness and alterations in titanium oxide layer thickness were blamed for these findings. Despite this, in vitro, Ti alloy (Ti-6Al-4V) was neither cytotoxic nor genotoxic. When matched controls were compared to patients with dental implants, in vivo investigations found no significant variations in micronucleus frequency. Sister chromatid exchange was observed to be more common in patients treated with nickel-chromium intermaxillary fixation devices than in those treated with Ti miniplates.

Metal ions are released from implants due to corrosion, and when other metals utilised in the oral cavity for a variety of restoration types coexist in the mouth, the danger of ion release due to corrosion increases significantly. Biological consequences might occur in a variety of ways, according to the literature. Hypersensitivity can occur as a result of being exposed to Ti particles discharged by the implant, and bone involvement can occur as a result of Ti particles accumulating in bone tissue. This may have a detrimental effect on the nuclear factor B ligand receptor activator and osteoprotegerin, both of which are required for osteoclast activation, inhibiting osteoblasts and causing bone resorption. Titanium can also make gingival epithelial cells more susceptible to microbes, leading to an increase in monocyte infiltration and inflammation.

Cases of malignancy around dental implants have also been reported in the literature. It is important to note that TiO2 has been designated as a potential carcinogen in humans by the International Agency for Cancer Research. Heavy metals can cause damage to DNA by interacting directly with it. Increased inflammatory response, impairment of cellular antioxidant systems, increased lipid peroxidation, and inhibition of DNA repair are some of the side effects; all of these can contribute to or encourage DNA

mutations. Nonetheless, multiple studies have proven that titanium, its alloys, and other heavy metals have no harmful effects on tissues and organs. The oral mucosa acts as a physical barrier to noxious compounds that could be converted into cytotoxic products or possibly reactive mutagenics if they enter the body. Genetic instability can result from an accumulation of genomic damage, which can show as chromosomal abnormalities.

The above results show that many of them are aware about genotoxicity induced implants.In another similar article shows that there is awareness among the dentists in Canada (26,27). The increasing rate in development of novel materials with applications in the dental field has led to an increased consciousness of the biological risks and tempting restrictions of these materials.

CONCLUSION :

Thus, within the limitations of the study it shows that 97% of the population are aware about the genotoxicity induced implants. The biocompatibility of a biomaterial used for the replacement or filling of biological tissue such as teeth always had a high concern within the health care disciplines for patients.

REFERENCES

1. Adell R, Lekholm U, Rockler B, Brånemark P-I. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw [Internet]. Vol. 10, International Journal of Oral Surgery. 1981. p. 387–416. Available from: http://dx.doi.org/10.1016/s0300-9785(81)80077-4

2. Kang B-S, Sul Y-T, Johansson CB, Oh S-J, Lee H-J, Albrektsson T. The effect of calcium ion concentration on the bone response to oxidized titanium implants [Internet]. Vol. 23, Clinical Oral Implants Research. 2012. p. 690–7. Available from: http://dx.doi.org/10.1111/j.1600-0501.2011.02177.x

3. Morais L, Serra G, Muller C, Andrade L, Palermo E, Elias C, et al. Titanium alloy mini-implants for orthodontic anchorage: Immediate loading and metal ion release☆ [Internet]. Vol. 3, Acta Biomaterialia. 2007. p. 331–9. Available from: http://dx.doi.org/10.1016/j.actbio.2006.10.010

4. Eliaz RE, Szoka FC. Robust and prolonged gene expression from injectable polymeric implants [Internet]. Vol. 9, Gene Therapy. 2002. p. 1230–7. Available from:

http://dx.doi.org/10.1038/sj.gt.3301786

5. Sun Z-L. Effects of Metal Ions on Osteoblastic-like Cell Metabolism and Differentiation: Thesis Submitted in Partial Fulfillment ... for the Degree of Master of Science in Biomaterials .. 1995. 102 p.

6. Schliephake H, Reiss G, Urban R, Neukam FW, Guckel S. Metal release from titanium fixtures during placement in the mandible: an experimental study. Int J Oral Maxillofac Implants. 1993;8(5):502–11.

7. Jorgenson DS, Mayer MH, Ellenbogen RG, Centeno JA, Johnson FB, Mullick FG, et al. Detection of Titanium in Human Tissues after Craniofacial Surgery [Internet]. Vol. 99, Plastic and Reconstructive Surgery. 1997. p. 976–9. Available from: http://dx.doi.org/10.1097/00006534-199704000-00006

8. Matthew I, Frame JW. DETECTION OF TITANIUM IN HUMAN TISSUES AFTER CRANIOFACIAL SURGERY [Internet]. Vol. 101, Plastic & Reconstructive Surgery. 1998. p. 1148. Available from: http://dx.doi.org/10.1097/00006534-199804040-00049

9. Tice RR, Agurell E, Anderson D, Burlinson B, Hartmann A, Kobayashi H, et al. Single cell gel/comet assay: Guidelines for in vitro and in vivo genetic toxicology testing [Internet]. Vol. 35, Environmental and Molecular Mutagenesis. 2000. p. 206–21. Available from: http://dx.doi.org/10.1002/(sici)1098-2280(2000)35:3<206::aid-em8>3.0.co;2-j

10. Website [Internet]. Available from: 19. Martin F. DNA damage in breast epithelial cells: detection by the single-cell gel (comet) assay and induction by human mammary lipid extracts [Internet]. Vol. 18, Carcinogenesis. 1997. p. 2299–305. Available from: http://dx.doi.org/10.1093/carcin/18.12.2299

11. Jensen OT. Clinical bone response to dental implant materials [Internet]. Bone Response to Dental Implant Materials. 2017. p. 129–38. Available from: http://dx.doi.org/10.1016/b978-0-08-100287-2.00007-0

12. Institute NC, National Cancer Institute. Dental Implant [Internet]. Definitions. 2020. Available from: http://dx.doi.org/10.32388/44ozyr

13. Hemalatha R, Dhanraj S. Disinfection of Dental Impression- A Current Overview. Cuddalore. 2016

Jul;8(7):661–4.

14. Ramya G, Pandurangan K, Ganapathy D. Correlation between anterior crowding and bruxism-related parafunctional habits. Drug Invention Today [Internet]. 2019;12(10). Available from: https://www.researchgate.net/profile/Kiran_Pandurangan2/publication/337223674_Correlation_between_anterior_crowding_and_bruxism-related_parafunctional_habits/links/5dcc083a92851c81804bf0fd/Correlation-between-anterior-crowding-and-bruxism-related-parafunctional-habits.pdf

15. Anjum AS, Ganapathy D, Kumar K. Knowledge of the awareness of dentists on the management of burn injuries on the face. Drug Invention Today [Internet]. 2019;11(9). Available from: https://www.researchgate.net/profile/Kiran_Pandurangan2/publication/337223550_Knowledge_of_the_awareness_of_dentists_on_the_management_of_burn_injuries_on_the_face/links/5dcbff5fa6fdcc5750470755/Knowledge-of-the-awareness-of-dentists-on-the-management-of-burn-injuries-on-the-face.pdf

16. Inchara R, Ganapathy D, Kumar PK. Preference of antibiotics in pediatric dentistry. Drug Invent Today. 2019;11:1495–8.

17. Philip J, Ganapathy D, Ariga P. Comparative evaluation of tensile bond strength of a polyvinyl acetate-based resilient liner following various denture base surface pre-treatment methods and immersion in artificial salivary medium: An in vitro study [Internet]. Vol. 3, Contemporary Clinical Dentistry. 2012. p. 298. Available from: http://dx.doi.org/10.4103/0976-237x.103622

18. Gupta A, Dhanraj M. Implant surface modification: review of literature. The Internet Journal of [Internet]. 2009; Available from: https://pdfs.semanticscholar.org/2621/efa71b775cbb82ac84373cfb09cd501045b6.pdf

19. Indhulekha V, Ganapathy D, Jain AR. Knowledge and awareness on biomedical waste management among students of four dental colleges in Chennai, India. Drug Invention Today. 2018;10(12):32–41.

20. Mohamed Usman JA, Ayappan A, Ganapathy D, Nasir NN. Oromaxillary prosthetic rehabilitation of a maxillectomy patient using a magnet retained two-piece hollow bulb definitive obturator; a clinical report. Case Rep Dent. 2013 Mar 4;2013:190180.

21. Ganapathy DM, Joseph S, Ariga P, Selvaraj A. Evaluation of the influence of blood glucose level on oral candidal colonization in complete denture wearers with Type-II Diabetes Mellitus: An in vivo Study. Dent Res J . 2013 Jan;10(1):87–92.

22. Menon A, Ganapathy DM. Factors that influence the colour stability of composite resins. Drug Invention [Internet]. 2019; Available from: http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09757619&AN=135479093&h=p0RtIVRRakA2WmTZKSO2mjg3a%2BDX%2FXUDjuHqOt369Jyhu1ivws6Lh%2FvaGeF8aiouB5onVQzLFOfI6yzLcQ4plw%3D%3D&crl=c

23. Dhanraj G, Rajeshkumar S. Anticariogenic Effect of Selenium Nanoparticles Synthesized Using Brassica oleracea. J Nanomater [Internet]. 2021 Jul 10 [cited 2021 Sep 13];2021. Available from: https://www.hindawi.com/journals/jnm/2021/8115585/

24. Ganapathy D, Department of Prostodontics, Saveetha Dental College, Saveetha Institute of Medical and Technical Sciences, – C, India. Nanobiotechnology in combating CoVid-19 [Internet]. Vol. 16, Bioinformation. 2020. p. 828–30. Available from: http://dx.doi.org/10.6026/97320630016828

25. Cetin Y, Ibrahim AMH, Gungor A, Yildizhan Y, Balog M, Krizik P. In-vitro evaluation of a partially biodegradable TiMg dental implant: The cytotoxicity, genotoxicity, and oxidative stress [Internet]. Vol. 14, Materialia. 2020. p. 100899. Available from: http://dx.doi.org/10.1016/j.mtla.2020.100899

26. Shahi S, Özcan M, Dizaj SM, Sharifi S, Husain NA-H, Eftekhari A, et al. A review on potential toxicity of dental material and screening their biocompatibility [Internet]. Vol. 29, Toxicology Mechanisms and Methods. 2019. p. 368–77. Available from: http://dx.doi.org/10.1080/15376516.2019.1566424

27. British Standards Institute Staff. Biological Evaluation of Medical Devices.Guidance on Tests to Evaluate Genotoxicity. Supplement to ISO 10993-3. 1915. 60 p.

28. Thangavelu L, Nallaswamy V.D, Ezhilarasan D, Flipped classroom teaching and learning improves dental students performance in pharmacology, International Journal of Dentistry and Oral ScienceVolume 8, Issue 1, Pages 1392 - 1394January 2021.

29. Lakshmi, T, Medicinal value and oral health aspects of acacia catechu-an update, International

Journal of Dentistry and Oral ScienceVolume 8, Issue 1, Pages 1399 - 1401January 2021.