Journal of Contemporary Issues in Business and Government Vol. 27, No. 2, 2021
https://cibg.org.au/

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.02.268

Assessment of patients undergoing re-restoration after class ii amalgam

MEERA THEENATHAYALAN[1], DR.MAHALAKSHMI[2]*, DR.DEEPAK. S[3]

[1]Saveetha Dental College and Hospitals, Saveetha Institute Of Medical and Technical Sciences, Saveetha University, Chennai, India.
[2]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute Of Medical and Technical Sciences, Saveetha University, Chennai, India.
[3]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Saveetha Dental College, Saveetha Institute Of Medical and Technical Sciences, Saveetha University, Chennai, India.
*Corresponding Author
Email ID: 151501011.sdc@saveetha.com , mahalakshmij.sdc@saveetha.com, deepaks.sdc@saveetha.com

Abstract: Amalgam is a restorative material especially suitable for class I and class II restoration in teeth that encounter heavy chewing forces. Amalgam restorations may also present degradation in the intra oral environment due to secondary caries, fracture and marginal breakdown and wear. The aim of the study is the number of patients undergoing re restoration after class II amalgam. It is a retrospective study. Data collection was done and entered in the excel sheet. Parameters assessed were age, gender, teeth no. and re restoration after class II amalgam. The data collection was tabulated in excel and data analysis was done using SPSS software. The association between study variables was calculated using the chi-square test. The result showed 940 individuals with re restoration after class II amalgam. The frequency was seen to be 39.2%%. The chi square test showed positive correlation between gender and amalgam restoration (P value <0.05). It may be concluded that amalgam longevity is an important issue for patients, governments and dentists to define the court of dental treatment. The re-restoration and other types of local defect increases the longevity of the amalgam restoration.

Keywords: Amalgam , Conservative Dentistry, Class II Restoration, Re- Restoration

INTRODUCTION

Amalgam is a restorative material especially suitable for class I and class II restoration in teeth that encounter heavy chewing forces. The advantages of amalgam restoration include resistance wear, tolerance to a wide range of clinical placement conditions, and excellent load [(Kopperud *et al.*, 2012)][(Anusavice, 1989)]. Bearing properties however, amalgam restorations may also present degradation in the intra oral environment due to secondary caries, fracture and marginal breakdown and wear [(Friedl, Hiller and Schmalz, 1994)]. The traditional solution for those failures has been the complete replacement of the restoration, which may also include minor imperfection in the restoration, and replacement of defective restoration represents a major concern in dental practice , reaching upto 60% of the operative dentistry interventions [(Mjör and Um, 1993)][(Mjör and Toffenetti, 1992)]. It is a recommended procedure in restorative dentistry to place an intermediary cement base under deep preparations for amalgam restorations. These bases are of low thermal conductivity and serve to protect the vital tissues from thermal shock. A further requirement is that the base have sufficient strength to withstand both the forces of condensation and mastication transmitted to it through the restoration. Consequently the medium survival time (MST) of amalgam varies from 2 to 11 years , but most studies play it at 5 years. Complete restoration has replacement done, which has its own disadvantages , one big it's time consuming , unnecessary removal of healthy tissue, enlarging preparation and restoration sizes, the risk of converting the restoration into an indirect restoration and the possibility of causing major damages to the pulpal tissue. It was determined that a minimum compressive strength of 170 psi was necessary to prevent displacement of the base during condensation [(Moncada *et al.*, 2009)]-[(Brantley *et al.*, 1995)].

The longevity of dental restorations is dependent on many factors, including those related to materials, the dentist, and the patient. Dental amalgams have successfully served the profession for over a century. The main reasons for restoration failure are secondary caries, fracture of the bulk of the restoration or of the tooth, and marginal deficiencies and wear. The importance of direct-placement, aesthetic, tooth-colored restorative materials is still increasing. Amalgam restorations are being replaced because of alleged adverse health effects and inferior aesthetic appearance. All alternative restorative materials and procedures, however, have certain limitations. In the clinical settings, it is very common to find teeth that have the last part of their structures ,

affecting at least one of the proximal areas [(Özcan *et al.*, 2011)]. The reconstruction of such cavities is such a challenge for the operative , not only in the endodontic and restorative field , but also in the periodontal field. The correct choice of treatment plan is crucial to success , but it's difficult due to its scarcity of clinical protocol and lack of concern on the optimal method of restoration in such cases. These systems used the fracture strength of the amalgam under load as an index of the support provided by the bases. Variations in the model systems particularly pertaining to materials used in place of the natural tooth and the difficulty in reproducing the loading on the surface of the amalgam restoration, have precluded comparisons between the various studies and the in vivo situation [(Özcan *et al.*, 2010)]. Previously our team had conducted numerous clinical trials, lab animal studies and in vitro studies over the past 5 years [(Ramamoorthi, Nivedhitha and Divyanand, 2015)]-[(Nasim and Nandakumar, 2018)]. Now we are focussing on retrospective studies. The idea for this study stemmed from the current interest in our community. Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Deogade, Gupta and Ariga, 2018; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Jeevanandan and Govindaraju, 2018; J *et al.*, 2018; Menon *et al.*, 2018; Prabakar *et al.*, 2018; Rajeshkumar *et al.*, 2018, 2019; Vishnu Prasad *et al.*, 2018; Wahab *et al.*, 2018; Dua *et al.*, 2019; Duraisamy *et al.*, 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu *et al.*, 2019; Mehta *et al.*, 2019; Panchal, Jeevanandan and Subramanian, 2019; Rajendran *et al.*, 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma *et al.*, 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi *et al.*, 2020; Samuel, Acharya and Rao, 2020)
So the aim of our study was to assess the number of patients undergoing re restoration after class II amalgam restoration.

MATERIALS AND METHODS

This study was approved by the research ethics committee of saveetha dental college. The dental records of 940 patients who reported to the clinic for re restoration after class II amalgam were investigated by collecting the data and entered in the excel sheet. The male and female distribution among the study population was evaluated. The collection of data was divided on 4 parameters , the age of the patient, the gender of the patient , teeth number and re restoration after class II amalgam. After grouping the parameters , data copied to the software and statistical analysis was carried out. Statistical analysis was done using IBM SPSS software. The significance level was at 0.5. Descriptive analysis and chi-square tests were done. Graphs were tabulated. Inclusion Criteria : Patients of age group 0-30 years were included, and both male and females were included. Exclusion Criteria : Other than class II amalgam re restoration, other treatments such as class I amalgam re restoration , RCT and extraction were excluded.

RESULTS AND DISCUSSION

The most common affected age group was above 60 years (52%), followed by 30-49 years (32%). Percentage of females and males among the population were 42% and 58% respectively.

The 1st quadrant and 2nd quadrant had the most restoration. The upper posteriors showed the most restoration of amalgam class II MO. There was a significant difference shown in the teeth number and age of the affected patients. Teeth number affected with gender for affected patients.

Association between gender and type of restoration with amalgam re restoration showed p - value to be .000, which showed a positive correlation between two parameters (Graph 1). Association between teeth no. and type of restoration with amalgam re restoration showed p - value to be .375, which showed a negative correlation between two parameters (Graph 2).

Amalgam longevity is an important issue for patients , governments and dentists to define the loss of dental treatment. Minimal intervention dentistry such as re restoration, repair or refinishing of localised defeat of restoration could increase the longevity of the amalgam restoration and reduce patient stress regarding treatment cost. This study did not show a biological risk for the teeth where there were on tooth fracture, a low rate of restoration failures and no pulp injuries. These results are explained by use of non invasive techniques [(Allander, Birkhed and Bratthall, 1990)][(Dahl and Eriksen, 1978). The main reasons for restoration failures is secondary caries lesion located at the margins of the restorations. These lesions should be clinically differentiated from stained ad detached margins in order to find soft dental tissues or caries area [(Elderton and Nuttall, 1983)]. Most of the dentists were traditionally trained in replacement techniques. Only recently have a number of dental schools included restoration repair in their educational programs, which could explain why repair is not popular yet in operative dentistry [(Eriksen, Bjertness and Hansen, 1986)].

Developing a restoration that will last the patient's lifetime has long been a goal of the dental profession. Dentists decide when to place or replace the restoration. Select the restoration materials and decide on methods of placing restoration materials. Amalgam restorations have served the profession well and will continue to do so in the years to come. In terms of longevity, they are probably superior to composite resins, especially when used for large restorations and cusp capping. The newer high copper single composition alloys offer superior properties but may not offer as good a seal as older amalgams. Composite resins are a viable alternative to

amalgam for posterior restorations. They are more technique sensitive but offer a better seal and meet the patient's demands for esthetics [(Shenoy, 2008)]. Fears about their longevity are unfounded and they perform well in clinical conditions. Their use in large restorations and in cusp capping situations is still a matter of debate. Dental amalgam is the most widely and successfully used posterior restorative materials till today. Dental amalgam has performed a valuable service for more than a century despite periodic citation**.** In the years to come, dental students will be called upon to place composite restorations as soon as they graduate and enter clinical practice [(Terashima, 1970)]. Comparison of the stresses induced in the amalgam restoration when the cavity floor contains a central area of enamel and when the cavity floor is of equal depth but composed only of dentin showed that the former induced less stress in the amalgam restoration. It is presumed that the higher modulus of the enamel provides support in the area where the deflection of the amalgam would normally be the greatest. Thus, it reduces the induced tensile stresses in the amalgam. Although it is not recommended that enamel be left in a cavity floor for support, the results indicate that if the cavity has sufficient depth for an amalgam restoration and some enamel is still present, it will not contribute to the mechanical failure of the restoration but will reduce the tensile stress at the amalgam tooth interface [(Farah, Hood and Craig, 1975)].
Cavity design, cavity wall treatment and proper handling and condensation of a high quality amalgam alloy are factors considered to be of importance in relation to the prevention of recurrent caries and marginal fractures. In addition, proper contour and finishing of the restorations, particularly in the interproximal regions, eliminating plaque-retentive irregularities and restoring optimal oral hygiene conditions are of decisive caries-preventive importance. Healey and phillips reached the conclusion that over 90% of all amalgam replacements could be traced back to the operative procedure. This indicates that benefits obtained by metallurgic improvements may be of marginal importance for the durability of amalgam restorations [(Healey and Phillips, 1949)]. Many of the quality studies of amalgam restorations seem to concentrate mainly on the integrity of the occlusal part of the restorations [(Mahler, Terkla and Van Eysden, 1973)]. Inferior surface texture, a typical material shortcoming, constitutes the single most dominating factor leading to poor quality ratings of amalgam restorations [(Shaini *et al.*, 2001)]. This factor is, however, of minor importance when the durability of amalgam restorations is considered. The low frequency of overhangs reported in many clinical quality studies of amalgam restorations compared with the high frequency found in investigations studying this aspect in particular [(Arneberg, Silness and Nordbo, 1980)] indicates that the gingival/interproximal conditions may have been neglected in many quality evaluations of amalgam restorations. Results from quality studies of amalgam restorations have incited the development of new amalgam alloys with low corrosion potential, high initial strength and low marginal fracture tendency [(Solanki, 2012)]. These factors undoubtedly improve the quality and clinical performance. But it remains to be seen to what extent they will expand the durability of amalgam restorations. Given the technique sensitivity and the learning curve associated with composites, it is time for our curriculum to absorb this change and provide more opportunities for students to hone their skills. The reasons for its popularity lie in its ease of manipulation, relatively low cost , and long clinical service life.Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Mathew *et al.*, 2020)

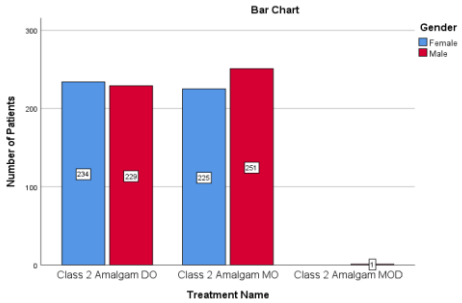

Fig.1: Bar graph showing the association between the class II amalgam restoration and gender of the patients who reported for re restoration. The X axis denotes the gender of the patient and type of Class II amalgam restoration. Y axis represents the number of the patient who reported with re restoration. It was found that Class II MO type restoration was most commonly re-restored in male(Red) and female(Blue) patients than the other type of Class II restoration. Chi square statistical test was done and the association was found to be significant with p value .000 (P value - <0.005, statistically significant).

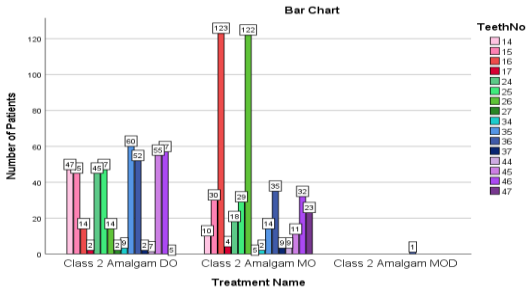

Fig.2: Bar graph showing the association between the class II amalgam restoration and number of the patients who reported for re restoration. The X axis denotes the type of Class II amalgam restoration and tooth number of the patient. Y axis represents the number of the patient who reported for re restoration. It was found that the maximum number of patients who reported for re restoration, was found in the region 16(Pink) and 26(Green). Chi square statistical test was done and the association was found to be not significant with p value .375 (P value - >0.005, statistically not significant).

CONCLUSION

Amalgam is still the most often used materials for restoration in posterior teeth. The high percentage of amalgam fillings replaced because of secondary caries demands an improvement of the operative techniques as well as effective prophylaxis programs and good oral hygiene. Amalgam longevity is an important issue for patients, government and dentists to define the cost of dental treatment.

Author Contribution

All authors have contributed equally.

Acknowledgement

With Sincere gratitude, we acknowledge the staff members and students of saveetha dental college and study participants for their extended support towards the completion of research.

Conflict of interest

There is no conflict of interest.

REFERENCES

1. Allander, L., Birkhed, D. and Bratthall, D. (1990) 'Reasons for replacement of Class II amalgam restorations in private practice', *Swedish dental journal*, 14(4), pp. 179–184. Available at: https://www.ncbi.nlm.nih.gov/pubmed/2255996.
2. Anusavice, K. J. (1989) *Quality evaluation of dental restorations: criteria for placement and replacement : proceedings of the International Symposium on Criteria for Placement and Replacement of Dental Restorations, Lake Buena Vista, Florida, October 19-21, 1987*. Quintessence Pub Co. Available at: https://books.google.com/books/about/Quality_evaluation_of_dental_restoration.html?hl=&id=WTxqAAAAMAAJ.
3. Arneberg, P., Silness, J. and Nordbo, H. (1980) 'Marginal fit and cervical extent of class II amalgam restorations related to periodontal condition', *Journal of Periodontal Research*, pp. 669–677. doi: 10.1111/j.1600-0765.1980.tb00327.x.
4. Brantley, C. F. *et al.* (1995) 'DOES THE CYCLE OF RERESTORATION LEAD TO LARGER RESTORATIONS?', *The Journal of the American Dental Association*, pp. 1407–1413. doi: 10.14219/jada.archive.1995.0052.
5. Dahl, J. E. and Eriksen, H. M. (1978) 'Reasons for replacement of amalgam dental restorations', *European Journal of Oral Sciences*, pp. 404–407. doi: 10.1111/j.1600-0722.1978.tb00644.x.
6. Deogade, S., Gupta, P. and Ariga, P. (2018) 'Effect of monopoly-coating agent on the surface roughness of a tissue conditioner subjected to cleansing and disinfection: A Contact Profilometric In vitro study', *Contemporary Clinical Dentistry*, p. 122. doi: 10.4103/ccd.ccd_112_18.
7. Dua, K. *et al.* (2019) 'The potential of siRNA based drug delivery in respiratory disorders: Recent advances and progress', *Drug development research*, 80(6), pp. 714–730. doi: 10.1002/ddr.21571.
8. Duraisamy, R. *et al.* (2019) 'Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments', *Implant dentistry*, 28(3), pp. 289–295. doi: 10.1097/ID.0000000000000885.
9. Elderton, R. J. and Nuttall, N. M. (1983) 'Variation among dentists in planning treatment', *British Dental Journal*, pp. 201–206. doi: 10.1038/sj.bdj.4805041.

10. Eriksen, H. M., Bjertness, E. and Hansen, B. F. (1986) 'Cross-sectional clinical study of quality of amalgam restorations, oral health and prevalence of recurrent caries', *Community Dentistry and Oral Epidemiology*, pp. 15–18. doi: 10.1111/j.1600-0528.1986.tb01486.x.
11. Ezhilarasan, D. (2018) 'Oxidative stress is bane in chronic liver diseases: Clinical and experimental perspective', *Arab journal of gastroenterology: the official publication of the Pan-Arab Association of Gastroenterology*, 19(2), pp. 56–64. doi: 10.1016/j.ajg.2018.03.002.
12. Ezhilarasan, D., Apoorva, V. S. and Ashok Vardhan, N. (2019) 'Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(2), pp. 115–121. doi: 10.1111/jop.12806.
13. Ezhilarasan, D., Sokal, E. and Najimi, M. (2018) 'Hepatic fibrosis: It is time to go with hepatic stellate cell-specific therapeutic targets', *Hepatobiliary & pancreatic diseases international: HBPD INT*, 17(3), pp. 192–197. doi: 10.1016/j.hbpd.2018.04.003.
14. Farah, J. W., Hood, J. A. and Craig, R. G. (1975) 'Effects of cement bases on the stresses in amalgam restorations', *Journal of dental research*, 54(1), pp. 10–15. doi: 10.1177/00220345750540010101.
15. Friedl, K. H., Hiller, K. A. and Schmalz, G. (1994) 'Placement and replacement of amalgam restorations in Germany', *Operative dentistry*, 19(6), pp. 228–232. Available at: https://www.ncbi.nlm.nih.gov/pubmed/9028243.
16. Gheena, S. and Ezhilarasan, D. (2019) 'Syringic acid triggers reactive oxygen species-mediated cytotoxicity in HepG2 cells', *Human & experimental toxicology*, 38(6), pp. 694–702. doi: 10.1177/0960327119839173.
17. Gomathi, A. C. *et al.* (2020) 'Anticancer activity of silver nanoparticles synthesized using aqueous fruit shell extract of Tamarindus indica on MCF-7 human breast cancer cell line', *Journal of Drug Delivery Science and Technology*, p. 101376. doi: 10.1016/j.jddst.2019.101376.
18. Healey, H. J. and Phillips, R. W. (1949) 'A Clinical Study of Amalgam Failures', *Journal of Dental Research*, pp. 439–446. doi: 10.1177/00220345490280050301.
19. Jeevanandan, G. and Govindaraju, L. (2018) 'Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: a double blinded randomised clinical trial', *European Archives of Paediatric Dentistry*, pp. 273–278. doi: 10.1007/s40368-018-0356-6.
20. J, P. C. *et al.* (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research*, 20(4), pp. 531–534. doi: 10.1111/cid.12609.
21. Kopperud, S. E. *et al.* (2012) 'Longevity of posterior dental restorations and reasons for failure', *European Journal of Oral Sciences*, pp. 539–548. doi: 10.1111/eos.12004.
22. Mahler, D. B., Terkla, L. G. and Van Eysden, J. (1973) 'Marginal Fracture of Amalgam Restorations', *Journal of Dental Research*, pp. 823–827. doi: 10.1177/00220345730520042901.
23. Malli Sureshbabu, N. *et al.* (2019) 'Concentrated Growth Factors as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Report of Two Cases', *Case reports in dentistry*, 2019, p. 7046203. doi: 10.1155/2019/7046203.
24. Mathew, M. G. *et al.* (2020) 'Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary …', *Clinical oral investigations*. Available at: https://link.springer.com/article/10.1007/s00784-020-03204-9.
25. Mehta, M. *et al.* (2019) 'Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases', *Chemico-biological interactions*, 308, pp. 206–215. doi: 10.1016/j.cbi.2019.05.028.
26. Menon, S. *et al.* (2018) 'Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism', *Colloids and Surfaces B: Biointerfaces*, pp. 280–292. doi: 10.1016/j.colsurfb.2018.06.006.
27. Mjör, I. A. and Toffenetti, F. (1992) 'Placement and replacement of amalgam restorations in Italy', *Operative dentistry*, 17(2), pp. 70–73. Available at: https://www.ncbi.nlm.nih.gov/pubmed/1437690.
28. Mjör, I. A. and Um, C. M. (1993) 'Survey of amalgam and composite restorations in Korea', *International dental journal*, 43(4), pp. 311–316. Available at: https://www.ncbi.nlm.nih.gov/pubmed/8276514.
29. Moncada, G. *et al.* (2009) 'Sealing, Refurbishment and Repair of Class I and Class II Defective Restorations', *The Journal of the American Dental Association*, pp. 425–432. doi: 10.14219/jada.archive.2009.0191.
30. Nasim, I. and Nandakumar, M. (2018) 'Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis', *Journal of Conservative Dentistry*, p. 516. doi: 10.4103/jcd.jcd_110_18.
31. Özcan, M. *et al.* (2010) 'Bond Strength Comparison of Amalgam Repair Protocols Using Resin Composite in Situations With and Without Dentin Exposure', *Operative Dentistry*, pp. 655–662. doi: 10.2341/10-091-l.
32. Özcan, M. *et al.* (2011) 'Effects of Different Surface Conditioning Methods on the Bond Strength of Composite Resin to Amalgam', *Operative Dentistry*, pp. 318–325. doi: 10.2341/10-294-l.

33. Panchal, V., Jeevanandan, G. and Subramanian, E. M. G. (2019) 'Comparison of post-operative pain after root canal instrumentation with hand K-files, H-files and rotary Kedo-S files in primary teeth: a randomised clinical trial', *European archives of paediatric dentistry: official journal of the European Academy of Paediatric Dentistry*, 20(5), pp. 467–472. doi: 10.1007/s40368-019-00429-5.
34. Pc, J., Marimuthu, T. and Devadoss, P. (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research*. Available at: https://europepmc.org/article/med/29624863.
35. Prabakar, J. *et al.* (2018) 'Comparative Evaluation of Retention, Cariostatic Effect and Discoloration of Conventional and Hydrophilic Sealants - A Single Blinded Randomized Split Mouth Clinical Trial', *Contemporary clinical dentistry*, 9(Suppl 2), pp. S233–S239. doi: 10.4103/ccd.ccd_132_18.
36. Rajendran, R. *et al.* (2019) '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', *Pesquisa Brasileira em Odontopediatria e Clínica Integrada*, pp. 1–10. doi: 10.4034/pboci.2019.191.61.
37. Rajeshkumar, S. *et al.* (2018) 'Biosynthesis of zinc oxide nanoparticles usingMangifera indica leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells', *Enzyme and microbial technology*, 117, pp. 91–95. doi: 10.1016/j.enzmictec.2018.06.009.
38. Rajeshkumar, S. *et al.* (2019) 'Antibacterial and antioxidant potential of biosynthesized copper nanoparticles mediated through Cissus arnotiana plant extract', *Journal of photochemistry and photobiology. B, Biology*, 197, p. 111531. doi: 10.1016/j.jphotobiol.2019.111531.
39. Ramadurai, N. *et al.* (2019) 'Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial', *Clinical oral investigations*, 23(9), pp. 3543–3550. doi: 10.1007/s00784-018-2775-5.
40. Ramakrishnan, M., Dhanalakshmi, R. and Subramanian, E. M. G. (2019) 'Survival rate of different fixed posterior space maintainers used in Paediatric Dentistry - A systematic review', *The Saudi dental journal*, 31(2), pp. 165–172. doi: 10.1016/j.sdentj.2019.02.037.
41. Ramamoorthi, S., Nivedhitha, M. S. and Divyanand, M. J. (2015) 'Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial', *Australian endodontic journal: the journal of the Australian Society of Endodontology Inc*, 41(2), pp. 78–87. doi: 10.1111/aej.12076.
42. Ramesh, A. *et al.* (2018) 'Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study', *Journal of periodontology*, 89(10), pp. 1241–1248. doi: 10.1002/JPER.17-0445.
43. Samuel, S. R., Acharya, S. and Rao, J. C. (2020) 'School Interventions-based Prevention of Early-Childhood Caries among 3-5-year-old children from very low socioeconomic status: Two-year randomized trial', *Journal of public health dentistry*, 80(1), pp. 51–60. doi: 10.1111/jphd.12348.
44. Shaini, F. J. *et al.* (2001) 'A comparison of the mechanical properties of a gallium-based alloy with a spherical high-copper amalgam', *Dental Materials*, pp. 142–148. doi: 10.1016/s0109-5641(00)00054-3.
45. Sharma, P. *et al.* (2019) 'Emerging trends in the novel drug delivery approaches for the treatment of lung cancer', *Chemico-biological interactions*, 309, p. 108720. doi: 10.1016/j.cbi.2019.06.033.
46. Shenoy, A. (2008) 'Is it the end of the road for dental amalgam? A critical review', *Journal of conservative dentistry: JCD*, 11(3), pp. 99–107. doi: 10.4103/0972-0707.45247.
47. Solanki, G. (2012) 'USES OF HIGH COPPER AMALGAM ALLOYS IN DENTISTRY', *International Journal of Biomedical and Advance Research*. doi: 10.7439/ijbar.v3i2.351.
48. Sridharan, G. *et al.* (2019) 'Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(4), pp. 299–306. doi: 10.1111/jop.12835.
49. Terashima, S. (1970) 'Differentiation of the Two Layers of Carious Dentin by Staining', *THE JOURNAL OF THE STOMATOLOGICAL SOCIETY,JAPAN*, pp. 279–286. doi: 10.5357/koubyou.37.279.
50. Varghese, S. S., Ramesh, A. and Veeraiyan, D. N. (2019) 'Blended Module-Based Teaching in Biostatistics and Research Methodology: A Retrospective Study with Postgraduate Dental Students', *Journal of dental education*, 83(4), pp. 445–450. doi: 10.21815/JDE.019.054.
51. Vijayashree Priyadharsini, J. (2019) 'In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens', *Journal of periodontology*, 90(12), pp. 1441–1448. doi: 10.1002/JPER.18-0673.
52. Vishnu Prasad, S. *et al.* (2018) 'Report on oral health status and treatment needs of 5-15 years old children with sensory deficits in Chennai, India', *Special care in dentistry: official publication of the American Association of Hospital Dentists, the Academy of Dentistry for the Handicapped, and the American Society for Geriatric Dentistry*, 38(1), pp. 58–59. doi: 10.1111/scd.12267.
53. Wahab, P. U. A. *et al.* (2018) 'Scalpel Versus Diathermy in Wound Healing After Mucosal Incisions: A

Split-Mouth Study', *Journal of oral and maxillofacial surgery: official journal of the American Association of Oral and Maxillofacial Surgeons*, 76(6), pp. 1160–1164. doi: 10.1016/j.joms.2017.12.020.

54. MOORE, D. L. & STEWART, J. L.: Prevalence of defective dental restorations. /. Prosthet. Dent. 1967: 17: 372-378.