Evaluation of Various Finish Line Configuration Established by Various Dental Students-A Retrospective Study

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Abstract

Purpose: The aim of this study was to retrospectively evaluate the various types of finish line configuration given on different teeth for patients undergoing fixed dental prosthesis treatment. **Materials & Methods:** A total of 996 patient data were taken from 86000 of patient data after reviewing, duplicate and missing entries were omitted. So a total of 722 entries were evaluated. The data was collected from patient records in Saveetha Dental College, over a period of one year. The evaluation was based on the type of finish line configuration given by the dental students, both the undergraduates and postgraduates in their fixed dental prosthesis cases. **Statistical Analysis:** The results of the study were subjected to statistical analysis. Data analysis was done using SPSS software version 23.0. Chi-square test and frequency evaluation was done to evaluate the most frequently used finish line configuration. **Results:** It was found that the shoulder finish line was widely used followed by chamfer finish line configuration. $p=.193(p>0.05)$, although is statistically not significant and indicates strong evidence for the null hypothesis the trend is towards shoulder finish line. **Conclusion:** The present study concluded that most of the dental students preferred shoulder finish line configuration followed by chamfer, knife edge and the least frequently used finish line configuration is feather edge and radial shoulder on the tooth surface for their fixed partial dental treatment. The trend is towards shoulder finish line mainly because of esthetics and zirconia as a material of choice.

Keywords: Finish line; Chamfer; Feather edge; Radial shoulder; Fixed prosthesis

Introduction

The aim of FPD is to restore function and esthetic of lost intraoral structures without affecting the oral and general health of the patients. [1]

Ill-fitting restoration potentially affects abutment teeth and supporting periodontium as it provides access and host for oral bacteria adherence which can cause secondary caries and traumatic periodontal irritation. [2,3]

The goal of the prosthodontist is to control oral disease while restoring esthetics and function with durable, biocompatible restorations.

Knowledge of the responses of periodontal tissues to artificial crowns and fixed partial dentures is crucial in the development of treatment plans with predictable prognosis.

Design of tooth preparations can have an effect upon the success of individual restorations and upon the success and continued use of techniques and types of restorations as well. Precise well-fitting cast metal restorations have some discrepancies between the margins of the restoration and the preparation of abutment teeth. Poor marginal discrepancy creates high plaque accumulation and exposes the cemented region to the oral environment, which increases micro-leakage and leads to periodontal diseases. Finally restoration losses its mechanical stability and failures occur. [4]

Insufficient adaptation of restorations may result in an increase in plaque accumulation, ultimately which can result in pulpal

inflammation. [4,5] Luting cement fills space between a fixed prosthesis and the prepared tooth. [6,7] Inadequately sealed margins along with occlusal discrepancies cause the crowns to loosen prematurely. [8] Furthermore, exposure of the dental luting agent at the marginal gap to the oral environment also leads to a rapid increase in cement dissolution, a situation which is widely recognized as a major cause of restoration failure.

For an extensively damaged tooth or to replace a missing tooth, even in the advanced developing technique to restore missing teeth, traditional crowns are still indicated for many patients. It involves a sequence of tooth preparation, framework trial, ceramic layering and final cementation. Tooth preparation is defined as the 'mechanical treatment of dental diseases or injury to hard tissues that restore a tooth to the original form. [9]

Objectives of tooth preparation are reduction of the tooth in miniature to provide retention, preservation of healthy tooth structure to secure resistance form, provision for acceptable finish line, performing pragmatic axial tooth reduction to encourage favourable tissue response from artificial crown contour.

The finish line, by definition, is the apical limit of the abutment tooth model and the margin of the reconstruction must end on it, *i.e.*, it represents the point of transition between the biologic and artificial parts. Being able to identify the zone that is apical to the finish line in absolute precision is fundamentally important for two reasons: It allows defining the preparation limit with certainty and being intact, it maintains the anatomic characteristics of that tooth.

The requirements of a successful restoration margin are that they must fit as closely as possible against the finish line of the preparation to minimize the width of exposed cement, they must have sufficient strength to withstand the forces of mastication and it should be located in areas where the dentist can inspect and the patient can clean them.

Functions of the finish line, the correct marginal adaptation of wax trial depends on the finish line on the cast, it acts as a measure of tooth structure that is removed, it is used to evaluate the accuracy of impressions made for indirect restorations, it helps to evaluate the quality of the die and in accurate die trimming and it helps determining the restoration is fully seated while cementation.

Types of finish lines are Chamfer finish line, Heavy chamfer finish line, Shoulder finish line, shoulder with bevel, radial shoulder, knife edge finish line, feather edge finish line. Different finish lines have different effects on the escape of cement during the cementation process studies recommended that finish line design influence the marginal discrepancy. [10] Subgingival marginal openings in the range of 39 to 119 μm and supragingival margins of 2 to 51 μm were judged to be clinically acceptable. [11] The maximum acceptable marginal opening was 120 μm ranging from 100 to 120 μm. [12] Byrne reported that discrepancies of less than 10 μm were routinely

possible. [13] Heavy chamfered and rounded shoulder finish lines have been advocated for all-ceramic crowns. [14]

Many studies which involved case reports [15], surveys [16], systematic reviews [17-19], literature reviews, [20-23] *in vivo* studies, [24-26] *in vitro* studies [27,28] and retrospective studies [29] were carried out by our team previously. We are currently focusing on epidemiological studies by the dental clinicians in an institutional setting. The main objective of the study is to find the most frequently used finish line configuration and the association between the finish line on various tooth surfaces, a type of restoration material given by undergraduate and postgraduate students. Previously our team has a rich experience in working on various research projects across multiple disciplines. [30-44] Now the growing trend in this area motivated us to pursue this project.

Methodology

Sample collection

A total of 996 patient data were taken from 86000 of patient data after reviewing, duplicate and missing entries were omitted. So a total of 716 entries were evaluated. The data was collected from the patient database of Saveetha dental college between 01 June 2019 and 31 March 2020. Samples with improper data and repetitions were excluded from the study and ethical approval was done by the institutional review board (SDC/SIHEC/2020/DIASDATA/0619-0320). The data is then arranged and checked for the frequency of different finish lines used and the type of finish line configuration used in different regions.

Inclusion criteria

Patients with informed consent and Patients undergoing fixed partial denture treatment.

Exclusion criteria

Patients without informed consent and Complete or partial edentulous patients with removable prosthesis.

Statistical analysis

The results of the study were subjected to statistical analysis. Data analysis was done using SPSS software. Frequency evaluation and Chi-square test was done to evaluate the type of finish line configuration given to various teeth by different groups of students. Dependent variables include the type of finish line configuration given, teeth receiving fixed restoration treatment and the type of practitioner (undergraduate and postgraduate). Independent variables include age and sex of the patient.

Results and Observations

From the retrospective study, the highest percentage of finish line configuration used is shoulder with a percent of 76.8%, followed by chamfer with a percent of 19.4%, radial shoulder with a percent of 2.93%, Least Percent was reported by knife

edge and feather edge with a percent of 0.7% and 0.14% respectively [Figure 1].
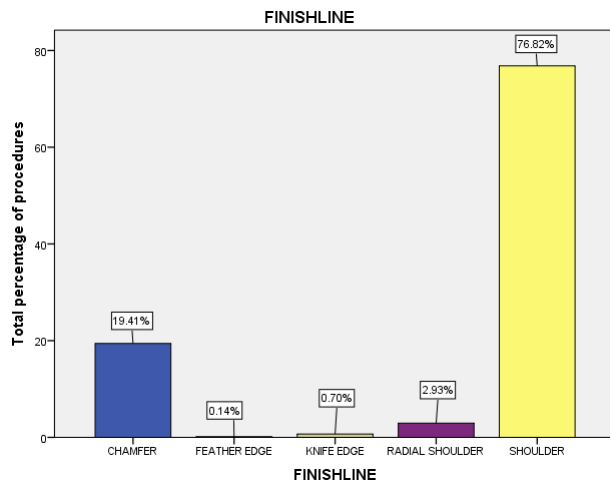
Figure 1: The bar graph showing the percentage of various finish line configurations given by dental students. X axis represents the type of finish lines and Y axis represents the total percentage of the procedures. The highest percentage of finish line used was shoulder followed by chamfer, radial shoulder, knife edge and feather edge.

In all metal types of restoration, a total of 25 cases were reported in that shoulder is the most commonly used with a count of 20, followed by chamfer with 3 count and radial shoulder with 2 count.

In metal ceramic types of restoration, a total of 179 cases were reported in that shoulder is the most commonly used with a count of 142, followed by chamfer with 32 count, radial shoulder with 3 count and knife edge with 2 count.

In all ceramic types of restoration, a total of 512 cases were reported in that shoulder is the most commonly used with a count of 388, followed by chamfer with 104 count, radial shoulder with 16 count, knife edge with 3 count and feather edge with 1 count.

Table 1: The table shows the correlation of materials used in final restoration with the type of finish line configuration and the p-value is 0.257 (>0.05) and found to be statistically not significant.

Restoration			Finish line			Chi-square value 5.723
	Chamfer	Feather edge	Knife edge	Radial shoulder	Shoulder	
All metal	3	0	0	2	20	
Metal ceramic	32	0	2	3	142	P value 0.257
All ceramic	104	1	3	16	388	
Total	139	1	5	21	550	

Association between the type of finish line and the type of final restoration, material was done using Chi square test (Chi-Square Value=5.723, Phi Value=.089 and p- value=.257) and found to be statistically not significant [Table 1] and also phi value shows the weak correlation present.

The bar graph shows the percentage of finish line configurations given to various final restorative materials used.

In all metal restoration, the shoulder is the most commonly used with an overall percentage of 2.79%, and least is radial shoulder with overall percentage of 0.28%.

In metal ceramic types of restoration, the shoulder is the most commonly used with an overall percentage of 2.79% and least is knife edge with overall percentage of 0.28%.
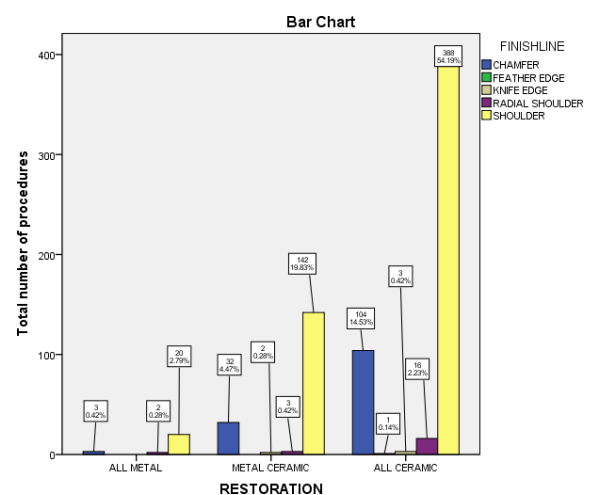
In all ceramic types of restoration, shoulder is the most commonly used with an overall percentage of 54.19% and least is feather edge with an overall percentage 0.14% [Figure 2].

Figure 2: The bar diagram shows the association between finish line configurations and various materials used. X axis represents the material used for final restoration and Y axis represents the total number of procedures with fixed restorative treatment. Chi-Square Value=5.723 and p-value=.257 (>0.05). Although statistically not significant it is implied that the majority of the finish lines established were shoulder finish

lines in all ceramic restorations rather than metal ceramic and all metal restorations.
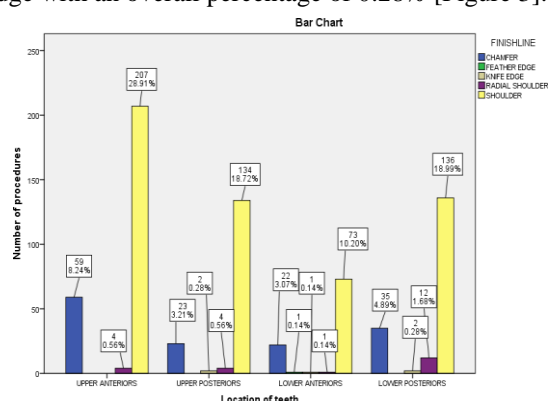
In restoring the upper anterior region, a total of 270 cases were reported in that shoulder is the most commonly used with a count of 207, followed by chamfer with 59 count and radial shoulder with 4 count. In upper posteriors, a total of 163 cases were reported in that shoulder is the most commonly used with a count of 134, followed by chamfer with 23 count, radial shoulder with 4 count and knife edge with 2 count. In lower anteriors, a total of 98 cases were reported in that shoulder is the most commonly used with a count of 73, followed by

chamfer with 22 count, radial shoulder with 1 count, knife edge with 1 count and feather edge with 1 count. In Lower posteriors, a total of 185 cases were reported in that shoulder is the most commonly used with a count of 136, followed by chamfer with 35 count, radial shoulder with 21 count, knife edge with 5 count and feather edge with 1 count. Association between the type of finish line and the location of the teeth in which the finish line is given was done using Chi square test (Chi-Square Value=25.258, Phi value=.188 and p-value=.956) and found to be statistically not significant [Table 2] and also phi shows weak correlation.

Table 2: The table shows the correlation of the type of finish line and the location of the teeth in which the finish line given and the p-value is .956 (>0.05)) and found to be statistically not significant.

Teeth	Finish line					Total	Chi-square value 5.723
	Chamfer	Feather edge	Knife edge	Radial shoulder	Shoulder		
Upper anteriors	59	0	0	4	207	270	
Upper posteriors	23	0	2	4	134	163	
Lower Anteriors	22	1	1	1	73	98	P value 0.257
Lower Posteriors	35	0	2	12	136	185	
Total	139	1	5	21	550	716	

The bar diagram shows the percentage of various finish line configurations given to various teeth, in the upper anterior region, shoulder is the most commonly used with an overall percentage 28.91% and least is radial shoulder with 0.56%. In upper posteriors, the shoulder is the most commonly used with an overall percentage of 18.72%, and least is knife edge with an overall percentage 0.28%. In lower anteriors, shoulder with an overall percentage of 10.20%.In Lower posteriors, shoulder is with an overall percentage 18.99% and least is with feather edge with an overall percentage of 0.28% [Figure 3].

However, the majority of the finish lines established were shoulder finish lines in the upper anterior region.

In undergraduate students, a total of 492 cases were reported in that shoulder is the most commonly used with a count of 354, followed by chamfer with117 count, radial shoulder with 15 count, knife edge with 5 count and feather edge with 1 count and among postgraduates, a total of 224 cases were reported in that shoulder is the most commonly used with a count of 196, followed by chamfer with 22 count and radial shoulder with 6 count.

Association between the type of finish line and different practitioners was done using Chi square test (Chi-square value=23.09, Phi value=.180 and p-value=.001) and found to be statistically significant with weak correlation present [Table 3].
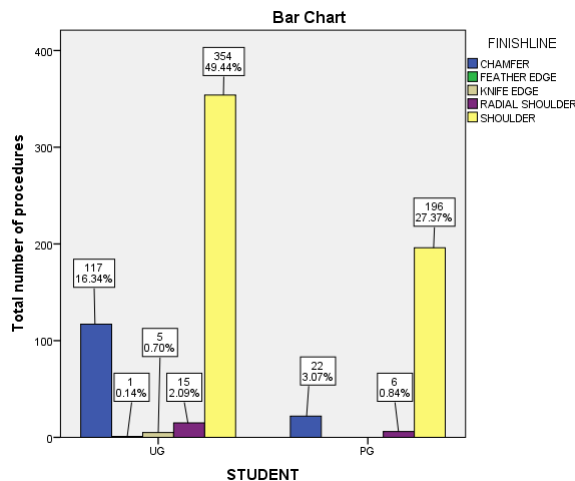
The bar diagram shows the percentage of type of finish line configuration given among undergraduate and postgraduate students.

In undergraduate students, shoulder is the most commonly used with an overall percentage of 49.44%, and least is feather edge with an overall percentage of 0.14% and among postgraduates, shoulder is the most commonly used with an overall percentage of 27.37% and least is radial shoulder with an overall percentage of 0.84% [Figure 4].

Minimal marginal discrepancy remains an essential factor for clinical success of all-ceramics crown restorations. However, marginal discrepancy is influenced by various manufacturing process parameters but finish line configuration of preparation is one of the primary stage design parameter.

Table 3: The table shows the correlation of the type of finish line and number of the students in which the finish line given and the p-value is .001 (<0.05) and found to be statistically not significant.

Student	Finish line					Total	Chi-square value 23.09
	Chamfer	Feather edge	Knife edge	Radial shoulder	Shoulder		
UG	117	1	5	15	354	270	
PG	22	0	0	6	196	163	P value .001
Total	139	1	5	21	550	716	

Figure 4: The bar diagram shows the association between finish line configuration and undergraduate, postgraduate students. X axis represents the dental students and Y axis represents the total number of procedures with fixed restorative treatment. Association between the type of finish line and dental students (UG and PG) was found to be statistically significant. Chi-Square value=23.09, p-value=.001 (p<0.05). Most of the students in undergraduate and postgraduates used shoulder as their finish line configuration.

Discussion

From this study, it is evident that most of the students preferred to use shoulder finish line configuration for their maximum cases and all ceramic material as their final choice of material with a percentage of 76.5 and 71.5.

In postgraduate students, only three finish lines have been used, among that shoulder the highest frequency followed by chamfer and radial shoulder with a count of 196, 22 and 6.

In undergraduates, shoulder has been widely used followed by chamfer, radial shoulder, knife edge and feather edge with a count of 34,117,15,5 and 1. The escape path of the cement at the margins decreases as the crown is seated on a prepared tooth.

Different finish lines have different effect on the escape of cement during the cementation process greater increases in marginal discrepancies are to be expected for greater degrees of finish line curvature abutment; thus, any preparations, which conform to higher degrees of Fusayama et al. reported that feather edge margin has the best sealing effect followed by the 45-degree shoulder and 90 degree shoulder. [49]

Shoulder and chamfer finish line expressed a vertical discrepancy far below at 120 microns, rounded shoulder finish line preparation has the better seat because it allowed the cement to escape more easily. [50]

Finish line designs or ceramic types did not influence the marginal fit of all ceramic copings used. Minimal marginal discrepancy remains an essential factor for clinical success of all-ceramics crown restorations.

However, marginal discrepancy is influenced by various manufacturing process parameters but finish line configuration of preparation is one of the primary stage design parameter.

The occlusal cement thickness was maximum with the feather edged preparation, followed by the long chamfer and chamfer marginal design.

These margins did not allow the castings to completely seat. This is because these margins seal earlier and start the filtration process sooner.

They substantially decrease the closing angle between the tooth preparation and the restoration and do not allow the cement to escape easily. [51]

Due to esthetic reasons, all ceramic has been widely used as their final restorative material. Generally, a shoulder finish line is preferred for all ceramic restorations where sufficient thickness of the margin is required for structural durability.

Some cases there is really no need for a thick shoulder finish line if the restoration is for full metal. The finish line should be chosen based on clinical situation, location and material used. [52-58]

Conclusion

Within the limitations of the current study, it was found that most of the students have used shoulder finish line for their fixed dental prosthesis treatment.

There is a trend towards shoulder finish line as the dentistry is going towards esthetics demand and all ceramic material is the treatment of choice but always the decision should be taken by the dentist based on clinical situation for a long lasting successful treatment outcome.

References

1. Land MF, Fujimoto J. Contemporary fixed prosthodontics. Mosby Elsevier Health Science; 1995;672.

2. Bader JD, Gary Rozier R, McFall WT, Ramsey DL. Effect of crown margins on periodontal conditions in regularly attending patients. J Prosthet Dent. 1991;65:75-9.

3. Knoernschild KL, Campbell SD. Periodontal tissue responses after insertion of artificial crowns and fixed partial dentures. J Prosthet Dent. 2000;84:492-8.

4. Beschnidt SM, Strub JR. Evaluation of the marginal accuracy of different all-ceramic crown systems after simulation in the artificial mouth. J Oral Rehabil. 1999;26:582-93.

5. Bindl A, Mormann WH. Marginal and internal fit of all-ceramic CAD/CAM crown-copings on chamfer preparations. J Oral Rehabil. 2005;32:441-7.

6. Jacobs MS, Stewart Windeler A. An investigation of dental luting cement solubility as a function of the marginal gap. J Prosthet Dent. 1991;65:436-42.

7. Sharma S. A comparative evaluation of the effect of resin based sealers on retention of crown cemented with three types of cement - An *in vitro* study. J ClinDiagn Res. 2014; 8: 251–255.

8. Gavelis JR, Morency JD, Riley ED, Sozio RB. The effect of various finish line preparations on the marginal seal and occlusal seat of full crown preparations. J Prosthet Dent. 2004;92:1-7.

9. Tylman SD. Theory and Practice of Crown and Bridge Prosthesis. 1960;1063.

10. Karatasli O, Kursoglu P, Capa N, Kazazoglu E. Comparison of the marginal fit of different coping materials and designs produced by computer aided manufacturing systems. Dent Mater J. 2011;30:97-102.

11. Christensen GJ. Marginal fit of gold inlay castings. J Prosthet Dent. 1966;16(2):297-305.

12. McLean JW, Von F. The estimation of cement film thickness by an *in vivo* technique. Br Dent J. 1971;131:107-11.

13. Byrne G, Goodacre CJ, Dykema RW, Moore BK. Casting accuracy of high-palladium alloys. J Prosthet Dent. 1986;55:297-301.

14. Pera P, Gilodi S, Bassi F, Carossa S. *In vitro* marginal adaptation of alumina porcelain ceramic crowns. J Prosthet Dent. 1994;72:585-90.

15. Ashok V, Nallaswamy D, Benazir Begum S, Nesappan T. Lip bumper prosthesis for an acromegaly patient: A clinical report. J Indian Prosthodont Soc. 2014;14:279-82.

16. Ashok V, Suvitha S. Awareness of all ceramic restoration in rural population. Res J Pharma Tech. 2016;9:1691-3.

17. Ganapathy DM, Kannan A, Venugopalan S. Effect of coated surfaces influencing screw loosening in implants: a systematic review and meta-analysis. World J Dent. 2017;8:496-502.

18. 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;9:68-75.

19. Kannan A, Venugopalan S. A systematic review on the effect of use of impregnated retraction cords on gingiva. Res J Pharma Tech. 2018;11:2121-2126.

20. Venugopalan S, Ariga P, Aggarwal P, Viswanath A. magnetically retained silicone facial prosthesis. Niger J Clin Pract. 2014;17:260-4.

21. Vijayalakshmi B, Ganapathy D. Medical management of cellulitis.Res J Pharma Tech. 2016;9:2067.

22. Subasree S, Murthykumar K, Dhanraj. Effect of aloe vera in oral health-A review. Res J Pharma Tech. 2016;9:609.

23. Selvan SR, Ganapathy D. Efficacy of fifth generation cephalosporins against methicillin-resistant Staphylococcus aureus-A review. Res J Pharma Tech. 2016;9:1815.

24. Jyothi S, Robin PK, Ganapathy D, Anandiselvaraj. Periodontal health status of three different groups wearing temporary partial denture. Res J Pharma Techn. 2017;10:4339.

25. Jain A, Ranganathan H, Ganapathy D. Cervical and incisal marginal discrepancy in ceramic laminate veneering materials: A SEM analysis. Contemp Clin Dent. 2017;8:272-278.

26. Duraisamy R, Krishnan CS, Ramasubramanian H, Sampathkumar J, Mariappan S, Navarasampatti SA. Compatibility of nonoriginal abutments with implants: Evaluation of microgap at the implant-abutment interface, with original and nonoriginal abutments. Implant Dent. 2019;28:289-95.

27. Ganapathy D, Sathyamoorthy A, Ranganathan H, Murthykumar K. Effect of resin bonded luting agents influencing marginal discrepancy in all ceramic complete veneer crowns. J ClinDiagn Res. 2016;10:ZC67-70.

28. Ajay R, Suma K, Ali S, Sivakumar JK, Rakshagan V, Devaki V, et al. Effect of surface modifications on the retention of cement-retained implant crowns under fatigue loads: An *In vitro* study. J Pharm Bioallied Sci. 2017;9:S154–S160.

29. Basha FYS, Ganapathy D, Venugopalan S. Oral hygiene status among pregnant women. Res J Pharma Techn. 2018;11:3099.

30. Ponnulakshmi R, Shyamaladevi B, Vijayalakshmi P, Selvaraj J. In silico and *in vivo* analysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats. Toxicol Mech Methods. 2019;29:276-90.

31. 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;24:3275-80.

32. Subramaniam N, Muthukrishnan A. Oral mucositis and microbial colonization in oral cancer patients undergoing radiotherapy and chemotherapy: A prospective analysis in a tertiary care dental hospital. J Investig Clin Dent. 2019;10:e12454.

33. Girija ASS, Shankar EM, Larsson M. Could SARS-CoV-2-Induced hyperinflammation magnify the severity of coronavirus disease (CoViD-19) leading to acute respiratory distress syndrome? Front Immunol. 2020;11:1206.

34. Dinesh S, Kumaran P, Mohanamurugan S, Vijay R, Singaravelu DL, Vinod A, et al. Influence of wood dust fillers on the mechanical, thermal, water absorption and biodegradation characteristics of jute fiber epoxy composites. J Polym Res. 2020;27.

35. Thanikodi S, Singaravelu D Kumar, Devarajan C, Venkatraman V, Rathinavelu V. Teaching learning optimization and neural network for the effective prediction of heat transfer rates in tube heat exchangers. Therm Sci. 2020;24:575-81.

36. Murugan MA, Jayaseelan V, Jayabalakrishnan D, Maridurai T, Kumar SS, Ramesh G, et al. Low velocity impact and mechanical behaviour of shot blasted SiC wire-mesh and silane-treated aloevera/hemp/flax-reinforced SiC whisker modified epoxy resin composites. Silicon Chem. 2020;12:1847-56.

37. Vadivel JK, Govindarajan M, Somasundaram E, Muthukrishnan A. Mast cell expression in oral lichen planus: A systematic review. J Investig Clin Dent. 2019;10:e12457.

38. Chen F, Tang Y, Sun Y, Veeraraghavan VP, Mohan SK, Cui C. 6-shogaol, an active constituents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating NrF2 signaling in human epidermal keratinocytes (HaCaT cells). J Photochem Photobiol B. 2019;197:111518.

39. Manickam A, Devarasan E, Manogaran G, Priyan MK, Varatharajan R, Hsu C-H, et al. Score level based latent fingerprint enhancement and matching using SIFT feature. Multimed Tools Appl. 2019;78:3065-85.

40. Wu F, Zhu J, Li G, Wang J, Veeraraghavan VP, Krishna Mohan S, et al. Biologically synthesized green gold nanoparticles from induce growth-inhibitory effect on melanoma cells (B16). Artif Cells Nanomed Biotechnol. 2019;47:3297-305.

41. Ma Y, Karunakaran T, Veeraraghavan VP, Mohan SK, Li S. Sesame inhibits cell proliferation and induces apoptosis through inhibition of STAT-3 translocation in thyroid cancer cell lines (FTC-133). Biotechnol Bioprocess Eng. 2019;24:646-52.

42. Ponnanikajamideen M, Rajeshkumar S, Vanaja M, Annadurai G. *In vivo* type 2 diabetes and wound-healing effects of antioxidant gold nanoparticles synthesized using the insulin plant Chamaecostus cuspidatus in albino rats. Can J Diabetes. 2019;43:82-9.e6.

43. Vairavel M, Devaraj E, Shanmugam R. An eco-friendly synthesis of Enterococcus sp.-mediated gold nanoparticle induces cytotoxicity in human colorectal cancer cells. Environ SciPollut Res Int. 2020;27:8166-75.

44. Paramasivam A, Priyadharsini VJ, kumar RS. N6-adenosine methylation (m6A): a promising new molecular target in hypertension and cardiovascular diseases. Hypertens Res. 2020;43:153-4.

45. Asavapanumas C, Leevailoj C. The influence of finish line curvature on the marginal gap width of ceramic copings. J Prosthet Dent. 2013;109:227-33.

46. Quintas AF, Oliveira F, Bottino MA. Vertical marginal discrepancy of ceramic copings with different ceramic materials, finish lines, and luting agents: an *in vitro* evaluation. J Prosthet Dent. 2004;92:250-7.

47. Komine F, Iwai T, Kobayashi K, Matsumura H. Marginal and internal adaptation of zirconium dioxide ceramic copings and crowns with different finish line designs. Dent Mater J. 2007;26:659-64.

48. Subasi G, Ozturk N, Inan O, Bozogullari N. Evaluation of marginal fit of two all-ceramic copings with two finish lines. Eur JDent. 2012;6:163-8.

49. Iwaku M, Nagata N, Hosoda H, Fusayama T. Edge strength of powdered gold fillings. J Dent Res. 1966;45:1468-72.

50. Cho L, Choi J, Yi YJ, Park CJ. Effect of finish line variants on marginal accuracy and fracture strength of ceramic optimized polymer/fiber-reinforced composite crowns. J Prosthet Dent. 2004;91:554-60.

51. Tjan AHL, Sarkissian R, Miller GD. Effect of multiple axial grooves on the marginal adaptation of full cast-gold crowns. J Prosthet Dent. 1981;46:399-403.

52. Priyadharsini VJ. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019;90:1441-8.

53. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygiumcumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019;48:115-21.

54. 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;89:1241-8.

55. 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;24:3275-3280.

56. 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;48:299-306.

57. 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. 2018;20:531-534.

58. 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;23:3543-3550.