
Evaluating The Frequency Of Additive Retentive Features By Dental Students During Tooth Preparation For Fixed Partial Dentures - An Institution Based Retrospective Study

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Abstract: Aim: The aim of this study was to retrospectively evaluate the frequency of additional retentive features used during tooth preparation for Fixed Partial Dentures by the dental students and to determine preference of retentive features in each sextant.

Method: The data for this study was collected from June 2019 to March 2020 after taking ethical clearance from the Institutional Review Committee. A total of 999 case records of the patients who received fixed partial denture in a dental institution at Chennai was included. The data regarding the tooth preparation was collected from the case record. SPSS 20 version was used for statistical analysis. Chi-square test was applied to see association between the retentive features and tooth location.

Result: The study reported that 30.7% of tooth preparation had proximal boxes; 14.8% had grooves; 18.7% had occlusal offset and 35.7% did not incorporate any additional retentive feature. Association between the retentive features and location of the tooth was found to be statistically significant.

Conclusion: Most of the dental students did not prefer additional retentive features followed by proximal box, grooves and occlusal offset. Association between the retentive features and location of the tooth was found to be statistically significant with p value of 0.02. In sextant 1, 5 and 6 no additional retentive features were preferred. In sextant 2 and 4, proximal box was highly preferred. In sextant 3, both proximal box and no additional retentive feature was equally preferred.

Keywords: Additional retentive features; grooves; occlusal offset; proximal box

INTRODUCTION:

Fixed partial denture is a very common procedure practiced over ages for replacing the missing teeth. Teeth require preparation to receive restorations, and these preparations must be planned and executed with maximum attention (Smith, 2003). The removal of dental biological material should be based on fundamental principles from which basic criteria can be developed to help in predicting the success of prosthodontics treatment. Rosenstiel proposed biologic principles like conservation of tooth structure, avoidance of over contouring, supra gingival margins, harmonious occlusion, protection against tooth fracture; mechanical factors that include retention, resistance form deformation; esthetic factors like minimal display of metal, maximum thickness of porcelain, sub gingival margins (Land and Fujimoto, 1995). Other basic principles by various authors include conservation of tooth structure, retention, resistance form, structural durability, marginal integrity and preservation of periodontium (Nallaswamy, 2017).

Longevity of the prosthesis is of paramount importance in fixed prosthodontics. The most mechanical failure of fixed prosthodontic restorations occurs after several years of services (Schwartz et al., 1970) (Foster, 1990). Walton et al. found that mechanical failure accounted for 69.5% of failures compared for 28.5% of failures due to oral diseases (Walton, Gardner and Agar, 1986). Retention form has been regarded as one of the key principles in dictating the success of crowns and fixed partial dentures (Potts, Shillingburg and Duncanson, 2004). It is defined as "the ability of preparation to prevent displacement of restoration in a direction opposite to the path of insertion". The factors such as magnitude of dislodging force; geometry of the tooth preparation; taper; surface area; stress concentrations; type of preparation; roughness of the fitting surfaces of the restorations

and materials being cemented must be considered in deciding whether retention is adequate for a given fixed restoration (Garber and Goldstein, 1994). Retention involves primary and secondary type, in which primary retention is obtained from a sleeve or a wedge preparation. Secondary retentive features involve pins, proximal grooves, boxes and occlusal offset. Figure 1 depicts the additional retentive features.

A number of authors have attempted to determine resistance by subjecting restorations to oblique or lateral forces (Maxwell, Blank and Pelleu, 1990). Proussaefs, Roudsari and Satterthwaite explained the effectiveness of mesiodistal grooves, mesiodistal boxes and total occlusal convergence in enhancing resistance form (Roudsari and Satterthwaite, 2011). Potts et al, Kishimoto et al, and Owen et al further emphasized the importance of the placement of grooves to the resistance form of a tooth preparation (Potts, Shillingburg and Duncanson, 2004) (Kishimoto, Shillingburg and Duncanson, 1983) (Owen, 1986). Conditions where there is short walled abutments or inadequate retention form, these modifications with auxiliary features may be beneficial. The design of the occlusal surface of the preparation can also affect the retention form of a crown preparation. Zuckerman has shown by using a mathematical model that the placement of inclined planes on the occlusal surface of a crown preparation rather than a flat surface can increase the resistance form (Zuckerman, 1988). The same can be achieved by the placement of an occlusal isthmus. The findings of different authors regarding enhancement of retention by provision of retentive features are at variance. The aim of this study was to evaluate the frequency of use of additional retentive features like proximal box, grooves and occlusal offset during tooth preparation for fixed dental prosthesis among dental students and to determine the preference of retentive features in each sextant. 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)

MATERIALS AND METHOD: MATERIALS AND METHODS:

Study setting:

The present retrospective study was conducted by reviewing patient records from June 2019 to March 2020, in the Department of Prosthodontics, in a dental school in Chennai. The data was examined by 2 examiners.

Study population:

Study population included case records of patients who underwent Fixed partial denture treatment in the Department of Prosthodontics, in a dental school in Chennai during the month of June 2019 to March 2020. .

Ethical approval:

Ethical approval was obtained from the Institutional Review Board (IRB) of the University to use the data from case records (SDC/SIHEC/2020/DIASDATA/0619-0320). Informed consent was obtained from the patient at the time of oral examination. Case sheets with informed consent were included in the study.

Sampling:

Patients between the age group 18-80 years who have undergone Fixed partial denture treatment, were included in the study and their case records were retrieved. Case records of 962 patients were collected and the missing entries were omitted. So a total of 806 case records were obtained. The degree of taper, occlusal convergence and parallelism preferred during tooth preparation was analysed. The additional retentive features like proximal box, grooves and occlusal offset if used was noted down in relation to each sextant. Photographic verification was done to cross verify the collected data.

Inclusion and exclusion criteria:

Abutments that were ideal and endodontically treated were included in the study. Periodontally compromised abutments and those with severe loss of tooth structure were excluded in the study.

Statistical analysis:

The frequency and percent of additional retentive features used during tooth preparation was evaluated. Analysis was done using Statistical Package for Social Sciences (SPSS) version 23.0. Independent variables are age and time whereas dependent variables were additional retentive features. Statistical tests like chi-square association were used to determine the association for sextant. P values <0.05 were considered significant.

RESULTS:

When evaluating the data, it was found that 30.7% (n=307) of tooth preparation had proximal boxes incorporated in it; 14.8% (n=148) had grooves; 18.7% (n=187) had occlusal offset and 35.7% (n=357) of the tooth preparations did not incorporate any additional retentive feature (figure 2). Association between the retentive features and location of the tooth was done using Chi Square test with p value = 0.02, and was found to be statistically significant. In sextant 1, dental students preferred the proximal box with 34.6% (n=36). In

sextant 2, 42.1% (n=149) of tooth preparation, no additional retentive feature was used. In sextant 3, proximal box and no additional feature was preferred with 33.1% (n=42). In sextant 4, dental students did not prefer any retentive feature with 29.9% (n=40). In sextant 5 and 6, proximal box was highly preferred with 35.4% (n=52) and 36.8% (n=49) respectively (figure 3).

DISCUSSION:

Previously our team has conducted numerous original studies over the past 5 years (Ariga et al., 2018)(Jyothi et al., 2017)(Duraisamy et al., 2019)(Selvan and Ganapathy, 2016)(Ganapathy, Kannan and Venugopalan, 2017)(Subasree, Murthykumar and Dhanraj, 2016)(Jain, Ranganathan and Ganapathy, 2017)(Vijayalakshmi and Ganapathy, 2016)(Ashok and Suvitha, 2016)(Ganapathy, 2016)(Ashok et al., 2014)(Basha, Ganapathy and Venugopalan, 2018)(Kannan and Venugopalan, 2018)(Ajay et al., 2017)(Venugopalan et al., 2014). The idea for this study stemmed from the current interest in our community Tooth preparation is an art, which is based on fundamental principles for a predictable success of the prosthesis. In-depth knowledge and an understanding of the various criteria is a prerequisite to the development of optimum tooth preparation (Jayna et al., 2015). The present study evaluated the frequency of use of additional retentive features during tooth preparation for FPD by dental students. This study demonstrated that most of the students did not prefer additional retentive features like box, grooves and occlusal offset during their tooth preparation. Many articles suggest that in a clinical situation, where crown height is adequate TOC can be more than 20°. However, in situations where crown height is inadequate TOC <20° should be planned, with some auxiliary retentive features in preparation or on the internal surface of the crown. The findings in this study agree with the work conducted by Proussaefs et al, who reported that placing auxiliary retentive features like grooves and boxes were not effective at increasing resistance form for a short tooth preparation with 20° TOC. Perhaps, they would have been effective if they had been placed with less TOC(Proussaefs et al., 2004). Teteruck and Mumford investigated the degree of adaptation with different crown modifications. It was consistently found that along grooves and interproximal boxes there was an increased gap or loss of adaptation between the die and the crown(Teteruck and Mumford, 1966). Among the retentive features, proximal box was preferred over grooves and occlusal offset. Sangwan et al proposed that two interproximal boxes significantly increased the resistance form. However, two interproximal grooves did not increase the resistance form (Sangwan et al., 2016). The interproximal boxes increase the resistance form by preventing rotation of the restoration and increasing the surface area of the preparation. The boxes should be placed within a sound bulk of tooth tissue or core without any weak surrounding areas which are liable to fracture (Blair, Wassell and Steele, 2002). Reisbick and Shillingburg also concluded that resistance value increases significantly with the addition of boxes in the preparation (Reisbick and Shillingburg, 1975).

Tooth location is a critical factor in achieving adequate resistance form in preparation taper (Parker et al., 1991). It was found that association of use of additional retentive feature and location of tooth was statistically significant. In sextant wise examination, it was observed that students highly preferred proximal boxes or did not incorporate any additional feature. Many studies suggest that a definitive tooth preparation with proper taper and parallel walls provide a good retention. The resistance form could have been improved with other factors like use of computer-aided design-computer-aided manufacturing (CAD-CAM) technology instead of lost wax technique used in the present study for crown fabrication. CAD-CAM technology would have improved the internal adaptation and fit of the crowns and would have resulted in improved force values.

This study is limited to the following factors that include the tooth preparation for both all metal and metal ceramic restorations. Other modifications like height and total occlusal convergence could have been taken into consideration. The retentive feature for vital and non vital abutments could have been evaluated. This study provides a brief knowledge about clinical use of additional retentive features among dental students. 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)

CONCLUSION:

Within the limitations of the study, it was observed that most of the tooth preparations done by the dental students did not incorporate any additional retentive feature. Among the auxiliary retentive features, proximal box was highly preferred over the occlusal offset and grooves. Association between the retentive features and location of the tooth was found to be statistically significant. It was observed that in sextant 1, 5 and 6 no additional retentive features were preferred. In sextant 2 and 4, proximal box was highly preferred. In sextant 3, both proximal box and no additional retentive feature was equally preferred.

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AUTHOR CONTRIBUTIONS:

Dr.Harini Sri, carried out the study by collecting data and drafted the manuscript after performing the necessary statistical analysis. Dr. Nabeel Ahmed aided in conception of the topic, has participated in the study design, statistical analysis and has supervised in preparation of the manuscript. Dr. Keerthi Shashanka has participated in the study design and has coordinated in developing the manuscript. All the authors have discussed the results among themselves and contributed to the final manuscript.

CONFLICT OF INTEREST:

None declared.

REFERENCE:

1. Ajay, R. et al. (2017) 'Effect of surface modifications on the retention of cement-retained implant crowns under fatigue loads: An In vitro study', *Journal of Pharmacy And Bioallied Sciences*, p. 154. doi: 10.4103/jpbs.jpbs_146_17.
2. Ariga, P. et al. (2018) 'Determination of Correlation of Width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A Systematic Review', *World Journal of Dentistry*, pp. 68–75. doi: 10.5005/jp-journals-10015-1509.
3. Ashok, V. et al. (2014) 'Lip Bumper Prosthesis for an Acromegaly Patient: A Clinical Report', *The Journal of Indian Prosthodontic Society*, pp. 279–282. doi: 10.1007/s13191-013-0339-6.
4. Ashok, V. and Suvitha, S. (2016) 'Awareness of all ceramic restoration in rural population', *Research Journal of Pharmacy and Technology*, p. 1691. doi: 10.5958/0974-360x.2016.00340.1.
5. Basha, F. Y. S., Ganapathy, D. and Venugopalan, S. (2018) 'Oral Hygiene Status among Pregnant Women', *Research Journal of Pharmacy and Technology*, p. 3099. doi: 10.5958/0974-360x.2018.00569.3.
6. Blair, F. M., Wassell, R. W. and Steele, J. G. (2002) 'Crowns and other extra-coronal restorations: Preparations for full veneer crowns', *British Dental Journal*, pp. 561–571. doi: 10.1038/sj.bdj.4801428.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.
13. Foster, L. V. (1990) 'Failed conventional bridge work from general dental practice: clinical aspects and treatment needs of 142 cases', *British dental journal*, 168(5), pp. 199–201.
14. Ganapathy, D. (2016) 'Effect of Resin Bonded Luting Agents Influencing Marginal Discrepancy in All Ceramic Complete Veneer Crowns', *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*. doi: 10.7860/jcdr/2016/21447.9028.
15. Ganapathy, D. M., Kannan, A. and Venugopalan, S. (2017) 'Effect of Coated Surfaces influencing Screw Loosening in Implants: A Systematic Review and Meta-analysis', *World Journal of Dentistry*, pp. 496–502. doi: 10.5005/jp-journals-10015-1493.
16. Garber, D. A. and Goldstein, R. E. (1994) *Porcelain & composite inlays & onlays: esthetic posterior restorations*. Quintessence Pub Co.
17. 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.
18. 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.
19. Jain, A., Ranganathan, H. and Ganapathy, D. (2017) 'Cervical and incisal marginal discrepancy in ceramic laminate veneering materials: A SEM analysis', *Contemporary Clinical Dentistry*, p. 272. doi: 10.4103/ccd.ccd_156_17.
 20. Jayna, M. et al. (2015) 'Clinical insight into tooth preparation: An update', *The Saint's International Dental Journal*, p. 2. doi: 10.4103/2454-3160.161793.
 21. 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.
 22. 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.
 23. Jyothi, S. et al. (2017) 'Periodontal Health Status of Three Different Groups Wearing Temporary Partial Denture', *Research Journal of Pharmacy and Technology*, p. 4339. doi: 10.5958/0974-360x.2017.00795.8.
 24. Kannan, A. and Venugopalan, S. (2018) 'A systematic review on the effect of use of impregnated retraction cords on gingiva', *Research Journal of Pharmacy and Technology*, p. 2121. doi: 10.5958/0974-360x.2018.00393.1.
 25. Kishimoto, M., Shillingburg, H. T., Jr and Duncanson, M. G., Jr (1983) 'Influence of preparation features on retention and resistance. Part II: three-quarter crowns', *The Journal of prosthetic dentistry*, 49(2), pp. 188–192.
 26. Land, M. F. and Fujimoto, J. (1995) *Contemporary Fixed Prosthodontics*. Mosby Elsevier Health Science.
 27. 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.
 28. 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>.
 29. Maxwell, A. W., Blank, L. W. and Pelleu, G. B., Jr (1990) 'Effect of crown preparation height on the retention and resistance of gold castings', *General dentistry*, 38(3), pp. 200–202.
 30. 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.
 31. 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.
 32. Nallaswamy, D. (2017) *Textbook of Prosthodontics*. JP Medical Ltd.
 33. Owen, C. P. (1986) 'Factors influencing the retention and resistance of preparations for cast intracoronal restorations', *The Journal of Prosthetic Dentistry*, pp. 674–677. doi: 10.1016/0022-3913(86)90440-3.
 34. 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.
 35. Parker, M. H. et al. (1991) 'Evaluation of resistance form for prepared teeth', *The Journal of prosthetic dentistry*, 66(6), pp. 730–733.
 36. 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>.
 37. Potts, R. G., Shillingburg, H. T., Jr and Duncanson, M. G., Jr (2004) 'Retention and resistance of preparations for cast restorations. 1980', *The Journal of prosthetic dentistry*, 92(3), pp. 207–212.
 38. 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.
 39. Proussaefs, P. et al. (2004) 'The effectiveness of auxiliary features on a tooth preparation with inadequate resistance form', *The Journal of prosthetic dentistry*, 91(1), pp. 33–41.
 40. 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.
 41. Rajeshkumar, S. et al. (2018) 'Biosynthesis of zinc oxide nanoparticles using *Mangifera indica* leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells', *Enzyme and microbial technology*, 117, pp. 91–95.
 42. 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.
43. 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.
 44. 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.
 45. 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.
 46. Reisbick, M. H. and Shillingburg, H. T., Jr (1975) 'Effect of preparation geometry on retention and resistance of cast gold restorations', *Journal - California Dental Association*, 3(4), pp. 51–59.
 47. Roudsari, R. V. and Satterthwaite, J. D. (2011) 'The influence of auxiliary features on the resistance form of short molars prepared for complete cast crowns', *The Journal of prosthetic dentistry*, 106(5), pp. 305–309.
 48. 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.
 49. Sangwan, R. et al. (2016) 'Evaluation of the effectiveness of auxiliary features on resistance with decreased occluso-cervical height: An In Vitro study', *Indian Journal of Dental Sciences*, p. 139. doi: 10.4103/0976-4003.191730.
 50. Schwartz, N. L. et al. (1970) 'Unserviceable crowns and fixed partial dentures: life-span and causes for loss of serviceability', *Journal of the American Dental Association*, 81(6), pp. 1395–1401.
 51. Selvan, S. R. and Ganapathy, D. (2016) 'Efficacy of fifth generation cephalosporins against methicillin-resistant *Staphylococcus aureus*-A review', *Research Journal of Pharmacy and Technology*, p. 1815. doi: 10.5958/0974-360x.2016.00369.3.
 52. 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.
 53. Smith, B. G. N. (2003) 'Planning and Making Crowns and Bridges'. doi: 10.3109/9780203419557.
 54. 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.
 55. Subasree, S., Murthykumar, K. and Dhanraj (2016) 'Effect of Aloe Vera in Oral Health-A Review', *Research Journal of Pharmacy and Technology*, p. 609. doi: 10.5958/0974-360x.2016.00116.5.
 56. Teteruck, W. R. and Mumford, G. (1966) 'The fit of certain dental casting alloys using different investing materials and techniques', *The Journal of Prosthetic Dentistry*, pp. 910–927. doi: 10.1016/0022-3913(66)90014-x.
 57. 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.
 58. Venugopalan, S. et al. (2014) 'Magnetically retained silicone facial prosthesis', *Nigerian journal of clinical practice*, 17(2), pp. 260–264.
 59. Vijayalakshmi, B. and Ganapathy, D. (2016) 'Medical management of cellulitis', *Research Journal of Pharmacy and Technology*, p. 2067. doi: 10.5958/0974-360x.2016.00422.4.
 60. 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.
 61. 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.
 62. 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.
 63. Walton, J. N., Gardner, F. M. and Agar, J. R. (1986) 'A survey of crown and fixed partial denture failures: length of service and reasons for replacement', *The Journal of prosthetic dentistry*, 56(4), pp. 416–421.
 64. Zuckerman, G. R. (1988) 'Resistance form for the complete veneer crown: principles of design and analysis', *The International journal of prosthodontics*, 1(3), pp. 302–307.

FIGURES:

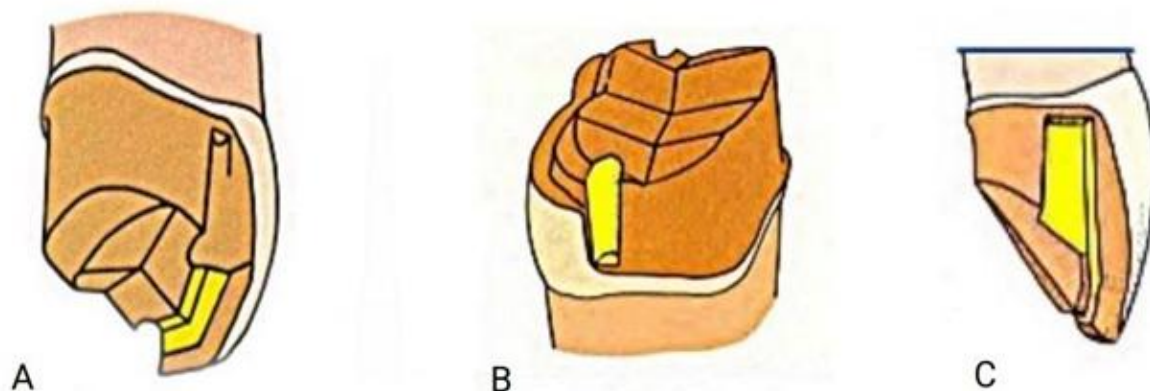


Fig.1 : Additional retentive features. (A) Occlusal offset (B) Proximal groove (C) Proximal box

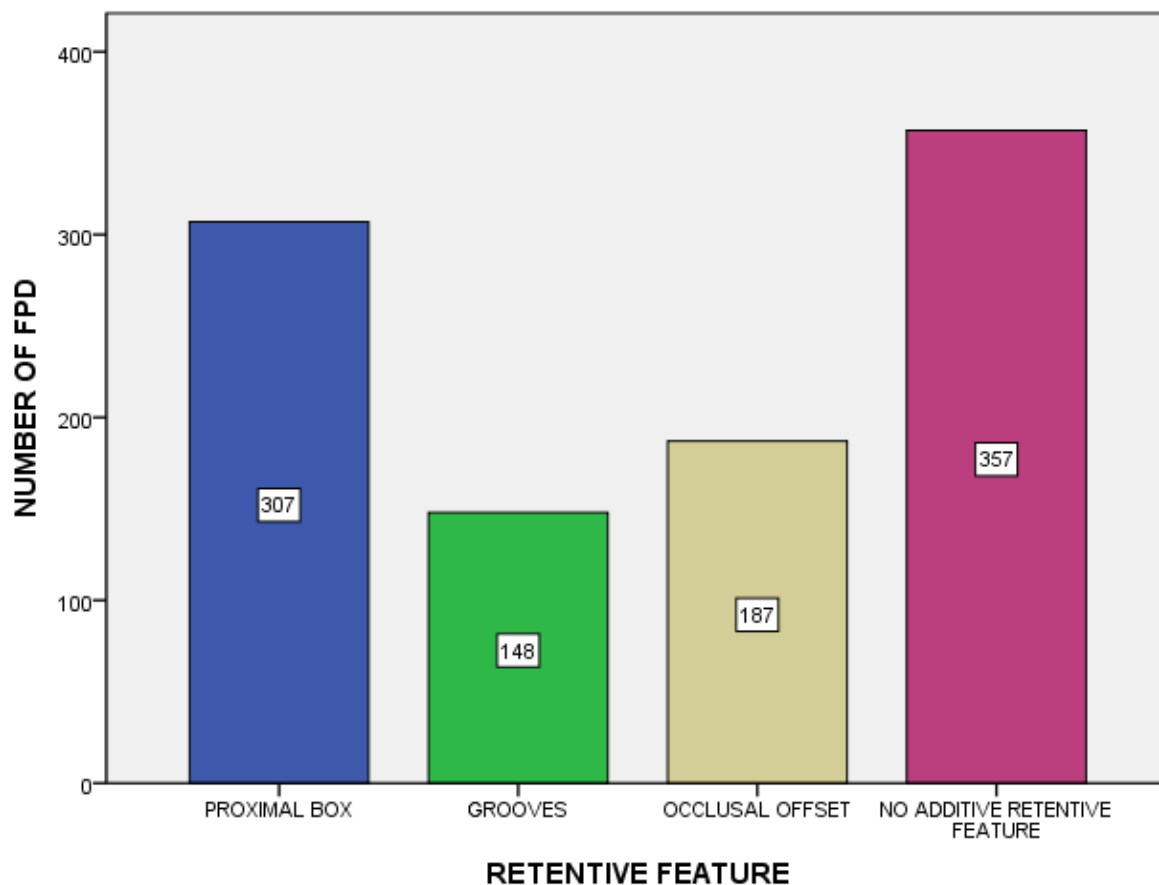


Fig.2 : Frequency distribution of additive retentive features. X axis represents retentive features and Y axis represents the number of FPD. 30.7% (n=307) of tooth preparation had proximal boxes (blue) incorporated in it; 14.8% (n=148) had grooves (green); 18.7% (n=187) had occlusal offset (brown) and 35.7% (n=357) of the tooth preparations did not incorporate any additional retentive feature (purple).

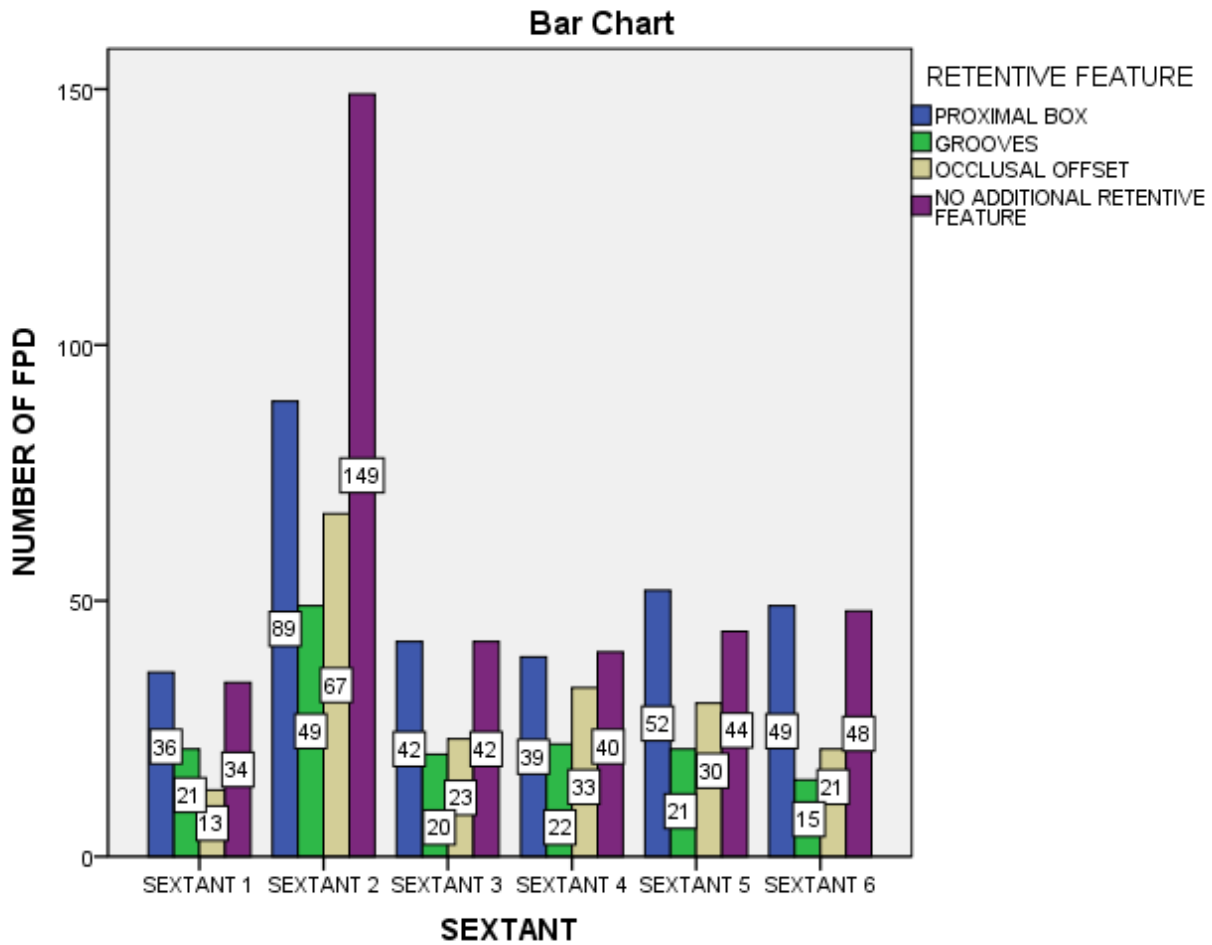


Fig.3 : Association of additional retentive features and different sextants. X axis represents sextant and Y axis represents number of FPD. Association was determined using Chi Square test with p value = 0.02 (p value <0.05) was found to be statistically significant. In sextant 1, 5, 6, proximal box was highly preferred. In sextant 2 and sextant 4, had no additional retentive features. In sextant 3, proximal box and no additional feature was preferred.

LIST OF FIGURE LEGENDS:

Figure 1 : Additional retentive features. (A) Occlusal offset (B) Proximal groove (C) Proximal box

Figure 2: Frequency distribution of additive retentive features. X axis represents retentive features and Y axis represents the number of FPD. 30.7% (n=307) of tooth preparation had proximal boxes (blue) incorporated in it; 14.8% (n=148) had grooves (green); 18.7% (n=187) had occlusal offset (brown) and 35.7% (n=357) of the tooth preparations did not incorporate any additional retentive feature (purple).

Figure 3 : Association of additional retentive features and different sextants. X axis represents sextant and Y axis represents number of FPD. Association was determined using Chi Square test with p value = 0.02 (p value <0.05), and was found to be statistically significant. In sextant 1, 5, 6, proximal box was highly preferred. In sextant 2 and sextant 4, had no additional retentive features. In sextant 3, proximal box and no additional feature was preferred.