Evaluation of Clinical Marginal Adaptations of the Copings Fabricated in Cad Cam - Retrospective Study

Rithanya.P[1], Subhashree.R[2],

[1]Research Associate, Dental Research Cell, [2]Senior Lecturer, Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India.

Abstract

CAD CAM Technology is a computer aided design and manufacturing system for the production of crowns. A variety of metal and all ceramic materials is available for the crown fabrication. The accuracy and the fit of the prosthesis depends on the CAD CAM system and each component individually like the milling and the scanner units. The aim of the present study was to determine the marginal adaptations of copings fabricated with CAD CAM and to analyse which technique has been used commonly to check the marginal fit of the copings. The study was carried out on a hospital setting with ethical approval. The records of the patients were collected and Chi square test was done to evaluate the results. From the overall study, it was found that there were different methods for the evaluation of fit of the copings. Most of the FPD patients were in the age group of 26 to 40 years. Most common method for checking marginal fit adaptation was RVG/IOPA. (p value =0.37) which is not statistically significant, followed by the catching on probing and the fit checker.

Keywords: *Copings, CAD CAM, Marginal fit adaptations, IOPA/RVG, Fit checker, Catching on probing.*

Introduction

The demand for better esthetics by the patients has increased over the years [1]. The use of all ceramic has increased due to its esthetics, colour stability and biocompatibility, but it is not indicated for long span bridges until the introduction of Zirconia [2]. According to the Millennium research group, it has been estimated the use of all ceramic crowns by 2015 from 40% to almost 70% [3]. The weakest link in the FPD treatment is the tooth restorative marginal interface. The marginal fit is an important factor [4]. For the long term success of the prosthesis. Poor form may cause dissolution of cement, percolation of the fluid, further leading to secondary caries [5]. McLean has given a clinically acceptable, marginal fit to be within 120 micrometer [6]. Sailer et al.m in 2006 stated all ceramic restorations failed 10.9% to 21.7% cut to secondary caries [7].

The advent of CAD CAM systems using optical scanning and computerised processing produced excellent fit and adaptation. Systems milling partially sintered zirconia could produce marginal values of about 34 to 78 micrometers [8, 9].

Digitalisation in prosthodontics have paved the way for new generation ceramics with unprecedented strength and performance [10]. Different methods have been used to assess marginal and internal adaptations of indirect restorations. Clinically, marginal fit can be analysed using a probe, dental mirror and adequate illumination and magnification [11, 12]. Marginal fit can also be indirectly evaluated radiographically and through epoxy resin replicas by light and electron scanning microscopy [13]. It is also possible to cross section the prepared tooth or master due the restoration for direct [14].

Assessment of the space correspondent to the cement gap- a surrogate measure of the marginal and internal adaptation under a microscope [15]. A popular

Corresponding author:
Subhashree.R,
Senior Lecturer, Department of Prosthodontics,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences,
Saveetha University, 162, PH Road, Chennai 600077,
TamilNadu, India. Contact no: +91 9790741570
email id: subhashreer.sdc@saveetha.com

non destructive method used to assess the marginal and internal fit in viva and in vitro is the silicone replica technique. A light body PVS material is used to record the space between the preparation and the internal surface of the restoration [16]. Recently, micro computed tomography (micro CT) imaging has also been used as non destructive methods to evaluate the Archibald and internal adaptations of indirect restorations [17]. There is consensus on which is the best non destructive method in evaluating the marginal and the internal adaptations of indirect restorations [18, 19]. All the previous studies mentioned in the review have compared the silicone replica technique with the cross sectional technique. Based on Beer-Lambert law proportionally between a known thickness and the light transmitted through the material can be assumed [20, 21]. Therefore the objective of this study was to determine the most commonly used technique or the evaluation of marginal fit adaptation in copings fabricated in CAD CAM.

Materials and Methods

The present study is a retrospective study carried out in a hospital setting under a specific population predominantly South Indian population. It is a single centred study with a small sample size. It was carried out under Institutional Review board approval. In this study, data of the patients were collected by complete analysing of data of 86000 patients between June 2019 and March 2020. Data including patient name, age, gender, radiographic verification of the copings and the marginal fit adaptations were collected. And for further analysis the collected data was cross verified by another examiner. The collected data was tabulated using Excel Spreadsheets and the data was analysed using SPSS software version 19. The statistical test used in this study was Chi square test with p value<0.05 and confidence interval of 95%.

Results and Discussion

From the present study, it was found the different methods were used for the evaluation of marginal fit of the copings. Out of which the most common was the radiographic evaluation. (IOPA/RVG) (p value=0.37) which is statistically not significant. RVG/IOPA was the most commonly used technique which was followed by the fit checker used to analyse the marginal fit in the posterior region in most of the cases (Fig 1). This study analysed the commonly used method for the evaluation of marginal fit in copings fabricated in CAD CAM. According to the study, RVG/IOPA was the most commonly used method to evaluate the marginal fit. And the second common was the fit checker, mostly used in the posterior regions. The most common age groups of FPD patients were seen in the age groups of 26 to 40 years. Age group 18 to 25 years (20.3%) most commonly involved sextant 1, age group 25 to 40 years (52.8%) involved sextant. Age group 41 to 60 years (43.0%) mostly involved sextant 3 and the age group above 60 years(9.8%) involved sextant 4. In the correlation between the age groups involved, 26 to 40 years of age was the common age group with FPD patients. The use of IOPA/RVG was common in all the six sextant. Particularly in sextant 5 and sextant 2 (44%) and (39.2%) catching on probing was used to evaluate the marginal fit adaptation. In sextant 4 (26.6%) primarily the fit checker was used (p=0.037) statistically not significant. Comparing the gender in the present study, the males had a higher predilection of FPD when compared to the female population (Fig 2). In the correlation between the sextant involved and the types of coping evaluation: RVG/IOPA was commonly used in all the six sextants. Followed by the catch on probing technique and the fit checker.

Marginal and internal adaptations is one of the most important factors for the success and clinical longevity of the crowns. Marginal misfit may lead to hypersensitivity, secondary caries and periodontal problems. It may also result in thick cement film, exposing the luting material and promoting its dissolution over a period of time [22]. Poor internal adaptations can lead to lack of restoration retention and poor resistance form from the tooth restoration complex. According to previous studies, it was reported that microscopes can result in inaccurate measurement, projection errors and rounding of the margins [23]. The cross sectioning technique may result in distortion of the restoration during sectioning. The silicone replica technique is considered the reliable method to evaluate the marginal fit, on the other hand it may result in tearing of the silicone film, sectioning plane error. Veneers fabricated using leucite reinforced lithium disilicate exhibited the least marginal discrepancy followed by lithium disilicate ceramic [24]. The micro CT imaging technique allows a two or three dimensional assessment of the marginal fit adaptations

of the restorations, non destructively.

Marginal discrepancy severely affects the long term success of All ceramic complete veneer crowns. Masticatory forces cause fatigue to the dental luting agents. It was reported that there was an effect on the periodontium and the tooth most commonly in the lower sextants due to poor oral hygiene [25]. Beuer et al., suggested there was higher prevalence in the posterior teeth following extractions [26]. Nawafleh et al. According to the study concluded, 85.5% of caries and missing teeth were seen among the age groups between 20 to 34 years [27]. Seo et al, said that the prevalence of decay and missing teeth was about (94.3%) among the age groups 35 to 45 years [28]. The success of all ceramic crowns included factors namely, esthetic value, resistance to fracture and third being marginal fit [29]. RVG provided best results with superior image recording capabilities [30]. Fit checker brought about newer advancements in checking the marginal fit accuracy of the prosthetics [31]. Therefore, the marginal fit and internal adaptation of indirect restorations is critically important in restorative dentistry. The limitations of the present study was single centred and short study samples.

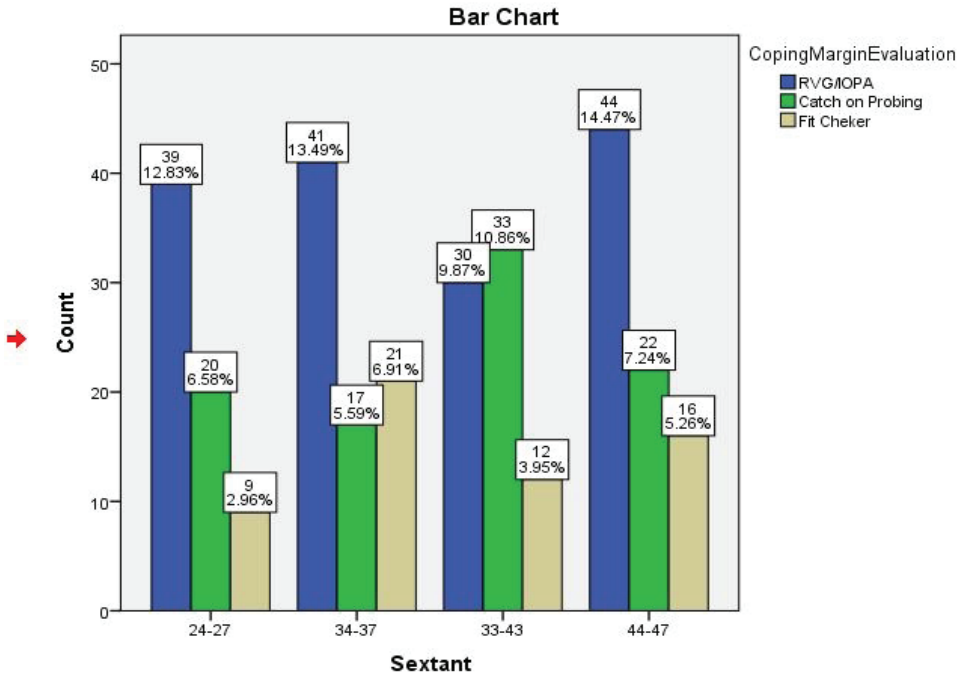

Figure 1: Bar chart depicting the association between the sextants involved and the methods of coping evaluation being used. The X-axis denotes the sextants and Y-axis denotes the percentage of the method of coping evaluations. Blue denotes RVG/IOPA, green denotes catching on probing and yellow denotes fit checker. IOPA/RVG is the most common method used for marginal evaluation of coping than catching on probing and the fit checker, however it is statistically not significant. Pearson's Chi square test value :13.390; df : 6; p value = 0.37 (> 0.05)

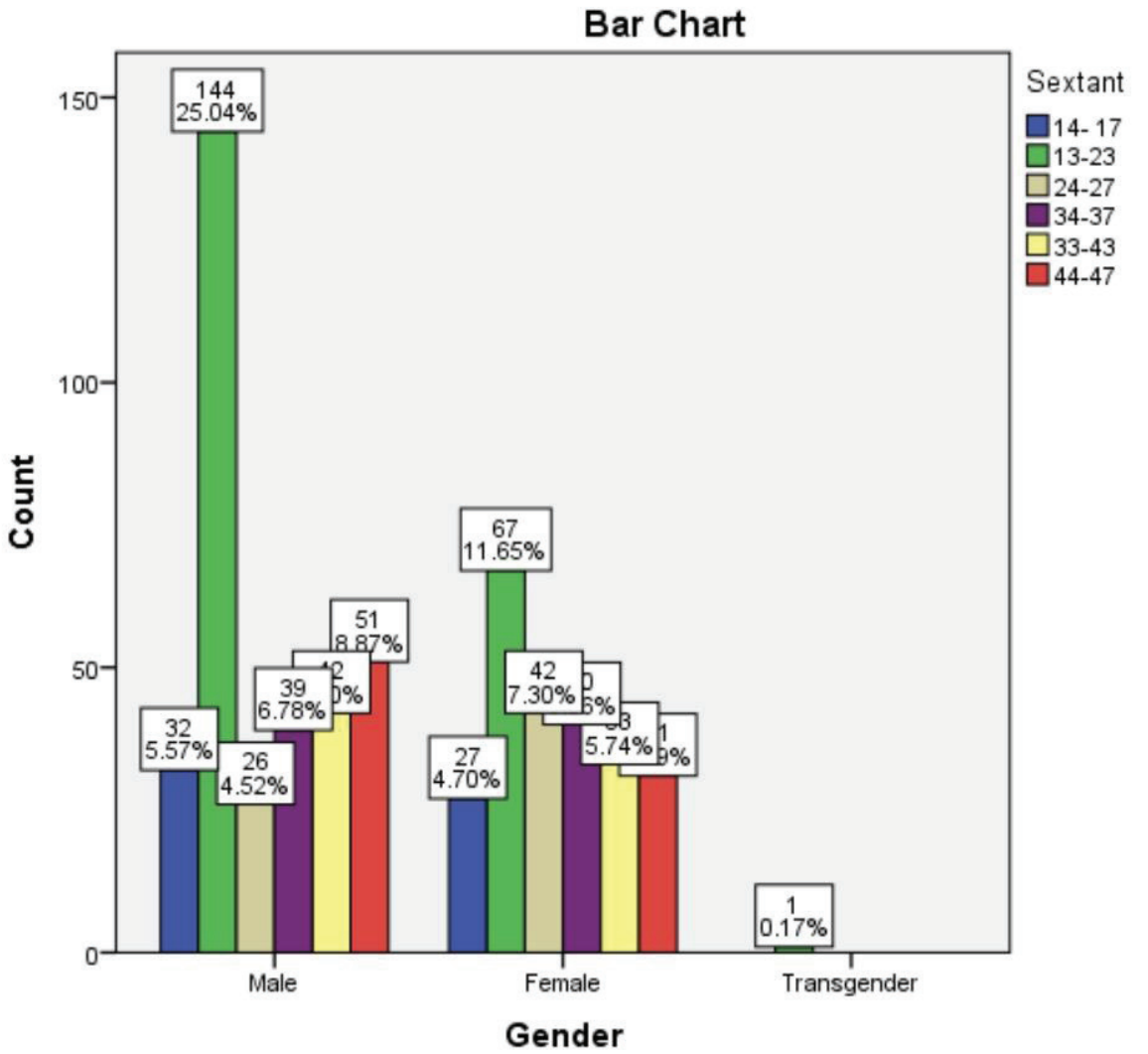

Figure 2: Bar chart depicting the association between the gender and number of FPD done in each sextant. X axis denotes the gender and Y axis denotes the number of FPD in each sextant. Blue denotes sextant 1, green denotes sextant 2, beige denotes sextant 3, purple denotes sextant 4, yellow denotes sextant 5 and red denotes sextant 6. Chi square test was done and the association was found to be significant. Pearsons's chi square value: 25.210 ; df : 10; p value : 0.005 (<0.05) hence statistically significant, proving that males have undergone more FPD treatment than females.

Conclusion

Radiograph has been the gold standard for many years for evaluation of fit of fixed dental prosthesis. According to the limitations of the study IOPA/RVG was found to be a commonly used method to evaluate the marginal fit of the crown fabricated in CAD CAM followed by catching on probing and the fit checker. Males have undergone FPD more than females mostly in the second sextant.

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References

1. Krishna J, Kumar V, Savadi R. Evolution of metal-free ceramics [Internet]. Vol. 9, The Journal of Indian Prosthodontic Society. 2009. p. 70. Available from: http://dx.doi.org/10.4103/0972-4052.55247
2. Contrepois M, Soenen A, Bartala M, Laviole O. Marginal adaptation of ceramic crowns: A systematic review [Internet]. Vol. 110, The Journal of Prosthetic Dentistry. 2013. p. 447–54. e10. Available from: http://dx.doi.org/10.1016/j.prosdent.2013.08.003
3. Haselton DR, Diaz-Arnold AM, Hillis SL. Clinical assessment of high-strength all-ceramic crowns. J Prosthet Dent. 2000 Apr;83(4):396–401.
4. Ganapathy DM, Kannan A, Venugopalan S. Effect of Coated Surfaces influencing Screw Loosening in Implants: A Systematic Review and Meta-analysis [Internet]. Vol. 8, World Journal of Dentistry. 2017. p. 496–502. Available from: http://dx.doi.org/10.5005/jp-journals-10015-1493
5. Sailer I, Fehér A, Filser F, Gauckler LJ, Lüthy H, Hämmerle CHF. Five-year clinical results of zirconia frameworks for posterior fixed partial dentures. Int J Prosthodont. 2007 Jul;20(4):383–8.
6. Gonzalo E, Suárez MJ, Serrano B, Lozano JFL. A comparison of the marginal vertical discrepancies of zirconium and metal ceramic posterior fixed dental prostheses before and after cementation [Internet]. Vol. 102, The Journal of Prosthetic Dentistry. 2009. p. 378–84. Available from: http://dx.doi.org/10.1016/s0022-3913(09)60198-0
7. Jacobs MS, Stewart Windeler A. An investigation of dental luting cement solubility as a function of the marginal gap [Internet]. Vol. 65, The Journal of Prosthetic Dentistry. 1991. p. 436–42. Available from: http://dx.doi.org/10.1016/0022-3913(91)90239-s
8. Schaefer O, Watts DC, Sigusch BW, Kuepper H, Guentsch A. Marginal and internal fit of pressed lithium disilicate partial crowns in vitro: A three-dimensional analysis of accuracy and reproducibility [Internet]. Vol. 28, Dental Materials. 2012. p. 320–6. Available from: http://dx.doi.org/10.1016/j.dental.2011.12.008
9. Ashok V, Suvitha S. Awareness of all ceramic restoration in rural populations [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1691. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00340.1
10. Ashok V, Nallaswamy D, Benazir Begum S, Nesappan T. Lip Bumper Prosthesis for an Acromegaly Patient: A Clinical Report. J Indian Prosthodont Soc. 2014 Dec;14(Suppl 1):279–82.
11. Basha FYS, Ganapathy D, Venugopalan S. Oral Hygiene Status among Pregnant Women [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 3099. Available from: http://dx.doi.org/10.5958/0974-360x.2018.00569.3
12. Venugopalan S, Ariga P, Aggarwal P, Viswanath A. Magnetically retained silicone facial prosthesis [Internet]. Vol. 17, Nigerian Journal of Clinical Practice. 2014. p. 260. Available from: http://dx.doi.org/10.4103/1119-3077.127575
13. Moörmann WH. The evolution of the CEREC system [Internet]. Vol. 137, The Journal of the American Dental Association. 2006. p. 7S – 13S. Available from: http://dx.doi.org/10.14219/jada.archive.2006.0398
14. 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 [Internet]. Vol. 9, World Journal of Dentistry. 2018. p. 68–75. Available from: http://dx.doi.org/10.5005/jp-journals-10015-1509
15. Psillakis JJ, McAlarney ME, Wright RF, Urquiola J, MacDonald DE. Effect of evaporation and mixing technique on die spacer thickness: a preliminary study. J Prosthet Dent. 2001 Jan;85(1):82–7.
16. Kannan A, Venugopalan S. A systematic review on the effect of use of impregnated retraction cords on gingiva [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 2121. Available from: http://dx.doi.org/10.5958/0974-360x.2018.00393.1
17. Selvan SR, Ganapathy D. Efficacy of fifth generation cephalosporins against methicillin-resistant Staphylococcus aureus-A review [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1815. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00369.3
18. Vijayalakshmi B, Ganapathy D. Medical management of cellulitis [Internet]. Vol. 9,

Research Journal of Pharmacy and Technology. 2016. p. 2067. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00422.4

19. Subasree S, Murthy Kumar K, Dhanraj. Effect of Aloe Vera in Oral Health-A Review [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 609. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00116.5
20. Jyothi S, Robin PK, Ganapathy D, Anandhi Selvaraj. Periodontal Health Status of Three Different Groups Wearing Temporary Partial Denture [Internet]. Vol. 10, Research Journal of Pharmacy and Technology. 2017. p. 4339. Available from: http://dx.doi.org/10.5958/0974-360x.2017.00795.8
21. Duraisamy R, Krishnan CS, Ramasubramanian H, Sampathkumar J, Mariappan S, Sivaprakasam AN. Compatibility of Non Original Abutments With Implants [Internet]. Vol. 28, Implant Dentistry. 2019. p. 289–95. Available from: http://dx.doi.org/10.1097/id.0000000000000885
22. 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 [Internet]. Vol. 9, Journal of Pharmacy And Bioallied Sciences. 2017. p. 154. Available from: http://dx.doi.org/10.4103/jpbs.jpbs_146_17
23. Ganapathy D, Sathyamoorthy A, Ranganathan H, Murthy Kumar K. Effect of Resin Bonded Luting Agents Influencing Marginal Discrepancy in All Ceramic Complete Veneer Crowns. J Clin Diagn Res. 2016 Dec;10(12):ZC67–70.
24. Jain A, Ranganathan H, Ganapathy D. Cervical and incisal marginal discrepancy in ceramic laminate veneering materials: A SEM analysis [Internet]. Vol. 8, Contemporary Clinical Dentistry. 2017. p. 272. Available from: http://dx.doi.org/10.4103/ccd.ccd_156_17
25. Hmaidouch R, Weigl P. Tooth wear against ceramic crowns in posterior region: a systematic literature review [Internet]. Vol. 5, International Journal of Oral Science. 2013. p. 183–90. Available from: http://dx.doi.org/10.1038/ijos.2013.73
26. Beuer F, Korczynski N, Rezac A, Naumann M, Gernet W, Sorensen JA. Marginal and internal fit of zirconia based fixed dental prostheses fabricated with different concepts. Clin Cosmet Investig Dent. 2010 Feb 25;2:5–11.
27. Nawafleh NA, Mack F, Evans J, Mackay J, Hatamleh MM. Accuracy and reliability of methods to measure marginal adaptation of crowns and FDPs: a literature review. J Prosthodont. 2013 Jul;22(5):419–28.
28. Seo D, Yi Y, Roh B. The effect of preparation designs on the marginal and internal gaps in Cerec3 partial ceramic crowns. J Dent. 2009 May;37(5):374–82.
29. Kohorst P, Junghanns J, Dittmer MP, Borchers L, Stiesch M. Different CAD/CAM-processing routes for zirconia restorations: influence on fitting accuracy. Clin Oral Investig. 2011 Aug;15(4):527–36.
30. Grenade C, Mainjot A, Vanheusden A. Fit of single tooth zirconia copings: comparison between various manufacturing processes [Internet]. Vol. 105, The Journal of Prosthetic Dentistry. 2011. p. 249–55. Available from: http://dx.doi.org/10.1016/s0022-3913(11)60040-1
31. Olivera AB, Saito T. The Effect of Die Spacer on Retention and Fitting of Complete Cast Crowns [Internet]. Vol. 15, Journal of Prosthodontics. 2006. p.243–9.Availablefrom: http://dx.doi.org/10.1111/j.1532-849x.2006.00113.x