VOLUME - 9, ISSUE - 7, JULY - 2020 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Prosthodontics

ASSESSMENT OF MARGINAL ADAPTATION OBTAINED BY USING TWO DIFFERENT COPING TECHNIQUES –AN INVITRO STUDY

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ABSTRACT

Background of the study: Marginal adaptation is essential for the extensive clinical achievement of single- or multiple-unit fixed-prosthesis. Micro leakages, accumulation of debris or plaque, secondary caries followed by restoration failure are the most common technical hitches associated with development of marginal gap between the tooth and the restorative material. **Aim and objectives:** The aim of this in-vitro study is to assess the marginal adaptation obtained by using two different coping techniques. **Materials and method:** A randomly selected phantom teeth of 46 (mandibular molar) and tooth preparations were made using medium-grit diamond burs followed by fine diamond burs to provide smooth finished margins.Wax pattern were made a group A without margin wax and with margin wax as group B Marginal gap discrepancies measurements were made along the coping margins of Group A- (n=10) and Group B-(n-10). under a stereomicroscope at original magnification (50x). Once calibrations were made, all the four measurements from each marginal aspect (buccal, lingual, mesial and distal aspects) in both groups were recorded. Chi square test, One-way ANOVA and Wilcoxon signed test were used to compare the mean values, standard deviation, F value, and P value of each test group. **Results:** One-way ANOVA Analysis showed significant statistical difference $p<0.05$ on comparing the lingual, mesial and distal aspects between the two groups. The results of the marginal gap measurements revealed statistically significant differences between the two groups ($p<0.05$) by Wilcoxon Signed Ranks Test. **Conclusion:** From the above results it was observed that group B showed lesser marginal gap discrepancies than group A. In addition to this result, marginal gaps values of both groups before and after cementation were within the clinically satisfactory or acceptable level.

KEYWORDS : Coping, Inlay-wax, Marginal Gap, Precision, Porcelain-Fuse to metal.

INTRODUCTION:

Metals, ceramics or combination of the both are the preferred choice of materials for crown and bridge in a multiple-unit fixed-prosthesis [1]. Full metals are least recommended nowadays owing to its inferior aesthetic property, similarly full ceramic were used merely for single tooth replacement or short span bridges owing to its tendency to wear easily on excessive force [2]. Metal ceramic restorations fabricated as porcelain fused-to-metal (PFM) copings are often preferred due to its compatible esthetics and fracture toughness with other materials.

Precision of the cast metal fit has always sustained as one of the crucial factors in determining success of the prosthesis or restoration. Accurate marginal adaptation is essential to achieve improved mechanical, biological and esthetic prospects of the restorations. Inaccurate marginal fit is responsible for retention of plaque; micro leakage and failure of luting cement [3]. Clinical factors like tooth preparation geometry, including finish line and degree of taper, impression materials, and luting cement [4] along with technical factors such as wax, die stone and casting investments, die spacer and the casting preparation methods highly influence the outcome of the restoration by directly affecting the marginal gap [5]. Based on literature review, ideal marginal gap of 25–40 m is often recommended. Marginal gaps as high as 120 m are considered clinically acceptable as demonstrated by Christensen [6], McLean and Von Fraunhoffer [7] and by Dedmon [8] through various observational studies.

Traditional casting technique by lost-wax casting method requires patterns for preparation. The technique for pattern fabrication is an important variable that can affect the marginal fit of cast restoration. Materials such as inlay casting wax, auto polymerizing resins and light cured resins were often used based on the requirements and desirability [9]. Adequate strength, rigidity, ease of manipulation and absence of residue on burnout was considered as an important advantage in the use of wax whereas auto polymerizing resins though offer strength, rigidity, and dimensional stability but immediate investment is not possible [10]. Schwartz et al in 1986 suggested over waxing the margins of wax pattern by 0.25mm to 0.5mm with soft red utility wax so that the margins could be refined on the die before seating on the tooth or by Removing wax from internal surface of wax pattern or by Internal relief of cast restoration by sandblasting, mechanical milling with burs with and without disclosing wax, acid etching electrochemical milling to evaluate and improve the marginal adaptations of the restorations [11]. The present in-vitro study was aimed to assess the marginal adaptation obtained by using two different coping techniques.

MATERIALS AND METHODS:

A randomly selected typodont teeth 46 were prepared to receive PFM crowns and stabilized by mounting typodont at their apex into the phantom head. All preparations were made using medium-grit diamond burs followed by fine diamond burs to provide smooth finished margins. The preparations followed conventional guidelines for PFM restorations leaving space for 0.5mm thickness of metal and 1mm thickness of porcelain. A two stage putty wash impression made and cast was poured using type IV dental stone. Ditching and die cutting done, die hardner and dir spacer applied . wax pattern fabricated using two different method group A of coping wax without marginal wax and group B with marginal wax were divided into two groups of 10 specimens each.

Distance from the external crown margin to the opposite preparation line or surface at the point in shortest perpendicular distance was taken as the marginal gap measurements were evaluated under a stereomicroscope at original magnification (50x). Marginal gap measurements were made along the coping margins fitted on master die (typho tooth)luted with fit-checker GC company manupulated accordingly to manufactures instruction and finger pressure is given until the material is set, excess is removed and examination done under sterio-microscope Group A- without margin wax , Group B- with margin wax.

Once calibrations were made, all of the four measurements

from each marginal aspect (buccal, lingual, mesial and distal aspects) in both groups were recorded.

STATISTICAL ANALYSIS:

The obtained data from the total marginal gap measurements were statistically analyzed (SPSS 26.0 for Windows, Chicago, IL, USA) by using Chi-square calculator for goodness of fit test and Wilcoxon Signed Ranks tests at 0.05 and 0.01 significance levels.

RESULTS:

The mean marginal gap measurements of both groups were evaluated on all the aspects. Group A shows mean marginal gap measurement with mean ± S.D of 142.7± 52.0 μm (buccal), 158.3± 53.3 m (lingual), 94.8 ± 45.9 μm (mesial) and 108.87 ± 47.3 μm (distal). Group B shows mean marginal gap measurements with mean ± S.D of 119.43 ± 26.7 μm, (buccal), 82.8 ± 19.4 m (lingual), 41.8 ± 26.5 μm (mesial) and 50.60 ± 19.4 μm (distal) respectively. Chi square test was used to compare the mean values, standard deviation, F value, and P value of each test group showed p-value of .0035. The result is significant at $p < 0.05$ (Table 1) (Graph 1).

Comparison of mean value of the marginal gap obtained for each aspect of both the groups was done to evaluate the significance among the aspects within the groups by using One-way ANOVA. Significant statistical difference $p<0.05$ was observed on comparing the lingual (Table 2), mesial (Table 3) and distal (Table 4) aspects between the two groups whereas no statistical significance was observed on the buccal aspect between the two groups.

The results of the marginal gap measurements for both the groups between the buccal, lingual, mesial and distal aspects by Wilcoxon Signed Ranks Test showed value of W= 75. The distribution is approximately normal. The value of z was found to be -4.5028. The p-value is < .00001 and revealed a statistically significant differences between the two groups under the study ($p<0.01$) (Table 5) (Graph 2)

DISCUSSION:

Failure of metal ceramic restorations has been observed frequently due to poor marginal fit. The preliminary fit is therefore, a disparagingly significant consideration in assessing their acceptability [12]. Although margin gaps can be measured under different conditions, the method of vertical marginal discrepancy defined by Holmes et al [13] was used in the present study where measurements between the castings and the tooth were made from points along the surface, at the margin, on the external surface of the casting.

In the present study lesser marginal gap in both the groups were obtained due to use of shoulder finish line preparation as recommended for metal-ceramic restorations. This is in accordance with the similar studies performed by Faucher and Nicholls [14] , Shillingburg et al [15] and Preston [16] on metal-ceramic restorations that revealed "shoulder" finish line preparation had less marginal distortion than the "chamfer" type and also that shoulder margin design performed better than the chamfer in traditional PFMs where as in contrast many studies showed finish line design had no impact on marginal adaptation.

Comlekoglu et al in 2009 observed Shoulder and mini-chamfer finish lines showed comparable marginal gap values and therefore both can be recommended in the clinical application of zirconia or all ceramic crowns. On the other hand, the results of this study were parallel with an earlier study in which heavy chamfer finish line exhibited more marginal opening than a 90° shoulder with a rounded axio-gingival line angle design for the preparation of metal-ceramic crowns owing to the rheological properties of framework material differ from these materials such as creep behavior and many other aspects [17].

In the present study it was observed group B showed greater significance than Group A method of coping. This is in accordance to the study by Shih et al in 2011 who examined the effect of four margin designs on marginal adaptation of Captek crowns and showed marginal discrepancies between crowns and matching dies at the coping stage has significant effect [18]. The present study results observed by shoulder finish line preparation were similarly to the above study indicating the decreasing trend of marginal gap from shoulder to shoulder with bevel.

Chandrasekar et al in 2012 conducted an in-vitro study to evaluate and compare the marginal adaptation of zirconium coping and nickel–chromium coping using the shoulder finish line design. The study showed a mean marginal gap of 129.98 and 2.57 m was recorded in Ni–Cr copings [19]. Similar mean marginal gap was also observed in the present study by both the groups with significantly higher mean value and S.D in group A than group B. it should be noted that the present study the testing is carried out on the metal die which does not represent the intra-oral condition in which teeth undergo cyclic loading at varying degrees and also subjected to chemical and thermal changes within the oral environment.

Huang et al in 2015 in his study observed the marginal fit of Selective laser melting technology of Co-Cr metal ceramic crowns was similar to that of the cast Au-Pt metal ceramic crowns and was better than that of the cast Co-Cr metal ceramic crown [20]. In the present study two different method of coping for Co-Cr metal ceramic crown showed significant difference from the 2 different coping cast metal ceramic crowns in lingual, mesial and distal fit but were less accurate in buccal fit. Similar to the above study Tooth type did not influence the marginal and internal fit of the metal ceramic crowns.

Study by Rai.R et al conducted a study to evaluate the marginal fit of metal ceramic crowns obtained by conventional inlay casting wax pattern using conventional impression with the metal ceramic crowns obtained by CAD/CAM technique using direct and indirect optical scanning. The study revealed Metal ceramic crowns obtained from direct optical scanning showed the least marginal and internal gap when compared to the castings obtained from inlay casting wax and indirect optical scanning [21]. In the present study coping without wax showed inferior results when compared to conventional inlay casting wax pattern method and similarly the marginal gap was comparatively lower in wax pattern method than the other method used in the study.

CONCLUSION:

Significant marginal gaps occurred with use of two different coping methods. In addition to this result, marginal gaps values of both groups before and after cementation were within the clinically acceptable level. This study result could prove beneficial for the dental practitioners to avoid "marginal gap" from the clinical perspective by adapting proper coping technique. Further laboratory experiments must be performed to test the change of marginal gap value after porcelain build up and the behavior of conventional and dual-cure resin cements under various loading conditions.

Acknowledgement: NIL
Conflict Of Interest: NONE DECLARED

ILLUSTRATIONS: TABLES AND GRAPHS:

Table 1: chi-square test showing the comparison of mean

values, standard deviation, F value, and P value of each test group.

RESULTS	BUCCAL	LINGUAL	MESIAL	DISTAL	MEAN
GROUP A	142.76 (165.02) [3.21]	158.39 (151.74) [0.26]	94.85 (85.35) [0.88]	108.87 (99.89) [0.66]	502.84
GROUP B	119.43 (95.98) [5.52]	82.88 (88.26) [0.44]	41.80 (49.65) [1.51]	50.60 (58.11) [1.13]	292.32
MEAN	261.19	240.17	135.65	158.47	795.16
The chi-square statistic is 13.6019. The p-value is .0035. The result is significant at p < .05.					

TABLE 2: One-way ANOVA analysis showing the mean value of the marginal gap measurements on the lingual aspect.

LINGUAL	A- LINGUAL	B- LINGUAL	N	
N	10	10	20	
∑X	1583.922	828.845	2412.767	28507.0638
Mean	158.3922	82.8845	120.638	1613.2289
∑X2	276529.1437	72088.2692	348617.4129	F = 17.67081
Std.Dev.	53.3836	19.4075	55.0336	
The f-ratio value is 17.67081. The p-value is .000534. The result is significant at p < .05.				

TABLE 3: One-way ANOVA analysis showing the mean value of the marginal gap measurements on the mesial aspect.

MESIAL	A- MESIAL	B- MESIAL	N	
N	10	10	20	
∑X	948.576	418.022	1366.598	14074.3773
Mean	94.8576	41.8022	68.33	1408.5075
∑X2	108977.8999	23829.1176	132807.0175	F = 9.99241
Std.Dev.	45.9447	26.5725	45.5536	
The f-ratio value is 9.99241. The p-value is .005405. The result is significant at p < .05.				

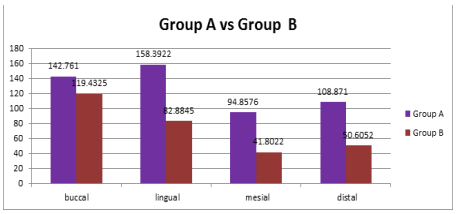
TABLE 4: One-way ANOVA analysis showing the mean value of the marginal gap measurements on the distal aspect.

DISTAL	A- DISTAL	B- DISTAL	N	
N	10	10	20	
∑X	1088.71	506.052	1594.762	16974.517
Mean	108.871	50.6052	79.738	1309.3291
∑X2	138684.6937	29021.0395	167705.7332	F = 12.96429
Std.Dev.	47.3236	19.4713	46.1932	
The f-ratio value is 12.96429. The p-value is .002044. The result is significant at p < .05.				

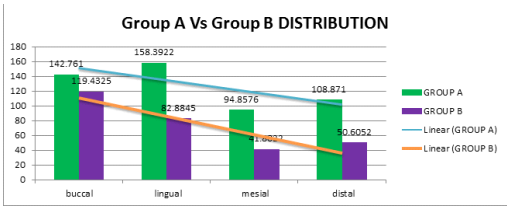
TABLE 5: Marginal gap measurements for both the groups between the buccal, lingual, mesial and distal aspects by Wilcoxon Signed Ranks Test

WILCOXON SIGNED-RANK TEST CALCULATOR	
W-value: 75	The value of W is 75. The distribution is approximately normal.
Mean Difference: 12.96	
Sum of pos. ranks: 745	Sum of neg. ranks: 75
Z-value: -4.5028	The value of z is-4.5028. The p-value is < .00001.
Mean (W): 410	Standard Deviation (W): 74.4
The result is significant at p < .05.	

GRAPH 1: graph showing the mean value of the marginal gap measurements on all the four aspect.



GRAPH 2: graph showing the mean value of the marginal gap measurements on all the four aspect with linear correlation distribution line.



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