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Effect of Preparation Design on Marginal Gap of Metal-Ceramic Restorations

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The aim of this study was to evaluate the influence of three marginal geometries on the fit of metal ceramic crown. An Ivorine central incisor tooth was prepared as master model to receive metal ceramic-crown with 1.2 mm width of three marginal designs: shoulder, shoulder bevel and deep chamfer finish lines on the facial surface continued with 0.7 mm chamfer on the palatal surface. After making totally 30 stone dies, wax patterns were prepared and casted. Each casting was kept on respective stone die and sectioned faciopalatally. All of the 60 sections were examined under light microscope. Mean marginal gap of shoulder-bevel was 6.85 μm (group 1), shoulder 8.65 μm (group 2) and chamfer 8.35 μm (group 3). There was significant difference between group one and two, also group one and three ($p<0.0001$). Based on present result it can be concluded that the shoulder-bevel finish line preparation had better fit than shoulder and chamfer preparations.

Key words: Finish line, marginal fit, internal gap, margin design, marginal geometry

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INTRODUCTION

The use of metal ceramic restoration has markedly grown as the result of technical improvements. The long-term clinical success of metal ceramic restoration depends on the marginal fit (Shillingburg *et al*., 1987; Hunter *et al*., 1990). There are many finish-line preparations but the shoulder, shoulder-bevel and deep chamfer are mostly used as finish lines for metal ceramic restoration (Belser *et al*., 1985; Rosenstiel *et al*., 2006). Up on casting, marginal gaps ranged from 40 to 61.5 μm. It has been suggested that a marginal gap of 120 μm is the maximum clinically acceptable gap size (Christensen, 1966; Mclean *et al*., 1971). Marginal integrity is an important element in evaluating the success of restoration. This has been shown to develop recurrent marginal carries and effect on the periodontal health (Mitchell *et al*., 2001; Suarez *et al*., 2003). Many studies have investigated marginal design and marginal discrepancy of metal ceramic restoration but they failed to clarify which one is the most desirable finish-line configuration in terms of marginal fit and neglected to assess the adaptation of casting prior to cementation. Also studies reporting the influence of finish-line deign on the fit of metal ceramic restoration have conflicting conclusions (Petteno *et al*., 2000; Shillingburg *et al*., 2003; Syu *et al*., 1993; Akbar *et al*., 2006; Kokubo *et al*., 2006). The aim of this study was to evaluate the marginal fit of metal ceramic restoration with three marginal designs.

MATERIALS AND METHODS

This is an experimental study performed in school of dentistry, Kerman, Iran 2005. An Ivorine maxillary central incisor was prepared as a master die to receive metal ceramic restoration using standard procedures with 1.2 mm 90° labial shoulder finish line lingual to contact point. The finish line was continued as a 0.7 mm chamfer on the palatal surface (Shillingburg *et al*., 1987, 1997).

After preparation of ivorine tooth ten impressions were taken using a medium viscosity addition silicone impression material. (Reprosil, Caulk Dentsply International York pa USA). The impressions were checked for accuracy under a stereo microscope with magnification of 10x(Deneric renfert hizingen West Germany).

Then the impressions were poured with die stone type (Silky Rock, whip mix USA) using the direction of manufacture. Following exactly similar procedure totally 10 stone dies were made. The wax patterns were made following the procedure explained by Russell (1972) to achieve wax pattern of same size, shape, location and angulations of the sprue with blue inlay wax (Caro Wax, Renfert, Germany) for each die. The margin of wax patterns was improved by remelting the entire marginal periphery on the stone die. Then wax patterns were invested with phosphate bonded investment (Castourit Super C Dent Arum Germany) in a separate ring to achieve a uniform thickness of investment around the pattern. The casting was performed with Ni-chromium alloy (Remanium C.S Dentaurum Germany).

The investment residue and oxide layer were removed by placing the casting in the hydro fluoric acid (48%) for 10 min to prevent marginal distortion. The castings were examined under stereo microscope to identify any defects. Each casting was kept on the respective stone die and was sealed at the proximal surface for embedding in the clear resin for sectioning. The samples were sectioned in the midline of the casting in the labiolingual direction and totally 20 sections got ready for measurement.

Measurements were made using Light microscope (Olympus PMG3). The sites were selected for measuring reference as A: Labial marginal site, 100 μm from reference point, which is cavosurface of margin and C: Lingual margin site 100 μm from reference point. Each site was measured three times and the mean was noted as gap for more accuracy of measurement. One Section from each group was used for photographing (Fig. 1). For shoulder-bevel preparation the shoulder finish line on the master die was converted to shoulder-bevel by using flame shape diamond point (Diatec Swiss). A 0.5 mm wide bevel was added to earlier shoulder at labial surface. This caused all the surfaces of master die remain intact except shoulder that was converted to shoulder-bevel. Then all steps which had been made for shoulder preparation were followed for shoulder-bevel to get 20 sections for measurement (Fig. 2). For deep chamfer preparation, the shoulder-bevel on the master die was changed to the chamfer and 20 sections were made for chamfer (Fig. 3). Totally 60 sections from the three groups were measured.

Statistical analysis: The data were statistically analyzed by one way analysis of variance and Tukey-test ($p<0.05$)

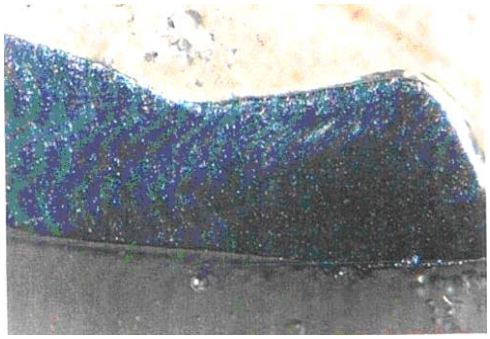

Fig. 1: Shoulder preparation

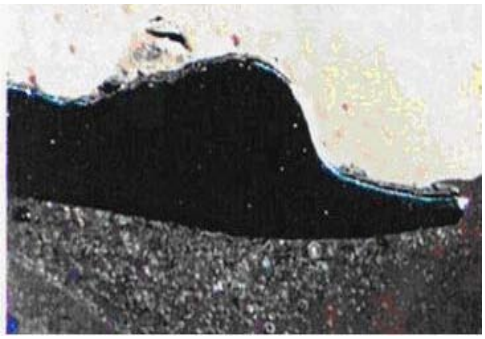

Fig. 2: Shoulder-bevel preparation

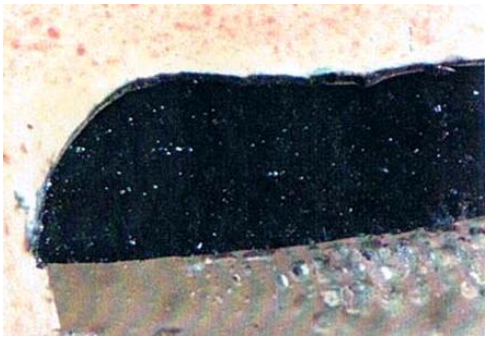

Fig. 3: Chamfer preparation

RESULTS AND DISCUSSION

In this study, totally 120 sites have been recorded in micron. The mean marginal opening in labial marginal site (A) for shoulder-bevel (group 1), shoulder (group 2) and chamfer (group 3) were 6.85, 8.65 and 8.35 μm, respectively. The mean marginal opening in lingual marginal site (C) were maximum in shoulder bevel (8.75 μm), minimum in chamfer (7.75 μm) and shoulder (8.4 μm) in between (Table 1). The effect of finishing geometry on marginal adaptation varied depending on the type of finish lines. Analysis of variance and t-test showed statistical significant difference between group 1 and 2 and also group 1 and 3 ($p<0.0001$) (Table 2).

The margin of metal ceramic restoration is referred as the most important but weak link in the clinical success of restoration. Various finish lines have been advocated for metal ceramic restoration but mostly shoulder, shoulder bevel and deep chamfer are used. The longevity of restoration depends on the marginal fit so obtaining least opening is the primary requisite of restoration (Shillingburg *et al*., 1987, 1997, 2003). As there is no single type of finish line that can be used with good effect in all conditions, so in this study, the most commonly used marginal designs were selected to evaluate fit of margin. As the anterior teeth preparation requires various facial finish lines and the restoration can be cemented by finger pressure, the central incisor was selected. To achieve a standard wax pattern of the same size, shape, location and angulations of sprue, a standard wax pattern technique described by Russell (1972) was used. All copings were fabricated by same dental technician and to increase accuracy of measurement, it was preformed by one person. The specimens were divided in three groups: shoulder-bevel (group 1), shoulder (group 2) and deep chamfer (group 3).

Table 1: Mean, standard deviation and confidence limit of marginal gap between stone die and metal coping

Site	Preparation design	Mean (μm)	SD	CL 95%
A	Shoulder-bevel	6.85	1.73	6.1-7.610
	Shoulder	8.65	1.35	8.06-9.24
	Chamfer	8.35	1.38	7.74-8.96
C	Shoulder-bevel	8.75	1.83	7.95-9.55
	Shoulder	7.75	1.35	7.36-8.14
	Chamfer	8.40	1.27	7.78-8.92

A: Labial marginal site 100 μm from reference point, C: Lingual margin site 100 μm from reference point

Table 2: Statistical results for marginal gap of stone die and metal coping between and within groups

Site	Source of variation	SS	df	MS	F-value	p-value
A	Between groups	111.600	2	55.800	24.910	0.000
	Within groups	127.680	57	2.240		
	Total	239.280	59	-	-	-
C	Between groups	0.506	2	0.253	0.129	>0.050
	Within groups	111.720	57	1.960		
	Total	112.226	59	-	-	-

A: Labial marginal site 100 μm from reference point, C: Lingual margin site 100 μm from reference point

Results showed that the mean marginal gap of site A was increased in shoulder-bevel (6.85), deep chamfer (8.35) and shoulder (8.65), respectively which was the same as studies of Rosner (1963), Panno *et al*. (1986) and Cho *et al*. (2004) and was different from the studies of Kokubo *et al*. (2006), Akbar *et al*. (2006) and Boeckler (2005). There was statistically significant difference between group 1 and 2 ($p<0.001$) and also between group 1 and 3 ($p<0.007$) but there was no significant difference between group 2 and 3 ($p<0.49$).

The maximum mean marginal gaps in site C was in shoulder-bevel (8.75) and minimum in shoulder (7.75) and chamfer in between (8.4).

There was no significant difference between groups in site C that was clinically confirmed by the study of Al-Wazzan and Al-Nazzaw (2007).

The shoulder-bevel had better fit that may be due to more acute angle of margin. The more open margin of shoulder is probably because of the axial wall of coping which comes in contact with axial wall of preparation before complete setting of restoration.

As cementation can affect marginal fit of restoration it is recommended to perform a study for evaluating the effect of cement on marginal discrepancy of various designs.

CONCLUSION

According to the results of this study as the shoulder bevel had better fit than shoulder and deep chamfer designs and also there was significant difference between shoulder bevel and shoulder, so it is recommended to use shoulder bevel finish line in the metal ceramic restoration.

REFERENCES

Akbar, J.H., C.S. Petrie, M.P. Walker, K. Williams and J.D. Eick, 2006. Marginal adaptation of cerec 3 CAD/CAM composite crowns using two different finish line preparation designs. J. Prosthet. Dent., 15: 155-163.

Al-Wazzan, K.A., A.A. Al-Nazzaw, 2007. Marginal and internal adaptation of commercially pure titanium and titanium-aluminum- vanadium alloy cast restorations. J. Contemp. Dent. Prac., 8: 19-26.

Belser, U.C., M.I. MacEntee, W.A. Richter, 1985. Fit of three porcelain-fused-to-metal marginal designs *in vitro*: A scanning electron microscope study. J. Prosthet. Dent., 53: 24-29.

Boeckler, A.F., A. Stadler and J.M. Setz, 2005. The significance of marginal gap and overextension measurement in the evaluation of the fit of complete crowns. J. Contemp. Dent. Pract., 6: 26-37.

Cho, L., J. Choi, Y.J. Yi and C.J. park, 2004. Effect of finish line variants on marginal accuracy and fracture strength of optimized polymer/fiber-reinforced composite crowns. J. Prosthet. Dent., 91: 554-560.

Christensen, G.J., 1966. Marginal fit of gold inlay castings. J. Prosthet. Dent., 16: 297-305.

Hunter, A.J. and A.R. Hunter, 1990. Gingival crown margin configurations.1. Terminology and widths. J. Prosthet. Dent., 64: 548-552.

Kokubo, Y., M. Tsumita, C. Ohkubo, P. Vult Von Steyren, T. Murata and S. Fukushima, 2006. Clinical marginal gap of porcelain fused to electro-formed gold coping crown. Eur. J. Prosthodont. Restor. Dent., 14: 85-89.

Mclean, J.W. and A.J. Von Fraunhofer, 1971. The estimation of cement film thickness by an *in vitro* technique. Br. Dent. J., 131: 107-111.

Mitchell, C.A., M.R. Pintado and W.H. Douglas, 2001. Nondestructive *in vitro* quantification of crown margins. J. Prosthet. Dent., 85: 575-584.

Panno, F.V., F. Vahidi, I. Gulker and K.M. Ghalili, 1986. Evaluation of the 45 degree labial bevel with a shoulder preparation. J. Prosthet. Dent., 56: 655-661.

Petteno, D., O. Schierano, F. Bassi, M.E. Bresciano and S. Carossa, 2000. Comparison of marginal fit of 3 different metal-ceramic systems: An *in vitro* study. Int. J. Prosthodont, 13: 405-408.

Rosenstiel, S.F., M.F. Land and J. Fujimoto, 2006. Contemporary Fixed Prosthodontics. 4th Edn., Mosby, Inc., St. Louis, pp: 209-258.

Rosner, D., 1963. Function, placement and reproduction of bevels for gold casting. J. Prosthet. Dent., 13: 1160-1166.

Russell, S.D., 1972. A simplified method for multiple wax pattern duplication. J. Prosthet. Dent., 27: 217-220.

Shillingburg, H.T., R. Jacobi and S.E. Brackett, 1987. Fundamentals of Tooth Preparation. 1st Edn., Quintessence Publishing Co., Chicago, pp: 9-52.

Shillingburg, H.T., S. Hobo and L.D. Whitsett, 1997. Fundamental of Fixed Prosthodontics. 3rd Edn., Quintessence Publishing Co., Chicago, pp: 119-139.

Shillingburg, H.T.Jr., S. Hobo and D.W. Fisher, 2003. Preparation design and margin distortion in porcelain-fused-to-metal restorations. J. Prosthet. Dent., 89: 527-532.

Suarez, M.J., D.E. Gonzalez, P. Villaumbrosia, G. Pradies and J.F. Lozano, 2003. Comparison of the marginal fit of porcera allceram crowns with tow finish lines. Int. J. Prosthet. Dent., 16: 229-232.

Syu, J.Z., G. Byrne, L.W. Laub and M.F. Land, 1993. Influence of finish-line geometry on the fit of crowns. Int. J. Prosthet. Dent., 6: 25-30.