Marginal fit of shoulder and chamfer finish line of metal crown

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Abstract:

Background: *Marginal fit is very important for the longevity of restoration .The junction between the cemented restoration and the tooth is always a potential site for recurrent caries, gingivitis and periodontitis and ultimately failure of crown as well as teeth.*

Hypothesis: *Shoulder finish line for anterior teeth and chamfer for posterior teeth are equally effective.*

Objectives: *To evaluate the marginal gap of metal crown at two locations (facial/buccal and palatal/lingual) around the margin.*

Methods: *Thirty extracted human teeth were prepared with shoulder margin (group-A) and another thirty teeth were prepared with chamfer (group-B) as methodically. Metal crown was fabricated by lost wax technique of casting procedure. All of the crowns (both group-A and group-B) were cemented by glass inomer luting cement as their respected teeth. Each crown was sectioned in faciolingual direction at the midpoint of each surface by slow speed isomet saw. The sectioned crowns were examined under scanning electron microscope for measurement of marginal gap. Data were collected on the basis of marginal gap of each crown was compared. Collected data were processed and analyzed using SPSS (Statistical Package for Social Service) version 12.*

Results: *The mean differences of marginal gap at facial/buccal and palatal/lingual midpoint were statistically significant between two groups.*

Conclusion: *Shoulder finish line for anterior teeth had better marginal fit than chamfer finish line for posterior teeth.*

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Introduction:

The portion of tooth which is covered by enamel is known as crown. There are three types of crown: anatomic crown, clinical crown, artificial crown. Portion of natural tooth that extends from its cementoenamel junction to the occlusal surface or incisal edge is called anatomic crown. The portion of natural tooth that extends from the bottom of the sulcus to the occlusal surface or incisal edge is called clinical crown. The entire part of natural teeth that restores anatomy, function and esthetics, usually metal, porcelain, synthetic resin or combination is called artificial crown.

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Marginal accuracy is considered a crucial factor in the success and longevity of a cast restoration. Ideally, cemented cast restoration margin should precisely meet the finish line of the prepared teeth with non detectable junctions. Practically clinical perfection is difficult to achieve and difficult to verify[1]. A cast crown is considered satisfactory when is presents suitable anatomical form, correct polishing and adequate marginal adaption[2]. Successes depend on the marginal adaption of the casting, the surface of the margins and the luting cement used.

The accuracy of the casting will be determined by the preciseness of the previous construction procedure such as the impression, the construction of the gypsum die, the waxing technique, the investment technique and the casting procedure[3].

The objective of luting cement is to fix the casting to the preparation and to seal the gap between the crown and preparation. One of the greatest shortcomings of dental luting cements is high solubility rate and their permeability. The excellence of the finish line depends on the accurate finish of the preparation[3].

The presently used preparation margins are shoulder, chamfer, shoulder bevel, knife edge, slope shoulder etc.

The requirements of preparation are minimum width of 0.5 mm for prepared margins, bevel angulations between 30 degrees and 45 degrees for optimum margin closure, smooth surface on prepared margins, preparation without overextension or unsupported enamel and easy to identification in the impression or on the die.

Smooth prepared margins can be identified easily on the die. Rough prepared margins may cause incomplete fit of cement, decreasing cement solubility. After crown cementation, the cavosurface angle of the margin may not be covered by cement. The margin must be as smooth as possible to reduce accumulation, vitro studies can help to estimate the marginal adaption of different type of margin [1].

An in vitro study with a stainless-steel device show minimal marginal opening averaged 114 and 93 um acceptable by a group of prosthodontists[4].

Marginal fit is very important because the junction between the cemented restoration and the tooth is always a potential site for recurrent caries due to the dissolution of luting agent and the inherent roughness. If the adaption of restoration of teeth is more accurate, lesser the chance of recurrent caries or periodontal disease, ultimately the longevity of the restoration is increased[5]. Special measurements of these gaps can be compared to the theoretical zero. Minimal dimension for the gaps were not determined clinically; consequently there are no existing standard for measures these gaps[5].

The study evaluate the marginal fit of shoulder finish line for anterior teeth and chamfer for posterior teeth. In this study human teeth were selected because human teeth are usually restored by easily available metal alloy or composite resin. The properties of most artificial substitutes are not often as those of human teeth[5]. Nikel-chromium-Beryllium (NiCrBe) alloy were used because of its biocompatibility, high mechanical strength , less clinical inconvenience ,satisfactory resistance to corrosion, make these alloy more appropriate structural materials than other alloys.

Materials & methods:

This observational in vitro study was carried out in the Department of Prosthodontics, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Department of Materials & Metallurgical Engineering, Bangladesh University of Engineering & Technology (BUET), Dhaka.

Freshly extracted human anterior and posterior teeth were divided into 2 groups each containing 30 teeth. In Group A: This group consisted of maxillary anterior teeth with shoulder margin. In Group B: This group consisted of maxillary posterior teeth with chamfer margin .well formed healthy and freshly extracted human maxillary teeth are selected for the study.

Research instruments and materials:

Scanning Electron Microscospe

Slow speed isomet saw

Alginate

Dental stone

Glass inomer cement

NiCrBe Alloy

Clinical procedure:

The teeth selected were immersed in 1% solution in a screw capped glass vial for two days to remove any organic debris from the root surface as well as for preservation.

All teeth were carefully cleaned to eliminate tartar, calculus, stain and remained tissue with the help of ultrasound scaler. Then the specimens were again immersed in 1% sodium hypochlorite for 24 hours. After 24 hours, the cleaned teeth were stored in normal saline prior to tooth preparation for the study.

Tooth preparation was carried out methodically. Then all teeth were immersed in normal saline.

Tooth Preparation:

The reduction of teeth were done by following biologic & mechanical consideration. Enamel was reduced from all surfaces of teeth for metal crown.

Facial reduction:

Depth orientation grooves were placed on the labial and incisal surface with the flat end tapered diamond. The grooves were 1.2 mm deep on the labial surface and 2 mm deep in the incisal edge. The labial grooves were cut with the diamond held parallel to the gingival one third of the labial surface. A second set of two grooves was made parallel to the incisal two third of the uncut labial surface. The labial surface of all metal preparation is done in two planes to achieved adequate clearances for good esthetics without encroaching the pulp.

The gingival portion of labial surface is reduced 1.2 mm depth by the flat end tapered diamond bur .This reduction extend around the labiproximal line angles and fade out on the lingual aspect of the proximal surface .The end of the flat end tapered diamond bur will form the shoulder finish line while the axial reduction is done with the side of the diamond .The shoulder margin were minimum of 1.0 mm wide.

Incisal reduction:
The reduction of incisal edge /occlusal surface was done about 2 mm for adequate metal thickness.

Lingual reduction:
Lingual reduction was done carefully with the small wheel diamond. Because over reduction of the junction between the cingulam and the lingual wall was necessary for the retention of the crown.

Proximal Reduction:
Using the round end diamond , proximal reduction was done.

Finish line preparation:
For anterior teeth,1 mm shoulder margin were done by flat end tapered diamond and for posterior teeth ,chamfer margin were done by torpedo diamond.

Finishing line preparation:
All axial wall were smooth, all sharp angles were rounded line. Care was taken not to create undercut in the axial walls where they join the finish line.

Laboratory Procedure:
Impression of the prepared teeth were taken by irreversible hydrocolloid impression material alginate (lygin, dentamerica, USA) by using stock tray. Working cast and dies were fabricated with the stone. Preparation of dies & metal crowns were made by lost wax technique.

Then all metal crowns were cemented onto their respected teeth by glass inomer luting cement. Then each crown was sectioned with a diamond wafering saw in faciolingual direction at the midpoint of each tooth. Every specimen was examined under a scanning Electron microscope for measurement of marginal gap. Measurement of marginal gap were determined at the facial/buccal and palatal midpoint of each crown. Available data were analyzed statistically. Chi square test and student's t test were performed to detect statistical significance of the study.

P value < 0.05 was accepted as significant.

Results:
Frequency of marginal gap at facial/buccal midpoint in both groups (n=60)

The highest frequency of marginal gap at <50 μm was in group A and at >100 was in group B. At <50 μm the frequency of marginal gap was higher in group A than that of group B & it was statistically significant ($p< 0.01$). At 50-100 μm the frequency of marginal gap was higher in group B than that of group A & it was statistically non significant. At >100 the frequency of marginal gap was higher in group B than that of group A & it was statistically significant ($p< 0.01$).

Table-I

Facial/buccal mid point (μm)	Group A n=30		Group B n=30		P value
	N	%	n	%	
<50	24	80.0	0	0.0	0.001^{**}
50-100	3	10.0	10	33.0	0.060^{ns}
>100	3	10.0	20	66.7	0.001^{**}

Group A= shoulder margin, Group B = chamfer margin,** =p< 0.01, ns = non significant, N = Total number of subjects

Frequency of marginal gap at palatal midpoint in both groups (n=60)

The highest frequency of marginal gap at50-100 μm was in group A and at >100 was in group B. At <50 μm the frequency of marginal gap was higher in group A than that of group B & it was statistically significant ($p< 0.01$). At 50-100 μm the frequency of marginal gap was higher in group A than that of group B & it was statistically non significant. At >100 the frequency of marginal gap was higher in group B than that of group A & it was statistically significant ($p< 0.01$).

Table II

Palatal mid point(μm)	Group A n=30		Group B n=30		P value
	N	%	n	%	
<50	6	20.0	0	0.0	0.011^{*}
50-100	18	60.0	12	40.0	0.121^{ns}
>100	6	20.0	18	60.0	0.003^{**}

Group A= shoulder margin, Group B = chamfer margin ,* =p< 0.05 ,** =p<0.01,ns = non significant, N= Total number of subjects

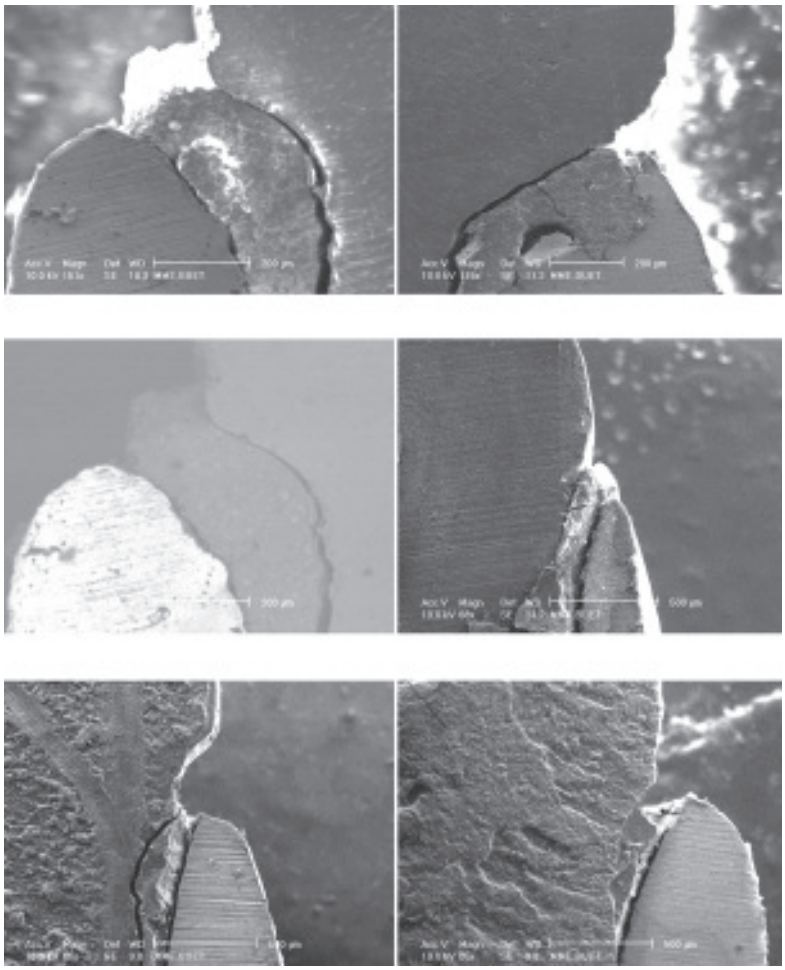
Mean ± SD of marginal gap at two location of both groups (n=60)

In group A , the mean ±SD of marginal gap was 50.1±26.1 μm at facial/buccal midpoint and 80.7±30.4μm in palatal midpoint. In group B , the mean±SD of marginal gap was 115.5±21.4μm at facial/buccal midpoint and 151.3±52.2μm in palatal midpoint . In group A mean marginal gap was higher at palatal mid point than that of facilal/buccal midpoint and it was statistically highly significant. In group B mean marginal gap was higher in palatal midpoint than that of facial/buccal midpoint and it was statistically highly significant.

Table-III

	Facial/buccal midpoint (µm)Mean±SD	Palatal midpoint (µm)Mean±SD	P value
GroupA	51.8±26.1	80.7±30.4	0.001**
Group B	115.5±21.4	151.3±52.2	0.007**

Data were analyzed using unpaired students "t" test,Group A= shoulder margin ,Group B = chamfer margin ,** =p<0.01, ns = non significant, N = Total number of subjects



Discussion:

This In vitro study was conducted to evaluate the marginal fit of shoulder margin and chamfer margin for metal crown. Marginal continuity and marginal gaps were observed among the all crowns of this study. The distribution of marginal gap measured and compared at facial/buccal midpoint in both groups. In group A,<50 µm marginal gap were found in 80% of crowns, 50-100 µm and also > 100 µm marginal gap were found in 10% of crowns. In group B, 50-100 µm marginal gap were found in 33% of crowns, > 100 µm marginal gap were found in 66.7% of crowns, but there were no crown which had <50 µm of marginal gap.The distribution of marginal gap measured and compared at palatal midpoint in both groups. In group A, <50 µm marginal gap were found in 20% of crowns, 50-100 µm were found in 60% of crowns and > 100 µm marginal gap were found in 20% of crowns. In group B >100 µm marginal gap were found in 60% of crowns, 50-100 µm marginal gap were found in 40% of crowns but there were no crown which had <50 µm of marginal gap. In shoulder finish line for anterior teeth, mean marginal gap was higher in palatal midpoint than that of facial/buccal midpoint and in chamfer finish line for posterior teeth, mean marginal gap was higher in palatal than that of facial /buccal midpoint. Holmes[6]

states that marginal fit of crown at four locations that is facial, palatal, mesial, distal by using castable ceramic crown and gold crown. They found higher value at facial and palatal midpoint. They also found better marginal fit in ceramic crown than that of gold crown. The present study made similar observation though the material used in this study was nickel chromium berkelium alloy[6]. Blackman[7] states that marginal fit of mental crown which is made of pure titanium. They measured 0.050 mean marginal gap. The present study made similar observation though in this study steel dies, zinc phosphate cement is used and 45 degree facial and 90 degree palatal margin were made by indirect technique[7]. Petteno[8] states that marginal fit of crown by using three different metal ceramic systems that were composite alloy, electroforming and high noble alloy[8]. The present study made dissimilar observation because the material used in this study was different. Rosentritt[5] states that marginal adaptation of crowns which was made ceramic and fixed on natural and artificial teeth. They found better adaptation of natural teeth than artificial teeth[5]. The present study made similar observation because natural teeth were used in this study. Wazzan[1] states that the marginal and internal fit of crown which was made by commercially pure titanium (CPTi) and titanium-aluminium-vanadium (Ti-6Al-4V) alloy cast restorations[1]. The present study made similar observation through the material used in this study which was nickel chromium beryllium (Ni-Cr-Be) alloy[1]. Petro[2] states that marginal and internal discrepancy of complete cast crown by using different casting method[2].

In various studies marginal fit measured and reported in varieties of way, different margin, impression materials, dental stone, investment materials, casting procedure, luting agent, alloy were chosen. In this study alginate, type IV dental stone, conventional casting technique and NiCrBe alloy was selected because these were randomly used in Bangladesh. Every step should be done with great care and perfectly to avoid gaps or discontinuity as well as misfit[7].

Conclusion:

Under the completion of the study, Shoulder finish line of anterior teeth and chamfer finish line of posterior teeth of metal crown were successfully adapted. Marginal gap of shoulder finish line anterior teeth and marginal gap of chamfer finish line of posterior teeth were within the acceptable limit. Marginal fit of shoulder finish line anterior teeth was better than chamfer finish line of posterior teeth of metal crown.

Referrence:

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