Original Article

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EVALUATION OF MARGINAL FIT OF METAL CERAMIC AND METAL FREE CERAMIC CROWNS: AN IN VITRO STUDY

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ABSTRACT:

An esthetically pleasing appearance of teeth is the best asset for a good smile.Ceramic restorations because of their natural translucency and tooth like color provide excellent esthetics and are virtually indistinguishable from the adjacent natural dentition.The absence of metal layer in all ceramic restorations helps in transmission of light through the full depth of the restoration there by enhancing the translucency creating a life like appearance.Depending upon the clinical demand,both all ceramic and porcelain fused to metal can be used for full veneer crowns.This study is performed to analyze the marginal fit of heat pressed all ceramic crowns and metal ceramic crowns.

Keywords: Satisfaction; Orthodontic treatment; Motivation; Survey

INTRODUCTION:

Full veneer ceramic crowns are very successful in covering the entire tooth they can totally mask the previous condition to create a new appearance. Dr. Charles Land[1] introduced one of the earliest forms of ceramic crowns in 1903.Then the first metal-ceramic crown was described by Brecker [1] in 1956.Since then various types of metal-ceramic restorations have been developed with advancements being made in both the type of the metal and the porcelain for an effective metal ceramic bond.

The porcelain fused metal restorations have a long proven record of success but the esthetic limitations like lack of metal translucency ,exposure of metal collar in the anterior region,paved way for all ceramic metal free restorations.Mclean and Hughes [2] in 1965 introduced the first all ceramic porcelain jacket crowns made of high strength alumina core.

Heat pressed ceramics were introduced by Ivoclar in the 1990s [2].Here ceramic substructure(ceramic core) is made by pressing the ceramic ingots into a refractory mold made by the lost wax technique.Mclean and Von Fraunhofer [3] after examining more than 1000 crowns clinically over a period of 5 years showed that the clinically acceptable crown marginal discrepancies could range up to 120μm after cementation.

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Earlier studies have reported the marginal fit of all ceramic crowns to be inferior to that of the traditional metal ceramic crowns.But of late,the heat pressed ceramic restorations provide a better marginal fit because of the leucite reinforcement in them which imparts more strength to the core ceramic.

This study is performed to analyze the marginal fit of the metal copings made by induction casting with that of the ceramic copings made by heat pressing and also assess the marginal fit occurred after porcelain application in both the groups.

MATERIAL AND METHODS:

This in vitro study was performed to evaluate the accurate marginal fit of the metal ceramic and pressed ceramic jacket crowns over the prepared tooth.This study also involved to evaluate the distortion of metal and ceramic copings due to repeated heating during the processing procedure.

A typhodont maxillary right central incisor was prepared for a jacket crown. Labial and axial reduction of 1.5 mm was made along with a 2 mm incisal reduction and an uniform shoulder of 1.5mm. The height of the preparation was 7mm with the convergence angle of 6°. 20 Impression of the prepared tooth were made in light body impression material, cast made with die stone.

The 20 stone dies were then divided into 2 groups as group I and group II. Group I is for the fabrication of metal ceramic crowns. Group I is again of subgroup IA of metal coping before veneering of porcelain and Sub group IB metal crown after veneering of porcelain.Group –II is again of subgroup II-A Heat pressed all ceramic coping before porcelain veneering and sub-group-II-B heat pressed all ceramic crowns after porcelain veneering.

The materials used are diestone, bellavest, addition silicone , inlay wax, ceramic ingots, and ceramic veneering. Equipment used are casting machine, ceramic furnace, vaccum mixer and sectioning machine.

FABRICATION OF METAL COPING:

EQUIPMENTS USED IN THE STUDY

MULTIMAT 2 TOUCH &PRESS FURNACE

VACCUM MIXER

In this following procedure adopted, as application of die spacer by 3 layer of paint on the die of 33-40µm was applied 1mm short of the margins. Preparation of wax pattern of uniform thickness of 0.5mm. The dimensions were confirmed

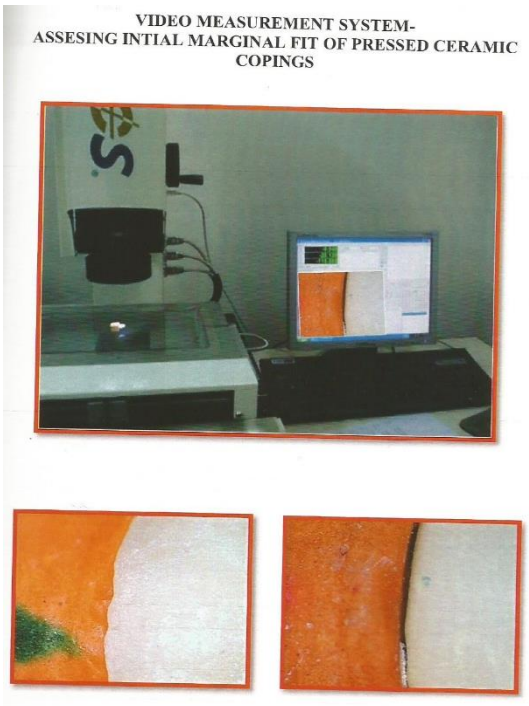
by measuring at multiple points with a wax thickness caliper[4,5].Investing and burnout and casting was done.

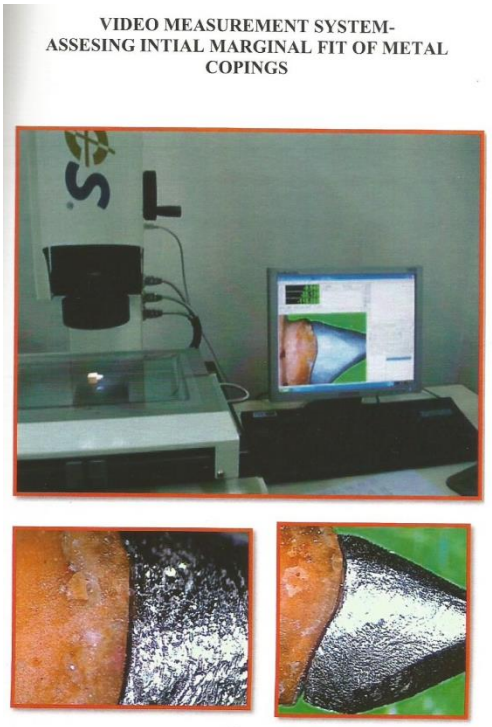
FABRICATION OF PRESSABLE CERAMIC COPINGS:

In this die spacer applied and thickness of 30-40 µm. Wax pattern of .7mm thickness and investing and burnout done as the routine procedure. And the pellet of pressable ceramic is placed in the mould, Multimat touch and press is used.

MEASUREMENT OF INITIAL MARGINAL FIT OF THE COPINGS:

Marginal fit was measured using the video measuring system. The measurement were made at the following 6 points around the circumference of the crowns. 1 point- mid facially, 1 point- mid palatally, 2-points on the mesial side, 2 points on the distal side. The mean of all the 6 values measured is the initial marginal fit of the coping. The measurement sites were marked for reproducible identification by scoring the die with sharp blade.





Porcelain build up on the metal coping by layering is done by the layering technique after degassing the opaque porcelain, boy porcelain and finally glazing at the particular temperature by as per the manufacture instruction .

SECTIONING OF THE FINAL SAMPLES:

The crowns were cemented to the dies with Zn PO_4 cement using finger pressure. The samples were then sectioned faciolingually and mesiodistally using diamond sectioning saw, following the guide marks on the dies. There are 2 interfaces for each point if sectioning so measurement can be made at 8 points around the crown. Mean vertical and horizontal marginal discrepancies were calculated from the values obtained.

RESULT:

The test samples were divided into 2 major groups based on the types of the copings used for the jacket crowns.

Group-I metal coping- for metal ceramic crowns

Group-II heat pressed ceramic coping-for all ceramic crowns.

The sub groups IA- metal coping before veneering of porcelain Sub group IIA ceramic coping before veneering of porcelain.

Marginal fit of these copings were verified by measuring 6 points as discussed before. The mean all the 6 points was taken as the initial reading of marginal fit before veneering of porcelain. The completed crowns were cemented. The final samples were considered as subgroup I-B and Sub group II-B. The marginal fit of the samples were assessed by the cross sectional method. The mean and standard deviations were calculated and the results analyzed by variance test and ANOVA among the groups and also within the groups.

Table: 1

Metal Coping before veneering (subgroup IA)	Pressed ceramic coping before veneering (subgroup II A)	P-value
MEAN±S.D	MEAN±S.D	0.00001***
51.34±3.46	45.65±4.27	0.00001***

***denotes significant at 1% level

Table: 2

Metal Coping before veneering (subgroup IA)	Metal ceramic coping after veneering (subgroup IB)	P-value
MEAN±S.D	MEAN±S.D	0.00003***
51.34±3.46	79.15±3.07	0.00003***

***denotes significant at 1% level

Table: 3

Pressed Ceramic Coping before veneering (subgroup IIA)	Pressed ceramic coping before veneering (subgroup IIB)	P-value
MEAN±S.D	MEAN±S.D	0.00001***
45.65±4.27	67.97±3.34	0.00001***

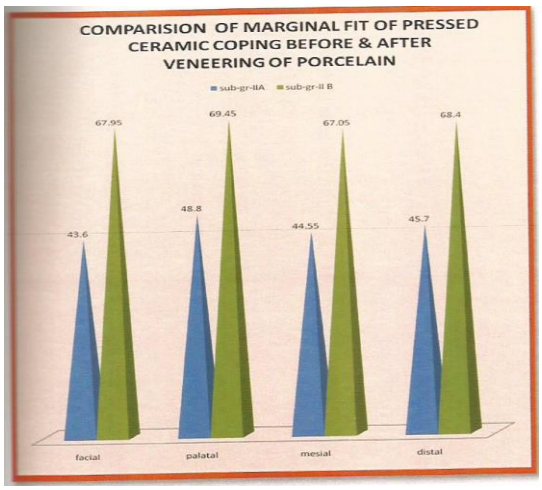
***denotes significant at 1% level

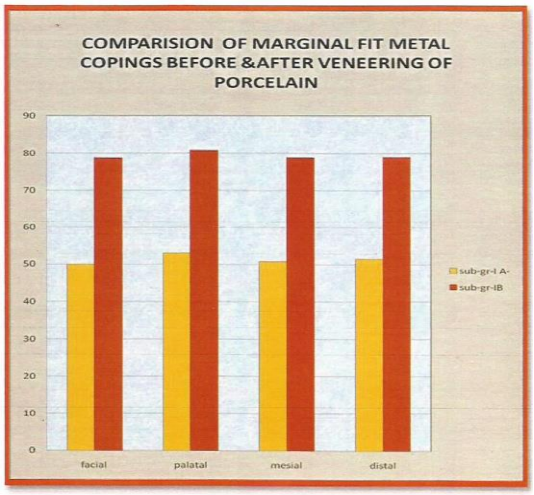
Interpretation of results:

Table 1: It can be observed that the samples in the sub group IIA have a lesser values of the marginal fit(45.6μm) than the samples in sub group IA (51.2 μm). The significant value at 1% level. This shows the pressed copings had a better marginal fit than metal copings.

Table 2: The sub group IB (79.32 μm) have marginal fit higher than that of the samples in sub group IA (51.2μm).The difference significant by 1% level. This shows an increase in the marginal opening of the metal ceramic coping after veneering with porcelain.

Table 3: The samples in the subgroup IIB have higher values of marginal fit (68.21μm) than that of the samples in subgroup IIA (45.6 μm). The difference is significant by 1% level. This indicates there was an increase in the marginal opening of the pressed ceramic copings after veneering of porcelain.But the amount of distortion was less than that observed for the metal copings.





DISCUSSION:

The heat pressed ceramic contains Leucite-reinforced feldspathic porcelains strengthened by incorporating leucite $K_2OAL_2O_34SiO_2$ crystals approximately 45 vol percent in glass matrix[2]. In this study analysis the marginal fit of porcelain jacket crowns with metal ceramic crowns and pressable ceramics. SiegbertWitkowski et al 2006 used stone dies duplicates of a human maxillary central incisor prepared for a metal ceramic crown in his study on a marginal fit of titanium copings.

All metal copings in this study were in a uniform thickness .05 mm. In this study nickel chromium alloys to make metal copings in a uniform thickness of 0.5-1mm thickness. All copings were seated on their respective dies and the initial marginal fit was verified by using the video measuring system at a magnification of 100x. The final marginal fit of the samples after veneering with porcelain was analyzed by the cross sectional method.

Homes et al in 1989 established measurements of both internal fit and marginal fit and concluded that the best method was to determine the absolute marginal discrepancy by measuring the distance from the margin of the casting to the cavo surface of the tooth preparation. From the result of this study it may concluded that both the groups of crowns had marginal fit within clinically acceptable levels. But the pressed ceramic crowns had b the better marginal fit than the metal ceramic crowns. The marginal fit of the copings were not measured after each firing cycle. So it is difficult to assess the amount of distortion during firing.[4-6]

CONCLUSION:

This in vitro study was performed to evaluate the accurate marginal fit of the metal ceramic and pressed ceramic jacket crown over the prepared tooth and also to analyze the distortion of the metal and ceramic copings due to repeated firing during the processing procedure. The marginal fit of the samples were measured before and after veneering the porcelain. The results obtained were statistically analyzed.

Within the limitations of the present study and from the results obtained the following conclusions were drawn. The pressed ceramic copings have better initial marginal fit than that the metal copings. Both metal copings and pressed ceramic copings show a decrease marginal fit after veneering of veneering porcelain. But the amount distortion in the pressed ceramic copings is less than that observed in the metal copings.The pressed ceramic crowns have a better adaptation than the metal ceramic crowns even after exposure to multiple high temperature firing cycles.

The results of the study show that the pressed ceramic jacket crowns can be reliably used as an alternative to the traditional metal ceramic crowns because of their better marginal fit and superior esthetic value.

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