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RESEARCH ARTICLE

EFFECT OF THE FINISH LINE DESIGN UPON THE MARGINAL SEAL OF A COMPLETE CAST CROWN.

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Precision, marginal fit, finish line**.**

Abstract

Introduction: The successful clinical longevity of any indirect dental restoration is dependent upon the precision in its marginal fit. Many factors influence the marginal fit of a complete cast crown like type of cement, cementation pressure, venting, and internal relief of the crown.
Aims and objectives: this study was conducted to evaluate the influence of a finish line design of a tooth preparation upon the sealing ability of a complete cast crown.
Materials and methods: Thirty complete cast crowns were fabricated from three types of 8mm wide and 6mm high stainless steel dies with 5^0 angle of convergence differing only in finish line configuration i.e., one with 90^0 shoulder, other with 90^0 shoulder with bevel and another with chamfer. Ten crowns from each type of the die were made. A measured volume of autopolymerising resin (Duralay, Reliance, and Mfg.) was poured into castings to make direct Duralay dies. Crowns were cemented upon the Duralay dies and die sectioning was done with diamond discs. The cement space thickness was measured at the middle of the finish line with reflecting microscope.
Results: There is statistically significant difference in the seal of the finish line 90^0shoulder versus 90^0 shoulder with bevel and 90^0 shoulder versus chamfer of 0.00001 that is statistically significant at $p< 0.05$ and 90^0 shoulder with bevel versus chamfer showed p value of 0.49 that is highly insignificant at $p< 0.05$.
Conclusion: Within the limitations of the study, it can be concluded that finish line design of any preparation affects the sealing ability of the complete cast crown.

Introduction:-

Precision in the marginal fit of a complete cast crown maximizes its clinical longevity. Discrepancy in the marginal seal of a complete cast crown results in microleakage, plaque retention, secondary caries, pulpal decay and periodontal disease[1, 2]. Sealing discrepancies in the range of 100micrometers is clinically acceptable with regard to longevity of the restoration[3, 4]. Omar proposed that shoulder with bevel seals better than 90^0shoulder in Porcelain fused to metal crown[5]. Shillinburg[6] stated that shoulder finish line has less marginal distortion as compared to chamfer after porcelain firing. Fusayama et al [7]cemented cast full crowns onto extracted teeth prepared with the 90-degree shoulder, the 45-degree shoulder, and featheredge margins. They reported that the feather edge margin provided the best sealing effect followed by the 45-degree shoulder and 90-degree shoulder respectively.

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Aims and objectives:
This study was conducted to evaluate the effect of finish line design upon the marginal seal of a complete cast crown.

Materials and methods:-

Die preparation:
Three 8mm wide and 6mm high stainless steel dies are machined to simulate the size of an average molar with shoulder, shoulder with bevel and chamfer finish lines. Each die is machined with 5^0 angle of convergence per axial wall and the occlusal surface is dimpled to reorient the crowns properly.

Complete cast crown construction:
Ten complete cast crowns are fabricated from each die. Wax patterns were made from molten inlay wax (Bego, Germany) kept in electrically mentained water bath (Bego, Germany) at 160^0F. The wax patterns invested in phosphate bonded investment (Degudent, DENTSPLY, USA) were cast in cobalt chromium alloy using induction casting machine (Ducatron, UGIN, France). The complete cast crowns were retrieved, desprued and pickled.

Direct die fabrication:
A measured volume of methyl methacrylate (Duralay; Reliance Dental Mfg. Co, Chicago, III) was poured into the castings to make direct dies.

Complete cast crown cementation:
The crowns were cemented onto Duralay dies with zinc phosphate cement (Tenacin, Caulk) under 100 pounds pressure for 10 minutes. The orange wood stick was used for uniform and even distribution of the pressure with an Instron testing machine (Instron Corp, Canton, and Mass).Then, the centre wise die sectioning was done with a diamond disk on an ultrastructural analysis cutting machine (Buehler Ltd, Evanston, III). The measurement of the cement space thickness at the middle of the finish line of each half of each die was done with reflecting microscope. Then, the average marginal cement space thickness for each die was determined.

Results:-

The mean of the cement space thickness at the shoulder, shoulder with bevel and chamfer finish lines are 0.134mm, 0.089mm and 0.094mm with standard deviation of 0.0176, 0.089 and 0.0179respectively as shown in the table1and figure 1. The measurements of the marginal cement space thickness of the complete cast crowns cemented upon the Duralay dies when subjected to one way analysis ANOVA showed p-value of 0.00001 that is statistically significant at p-value of 0.05.

Table1:- The marginal cemental space thickness of the cast crowns cemented at the Duralay dies in mm.

	Shoulder	Shoulder with bevel	chamfer
i.	0.125	0.089	0.092
ii.	0.151	0.091	0.103
iii.	0.145	0.095	0.112
iv.	0.175	0.079	0.115
v.	0.127	0.078	0.089
vi.	0.131	0.067	0.073
vii.	0.124	0.087	0.095
viii.	0.129	0.098	0.121
ix.	0.115	0.099	0.075
x.	0.125	0.115	0.072
mean	0.134	0.089	0.094
Standard deviation	0.0176	0.0133	0.0179

Table2:- Comparison of the seals the various finish line designs create in a complete cast crown by ANOVA (F-Test)

	Shoulder versus shoulder with bevel	Shoulder versus chamfer	Shoulder with bevel versus chamfer
P value by F test	0.00001	0.000086	0.49
P<0.05 significant	Statistically significant	Statistically significant	Highly insignificant

Figure1:- Distribution of marginal cemental space thickness among the various finish lines.

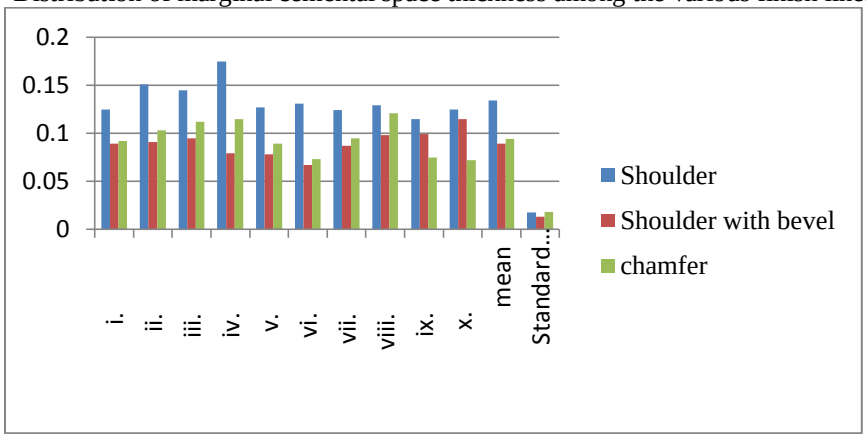
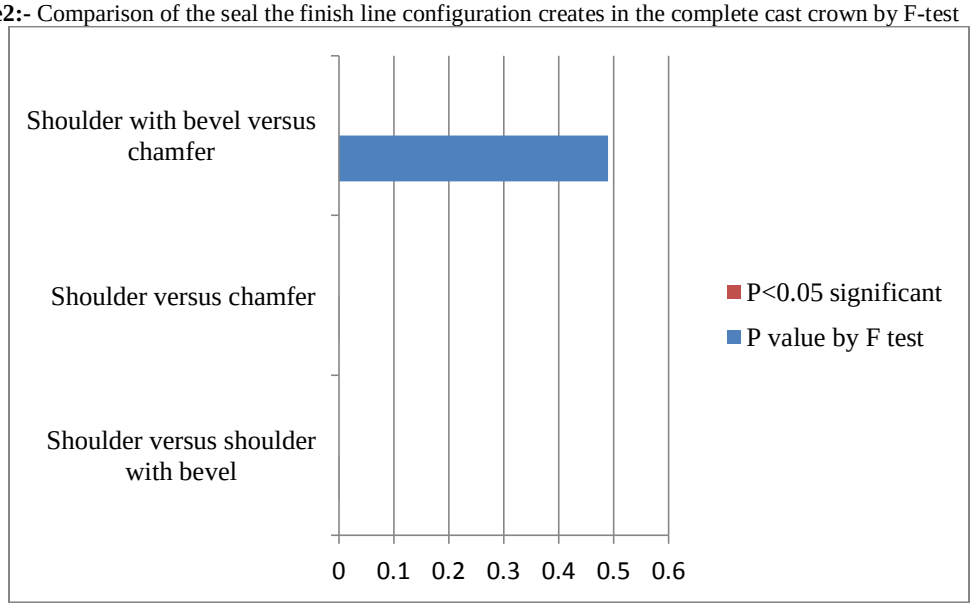


Figure2:- Comparison of the seal the finish line configuration creates in the complete cast crown by F-test



Discussion:-

Gavelis J.R. et al[8] has shown that marginal configuration of a complete cast crown preparation affects the marginal fit of the cast crown.

It has been proposed that feather edge seals better than 90^0 shoulder finish line. The cast crowns seat better on 90^0 shoulder preparations than feather and 90^0 shoulders with bevel preparations. In this study, the 90^0 shoulder with bevel with average marginal opening of 0.089mm seals better than 90^0shoulder and 90^0 shoulder with bevel finish line preparations that opened at margins by 0.134 and 0.094 mm respectively. There is statistically significant difference in the seal the finish line 90^0 shoulder versus 90^0 shoulder with bevel and 90^0 shoulder versus chamfer of 0.00001 that is statistically significant at $p< 0.05$ and 90^0 shoulder with bevel versus chamfer showed p value of 0.49 that is highly insignificant at $p< 0.05$ as shown in table 2 and figure 2.

Holmes et al[9] reported sealing discrepancy values of 0.036 mm for electroformed metal-ceramic crowns with a chamfer configuration; these values were lower than those observed in the present study. The lower result may be due to measurement carried out in non cemented crowns.

Fusayama et al[10] cemented cast full crowns onto extracted teeth prepared with the 90-degree shoulder, the 45-degree shoulder, and featheredge margins. They reported that the featheredge margin provided the best sealing effect followed by the 45-degree shoulder and 90-degree shoulder, respectively. Obviously, it is seen in the present study that the 90^0 shoulder with bevel seals better than shoulder configuration.

Conclusion: Within the limitations of the study, it can be concluded that finish line design of any preparation affects the sealing ability of the complete cast crown.

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