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Effect of venting on the marginal seal of a complete cast crown

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Abstract
Introduction: A complete cast crown seated with good marginal and occlusal adaptation is very important for the health of the stomatognathic system. The cementation that prevents the complete crown seating is affected by cementation pressure, duration of cementation, powder/liquid ratio of the cement, preparation dimensions, type of cement, occlusal perforations, die spacers, and relief of the internal crown surface have been related to the film thickness.
Aims and objectives: This study was conducted to evaluate the effect of venting on marginal adaptation of the complete cast crown.
Methodology: Twenty complete cast crowns were fabricated from a 8mm wide and 6mm high stainless steel die with shoulder preparation approximating the volume of a molar crown preparation. Twenty direct dies were fabricated by vibrating autopolymerising resin into complete cast crowns (McCune's direct die fabrication technique). Ten crowns were vented and ten left unvented. The vented and non-vented crowns were cemented onto the Duralay dies. The Duralay dies with cemented crowns were sectioned with diamond discs. Reflecting microscope was used to measure the mid margin cement space thickness.
Results: The mean of the marginal opening of unvented complete cast crowns is 0.124mm with standard deviation of 0.055 while as the mean of the marginal opening of vented complete cast crowns is 0.067mm with standard deviation of 0.033. The students paired t- test was used to compare the marginal adaptation of vented versus non vented complete crowns at p value of 0.01.

Keywords: Vented crown, direct die fabrication, cement space thickness, marginal adaptation

Introduction
The complete cast crown is the most important indirect dental restoration that restores the form and function of a severely damaged crown. Most clinicians have observed that cementation prevents the full seating of the crown leading to sealing and seating discrepancy of the crown. Jorgenson stated that the crown with great dental cement bulk when directed to full marginal seat, the excess cement escapes through space at the marginal collar. The closer the crown reaches its seating the narrower the space for cemental escape becomes. The mixture of cement is affected by this movement and undergoes partial separation into its two basic phases, solid and liquid. The solid particles clump together, forming a sievelike mass which only allows passage of the thinner liquid, causing a further separation and filtration process to occur.
The factors of cementation pressure, duration of cementation, powder/liquid ratio of the cement, preparation dimensions, type of cement, occlusal perforations, die spacers, and relief of the internal crown surface have been related to the film thickness.

Aims and objectives: The present study was conducted in order to compare the marginal sealing of nonvented, unrelieved full-crown castings with that of similar castings which were vented, but not relieved.

Materials and Methods
Master die preparation: A stainless steel die is machined to represent an average molar preparation for a complete cast crown. A stainless steel die with base diameter of 8mm, height of 6mm and each axial wall with 6^0 taper and total angle of convergence of 10^0 is machined with 1mm shoulder preparation.

Crown construction: The 20 crowns were waxed on the steel die, invested (Beauty Cast; Whip Mix Corp, Louisville, Ky), and cast (Firmilay; J. F. Jelenko, New Rochelle, NY) in type III gold. After divesting, the castings were retrieved, pickling was done and sprues were removed.

Direct die fabrication as described by McCune: Twenty dies were fabricated directly by vibrating a measured volume of methyl methacrylate (Duralay; Reliance Dental Mfg. Co, Chicago, Ill) into the complete cast crowns. The dies were undercut below the finish line to facilitate measurements and indexed to aid proper repositioning at cementation.

Cementation

The powder and liquid of zinc phosphate were placed on chilled cement slab to dissipate the exothermic heat. The powder was added to the liquid in increments and mixed for 1.5 minutes in accordance with the manufacturer's instructions. The ten complete cast crowns were filled with the cement and cemented onto Duralay dies with an Instron testing machine (Instron Corp, Canton, and Mass). The 100 pounds pressure was applied to the occlusal surface of the crown for ten minutes via orange wood for even and uniform distribution of the pressure. The excess cement was removed by placing dies with crowns in ultrasonic cleaner for three minutes. A round bur was used to prepare a vent in the mid occlusal zone of another ten crowns by means of venting technique described by Bassett. These vented complete cast crowns were cemented on the Duralay dies similarly. Thus, the cemented crowns were categorized into two groups as under:

Group I: The cemented crowns cemented onto Duralay dies without vent.

Group II: The cemented crowns cemented onto Duralay dies with vent.

Die sectioning: The Duralay dies with cemented crowns were section in the middle region with a diamond disk on an ultrastructural analysis cutting machine (Buehler Ltd, Evanston, Ill). The cement space thickness was measured with the eye piece micromotor mounted on reflecting microscope at middle of margin of each section of the group I and II die.

Results

The mean of the marginal opening of unvented complete cast crowns is 0.124mm with standard deviation of 0.055 while as the mean of the marginal opening of vented complete cast crowns is 0.067mm with standard deviation of 0.033 as shown in table 1 and figure 1. The results of measurements of a paired test comparing vented versus non vented crowns were statistically significant at p- value of 0.05.

Table 1: Marginal gap in mm of vented versus non vented complete cast crowns.

	Group I	Group II
1.	0.121	0.033
2.	0.134	0.121
3.	0.152	0.049
4.	0.160	0.037
5.	0.111	0.072
6.	0.024	0.117
7.	0.031	0.054
8.	0.171	0.062
9.	0.157	0.097
10.	0.179	0.031
Mean	0.124	0.0673
Standard deviation	0.055	0.033

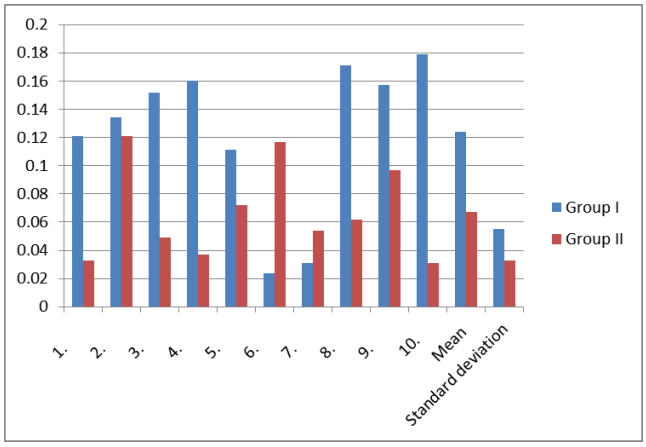

Fig 1: Graph representing marginal gap in mm of vented versus non vented complete cast crowns.

Discussion

Hembree JH Jr, Kaufman EG, Cooper TM, Van Nortwick WT proposed that die relief and crown venting significantly improved the seating of complete cast crowns in both *in vitro* (18.7 to 96 µm). This study supports all these authors that vented crowns seated more properly then non-vented complete cast crowns.

Jorgensen observed that incompletely seated crowns were frequently tilted after the cement had set resulting in different film thicknesses.

According to this logic, when crowns are vented, greater improvement in seating would be expected in premolars than in molars assuming a uniform vent size.

Jones reported an 85 µm average improvement in seating with vented crowns cemented *in vitro* to extracted premolars as compared with 37 µm improvement in extracted molars.

Van Northwick and Gettlemen demonstrated a highly significant correlation between the incompleteness of crown seating and tilting in the cemented crown.

All these authors demonstrated that venting a complete cast crown improves its seating both marginally and oclusally.

Conclusion

Within the limitations of the study, it can be concluded that venting improves the marginal adaptation of the complete cast crowns. Further studies are to be carried out which will more nearly reproduce the clinical conditions found during cementation of full cast crowns before recommending venting as a routine procedure.

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