



## Evaluation and Comparison of Marginal Fit between Complete and Partial Provisional Crowns: An In-Vitro Study

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### ABSTRACT

**Aim:** The aim of this study was to evaluate and compare marginal fit of complete provisional crowns and partial provisional crowns. **Materials and methods:** A total of thirty standardized provisional crowns were fabricated on a prepared typhodont molar and canine having shoulder finish line and 5-degree taper. Group A: Fifteen complete provisional crowns on molar and Group B: Fifteen partial provisional crowns on canine were made using polyvinyl siloxane impression as matrix filled with autopolymerising acrylic resin. Excess flash was trimmed from the crown margins during the elastic phase of polymerization and resealed on the preparation; allowed to set completely in water bath at 37° C. The crowns were then cemented on the prepared typhodont tooth using a thin coat of zinc oxide eugenol cement. The marginal discrepancy of the cemented provisional crown was determined by measuring the space between the margin of the crown and the finish line of the preparation; measured by a stereomicroscope mounted digital camera, adjusted to a magnification level of 40x. For each crown and preparation assembly, measurements were made at 4 reference points in complete provisional crowns and 3 reference points in partial coverage provisional crowns marked randomly around the circumference of the preparation finish line. Student's t-test was applied, and mean value was calculated. A spearman's correlation coefficient was calculated to assess the relationship between marginal discrepancies of these provisional crowns.



**Results:** Statistically significant difference was found between the means of both the crowns ( $p < 0.001$ ). Marginal fit discrepancy was less in complete provisional crowns (95.664) than the partial coverage provisional crowns (124.577). The overall results of the in-vitro study indicated that among the two groups, group A was the most dimensionally stable followed by group B.

**Conclusion:** Marginal fit discrepancy of complete provisional crowns was lesser than the marginal fit of partial coverage provisional crowns. Complete provisional crowns are more precise with margin adaptation and these stable margins withstand the segue into more definitive treatment.

**Clinical Significance:** Provisional crown failures are found to be vehement mistake when the patient returns to the clinic for the follow-up definitive treatment. Provisional crown failures are technique sensitive failures that can be avoided with a thorough understanding of the behavioural pattern of the materials used, in the stringent oral environment.

**Keywords:** Provisional Crown, Margin fit, case-control study

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## INTRODUCTION

Provisional restoration plays a vital role in the long-term success of fixed partial restorations. These interim restorations are essential to cover freshly cut dentin and prevent tooth movement. Used individually on a single tooth or on multiple prepared teeth, provide coverage for abutment tooth as part of a splint or fixed partial denture prior to the placement of permanent prosthesis.<sup>1,2</sup> Provisional restorations protect the pulp from thermal changes, maintain proper contacts, restores occlusion, aesthetics, and function.<sup>3</sup> This interim treatment using a provisional restoration also plays a particular role in diagnostic procedures and continued evaluation of treatment plan, as they resemble the form and function of the definite rehabilitation that they precede.<sup>5</sup> One of the most important factor that determine the success of a provisional restoration is adequate vertical marginal fit. Obtaining the best possible marginal adaptation of a provisional restoration effectively protects the pulp from thermal, bacterial, and chemical insults. Pronounced marginal discrepancy can result in development of pulpal sensitivity, gingival recession, and tissue inflammation.<sup>4,8</sup> Material selection for a provisional crown is based on how their mechanical, physical, and handling properties fulfil specific requirements for any clinical use. Biocompatibility of the material, colour stability for a good shade match, highly

polished surface, are some of the other factors based on which the provisional crown materials are selected. The most common materials used for custom interim-fixed restorations are several types of acrylic resins such as polymethyl methacrylate (PMMA) resin, polyethylmethacrylate (PEMA) resin, polyvinyl methacrylate resin, bis-acryl composite resin, and visible light-cured urethane dimethacrylates.<sup>6,7,9</sup> Custom crowns are fabricated by these resins, whereas prefabricated forms include stock aluminium cylinders, anatomical metal crown forms, clear celluloid shells and tooth coloured polycarbonate crown forms.<sup>10</sup> Marginal accuracy is of paramount importance because an acceptable fit at the margins is essential for maintaining gingival health and protecting the tooth from physical, chemical, bacterial and thermal injuries. The marginal fit or accuracy of a restoration can be defined best in terms of the "misfit" or the gap measured at various points between the restoration and the tooth.<sup>4</sup> The current study was done to compare and evaluate the marginal fit of complete provisional crowns and partial provisional crowns.

## MATERIALS AND METHODS

Molar and canine typhodont teeth (Fig 1, 2) were selected for the study and tooth preparation was completed with a high-speed air-rotor. Tooth preparation on the molar tooth was for complete coverage crown with



shoulder margin, whereas the canine tooth was prepared for partial coverage crown with shoulder margin. Both the crown preparations had a taper of approximately five degrees. Prior to the tooth preparation, a polyvinyl siloxane impression (Fig 3) of the unprepared molar and canine typhodont tooth was made that formed the matrix for provisional crown fabrication. A direct technique was used for the fabrication of provisional crowns on the prepared typhodont tooth. Autopolymerising acrylic resin (Fig 4) of suitable shade was mixed and allowed to set to a dough consistency (disappearance of the sheen of surface-free monomer) followed by packing the same into the PVS impression matrix. The prepared typhodont tooth was lightly lubricated with petrolatum, followed by seating of the acrylic resin loaded impression matrix. The provisional crowns were removed and re-seated once during the elastic phase of the polymerization to trim away the excess flash from the crown margins. The crowns were then re-seated and allowed to set completely in a water bath at 37° C. The completely cured provisional crowns were

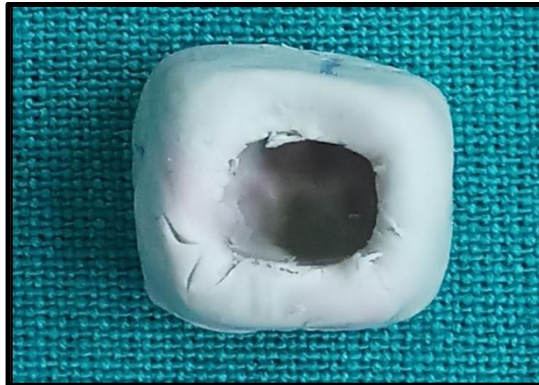
finished and polished as per the manufacturer's instructions. The finished crowns were coated with a thin coat of zinc oxide eugenol cement and seated on the prepared typhodont tooth with a rocking dynamic force applied by fingers. A firm finger pressure was applied for five minutes followed by the removal of the excess cement with an explorer. Crowns were divided into two groups: Group A (Complete Coverage Provisional Crowns) (Fig 5) and Group B (Partial Coverage Provisional Crowns) (Fig 6). The marginal discrepancy was determined by measuring the space between the margin of the crown and the finish line of the preparation. A digital camera (Fig 7) fixed to a stereomicroscope (Fig 8), adjusted to a magnification level of 40x and a special software was used to assess the marginal discrepancy. For each crown and preparation assembly, measurements were made at four reference points in complete provisional crowns and three reference points in partial coverage provisional crowns marked random around the circumference of the finish line of the preparation.



**Fig 1: Typhodont tooth (molar)**



**Fig 2: Typhodont tooth (canine)**



**Fig 3: Elastomeric impression matrix**



**Fig 4: DPI tooth coloured self cure acrylic powder**



**Fig 5: Molar crowns**



**Fig 6: Canine crowns**



**Fig 7: Digital Microscope Camera**



**Fig 8: Stereomicroscope**

## STATISTICAL ANALYSIS AND RESULTS

Student's t-test used to calculate the mean value between the two groups. Spearman's correlation coefficient was calculated to assess the relationship between marginal discrepancies of these provisional crowns. Data distribution was assessed for Normality using Shapiro-Wilk test. Student's t-test was used for paired samples for intra-group comparison. Spearman's correlation coefficient was also calculated to assess the

relationship between the two groups. A correlation is said to be strong or positive if the values range from 0.7 to 1. All values were considered statistically significant for a value of  $p < 0.05$ . Group A: mean of the distal surface ( $19.799 \pm 9.740$ ) was found to be more in comparison with lingual ( $17.928 \pm 4.399$ ), than the buccal ( $19.697 \pm 5.556$ ) and mesial surface ( $19.351 \pm 4.831$ ). Table 1 and graph 1 show the individual means of the



complete provisional crowns on various surfaces. Group B: maximum score found ( $35.211 \pm 9.199$ ) on the distal surface was more as compared to lingual ( $24.619 \pm 3.937$ ) and mesial ( $33.603 \pm 8.732$ ) surfaces. Table 2 and graph 2 shows the individual means of the partial coverage provisional crowns on various surfaces. Student's t-test was applied, and the mean value was calculated. A t-value of 8.126 was obtained for both the means. Statistically significant difference was found between the means of both the crowns ( $p < 0.001$ ). Thus, it was found that marginal fit discrepancy was less in complete provisional crowns (95.664) than the partial coverage provisional crowns (124.577). Table 3 and graph 3 shows the total mean of both the complete provisional and partial coverage

provisional crowns. Spearman's correlation coefficient was calculated to assess the relationship between marginal discrepancies of these provisional crowns. A correlation to be considered strong or positive, the values have to range from 0.7 to 1. Thus, a strong correlation was found amongst both the complete provisional (0.99) and partial coverage provisional crowns (0.92). Results also show the correlation between the complete provisional and partial coverage provisional crowns. Result showed a significant difference in the marginal fit of the crowns studied and marginal fit discrepancy of complete provisional crown was lesser in comparison to the marginal fit of partial coverage provisional crowns.

Sl. No.	Surfaces Involved	N	Mean	SD
1.	Buccal	15	19.697	5.556
2.	Lingual	15	17.928	4.399
3.	Mesial	15	19.351	4.831
4.	Distal	15	19.799	9.740
5.	Average	15	18.889	3.422

**Table 1: Individual mean of Complete Provisional Crowns (Molars)**

Sl. No.	Surfaces involved	N	Mean	SD
1.	Distal	15	35.211	9.199
2.	Lingual	15	24.619	3.937
3.	Mesial	15	33.603	8.732
4.	Average	15	31.144	4.909

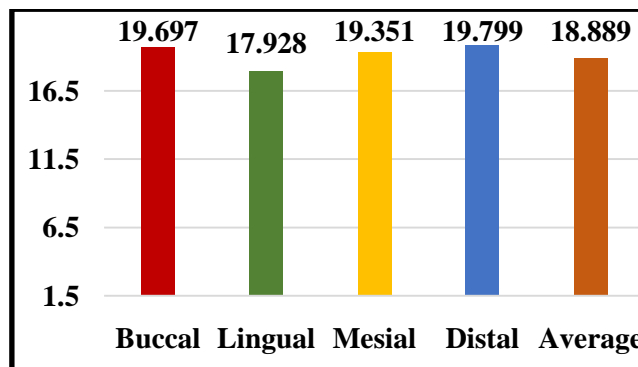
**Table 2: Individual mean of Partial Coverage Provisional Crowns (Premolars)**



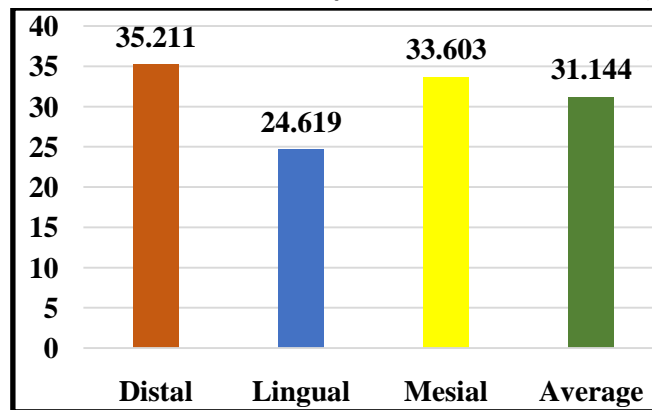
Sl. No.	Type of crown	Mean	SD	t-test	p-value
1.	Complete provisional crowns	95.664	27.948	8.126 <sup>a</sup>	<0.001 <sup>b</sup>
2.	Partial coverage provisional crowns	124.577	26.777		

<sup>a</sup>p < 0.05- statistically significant, <sup>b</sup>student t-test

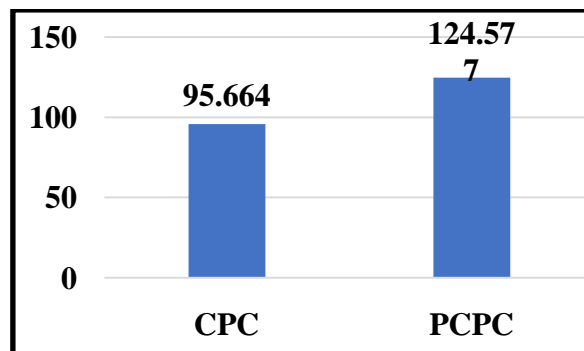
**Table 3: Total mean of complete provisional and partial coverage provisional crowns**



**Graph 1: Individual mean of Complete Provisional Crowns (Molars)**



**Graph 2: Individual mean of Partial Coverage Provisional Crowns (Premolars)**



**Graph 3: Total mean of complete provisional and partial coverage provisional crowns**



## DISCUSSION

Close marginal adaptation of provisional resin crown to finish line of a prepared tooth protects the pulp from the thermal, bacterial, and chemical insults. In order to overcome from these insults, marginal accuracy of provisional restorations are important.<sup>1</sup> The current study was carried out to observe the effectiveness of conventional full coverage provisional crown over three-quarter partial provisional crown. One of the major predictors of long-term success of any dental restoration is its marginal fit, which is a notion never been defined certainly. Marginal gap is defined as the perpendicular measurement from the marginal surface of the restoration to the axial wall of the preparation. Much has been said about different variables affecting the marginal fit.<sup>25</sup> In a hypothetical preparation setup with clear-cut margins, at least seven types of variables might correspond to marginal accuracy. These include internal gap, marginal gap, overextended or under-extended margins, and vertical/horizontal/ and absolute marginal discrepancies. However, since actual margins are usually blunt, different subtypes may also be considered as definitions for some discrepancies. Various methods have been utilized for measuring marginal adaptation, including sectioned or embedded specimens as well as direct visualization by stereo- or electron-microscopy and clinical examinations.<sup>25</sup> Among the requirements of a proper provisional restoration material, marginal adaptation is the most important one. A fine margin may provide health for the prepared tooth as well as its gingival tissues which is necessary for further cementation. Marginal failure might lead to microleakage, postoperative sensitivity, and recurrent dental caries. Numerous factors such as the gap between the tooth and the restorative material, dentinal fluids, material properties such as dissolution and coefficient of thermal

expansion, polymerization shrinkage could lead to margin failure. It may cause pulpitis in vital teeth due to bacterial toxins and may reduce restoration longevity because of bacterial colonization through the restoration tooth gap or in dentinal tubules.<sup>25</sup> Robinson and Hovijitra<sup>12</sup> compared four brands of materials and reported that the Sculttan brand had less marginal discrepancy. It was assumed that the observed marginal openings were caused by polymerization shrinkage. In the current study, significant difference in the marginal fit of the crowns studied was noticed. This could be attributed to the polymerization shrinkage of poly-methyl methacrylate resin used. As well, the marginal fit discrepancy of complete provisional crown was lesser in comparison to the marginal fit of partial coverage provisional crowns. Tjan et al. compared six provisional materials (three auto-polymerizing and three photo-polymerizing) and reported that Interim crowns made with Splintline (a product of ethyl methacrylate) and Protemp materials had the best marginal adaptation.<sup>15</sup> Ehrenberg et al compared changes in marginal gap of two materials under the effect of water absorption and thermo cycling and observed that thermo cycling was able to change significant marginal gaps in both Bis-acrylic resin composite, and polymethyl methacrylate (PMMA) copolymer.<sup>19</sup> Nivedita and Prithviraj compared light-cured and self-cured provisional resins and showed that light-cured resins might have better marginal fit.<sup>18</sup>

## CONCLUSION

Marginal fit of the crowns has always been an Achilles heel of fixed Prosthodontics. Lot many failures in a fixed prosthesis has been attributed to the margin configurations and placement. Margin configuration has also been the basis for the selection materials for crown fabrication. Same has been true for the





provisional crowns as well. It is thereby an imperative statement that, based on the margin failures detected; it is always good to go by a complete coverage crown as a choice for both definitive and provisional coverage. This enhances the longevity of the treatment outcome. The drawback of the above study is that these provisional crowns have to undergo more stringent tests that emulate the harsh oral environment for better results.

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