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Marginal Accuracy Of Provisonal Restoration Material Used In Fixed Partial Dentures An In-Vitro Study

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Abstract

Statement of Problem : One of the most important requirements for provisional restorations is good marginaladaptation. Polymerization shrinkage and mixing technique of provisional restorative materials can jeopardize the marginal integrity of provisional restorations.

Purpose : The purpose of this study was to compare the marginal accuracy of provisional restorations made with4 provisonal restorative materials

Material and methods : A direct technique was used to fabricate 40 provisonalrestorations with 4 materials: ProtempTM II, Swift-temp,Cooltemp and Ashvin (n=10). The provisional restorations were made on a prepared central incisor -shaped metal die with a vinyl polysiloxane impression as a matrix. Marginal discrepancy was measured at the six points three on either side of midpoint of buccal, palatal, mesial, and distal surfaces of metal die finish line with a scanning microscope. Comparisons were made withanovatest (a=.05).

Results : The Grand mean marginal gap of ProtempTMII ,Swifttemp ,Cooltemp and Ashvin were 210.26, 205.52,160.47 and220.24 mm, respectively. Ashvin exhibited maximum marginal gap and was significantly different from the other materials tested (P,.001). However, there were very little statistical differences between the other 3 materials tested.

Conclusions : Provisional restorations made from the Bis-GMA and conventional acrylic resins tested produced better marginal fit. PMMA demonstrated significant increases in marginal gap size.

Key Words
Provisional restorations,marginal gap ,marginal discrepancy.

Introduction

A provisional restoration is a temporary dental restoration designed to enhance aesthetics and function for a limited period of time which is to be replaced by a definitive dental restoration[1]. Fabrication of provisional restorations is an important step toward achieving a successful fixed prosthodontic treatment.[1,2]

Provisional restorations are needed to maintain gingival health and protect the pulp of prepared teeth.[3-6]. The term provisional may suggest that this step requires less stringent adherence to prosthodontic principles than other steps of crown or fixed partial dentures fabrication. However lack of attention at any step in the restorative procedure can yield disastrous results. An improper provisional restoration may result in the eventual loss of more time than that was initially thought saved. It is therefore essential that biological, mechanical and aesthetic requirements are satisfied by provisional restoration. The mean duration of a provisional restoration is seven to ten days, but sometimes clinical delay, disease, financial constrains etc may prolong the period for which it is in use. Therefore the success of fixed prosthodontics to a large extent depends on the care and method in which the provisional restoration is designed and fabricated.

Ideal requirements of provisional restorative materials are adequate working time, ease of mix and repair, bio compatibility with pulp and soft tissues, dimensional stability during and after fabrication, marginal adaptation,shade and color stability etc.

Out of these ,one of the important requirement of the provisional restoration is good marginal adaptation. Poor marginal fit allows the passage of fluids and bacteria into the gap and may predispose the tooth to caries or pulpitis. Therefore the objective of this in-vitro study was to compare the marginal accuracy of four provisional restorative materials commonly used in clinical practice.

Material And Methods

The present study was undertaken at department of Prosthodontics, Himachal Dental College Sundernagar. An in-vitro method was used to simulate a clinical technique in which the interim crowns were made directly on the prepared metal die using a matrix. For holding of this matrix and metal die this metal jig was fabricated as per dimensions given by

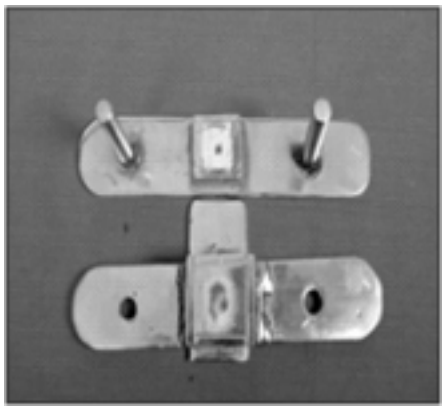


Fig. 1 : Male And Female Parts Of Metal Jig

Farhanz el al.[8] **(Fig.1)**

Dimensional details of the apparatus:
Volumetric Dimension:

1	Male Part	30 × 30 × 25mm
2	Female Part	30.5 × 30.5 × 45 mm
3	Clearance Space	20mm Material

The provisional restorative materials used in the study are shown in **Table A**.

Table A Provisional restorative materials and their manufacturers

Group	Materials Used	Manufacturer
A	ProtempTM II (BIS -GMA composite)	3M ESPE AGDental products D-82229 Seefeld -Germany
B	Swift-Temp (BIS -GMA composite)	SHOFU INC, 11 Kamitakamatsu-Cho, Fukuine, Higashiyama-ku, Kyoto 650-0983-Japan
C	Cool Temp (BIS -GMA composite)	COLTENE /WHALEDENT Feldwiesenstrasse 20 9450 Altstatten -Switzerland
D	Ashvin (PMMA)	ASHVIN A -95 /1, Wazirpurindl. area, Delhi -110052(India)

An artificial maxillary central incisor (FRASECO German) was prepared to receive a complete crown restoration with a shoulder finish line. Putty reline technique was used to make the impression of the prepared tooth using elastomeric impression material. Inlay casting wax (Bego) was flown into the impression of that tooth. Root portion was built rectangular with the inlay casting wax. Then the wax pattern was retrieved from this impression along with the root portion. It was then invested and casted. The model retrieved after casting was finished and polished A matrix was prepared to hold the provisional restorative material over the prepared tooth. A crown analogue was prepared over the metal die used in the study.. The metal die with the crown analogue was mounted in the plaster of paris in the male part of the metal jig and polivinylsiloxane putty impression of the die was taken along with crown analogue. For this, an equal proportion of base and catalyst pastes of polivinylsiloxane putty impression material was mixed and placed in the female part of the jig. The female part was inverted over the male part till the mark of location on both parts coincided with each other .The polymerized impression served as the matrix for making the provisional restorations.The matrix was filled with various provisional crown materials used in the study respectively and was seated over the metal die to fabricate theprovisional crowns **Fig 2**.The gingival margins of all provisional restorations were trimmed with rubber wheel under a microscope at 10X magnification. Trimming of all interim restoration margins was performed by single operator. Then the crowns were made conductive by placing them in ion sputter coater **Fig 3,4**. Each provisional restoration along with the metal die was held in place with the help of a stub in the chamber of the scanning electron microscope **Fig 5**. The marginal discrepancy of each provisional restoration was determined by measuring the vertical space between the margin of the provisional restoration and the finish line of the metal die under Scanning Electron Microscope.

For each interim restoration, measurements were made on all four sides i.e. buccal, mesial distalandlingual, **Fig 6, 7, 8, 9**. On one given side a reference point at the middle of margin was marked. Three measurements were made on the either side of the reference point. Hence marginal gap on each surface was recorded at six different points and a mean of these six readings was obtained on each side. The data thus

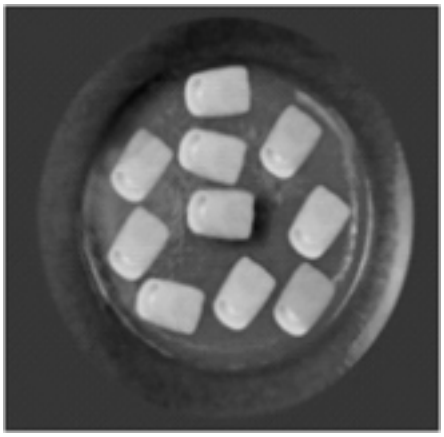


Fig. 2 : Fabricated Samples

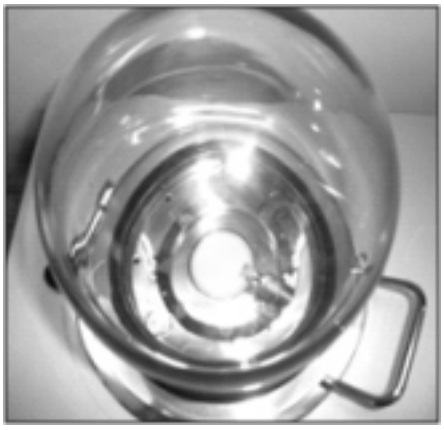


Fig. 3 : Loaded Sample In Sputter Coater

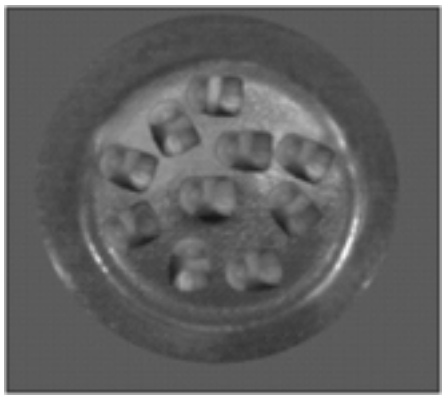


Fig. 4 : Samples After Gold Coating

Fig. 5 : Loaded Sample In Sem

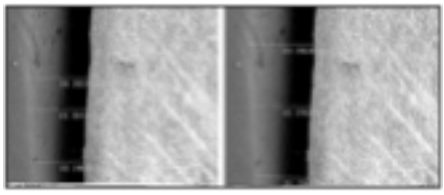


Fig. 6 : Marginal Gap On Either Side Of The Reference Line On The Buccal Surface.

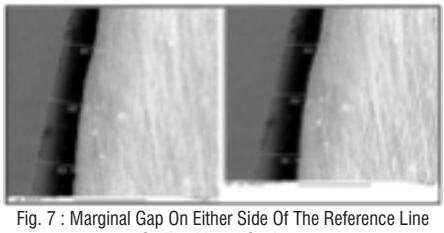


Fig. 7 : Marginal Gap On Either Side Of The Reference Line On The Mesial Surface.

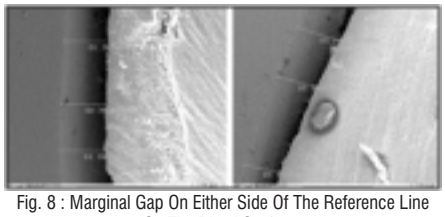


Fig. 8 : Marginal Gap On Either Side Of The Reference Line On The Distal Surface.

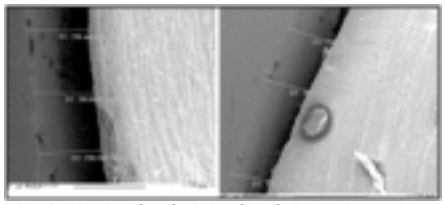


Fig. 9 : Marginal Gap On Either Side Of The Reference Line On The Lingual Surface.

obtained was subjected to statistical analysis.

Observations

A total number of forty samples, prepared from four different kinds of provisional restorative materials, were evaluated for the marginal discrepancies. The data obtained was analyzed under following parameters :

Table 1 Vertical Mean marginal gap in (microns) of Protem™ II (Group A)

	Buccal	Mesial	Distal	Lingual
N (Number of readings)	60	60	60	60
Mean	220.63	212.05	190.30	218.07
Std. Error of Mean	10.223	7.883	6.629	6.055
Std. Deviation	79.190	61.065	51.349	46.900

Table 1 shows the mean marginal gap on each of the four surfaces of the provisional restoration obtained fromProtempTMII. The mean marginal gap is maximum on the buccal side i.e. (220.63) and minimum in distal (190.30).

Table 2 Vertical Mean marginal gap in (microns) of Swift-Temp (Group B)

	Buccal	Mesial	Distal	Lingual
N (Number of readings)	60	60	60	60
Mean	193.23	195.52	186.43	246.90
Std. Error of Mean	10.796	9..467	7.752	10.279
Std. Deviation	83.629	73.330	60.050	79.624

Table 2 shows the mean marginal gap of Swift-Temp on each of the four surfaces of the provisional restoration. The mean marginal gap is maximum on the lingual side i.e. (246.90) and minimum on distal (186.43).

Table 3 Vertical Mean marginal gap in (microns) in Cool Temp(Group C)

	Buccal	Mesial	Distal	Lingual
N (Number of readings)	60	60	60	60
Mean	109.52	162.82	166.67	202.88
Std. Error of Mean	5.989	11.081	5.107	9.696
Std. Deviation	46.389	85.831	39.555	75.103

Table 3 shows the mean marginal gap fabricated with Cooltemp on each of the four surfaces of the provisional restoration .The mean marginal gap is maximum on the lingual side i.e. (202.88) and minimum in buccal (109.52).

Table 4 shows the mean marginal gap fabricated with Ashvin on each of the four surfaces of the provisional restoration. The mean marginal gap is maximum on the lingual side i.e. (243.58) and minimum in mesial (202.38).

Table 4 Vertical Mean marginal gap in (microns) in Ashvin(Group D)

	Buccal	Mesial	Distal	Lingual
N (Number of readings)	60	60	60	60
Mean	211.15	202.38	223.85	243.58
Std. Error of Mean	6.553	6.441	5.886	5.497
Std. Deviation	50.762	49.894	45.592	42.581

Table 5 Grand Mean Marginal Gap and Grand Standard Deviation (microns) of the four provisional restorative materials

Material	Grand Mean Marginal Gap	Grand Standard Deviation	n
Protemp ™ II	210.2625	25.76554	240
Swift-Temp	205.5208	35.35088	240
Cool Temp	160.4708	36.28790	240
Ashvin	220.2417	20.55089	240

Table 5 represents the descriptive statistics .This table basically describes the Grand Mean Marginal Gap (microns) and Grand Standard Deviation of the four provisional restorative materials which were used in the study. Maximum Grand mean marginal gap is observed for Ashvin (220.2417) followed by :Protemp™ II 210.2625 ,Swift Temp 205.5208 and Cool Temp 160.4708

Table 6 Pair wise Comparison (Buccal Surface)

Dependent Variable (I) Crowns	(J) Crowns	Mean Difference (I-J)	Std. Error	p value
Buccal	Protemp™ II	Swift-Temp	27.400	12.245	.026
		Cool Temp	111.117	12.245	.000
		Ashvin	9.483	12.245	.439
	Swift-Temp	Protemp TM II	-27.400	12.245	.026
		Cool Temp	83.717	12.245	.000
		Ashvin	-17.917	12.245	.145
	Cool Temp	Protemp TM II	-111.117	12.245	.000
		Swift-Temp	-83.717	12.245	.000
		Ashvin	-101.633	12.245	.000
	Ashvin	Protemp TM II	-9.483	12.245	.439
		Swift-Temp	17.917	12.245	.145
		Cool Temp	101.633	12.245	.000

Table 6 represents the pair wise comparison of the four different materials used in the study on the Buccal surface. The above stated table represents the mean difference, Std. error and significant difference. According to the above stated table,Protemp™ II shows the significant difference with Swift-Temp and CoolTemp i.e. (27.400 and 111.117) at 5% and 1% level respectively.

Table 7 represents the pair wise comparison between the four different materials used in the study on the mesial surface. According to the above stated table the protemp™ II shows the significant difference with Cool Temp i.e. (49.233) at 1% level. Similarly, it is also found that there is a significant difference between CoolTemp with Swift -Temp i.e.(32.700) and Ashvin(39.567) at 1% level.

Table 7 Pair wise Comparison (Mesial Surface)

Dependent Variable (I) Crowns	(J) Crowns	Mean Difference (I-J)	Std. Error	p value
Mesial	Protemp™ II	Swift-Temp	16.533	12.571	.190
		Cool Temp	49.233	12.571	.000
		Ashvin	9.667	12.571	.443
	Swift-Temp	Protemp TM II	-16.533	12.571	.190
		Cool Temp	32.700	12.571	.010
		Ashvin	-6.867	12.571	.585
	Cool Temp	Protemp TM II	-49.233	12.571	.000
		Swift-Temp	-32.700	12.571	.010
		Ashvin	-39.567	12.571	.002
	Ashvin	Protemp TM II	-9.667	12.571	.443
		Swift-Temp	6.867	12.571	.585
		Cool Temp	39.567	12.571	.002

Table 8 Pair wise Comparison (Distal Surface)

Dependent Variable (I) Crowns	(J) Crowns	Mean Difference (I-J)	Std. Error	p value
Distal	Protemp™ II	Swift-Temp	3.867	9.076	.670
		Cool Temp	23.633	9.076	.010
		Ashvin	-33.550	9.076	.000
	Swift-Temp	Protemp TM II	-3.867	9.076	.670
		Cool Temp	19.767	9.076	.030
		Ashvin	-37.417	9.076	.000
	Cool Temp	Protemp TM II	-23.633	9.076	.010
		Swift-Temp	-19.767	9.076	.030
		Ashvin	-57.183	9.076	.000
	Ashvin	Protemp TM II	33.550	9.076	.000
		Swift-Temp	37.417	9.076	.000
		Cool Temp	57.183	9.076	.000

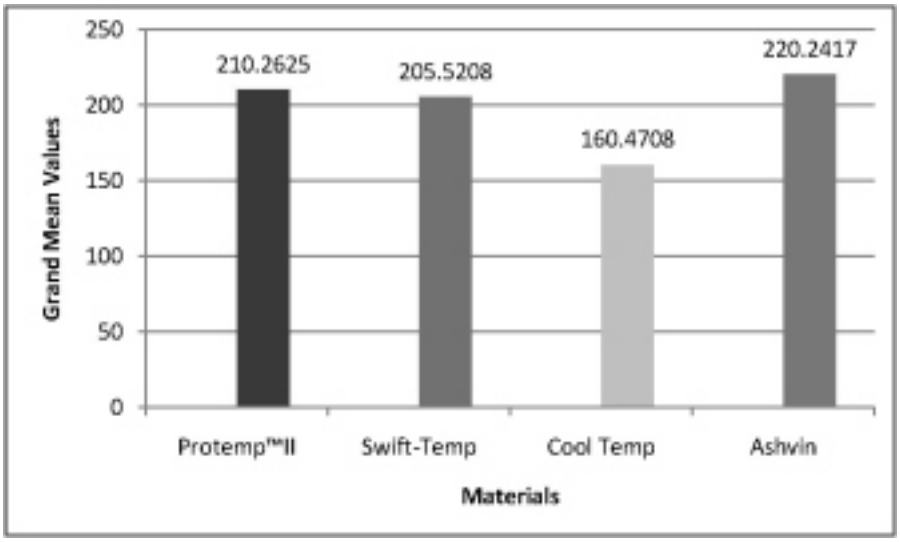
Table 8 represents the pair wise comparison between the four different materials used in the study on the distal surface. On the distal surface Protemp™II, Swift-Temp and Ashvin shows a significant difference of (23.633, 19.767 and 57.183) respectively with the cool temp .

Table 9 represents the pair wise comparison between the four different materials used in the study on the lingual surface. There is an insignificant difference of (15.183) at 5% level between Protemp™II and Cool Temp. As far as Ashvin and Swift Temp are concerned there is a significant

Table 9 Pair wise Comparison (Lingual Surface)

Dependent Variable		(I) Crowns (J) Crowns	Mean Difference (I-J)	Std. Error	p value
Lingual	Protemp™ II	Swift-Temp	-28.833	11.545	.013
		Cool Temp	15.183	11.545	.190
		Ashvin	-25.517	11.545	.028
	Swift-Temp	Protemp TM II	28.833	11.545	.013
		Cool Temp	44.017	11.545	.000
		Ashvin	3.317	11.545	.774
	Cool Temp	Protemp TM II	-15.183	11.545	.190
		Swift-Temp	-44.017	11.545	.000
		Ashvin	-40.700	11.545	.001
	Ashvin	Protemp TM II	25.517	11.545	.028
		Swift-Temp	-3.317	11.545	.774
		Cool Temp	40.700	11.545	.001

Graph 1 : Grand Mean Marginal Gap



difference of (40.700 and 44.017) at 1%level with Cool Temp. Protemp™II shows significant difference with Swift-Temp (28.833)at 1% level and Ashvin (25.517) at 5%level.

Discussion

Fabrication of provisional restoration is an important step towards achieving successful prosthodontic treatment. Provisional crowns are seated on the prepared abutments at a critical phase of treatmentthat is when gingiva is injured during crown preparation and any discrepancies in marginal adaptation of provisional restoration further complicates the situation. Therefore the most important morphologic and physiologic requirements for a provisional crown is suitable marginal adaptation. The purpose of this in-vitro study was to compare vertical marginal discrepancy of provisional crowns made from four provisional restorative materials. The four materials included in the study were different brands of chemically cured Bis-GMA resins and one PMMA resin.

On measuring the marginal discrepancy as seen in **Table No 1-4** provisional restorations made under group D i.e. restoration made from Ashvin demonstrate significant increase in marginal gap size as compared to the other three materials tested on all the four surfaces .It is assumed that the observed marginal discrepancies were caused by the polymerization shrinkage of self cure resins. The results of this study were similar to the findings of study conducted by Robinson and Hovijitra[4] who have attributed the marginal discrepancy to polymerization shrinkage. Similar results were obtained by Braden and Clark as well. [33]

Table 5 describes the grand mean marginal gap and grand standard deviation of the four provisional materials used in the study. This can be seen that the grand mean marginal gap of cool temp is minimum as compared to other materials used in the study. It is further observed that the grand standard deviation of cool temp is minimum and maximum is of Ashvin. It depicts that Cooltemp material has the best marginal fit on all the surfaces.

The above mentioned facts are further clarified in **Table no 6 -9** where pair wise comparison of different materials was carried out on all the four surfaces.From the comparisons done in **Table no. 6-9** it was concluded thatCooltemp shows the best marginal fit on all the four surfaces followed byswift-temp protempand ashvin.

From the above mentioned observations it is clear that the provisional restorations made from Bis-GMA composite resins showed more close adaptation as compared those made with PMMA. This is due the fact that polymerization shrinkage is less in composite resins as compared to self cure resins .Moreover there is lack of exothermic reaction in composite resins which contributes to better adaptability .These results are comparable to previous studies conducted by Young et al[30] and Farahanz et al[8] where they have concluded that composite resins show less marginal discrepancy as compared to self cure resins.

Further it is clear from the observations that among the different composite resins used in the study Cool Temp showed least marginal discrepancy followed by Swift Temp and Protemp™II.

This finding can be explained by the fact that Cooltemp was supplied as a cartridge based dispensing system with auto mix technique resulting in a more accurately proportioned and consistent mix.

In case of Swift Temp a calibrated mixing pad was provided on which equal lengths of base and catalyst pastes could be dispensed for a more accurate mix. Whereas in case of Protemp™ II base and catalyst were provided in separate cartridges and there were chances of error while dispensing the two pastes resulting into less accurately proportioned and consistent mix. This fact was emphasized by Bausch et al, in their study on polymerization shrinkage of composite resins where they concluded that accurate proportioning of base and catalyst pastes resulted intopolymerization shrinkage. Same results were obtained by Farahanz et al,[8] where they analyzed that cartridge based dispensing system with auto mix technique resulted into less marginal discrepancy. So it is clear that the composite resin based provisional restorative materials show less marginal discrepancy as compared to self cure resins. However, in a study conducted by Barghi and Simmons on marginal integrity of the self cure resin temporary crowns it was concluded that if self cure resin has to be used as a provisional restorative material, a reline technique should be employed to improve the marginal integrity.

Summary and Conclusion

The primary objective of a provisional restoration is to maintain good gingival health prior to the placement of the final restoration. An accurate marginal fit of temporary crowns is an important factor that needs consideration as it protects the prepared teeth from physical, chemical, bacterial and thermal injury. Thus, the present study aims at studying the marginal accuracy of the provisional restorations and evaluating the best possible marginal adaptation amongst the commonly used materials.

It may be concluded from the present study that:

1) Bis-GMA provisional restorative material shows the better marginal fit and out of four materials used in studyCooltemp showed the best fit on all the surfaces
2) Ashvin (PMMA), on the other hand, showed a poor overall marginal fit as compared to other Bis-GMA based materials.
3) It can also be concluded that more accurately proportioned and consistent mix resulted in better marginal fit .

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