

## IN VITRO STUDY ON MARGINAL MICROLEAKAGE OF FOUR TEMPORARY CEMENTS IN PROVISIONAL CROWNS

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### Abstract

**Background:** Prolonged retention of provisional restoration is depends upon the long term affinity between restoration and teeth structures which depend upon the use of good mechanical characteristics, low solubility, and superior adhesion quality of luting cement which also resist bacterial and molecular penetration. Hence, assessment of marginal leakage of provisional restorative materials sealed with provisional cements using the standardized procedures is essential.

**Aim:** This study aimed at *in vitro* study of microleakage of 4 provisional cements, a cavity base compound and a zinc-phosphate luting cement in provisional acrylic resin crowns fixed on extracted human teeth.

**Material & Methods:** The teeth with acrylic restorations were randomly divided into 6 groups of 6 specimens each. Each group received different types of temporary cement. Acrylic resin crowns were made and fitted on intact human premolars with the 4 cements. All restorations were applied in a standardized manner. Specimen were submerged in a 2% methylene blue solution, then sectioned and observed under a stereomicroscope for the detection of marginal microleakage. Obtained data were subjected to ANNOVA and Chi –square test to know statistical significant difference between different groups. P value less than 0.05 was considered significant.

**Results and observation:** Mean frequency of microleakage was statistically significant among all the groups under study with Pvalue<0.017.

**Conclusion:** Among all the temporary cement, Zinc-phosphate cements has the best property with reduced microleakage. Even it is used as cavity base but can be used as good temporary cement as far as microleakage is concerned.

**Key words,** Microleakage, provisional cement, restorations, crowns, *in vitro*

### INTRODUCTION

There are number of fixed prosthodontic restorations or fixed partial dentures using metal and integral ceramics available for provisional restoration. During the process of provisional restoration, it is importantly taken into consideration that restorations adequately protects the pulp from peripheral stimuli, sustain the position of teeth, maintain correct occlusion and must be fabricated in such a manner which allow easy cleaning by patient (1). In addition , primordial factors which affect the success of restoration ; are remain stable in mouth until final restoration occur, no dislodgment should

be there as it can damage restoration, secondary factors which affect its stability are as pulpal and periodontal alterations, modifications in tooth positioning, cavities and social constraint. Though, the key to success is the selection of appropriate luting cement and cementation process.

Luting cement is basically used as temporary cementing media for provisional restorations. This cementation provides several clinical applications like providing aesthetic look, better for mouth hygiene, improved articulation in the mouth of patient, abutment teeth management, periodontal treatment and occlusal adjustments, dislodgment of teeth,

protection from caries and pulp (2,3,4,5). Temporary cementing acts as a cementing agent between restoration and the prepared tooth, linked them via some connection that could be combinatorial, mechanical and micro-mechanical types (6). This attachment is very important to avoid microleakage by mechanically locking the restoration to prevent abutment during chewing. Temporary cement used with provisional crowns particularly placed for long duration, become very prone to washout, responsible for marginal leakage, bacterial infiltration and caries.

Initially, temporary cements involve two essential types: the first type contains zinc-oxide eugenol and the other one is without zinc-oxide eugenol i.e. only zinc-oxide powder (7). Presence of eugenol in cementing agent obtund the pulp but interfere with the setting of acrylic resins and softens acrylic resins. Therefore, cementing material is usually prepared without eugenol by adding polyorganic acid and polycarboxylate formulation. This eugenol free temporary cementing have good strength, prevent microleakages and also easily removable from tooth preparation whenever required (8).

Main reason of microleakage is alterations in dimension of crown material which mainly occur due to polymerization reduction, thermal narrowing, inclusion of water and mechanical stress (9) and microleakage also takes place from marginal gap whenever innately weak provisional cement is used (10).

Several researcher evaluate the microleakage of provisional restorations cemented with a variety of temporary cements using *in vitro* studies with dyes (11,12). This is one of the easy and cheap method of assessing efficacy of cementing material as dye is more easily diffused than bacteria and their byproducts, dentinal fluid found in vital teeth, which have an affirmative pressure, and the settling of fibrinogen within the sectioned tubules may distinguish molecular infiltration (13).

Therefore, in the present work an *in vitro* study was planned and carried following standardized procedures out to compare the marginal microleakage of provisional crowns cemented with four temporary luting cements.

#### Materials and Methods:

In the present work, different cementing material like Zinc phosphate cement, Provisional eugenol free cement, Provisional calcium hydroxide and

Provisional ZOE were to study differential marginal leakage.

Patients's first premolars, extracted for orthodontic reasons with the same average crown size were selected after achievement of informed consent from the patients. The teeth were embedded in self-curing acrylic resin in cylindrical resin bases with the aid of a surveyor, so that the teeth were kept perpendicular to the cylinder base. For this purpose provisional restorations of standardized thickness (1.5mm) were fabricated with self-curing acrylic resin directly over the preparations with a brush (14), keeping the occlusal surfaces flat. Each tooth was prepared for a complete crown with a 1 mm shoulder. The provisional crowns were fabricated using the direct technique. For this purpose, standardized dimension of wax pattern was fabricated above the ready tooth by means of computer aided designing/computer aided manufacturing milling machine.

Thus prepared teeth were then thermocycled to imitate the oral atmosphere via water baths kept at 5°C and 55°C for subjecting the restoration to thermal stresses (15). After that, immersion of cemented temporary crowns were done in 2% methylene blue solution. The specimens were then embedded in the clear auto polymerizing acrylic resin following standardized technique using custom made metal jig. The standardized method for sectioning was followed and the sectioning of the specimens was done buccolingually through the middle of the ready specimen via diamond blade attached to die cutting machine subsequent the grooves on the surface of the resin. The sectioned specimens were then observed under stereomicroscope to assess the level of dye penetration. To record microleakage scale of (16) was followed:

- 0: No microleakage
- 1: Microleakage to one-third of the axial wall
- 2: Microleakage to two-thirds of the axial wall
- 3: Microleakage along the full length of the axial wall
- 4: Microleakage over the occlusal surface.

Obtained data were subjected to ANNOVA to know statistical significant difference between different groups. P value less than 0.05 was considered significant.

#### Results and Observations

The teeth with acrylic restorations were randomly divided into 6 groups of 6 specimens each. Each group received different types of temporary cement.

**Table I: Grouping of experimental provisional cement**

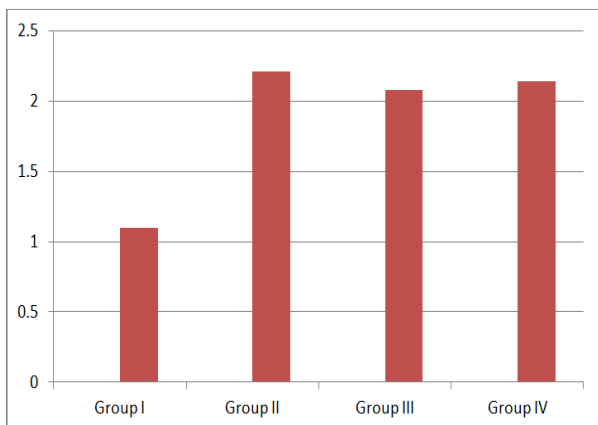
Group	Cement
I	Zinc phosphate cement
II	Provisional eugenol free cement
III	Provisional calcium hydroxide
IV	Provisional ZOE

Table I depicted the experimental grouping of different provisional cement.

**Table II: Comparison of microleakage among the four provisional cement**

Number	Group I (Mean±SD)	Group II (Mean±SD)	Group III (Mean±SD)	Group IV (Mean ± SD)
	1.10±.098	2.21±1.2	2.08± 1.76	2.14±0.99
P value	P<0.001	P<0.023	P<0.05	P<0.019
SE	0.14	0.35	0.18	0.24

\* $\chi^2 = 19.21$



**Figure 1: Frequency distribution of microleakage values (0, 1, 2, 3, 4) in each experimental group**

Results suggested that dye penetration is occurs in each group of provisional cementing at cement-dentine interface. However, little dye penetration seen at the interface of cement and resin by group I provisional cement i.e. Zinc phosphate cement. As compared to other provisional cement material Zinc phosphate cement showed good binding with acrylic resin crown.

The differences in the mean values among the treatment groups are great enough and data is statistically significant difference (P< 0.017).

**Discussion**

The important cause of fixed restoration failures is microleakage or marginal gap (17, 18). The quantity of cement exposed to oral fluids, which depends on the marginal gap, may be associated to cement dissolution. Microleakage is enhanced due to cement

dissolution, but another reasons of dissolution are mechanical characteristics of luting cement and involved adhesion between cement and tooth structure (19).

On the basis of specific physical properties and handling characteristics, there are number of criteria for the assessment of cement-retained implant restorations (20,21). Cement must have following characteristics: low viscosity for easy seating, easy to mix, extended working time, short setting time, insolubility in the mouth, high shear, tensile, and compressive strength, biocompatible, and radiopaque.

In addition, thermal cycle also produces additional strain on restorations and causing failure of weak bonds (15). However, less thermocycling is used in the present study to stop the microliakge due to this factor.

*In vitro* microleakage tests carried out with dyes are observed to be best to detect efficacies of provisional cement with crowns. The observation and results thus obtained was as accordance with the study done by (16).

In the present studies variation is microliakage is seen among the groups, might be due to differential interaction of different temporary cement (Zinc phosphate cement, Provisional eugenol free cement, Provisional calcium hydroxide IV and Provisional ZOE) with provisional crown material.

Several types of improved eugenol-free cements have been introduced that contain polyorganic acid, polycarboxylate, etc. These cements are used with the advantage that do not obstruct with definitive cementation and also have low film thickness. They have the features of being compatible with resin provisional materials, with permanent resin cements and show greater retention compared to ZOE cement (22).

Microleakage seen with all provisional cements under study occurred between biologic tissue and cement. While the weakness of this interface is necessary to permit simple elimination of the interim restoration from the teeth, this has an unfavourable effect on the marginal seal, consequently increasing microleakage. Cement dissolution is a time taking process, and most likely enhanced by cement microfractures (19). Hence, in this present study, effects of the mechanical resistance of cement was examined and its adhesion to the tooth rather than just the

consequences of cement dissolution in the microleakage process.

Thus, the selection of good provisional cement is also important with regard to the maintenance of the restorations. Imperfect cementing material causes complications such as microleakage from marginal gap, subsequent cavities and loss of the provisional restoration with consequent migration of antagonist and adjacent teeth may occur (23). Characteristics of provisional cements differ as to flow, setting time, film thickness, retention (24) and temperature (25). The temporary cement should set rapidly and give adequate maintenance for the provisional restoration (24). Hence, the retentive luting cement must be as to provide enough strength for retention of the provisional restoration, sealing of all retainers (24, 26,27) and simple elimination of the crown whenever required, not becoming more retentive with time (27).

#### References:

1. Fisher DW, Shillingburg HT, Dewhirst RB. Indirect temporary restorations. J Am Dent Assoc. 1971; 82:160-3.
2. Arfaei AH, Asgar K. Bond strength of three cements determined by centrifugal testing. J Prosthet Dent. 1978; 40: 294-298.
3. Gilson TD, Myers GE. Clinical studies of dental cements. III. Seven Zinc oxide-eugenol cements used for temporarily cementing completed restorations. J Dent Res. 1970;49: 14-20.
4. Moser JB, Brown DB, Greener EH. Short term bond strengths between adhesive cements and dental alloys. J Dent Res. 1974; 53:1377-1386.
5. Dinçkal N. Simanlar (Cements). Atatürk Üniv Di\_ Hek Fak Derg. 1993; 3: 57-62.
6. Strassler HE. Provisional Cements. Vol. 4. Dentalaegis.com: Published by AEGIS Communications Maryland. 2008;4:1-12.
7. Council on dental materials and devices. New American dental association specification No.30 for dental zinc oxide-eugenol type restorative materials. J Am Dent Assoc. 1977; 95:991-995.
8. Arora SJ, Arora A, Upadhyaya V, Jain S. 2016. Comparative evaluation of marginal leakage of provisional crowns cemented with different temporary luting cements: *In vitro* study. The Journal of Indian prosthodontic Society. 16 (1); 42-48.
9. Larson TD. The clinical significance and management of microleakage. J Minn Dent Assoc. 2005;84:9-15.
10. Sadan A. Clinical considerations in cement selection for provisional restorations - Part 1. Pract Period Aest Dent. 2000; 12:638.
11. Verma *et al.*, marginal accuracy of provisional restoration material used in fixed partial dentures an *in-vitro* study. Indian Journal of Dental Sciences. 2012; 4 (3):25.
12. Jacobs MS, Windeler, A.S. An investigation of dental luting cement solubility as a function of the marginal gap. J Prosthet Dent. 1991;65:436-442.
13. Pasley DH. Clinical considerations of microleakage. J Endod. 1990; 16: 70-77.
14. Trowbridge HO. Intradental sensory units: physiological and clinical aspects. J Endod. 1985; 11:489-98.
15. Wendt SL, McInnes PM, Dickinson GL. The effect of thermocycling in microleakage analysis. Dent Mater. 1992; 8: 181-4.
16. Tjan AH, Castelnuovo J, Shiotsu G. Marginal fidelity of crowns fabricated from six proprietary provisional materials. J Prosthet Dent. 1997;77:482-5
17. Lewinstein I, Fuhrer N, Gelfand K, Cardash H, Pilo R. Retention, marginal leakage, and cement solubility of provisional crowns cemented with temporary cement containing stannous fluoride. Int J Prosthodont. 2003; 16:189-193.
18. Gagliardi RM, Avelar RP. Evaluation of microleakage using different bonding agents. Oper Dent. 2002;27:582-586.
19. White SN, Inges S, Kipnis V. Influence of marginal opening on microleakage of cemented artificial crowns. J Prosthet Dent. 1994;71:257-264.
20. Nejatidanesh F, Savabi O, Ebrahimi M, Savabi G. Retentiveness of implant-supported metal copings using different luting agents. Dent Res J (Isfahan) 2012; 9:13-8.
21. Powers JM, Sakaguchi RL. Craig's Restorative Dental Materials. 12th ed., Mosby, Missouri, Elsevier. 2006; 386-93.
22. Diaz-Arnold AM, Vargas MA, Haselton DR. Current status of luting agents for fixed prosthodontics. J Prosthet Dent. 1999;81:135-41.
23. Shillingburg H. Fundamentals of Fixed Prosthodontics. 3<sup>rd</sup> ed. Co Inc., U.S, Chicago: Quintessence Publishing. 1997;225-56.
24. Millstein PL, Hazan E, Nathanson D. Effect of aging on temporary cement retention *in vitro*. J Prosthet Dent. 1991; 65:768-71.
25. Mesu FP. The effect of temperature on the compressive and tensile strengths of cements. J Prosthet Dent 1990; 21:197-200.
26. Stevens L. The properties of four dental cements. Aust Dent J. 1975; 20:361-7.
27. Lepe X, Bales DJ, Johnson GH. Retention of provisional crowns fabricated from two materials with the use of four temporary cements. J Prosthet Dent. 1999; 81:469-75.