Original Article

"A Comparison Of The Marginal Leakage Of Temporary Crowns Luted Using Temporary Cement Enriched With Three Different Additives"

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Abstract

INTRODUCTION: Dental caries stand a persistent issue in clinical practice. It has been observed that dental caries is the primary reason for the failure of fixed dental prosthesis. Poor marginal fit and under steady materials increases the chances of repetitive caries around long-lasting temporary restorations. With the aim to preserve teeth from bacteria, researches have suggested to incorporate antibacterial and anticariogenic properties to dental materials. The motive of this research is to analyze the outcome of incorporation of Hexidine mouthwash, Profluorid varnish and Listerine mouthwash, individually to a non-eugenol based provisional cement, on the microleakage of temporary acrylic crowns. **MATERIALS AND METHOD:** Ten extracted with proper anatomic maxillary first premolar teeth were selected. Tooth preparation was done using standardization. Tooth colored auto-polymerising acrylic resin were used to create 40 temporary crowns. The prepared provisional crowns were splitted up into 4 categories of 10 crowns. Crowns were cemented on the prepared teeth after enriching with the three solutions individually. All samples were stored in proper100% humidity with the temperature of 37°C for at least 1 hour, then thermocycled 100 times with the temperature between 5°C and 55°C for 10 seconds time, and then after kept in 100% humidity at temperature of 37°C. Samples were placed in a container of 0.5% basic fuchsin, after that placed in an incubator with the temperature 37°C for minimum 6 hours. Cemented crowns were undergone for tensile dislodgment force with crosshead speed of 5mm/min by operating universal testing machine. After crown detachment, microleakage was checked. Dye penetration with maximum depth through the margins of teeth and the axial walls of was examined using standardized examination system. **RESULT:** Temporary cement enriched with PROFLUORID VARNISH has shown least degree of dye penetration, and control group without additives was having the highest mean degree of dye penetration. **CONCLUSION:** The present study concluded that profluoride varnish as an additive in provisional cements is the most effective in decreasing microleakage when temporary crowns are luted with non-eugenol temporary cement (provicol).

KEYWORDS: - Provisional crown, Provisional cement, Microleakage, Dental Prosthesis

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INTRODUCTION: -

Fixed dental prosthodontics is the art and science of reinstating destructed teeth using all-metal, metal with ceramic, or all-ceramic restorations, and reinstating missing tooth or teeth by fixed dental prosthesis. Effectively

treating a patient through fixed dental prosthesis needs a considerable amalgamaton of so-many aspect for dental treatment that includes patient's knowledge as well as avoidance of other dental disease, proper check up, periodontal cure, operative expertise, occlusal considerations, and occasionally placement of complete removable denture or partial removable denture and endodontic cure.[1]

Fixed dental prosthesis using metal and ceramics requires a more trimming of dental tissue to achieve the good esthetic effect that causes the disclosure of so many dentinal tubules. These dentinal tubules are probable pathway for spreading and expansion of bacteria.[2] That why preservation of the prepared tooth or teeth until the final prosthesis is being fabricated, is very much needed for the everlasting victory of the therapy. Newly uncovered dentine is initially preserved by the temporary crowns.[3-5]

Marginal leakage is important parameter that may influence the success of a long-term temporary prosthesis. Failure is usually due to improper tooth preparation, bad fit of the prosthesis, or excursive occlusal encroaching.[6-8] Polymerization shrinkage of the acrylic resin creates a problem in the adaptation of the provisional prosthesis.

The luting cement should also have great mechanical properties, little dissoluble, and best adhesion to withstand bacterial and molecular infiltration because temporary crowns luted with temporary cements are prone to dental cement washout, microleakage, bacterial infiltration, and caries, especially when placed for a short period of time.[3]

In an effort to shield teeth from germs, scientists have looked into the idea of adding antibacterial chemicals to dental materials.[9-12] Antibacterial properties of restorative dental materials has been achieved by adding Chlorhexidine.[13] Evidence in vitro strongly suggests that anticariogenic potential of restorative materials has been achieved by adding fluoride.[14-18]. Listerine antiseptic helps to prevent and reduce supragingival plaque and gingivitis.[19]

This research is done to evaluate microleakage of temporary crowns which were made up of tooth colored auto polymerizing acrylic resin (DPI), cemented with Provicol (VOCO) provisional cement, enriched with three different additives- Hexidine, Profluorid varnish and Listerine.

NULL HYPOTHESIS: There is no effect on microleakage of provisional crowns luted with non-eugenol based provisional cement enriched with Hexidine mouthwash, Profluorid varnish and Listerine mouthwash.

AIM AND OBJECTIVES

AIM

The motive of the research is to differentiate the outcome of incorporation of Hexidine mouthwash, Profluorid varnish and Listerine mouthwash, individually to a non-eugenol based provisional cement, on the microleakage of provisional acrylic crowns.

OBJECTIVES

To determine the degree of dye penetration of temporary crowns luted with temporary cement enhanced with Hexidine mouthwash, Profluorid varnish and Listerine mouthwash.

MATERIALS AND METHOD: -

Study Design and Criteria

Ten extracted non carious maxillary first premolar teeth of adequate crown size and length were selected (Figure-1). Standardized tooth preparation was done along with shoulder margin of 1 mm. High speed dental hand piece clamped to surveying arm of Wills surveyor was then used to provide convergence angle of 12^0. This protocol was followed for each tooth.

A total of 40 temporary crowns were made using Tooth colored autopolymerising acrylic resin (DPI) using a direct technique (Figure-2). An anchoring hook was attached to the occlusal surface of temporary prosthesis to serve as a clamp to the universal testing machine. The prepared provisional crowns were divided into 4 groups of 10 crowns each. **Group A**: - Provisional crowns cemented with provisional cement (Provicol)

without additives (Control Group), **Group B**: - Provisional crowns cemented with provisional cement (Provicol) enriched with **Hexidine, Group C**: - Provisional crowns cemented with provisional cement (Provicol) enriched with **Profluorid Varnish, Group D**: - Provisional crowns cemented with provisional cement (Provicol) enriched with **Listerine**

A thin layer of Provisional cement (Provicol) was placed along margins of provisional crowns after enriching with the three solutions individually (Hexidine, Profluorid Varnish and Listerine) and the crowns were luted on the selected teeth after 30 seconds of mixing. A steady force of 50 N was then given using a universal testing machine for the first minute (Figure-3, 4).

All samples were kept at 37°C with 100% humidity for an hour before being thermocycled 100 times at temperatures ranging from 5 to 55°C (Figure 5) with dwell periods of 10 seconds and then stored in 100% humidity at 37°C. The samples were submerged in a solution of 0.5% basic fuchsin (Figure-6), and then put in an incubator at 37°C for 6 hours. The samples were then dried, cleaned, and kept at a relative humidity of 100% at 37°C for one week.

Cemented crowns were pulled out of the dye and subjected to tensile dislodgment force using a 5mm/min crosshead speed (Figure-7). Crown separation was followed by an evaluation of marginal leakage. According to a defined approach, the maximal dye penetration depth through the axial walls and margins was assessed. The level of dye penetration that was most severely noticed for each tooth was noted.

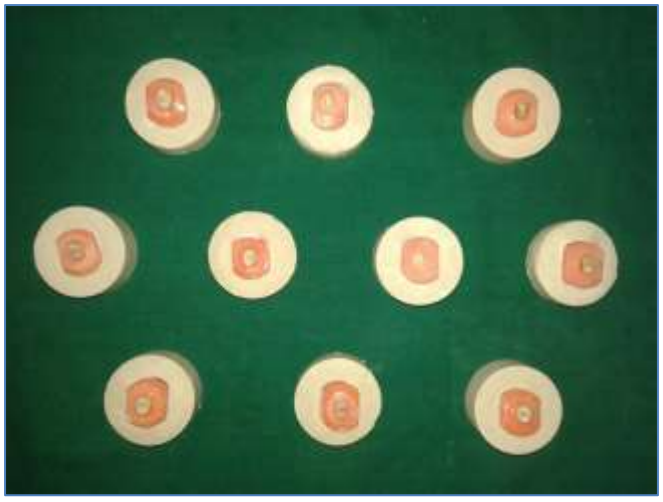
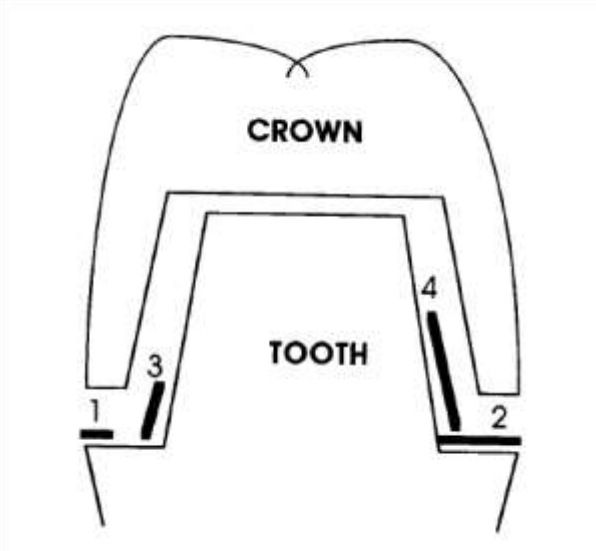


Fig.1: Ten Maxillary first premolars mounted in Acrylic supported by Dental Plaster.

Fig.2: 40 Provisional crowns made of Tooth Coloured Autopolymerising Acrylic Resin.

Fig.3: Universal Testing Machine. (Instron)

Fig.4: Specimen subjected to Load after Cementation in Universal Testing Machine.



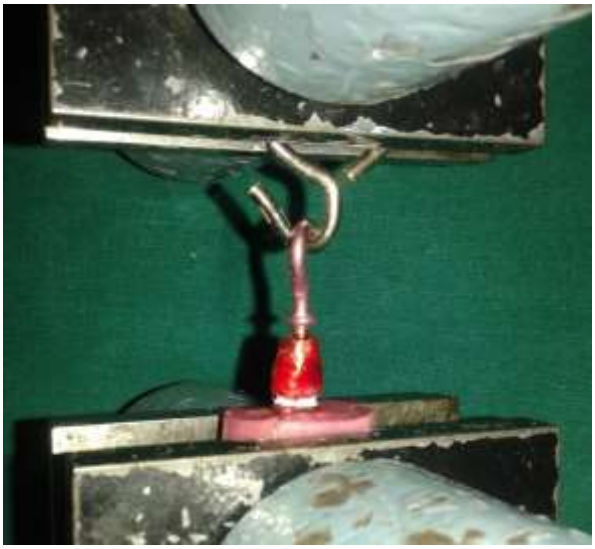


Fig.5: Thermocycling unit and Digital Thermometer

Fig.6: Solution of 0.5% basic fuchsin

Fig.7: Specimen subjected to dislodging forces in Universal Testing Machine.

Fig.8: Level of dye penetration

TESTING OF SPECIMENS

Testing for marginal leakage

Crown separation was followed by an evaluation of marginal leakage. The dye penetration assessment was carried out by two researchers who had undergone training and calibration for standards. According to a defined approach, the maximal dye penetration depth through the axial walls and margins was assessed. The level of dye penetration that was most severe for each tooth was noted. The following assessment criteria were used: (Figure-8)
0 = no penetration,

1 = penetration up to half the width of the shoulder margin,
2 = penetration to the full width of the shoulder margin,
3 = penetration up to a third of the axial wall, and
4 = penetration beyond a third of the axial wall.

STATISTICAL ANALYSIS

Degree of dye penetration obtained after testing were analyzed using one-way analysis of variance test (ANOVA), using a statistical software (IBM SPSS 22.0 software, SPSS Inc., Chicago, USA, IL) on a personal computer. For each group, the means and standard deviations were reported.

ETHICAL STATEMENT

This research was carried out under the ethical guidelines of the Institutional Research and Ethical Committee. Since this study was in vitro, hence it did not require ethical clearance.

RESULTS

Table 1: Shows initial data analysis by utilizing a one-way (ANOVA) analysis of variance test. It is showing the average values with standard deviations (SD) of the degree of Dye penetration of each group. Mean degree of Dye penetration with standard deviation (SD) in Group A : - Provisional crowns cemented with provisional cement (Provicol) without additives (Control Group), Group B : - Provisional crowns cemented with provisional cement (Provicol) enriched with Hexidine, Group C : - Provisional crowns cemented with provisional cement(Provicol) enriched with Profluorid Varnish, Group D : - Provisional crowns cemented with provisional cement(Provicol) enriched with Listerine were 3.10 ± 0.99, 2.80 ± 0.78, 1.90 ± 1.37, 2.30 ± 0.82 respectively. . In all group the descending order of mean degree of Dye penetration were Group A (3.10 ± 0.99) > Group B (2.80 ± 0.78) > Group D (2.30 ± 0.82) > Group C (1.90 ± 1.37). Group C : - Provisional crowns cemented with provisional cement(Provicol) enriched with Profluorid Varnish showed the lowest mean degree of Dye penetration, and Group A : - Provisional crowns cemented with provisional cement (Provicol) without additives (Control Group)was having the highest mean degree of Dye penetration The result indicate that there was a significant influence (Table-2) of the additives on the microleakage of the temporary crowns luted with provisional cement. Microleakage was lowest for Group C: - Provisional crowns cemented with provisional cement (Provicol) enriched with Profluorid Varnish. (Graph-1)

TABLE 1: Initial data analysis by using a one-way (ANOVA) analysis of variance test for Degree of Dye Penetration.

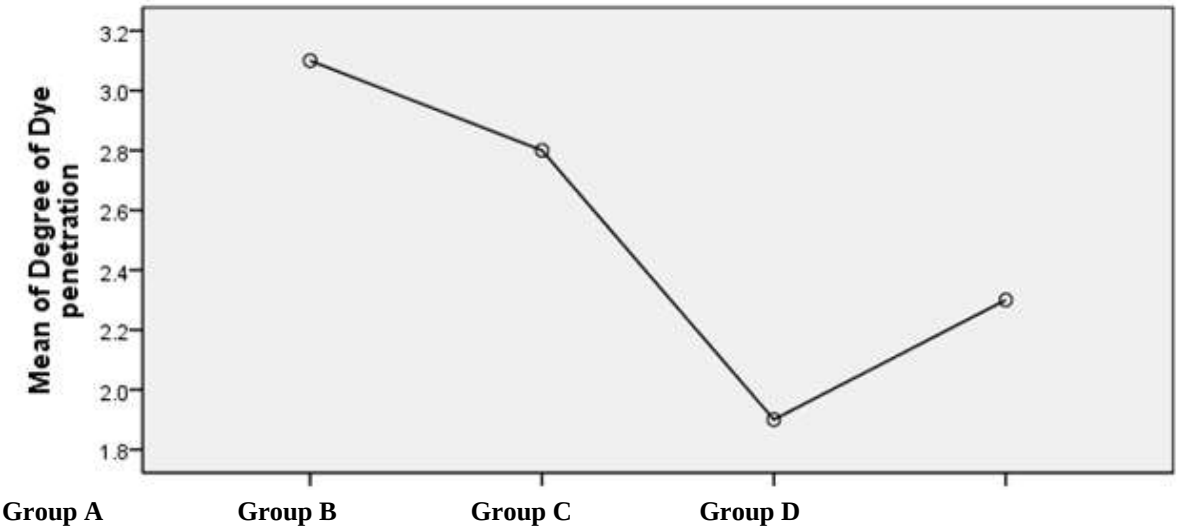
Groups	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Group A	10	3.10	0.994	0.314	2.39	3.81	2	4
Group B	10	2.80	0.789	0.249	2.24	3.36	1	4
Group C	10	1.90	1.370	0.433	0.92	2.88	0	4
Group D	10	2.30	0.823	0.260	1.71	2.89	1	4
Total	40	2.53	1.086	0.172	2.18	2.87	0	4

TABLE 2: Significance as determined by tukey's post hoc test with multiple comparisons between Degree of Dye penetration for the different groups

Group (I) Numbers	Group(J) Numbers	Mean Difference (I-J)	Std. Error	Significance	95% Confidence Interval	
					Lower Bound	Upper Bound

Group A	Group B	0.300	0.456	0.912	-0.93	1.53
	Group C	1.200	0.456	0.058	-0.03	2.43
	Group D	0.800	0.456	0.312	-0.43	2.03
Group B	Group A	-0.300	0.456	0.912	-1.53	0.93
	Group C	0.900	0.456	0.217	-0.33	2.13
	Group D	0.500	0.456	0.695	-0.73	1.73
Group C	Group A	-1.200	0.456	0.058	-2.43	0.03
	Group B	-0.900	0.456	0.217	-2.13	0.33
	Group D	-0.400	0.456	0.817	-1.63	0.83
Group D	Group A	-0.800	0.456	0.312	-2.03	0.43
	Group B	-0.500	0.456	0.695	-1.73	0.73
	Group C	0.400	0.456	0.817	-0.83	1.63

GRAPH 1: Comparison between mean values of degree of Dye penetration for the different groups.



DISCUSSION: -

The repair and replacement of teeth with artificial replacements that the patient cannot remove from their mouth is the focus of fixed dental prosthodontics. Its focus is to restore, comfort, function and esthetics for the patient. Fixed dental prosthodontics can offer extraordinary satisfaction. The replacement of missing teeth using fixed dental prosthesis has many advantages over removable dental prosthesis.20,21 They are more stable during function, less traumatic to the soft tissues and more accepted by the patient. It is therefore the good treatment option whenever possible.

There are a number of factors affecting the failure of a fixed dental prosthesis, marginal leakage being one of them.The clinically undetected movement of germs, fluid, chemicals, or ions between a tooth and the restorative that has been placed on it is known as marginal leakage. It is a multifaceted problem. It is affected by various factors like preparation design, casting itself, cementation technique and the temperature changes.22,23

Temporary restorations, like as temporary crowns, are crucial in permanent dental prosthodontics therapy for a variety of reasons, such as safeguarding the pulp from external impulses, maintaining the right position of the teeth, and maintaining proper occlusion and aesthetics. Temporization is commonly necessary for days to several months for patients undergoing extensive prosthodontic therapy. This is primarily true when assessing changes in function, occlusal vertical dimension, aesthetics, or when crown lengthening has been necessary.24-28 Patients who undergo full mouth rehabilitation may need interim restorations for many months.

In this research, chlorhexidine was used as one of the additives. The present study represents increased marginal leakage (Table-1), although it was statistically not significant (Table-2) when temporary crowns were luted with

temporary cement enhanced with hexidine when compared with control group. Whereas previous study by Lewinstein29 showed no change in marginal leakage.

the antibacterial properties of permanent cement polycarboxylate mixed with chlorhexidine gluconate has been evaluated by Schwartzman and Caputo30. They had discovered that the antimicrobial effect of polycarboxylate cement can be increased by adding chlorhexidine gluconate. Ribeiro and Ericson31 added chlorhexidine in glass ionomer cement and examined its antibacterial effect but did not study the effect of adding chlorhexidine in marginal leakage of cemented crowns.

Another additive added to temporary cement in this study was profluorid varnish. Previous in vitro studies suggest that materials who has the tendency to release fluoride have anticariogenic properties. The addition of profluorid varnish to temporary cement in this study lead to decreased marginal leakage (Table-1) when compared to control group or any other group. This is a result of the varnish's beneficial characteristics, which produce a viscous, sticky coating that attaches to the acrylic resin or luting agent on one side and the tooth surface on the other. This viscous coating may act as a long-lasting sealer and lessen marginal leakage in temporary crowns. These results are further supported by Lewinstein's study. He used duraphat fluoride varnish (Colgate Palmolive India Ltd) as an additive in provisional cement and found decreased marginal leakage. While Lewinstein29 used temporary cement containing eugenol and in present study non-eugenol cement was used, which accounts for increased strength.

The American Dental Association Council has authorised Listerine, an antiseptic on Dental Therapeutics, to aid in preventing and treating gingivitis and supragingival plaque. Listerine who acts as antiseptic is approved by the ADA council on Dental Therapeutics to help prevent and reduce gingivitis as well as supragingival plaque. This study showes that when temporary crowns were cemented with temporary cement added with Listerine, the marginal leakage decreased as compared to control group, but it was more compared to those cemented with provisional cement enriched with profluorid varnish. There are no studies in literature regarding addition of Listerine as an additive in provisional cements to compare results as Listerine is an antiseptic solution and its main effect is plaque control.

Hence the present study concluded that profluoride varnish as an additive in provisional cements is the most effective in decreasing microleakage when temporary crowns are luted with non-eugenol temporary cement (provicol).

CONCLUSION: -

Provisional cement enriched with PROFLUORID VARNISH has shown least degree of dye penetration, profluorid varnish demonstrates to be the best additive and provisional cement provicol enriched with profluorid varnish can be regarded as best cement for the purpose of cementing provisional crowns. It has proved to be the cement of highest benefit by having magnificent properties of least microleakage hence can be promoted in clinics as this is the property being looked for cements in practice.

LIMITATIONS: -

In this present study, the effect of incorporation of Hexidine mouthwash, Profluorid varnish and Listerine mouthwash, individually to a non-eugenol based provisional cement, on the microleakage of temporary acrylic crowns has been checked, but certain other aspects can be taken into consideration and more studies can be carried out in this regard.

Effect of incorporation of Hexidine mouthwash, Profluorid varnish and Listerine mouthwash, individually to a non-eugenol based provisional cement, on the retention of temporary acrylic crowns can be evaluated. Further studies can be done using eugenol based provisional cement instead of non- eugenol based provisional cement, permanent cement instead of provisional cement, permanent crown instead of provisional crown.

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