Original Article

International Journal of Dental and Health Sciences
Volume 03,Issue 06

IN VITRO COMPARISON OF RETENTION AND MARGINAL LEAKAGE OF PROVISIONAL CROWNS CEMENTED WITH PROVISIONAL CEMENT ENRICHED WITH THREE DIFFERENT ADDITIVES

Uthappa Malchira Aiyappa[1], Mansi Nautiyal[2], Gana Gangamma[3], Basavaraj S Salagundi[4], Rupesh P L[5]
1.Reader, Department of prosthodontics,Coorg institute of dental sciences, Virajpet, Karnataka
2. Post graduate student, Department of prosthodontics,Coorg institute of dental sciences, Virajpet, Karnataka
3. Post graduate student ,Department of periodontics ,Coorg institute of dental sciences, Virajpet, Karnataka
4. Professor, Department of prosthodontics,Coorg institute of dental sciences, Virajpet, Karnataka
5. Professor, Department of prosthodontics,Coorg institute of dental sciences, Virajpet, Karnataka

ABSTRACT:

A number of studies have been conducted to analyze the retention and marginal leakage of temporary cements with addition of Chlorhexidine Gluconate and Fluoride varnish. However, results drawn from these studies were conflicting. The aim of this study was to evaluate the retention and marginal leakage of the cement after it has been enriched with different additives. Forty samples were prepared and divided into four groups (Control, Chlorhexidine, Fluoride and Listerine). The crowns were cemented to the prepared tooth using a temporary cement (Freegenol) as control and after the addition of three different additives to their respective groups. The samples were immersed in gentian violet stain for 24hrs and were subjected to retention testing in a universal testing machine. Later the tested specimens were viewed under a Labovision stereo microscope to check the amount of marginal leakage. Statistical analysis was done using ANOVA and t test. It was found that addition of different liquids (Chlorhexidine, Fluoride, Listerine) increased the retentive capacity of temporary cement used, but addition of Listerine also increased the marginal leakage of the test specimens.

Key words: Retention, Marginal leakage, Chlorhexidine gluconate, Bifluoride varnish, Listerine

INTRODUCTION

Provisional fixed Prosthodontics treatment involves a multifaceted array of clinical activities, special knowledge, material selection and management. There are multiple areas of critical concern with provisional restorations including esthetics, comfort, speech, function, periodontal health and maxillomandibular relationship [1]. Biological demand is that the prepared teeth are to be protected and stabilized, with provisional restorations that resemble the form and function of the planned definitive treatment[2]. Provisional restorations are also used for diagnostic purpose to identify an optimum treatment outcome[3,4]. They must be nontoxic, provide pulpal protection, have smooth finish, resist fracture from occlusal forces, be rigid, esthetically acceptable, easy to fabricate, readily modified and cost effective[5,6]. Clinical situations may sometimes dictate the need for long-term provisional restorations. Therefore, it may be required to place them with provisional cement for an extended period. Since provisional crowns luted with provisional cements are susceptible to cement washout, marginal leakage, bacterial

*Corresponding Author Address: Dr. Uthappa Malchira Aiyappa. E-mail: docprathith11@gmail.com

infiltration, and caries, especially when placed for longer than a few weeks. The luting agent should also have good mechanical properties, low solubility, and good adhesion to resist bacterial and molecular penetration [7,8]. The properties of temporary cements vary as to flow, setting time, film thickness, retention and temperature[9]. The temporary cement should set quickly and provide enough retention for the provisional restoration to be properly maintained during function. A number of studies have been conducted to analyze the retention and marginal leakage of temporary cements with addition of Chlorhexidine Gluconate and Fluoride varnish. But, the results drawn from these studies were conflicting. The purpose of this study was to evaluate the retention and marginal leakage of the cement after the cement has been enriched with different additives.

MATERIALS AND METHODS

Specimen preparation

Forty intact maxillary first premolars with ideal crown lengths were collected. These teeth were mounted into a metal jig filled with impression compound (PINNACLE, DPI, Mumbai, India) with the aid of a surveyor, so as to enable the specimen to be mounted parallel to its long axis.

Tooth preparation

In order to obtain uniform taper for the preparations a clamp was fabricated, to secure a high speed air-rotor handpiece (NSK, Japan) to the surveyor. This clamp maintained the handpiece in a constant relationship with the horizontal arm of the surveyor (Fig 1). Its vertical position could be adjusted with the vertical arm of the Jelenko surveyor. The metal jig with the mounted specimens was secured to the surveying table prior to tooth preparation. Occlusal surface of the premolars was prepared to a depth of 1mm. Axial reduction was done of 1.5 mm with the aid of a diamond bur. The hand piece was then secured to the clamp on the vertical arm of the surveyor. The orientation of the hand piece and the convergence of the diamond bur ensured a constant taper to all the preparations.

Crown fabrication:

The prepared specimens were mounted into autopolymerising acrylic (DPI self cure tooth moulding powder, Mumbai, India). The finish lines were placed above the acrylic resin. All the mounted specimens were trimmed and made into acrylic blocks of size 1cm×2cm. The acrylic crowns were fabricated by a single operator to prevent inter operator variation. Uniform thickness of the crowns near the margins of the prepared teeth was maintained. A loop was made on the occlusal aspect of the crown to aid in stabilizing the specimen to a hook in the universal testing machine (INSTRON, model-h 50K M, Hounsfield, UK). The test specimens were randomly arranged and divided into four groups of ten specimens each. Each group was colour coded to aid in differentiating the specimens.

Cementation of the crowns

The two paste system of Freegenol cement (GC Corporation Tokyo, Japan) was dispensed. For each one inch of the cement

dispensed 10 micro liters of the three additives Fluoride varnish (BIFLUORID 12, VOCO, Cuxhaven, Germany), Chlorhexidine (HEXIDENE, ICPA healthcare Products Ltd, India) and Listerine (Johnson & Johnson Limited, Bangalore, India) were added. Once the cement was mixed it was loaded into the individual crowns and cemented on to the prepared tooth. The crowns were stabilized with digital pressure until setting time. All the specimens were immersed in gentian violet laboratory dye for a period of 24 hours after final set of the cement.

Retention testing

The retention test for all the samples were performed on an INSTRON automated universal testing machine (Fig 2). One of the jaws of the load cell grasped a hook at one end and the other grasped the test specimen block. The load cells were moved apart at the designated cross-head speed of 0.5mm/minute. A vertical tensional force was applied on the crowns and the tooth until the crowns were dislodged from the prepared tooth. The readings were directly recorded from the machine, for each of the specimens.

Test for marginal leakage.

The specimens which were retrieved form the retention testing were viewed under a Labovision Stereo Microscope. The microscope had a built in camera, from which standardized photographs of the dye penetration into the crowns were captured. The photographs from the camera was calibrated by 10 x magnification eye piece, 1 x zoom and the camera being standardized to a 3 x optical zoom The amount of micro leakage was observed only on the crown and tooth interface. The pictures thus obtained from the microscope were transferred to a personal computer having Dewinter Biowizard 4.1 Software (fig 3). The readings from the universal testing machine and the software were subjected to statistical analysis.

RESULTS

This study evaluated the tensile bond strength and dye penetration of Freegenol cement only, and when the cement is enriched with three different additives.

Graph 1 shows the distribution of tensile bond strength in newtons among all the four groups. It was seen that the highest mean value of chlorhexidine group (22.1) followed by fluoride (18.2) and Listerine (12.0) groups . The control group showed the least mean value of 9.6. The retention of four groups were compared with each other in table 1. It was seen that the specimens in which Chlorhexidine was added showed the highest mean value (22.10). This was followed by fluoride varnish (18.200) and Listerine (12.00). The control group (9.6000) had the least mean value in this study.

The marginal leakage among all the four groups was compared in graph 2. It was seen that the highest mean value (2.204) of Listerine, followed by control group (1.563), chlorhexidine (0.441). The fluoride group showed the least amount of marginal leakage with the mean value of 0.356. It was seen that the mean values as shown in table 2 are the maximum for Listerine (2.204) followed by control group (1.535),

Chlorhexidine (0.4414) and least in case of Fluoride varnish (0.37526) group.

The comparison in the retention between the groups was done using independent sample t test. The results showed a statistically highly significant difference ($p<0.001$) between Control/Chlorhexidine and Control/Fluoride groups. It was also seen that the difference between Control / Listerine and Chlorhexidine / Fluoride was not statistically significant ($p >0.05$).

For comparing the marginal leakage between the groups, the independent sample t test results showed statistically highly significant difference ($p< 0.001$) between Control/Chlorhexidine, Control/Fluoride, Chlorhexidine/ Listerine and fluoride/ Listerine. It was seen that the difference in marginal leakage between Chlorhexidine and Fluoride was not statistically significant ($p >0.05$).

DISCUSSION :

Clinical situations may dictate the need for long-term provisional restorations. Provisional crowns cemented with provisional luting agents are susceptible to cement washout, marginal leakage, bacterial infiltration, and caries, especially when placed for prolonged periods [7]. This in vitro study compared the marginal leakage as well as the retention of temporary crowns cemented with a provisional luting agent enriched with chlorhexidine gluconate 0.2%, Listerine and fluoride varnish respectively. Addition of Chlorhexidine to restorative dental materials to enhance its antibacterial properties has received much attention [7]. The Fluoride varnish (Bifluoride 12) used in this study is a synthetic resin composed mainly of sodium and calcium fluoride. Listerine is a commercially available mouth wash and is composed of volatile oils such as Thymol, Menthol, Benzoic acid and Eucalyptus. Crowns cemented with a luting agent enriched with Chlorhexidine Gluconate exhibited the highest retention followed by those cemented when the luting agent were enriched with fluoride varnish. The result concurs with those of studies by Lewinstein et al and Fuhrer N et al. Lewinstein et al in an in vitro study found that incorporating Chlorhexidine Diacetate into provisional cements increased the retention of provisional crowns by three folds as compared to provisional cements without additives [7]. In another study by Lewinstein I et al, a twofold increase in the retention of provisional crowns was observed when they were cemented with provisional cement enriched with fluoride varnish [10] . An in vitro study by Lewinstein I et al, found that the incorporation of SnF_2 significantly increased the retention capacity of Freegenol and Tempbond NE (provisional cements) [10]. The increase in retention upon incorporating these additives remains unexplained, however one of the reasons for increased retention according to Lewinstein I et al is that Freegenol is an acid-base oxide cement, when Fluoride varnish is added, it might react with the non eugenol cement to create a stronger structure while there would be no effect on eugenol type cement [11]. Micro leakage was observed in all the provisional crowns tested in the current study. The marginal

leakage was tested on the cement and tooth interface. Cement dissolution is a slow process, and probably could take place only later, enhanced by cement microfractures. Therefore this study mainly examined the effects of the mechanical resistance of cement and its adhesion to the tooth rather than just the consequences of cement dissolution in the microleakage process [8].

The results of the present study demonstrated that the crowns cemented with Fluoride enriched cement showed the least amount of marginal leakage followed by those cemented with Chlorhexidine enriched cement. However, those which were cemented with Listerine enriched cement showed an increase in the marginal leakage. According to Lewinstein et al, fluoride varnish when added to cement created a sticky, viscous layer which served as an effective long term sealant and thus reduced marginal leakage in provisional crowns. With certain luting agents such as Temp-Bond, fluoride varnish with its sticky consistency altered the surface characteristics of the luting agent to increase adherence between the crown and tooth structure, resulting in greater retention [10].

In another study by Lewinstein et al following the addition of SnF_2, the solubility and disintegration of zinc oxide eugenol cement increased fourfold, zinc oxide noneugenol cement increased sixfolds, and Freegenol (cement used in the current study) increased sevenfold. An increase in solubility of the cement may improve its antibacterial properties by releasing fluoride, thereby reducing the demineralization of the tooth substance [11]. From the results of the current study it can be said that Fluoride and Chlorhexidine when added to the provisional cement improved the resistance to marginal leakage considerably. But the addition of Listerine interfered with the basic physical properties of the cement and increased the marginal leakage.

The limitations to this in vitro study are, the methodology used does not directly simulate the intraoral situation with regard to forces, saliva, and leakage of different bacteria. Thermocycling was not carried out to simulate the oral atmosphere. The duration of cement contact on the tooth surface was only for 24 hours before it was subjected to retention testing. The time period for the dye penetration was very short.

CONCLUSION

Within the limitations of this in –vitro study the following conclusions were drawn.

1. The retention of crowns cemented with temporary cement enriched with additives (chlorhexidine mouth wash, fluoride varnish and Listerine mouthwash) demonstrated enhanced retention compared to crowns cemented with temporary cement without additives.

2. The addition of chlorhexidine resulted in the greatest improvement in the retention of the crowns, followed by temporary cement enriched with fluoride varnish.

3. The addition of Listerine to the temporary cement resulted in improvement in the retention of crowns but this improvement was the least in comparison to cement enriched with other additives.

4. However the addition of Listerine resulted in the highest marginal leakage in comparison to all the other study groups. It demonstrated values which were even greater than those seen with crowns cemented with temporary cement without additives.

5. The addition of fluoride varnish demonstrated the greatest reduction in the marginal leakage.

6. Addition of chlorhexidine to temporary cement also resulted in reduction in the marginal leakage in comparison to cement without additives.

REFERENCES:

1. Burns DR et al. Review of selected dental literature on contemporary provisional fixed prosthodontics treatment: Report of the committee on research in fixed prosthodontics of academy of fixed prosthodontics. J.Prosthet.Dent 2003; 90: 6474-97.
2. Fox CW et al. Provisional restoration for altered occlusion. J Prosthet Dent1984; 52:567-72.
3. Lowe RA. The art and science of provisionalization. Int J Periodontics restorative Dent 1987; 7:64-73.
4. Baldissara P et al. Comparative study of the marginal microleakage of six cements in fixed provisional crowns. J Prosthet Dent1998; 80:417-22.
5. Fedrik DR. The provisional fixed partial denture. J Prosthet Dent1975; 34:520-6.
6. Krug RS. Temporary resin crowns and bridges. Dent Clin North Am1975; 19:313-20.
7. Lewinstein I et al. Retention and marginal leakage of provisional crowns cemented with provisional cements enriched with chlorhexidine diacetate. J Prosthet Dent 2007; 98:373-378.
8. Baldissara P et al. Comparative study of marginal microleakage of six cements in fixed provisional crowns. J Prosthet Dent 1998; 80:417-22.
9. Rego MRM, Santiago LC**.** Retention of provisional crowns cemented with eight temporary cements .comparative study. J Appl Oral Sci 2004; 12(3): 209-12.
10. Lewinstein I et al. Effect of a fluoride varnish on the margin leakage and retention of lutedprovisional crowns. J Prosthet Dent 2003; 89:70-5.
11. Lewinstein I et al. Retention, Marginal Leakage, and Cement Solubility of Provisional Crowns Cemented with Temporary Cement Containing Stannous Fluoride. Int J Prosthodont 2003; 16:189–193.

FIGURES:

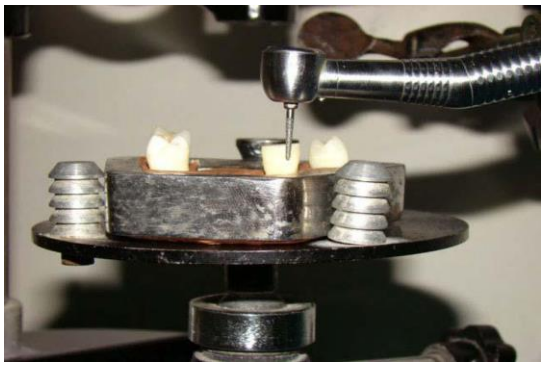

Fig-1: Tooth preparation using a airotor handpiece fixed to the surveying arm.

Fig- 2 : Universal testing machine with the specimens fit to the jaws for testing.

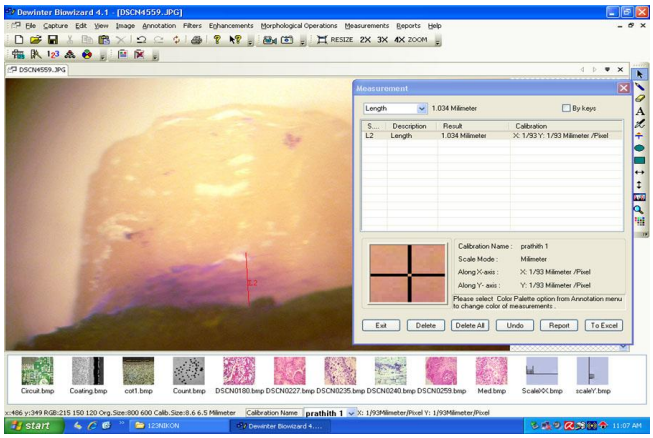

Fig 3. Labovision Stereo Microscope with Dewinter Biowizard 4.1 software showing marginal microleakage.

TABLES:

Table – 1 : Mean value, standard deviation and standard error for four different groups in retention test.

	N	Mean	Std. Deviation	Std. Error
CONTROL	10	9.6000	2.54733	.80554
CHLORHEXIDINE	10	22.1000	8.84998	2.79861
LISTERINE	10	12.0000	4.64280	1.46818
FLOURIDE	10	18.2000	6.44291	2.03743
Total	**40**	**15.4750**	**7.69611**	**1.21686**

Table – 2: Mean value, standard deviation and standard error for four different groups in marginal leakage test

	N	Mean	Std. Deviation	Std. Error
CONTROL	10	1.5635	.68179	.21560
CHLORHEXIDINE	10	.4411	.62376	.19725
LISTERINE	10	2.2040	.37526	.11867
FLUORIDE	10	.3564	.38111	.12052
Total	**40**	**1.1412**	**.93916**	**.14849**