



## The Effect of Eugenol-Free Temporary Cement's Remnants on Retention of Full Metal Crowns: Comparative Study

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### ABSTRACT

**Introduction:** The aim of this study was to evaluate the effects of eugenol-free temporary cement's remnants on the retentive strength of full metal crowns luted via zinc phosphate and resin cement (Maxcem) to the tooth structure.

**Materials and methods:** Forty complete standardized Ni-Cr crowns in four groups were cemented by two types of permanent cements: zinc phosphate cement and resin cement (Maxcem). In the two groups before permanent cementation of crowns, temporary acrylic crowns were cemented by eugenol-free temporary cement. Crowns' retention was evaluated by Universal testing machine. All data were analyzed by means of one-way ANOVA test in SPSS software version 11.5 ( $\alpha = 0.05$ ).

**Results:** There was no significant difference in groups with prior using eugenol-free temporary cement and groups with just using two permanent cements ( $p$ -value  $\geq 0.05$ ).

**Discussion:** The application of temporary cement before permanent cementation of full metal crowns does not have any adverse effect on retention of full metal crowns, when temporary cements are removed properly.

**Keywords:** Full metal crowns, Retention, Permanent cement, Temporary cement.

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### INTRODUCTION

The effective factors in retention and resistance of fixed casted restorations are: primary factors and secondary factors. Primary factors include the convergence rate of tapers, the length of exfoliation surface, surface areas, limiting replacement and placement's paths, correct exfoliation and finally the quality of surface exfoliation. Secondary factors are: grooves, boxes and pinholes.<sup>1</sup> Using

cements is another effective factor in retention of restoration. Cements have variety of types but they make retention in three important binding way:<sup>2</sup> mechanical (like nonadhesive cement), micromechanical bindings and molecular adhesions. Depends on situations, combination of these bindings are used for cementing restoration casts temporarily.<sup>3</sup> For allowing both patient and dentist to evaluate beauty and functions of these fixed casted restorations (crowns and bridges), they are cemented by temporary cements.<sup>4</sup> Also temporary cements could often have medicinal effect in reducing dental sensitivities after exfoliation.<sup>5</sup>

Some temporary cements have eugenol which is a radical residue like other phenolics and can penetrate in dentin.<sup>8</sup> Substances like phenolics prevent the polymerization of resin substances.<sup>6,7</sup>

Some contradictory results have been released about strength of binding to the dentin after placement of zinc oxide eugenol but recent researches represent that eugenol-free cements do not decline the strength of dentin binding.<sup>9</sup> In spite of those contradictory reports,<sup>10,11</sup> it has been cleared that eugenol-free cements do not decrease the strength of binding to permanent cement in comparison with healthy dentin<sup>9,12</sup> or freshly prepared dentin.<sup>13</sup> Woody and Davis stated that most negative effects in retention are not expressed by eugenol and the major reason is existence of cement's remnants. They declared that removing temporary cements mechanically is not very much effective<sup>14</sup> and cement's remnants can be spotted by microscope on surfaces which might have been considered clean in macroscopic views.<sup>13,15</sup> So lots of efforts have been done to omit cement's remnants.<sup>10,13,16</sup>

Bayindir et al did an investigation to study the differences between temporary eugenol and eugenol-free cements in retention of permanent cementation and also stiffness of the composite cores. They evaluated retention in crowns which were cemented provisionally with eugenol

and also eugenol-free temporary cements on composite cores and finally did permanent cementation with resin retentive cement. They stated that temporary cementation with eugenol causes a remarkable decrease in retention of resin cement in comparison with eugenol-free temporary cements.<sup>17</sup>

Yim et al studied the impact of dentin desensitizer on the crowns' retention with four types of cements: (i) glass ionomer cement, (ii) glass ionomer cement refined with resin, (iii) zinc phosphate cement, (iv) resin cement. They declared that using Gluma desensitizer causes a significant retention decrease in all different types of cement while using All bond 2 desensitizer along side with resin cement and refined glass ionomer causes a significant retention increase in all crowns.<sup>18</sup>

Johnson et al did a study to find out the impact of resin-based sealer—reduces the sensitivity of vital tooth after exfoliation—on retention of crown by using three types of cements. They showed that using resin sealer and zinc phosphate cement caused 42% retention decrease in crowns whereas using resin sealer with glass ionomer cement results in 55% retention increase in samples. They mentioned that samples which were cemented with resin cement lead to fracture while forcing instead of crown separations.<sup>19</sup>

The purpose of this study is to survey the impact of temporary cement's remnants on the retention of final restoration which were cemented with zinc phosphate cement and Maxcem cement. This survey would be reliable and other methods like chemical detergents such as various types of acids, pumice using, etc. not be necessary if retention decrease in final metal crowns were not notified after omitting temporary cement's remnants.

## MATERIALS AND METHODS

In this experimental study, 40 extracted human molars without any decay or fillings were selected, cleaned and kept in distilled water in the temperature of 23°C. For increasing retention, several grooves were made on the roots of teeth by a separator disk. Also self-cure acrylics and pistons of disposable syringes were used for fixing, then vertical axis of each tooth were placed parallel to the vertical axis of syringe's piston by a survivor and then were fixed in syringe.

The teeth were divided into four groups with 10 pieces in each of them randomly and they were named A, B, C and D. Occlusal surfaces were cut to the deep part of occlusal grooves by the separator disk and height of rest crowns became 4 mm so no enamel remained and dentin surface emerged.

After that axial walls of crowns were exfoliated by milling machine and prepared teeth were molded with condensational silicon impression material (putty and wash) based on two-stage impression method. In the next stage, impressions were casted by die stone, prepared and were ditched. Wax-cylinder pattern were shaped by one ring on the occlusal surface of dies. Finally 40 standardized Ni-Cr crowns were made according to usual laboratory methods. Required adjustments were made on casted crowns after considering inner surfaces of crowns and adopted. Furthermore temporary crowns were created for each sample with using self-cure acrylics and condensation silicone impression material.

These following procedures were done for cementing the crowns: In the first group (A) provided temporary crowns were cemented with eugenol-free temporary cement and were placed accurately by a gentle pressure. After 1 hour, temporary crowns were excluded from teeth and temporary cement's remnants were removed from the surface of teeth by an excavator. Afterward, teeth were rinsed with water syringes and dried with air. The final casted crowns were cemented on the provided teeth with zinc phosphate cement. Each crown was placed on the teeth by gentle pressure of finger and after that 98 N was forced to the crowns by a 10 kg weights in order to exclude extra cement. In the second group (B) crowns were cemented only with zinc phosphate cement based on the same method of first group.

In third group (C) just like first group, provided temporary crowns were cemented on the samples with temporary cement and after dislodging them, final crowns were cemented with Maxcem cement. So cement was placed directly in the crowns and also all other prepared surfaces of tooth, then restoration placed slowly on the tooth to allow cement flow through all possible margins. After correct placing of the restorations, crowns were forced by 98 N power of 10 kg weights, so that extra cement gets excluded. Extra cement was excluded in form of gel 2 to 3 minutes later and margins of crown were cured for 20 seconds.

In the fourth group (D) crowns were cemented only with Maxcem just like the procedure of third group, and samples were kept in distilled water for 24 hours in the temperature of 37°C, then they were transferred to the thermocycler machine in order to receive 1,500 thermic cycles between 5 and 55°C and 1 minute staying in each of them.

In the next stage, the samples remained in distilled water for 2 hours and after exiting them, crown's retention were measured by Universal Tensile Testing Machine. So in this step, they were placed into the machine in the way that clamps of immobile part fixed basis of samples and the mobile part forced tensile power with the speed of 0.5 mm/min by a

ring which was provided on the occlusal surface. The tension has been continued until dislodging the crowns from teeth. The machine had the capability to measure the minimum power at the point of dislodging. So after gathering data, mean and standard deviation were calculated and results were statistically analyzed by ANOVA in SPSS software version 11.5 ( $\alpha = 0.05$ ).

## RESULTS

The results of analyzing the mean retention have been shown in Table 1. Statistical one-way ANOVA has shown no significant difference between the mean retention strength among those with prior use of temporary cement (first and third group) and those without prior use of temporary cement (second and fourth group) ( $p$ -value = 0.442). Also statistical one-way ANOVA which can distinguish type of permanent cement showed that there was no significant difference in average retention power between resin phosphate cement groups (first group with prior using of temporary cement and second group without prior using of temporary cement) ( $p$ -value = 0.782). Moreover, there was no remarkable difference in mean retention power between Maxcem cement groups which refers to third group with prior using of temporary cement and fourth group without prior using of temporary cement ( $p$ -value = 0.174).

For increasing attentiveness in statistical research, also Wilcoxon test was done and previous results were confirmed at last.

**Table 1:** Mean of samples retention

Groups	Mean
First group (A)	256.60 ± 125.25
Second group (B)	237.60 ± 135.50
Third group (C)	176.55 ± 55.15
Fourth group (D)	274.30 ± 169.79

## DISCUSSION

This study showed that prior using of temporary cement did not have any effect on retention of permanent crowns. Diltz et al found out that previous preparation of core with ZOE has undesirable effects on the bond strength in all composition except zinc phosphate and amalgam. Among tested permanent cements, it seems that zinc phosphate cements take the least impact by existence of ZOE cement's remnants.<sup>20</sup> Diltz's study has differences with our study, for instance in material of cores, samples and also the method of excluding temporary cement. In their study temporary cement's remnants (ZOE) were rinsed by water flow and dried with air. The other contrast is the type of both temporary and permanent cement. In this study temporary cement was ZOE and permanent cement included zinc

phosphate, zinc polycarboxylate, resin cement and also glass ionomer. Maybe it is necessary to mention that the type of cement definitely affect the results. Also it seems that the method of excluding temporary cement affects the result, because Diltz et al did not try an ordinary and correct way of excluding temporary cement. Another point is that temporary cement had eugenol which prevents the polymerization of resin cements.<sup>20</sup>

Mojon et al did a study to compare two methods used for excluding ZOE temporary cement from amalgam. They found out that when temporary cement excluded with using dental fat desensitization (it's main materials are hexane, acetone, chloroform) it brings no bond strength differences in testing group and control group (without using temporary cement), but if it gets removed by using pumice powder, the bond strength of permanent cement will decrease.<sup>21</sup>

The main differences of that study with our study are in: (i) type of core (amalgam), (ii) type of temporary cement (ZOE) and permanent cement (resin cement), (iii) the method of excluding temporary cement.

As mentioned before, eugenol prevents polymerization of the resin cement and maybe this fact is one reason of having different study results.

Also the solvent which has been used in first method contains sensitizing substances (alcohol, etc.) and if it became used for vital tooth, it would make pulp sensitivities. So according to this point, this kind of excluding method cannot be considered as a casual method. Schwarts et al studied the effect of eugenol and eugenol-free temporary cement on bond strength of dual-cure resin cements. Dicore samples were provided and temporary cements were used on the samples' surface and resin cement bonded to the dentin. In the next step, shearing power was forced to samples by Instron Machine. It became clear that temporary cement would not have impact on the shearing bond strength if dentin were cleaned by pumice and prepared by Prisma Universal Bond 3 Dentin Bonding System.<sup>16</sup> The similarity between studies is in crowns, type of temporary cement and also primary exclusion of temporary cement mechanically (by using knife) but contrast is in using Dicor's buttons instead of crowns and also the method of excluding cement. The temporary cement was excluded by carver then dentin surfaces were rinsed by pumice and water, and finally were prepared by Prisma Universal Bond 3 after which they were dried. In spite of differences, the result of our study and this study was fairly the same.

Watanabe et al studied the effect of conditioner on resin binding after removing temporary cement. In this study provided samples were divided into two groups: one with using temporary cement and another without using temporary cement. Each group was also divided into three

subgroups. After removing temporary cement by curette surfaces of each sample, they were impregnated only with phosphoric acid or together with sodium hypochlorite gel.<sup>13</sup> Then stainless steel rods were cemented to dentin with Panavia cement, in the next step they went through thermic cycle and finally the surfaces were observed by SEM and X-ray. Watanabe et al declared that the bond strength was significantly affected by temporary cement, surface preparation of dentin and the effect of thermic cycle. They found out that using temporary cement significantly declines the tensile bond strength in all adhesive systems.<sup>13</sup> They also started using sodium hypochlorite gel after surface etching with phosphoric acid is more effective than phosphoric acid etching. The differences between this study and our study are both in temporary and permanent cement and also the operation. In this study a limited surface of tooth was exfoliated by a disk. Carbide bur of milling machine exfoliates the surface more polished than clinical types. This fact may affect the final retention because it lessens surface roughness and also temporary cement's remnants. In order to getting closer to clinical situation, we used crowns while they used acrylic plates and stainless steels.

Abo-Hamar et al studied the effect of removing both eugenol-free and eugenol cements on tensile bond strength in ceramic samples. They used three types of resin cement in different types of bonding and conical ceramic samples bonded to the dentin. Then tensile bond strength was measured by Instron machine after they were served for 24 hours in distilled water. They found out that if eugenol-free or eugenol temporary cement was removed carefully by excavator or sand blast, they will have no impact on the strength of permanent cement.<sup>8</sup> Similarity is in type of permanent cement which possessed both self-etch and total etch but the important difference is probably in whole procedure. They exfoliated a limited surface of tooth until the emergence of dentin surface by a polish paper (SiC papers ending with 600 grit). Maybe the quality of polishing with paper is as same as using milling machine.

Bayindir et al studied the effect of eugenol temporary cement on the crowns retention which was cemented by resin cement. They have declared that final retention would decrease if they were cemented with eugenol temporary cement.<sup>17</sup> Based on this fact; we used eugenol-free temporary cement in this study.

## CONCLUSION

According to the result of this study, using eugenol-free temporary cement before permanent cementation—with zinc phosphate and resin cement (Maxcem)—does not have any effects on crowns' retention.

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## MANUFACTURERS' DETAILS

- *Self-cure acrylics*: Meliodent, Heraeus-Kulzer GmbH, Wehrheim, Germany
- *Milling machine*: Milling machine, Vover Gx-NSK, Tokyo, Japan
- *Condensational silicon impression material*: Speedex, Asia Chemi Teb, Tehran, Iran
- *Die stone*: Super hard stone-Ernst Hinrichs GmbH-Borsigstrasse, Germany
- *Eugenol-free temporary cement*: Relyx™-3M ESPE, California, USA
- *Zinc phosphate cement*: Harvard cement-Harvard dental-GmbH, Berlin, Germany
- *Maxcem cement*: Maxcem resin cement-Kerr, California, USA
- *Thermocycler machine*: Thermocycler machine-Vafaei Industrial Factory, Isfahan, Iran
- *Universal Tensile Testing Machine*: TLCLO, Dartec series, Surrey, England

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