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Luting Cement for Implant Retained Prosthesis

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ABSTRACT

Background: There are only two ways to connect an implant prosthesis to the implant i.e. SR and CR implant-supported restorations. The most important factor to consider when making the right choice for luting cements for implant-retained prostheses is how cement's chemical properties affect the surface texture of titanium abutments and Co-Cr alloys.

Aim: To assess the best long term luting cement for IRP based on bond strength & surface integrity.

Material & Method: A total of 60 samples were included with luting cements i.e. GIC, $ZnPO_4$ and non- eugenol ZnO were evaluated on 2 sub-groups of A & B i.e. I, II,III in Thermocycling and autoclave respectively.

Result: We have found significant difference for surface roughness on evlaution of group A &B III as the p value was 0.001 while non significant on comparison of group A &B for I & II as the p value was 0.481 and 0.370 respectively.

Conclusion: In order to improve the long-term retention and surface integrity of titanium alloy prostheses, both luting cement and GIC prostheses may be utilized as surface cement.

Keywords: Surface cement, GIC, $ZnPO_4$, non- eugenol ZNO, sub-groups, group A& B, bond strength, surface roughness, luting , IRP.

INTRODUCTION

A fixed prosthesis that is supported by implants and it is nowadays a very common option that is provided by the doctor and requested by the patient. Screw-retained (SR) and cement-retained (CR) implant-supported restorations are the only two systems for attaching prostheses to an implant.[1] Depending on the specific clinical circumstance, one retention type may be more suitable than the other. Thus, both systems have advantages and disadvantages.[2] The prostheses may loosen or shatter, which is a disadvantage of SR implant-supported prostheses(IPS). In addition, the aesthetics of screw-retained prostheses may be compromised if the access opening is situated in close proximity to the surface of the patient's face. The biggest disadvantage associated with CR-IPS is the damage to the implant and superstructures that happens during the retrieval of the cast repair. In order to undertake intervention therapy and to guarantee that the supporting tissues and implant are correctly maintained, it is occasionally necessary to extract the implant. Recovery of the implant is sometimes essential. In order to enable retrievability, uncomplicated retrieval, and suitable retention of cement-retained implant-supported prostheses, the use of either a temporary luting agent or a screw should be able to be utilized. The luting cement that is used for cementation serves as the primary factor in determining this.[3]
Various factors, such as the strength of the cement and the procedure used for luting, can influence the long-term success of dental prostheses.These factors are influenced by the chemical composition of the cementing agent and the texture of the adhesive surface.[4] In order to ensure the success of any CRP , it is essential to choose the cement that is best suited to the specific prosthesis in question and has properties that are well-balanced. Due to the fact that it has the potential to

greatly affect the longevity of cementation and prosthetic devices, it is essential to have a full grasp of the mechanical properties of cement and its effect on the physical attributes of prostheses. A material's ability to withstand forces that cause the sliding of its internal structure is referred to as shear strength. Both vertical and horizontal measurements may be taken for the measurement. By causing shear and diminishing the component's cross-sectional area, surface corrosion may lower an item's shear strength.[5] In this respect, according to our study , various other studies have discussed different aspects of luting cements used for implant.[1,2,3,4,6,7].

The most important things about any IRP are how well the implant prostheses and abutment prostheses stick together and how long these prostheses last with luting cements. When selecting luting cements for implant-retained prostheses, the most important factor to consider is how the cement's chemical properties influence the surface texture of the titanium abutment and the cobalt chromium alloy.[5] This study looks at the shear bond strength and surface texture of cobalt-chromium alloy coping attached to a titanium alloy abutment with different luting cements. The examination considers the impacts of thermocycling and aging. This study will look at the most commonly used luting cements, which include glass ionomer cement (GC Gold Label), zinc phosphate cement (De Trey Zinc), and noneugenol zinc oxide cement (Templute). The purpose of this study is to determine the effect of long-term usage on the shear bond strength of luting cements and the surface texture of Co-Cr coping and titanium alloy abutment. This will be accomplished by thermocycling and autoclave aging.

AIM

To determine the best long term luting cement for IRP based on bond strength & surface integrity.

MATERIALS & METHOD

We have included a total of 60 samples in our study done in the department of prosthodontis & crown and bridge , school of dental science , KIMSDU ,Karad, Maharashtra with the material including titanium alloy, implant analog, Co-Cr alloy coping, GIC (GC gold table) , $ZnPo_4$, non-eugenol ZnO cement (templute) , gutta percha, DPI cold cure acrylic denture base resin and instruments & equipment includes hex and ratchet, mixing spatula & pad, univeral testing machine, autoclave unit as shown in figure 1

FIGURE 1 :AUTOCLAVE UNIT

thermocycling unit as shown in figure 2

FIGURE 2: THERMOCYCLING UNIT

and surface roughness as shown in figure 3

FIGURE 3: SURFACE ROUGHNESS

Thus, the samples were divided into 3 groups i.e. group 1 for GIC, group 2 for $ZnPO_4$ and group 3 for non-eugenol ZnO cement. Each group was divided into 2 i.e. subgroups (A) & (B) with n=10 each respectively, thus subgroup I(A) with n=10 samples for GIC, subgroup IIA) with n=10 samples for $ZnPO_{4,}$subgroup III(A) with n =10 samples for non-eugenol ZnO luting cementation, themocycled for 1 year and same for subgroup I,II,III (B) respectively.

RESULT

In our research, descriptive statsistics was expressed as mean ± standard deviation (SD) and standard error(SE) for comparison & evaluation. While ANOVA test & post hoc Turkey's test was applied to compare shear bond strength & surface texture , post-thermocycling of (group –A subgroups) and aging among (group – B subgroups).

1. **SHEAR BOND**

Group A (Thermo cycling)	Mean	SD	One wayAnova 'F' test value	p value, Significance
Group IA (GIC)	2.451	0.38	F = 13.006	p < 0.001**
Group IIA (Zinc Phosphate)	2.603	0.28		
Group III A (Non –Eugenol Zinc Oxide)	1.897	0.3		

Tukey's post hoc test to find pair wise comparison

Group	Comparison Group	Mean Difference	p value, Significance
Group IA (GIC) vs	Group IIA (Zinc Phosphate)	0.152	p =0.557
	Group III A (Non –Eugenol Zinc Oxide)	0.554	p =0.002*
Group IIA (Zinc Phosphate) vs	Group III A (Non –Eugenol Zinc Oxide)	0.706	p <0.001**

TABLE 1: INTRA- SUBGROUP COMPARISON OF GROUP A

During our research, on intragroup A (I,II&III) we have found according to table 1, that difference of shear strength was highly statsitically significant between the 3 sub group variables as p value was <0.001. Whereas on comparing group 1A with II using turkey post hoc test , mean difference was non significant as the p value was 0.557 . While, on comparison of group IA with group III A , mean difference was significant as the p value was 0.002 and this difference was highly significant when we have compare group IIA with group IIIA as the p value was <0.001 respectively.

Group B (Autoclaved)	**Mean**	**SD**	**One wayAnova 'F' test value**	**p value, Significance**
Group I B (GIC)	**2.366**	**0.8**	**F = 48.855**	**p <0.001****
Group II B (Zinc Phosphate)	**2.443**	**0.24**		
Group III B (Non –Eugenol Zinc Oxide)	**0.483**	**0.21**		
Tukey's post hoc test to find pairwise comparison				
Group	**Comparison Group**		**Mean Difference**	**p value, Significance**
Group I B (GIC) vs	**Group II B (Zinc Phosphate)**		**0.077**	**p = 0.937**
	Group III B (Non –Eugenol Zinc Oxide)		**1.883**	**p<0.001****
Group II B (Zinc Phosphate) vs	**Group III B (Non –Eugenol Zinc Oxide)**		**1.960**	**p<0.001****

TABLE 2: INTRA- SUBGROUP COMPARISON OF GROUP B

During our research, on intragroup B (I,II&III) we have found according to table 2, that difference for shear strength was highly statsitically significant between the 3 sub group variables as p value was <0.001. Whereas on comparing group 1B with II using turkey post hoc test , mean difference was non significant as the p value was 0.937 . While, on comparison of group IB with group III B , mean difference was highly significant as the p value was <0.001 and this difference was again highly significant when we have compare group IIB with group IIIB as the p value was <0.001 respectively.

2. SURFACE ROUGHNESS

Group A (Thermo cycling)	**Mean**	**SD**	**One wayAnova 'F' test value**	**p value, Significanc**
Group IA (GIC)	**0.434**	**0.066**	**F = 51.26**	**p < 0.001***
Group IIA (Zinc Phosphate)	**0.568**	**0.065**		
Group III A (Non –Eugenol Zinc Oxide)	**0.322**	**0.124**		
Tukey's post hoc test to find pairwise comparison				
Group	**Comparison Group**	**Mean Difference**	**p value, Significance**	

Group IA (GIC) vs	Group IIA (Zinc Phosphate)	0.133	p <0.001**
	Group III A (Non –Eugenol Zinc Oxide)	0.112	p <0.001**
Group IIA (Zinc Phosphate) vs	Group III A (Non –Eugenol Zinc Oxide)	0.245	p <0.001**

TABLE 3: INTRA- SUBGROUP COMPARISON OF GROUP A

During our research, on intragroup A (I,II&III) we have found according to table 3, that difference of surface roughness was highly statsitically significant between the 3 sub group variables as p value was <0.001. Whereas on comparing group 1A with II using turkey post hoc test , mean difference was highly significant as the p value was<0.001 . While, on comparison of group IA with group III A , mean difference was highly significant as the p value was <0.001 and this difference was highly significant when we have compare group IIA with group IIIA as the p value was <0.001 respectively.

Group B (Autoclaved)	Mean	SD	One way Anova 'F' test value	p value, Significance
Group I B (GIC)	0.452	0.043	F = 38.502	p <0.001**
Group II B (Zinc Phosphate)	0.547	0.022		
Group III B (Non –Eugenol Zinc Oxide)	0.389	0.050		

Tukey's post hoc test to find pair wise comparison

Group	Comparison Group	Mean Difference	p value, Significance
Group I B (GIC) vs	Group II B (Zinc Phosphate)	0.095	p < 0.001**
	Group III B (Non –Eugenol Zinc Oxide)	0.063	p = 0.005*
Group II B (Zinc Phosphate) vs	Group III B (Non –Eugenol Zinc Oxide)	0.158	p<0.001**

TABLE 4: INTRA- SUBGROUP COMPARISON OF GROUP B

During our research, on intragroup B (I,II&III) we have found according to table 4, that difference of surface roughness was highly statsitically significant between the 3 sub group variables as p value was <0.001. Whereas on comparing group 1A with II using turkey post hoc test , mean difference was highly significant as the p value was<0.001 . While, on comparison of group IA with group III A , mean difference was significant as the p value was 0.005 and this difference was highly significant when we have compare group IIA with group IIIA as the p value was <0.001 respectively.

	Group A (Thermo cycling)	Group B (Autoclaved)	Unpaired t test value	p value, Significance
Sub Group I (GIC)	0.434 (0.066)	0.452 (0.043)	t = -0.719	p =0.481
Sub Group II (Zinc Phosphate)	0.568 (0.065)	0.547 (0.022)	t =0.919	p =0.370
Sub Group III (Non –Eugenol Zinc Oxide)	0.322 (0.124)	0.389 (0.05)	t = -4.075	p =0.001*

TABLE 4: INTER- SUBGROUP COMPARISON

In intergroup comparison according to table 4 the surface texture i.e., surface roughness produced by all three cements in group B (i.e. five year autoclave aging) is more than surface roughness in group A (i.e. one year thermocycling) but surface roughness difference produced. On comparing sub-group I A & B and II the difference was non- significant as the p value was 0.481 and 0.370 respectively. But for sub-group III A & B the difference was significant as the p value was 0.001 respectively.

DISCUSSION

Implant-supported crowns come in two varieties: screw-retained and cement-supported. Compared to screw-retained restorations, cement-retained restorations have a more aesthetically pleasing look, making them the favored option among physicians. There has long been debate regarding the best cement to use for luting implant-supported restorations. [8] Glass ionomer cement, zinc phosphate cement, and non-eugenol zinc oxide were the three kinds of luting cements employed in this study. A study has shown that for an implant-supported prosthesis that is cement-retained, zinc oxide eugenol provides sufficient retention.[9] The researchers in their study used zinc phosphate cement because 19% of dental schools employ it and because it is a typical choice for cementations of cement-retained implant-supported restorations. Despite the existence of numerous other luting cement types, higher education programs and seventy percent of dental schools continue to teach zinc phosphate cement.[10,11] One major disadvantage of cement-retained repairs is the difficulty in removing excess cement. Peri-implant diseases such as peri-implant mucositis and peri-implantitis may occur as a result of this.[12] One benefit of using zinc phosphate cement is its radio-opacity, which enables excessive removal. It is the most radio opaque of the resin cements. Besides eugenol and non-eugenol zinc oxide, additional radio-opaque materials include zinc phosphate cement.[13] In the literature, glass ionomer cement was used for comparison with zinc phosphate cements for zinc retention, and it provided findings that were similar to those of zinc phosphate cement. [8, 14,15,16]

In order to select the most suitable luting cement for titanium alloy abutment and Co-Cr coping structures, a thorough comparison and evaluation of three widely used luting cements was carried out in this study. The results of this study are crucial for selecting the appropriate luting cement to use with Co-Cr coping and titanium alloy. This study investigated the impact of extended usage on a titanium alloy abutment bonded to a Co-Cr coping. The abutment-coping combinations were exposed to thermocycling and autoclave aging, while being treated with the three most commonly used luting cements. Examining and comparing the effects of aging on the surface texture of titanium alloy abutments and Co-Cr copings, as well as the shear bond strength of luting cements, is the focus of this study. The specimens were subjected to thermocycling and autoclave aging to replicate conditions found in the oral environment. Our objective was to investigate the potential impact of variations in mouth temperature on the shear bond strength of luting cements and the surface texture of luted titanium alloy abutment and Co-Cr alloy coping. Based on the results of this study, it has been observed that the shear bond strength of zinc phosphate cement surpasses that of glass ionomer and non-eugenol zinc oxide cement. Based on the findings, it has been observed that the surface roughness caused by zinc phosphate is higher compared to that resulting from glass ionomer and zinc oxide non-eugenol. This discovery offers additional support for the idea that increasing the roughness of the surface improves the strength of the bond under shear.

M. Barás¸ Gu¨ ncu¨ and colleagues investigated how three different cements retained on two implant abutments with varying surface shapes. According to the study results, Zinc phosphate showed better retention among the tested cements; Glass ionomer and eugenol-free zinc oxide followed in order.[17] To find their retentive strengths, Clayton GH, Driscoll CF, Hondrum SO tested many luting agents. They found that retentive strength of five different luting agents—zinc oxide-eugenol, glass-ionomer cement, hybrid glass-ionomer cement, composite resin, and zinc phosphate was evaluated; zinc phosphate produced a mean retentive strength 164% greater than glass-ionomer cement and 49% greater than composite resin cement. [18] Previous research has utilized a technique to simulate the effects of long-term usage in oral settings by artificially aging dental materials. This was done to study the impact of thermocycling on the bond strength of luting cement. Thermocycling can cause a decrease in the binding strength of luting cements.[19,20] Autoclave properties were used as an artificial hydrothermal method in combination with thermocycling in several dental studies to assess the impact of aging on the physical properties of materials.[21,22,23] The study results suggest that both thermocycling and autoclaving have a substantial influence on the aging of luting cements, resulting in a reduction in shear bond strength. This finding is corroborated by many sources in the literature. [16,20,21,22,23] Autoclave aging, lasting for 5 years, is more effective than thermocycling, which has a duration of just 1 year.

CONCLUSION

According to the findings of the study, the shear bond strength increased along with the surface roughness when a cobalt-chromium alloy coping was luted to a titanium alloy abutment. Additionally, it was shown that zinc phosphate luting cement was more retentive than glass ionomer and zinc oxide eugenol luting cements. This was most likely due to the increased surface roughness that was created by zinc phosphate-luting cement.

Furthermore, when cobalt-chromium alloy coping was luted to titanium alloy abutment, it was shown that glass ionomer luting cement was more retentive than zinc oxide eugenol. This was due to the fact that glass ionomer luting cement produces a surface that is more abrasive than zinc oxide eugenol. Therefore, the study concludes that both zinc phosphate and glass ionomer may be used as luting cement to enhance the long-term retention and surface integrity of implant-retained prostheses, particularly when a cobalt-chromium alloy coping is bonded to a titanium alloy abutment.

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