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Comparative Evaluation of Water Sorption And Solubility of Two Different Luting Dental Cements.

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Abstract
Introduction: *The solubility of dental luting cements influences both their rate of degradation and their biological compatibility**.** Because of this, the water sorption and solubility of dental cements are of considerable clinical importance and cannot be overlooked.*
All restorations have to be in oral cavity i.e. are subjected to oral environment. They degrade with time in presence of fluids resulting in open margins in fixed prosthesis leading to loss of retentive capability and risk of secondary caries.
Materials And Method: *|Two types of luting cements: Glass Ionomer cements and zinc phosphate cement were used in the study. A rectangular specimen of 10 mm in length, 3 mm in height and 5 mm in width was prepared with Addition silicone putty as matrix. 20 rectangular samples, 10 of each type of cement were prepared and weighed in high precision weighing scale and marked as W1. All the samples of group 1 and 2 were placed in distilled water for 7 days at 37^0 C and again measured on precision weighing scale and denoted as W2. All the samples of both groups were placed in microwave at 370C and left to dehydrate. These were denoted as W3. Data collected was tabulated and data was statistically analyzed using ANOVA and Krushall Wallis test.*
Water sorption of each sample was calculated as the weight of sample after immersion (W2) - weight of sample before immersion (W1) divided by volume of the sample in mm^3.
Solubility of the samples was calculated as the weight of sample before immersion (W1) - weight of sample after dehydration (W3) divided by volume of the sample in mm^3. The volume of the samples was calculated as 150 mm^3.
Results: *The maximum water sorption was found in group 1 and lowest in group 2. The solubility was maximum in group 1 and lowest in group 2. In intergroup comparison between the groups, the f value was found to be 9.14568 which was found to be statistically significant at p< 0.05.*
Conclusion: *Among the materials tested, Zinc phosphate showed more water sorption and solubility than Glass ionomer cement when used for luting purposes.*
Keywords: *Dehydrate, Luting, Sorption, Solubility.*

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I. Introduction

Dental cements are one of the essential requisites in clinical practice. They solve various purposes of luting, restorations and other specific uses. Luting cements are having classical property of minimum film thickness where as restorative cements are having high compressive strength to withstand masticatory loads.[1] Numerous dental cements are there in markets which have their specific properties as no dental cement is developed which could have properties to fulfill all the requirements. Their usage depends on various properties like strength, solubility, biocompatibility and water sorption. Strength and biocompatibility are discussed by number of authors, but water sorption and solubility needs to be studied. The solubility of dental luting cements influences both their rate of degradation and their biological compatibility**.**[2] Because of this, the water sorption and solubility of dental cements are of considerable clinical importance and cannot be overlooked.
All restorations have to be in oral cavity i.e. are subjected to oral environment. They degrade with time in presence of fluids resulting in open margins in fixed prosthesis leading to loss of retentive capability and risk of secondary caries. In literature,[3,4] water sorption is a property which reduces the ultimate strength of the

restorations. Many tests are recommended for testing solubility of dental restorations like checking PH of the restorations, but they are all static solubility tests which have little or no clinical implications. There was a need to study the water sorption and solubility with a new innovative technique and to find out comparative difference between water sorption and solubility of two types of dental cements. The aim of the present study is to find out the comparative evaluation of solubility or water sorption between two types of dental cements.

II. Materials And Method

The present study was undertaken on both types of luting cements: Glass Ionomer cements and zinc phosphate cement. The entire study was carried out in accordance to ADA guidelines. A wax rectangular specimen of 10 mm in length, 3 mm in height and 5 mm in width was prepared. Addition silicone putty was used to fabricate 2 indexes of the same wax pattern. For Glass ionomer cement type 1, 1 scoop of powder and two drops of liquid were mixed on a glass slab and filled in the putty index. The putty index was slightly over filled to compensate the setting shrinkage. The cement was allowed to set for 10 minutes and then were removed from the putty index. For Zinc phosphate, 1.4 gm of powder and 0.5 ml of liquid were mixed homogeneously in incremental fashion and placed in third putty index. The cement was allowed to set for 10 minutes and then was removed from the putty index. 20 rectangular samples, 10 of each type of cement were prepared and weighed in high precision weighing scale and marked as W1. All the samples of group 1 and 2 were placed in distilled water for 7 days at 37^0 C and again measured on precision weighing scale and denoted as W2. All the samples of both groups were placed in microwave at 370C and left to dehydrate. These were denoted as W3. Data collected was tabulated and data was statistically analyzed using ANOVA and Krushall Wallis test. Water sorption of each sample was calculated as the weight of sample after immersion (W2) - weight of sample before immersion (W1) divided by volume of the sample in mm^3.Solubility of the samples was calculated as the weight of sample before immersion (W1) - weight of sample after dehydration (W3) divided by volume of the sample in mm^3. The volume of the samples was calculated as 150 mm^3.

III. Results

All the data was tabulated and analyzed statistically. The data recorded in mg was converted to µg in order to calculate sorption and solubility. The maximum water sorption was found in group 1 and lowest in group 2. The solubility was maximum in group 1 and lowest in group 2. In intergroup comparison between the groups, the f value was found to be 9.14568 which was found to be statistically significant at $p< 0.05$.

IV. Discussion

With evolution in field of dentistry, more and more knowledge and curiosity about dental materials is developing and dental cements are no exception to it. It is already known that properties determine the usage and function of any dental material. Dental cements are also classified on the basis of their use in luting, restorative, pulpcapping, liners and bases and temporary cementation cements. Various studies[3,5,6] comparing mechanical properties of cements are there but there was a need to study solubility and water sorption at clinical level. It is also found in earlier studies that water sorption has a direct impact on physical properties of dental cements. Cattari lottani et al[7] found that water sorption deteriotes the physical properties of dental cements. They concluded that absorption of water acts as plasticizer thus decreasing the final setting of cement. The changing trend of people to fixed prosthesis marks increased usage of luting cements. The present study was carried out using two commonly used luting cements. The entire study was carried out in accordance to ADA guidelines to follow the gold standard procedures. A single wax specimen was used to fabricate 2 different putty molds, each belonging to one group which further constitutes 10 specimens in each group. The materials were mixed according to manufacturers guidelines and standard protocol was followed. The samples were dipped in distilled water with PH 5 at 37^0C in order to simulate intraoral conditions. Yanikoglu et al[8] uses artificial saliva at different pH values and found that statistically significant differences were found among the specimens stored in acidic, basic and neutral artificial saliva, it was observed that the cements were more soluble in acidic media and more stable at pH 7. The highest solubility found in zinc phosphate followed by zinc polycarboxylate and the least is glass ionomer cement. Even the microwave dehydration was carried out at 37^0C in order to avoid any effect of temperature on the solubility sorption. All the weights achieved in digital precision weighing scale were converted to µg to measure the water sorption and solubility in their respective units. The maximum water sorption was found in Zinc phosphate (202.67 µg/mm^3) and lowest in GIC type 1 (151.33 µg/mm^3). The solubility was found maximum in Zinc phosphate (70.67 µg/mm^3) and lowest in Gic type 1 (54 µg/mm^3). The results of the present study are in accordance to the studies conducted by Ghanim MA[9] and Keyf F[10] which also concluded Glass ionomer to have less water sorption than zinc phosphate. Knibbs and walls[11] also conducted a study to evaluate dental cements around cemented crowns and found more open margins in crowns cemented with glass ionomer cement than with zinc phosphate. They also stated possible reason of early contamination of glass ionomer cement which caused hydrolysis of the cement and finally the deteriotion.

Deniz et al[12] stated that higher level of solubility associated with Glass ionomer cement is due to early contamination of cement with water. They also concluded that cement should be kept away from contamination of water for first 6 minutes. Yoruc and dymus[13] also concluded that water sorption and solubility is maximum on first day and decreases after first three days. An in vivo study[14] with patients wearing luting specimens in the lingual flanges of inferior complete dentures showed that polycarboxylate and zinc phosphate cement dissolved more than glass ionomer cement. Under scanning electron microscopy, glass ionomer and polycarboxylate cements showed pits and extensive cracks on their surfaces, while zinc phosphate showed a large number of pits.[15]The study has certain short comings: the effect of different immersion mediums was not studied in this study and sample size was small. Further studies are directed to the incorporation of resin cements and resin bonded GIC in the study. Results would have been more informative if the study would have been carried out on in vivo conditions where the saliva ph and temperature is changing every second.

V. Conclusion

Among the materials tested, Zinc phosphate showed more water sorption and solubility than Glass ionomer cement when used for luting purpose.

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TAble 1: Mean values of all the three groups compiled

Group	**(W1) Mean /gm**	**Mg**	**(W2) Mean /gm**	**µg**	**(W3) Mean /gm**	**µg**
Group 1	0.3157	315700	0.3461	346100	0.3051	305100
Group 2	0.2482	248200	0.2709	270900	0.2401	240100

Table 2: Water sorptioin and solubility of both groups.

Group	Water sorption (**/mm^3)** W2-W1/V	Solubility W1-W3/V **(µg/mm^3) W1-W3/V**
Group 1	202.67	70.67
Group2	151.33	54

Volume = 150mm^3

Table 3: Distribution set up.

Group	Type of cement	No of samples	Manufacturer name
Group 1	Zinc phosphate	10	Prevest den pro, digiana, Jammu, Jammu Kashmir.
Group 2	Glass Ionomer cement	10	Gc corporation, Japan.

Table 4: Results.

	Group 1	Group 2	Total
N	10	10	20
∑X	966900	759200	1726100
Mean	322300	253066.6667	3475366.6667
$\sum X^2$	312537710000	192638060000	505175770000
Std. Dev	21281.9172	15966.3187	37248.2359

Table 5: Result simplified

Source	SS	Df	MS	F
Between treatments	7297926666.6667	2	3648963333.3333	
Within treatments	2393893333.3333	6	398982222.2222	9.14568
Total	9691820000	8		

P<0.05.

Graph 1: Mean water sorption and Solubility.

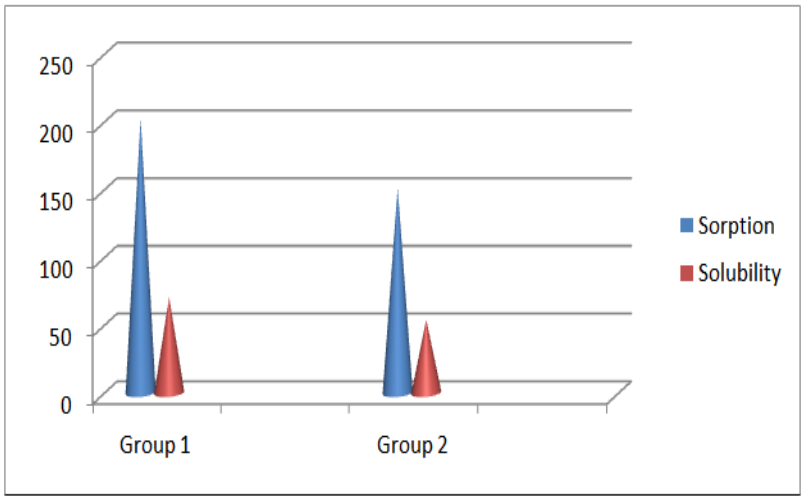

Figure 1: Samples used.

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