Effect Of Storage In Water On Solubility And Effect Of Thermocycling On Microhardness Of Four Different Temporary Restorative Materials

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Abstracts: Background: To compare the microhardness and solubility of temporary restorative materials after thermocycling. Objective is to evaluate and compare the solubility of temporary restorative materials after storage in water and to evaluate and compare micro hardness of temporary restorative materials after thermocycling. Methodology**:** Forty specimens will be prepared for the study. Specimens are prepared according to following four groups.(n=10). Group I – Cavit, Group II - MD Temp, Group III-Coltosol, Group IV – TMP- RS. All the temporary restorative material are manipulated according to manufacturer's instructions in the stainless steel moulds. All the samples are measured by weight. They are stored in distilled water for 7 days and again they are measured by weight after 7 days. The change in weight is evaluated. All the samples are thermocycled at 4 & 56 degree celsius with a dwell time of 60 seconds for 100 times. After thermocycling micro hardness is calculated by Vickers hardness test of all samples. Results: The study gives highly significant result with p value less than 0.001 of both solubility and micro hardness difference as detailed below. The least solubility is with Cavit G with value 0.011 followed by Coltosol F (0.039), TMP-RS(0.054) and MD Temp(0.122). The least change in micro hardness is with Cavit-G(13.48) followed by Coltosol F(15.54), MD Temp(18.07) and TMP-RS(20.41). All values are compared using one way ANOVA ($p<0.001$ highly significant). Conclusion**:** Within the limitations of study, Cavit-G has least solubility after storage in water and highest microhardness after thermocycling among four different temporary restorative materials. [Jani M NJIRM 2015; 6(2):75-78]

Key Words: Solubility, Micro hardness, Temporary restorative materials, Thermocycling, Coefficient of thermal expansion.

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Introduction: Temporary restorative materials are very important as they prevent leakage of saliva and infection into the root canals of teeth. They also maintain the occlusion for short period of time. It is hypothesized that the evaluated property would vary among different materials and change with storage in water and thermocycling. These properties will evaluate the durability of the materials. So I studied these properties of cements[1,2].

Material and Methods: Forty specimens were prepared for the study. Specimens are prepared according to following four groups.(n=10).Group I – Cavit, Group II - MD Temp, Group III- Coltosol, Group IV – TMP- RS. All the temporary restorative material are manipulated according to manufacturer's instructions in the stainless steel moulds(Fig.1&2). All the samples are numbered from 1 to 10. All the samples are measured by weight(Fig.3&4).They are stored in distilled water for 7 days and again they are measured by weight after 7 days(Fig.5). The change in weight will evaluate the solubility. All the samples are thermocycled at 4 & 56 degree celsius with a dwell time of 60 seconds for 100 times (Fig.6). After thermocycling microhardness is calculated by Vickers hardness test of all samples (Fig.7).

Group – I: Cavit

Group – II: MD Temp

Group – III: Coltosol

Group – IV: TMP RS

Figure 1

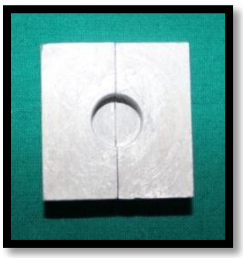

Figure 2

Figure 3

Figure 4

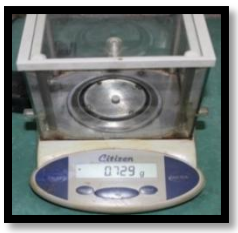

Figure 5

Figure 6

Figure 7

The mean change in microhardness is calculated and compared with one way ANOVA test.

Results: The study gives highly significant result with p value less than 0.001 of both solubility and micro hardness difference as shown in the Table 1 and 2. The least solubility is with Cavit G with value 0.011 followed by Coltosol F(0.039), TMP-RS(0.054) and MD Temp(0.122). The least change in microhardness is with Cavit-G (13.48) followed by Coltosol F(15.54), MD Temp(18.07) and TMP-RS(20.41).

Table 1- Comparison of mean difference change in solubility of four different materials

Material	Solubility difference Mean (SD)	P VALUE
CAVIT- G	0.011 (0.006)	
MD TEMP	0.122 (0.044)	P < 0.001**
COLTOSOL	0.039 (0.026)	
TMP RS	0.054 (0.044)	

**p<0.001 highly significant using one way ANOVA

Table 2- Comparison of mean difference change in micro hardness of four different materials

Material	Micro hardness difference Mean (SD)	P VALUE
CAVIT- G	13.48 (2.42)	
MD TEMP	18.07 (2.60)	P < 0.001**
COLTOSOL	15.54 (1.37)	
TMP RS	20.41 (2.54)	

**p<0.001 highly significant using one way ANOVA

Discussion: Marosky et al [3] concluded that there is correlation between ease of handling sealing ability thus premixed cement showed less marginal leakage and better sealing ability as fewer chances of manipulative errors compared with those cements that depends upon investigation skills in mixing powder – liquid components of the cements. So four different hydrophilic premixed, non-eugenol zinc –oxide based temporary cements. Cavit-G, MD-Temp, Coltosol, TMP-RS[1,4].

Thermocycling simulates the extreme temperatures of the mouth to which it is compatible. Thermocycling induces cyclic stresses

which will affect the strength and microhardness of any restorative materials because of different Coefficient of thermal expansion of the materials. According to Webber et al (1978), Cavit G and Coltosol F shows leak proof seal even after thermocycling because of their higher Coefficient of thermal expansion which is double to the Zinc oxide Eugenol cement[3,5].

Zinc-oxide eugenol (ZOE) is the most common type of material used for temporization when sealing teeth. Cavit®(ESPE) is used frequently in large part because of its easy, no mix formulation, and it provides a superior seal[6].Cavit, Cavit W and Cavit G are temporary filling materials self-curing under humidity for temporary filling of cavities. The final hardness of the three variants decreases in the sequence of listing. Cavit G can be removed in one piece without residue. Cavit G is indicated for temporary inlays as per manufacturer's instructions. The hardening process starts after a few minutes[7].

Coltosol F is a chemically hardening, radio-opaque, white filling material for temporary filling of dental cavities. Coltosol F is a zinc oxide/zinc sulphate based cement and is designed for short term temporary applications (designed to be used for max. 1-2 weeks)[8]. Composition- Zinc oxide, Zinc sulphate-1- hydrate, Calcium sulphate-hemihydrates, Diatomaceous earth, EVA resin, Natrium fluoride, Peppermint aroma. Its surface hardens within 20-30 min[9] and it is subjected to mastication pressure after 2-3 hour[10]. It is indicated in temporary fillings of class I and class II cavities and in temporary sealing in endodontics. It is contraindicated in established allergy to one of the components of Coltosol F[11]. It is contraindicated in more than 2 weeks temporary filling of cavities and in multiple areas which extend upto or under the gingiva. Side effects- Coltosol F hardens by absorbing water. Dehydration in the cavities of vital teeth can cause short term pain[12]. The cavity should therefore be kept moist using a water spray before applying Coltosol F. It expands during hardening[11]. This creates a very dense filling with good marginal seal although care must be taken with very thin enamel margins as fracture may result.

TMP-RS is temporary filling materials self curing under humidity for temporary filling of cavities. The final hardness of both variants decreases in the sequence of listing. It is of regular setting. TMP-SS is comparatively softer setting. The hardening process starts after a few minutes. Avoid any exposure to chewing pressure for about 2 hours after application[13,14].

Solubility is a chemical property referring to the ability for a given substance, the solute, to dissolve in a solvent. It is measured in terms of the maximum amount of solute dissolved in a solvent at equilibrium. Solubility is the property of a solid, liquid, or gaseous chemical substance called *solute* to dissolve in a solid, liquid, or gaseous solvent to form a homogeneous solution of the solute in the solvent[14]. The solubility of a substance fundamentally depends on the physical and chemical properties of the solute and solvent as well as on temperature, pressure and the pH of the solution. The extent of the solubility of a substance in a specific solvent is measured as the saturation concentration, where adding more solute does not increase the concentration of the solution and begin to precipitate the excess amount of solute[15-17].

These materials will provide an adequate seal and strength if used in sufficient thicknesses. It is essential that all materials be placed into an access preparation with parallel, or preferably divergent, walls[18].This is necessary to prevent masticatory forces from causing the temporary filling material to be pushed in an apical direction thus destroying the marginal seal[13]. After the canals have been appropriately filled (with either guttapercha or inter appointment intracanal medicaments), a dry cotton pellet should be placed to occlude the canal orifice(s)[5]. The cotton pellet need only be thick enough to block movement of the temporary material into the canal and thus simplify access for subsequent endodontic therapy or restorative procedures[9]. Conversely, it must be thin enough to allow for sufficient space between the cotton and the access preparation's cavosurface margin. This space permits placement of an adequate thickness of temporary material. A thickness of *at least* 3 millimetres is required[18].

Conclusion: Within the limitations of study, Cavit-G has least solubility after storage in water and highest microhardness after thermocycling among four different temporary restorative materials. Further in vivo studies, Cavit –G will show clinically better result to withstand oral moisture and oral temperature variation.

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