Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2018;7:3:5-12.

The Effect of Eugenol and Eugenol Free Cement on Transverse Strength of Provisional Restorative Resins: An Vitro Study

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ABSTRACT

Background: Provisional prosthesis must be cemented to the prepared tooth using a temporary cement. The effect of eugenol and eugenol free temporary cement on the transverse strength of provisional resins has not been completely clarified with evidence based information.

Aim: This study compared the effect of eugenol and eugenol free cement on transverse strength of provisional restorative resins.

Material and methods: Disks specimens were fabricated using metallic mould and glass plates. After being immerse at artificial saliva at 37 º C for 7 days , the specimens were fracture under 3 point loading in a universal strength machine at a crosshead speed of 0.75 mm/min. Maximal load to fracture in kilogram were recorded . Mean flexural strength were calculated in newton (n=10 group). Comparisons were made using one -way - ANOVA f and Tukeys Post Hot Test (P<0.001).

Results: Mean transverse strengths ranged from 41.79 to 92.53 N. Heat cure acrylic with non eugenol cement(Accucem)has highest transverse strength and bis acrylic (Trantemp) with eugenol cement has least transverse strength.

Conclusion: Within the limitations of this study, transverse strength of the heat cure acrylic with eugenol free cement is found to be highest.

Keywords: Eugenol, Eugenolfree cement, Provisional Restorative Resins.

INTRODUCTION

Provisional crowns are essential in fixed prosthodontic therapy.Even though a definitive restoration may be placed as quickly as twoweeks after tooth preparation, provisional restoration must satisfy the***biologic, mechanical and esthetic*** requirements.Because of unforeseen events (e.g. Laboratory delays orpatient unavailability) or when delay in placing permanent restorations is deliberate (e.g. because of etiological factors of TMJdisorder) a provisional restoration may have to function for anextended period.

The greatest stresses in a provisional restoration are likely tooccur during the chewing. A provisional

Received: Dec. 11, 2017: **Accepted:** Feb. 13, 2018
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pISSN 2278-0076
eISSN 2321-9270

restorative material must bestrong enough to resist fracture during function. ***Fracture resistance***of provisional restoration is an important concern for the restorative dentist and it is directly proportional to its transverse strength.Resistance to functional loads and displacement forcesare***"mechanical factors"*** that must be considered when choosing a provisional restorative materials. Breakage of such restorations can create functional and esthetic concern to the patient.Autopolymerizing resins are commonly used for makingprovisional restorations in fixed prosthodontic treatment. They are fixed to abutment teeth with a cementing agent that should have *lowstrength and an obtundent effect* on freshly prepared dentin.

Zinc oxide-eugenol cement is popular because it has lowstrength and is an obtundent. The use of zinc oxide and eugenol inconjunction with composite resins is *not recommended, since eugenol is an inhibitor of polymerization*. Curing of composite resinsagainst ZOE reduces their transverse bending strength and bringsabout a small decrease in hardness.[9,20,23]

Most of the studies have been done on composites and the effect of ZOE on its strength and retentive qualities. Similar studieson polymethylmethacrylate resins are scarce in the available dental literature. Thus considering these materials usage in dental practice, the objectives of this study are

1) To study the effect of zinc oxide eugenol cement on transverse strength of provisional restorative materials.
2) To study the effect of eugenol free cement on transverse strength of provisional restorative materials.
3) To compare the effect of zinc oxide eugenol cement versusnon eugenol cement on the transverse strength of provisional restorative materials.

MATERIAS AND METHODS

Materials used in the study :

1)Heat cure temporary crown and bridge acrylic resin (Dentalproducts of India).
2)Self cure temporary crown and bridge acrylic resin (Dentalproducts of India.)
3)Self cure provisional bis-acryl composite resin (Trantemp).
4)Modelling wax
5)Petroleum jelly
6)Zinc oxide eugenol temporary cement (Dental products of India).
7)Eugenol free cement (AccuCem)
8)Dental stone
9)Stellon separating media

Armamentarium used in this study :

1) Metallic mold with 2 glass slabs and 0.25mm metallic spacer
2) Wax bath
3) Dental flask (Kavo)
4) Hydraulic press (Kavo)
5) Hounsfield universal testing machine
6) Incubator
7) Acrylizer(Kavo)
8) Micromotor unit and straight hand piece

Methodology:

Specimen fabrication :

Three commercially available provisional resins were used for the study . Disks of resin (20mm in diameter and2mm thick) were made in a mould sandwiched between sheets of glass for group I (self cureacrylic,DPI) and group II (bisacrylic,Trantemp). Disks were allowedto cure in water bath for 5 minutes, after which the glass was removed and disks were further cured in air for 15 minutes. Theprotocol was designed to simulate clinical use of material. The excess material was trimmed from each disc.

Group III(Heat cure acrylic, DPI) includes heat cure provisional acrylic resin.Standardized wax specimens were made flasked, dewaxed andacrylized.A cementing agent was mixed according tomanufacturer's instructions and placed on the cured resin. Thethickness of cement was controlled by 0.25mm spacer and glassplate. 10 discs were made for eachresin / cement combination. Allspecimens were stored in an atmosphere of 100% humidity at 37 º Cfor 7 days.In addition, control samples of each resin were examinedwithout a cement. After one week, the cement was removed withmoist cotton swab and a blunt instrument.The fracture strength of each specimen was measured using 3point bending test with universal strength measuring machine(Hounsfield) with a crosshead speed of 0.75 mm/min(Fig 3).The fracture strength values obtained(Kg)were tabulated and were used to derive the transverse strengthvalues (N)of the specimens.one way ANOVA f test was applied to the data followed by tukeys post hoc-test t (P<0.001).

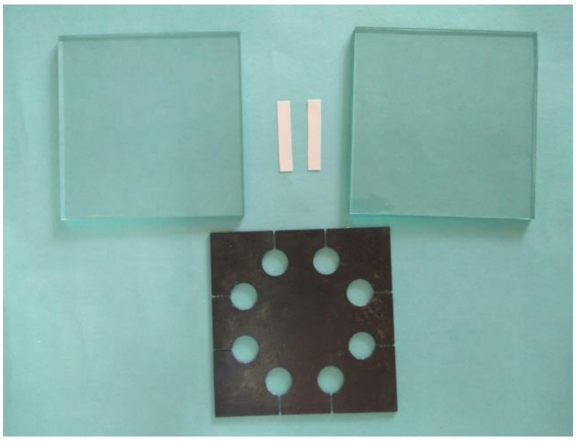


Fig 1: Metallic mould glass plates and cement spacers,

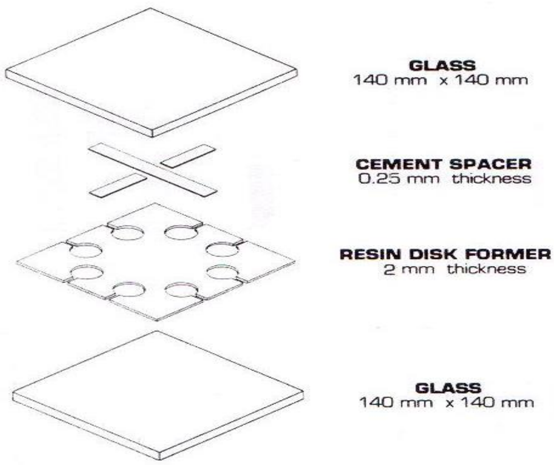


Fig 2: Schematic representation of metal mold with the spacer and glass plates.

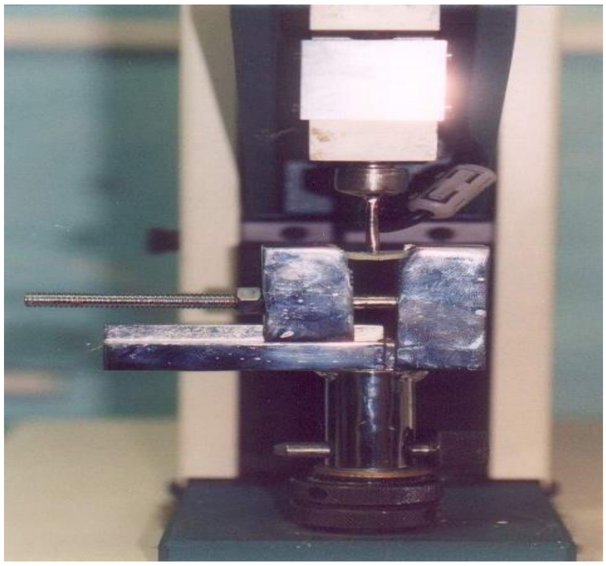


Fig 3: Three point strength testing apparatus,

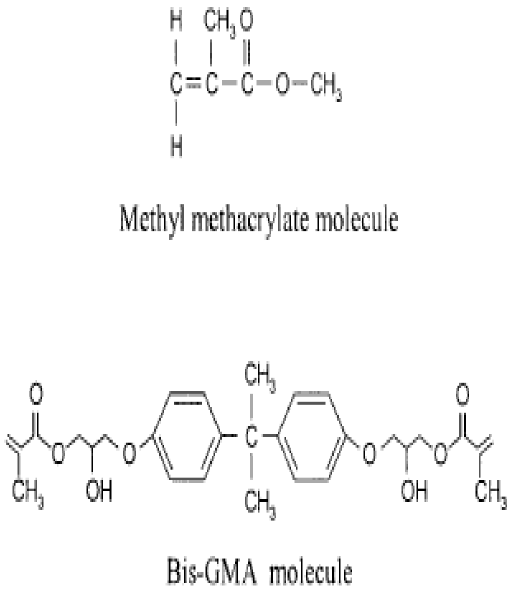


Fig 4: Molecular structure of synthetic dental resins.

Table 1: Showing transverse strength values of subgroupI A(control group),IB andIC.

Specimen Number	Control IA (N)	Eugenol group IB (N)	Non Eugenol group IC (N)
1	89.14	52.98	73.65
2	92.90	47.33	68.06
3	82.76	45.57	77.09
4	85.25	48.86	74.47

5	94.40	44.98	78.79
6	92.67	54.45	75.56
7	85.70	50.27	79.73
8	88.64	47.33	76.97
9	90.55	53.21	77.12
10	91.79	47.48	79.64
Mean	89.38	49.24	76.1
S.D	3.80	3.335	3.48
Minimum	82.76	44.98	68.06
Maximum	94.40	54.45	79.73

Table 2: Showing transverse strengthvalues of sub gruopIIA(control group), IIB and IIC.

Specimen Number	Control IIA (N)	Eugenol group IIB (N)	Non eugenol group IIC (N)
1	85.58	35.57	73.85
2	95.02	44.54	83.55
3	94.43	42.04	82.67
4	82.76	45.57	75.26
5	88.49	41.45	85.55
6	93.79	35.87	85.61
7	91.29	35.72	72.91
8	95.76	45.28	69.09
9	93.67	44.39	78.41
10	92.67	47.48	82.91
Mean	91.34	41.79	78.89
S.D	4.35	4.52	5.88
Minimum	82.76	35.57	69.09
Maximum	95.76	47.48	85.61

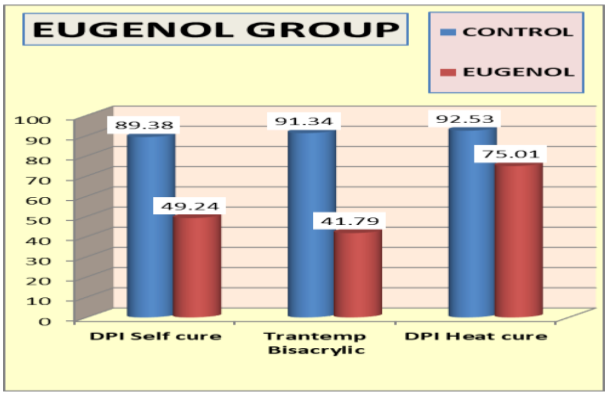
Table 3: Showing transverse strength values of sub groupIIIA(control group),IIIB and IIIC.

Specimen Number	Control IIIA (N)	Eugenol group IIIB (N)	Non eugenol group IIIC (N)
1	94.97	76.73	88.49
2	94.58	70.88	92.32
3	91.58	75.03	94.82
4	91.26	79.67	94.43
5	87.90	80.61	89.96
6	86.58	70.85	94.23
7	94.29	80.85	91.49
8	95.31	67.91	85.70

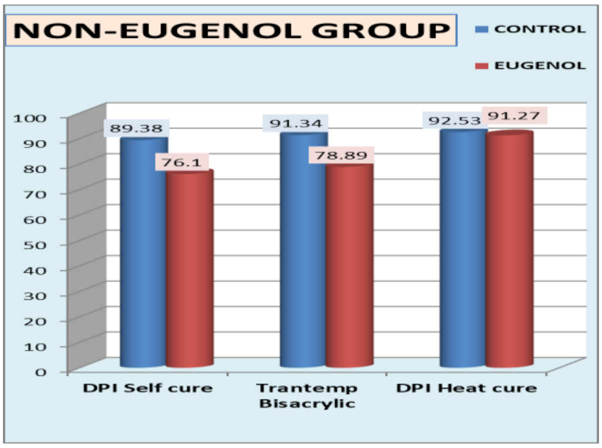
9	94.52	76.76	88.55
10	94.40	70.85	92.76
Mean	92.53	75.01	91.27
S.D	3.12	4.65	3.02
Minimum	86.58	67.91	85.70
Maximum	95.31	80.85	94.82

RESULTS

The mean transverse strength and standard deviations are presented Table 1,Table 2,Table 3.The mean transverse strength range from 41.79 to 92.53 N . Heat cure acrylic (DPI) with eugenol free cement (AccCem) highest transverse and bis acrylic (Trantemp) with eugenol cement has least transverse strength



Graph 1: Comparison of all three resin groups coated with zinc oxide eugenol cements with their control groups.



Graph 2:- Comparison of all three resin groups coated with non-eugenol cements with their control groups

DISCUSSION

Provisional restoration must provide function, comfort and anesthetic replacement for prepared tooth structure. Provisionalrestorations are used as diagnostic aids when correcting irregularocclusal planes, altering vertical dimension or planning for changesin the location and contour of gingiva or the size, shape and colour of the final restoration. In complex treatment, provisional restorations are an integral part of treatment planning process and must maintain their integrity throughout the diagnostic and restorative phases.Historically, the necessity for provisional treatment has beenprimarily derived from various methodologic process. The importance of interim treatment, is more far-reaching than is portrayed by this procedural necessity, and the requirements for satisfactory provisional restorations differ only slightly form definitive treatment they precede.

The present in vitrostudy was conducted with the following objectives.

1) To study the effect on zinc oxide eugenol cement ontransverse strength of provisional restorative materials
2)To study the effect of eugenol free cement on transverse strength of provisional restorative materials.
3) To compare the effect of zinc oxide eugenol cement versus non eugenol cement on the transverse strength of provisional restorative materials.

In the present study, 30 specimens of each material were obtained. They were coated with zinc oxide eugenol cement and non-eugenol cement ,ten specimens each. They were stored in water for 7 days in an incubator at 37ºc and later were conducted to 3 point bending test. For comparison purpose the specimens were divided into 3 sub groups in each group. The control group, eugenol group and non eugenol group were the subgroups.In group I (DPI self cure provisional acrylic resin) , in comparison to control group, other two subgroups showed statistically significant deviation. But eugenol group (I_B) showed more deviation. Similar trend was observedwith group II (Trantemp) bisacrylate provisional composite). When compared to control group other subgroups showed statistically significant deviation of which eugenol group (II_B) was more significant. In group III (DPI heat cure provisional acrylic resin) only the eugenol group (III_B) showed a statistically significant deviation but not noneugenol group (III_C). The reason for these decreased transverse strength values of eugenol group may be due to inhibition of polymerization by the free eugenol in the cement applied on the specimens.[3,6,9,11,14,16,20,22,23,25] Freshly mixed ZOE samples have a very high amount of free eugenol.[14] 11% free eugenol after 28 hours of mixing and 5% after 10 years has been demonstrated.[14] In a simplified account, the hydrogen atom from the OH group in the eugenol molecule is transferred to the benzoyloxy radical, which initiates the linking of monomer units. This eugenol transformed radical cannot appreciably initiate polymerization of the monomer molecules, but it can react with and terminate the free radicals of growing polymer chains, thusreducing the final conversion of the resin. The inhibiting effect isfound even with rather small quantities of eugenol.[14] In contact withwater immediate release of eugenol occurs due to acqueous leaching. The other reason may be due to roughness of the surfaces of resin cured against ZOE cement created due to occurrence of achemical reaction or by mutual dissolution of the components at theinterface. A rough surface may enhance crack initiation, which couldbe especially deleterious to the bending strength of the resin." A comparison was done between the three materials used,heat cure acrylic resin showed minimum decrease in strength incomparison to other two groups (self cure provisional acrylic and composite resins) in both eugenol and non eugenol groups.The reason for this variation could be due to the degree of polymerization.[1] Generally the degree of polymerization achievedusing chemically activated resins is not as complete as that achievedusing heat activated systems. This indicates there is a great amount of unreacted monomer in resin fabricated via chemical activation.[1,4]Resins polymerized via a chemical reaction display 3-5% freemonomer[1,3], whereas heat activated resins exhibit 0.2-0.5% of freemonomer.[1] This unreacted monomer creates two major difficulties.

First, the residual monomer serves a potential tissue irritant, thereby compromising the biocompatibility. Second, it acts as a plasticizer, which results in decreased transverse strength of resin.[1,24,3,4].The other reasons could be due to

1) the water absorption ofself cure resins which acts as plasticizer decreasing strength.[5]

2) dueto less time available for monomer in self cure resins to wet thepolymer beads so a less homogenous polymer is produced. Thisresults in a less rigid material with interior fatigue and impactresistance.[25]When comparison was done with in specimens luted with noneugenolgroup, highest values of transverse strength were shown byheat cure provisional acrylic resin which was statistically significant.

The difference between values of transverse strength of the other two groups i.e. D.P.I. self cure provisional acrylic resin and protempbis-acrylate provisional composite was not statistically significant as they had mean values of 74.16N and 77.87Nrespectively. The reason for the little higher strength of bisacrylateprovisional composite may be attributed to differences in *chemical composition*.[12]Traditional methylmethacrylate-type resins are

monofunctional. They are low-molecular weight, linear molecules thatexhibit decreased strength and rigidity. Base pastes of bis-acrylcomposites consist of bifunctional acrylates which are capable of cross-linking with another monomer chain. This crosslinkage imparts strength and toughness to the material.[5,12]

Although statistical analysis showed significant differences between the control group and eugenol and non eugenol subgroups of all groups and also in-between the groups, clinically these values of transverse strength may not be significant for fixed partial denture prosthesis in molar region. As it is demonstrated by various authors that chewing force on first molars of patients with fixed partial denture prosthesis is about 40% of force exerted by patients with naturaldentition.[4] The average biting force on adult teeth on molars,bicuspids and anteriors are 400 N, 300N, 200 N respectively.[4]

Based on the results of study, it can be suggested DPI heat cure provisional acrylic can be used with either eugenol or noneugenol cement when provisional prosthesis is expected for long time followed by protemp composite resin luted with noneugenol cement.

CONCLUSIONS

Within the limitations of this study ,transverse strength of the heat cure acrylic (DPI) with eugenol free cement (AccuCem) is found to be highest.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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