

Original Article

Effect of curing time on the strain at break of heat cured acrylic resin.

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ABSTRACT

Objectives: The aim of this study was to find out the effect of curing time on the strain at break of heat cured acrylic resin (1) cured at 100⁰c with time difference. **Methods :** In this study , 60 heat cured acrylic resin samples were processed with compression moulding technique at 100⁰c among which each of 20 samples were cured for 20, 40 and 60 minutes separately. Strain at break of heat cured acrylic resin were determined by using the Universal Testing Machine(4) with the help of QMAT software in computer. **Results :** The ANOVA result showed that there was no significant differences among the groups with respect to the strain at break of heat cured acrylic resin. The p- value of strain at break of heat cured acrylic resin is 0.590. The mean strain at break of heat cured acrylic resin cured at 100⁰c for 20 minutes was 3.5458% , 40 minutes was 3.4195 % , 60 minutes was 3.3187 % and standard deviation respectively 0.4158 % , 3.8640 % , 0.3902 % . **Conclusion :** The strain at break of heat cured acrylic resin cured at 100⁰c for different period of time (at 20 , 40 & 60 minutes) have given no significant differences.

Introduction : The word “strain” comes from the Middle English word “streinen” which is derived from the Old French word “estreindre” or “estrein” which means “to press together” and also from the Latin word “stringere” which means “to bind tightly.” Strain is defined as the amount of deformation an object experiences compared to its original size and shape. Strain is the change in shape or form of an object when stress is applied. Under applied forces, a physical body is deformed or altered. This is called strain. It only occurs when stress is present, and it is a concept that has no unit of measure.

It is synonymous with the term “deformation” which is what happens when stress is applied..Strain is a measure of deformation such as linear strain, the change of length per unit of linear dimensions; shear strain, the angular rotation in radians of an element undergoing change of shape by shearing forces; or volumetric strain, the change of volume per unit of volume. Strain gages are used extensively wherever they are convenient to use. The strain gage technique is based on the fact that resistance of a wire increases with increasing strain and decreases with decreasing strain . In this study, the strain at break of heat cured acrylic resin were measured by the computerized method.(1,4)

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Methods : On the basis of experimental design , metal specimens of dimension $65 \times 12.7 \times 2.5$ mm (2) were prepared by tool manufacturer . 60 test samples of heat cured acrylic resin were prepared in the $65 \times 12.7 \times 2.5$ mm (2) size among which 20 test samples were cured in boiling water at 100°c for 20 minutes , 20 test samples for 40 minutes , 20 test samples for 60 minutes. Dental stone was used to invest metal die for preparation of moulds for fabrication of intact acrylic resin pattern to prepare experimental samples. The mix of polymethyl methacrylate and monomethyl methacrylate was taken in the dough stage for packing into the mould of flask . The flask was then immersed into the water and was processed by compression moulding technique(6) where thermometer was set for record the temperature .

When the temperature reaches 100°c then stopwatch was used for record the time. The flask was allowed to bench cool before deflasking . Following the bench cooling procedure the flask was opened and acrylic pattern was carefully retrieved . Excess flash of the sample was trimmed by laboratory micro-motor with burs , finished by sand paper and polished with pumice powder . The polished samples were measured with vernier caliper to ensure that the samples were $65 \times 12.7 \times 2.5$ mm (2). A total of 60 samples were fabricated and to evaluate the strain at break of all the specimen of this study were tested by Hounsfield Universal Testing Machine(4) and were measured by QMAT software in the computer



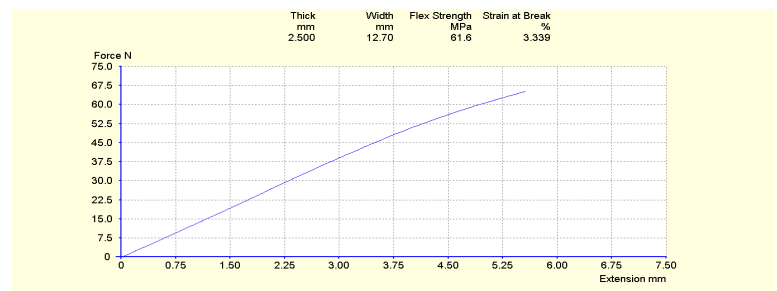
Universal Testing Machine



Placement of sample in Universal Testing Machine



Focusing the sample in three point bending part of UTM



Graph of strain at break of heat cured acrylic resin by QMAT software in computer

Results : The in vitro study was intended to compare the strain at break of heat cured acrylic resin cured in boiling water at 100⁰c for different period of time.

Table -1: The strain at break (%) of different groups.

Groups subgroups (n=20)	The strain at break (%) of different groups (Mean ± Standard deviation)
Group A	3.5458 ± 0.4158
Group B	3.3419 ± 3.8640
Group C	3.3187 ± 0.3902

Table – 2 : ANOVA Test of the strain at break of different groups of heat cured acrylic resin.

	Sum of square	df	Mean square	F	P value
Between groups	0.624	2	0.312	0.532	0.590
Within Groups	33.422	57	0.586		
Total	34.046	59			

The ANOVA result shows that there is a not significant difference between the groups with respect to the strain at break of heat cured acrylic resin . (P > 0.05 , P = 0.590)

df = Degree of freedom

F = F value reached from ANOVA Test.

Group A - Consist of 20 samples of heat cured acrylic resin cured in boiling water at 100⁰c for 20 minutes.

Group B - Consist of 20 samples of heat cured acrylic resin cured in boiling water at 100⁰c for 40 minutes.

Group C – Consist of 20 samples of heat cured acrylic resin cured in boiling water at 100⁰c for 60 minutes.

Discussion : This study was designed to compare the strain at break of heat cured acrylic resin cured in boiling water at 100⁰c for different period of time to assess the maximum strain at break of heat cured acrylic resin. In this study 20 samples (65×12.7×2.5)mm(2) of heat cured acrylic resin were selected from the samples for each group were cured for 20 minutes , 40 minutes , 60 minutes respectively. Samples were placed in 3 point bending testing machine (HOUNSFIELD Universal Testing Machine) (3,4) to get the strain at break of heat cured acrylic resin with the help of QMAT software in computer . The measurement of sample size and chosen methods were internationally recognized and had given more accuracy in measuring strain at break of heat cured acrylic resin. In table:1 the results shows that there was no significant difference in respect to the mean strain at break of heat cured acrylic resin cured at 100⁰c for 20 minutes, 40 minutes and 60 minutes respectively. In table: 2 the ANOVA result shows that the P value = 0.590(P > 0.05) which is a not significant different between the groups. In this study, the curing time at 100⁰c within 60 minutes showed very little changes in strain at break of heat cured acrylic resin. So if the curing time is above 2 hours and curing temperature is above 100⁰c than there may be a great change in the strain at break of heat cured acrylic resin.(1)

Conclusion :

With some limitations of the study , it can be concluded there was no significant difference of the strain at break of heat cured acrylic resin cured in boiling water at 100⁰c among the groups (cured for 20 , 40 and 60 minutes). It may also suggest that increase time of curing at 100⁰c within 1 hour might have very minor effect on the strain at break of heat cured acrylic resin.

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