Original Article

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COMPARING POLMERIZATION SHAINKAGE OF TWO DIFFERENT TYPES OF POST RESINS IN MOIST AND DRY ENVIRONMENTS AT DIFFERENT TIMES BY TWO METHODS OF MEASUREMENT

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ABSTRACT:

Due to the extensive use of cast posts and the importance of matching of impression with canal morphology, the study seeks to assess the polymerization shrinkage of two Duralay resin and pattern resin LS (GC) in different environments and at different times by using two methods of photography and digital caliper.

Methods: this is an experimental-laboratory study. A human tooth canine was used to standardize all samples. Samples included forty acrylic patterns divided into two groups of twenty. The first group was made of Duralay resin and the second group of pattern resin LS (GC). Each twenty-subject group was divided into two groups of ten in dry and moist environments (water). Then dimensional changes of the length and coronal diameter of the posts were carefully examined at intervals 0,1,6,24 hours with both photography and digital caliper with an accuracy of 0.01 mm. Results were analyzed using sphericity and greenhouse-geisser statistical methods for within-group analysis and post Hoc HSD (Tukey) for between-group analysis.

Results: The results showed that coronal diameter changes for both Duralay and pattern resin LS (GC) posts using caliper measurements is affected by time and environment that these changes were statistically significant (Pvalue <0 01), but this effect was higher for GC however, the difference was not significant.

In both types of post, shrinkage is reduced after six hours in a moist environment. results obtained by photographic method confirmed the previous results, except the results were not significantly different in the two types of resin (Pvalue> 0/073) and also there was no significant difference in the accuracy of two measuring methods of caliper and photography in a dry environment at time 6 h (Pvalue <0/01).

Conclusion: If the posts made are cast in one hour, storage environment does not have much impact on the shrinkage of the resin, but if it takes longer to reduce shrinkage resin should be held in moist environment (water). The results were also different for the two types of GC and Duralay resins and this difference reflected the superiority of Duralay.

Keywords: dimensional changes – dimensional stability - the cured resin – storage environment -time- post & core-pattern resin LS-Duralay

INTRODUCTION:

Teeth with root treatment lose many tissues, thus they need post and core for restoration. The posts are placed in a space created by removing part of the root canal filling material. Meanwhile, in

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some cases it is observed that there is a separation between the end of the post and the filling of the channel and this separation between the post and filling of the channel can jeopardize the prognosis [1].

Acrylic resins were introduced to dentistry in 1937 [2]. Acrylic resins have different mechanical and physical properties including transverse strength, shear strength, hardness, solubility and water absorption [3]. Despite the desirable properties of acrylic resins, one of its undesirable properties is the low dimensional stability of the material caused by polymerization shrinkage. Cast post and core can be created by pouring a pattern made directly within the mouth of the patient or based on a pattern made indirectly in laboratory. Direct technique is used for individual canals with convenient access and auto-polymerized and photo-polymerized resin and indirect method is more suitable for multiple canals or when access is difficult and thermo-polymerized resin is used instead of auto-polymerized resin [4].

Density increases during polymerization process and shrinkage occurs. The polymerization process is exothermic, thus the temperature of the material raises before complete hardening and therefore restoration contracts more when cooling. [5]

A variety of factors, including resin type, method of mixing powder and liquid, hardening level and polymerization method are involved in dimensional changes [6]. Dimensional changes of post and core patterns can prevent its full matching with the teeth [7]. In this regard, several studies have been conducted and conventional and sometimes contradictory results have been reported.

In the study conducted by mosbonov et al in 2005 entitled "evaluation of the gap between post and remaining gutta on clinical outcome of Endodontic therapy" it was found that the distance between post and gutta percha will increase the failure rate in endodontic treatment of teeth [8].

In a study conducted by Minoo Mahshid et al in 2005 entitled "evaluating the effect of time, antiseptic agent and storage environment on aspects of Duralay acrylic pattern", they concluded that the linear changes of Duralay resin follow a fixed pattern within a specific time, thus no specific time can be introduced as best to cast resin model [9].

In a study conducted by Moshref et al in 2006 entitled "comparison of linear dimensional changes of self-hardening Duralay resin in different storage environments", it was concluded that if the samples made of Duralay resin are cast quickly and within one hour, storage environment will not have much effect on the dimensional accuracy. However, if the interval between preparation of Duralay model and casting is more than one hour, sample should be kept in aqueous environment[10]. In a study in 2008 Asadzadeh evaluated in vitro leakage of canal regarding the gap between the post and the canal filling material. The results showed that the highest rate of leakage in the total area has been observed in the group with a gap of more than 2 mm between post and remaining gutta and the lowest rate of leakage in the total area was in the group with no gap between the post and the remaining filling of canal and the difference was statistically significant. (p <0/001) [1]

In the study by Gibs et al in 2014 aiming to compare the polymerization shrinkage of Duralay and GC acrylic resins and two photo-polymerizing groups, they concluded that the shrinkage was higher in one of the photo-polymerizing groups than in acrylic resins [11].

Given the importance of dimensional stability of acrylic resins in treatment outcomes as well as determining the appropriate resin with the lowest dimensional changes, the present study aimed to compare polymerization shrinkage of two types of post resins in moist and dry environments at different times by two measuring methods.

MATERIAL AND METHODS:

To standardize all samples, a human canine tooth with direct and mature root recently removed and lacking any decay, cracks and filling was chosen. In order to clean and remove superficial soft tissues, the tooth is placed in sodium hypochlorite solution 5.25% for an hour and then was put in normal saline until the test. The tooth was not undergone any root canal. First, radiographs were taken from the tooth to ensure the state of canal and its pulp and lack of problems within the canal. After radiographic assessment, the height of 16 mm was marked and it was cut perpendicular to the longitudinal axis using a disc in the presence of a steady flow of water.

After cutting the crowns with a K file No. 10 (Mani, Japan) and passing it over the root end and reducing 0.5 mm of it, the length of the tooth canal is calculated and using step back to Master Apical method with K file No. 40, filing and widening of canal up to file No. 70 (Mani , Japan) was Flare.

After preparation of the canal, it was dried using paper cone and resin sealer (AH26) was used as sample according to the manufacturer instructions. Then, gutta percha (Gapaelent, Co, Ltd, Koren) No. 35 and sealer were used for master cone and the secondary gutta percha was added using lateral condensation technique. Then root length was calculated and canal was emptied in the same direction mesiodistally by Piezo at an average length of 12 mm. Only 4 mm of gutta percha remained in the apical area.

To empty, Piezo reamer (Mani, Japan) no.4 was used for 1/3 of distal end of the canal and Piezo reamer no.5 for the 2/3 of coronal end of the canal and the canal was cone-shaped.

After canal preparation, pin jet (PINJET made in Brazil) was marked in accordance with the desired length. At the beginning, we clean and dry the canal and canal area was greased with a little Vaseline to prevent the binding of resin into the canal. Powder and resin monomer used for twenty samples of Duralay resins and twenty samples of GC resins according to manufacturer instructions for each sample that the instructions were the same for all samples, were mixed and then resin was placed on pin jet by paint technique and transferred into the canal. Thus, it passed the same length as passed before resin process. After initial hardening, up and down movements of resin model was used to ensure that it would not block inside the canal. After polymerization of resin, it was removed from the canal, samples were divided into 2 groups of 20 that the group 1 was made of Duralay resin (Reliance made in USA) and the group 2 of GC resin (made in America) pattern resin LS. Each group was divided into 2 groups of 10, in dry and aqueous environments and at intervals of 0, 1, 6, 24 hours, post length and coronal diameter of resin posts were measured with a digital caliper with an accuracy of 0.1. For more accurate work a clear Poti sample was matched to samples size. All posts were put in the Poti for photography. After preparation of photographs all data were analyzed by ImageJ program.

The results were analyzed using sphericity and greenhouse-geisser statistical method for intra-group analysis and test post Hoc HSD (Tukey) for inter-group analysis.

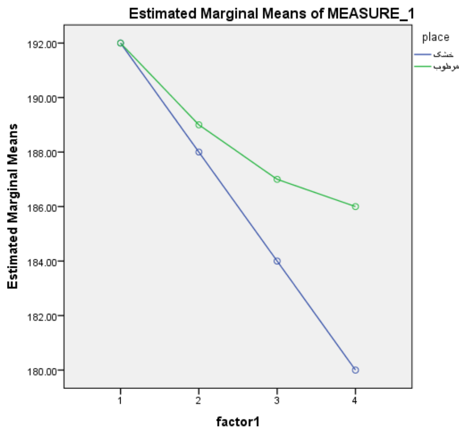
RESULT:

Inter group analysis: Post diameter with caliper: specifications including repeated measure, grouping and sample size are provided in the tables. The test results are significant for sphericity (Pvalue <0/01). As a result, greenhouse-geisser test was used to evaluate the intra-group impacts. According to the test, the effect of time was significant on post diameter (Pvalue <0/01). The intermediate impact of time and resin type on post diameter was

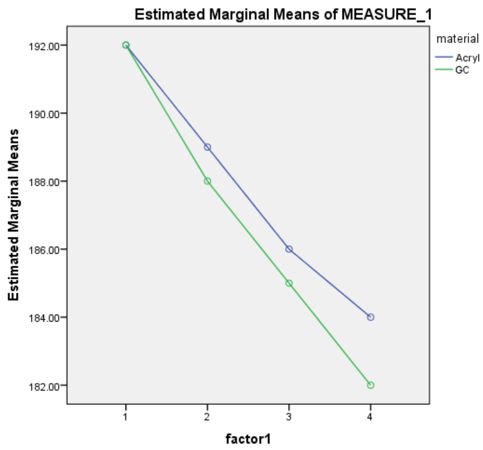
significant (P value <0/01). Finally the intermediate effect of time, storage environment and resin type on the diameter of the posts was significant (Pvalue <0.01).

Contrast test also compared changes in post diameter at all time intervals with that of 24 hours. Post diameter compared at 0, 1, 6 and 24 hours, would have a significant change (Pvalue <0.01). Post diameter intermediately affected by time and resin type had a significant change at all times compared with 24. Under the influence of time and environment, there was significant change at times 6 and 24 in a dry environment. And the post diameter at all times compare with time 24 showed a significant change (Pvalue <0.01).

Between-group analysis: The analysis of between-group differences showed that post diameter in different environments underwent a significant change (Pvalue <0.01)). Thus it can be seen that post diameter will have a significant change in the dry environment compared to the moist environment. Also, changes in a dry environment over time, especially for 24 hours, include the highest rate of changes. In fact, it can be noted that the post diameter in a dry environment follows a steady and ascending trend however; this trend has taken shape in a moist environment for some time and then is completely adjusted.



Looking at the chart we can see that the post diameter depends on the environment and the time rather than the type resin and in similar conditions of time and environment, changes in the posts diameter follow a relatively similar trend. Although the trend of GC resin is more compared to that of Duralay resin but it is not a significant difference.



TIME	D-variable	D-variable
1	PL0	CD0
2	PL1	CD1
3	PL6	CD6
4	PL24	CD24

Descriptive Statistics

	Material	Place	Mean	Std. Deviation	N
CD0-caliper	duralay	Dry	192.0000	.00000	10
		Water	192.0000	.00000	10
		Total	192.0000	.00000	20
	GC	Dry	192.0000	.00000	10
		Water	192.0000	.00000	10
		Total	192.0000	.00000	20
	Total	Dry	192.0000	.00000	20
		Water	192.0000	.00000	20
		Total	192.0000	.00000	40
CD1-caliper	duralay	Dry	188.0000	1.00000	20
		Water	189.0000	1.00000	20
		Total	189.0000	1.00000	40
	GC	Dry	188.0000	1.00000	10
		Water	188.0000	1.00000	10
		Total	188.0000	1.00000	20
	Total	Dry	188.0000	1.00000	20
		Water	189.0000	1.00000	20
		Total	188.0000	1.00000	40
CD6-caliper	duralay	Dry	185.0000	2.00000	10
		Water	188.0000	1.00000	10
		Total	186.0000	2.00000	20
	GC	Dry	184.0000	1.00000	10
		Water	186.0000	1.00000	10
		Total	185.0000	2.00000	20
	Total	Dry	184.0000	2.00000	20
		Water	187.0000	1.00000	20
		Total	186.0000	2.00000	40
CD24-caliper	duralay	Dry	180.0000	2.06155	10
		Water	187.0000	1.00000	10
		Total	184.0000	4.03741	20
	GC	Dry	179.0000	1.07497	10
		Water	185.0000	1.00000	10
		Total	182.0000	3.00000	20
	Total	Dry	180.0000	1.00000	20
		Water	186.0000	1.00000	20
		Total	183.0000	3.00000	40

Tests of Within-Subjects Effects

Measure: MEASURE_1

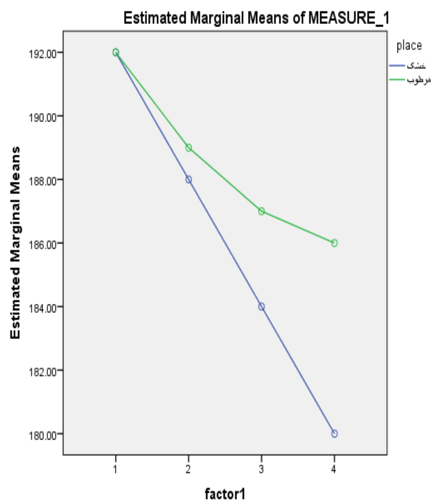
Source		Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Sphericity Assumed	1534.000	3	511.000	547.000	.000
	Greenhouse-Geisser	1534.000	1.000	918.000	547.000	.000
	Huynh-Feldt	1534.000	1.000	806.000	547.000	.000
	Lower-bound	1534.000	1.000	1534.000	547.000	.000
factor1 * material	Sphericity Assumed	15.000	3	5.000	5.000	.001
	Greenhouse-Geisser	15.000	1.000	9.000	5.000	.008
	Huynh-Feldt	15.000	1.000	8.000	5.000	.006
	Lower-bound	15.000	1.000	15.000	5.000	.023
factor1 * place	Sphericity Assumed	252.000	3	84.049	89.000	.000
	Greenhouse-Geisser	252.000	1.000	150.000	89.000	.000
	Huynh-Feldt	252.000	1.000	132.000	89.000	.000
	Lower-bound	252.000	1.000	252.000	89.000	.000
factor1 * material * place	Sphericity Assumed	1.000	3	.000	.000	.000
	Greenhouse-Geisser	1.000	1.000	.000	.000	.000
	Huynh-Feldt	1.000	1.000	.000	.000	.000
	Lower-bound	1.000	1.000	1.000	.000	.000
Error(factor1)	Sphericity Assumed	95.000	102	.000		
	Greenhouse-Geisser	95.000	56.000	1.000		
	Huynh-Feldt	95.000	64.000	1.000		
	Lower-bound	95.000	34.000	2.000		

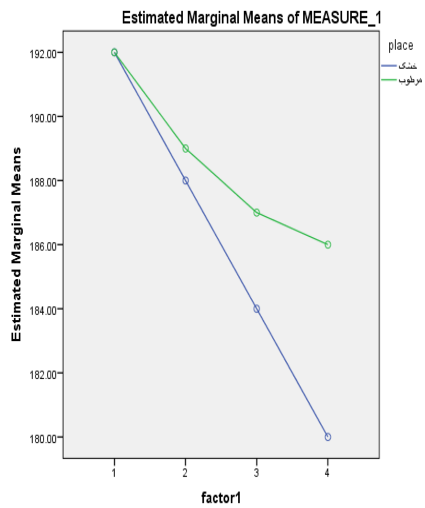
B) Within Group Analysis:

Post diameter by photography: specifications of repeated measure, grouping and sample size are provided in the tables. The test results for sphericity test was significant (Pvalue <0.01). As a result, greenhouse-geisser test was used to evaluate within-group effects. According to test and data obtained, the effect of time on the diameter of the post was significant (Pvalue <0.01). But the intermediate effect of time and resin type was not significant post diameter (P value> 0.073) intermediate effect of time and environment on the diameter of the posts was significant (Pvalue <0.01). Finally, intermediate effect of time, environment and resin type on post diameter was not significant (Pvalue <0.09). Thus, the photographic data shows differences in two cases to data obtained from the caliper.

Contrast test also compared changes in diameter of the posts at all time intervals when with 24 hours. Post diameter comparing at 0, 1, 6 and 24 hours, showed a significant change (Pvalue <0.01). Diameter of the posts by intermediate effects of time and resin type at all times compared with 24 showed a significant change. Under the influence of time and environment there was a significant change at 6 and 12 in a dry environment. And the diameter of the posts at all times compared with time 24 showed a significant change (Pvalue <0.01).

Between-group analysis: The analysis of between-group differences showed that diameter of the post in different environments undergoes a significant change (Pvalue <0.01). Thus it can be seen that the diameter of the posts in a dry environment is significantly different from that in a moist environment. As well as changes in a dry environment over time especially for 24 hours, include the highest rate of changes, post diameter in a dry environment follow a steady ascending trend but this trend has taken shape in a moist environment for some time and then is completely adjusted.





Descriptive Statistics

	material	Place	Mean	Std. Deviation	N
CD0-photography	duralay	Dry	192.0000	.00000	10
		Water	192.0000	.00000	10
		Total	192.0000	.00000	20
	GC	Dry	192.0000	.00000	10
		Water	192.0000	.00000	10
		Total	192.0000	.00000	20
	Total	Dry	192.0000	.00000	20
		Water	192.0000	.00000	20
		Total	192.0000	.00000	40
CD1-photography	duralay	Dry	189.0000	.00000	10
		Water	189.0000	.00000	10
		Total	189.0000	.00000	20
	GC	Dry	188.0000	.00000	10
		Water	189.0000	.00000	10
		Total	189.0000	.00000	20
	Total	Dry	188.0000	.00000	20
		Water	189.0000	.00000	20
		Total	189.0000	.00000	40
CD6-photography	duralay	Dry	185.0000	1.00000	10

		Water	187.0000	.00000	10
		Total	186.0000	1.00000	20
	GC	Dry	183.0000	2.00000	10
		Water	187.0000	1.00000	10
		Total	185.0000	2.00000	20
	Total	Dry	184.0000	2.00000	20
		Water	187.0000	1.05131	20
		Total	185.0000	2.00000	40
CD24-photography	duralay	Dry	181.0000	1.00000	10
		Water	186.0000	1.00000	10
		Total	183.0000	3.00000	20
	GC	Dry	179.0000	.00000	10
		Water	187.0000	1.00000	10
		Total	183.0000	3.00000	20
	Total	Dry	180.0000	1.00000	20
		Water	186.0000	1.00000	20
		Total	183.0000	3.00000	40

Multivariate Tests[a]

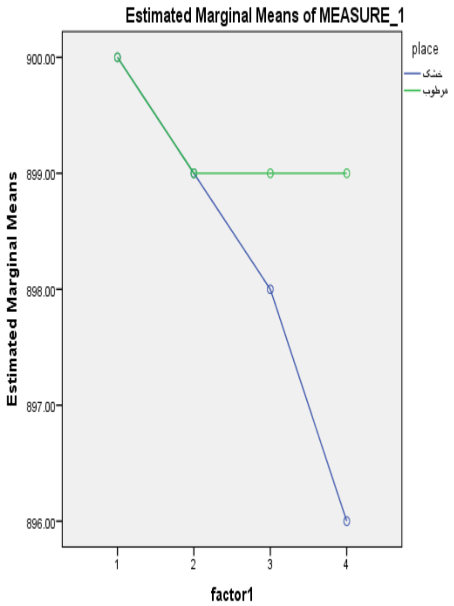
Effect		Value	F	Hypothesis df	Error df	Sig.
factor1	Pillai's Trace	.000	885.000[b]	3.000	34.000	.000
	Wilks' Lambda	.013	885.000[b]	3.000	34.000	.000
	Hotelling's Trace	78.000	885.000[b]	3.000	34.000	.000
	Roy's Largest Root	78.000	885.000[b]	3.000	34.000	.000
factor1 * material	Pillai's Trace	.000	2.000[b]	3.000	34.000	.073
	Wilks' Lambda	.000	2.000[b]	3.000	34.000	.073
	Hotelling's Trace	.000	2.000[b]	3.000	34.000	.073
	Roy's Largest Root	.000	2.000[b]	3.000	34.000	.073
factor1 * place	Pillai's Trace	.000	120.000[b]	3.000	34.000	.000
	Wilks' Lambda	.086	120.000[b]	3.000	34.000	.000
	Hotelling's Trace	10.000	120.000[b]	3.000	34.000	.000
	Roy's Largest Root	10.000	120.000[b]	3.000	34.000	.000
factor1 * material * place	Pillai's Trace	.000	2.000[b]	3.000	34.000	.090
	Wilks' Lambda	.000	2.000[b]	3.000	34.000	.090
	Hotelling's Trace	.000	2.000[b]	3.000	34.000	.090
	Roy's Largest Root	.000	2.000[b]	3.000	34.000	.090

C) Within Group Analysis:

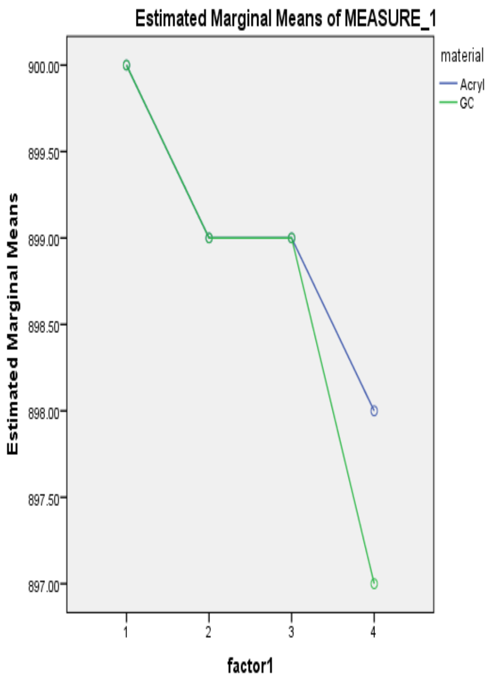
Post length with caliper: specifications including repeated measure, grouping and sample size are provided in the tables. The test results were significant for sphericity test (P value <0.0)). As a result, greenhouse-geisser test was used to evaluate the within-group effects. According to the test, the effect of time on post diameter was not significant (Pvalue> 0.05). Intermediate effect of time and resin type on the length of posts was not significant (Pvalue> 0.05). Intermediate effect of time and environment on the length of posts was significant (Pvalue <0.01). Finally the intermediate effect of time, environment and resin type on post length was not significant (Pvalue <0.01). Thus, it can only be said that the post length will have a significant difference in moist and dry environments. Contrast test also compared changes in length of posts at all intervals with 24 hours. The post length showed no significant change at times 0, 1, 6 and 24 hours. But the changes in the post length at 24 in a dry environment are significant.

Between-group analysis:

There has not been a significant change between groups. In fact, there was no difference in the length of posts in different environments. However, changes in the dry environment were more than moist environment, but these changes were not significant. However, changes in GC and Duralay also showed no significant difference.



Although GC have observed more changes than Duralay, but these changes are not significant. These changes peak, in particular between 6 and 24.



Descriptive Statistics

	material	Place	Mean	Std. Deviation	N
PL0-caliper	Duralay	Dry	900.0000	.00000	10
		Water	900.0000	.00000	10
		Total	900.0000	.00000	20
	GC	Dry	900.0000	.00000	10
		Water	900.0000	.00000	10
		Total	900.0000	.00000	20
	Total	Dry	900.0000	.00000	20
		Water	900.0000	.00000	20
		Total	900.0000	.00000	40
PL1-caliper	Duralay	Dry	899.0000	.00000	10
		Water	900.0000	.00000	10
		Total	899.0000	.00000	20
	GC	Dry	899.0000	1.03280	10
		Water	899.0000	.00000	10
		Total	899.0000	.00000	20
	Total	Dry	899.0000	.00000	20
		Water	899.0000	.00000	20
		Total	899.0000	.00000	40
PL6-caliper	Duralay	Dry	899.0000	.00000	10
		Water	899.0000	.00000	10
		Total	899.0000	.00000	20
	GC	Dry	898.0000	1.00000	10
		Water	899.0000	.00000	10
		Total	899.0000	1.00000	20
	Total	Dry	898.0000	1.00000	20
		Water	899.0000	.00000	20
		Total	899.0000	1.00000	40
PL24-caliper	Duralay	Dry	897.0000	1.00000	10
		Water	899.0000	1.00000	10
		Total	898.0000	1.00000	20
	GC	Dry	895.0000	1.00000	10
		Water	899.0000	.00000	10
		Total	897.0000	2.00000	20
	Total	Dry	896.0000	1.00000	20
		Water	899.0000	1.08942	20
		Total	897.0000	1.00000	40

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Sphericity Assumed	114.000	3	38.073	3.000	.090
	Greenhouse-Geisser	114.000	1.000	60.000	6.000	.100

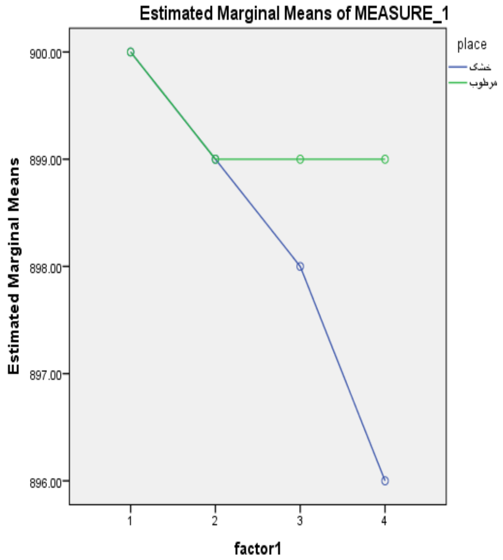
	Huynh-Feldt	114.000	2.000	53.000	4.000	.080
	Lower-bound	114.000	1.000	114.000	3.000	.750
factor1 * material	Sphericity Assumed	2.000	3	.000	1.000	.0970
	Greenhouse-Geisser	2.000	1.000	1.000	1.000	.250
	Huynh-Feldt	2.000	2.000	1.000	1.000	.290
	Lower-bound	2.000	1.000	2.000	1.000	.200
factor1 * place	Sphericity Assumed	43.000	3	14.000	34.000	.000
	Greenhouse-Geisser	43.000	1.000	23.000	33.000	.000
	Huynh-Feldt	43.000	2.000	20.000	43.000	.000
	Lower-bound	43.000	1.000	43.000	46.000	.000
factor1 * material * place	Sphericity Assumed	2.000	3	.000	1.000	.080
	Greenhouse-Geisser	2.000	1.000	1.000	1.000	.100
	Huynh-Feldt	2.000	2.000	1.000	1.000	.080
	Lower-bound	2.000	1.000	2.000	1.000	.290
Error(factor1)	Sphericity Assumed	64.000	108	.000		
	Greenhouse-Geisser	64.000	67.000	.000		
	Huynh-Feldt	64.000	76.000	.000		
	Lower-bound	64.000	36.000	1.000		

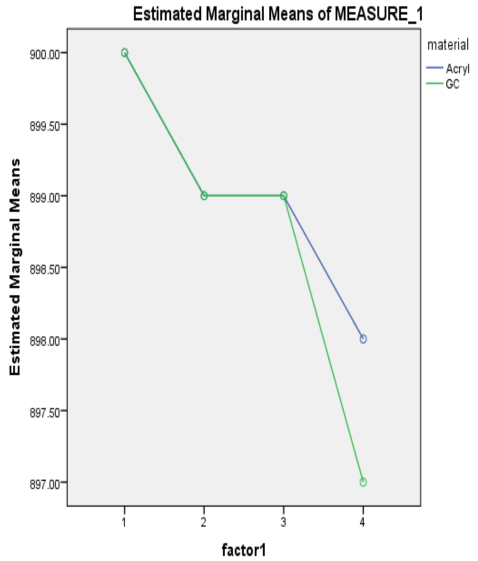
Within Group Analysis:

Post length with photography: specifications including repeated measure, grouping and sample size are provided in the tables. The test results for sphericity test was significant (P value <0.01). As a result, greenhouse-geisser test was used to evaluate the within-group effects. According to the test, there was no significant effect of time on the post length (Pvalue> 0.05). The intermediate effect of time and material type on the posts length was not significant (P value> 0.05). The only significant effect on the post length was the intermediate impact of environment and time that had a significant effect on post length (Pvalue <0.05). Finally, the intermediate effect of time, environment and resin type on post length was not significant (Pvalue> 0.05). It can only be said that the post length in moist and dry environments will show a significant difference. Contrast test also compared changes in the length of posts at all time intervals with 24 hours. The post length at times 0, 1, 6 and 24 hours, will not change significantly. But the changes in the post length at 24 in a dry environment are significant.

Between-group analysis:

There have been no significant changes between groups. In fact, there was no difference in the length of posts in different environments. While changes in the dry environment was more than moist environment, but these changes are not significant. In addition, changes in GC and Duralay resins also showed no significant difference.





Descriptive Statistics

	material	Place	Mean	Std. Deviation	N
PL0-photography	duralay	Dry	900.0000	.00000	10
		Water	900.0000	.00000	10
		Total	900.0000	.00000	20
	GC	Dry	900.0000	.00000	10
		Water	900.0000	.00000	10
		Total	900.0000	.00000	20
	Total	Dry	900.0000	.00000	20
		Water	900.0000	.00000	20
		Total	900.0000	.00000	40
PL1-photography	duralay	Dry	899.0000	.00000	10
		Water	900.0000	.00000	10
		Total	899.0000	.00000	20
	GC	Dry	899.0000	.00000	10
		Water	899.0000	.00000	10
		Total	899.0000	.00000	20
	Total	Dry	899.0000	.00000	20
		Water	899.0000	.00000	20
		Total	899.0000	.00000	40
PL6-photography	duralay	Dry	899.0000	.00000	10
		Water	899.0000	.00000	10
		Total	899.0000	.00000	20
	GC	Dry	898.0000	1.00000	10
		Water	899.0000	.00000	10
		Total	899.0500	1.00000	20
	Total	Dry	898.0000	1.00000	20
		Water	899.0000	.00000	20
		Total	899.0000	.00000	40
PL24-photography	duralay	Dry	897.0000	1.00000	10
		Water	899.0000	1.00000	10
		Total	898.0000	1.00000	20
	GC	Dry	895.0000	1.00000	10

		Water	899.0000	.00000	10
		Total	897.0000	2.00000	20
	Total	Dry	896.0000	1.00000	20
		Water	899.0000	1.08942	20
		Total	897.0000	1.00000	40

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Sphericity Assumed	119.000	3	39.000	3.000	.130
	Greenhouse-Geisser	119.000	1.000	72.000	4.000	.10
	Huynh-Feldt	119.000	1.000	64.000	3.000	.090
	Lower-bound	119.000	1.000	119.000	4.000	.089
factor1 * material	Sphericity Assumed	2.000	3	.000	1.000	.160
	Greenhouse-Geisser	2.000	1.000	1.000	1.000	.090
	Huynh-Feldt	2.000	1.000	1.000	1.000	.120
	Lower-bound	2.000	1.000	2.000	1.000	.080
factor1 * place	Sphericity Assumed	47.000	3	15.000	3.000	.060
	Greenhouse-Geisser	47.000	1.000	28.000	13.000	.045
	Huynh-Feldt	47.000	1.000	25.000	6.000	.065
	Lower-bound	47.000	1.000	47.000	4.000	.072
factor1 * material * place	Sphericity Assumed	3.000	3	1.000	3.075	.090
	Greenhouse-Geisser	3.000	1.000	2.000	7.075	.120
	Huynh-Feldt	3.000	1.000	2.000	3.075	.080
	Lower-bound	3.000	1.000	3.000	2.075	.950
Error(factor1)	Sphericity Assumed	67.000	108	.000		
	Greenhouse-Geisser	67.000	59.000	1.000		
	Huynh-Feldt	67.000	67.000	1.012		
	Lower-bound	67.000	36.000	1.000		

Compare perfection of two measuring methods namely Collis and Photography in dry Environment

Variable	N	MEAN	Std. Deviation	T-STDENT	df	Sig
	40	1.85	2	3.78	3.8	0.001
	40	1.86	2			

E) **Comparison between the two measuring methods of caliper and photography in a dry environment**

According to the table, we can see that the two instruments used i.e. caliper and photography, at the time 6, photography with a mean of 1.85 and standard deviation of 2, and caliper with a mean of 1.86 and standard deviation of 2, had a T value of 3.75. This value is significant for degrees of freedom of 3.8 in level less than 0.01.

DISCUSSION:

The aim of this study was to compare polymerization shrinkage of two types of GC and Duralay resins in moist and dry environments (water) at different times with 2 measurement methods using caliper and digital photography where we found the following results, post coronal diameter with digital calipers measurement, rather than being dependent on the type of resin depends on time and storage media and at similar time and environmental conditions changes in coronal diameter follow a relatively similar trend, although changes of GC resin are more than Duralay resin but this difference is not significant. Post coronal diameter using photographic measurements in different times and storage environments is undergoing significant changes. Post length in dry and moist environments shows no significant difference, although the changes in dry environments are more than those in moist environments, but they are not significant, however, changes in the two types of resin showed no significant differences. The results obtained in terms of post length for both methods of measurement i.e. caliper and photography, are the same. Also comparison of the accuracy of 2 methods of measuring i.e. caliper and photography in dry environment in area less than 0.01 mm is significant. In a study by Minoo Mahshid et al in 2005 entitled evaluation of the effect of time, antisepticagent and environment on aspects of Duralay resin model, they concluded that the linear changes of Duralay resin do not follow a fixed pattern at time intervals. Thus, no special time can be introduced as the best time for the cast of resin model. Based on the present results, the first hour is the best time to cast the resin independent of the storage environment and shrinkage differences become more obvious between two environments after 6 hours. [9]

In a study conducted by Moshref et al in 2006 entitled “comparison of linear dimensional changes of self-hardening Duralay resin in different storage environments”, it was concluded that if the samples made of Duralay resin are cast quickly and within one hour, storage environment will not have much effect on the dimensional accuracy. However, if the interval between preparation of Duralay model and casting is more than one hour, sample should be kept in aqueous environment [10]. The results of this study should are consistent with the results of our investigation. [10]

In the study by Gibs et al in 2014 aiming to compare the polymerization shrinkage of Duralay and GC resins and two photo-polymerizing groups, they concluded that the shrinkage was higher in one of the photo-polymerizing groups than in resins [11]. The results also showed higher rates of shrinkage in Duralay than GC resin. The results of this study are completely consistent with the results of our investigation. [11]

It seems that the researchers agree on the effect of time on the amount of resin shrinkage and the best time to cast them, with the exception of Dr. Minoo Mahshid et al who did not considered the best time to cast resin, however, based on our results, the first hour is the best time to cast the resin, independent of the storage environment and the shrinkage difference is more dramatic between the environments after six hours. Also, based on the studies by Gibs, Duralay was preferred over GC, noted, that our results also confirmed this, but reporting different amounts of shrinkage is due to the difference in storage environments and different resin sample sizes.

CONCLUSION:

If the posts are cast within one hour after they are made, environment will have little impact on resin shrinkage, but if it takes longer the shrinkage continues in dry environment, but stops in aqueous environment, thus to reduce the shrinkage, resin should be kept in a moist environment. The results were also different for the two types of GC and Duralay resins, but it confirmed the superiority of Duralay. Also comparing the accuracy of 2 methods of measuring including caliper and photography in a dry environment in area less than 0.01 mm was significant.

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FIGURES:

Figure 1