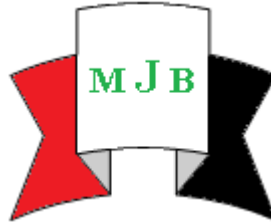


A Comparative Study Evaluate Dimensional Accuracy of Newly Poly Vinylsiloxanase Elastomeric Impression Material at Different Times and Conditions

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Abstract

Background: elastomeric impression materials are widely used registration of teeth and oral surrounding tissues, these materials have been developed newly through manufacture productions, dimensional accuracy is one of the most important feature showed be examined for each material at different conditions to evaluate material properties, a study therefore was undertaken to measure dimensional accuracy of newly elastomeric material at different times using different die stone types.

Materials and methods: fifty impression samples from two different elastomeric materials were taken of metal block (ADA) block conforming the American dental association specification no. (19) for impression materials, using two different types of die stone for each .Dimensional accuracy was measured by comparing the average length of middle horizontal line in each impression to the corresponding line in the metal die by using digitalized veirnea after 24 hr. of pouring,1 week. and after 1 month.. Surface roughness also measured by using profilometer, porosity of surface material, dries and moist conditions of impression materials were also discussed.

Results: dimensional accuracy under dry and moist conditions, surface roughness, surface porosity, and effect of different times of measurement procedures; all demonstrate significant differences for both types of silicon impression materials at the two different types of dental stone. Additional silicon material showed a non- significant difference in dimensional accuracy with type II dental stone, while both types of silicon materials showed anon- significant difference in surface roughness test for type III dental stone. The newly extra light silicon material showed also a non- significant difference for only type II dental stone after 24 hr. time of measurement.

Conclusion: based on the results obtained from this study there was a significant difference in dimensional accuracy, surface roughness, porosity, and moist condition effect measurements between different silicon impression materials with their different types of die stone .these variations gave us an idea that not all materials from the same category and same type should result in same properties and surface features.

Keywords: dimensional accuracy, elastomeric impressions, surface roughness, porosity.

الخلاصة

تستخدم مواد الطبعة المرنة بشكل واسع لتسجيل الانسجة الفموية المحيطة والاسنان وهذه المواد تطورت حديثا من خلال منتجات المصانع.دقة قياس الابعاد هي واحدة من العوامل المهمة التي يجب ان تخلص لكل مادة تحت حالات مختلفة لتقييم صفات المادة , لذلك دراسة اخذت على نظر الاعتبار لقياس دقة الابعاد لمادة طبعة حديثة الانتاج ذات مرونة لفترات زمنية مختلفة باستخدام انواع مختلفة من الداي ستون (البورك الصلب).

Introduction

Correct registration of impression materials produce an accurate impressions, not deform when removed from mouth or during experimental work [1,2]. The accuracy of an impression materials plays an important role in the production of well-fitting restoration, and thus to produce accurate cast for future decided proper treatment plan [3]. Many studies have been established to assess different properties of impression materials, of these properties may affect fitness of dental prosthesis, dimensional stability of the impression materials considered primarily for good restoration [4-6].

Earliest materials had been demonstrated a relatively poor dimensional stability, furthermore these materials were adversely affected by exposure to moisture contamination during time of impression taken [6].

Elastomeric impression materials are widely used in dentistry; these materials have been modified chemically and physically through years. Additional silicon or vinyl poly siloxane was used as impression material since 1970s, reaction of polymer end with vinyl group and no by-product during polymerization in contrast to the condensation type of silicon, these properties have been reported an accurate dimensional stability and surface reproduction of additional silicon material [7-9].

The accuracy of impression materials depends on many factors; composition of the material, manipulation procedure, and the die cast material itself. It is also depend on the surrounding conditions; moistening and dryness of impression surface [10- 12].

Evaluating the storage time of pouring material have been also demonstrate an

effect on the dimensional stability of the material [13-15], since addition silicon material have been reported a hydrophobic nature that to facilitate pouring procedure [16, 17].

In this study we investigate the dimensional accuracy of the traditional addition silicon material with newly type of extra light poly vinylsiloxane material using two different types of die stone and compare the results obtained, these readings were evaluated at different storage times. Many variables also been discussed; surface roughness, porosity, and moistening of surface die stone.

Materials and Methods

Fifty impression samples were made, two different types of elastomeric impression materials were used; addition silicon regular type (hydrophilic vinyl polysiloxane addition silicon impression material) (Zhermack, elite p&p), and extra-light body newly silicon soft type (vinyl polysiloxane impression material) (Bisco, Twinz vps). Each material was mixed and manipulated according to their mixing, and working time of manufactures instructions specific for each. Two different types of dental stone were used for making the cast models; Type III dental stone (elite model, ZHERMACK, Italy), Type IV extra hard dental die stone (elite rock, ZHERMACK, Italy).

Specimen's preparation

A test block certified according to the ADA specification no.19 was used for impression making [18], three vertical parallel lines scored on this block named A, B, and C. Two cross lines intersect horizontally as X, Y with these horizontal lines as seen in Fig. (1)(2). Rubber ring with dimensions of 30mm diameter and 20mm height was used for preparation of both elastomeric

impression materials samples and their corresponding die stone two types for each poly vinylsiloxanase materials. Each material was mixed and manipulated according to their mixing, and working time of manufactures specific for each, 30 min time was allowed for each elastomeric material to rest that allow for elastic recovery before pouring models[6,19], then die stone of both types was mixed and manipulated according to the manufactures instructions of water/ powder ratio. After hand mixing of stone, mixture was poured in the rubber ring above the set impression materials with continuous manual vibration to draw out air bubbles from the mixture and reduce porosity. Glass slab was placed on the upper border of the rubber ring, to obtain samples with flat and parallel surfaces. All stone specimens were removed gently from the rubber ring and the impressions, after one hour of mixing, and left for 24 hours at an average room temperature of $33^{\circ}\text{C} \pm 1.0$ and average relative humidity of $40\% \pm 5\%$ before measurement and during the duration of the testing period.

Surface roughness measurements

Twenty dental stone samples of type III and type IV, each ten for two different types of additional silicon materials were tested for surface roughness, R_a (μm), with profilometer device (surface roughness tester). Two measurements were taken for each sample and average reading was then calculated. Three readings were registered for each sample at different times; after 24hr and 1week after samples preparation.

Evaluation of dimensional accuracy:

After the preparation of samples according to the test block of the ADA specification no.19 was used for impression making [18], three

measurements were recorded for each stone sample; after 24hr, 1week, and 1 month of samples preparation by measuring the distance between the X, Y cross lines obtained using digitalized verneia device (Electronic Digital Caliper), three readings were taken and the mean results were obtained.

Measurements under moist conditions

For measurements under moist condition, fine mist of water (33°C temp.) From a spray bottle was applied to the surface of the test block before impression materials were injected. Care should be taken to ensure that a uniform mist of water covered the entire surface of test block that no excess water or beading should be done. This test was done for each 10 samples of both types of dental die stone for both the silicone regular type and the newly extra light silicon soft type. Dimensional accuracy was evaluated after 24 hr. of sample preparations and the same procedure taken under dry condition was followed under moist condition.

Porosity measurement

Twenty samples were made to measure surface porosity evaluation. Each sample of both types of dental stone materials was scanned with a scanner twice; before and after 24 hour of the moist condition procedure. Program Corel Draw X3 versions 13 used, a circle was drawn to outline the outer boarder of the sample. Another circle was drawn in the center of the first one with a diameter of 4 mm.

Surface porosity was evaluated by counting the no. of pores inside the smaller circle. For each stone sample surface porosity was measured twice and the average of the two readings was obtained one before moist condition and average after moist condition.

Statistical analysis with descriptive statistics and paired sample T- test at significance levels were assessed.

Results

Table (1) showed mean and standard deviation descriptive of the dimensional accuracy for all test groups. The results showed non-significant difference in the dimensional accuracy for both groups (group 1 with type IV) and (group 2 with type III) dental stone, at different times of measurements except for extra light silicon material(US) which showed significant difference after 1 week and highly significant difference after 1 month of measurements for both types of dental stone, additional silicon material(AS) showed a significant difference after 1 month of measurements for only type III stone samples table (2) and (3).

Mean and standard deviation of surface roughness for all test groups were explained in table (4) which showed that there was a non- significant difference in surface roughness for both types of silicon impression materials with type III dental stone while a significant results were obtained for both types of silicon impression materials with type IV dental stone samples as it shown in table (5).

Table (6) and (7) showed the descriptive mean and standard deviation of surface porosity for all test groups; both extra light and additional silicon impression materials showed a significant difference in surface porosity for both types of dental stone at different time of measurements. The newly extra light silicon material shows a non- significant difference for type IV dental stone after 24 hr. of measurement time.

For dimensional accuracy under moist condition, table (8) showed the descriptive mean and standard deviation

of all test groups which revealed significant difference of both types of impression materials for two types of dental stone used at different time of measurement table(9).

Discussion

The knowledge of dental material properties is imperative for dental practice that can choose appropriate material as an important factor for the accuracy of dental devices which is dependent upon an accurate cast or dies; inaccuracies in replication methods will affect adversely on the fitness and adaptation of final model. The dental profession continues to search for evaluating the advantages and disadvantages of each material to use them in clinic practice; the professional will be able to adjust the more precise reproduction aiming for final satisfaction in the case, the impression materials are produced as a solution to the limitations of older materials.

In our study we examine many surface properties of two types of poly vinylsiloxanase materials as it is widely used material in dental practice; the commercially available additional silicon regular type and the newly extra-light body silicon soft type. We used two different types of dental stone; type IV and type III materials die types.

For dimensional accuracy evaluation; our results showed a non- significant difference in the measurements for AS silicon material type with group 1 and group 2 dental stones within 1st 24 hr. and 1 week times of measurements, these results come in agreement with the most studies made on the additional type of silicon; addition silicones are the most accurate rubber impression materials within the 1st 7 days [5, 6, 19-23].while AS showed a significant difference after

1 month time for group 2 cast models; this may due to fluctuation in measurements within impression materials related to hygroscopic expansion or residual stress relaxation, this agreed with the findings of Rodriguez and Bartlett who found that impression materials were stable up to 2 weeks[24-26]. Difference in the compatibility reaction of silicon material with the different types of dental stone gave this variance between AS and group1 and 2 dental stone; the same results found by Craig who found that impression materials have different reactions with different types of dental stone [27, 28].The extra light newly silicon material US showed a different results from the AS silicon material type; significant difference of dimensional accuracy test at different time of measurements(24 hr.,1 week, and 1 month) for both types of dental stone group 1 and 2, these results agreed with the values obtained by Craig and Bell et al who found that some variations in dimensional accuracy from product to product from the same type [26, 29,30].As a results of these variations suggestions that accurate models and dies can be poured from addition silicon impressions after a week are not true for all products[19, 26, 31].

Material manipulation procedure also affects the excellent of the impression as carefully syringing the material will help to obtain accurate surface details more than hand mixing impression; this difference gave another reason that US silicon material showed significant difference in dimensional accuracy than AS silicon material [32-34].

For surface roughness evaluation our study showed a non-significant difference for both types of silicon AS and US impression materials with

corresponding models of type III while there was as a significant difference for both AS and US impression materials with type IV dental stone casts; these readings were taken at different times of measurements and also revealed the same results, these findings were agreed with the ones measured by Gaung Hong [19] who found that there is a difference in the material / dental stone combinations between the different kinds of commercial found materials that some may have appropriate combinations and the other may have not. This difference in surface roughness impression is that the degree of hydrophilicity of the silicon impression material would influence the free growth of the needle crystal of dental stone surface, the newly US material is highly hydrophilic than AS silicon type and this difference may be admitted in the compatibility with dental stones [19, 35, 36].

Porosity test was also evaluated in this study; the US silicon material showed much less bubbles with their corresponding dental cast type IV than AS silicon material with their die stone casts, the newly extra light silicon material have the features of high dimensional stability with no bubbles impression material, these properties may attributed to different reasons; Sabouhi et al found that many kinds of type IV dental stone showed more surface angle compatibility with additional silicon than type III dental stone [37]. Others found that the use of syringe manipulation of impression material will result in uniform mix and an impression with minimum bubbles in their corresponding dental stone [26]. The newly found additional silicon types are with hydrogen absorber surfactants to eliminate the hydrogen evolution

problems and accordingly numbers of air bubbles decrease [9, 26, 38].all these findings agreed with our results even in the difference of methodology.

Measurement of dimensional accuracy under moist conditions was also discussed in this study, our findings showed a significant difference for both US and AS types of silicon with both kinds of dental stone at different times of measurements. These findings forced the results found by Prattern and Graic who found that hydrophilic impression materials still cannot accurately produce the surface detail in the presence of moisture. These results indicated that during use of these materials one should keep moisture control during making impression [6, 39].Walker MP et al and Petrie found also that surface details were best under only dry conditions and moist condition did not produce superior polyvinyl siloxane impressions [40 ,41].

Conclusion

Based on the results of our study, we concluded that for dimensional accuracy test; the newly elastomeric impression silicon showed different values at different times of measurements on both type III and type IV dental stone while for the regular silicon type there was no difference on measurements after 24 hr. and 1 week times and a significant difference after 1 month. Dimensional accuracy under moist condition revealed that both types of silicon materials showed significant differences with both type III and type IV dental stone.

For surface roughness; both types of silicon materials showed no difference on type III dental stone and a significant difference for type IV dental stone.

Porosity test showed that the extra light type of silicon with much less surface bubble with type IV dental stone than

the regular silicon type of corresponding casts.

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Table 1 Descriptive of Dimensional accuracy test between AS and US different times of measurements.

		24hr		1week		1month	
		U.S	A.S	U.S	A.S	U.S	A.S
Group1	Mean	19.7	19.25	19.08	18.98	19.004	18.76
	SD	0.325	0.25	0.109	0.467	0.149	0.423
Group2	Mean	19.4	19.45	19.17	19.116	19.08	18.71
	SD	0.285	0.447	0.168	0.121	0.101	0.403

Table 2 T-test of dimensional accuracy between type IV (group 1) & type III (group 2) at different times of measurements

		24hr	1week	1month
Group1	t	2.714	0.546	1.355
	P	0.049	0.614	0.247
	Sig	S	NS	NS
Group2	t	0.232	0.57	2.014
	P	0.828	0.599	0.114
	Sig	NS	NS	NS

ANOVA test

	U.S		A.S	
	F-test	P-value	F-test	P-value
Group1	15.399	P<0.01 HS	1.913	0.19 NS
Group2	3.341	0.049 S	5.391	0.021 S

Table 3 LSD test of dimensional accuracy between AS and US at diff. times

		U.S		A.S	
		P-value	Sig	P-value	Sig
Group1	24rh&1week	0.001	S	0.308	NS
	24hr&1month	P<0.01	HS	0.074	NS
	1week&1month	0.551	NS	0.392	NS
Group2	24rh&1week	0.034	S	0.163	NS
	24hr&1month	0.028	S	0.007	S
	1week&1month	0.509	NS	0.089	NS

Table 4 Descriptive of roughness test between US& AS with type IV& type III die stone

		24hr		1week	
		U.S	A.S	U.S	A.S
Group1	Mean	1.11	1.85	1.114	1.89
	SD	0.105	0.514	0.097	0.494
Group2	Mean	1.914	2.288	1.976	2.424
	SD	0.747	0.551	0.760	0.622

Table 5 T-test of roughness between U.S&A.S with type IV and type III die stone

		24hr	1week
Group1	t	2.675	2.945
	P	0.049	0.042
	Sig	S	S
Group2	t	1.358	1.473
	P	0.246	0.215
	Sig	NS	NS

	U.S		A.S	
	t-test	P-value	t-test	P-value
Group1	2.443	0.048 S	2.582	0.049 S
Group2	0.78	0.479 NS	1.591	0.187 NS

Table 6 Descriptive of porosity test between US&AS with type (1) and (2) die stone at different time of measurements

		24hr		1week	
		U.S	A.S	U.S	A.S
Group1	Mean	2.3	4.1	2.5	3.1
	SD	0.447	0.547	0	0.547
Group2	Mean	4.1	3.4	3.5	2.9
	SD	0.894	0.223	0.707	0.547

Table 7 T-test of porosity between U.S&A.S with group (1) and (2) die stones

		24hr	1week
Group1	t	9.01	2.449
	P	0.001	0.049
	Sig	S	S
Group2	t	1.871	2.449
	P	0.135	0.049
	Sig	NS	S

Table 8 Descriptive of moist test between AS&US with group (1) & (2) die stones

		24hr		1week	
		U.S	A.S	U.S	A.S
Group1	Mean	16.642	14.564	17.092	14.898
	SD	2.367	0.405	2.186	0.441
Group2	Mean	17.722	14.21	17.006	14.2
	SD	2.062	0.091	2.552	0.048

Table 9 T-test of moist condition between different groups of die stones

		24hr	1week
Group1	t	2.18	2.241
	P	0.049	0.049
	Sig	S	S
Group2	t	3.875	2.474
	P	0.018	0.049
	Sig	S	S

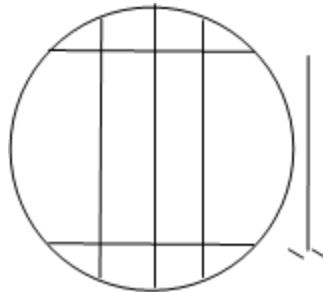


Figure 1 diagram of dimensional accuracy of die stone.



Figure 2 specimen preparation.