Linear setting expansion of three different types of dental stones Available in Iraqi market , a comparative study.

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Abstract

Aims of the study: To identify the must appropriate type of dental stone produces with minimal setting expansion

Materials and methods: Three typee of dental stone compared, two groups produced depending on the mixing ratio so that the setting expansion values obtained by the aids of extensometer then compare them statistically.

Results and discussion: Comparing setting expansion within each group the lowest setting expansion found in Elite model stone while the highest value in Silky Rock model, in Q.D. dental stone While comparing the two groups with each other shows no considerable changes take place due to increase in the W/P ratio

Conclusion: Increasing the W/P ratio to a considerable limit results in a minimal changes in the setting expansion for Silky Rock stone, while for Q.D. dental stone & Elite model the setting expansion decreased. Heat generated from the mixture didn't affected by the changes in W/P ratio.

Introduction

Dental stone is a naturally hydrated from calcium sulfate dihydrates,' $CaSO_4$,.$2H_2O$" and the alpha-form of calcium sulfate hemihydrate with physical properties superior to the beta-form (dental plaster). The alpha-form consists of cleavage fragments and crystals in the form of rods or prisms, and is therefore more dense than the beta-form (1). Dental stone probably more useful than any other material to dental practitioner (2)

Stone Powder particles are uniform, regular, less porous, prismatic shape and absorb less amount of water called " –calcium sulfate hemihydrates" (3,4)

Regardless of the type of gypsum product employed, expansion of the mass can be detected during the changes from the hemihydrate to dihydrate form of gypsum.(5)

Depending on the composition of the gypsum product the linear expansion may be as low as "0.05%" as high as "0.5%".(6,7)

Lautenschlager and Grabin (8) noted that after mixing of hemihydrates and water, crystals of dihydrates formed as these crystals grow in size and number. They impinge upon one another. They did not deform each other but rather push each other outward into a large space volume, causing expansion.

The setting expansion my be controlled by different manipulative conditions, as well as by the addition of some chemicals, such as addition of borax, solution of accelerators and retarders to balanced the setting expansion with particular setting time are known as anti-expansion solution which can reduce the total expansion. (9), Setting expansion is also influenced by the W/P ratio. And its

inversely proportional to W/P ratio (10,11)

Temperature, as high as 65°C may have a certain effect on this property, as heating which drives off water of crystallization will result in contraction of gypsum and this contraction is sufficient to impair the ability of these material to withstand the necessary dimensional requirements of their usage.(12,7)

The time and rate of spatulation have a definite effect on the setting of gypsum material within practical limits an increase in the amount of spatulation will increase the setting expansion. (11)

Stone powder is mixed with water to produce a workable mix. The theoretical ratio of water that can be incorporated in to 100mg of gypsum to react chemically with all the available calcium sulfate hemihydrate particles is 18.36 ml (10,13)

This variation in the amount of water is due to the method of production, dehydration, temperature, particles size of gypsum, length of calcinations , time of grinding of finished product and addition of surface active ingredient to the final product (6)

Materials and Mthods

Three types of dental stones used to construct 18 samples subdivided into two groups:

Group I: With a mixing ratio according to manifactural ratio Table 1.
Group II: With a mixing ratio of 33ml/100g according top ADA specification.

Each group contains nine samples, three samples for each type of stone. So that the study designed to evaluate the effect of mixing ratio on setting for each type of dental stone used by the aids of extensometer apparatus in order to recognize the type of dental stone produce the lower setting expansion compared to other types.

Mixing procedure:

Group I: According to manufactural instruction the mixing was made by adding over a 10 seconds dry powder to the correct amount of water in clean scratch free rubber bowel, the mixture was allowed to soaked for additional 20 seconds and then mixed for 1 min. to smooth consistency then poured in mould of the extensometer as shown in Fig.1.

Testing procedure:

Six measurement reading obtained over 2 hr of the procedure starting from the initial setting time so that reading divided in to " 00,15,30,60,90,120 min."

Results and Discusion

When comparing setting expansion within each group as shown in table 2 and 3 and fig. 2 at the end of the second hour the lowest setting expansion found in Elite model stone while the highest value in Silky Rock model, in Q.D. dental stone delay its setting expansion starting after the first thirty minutes while the other types of dental stone start after the first fifteen minutes.

Setting expansion within the first few minutes caused by exothermic reaction that occurs within the bulk of the material, other setting expansion caused by the particles size growing against and They impinge upon one another. They did not deform each other but rather push each other outward into a large space volume causing expansion.(8)

Comparing setting expansion in the group I with the group II , no considerable changes take place due to increase in the W/P ratio so that the

mixture reach a manipulative form with minimal increase in setting expansion for Silky Rock stone while reverse effect occur for both Elite model and Q.D. dental stone this is in agreement with (10,11) who said that Setting expansion is influenced by the W/P ratio and its inversely proportional to W/P ratio.

Table 1:Manifactural mixing ratio for first group.

Stone Type	Water	Powder
Silky Rock	**23 ml**	**100g**
Q.D. stone	**25 ml**	**100g**
Elite model stone	**30 ml**	**100g**

Fig. 1 Represent the mould of extensometer apparatus with the stone poured in it.

Table 2: represents linear expansion in three different dental stone groups: with Mixing Ratio According to manifactural instruction

		Time Intervals In Minutes					
		00	15	30	60	90	120
Silky Rock	S1	0.00	0.01	0.03	0.045	0.05	0.053
	S2	0.00	0.01	0.032	0.048	0.055	0.058
	S3	0.00	0.009	0.03	0.043	0.05	0.057
Q.D. Stone	S1	0.00	0.00	0.015	0.038	0.045	0.049
	S2	0.00	0.00	0.011	0.034	0.041	0.046
	S3	0.00	0.00	0.012	0.036	0.043	0.048
Elite Model	S1	0.00	0.007	0.019	0.031	0.037	0.040
	S2	0.00	0.006	0.021	0.029	0.031	0.035
	S3	0.00	0.004	0.02	0.028	0.03	0.034

Table 3: represents linear expansion in three different dental stone groups: with Mixing Ratio 100g/33 ml

		Time Intervals In Minutes					
		00	15	30	60	90	120
Silky Rock	S1	0.00	0.02	0.035	0.05	0.055	0.061
	S2	0.00	0.02	0.034	0.048	0.055	0.06
	S3	0.00	0.018	0.035	0.049	0.054	0.06
Q.D. Stone	S1	0.00	0.00	0.01	0.034	0.042	0.044
	S2	0.00	0.00	0.011	0.033	0.043	0.045
	S3	0.00	0.00	0.01	0.034	0.042	0.044
Elite Model	S1	0.00	0.012	0.024	0.029	0.03	0.031
	S2	0.00	0.011	0.023	0.029	0.031	0.031
	S3	0.00	0.011	0.023	0.028	0.03	0.031

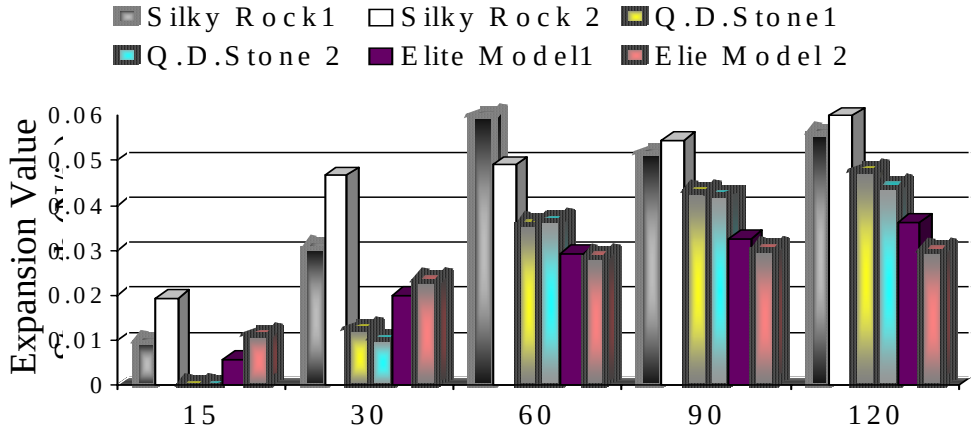

Fig. 2 Bar graph represents the comparison of setting expansion in Both group I and Group II.

Refernces

1- Glossary of Prosthodontic terms 8th edition. J Prosth dent.2005;94(1):30-31.
2- Craig R.G.: Restorative dental materials. 8th edition, Mosbey Company:.1989.
3- Peyton F.A., Anthony D.H.,Asgar K., Charberenan G.T.,Craig R.G. and Myers G.E.Restorative dental Materials. Mosbey Company: 1960.
4- Philips R.W.; Swartz M.L.and Norman R.D.: Materials for practicing dentist. Mosbey Compny,1969.
5- American Dental Association: Guide to dental materials and devices 1996.
6- Philips R.W.: Skinner's science of dental materials. Saunders Compny, 1996.
7- Johnson G.H.: Dimensional stability and detail reproduction materials .J Prosth.dent.1998;79(4):464-453.
8- Lautenschlager E.P. and Grabin F. Investigation of the expansion of dental stone .J Dent Res.1969; 48(2):204-210.
9- Noel R.:Dental material science university of dental school and hospital Ireland 1998
10- O'Brien W.J. andryge G: An outline of dental materials and their selection. Philadelphia W.B. Saunders Cpmpny.1978:58-69.
11- Craig R.G., O'B Rien WJ, Powers JM: Dental material properties and manipulation. 6th edition , St Louis Mosbey 1996.
12- Mahler D.B.:Plaster of paris and stone materials. J Prosth Dent 1955;5(2):241-54
13- McCabe J.F.: Anderson's applied dental materials 6th edition, London Oxford, Blackwell scientific puplication, 1990.