

The Effect of Adding Some Chemical Materials on The Water

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Abstract: The aims: To determine the effect of some chemical materials on the water powder ratio of dental stone. Material and Methods: Three types of chemical materials (rosin, nigella stavia oil and sodium lauryl sulfate) were incorporated into three kinds of type III dental stone (Zeta, Elite and Dental stone) at four concentrations (0.5%, 1%, 1.5% and 2%). The collected data of water powder ratio were subjected to the descriptive analysis (mean and stander deviation), student T test (to evaluate the difference between standard and experimental groups) and one-way analysis of variance (ANOVA) (to show if there are significant differences among experimental groups). Results: Revealed that the incorporation of these chemical materials into each type of dental stone resulted in changing their evaluated water powder ratio; this change varies with the type, concentration of the added chemical material and type of dental stone being used. Conclusion: The most pronounced effect of the chemical additives that used in this study on the water powder ratio of the experimental dental stones was achieved with the addition of sodium lauryl sulfate.

Keywords- water powder ratio, dental stone, plaster, Elite, Zeta

1. INTRODUCTION

Although gypsum products have been successfully used for many years, numerous attempts have been managed to develop die material with improved properties. Recent studies have concentrated on the addition of chemical materials into the dental stone in order to improve its properties (1,2) .

Water requirement is the most important property of calcined gypsum [3], it is an important factor in the quality of gypsum material and in order to compare mechanical properties of gypsum products, specimens must be prepared with uniform consistency (4) .

The effect of additives varies according to the nature of additive being added to gypsum products. Ridge and Boell(5) showed that the addition of gelatin, egg, albumin, sodiumhexamethaphosphate, sodium borate, sodium alginate and tannic acid to gypsum products increase the water requirement. Whereas, the addition of sodium citrate, ethelenediamine tetra-acetate and saponin reduce the water- powder ratio.

Combe and Smith (6) showed that the incorporation of wetting agents such as lignosulfate could reduce the water requirement of stone. Another study done by Zakaria et al (7) on the effect of liquid dispersing agent and microcrystallin additives on the physical properties of type IV gypsum showed that these additives affect the consistency of the mix, but the consistency can be kept close to that of the stander by lowering the water-powder ratio.

Anusavice (8) stated that when a small amount of surface active materials such as gum arabic plus lime added to hemihydratre can reduce markedly the water requirement of both plaster and dental stone.

Al-Sadietal (9) found that the addition of 1% Arabic gum and 0.132% calcium hydroxide to type III and IV dental stone helped in reducing the mixing water-powder ratio. This was in agreement with the conclusions done by Abdelaziz et al (10) .

Taha et al (11) concluded that the addition of 0.2% chlorhexidine to dental stone did not show any change in water-powder ratio. Whereas Twomey et al (12) found that when calcium hypochlorite was added to dental stone, extra mixing water was required to produce a material of the same consistency.

This study aimed to evaluate the effect of adding some chemical materials (rosin, nigella stavia oil and sodium lauryl sulfate) on the water powder ratio of dental stone as follows: Testing the change in the water powder ratio of the dental stone before and after the addition of chemical materials. Comparing the resultant physical and mechanical properties of dental stone (after the addition of chemical materials) with the properties of plaster (negative control) and the properties of die stone (positive control).

Three types of dental stone (Zeta, Elite and Dental stone) were used in this study into which three types of chemical materials were added (rosin, nigella stavia oil and sodium lauryl sulfate). The chemical materials

were added to the powder of dental stone in four percentages (0.5%, 1%, 1.5%, and 2%).

The effect of these chemical materials on the water powder ratio of the experimental dental stones (Zeta, Elite and Dental stone) had been evaluated by measuring the water-powder ratio before and after the addition of chemical materials.

Mixing procedure employed in the preparation of all the test specimens followed the ADA specification No. 25 for gypsum products (13).

The water-powder ratio was measured by using modified vicat apparatus according to ADA specification No.25. The collected data of water powder ratio were subjected to the descriptive analysis (mean and stander deviation), student T test (to evaluate the difference between standard and experimental groups) and one-way analysis of variance (ANOVA) (to show if there are significant differences among experimental groups).

3. RESULT

The mean and standard deviation of the measured water-powder ratio of the three types of dental stone after being blended with the chemical materials is listed in (Table 2).

This table revealed there is an alteration in the water-powder ratio of these dental stones being blended with the chemical materials. However, Statistical analysis reveals that there is no statistical significant difference in the water-powder ratio between experimental and control groups of the three types of dental stone after the addition of rosin except that a significant reduction in the water-powder ratio of Dental stone when it is blended with rosin at concentration of 1 and 1.5% at ($t=8.062$, $t=8.66$, $p<0.05$). A significant reduction was seen in the water-powder ratio of Zeta stone at ($t=4.373$, $t=7.071$, 8.345 , $p<0.05$) after the addition of rosin at a concentration of 0.5, 1 and 1.5%.

The addition of nigella stavia oil to each of the three types of dental stones reduces their water-powder ratio. However, this reduction was not statistically significant, except that when nigella stavia oil has been added at a concentration of 1% to Dental stone ($t=4.243$ $p<0.05$) and at a concentration of 0.5 and 1 % when it added to Zeta at ($t=4.333$, $t=5.960$, $p<0.05$)

4. DISCUSSION

The water-powder ratio must be carefully controlled because of the deviation from this ratio which is recommended by the manufacturer will change both consistency of the material and the properties of the set mass (13,14). Many experimental attempts to improve the mechanical properties of dental stone are oriented mainly towards the decrease of the gauging water requirement (16).

In this study, the examined water-powder ratio varies with respect to the type of stone being used and the type and concentration of the chemical materials being incorporated with it.

According to the results of this study, the addition of the chemical materials causes a reduction of the water-powder ratio of the experimental dental stones. It appears that the surface condition of grains of hemihydrate play an important role in determining the water requirement (3). The addition of the chemical modifier would

change the adhesive force in the compacted powder, allowing the powder particles to be more easily wetted by water and thereby reduces the water requirement (17,18). This was advocated by Craig and Powers (19) who reported that the difference in the physical shape and nature of the crystals makes it possible to obtain the same consistency with less excess water. This means that the variations that may occur in the surface properties of hemihydrate crystals in response to the addition of chemical materials play an important role in changing the water- powder ratio.

5. CONCLUSION

The differences in the examined properties of dental stone, which is basically calcium sulfate hemihydrate, related to the different interactions between the chemical additives and the hemihydrate. Incorporating of suitable chemical materials can produce dental stone with superior mechanical properties.

6. REFERENCES

1. Amer A.Taqa, Tariq Y. K. Bashi, and Lect.Omar Abdul Mohsin Sheet, "Evaluation of Thermal Effect, Setting Temperature of Plaster and Its Effect on the Softening of Wax on Various Gypsum Products after Adding Additives." International Journal of Dental Sciences and Research, vol. 3, no. 6 (2015):128- 136. doi: 10.12691/ijdsr-3-6-2.
2. Amer A Taqa, Nada Z. M. and Tariq Y. K. Bash, The effect of adding some chemical materials on the compressive strength and surface hardness of dental stone, Eastern Academic Journal, Issue 4, pp.104- 110, December, 2015.
3. Ridge MJ and Boell GR (1962) Effects of some additives on the water requirement of calcined gypsum. J. Appl. Chem.; 12:521-526.
4. Lindquist TJ, Stanford CM and Knox E (2003) Influence of surface hardener on gypsum abrasion resistance and water sorption. J Prosthetic Dent; 90(5):441-6.
5. Ridge MJ and Boell GR (1962) Physical properties of calcined gypsum. J Appl. Chem.; 12: 437-444.
6. Combe EC and Smith (1964) Some properties of gypsum plasters. Brit Dent J; 117(6): 237- 145.

7. Zakaria RM, Johnston WM, Reisbick MH and Campagni WV (1988) The effects of a liquid dispersing agent and a microcrystalline additive on the physical properties of type IV gypsum. *J Prosthetic Dent*; 60(5):630-637.
8. Anusavice KJ (1996) Phillip's science of dental materials. 10th Ed, WB Saunder Company, pp 185-208.
9. Al-Sadi S, Combe E C and Cheng Y (1996) Properties of gypsum with the addition of gum arabic and calcium hydroxide. *J Prosthetic Dent*; 76(5): 530-4.
10. Abdelaziz KM, Combe EC and Hodges JS (2002a) The effect of disinfectants on the properties of dental gypsum: Part 1: Mechanical properties. *J Prosthodont*; 11(3):161-7.
11. Taha MY, Amer A. Taqa, Zakariya NA (2000) Chemical and microbiological study of incorporated chlorhexidine in alginate and stone. *Iraqi Dent J*; 25:281-291. 69(3):333-9.
12. Twomey JO, Abdelaziz KM, Combe EC and Anderson DL (2003) Calcium hypochlorite as a disinfecting additive for dental stone. *J Prosthet Dent*; 90(3):282-8.
13. American Dental Association Specification (1974- 1975) Guide to dental materials and device. pp 86-96,255-260.
14. Kaiser DA and Nicholls JI (1976) A study of distortion and surface hardness of improved artificial stone casts. *J Prosthet Dent*; 36(4):373-381.
15. Craig RG and Powers JM (2002) Restorative Dental Mterials.11th Ed, Mosby Company, pp 392-404.
16. Kotsiomiti E, Diakoyianni I, Pissiotis A and Kaloyannides A (1995) Effect of the addition of ammonium salts on improved dental stone's surface hardness. *Hellenic Dental Journal*; 5:45-50.
17. Mori T and Yamane M (1982) Fractography of cast gypsum. *Aust Dent J*; 27(1): 30-47