

The effect of different types of chlorhexidine solutions on the compressive strength of dental stone materials.

Nihad Hasan Mohammed BDT, MSc, Lecturer, dental technology, Health and Medical Technical College.

Abstract

Background: Infection control in dentistry is becoming more important , new products and methods are being developed to prevent cross- contamination between dental patients and dental personal via impression ,model ,record base and appliance however ,there is growing concern on dental cast disinfection ,incorporation of disinfection solution in dental stone could provide an effective method to disinfect stone cast.

Methods: this project was under taken in an attempts to study the effect of the disinfection solutions on the compressive strength of dental stone .accordingly , three type of disinfectant solution were incorporated into one brand of dental stone.(60) samples made from dental stone materials divided into(4) group first group was control mixing dental stone with distil water; the second group was mixed dental stone with(Corsodyl) mouth wash glaxo smith line group of companies united kingdom groupes mixing dental stone with (chlorhexidine digluconate 0.2%), the third group that mixed dental stone with (Zak DNV Syria) mouth wash (chlorhexidine digluconate 0.12%), the four group that (AL-Mansor) mouth wash almansor company(chlorhexidine digluconate 0.2%).

The properties evaluated was compressive strength the results were compared with those obtained from (Hi-Stone) which was used as control.

Results: the results revealed that incorporation of disinfection solution in stone mixture improved compressive strength of dental stone.

Conclusions: In conclusion, dental stone containing chlorhexidine digluconate (0.2% Almansor company Iraq) provide to be superior among the other tested groups.

الخلاصة

هذه الدراسة تختص بالسيطرة على العدوى التي تنتقل عن طريق تعقيم مادة الطبعة أو القالب المصنوع من مادة حجر الكلس أو من خلال مواد أطقم الأسنان وتتم السيطرة على التلوث باستخدام مواد معقمة وهي مضادات لنمو البكتيريا الملتصقة على سطح التعويضات السنية عن طريق استخدام المعقمات التالية وهي (الكور هكسدين الأمريكي بتركيز 0.2%) و(الزك السوري بتركيز 0.12%) والنوع الآخر هو (الكور هكسدين العراقي بتركيز 0.2%) تم قياس الصفة الميكانيكية وهي القوة الضاغطة وتم مقارنة هذه المجموع مع المجموعة القياسية وذلك بخلط الستون حجر الكلس مع الماء المقطر ومقارنتها مع المجموعات الأخرى التي تم فيها خلط الستون حجر الكلس مع الأنواع المختلفة للكور هكسدين تم احتساب القوة الضاغطة لكل العينات واطهرت النتائج إن مجموعة الكور هكسدين العراقي المخلوط مع حجر الكلس أعطى أعلى قوة ضاغطة بالمقارنة مع المجموعة القياسية والمجموعات الأخرى يمكن الاستنتاج انه الستون المخلوط مع الكور هكسدين العراقي بتركيز 0.2% أعطى أعلى النتائج بقياس القوة الضاغطة بالمقارنة مع المجموعة القياسية والمجموعات الأخرى .

Introduction

Effective infection control procedures should be exercised by all dentists in office dental auxiliaries ,and dental technicians to prevent the transmission of diseases; the dental office has primary responsibility for infection control and if disinfection procedures are not practiced a cycle of cross-contamination may occur ,thereby exposing personnel and patient to infection (1;2;3; 4) a method of disinfection of stone cast should be a part of infection control procedure of dental office

and dental laboratory since gypsum casts considered a potential source of contamination for dentists and dental personnel (5;6;7;8)

Recently incorporation of disinfectant into gypsum materials has been suggested .A ready made gypsum material impregnated with powder disinfectant was proved to effective in elimination of bacterial contamination of the impression and stone cast in the same time maintain accepted physical and mechanical properties of stone cast. Another method was demonstrated to incorporation disinfectant solution into stone mixture in at use and was proved to be effective and efficient in the disinfectant of stone cast uniformly as well as the dental impression (9;10) but still the effect of those disinfection solution on stone cast is not known , disinfectant agents should have no adverse effect on physical and mechanical properties of stone cast.

Since cast and die materials have to meet specific principle requirements to produce a satisfactory restoration (11;12).

According to author knowledge no polished work available concerning the effect of the disinfectant solution on these properties.

Dental Cast come into direct contact with impression materials and other items that are contaminated by saliva and blood from a patients mouth leaving the casts susceptible to cross contamination; topical methods of disinfecting casts are difficult to control , thus a method to control cross=contamination between patients and laboratory personal is needed During fabrication of the prosthesis , contamination of the dental cast can occur multiple times during each appointment cause of cast contamination are, the acrylic resin record base that is placed directly into the patients mouth for maxillary and mandible relationship records the trial denture that is inserted at the try-in appointment and evaluation before the final processing of the prosthesis (15;16;17;18).

Materials and methods:

MATERIAL:

1. Dental stone type 3 / titan silo tambour 46028 reccastrade (GR) Italy.
2. Distilled water (Janin lab).
3. Separating medium (Ioda, Syria).
4. Disinfection solution (Table 1).

Table (1):types of disinfectant solution used in these study

Type	Product	Manufacturer
Corsodyle mouth wash	0.2%	Glaxo smithkline group of companies united kingdom chlorhexiden digluconate
Zak mouth wash	0.12%	DNV Syria moth wash chlorhexiden digluconate
Almansor mouth wash	0.2%	Almansor company Iraq chrohexidine digluconate

EQUIPMENT AND INSTRUMENT

1. Compressing strength testing machine (made in Germany L.H)
2. Vibrator (Japan).
3. Electronic balance.(Germany)
4. Stainless steel spatula.
5. Rubber bowel.
6. Measuring cylinder.
7. Cement slab.
8. Special split glass model for preparation of compressive strength specimens.
9. Timer.
10. Wax knife.

METHODS

TEST CONDITION

The preparation of the test specimen and test procedure were conducted at laboratory environment of $(20.7 \pm 0.6) ^\circ\text{C}$ temperature and (50.10)% relative humidity.

The tested solution (distilled water and disinfectant solution) were also stored under the same condition the stone sample kept in air-tight container under similar condition for at least ten hours.

MIXING PROCEDURE

Mixing procedure employed in the preparation of all the test specimens followed the{ ADA specification No.25 for gypsum products (1980)} prior to weighing the sample ,the dry material was thoroughly remixed completely , stirring or by rolling the container end over end to ensure uniform distribution of all the ingredients.

All the test specimens mixed according to the manufacturers recommended W/P ratio.

Each (100 gm) of dental stone powder was mixed with (33 ml) of tested solution. The standard mix was made by adding ,over a period of ten seconds, the dry powder to the recommender amount of tested solutions in a clean rubber bowl. The mixture should be allowed to soak for twenty second and hard spatula Ted for one minute to smooth consistency with a round , stiff bladed steel spatula.

TESTING GROUPS the following testing solution were mixed with dental stone powder

Group A: Distilled water + stone powder (control group).

Group B: Corsodyl (0.2)% chlorhexidine digluconate + stone powder.

Group C: Zak (0.12%) chlorhexidine digluconate + stone powder.

Group D: Almasure(0.2%) chlorhexidine digluconate + stone powder.

* Each group contain (15) samples that the total samples used in these study was (60) specimens.

COMPRESSIVE STRENGTH TEST

Compressive strength values were calculated according to the { ADA specification No.25 for gypsum(1980)}.

A: Preparation of the Test Specimen

A special split mold was made of glass, which used to prepare five specimens each specimens cylindrical in shape of (20 m.m) diameter and (40 m.m) length figure (2)



Figure (2): special split glass model used for preparation of compressive strength specimens.

The mold was coated with separating medium before pouring the mix to facilitate the removal of the specimens from the mold after setting.

The mix was poured or spatula Ted down the side of the inclined mold retained on glass plate. The mold was vibrated gently while being filled. The over filled mold was covered with another glass plate which was rocked into place and pressed firmly into contact with the top surface of the mold to ensure parallel ends. The five specimens were removed from the splinted mold after half an hour from the start of mix and stored for further half an hour at room temperature (20.7 ± 0.6)C^o and (50. 10)% relative humidity until the specimen were tested. Figure(3)



Figure (3): specimens used in these study.

B: Testing Machine and Procedure

The test for compressive strength was conducted on (Compressive strength testing machine) with load cell (600 KN).

The specimen placed on the test machine so that the top and the bottom of the specimen in contact with steel, flat, rigid platens. The specimen was loaded to failure under loading rate 350 Kg/cm²/min. figure (4).



Figure (4) : compressive strength testing machine.

The maximum load carried by the specimen was taken from a digital screen of the machine and calculation of the compressive strength value was obtained.

C: Calculation of Compressive Strength Values

The compressive strength value was determined from the value of the maximum load at the point of specimen fracture according to the following formula

$$\text{Compressive strength} = \frac{\text{force}}{\text{area}} = \text{kg/cm}^2$$

$$*\text{surface area} = \text{area of cycle} = 3.14 \text{ cm}^2$$

Results

The effects of different disinfectant solution on the compressive strength of dental stone are as follows:-

In table (1) shows the mean, the SD and SE of the compressive strength test for the experimental and control group. Figure (1)

In corporation of different disinfectant solution were produced different effect on the strength property the highest mean value was record for group D {mean= 22.21} then the group B {mean= 18.19} and the lowest mean value was recorded for group A {mean =17.50} , and group C {mean =16.77}.

Table(1):comparison between of compressive strength (N/MM²) of dental stone groups mixed with different solution

Groups	N	Mean	Std. deviation	Std. Error	Range	
					Min.	Max.
A – distilled water	15	17.50040	.87197683	.27574328	16.59116	18.67271
B – corsodyl (0.2%)	15	18.91759	.57358767	.18138435	18.36660	19.89715
C – zak (0.12%)	15	16.77483	1.02849678	.32523924	15.61161	18.36660
D – almansure(0.2%)	15	22.21134	1.25792590	.39779110	21.12159	24.48880

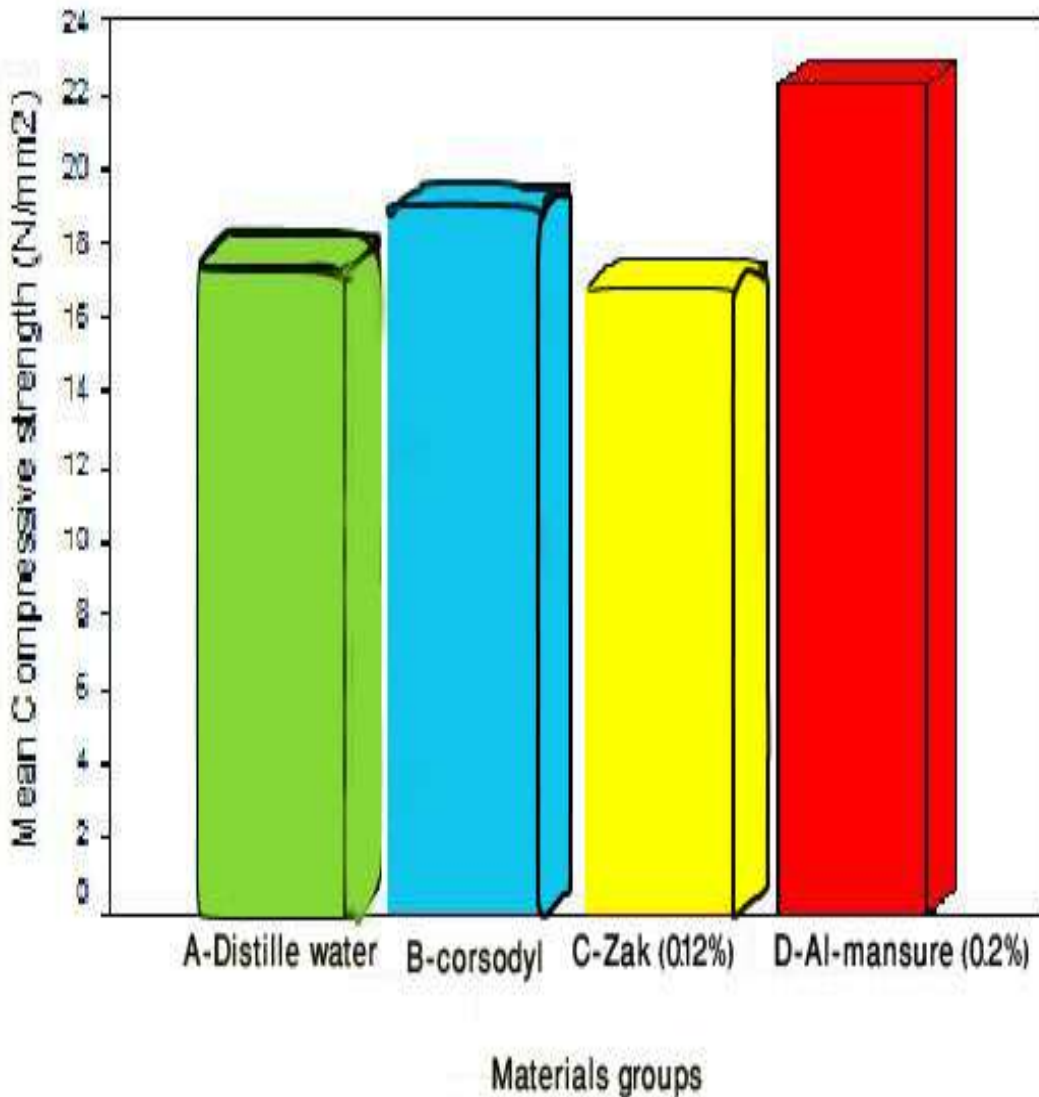


Figure (1): comparison between of compressive strength (N/mm²) dental stone groups mixed with different disinfection solution

statistical analysis by ANOVA test showed the relationship between the control group (distilled water) and other study groups show in table{2}

Statistically there was a highly significant value at ($p < 0.01$) the (0.2%Almansur) group and (Corsodyl 0.2%) group indicated highly significant at ($p < 0.01$) as comparison Has done with control group (distilled water) the highest compressive strength value was recorded for group D(mean=22.21) while the lowest value was obtained for group C (mean =16.77 n//mm²) the mean compressive strength value of group B and group A were (18.91 n/mm² and 17.50 n/mm²) respectively show in table (1).

One way analysis of variance was performed to test the difference in the compressive strength mean of the testing group (table 2). It is obvious that group D had significantly higher compressive strength than the other groups ($p < 0.01$).

- Table (2) : the ANOVA test for compressive strength (N/MM²) among dental stone groups.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	174.309	3	58.103	62.317	.000
Within Groups	33.566	36	.932		HS
Total	207.875	39			

Statistical comparison between the mean of each testing group and that of the control by using LSD least significant difference test show in table (3).

- Table (3): the least significant difference (LSD) of multiple comparison test for compressive

Materials groups	Materials groups	LSD	
		P-value	Sig.
A- distill water	B-corsodyl (0.2%)	.002	HS
	C- ZaK (0.12 %)	.102	NS
	D-AI mansure (0.2 %)	.000	HS
B- corsodyl (0.2 %)	C- ZaK (0.12 %)	.000	HS
	D-AI mansure (0.2 %)	.000	HS
C- ZaK (0.12 %)	D-AI mansure (0.2 %)	.000	HS

strength (N/MM²) among dental stone groups.

From the results obtained it was found that group D,A and B an increase in its compressive strength and this increase was highly significant ($P < 0.001$) while the compressive strength of group C was decreased significantly ($P < 0.05$)

Discussion

The effect of different disinfectant solution on the compressive strength of dental stone are indicated in table (1) lists the result of compressive strength for all test specimens.

In the table (3) indicated least significant differences the result revealed that the specimens that were disinfectant with Almansure (0.2%) mean= 18.19. show higher mean values of compressive strength than those were disinfectant with Zak (0.12%)mean =16.77.

These result can be attributed to the requirement of dental stone as the chlorhexidine solution was incorporated; these might be related to differences in the disinfectant method and type of stone used in these studies. These result are in agreement with result of (Tan, 1993; Schneider

and Taylor ,1984) from ANOVA test in table (2) the result indicated ($P < 0.01$) a highly significant differences between group and with in groups.

The disinfection of impressions and casts to prevent cross contamination dental patient to dental laboratory personnel is an important step in a total infection control program.

The incorporation of disinfectant solutions in dental stone could provide an efficient and effective method to disinfect dental impression and stone cast (Schneider and Taylor, 1984;virgina et al ;1984).

Detecting the effect of the disinfectant solutions on the compressive strength of stone cast is great importance since gypsum product must have specific properties for dental application.

The specimens are still at a wet strength similar to that accruing in actual use since casts and models may be subjected to near saturation with water several times during routine usage cycle. It is not feasible to consider using them incompletely dry state even through complete drying in air requires approximately seven days (American dental association, 1975;stern et al;1991).

It seems that chlorhexidine solution (0.2%) concentration increased significantly the compressive strength of dental stone which indicate denser material, the result might be attributed to change in the water requirement of dental stone as the chlorhexidine solution was incorporated. These might be related to differences in the disinfectant method and type of stone used as in these studies(Jonathan ,2003; Lucas et al ,2009)

CONCLUSIONS

This study was designed to evaluate some of the compressive strength of dental stone containing disinfectant solution relative to accepted dental stone and method logy directed in the ADA specification No.25 for gypsum 1980.

The following conclusions could be with drown:-

1 .the best disinfectant solution to be use for maintenance of maximum compressive strength is chlorhexidine solution in Al-Mansor mouth wash (0.2%) concentration.

2 .the addition of 0.2% chlorhexidine solution showed an improvement of the tested compressive strength, therefore, chlorhexidine at 0.2% concentration can be considered the ideal disinfectant solution to be incorporated into stone mixture for cast disinfection.

REFERENCES

1. Council on dental therapeutics (1985):council on prosthetic service and dental laboratory relation ;guide lines for infection control in the dental office and the commercial dental laboratory;j.am.dent.association .110;pp:969-973.
2. Leung R.L. and SCHONFELD ,S.E.(1983): "Gypsum casts as a potential source of microbial cross-contamination". J. prosth. dent. 49. pp:210-211.
3. Mansfield ,G.M. and WHITE ,J.M.(1997): "Antimicrobial effects from incorporation of disinfection into gypsum casts "Int. J. prosth, 4(2), 100-5.
4. Al –jalili S.N.(1994): "the effect of chlorhexidine in the disinfection of Alginate impression and dental stone cast" . A master thesis , University of Baghdad.
5. KOWK ,W.M. and RALPH, W.J.(1984): "The use of chemical disinfection in dental prosthetics" Aust, dent.J.,29(3), pp:180-183.
6. Centers For Disease Control(1986): "Recommended infection control practices for dentistry ". MMWR, 35, pp:237-242.
7. Jonathan , O.T.(2003): "Calcium hypochlorite as a disinfecting additive for dental stone , 90 (3).
8. Schneider R.I. and Taylor ;T.D.(1984):compressive strength and surface hardness of type IV die stone when mixed with water substitutes ;.prosth.dent.52(4);pp:510-514.
9. Tan ;H.K.(and others)(1993):effects of disinfecting irreversible hydrocolloid impression on the resultant gypsum casts :part I :surface quality .prosth.dent.69;pp:250-257.
10. American dental Association ;(1975):Guide to dental materials and device.pp:86-90.
11. Bass, R.A. (and other)(1992): "the effect of surface disinfection on dental cast". J.prosth. dent. 67, pp:723-725.
12. Combe;E.C.and smith;d.c.(1971):improved stones for the construction of modes and dies;.dent.res.50(4)pp:897-901.
13. Consani;S,and Ruhnke;l,S.(1984):physical properties of gypsum influenced by water substitute .j.prost.dent;52(4)pp:510-514.
14. Leung R.L. and SCHONFELD ,S.E.(1983): "Gypsum casts as a potential source of microbial cross-contamination". J.prosth. dent. 49. pp:210-211.
15. Lucas, ARIOLI-FILHO JN , NOGUEIRASS, BATISTA AU , Pereira Rde p(2009): effect of incorporation of disinfectant solution on compressive strength , setting time , linear dimensional stability , and detail reproduction in dental stone casts.
16. McCabe ,J.F.(1985): "Andersons applied dental materials ".6th ed . Blackwell scientific publication.
17. Palenek ;C.j.and miller.ch.(1985):disinfection procedures in the dental office .indiana unvi.sch.dent.;aspsis rev.(new sletter)1(9)pp:1-2.
18. park;K.and park ;N.(1989):effect of chlorhexidine on the in vitro study and in vivo herpes simplex virus infection ;tripleoes ;67;pp:149-158.
19. Sanda; M.E.E.(and others)(1982):use of additives to improve the mechanical properties of gypsum products ;.dent.res,61(6);pp:808-810.
20. Stern ;M.A.(and others)(1991):an evaluation of dental stone after repeated exposure to spray disinfection part II:abrasion and compressive strength ..prosth.dent.65;pp:713-718.
21. Virginia ;A.(and others)(1984):preliminary investigation of a methods of disinfection of dental impression ..prosth.dent.52(6);pp:877-879.