The effect of SOLO and sodium hypochlorite disinfectant on some properties of different types of dental stone

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ABSTRACT

Background: Dental casts come into direct contact with impression materials and other items that are contaminated by saliva and blood from a patient's mouth, leaving the casts susceptible to cross-contamination. The disinfectant solutions of the impression materials cause various adverse reactions. Therefore, disinfection of dental casts may be effective in preventing cross infection. This study was carried out to evaluate the surface hardness, dimensional accuracy, reproduction of details and surface porosity of type III, type IV and type IV extra hard dental stone after immersion in and spray by using SOLO and Sodium hypochlorite disinfectant solutions.

Materials and methods: 240 Stone samples were prepared in rubber rings, A total of 60 test block were prepared for each test (surface hardness, dimensional accuracy, reproduction of details and surface porosity).the samples were divided into three groups (20 for each type of stone) type (III, IV, IV extra hard); SOLO and Sodium hypochlorite disinfectant by 2 methods (immersion and spray) were used in each test.

Results: the results of dimensional accuracy, reproduction of details, surface hardness and surface porosity revealed no significant difference for all types of tested stone samples after immersion or spraying in SOLO and NaOCl except the surface hardness of type IV extra hard showed significant difference after spray with SOLO and the surface porosity of type IV extra hard showed significant difference after immersed in both SOLO and NaOCl solutions.

Conclusions: Based on the results of this study immersion in and spray by using SOLO and NaOCl disinfectant solutions produced no adverse effect on dimensional accuracy, reproduction of details, surface hardness and surface porosity for type III, type IV dental stone and for type IV extra hard dental stone except for the surface hardness for type IV extra hard when sprayed with SOLO and the surface porosity when type IV extra hard stone immersed in the SOLO and NaOCl solutions.

Key words: dental stone, immersion, spraying, SOLO, Sodium hypochlorite. (J Bagh Coll Dentistry 2013; 25(2):8-17).

INTRODUCTION

Dentistry is predominantly a field of surgery, involving exposure to blood and other potentially infectious materials therefore requires a high standard of infection control and safety practice in controlling cross-contamination. The cross contamination with stone casts is especially present in Prosthodontics because of multiple opportunities for the transfer of infectious agents to the casts through impressions, record bases, occlusion rims, and trial dentures [1- 5].

In 1996, the ADA along with the National Association of Dental Laboratories of the United States (NADL) formulated (Infection Control Recommendations for the Dental Office and Dental Laboratory), which for the first time included recommendations for the commercial laboratory as well as the dental office [6,7] .The disinfection of the impression is difficult and associated with several problems, so the disinfection of casts became an important procedure for obtaining uncontaminated models thus establishing a cross-contamination control procedure [8-10]. It is important that disinfectant solutions should not only be effective as antimicrobial agents, but also should not degrade the physical properties of the gypsum casts [11].

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American Dental Association (ADA) and the Centers for Disease Control and Prevention have suggested methods for the disinfection of dental casts, including immersion in or spraying with a disinfectant. Other methods for disinfection of the casts include incorporating chemicals into gypsum at the time of mixing or using die stone containing a disinfectant [6, 12-15].

Disinfection by soaking in chemical materials has been shown to cover all surfaces in one time, while spraying is not capable of disinfecting all surfaces effectively and also cannot cover all undercuts. Contrary to immersing, spraying can significantly reduce the amount of distortion [16,17].

Sodium hypochlorite is one of the original and most widely used disinfectants [11, 18]. The literature shows that it is effective against a broad spectrum of micro-organisms including Human Immunodeficiency Virus, viruses ,fungi, bacterial species and their spores [19-26]. Ivanovski et al in 1995 found that alteration in the physical properties of the casts resulted when the sodium hypochlorite disinfectants was incorporated into dental stone [14]. While Breault et al reported that the addition of a solution of sodium hypochlorite actually increases the compressive strength of gypsum and decreases the setting time, but leaves other physical properties unchanged [27]. On the

other hand Kumar et al in 2012 [11] found that repeated immersion of type III dental stone specimens in slurry of distilled water with sodium hypochlorite and glutaraldehyde, along with drying in air, caused a significant increase in linear dimension and a significant decrease in hardness.

Sarma and Neiman reported that sodium hypochlorite produced the least undesirable effects with regard to surface erosion, surface hardness, compressive strength, and chemical reactivity when compared with gluteraldehyde, phenol and iodophor. [28]

Some studies showed that the casts should be sprayed rather than immersed in disinfecting solutions like Berko in 2001 who found that spraying with madacide could be used to disinfect dental cast with least effect when compared with the other methods(immersion and incorporation).[29] While other studies like Tarik &Al-Ameer found that the Immersion method had more inhibitory effect to the microorganism followed by incorporation method and the least inhibitory effect was for spray method.[30]

Michael et al 2010 studied the change in the compressive strength and surface roughness of type IV dental stone casts after several times of immersion or spraying with sodium hypochlorite disinfectant solution. The results showed that both spraying and immersion significantly decreased the compressive strength after 24 hours and increased the value of the roughness, with immersion as a higher value [31].Also, Lucas et al found that reproduction of details, dimensional stability, and setting time of the type IV die stone specimens were significantly altered when sodium hypochlorite was added to the stone. [32] While Abdullah in 2006 demonstrated that repeated immersion of stone in slurry with water and slurry with sodium hypochlorite caused some degree of damage to surface details, increase in linear dimension and decrease in wet compressive strength. [33]

In 2012 Abass et al reported that SOLO disinfectant solution produced no adverse effect on the color stability, surface hardness, and surface roughness of the hot cure, cold cure, and soft acrylic denture lining materials [34]. The purpose of this study was to investigate the change in the surface hardness, dimensional accuracy, reproduction of details and surface porosity of type (III, IV, IV extra hard) of dental stone after immersion or spraying with sodium hypochlorite and solo disinfectant solution.

The hypothesis was that the immersion or spraying in NaOCl and SOLO solution disinfection procedure could influences the dimensional stability, reproduction of details, surface porosity, and surface hardness of type (III, IV,IV extra hard) of dental stone.

MATERIALS AND METHODS

Disinfectant solutions used in this study were:

1-SOLO Disinfectant solution (SOLO, Ebiox Ltd., Healthcare Enterprise House, UK.) diluted to 2% according to the manufacturer's instructions and duration of immersion was 5 min.

2- Sodium Hypochlorite solution (Fas (6% w/v), Baghdad, Iraq), the Sodium hypochlorite solution was diluted to 0.6 % by using the household bleach of hypochlorite solution and diluted with water at a ratio of 1 part of bleach: to 10 parts of water to make 1:10 ratio and the samples were immersed in this solution for 10 minutes [35] according to the ADA recommendation for disinfection.

Spray procedure was done by spraying the stone specimens with the disinfectant solution until saturation of the surface of the specimens was apparent, that is the liquid spray no longer penetrated the stone whereby the liquid residue was evident on the stone surface. While the Disinfection by immersion was done by using a suitable sized container filled with fresh disinfectant solutions that cover the stone samples completely.

Preparation of the dental stone specimens:

Three Types of dental stone were subjected to SOLO & sodium hypochlorite (Naocl) disinfectant solution by two different ways (spray & immersion).the stone selected was:

1. Type III dental stone (elite model, ZHERMACK, Italy),
2. Type IV dental die stone (elite stone, ZHERMACK, Italy)
3. Type IV extra hard dental die stone (elite rock, ZHERMACK, Italy)

An Electronic balance and a measuring cylinder were used for measuring the stone and water according to the manufacturer's instructions, after hand mixing the mixture was poured in rubber ring with dimensions of 20mm height and 30mm diameter which was used for making the stone samples. Constant manual vibration was used during the pouring process of the mixed dental stone to draw out air bubbles from the mixture and reduce porosity. Glass slabs were placed on the upper and lower borders of the rubber ring, to obtain samples with flat and parallel surfaces. All stone specimens were removed gently from the rubber ring after one hour of mixing and left for 24 hour at an average room temperature of 21˚C and average relative humidity of 40 %

before measurement and during the duration of the testing period.

A total of 240 samples were prepared; 60 samples for each tested group (Dimensional accuracy, Reproduction of details, Surface porosity and microhardness), for each test the samples were divided to twelve groups according to the types of the investigated stone and the types of the disinfectant and the method of disinfectant procedure as shown in table 1. As listed below:- fig1

Group 1: type III dental stone, immersed in SOLO disinfectant
Group 2: type III dental stone, sprayed by SOLO disinfectant
Group 3: type III dental stone, immersed in NaCl disinfectant
Group 4: type III dental stone, sprayed by NaCl disinfectant
Group 5: type IV dental stone, immersed in SOLO disinfectant
Group 6: type IV dental stone, sprayed by SOLO disinfectant
Group 7: type IV dental stone, immersed in NaCl disinfectant
Group 8: type IV dental stone, sprayed by NaCl disinfectant
Group 9: type IV extra hard dental stone, immersed in SOLO disinfectant
Group 10: type IV extra hard dental stone, sprayed by SOLO disinfectant
Group 11: type IV extra hard dental stone, immersed in NaCl disinfectant
Group 12: type IV extra hard dental stone, sprayed by NaCl disinfectant

Surface hardness evaluation:

The surface hardness was evaluated for each 12 test groups at 2 time intervals the first was before the disinfection procedure and the second was after one hour of disinfection. after setting of the stone about 1 h after mixing and pouring of the stone mixture in the ring the first indentation was performed for all groups then disinfection was commenced for all the samples, according to the disinfection regime for each group after the disinfection procedure we wait 1 h then all specimens were tested in Brinell Hardness Tester, with a tungsten carbide sphere of (4mm) in diameter and 40 Kg load that was maintained for 30 seconds on the surface of the samples The surface hardness was performed by the Brinell hardness test because some researchers found in their study that the Brinell hardness test was the most suitable among other surface hardness tests for gypsum products [36]. The resulted hardness value represented by the Brinell Hardness Number (BHN) was calculated from the following formula below; where (L) is the load in kilograms, (D) diameter of sphere (4 mm), and (d) diameter of indentation in millimeters:.

$$BHN = \frac{L}{\frac{p\ D}{2}\left(D - \sqrt{D^2 - d^2}\right)} = \frac{Kg}{mm^2}$$

Dimensional accuracy evaluation:

A test block certified according to ADA specification No. 19 [37] was used to make dental stone samples for evaluation of dimensional accuracy. The test block was engraved with 3 parallel lines, X, Y, and Z and two cross lines of (cd) and (c´d´), as seen in figure (2).

Before the fabrication of each specimen, the surface of the test block was cleaned with cotton gauze soaked in alcohol, rinsed with distilled water, and dried. The test block was fixed under the ring (20mm height and 30mm diameter) and the gypsum product was poured with constant vibration into the ring and then covered with a glass slab.

Two measurements were recorded for each stone sample; the first was before the disinfection procedure (the first measurements were performed after 24 h after mixing and poring of the stone) and the second was after one hour of disinfection. The samples were scanned with a scanner to achieve a digital picture from which the measurement of the distance (cd) - (c´d´) was obtained with the computer program Corel Draw X3 version 13.

Reproduction of details evaluation:

According to the ADA specification for detail reproduction of the dental stone Test block was used to assess reproduction of details. The test block had a 60^0 angle groove with a width of 0.05 mm and a cross line groove that passed at a perpendicular angle to the 0.05 mm wide groove. The stone samples were poured, in the rubber ring (20mm height and 30mm diameter) while placed over the test block as previously mentioned; Vibration was used during the pouring process of the mixed dental stone.

The examination for reproduction of details of the stone samples was randomly conducted by 10 examiners, without magnification, under low angle illumination. The samples made for each gypsum product were examined before and after disinfection.

The ANSI/ADA specification No.25 requires that gypsum products reproduce a line of 0.05mm in width. The samples were scored in relation to scoring system from 1-4. Reproduction of a 0.05mm wide line on the test samples was used as

criteria for surface detail evaluation scoring system as follows:

Score 1: Well-defined, sharp, and continuous.

Score 2: Continuous and clear for more than half the length.

Score 3: The continuity and clearness was less than half the length.

Score 4: The ridge failed to be reproduced along the length of the sample.

Surface porosity evaluation:

A total of 60 samples were made for Surface porosity evaluation. Each stone sample was scanned with a scanner twice; before and after one hour of the disinfection procedures. Then, with the use of the program Corel Draw X3 version 13, a circle was drawn to outline the outer border of the sample. In the center of this circle another circle was drawn with a diameter of 4 mm. Surface porosity was assessed by counting the number of pores inside the smaller circle. Surface porosity of each stone sample was read twice and an average of the two attempts was obtained for each of stone samples. Thus an average was obtained before disinfection and one after.

Statistical analysis included descriptive statistics and paired sample T-test statistical at a significance level was (S) $P< 0.05$, (HS) $P<0.01$, (NS),$P>0.05$.

RESULTS

The mean and standard deviation of the surface hardness for all tested group are listed in table (1). The results showed no significant difference in the hardness for all groups except type IV extra hard dental stone which showed significant increase in the hardness after disinfection with SOLO by spraying method table (2).

The mean and standard deviation of the surface porosity for each tested group were calculated and listed in table (3). The results showed no significant difference in mean porosity for all types of stone of both disinfection methods except for type IV extra hard when immersed with SOLO and NaOCl solution table (4).

The mean and standard deviation of the dimensional stability values for all tested groups are shown in table (5). The paired samples t–test showed no significant differences in the dimension of the test samples for all of the test groups after sprayed or immersed in SOLO and NaOCl as present in table (6).

The results of reproduction of details test revealed that disinfection of dental stone specimens with NaOCl solution and SOLO both by spraying and immersion produced insignificant effect on the reproduction of details value as seen in table (7). As showed in the results that all the test samples had the same score, in which the percentage were 100% score 1, no samples registered score (2, 3 or 4).

DISCUSSION

In Prosthodontics, objects potentially contaminated with pathogenic microorganisms are transported between dental laboratory and dental clinic. It has been claimed that to avoid cross contamination, specific disinfection measures should be followed. The usual solution to this problem has been to chemically disinfect the casts and the efficacy of such disinfectants has been the subject of several studies [11,38].

The dental profession continues to search for improved methods to protect personnel and patients from possible microbial cross-contamination. To date, no single approach exists to accomplish this objective. It is recognized that microorganisms can be transferred to a gypsum cast from a contaminated dental impression. Efforts to minimize the amount of microbial contamination vary widely. The most widely used disinfection protocols involve either spray or immersion of dental casts in different chemical disinfectants.

In this study NaOCl disinfectant solution was used because one of the ADA recommended disinfectants is chlorine compounds such as (1:10 dilution) of sodium hypochlorite solution. SOLO disinfectant solution was used because this new product was found by some studies very effective as disinfectant solution for acrylic and soft liner [34].

The result of surface hardness showed that an improvement of hardness for most types of dental stone after treatment with the disinfectant solution this may be due to the more crystals will be formed with time as a result of dehydration of the stone from the excess water which allow more calcium sulfate dihydrate crystals to precipitate to anchor the larger crystals so increase the hardness of the stone will occur; while the type IV stone samples showed decrease in surface hardness after sprayed with SOLO solution this may be due to reaction between disinfectant and stone. In general this finding was in agreement with those of a previous study by Syed Mohammed et al and Kumer et al. who found the decreased hardness in gypsum specimens immersed in disinfectant solutions may have been a result of a reaction between disinfectants and stone, the disinfectant may have reacted with gypsum to produce decreased hardness. The disinfectant did not visibly roughen the impression, but a film of disinfectant could be remained on the material

even after thorough rinsing with water. This concentrated residual disinfectant may have reacted with gypsum to produce decreased hardness. [11,39,40] On the other hand the treatment with the two disinfectant solutions by the two methods for all tested groups shows no significant difference in hardness after treatment. This in agree with the result of Kumer et al who found repeated disinfection of stone casts in NaOCl and glutaraldehyde solutions showed no significant difference in hardness value [11].

The dimensional stability test revealed that some tested groups showed expansion and other groups showed shrinking although both groups were statistically insignificant after treatment with the disinfectant (NaOCl solution and SOLO) by spraying and immersion. In 2004 Hall et al also found that some stone samples expanded and others shrinked. They could not find any explanation for the results, although the amount of shrinkage was not significantly different [41]. none of dental stones underwent expansion or contraction that resulted in statistically significant linear dimensional change. The findings of this study are in general agreement with previous studies. In which there was no significant difference in dimensional change in gypsum products after immersed or spray with the disinfectant. [11,13,41,42]

the surface porosity of all the test groups was insignificantly different (table 7) after treatment with the disinfectant solution (NaOCl and SOLO) both by spraying and immersion and this could be due to the fact that the disinfectant solutions and the methods employed were safe and no interaction occured between the stone and the solutions, except the type IV extra hard stone samples that were immersed in SOLO and NaOCl solution which was statistically significant after treatment. This may be due to interactions that occured between stone and the solution which caused solubility or leaching of some molecules present leaving air bubbles in place or may be due to voids formation on the surface of the dental cast due to air bubbles entrapped during mixing and pouring of the gypsum product. in this research Manual spatulation was employed because most of the Iraqi dentists mix the gypsum products manually. Also, The results of the studies conducted by Mazzetto et al. [43] and Schelb [44] both showed that the two different techniques of spatulation, manual spatulation and vacuum mechanical spatulation, did not influence the superficial smoothness of the models significantly.

Detail reproduction is an important characteristic of the plaster, since the correct adaptation of the prosthetic restoration is directly related to the exactitude of the cast. The result of this study showed that the stone samples immersed or sprayed with the SOLO and NaOCl disinfection solutions showed no signs of deterioration of surface details. They were in resemblance with the stone samples before disinfection which all had scores 1, all the gypsum products used in this research had the same capacity for surface details reproduction. This was in agreement with Rudd et.al.[45] and Abass in 2009 [46] , But the results of reproduction of details was in disagreement with Abdullah [45] , who found that immersion of dental stone type III and IV in slurry of NaOCl solution lead to some deterioration to the dental stone.

REFERENCES

1. Marya CM, Shukla P, Dahiya V, Jnaneswar A. Current status of disinfection of dental impressions in Indian dental colleges: a cause of concern. J Infect Dev Ctries. 2011; 5(11):776-780.
2. The Japan Prosthodontic Society. A guideline for infection control protocol in prosthodontic practice. Ann Jpn Prosthodont Soc 2007; 51: 629-689.
3. Egusa H, Watamoto T, Abe K, Kobayashi M, Kaneda Y, Ashida S, Matsumoto T, Yatani H. An analysis of the persistent presence of opportunistic pathogens on patient derived dental impressions and gypsum casts. Int J Prosthodont 2008; 21: 62-68.
4. Rutala WA, Weber DJ, Healthcare Infection Control Practices Advisory Committee (HICPAC). Guideline for disinfection and sterilization in healthcare facilities, Atlanta: Centers for Disease Control and Prevention (CDC); 2008: 20-21, 88-89, 104-105.
5. Hiraguchi H, Kaketani M, Hirose H , Yoneyama T. Effect of immersion disinfection of alginate impressions in sodium hypochlorite solution on the dimensional changes of stone models. Dent Mater J 2012; 31(2): 280–286(ivsl)
6. American Dental Association: Infection control recommendations for the dental office and dental laboratory. JAm Dent Assoc 1996;127:672-680
7. Watkinson AC. Disinfection of impressions in UK dental schools. British Dent J 1988; 164:22-23.
8. Leung RL, Schonfeld SE. Gypsum casts as a potential source of microbial cross contamination. J Prosthet. Dent 1983;.49, :210-211,
9. Abdelaziz KM, Combe EC, Hodges JS. The effect of disinfectants on the properties of dental gypsum. Part 2: Surfaces properties. J Prosthodont. 2002; 11: 234–240.
10. Bal BT, Yılmaz H, Aydın C et al. Antibacterial and antifungal properties of polyether impression materials. J Oral Sci 2001; 49: 265–270
11. Kumar RN, Reddy SM, Karthigeyan S, RPunithavathy, Karthik KS, Manikandan R. The effect of repeated immersion of gypsum cast in sodium hypochlorite and glutaraldehyde on its physical properties: An in vitro study. J Pharm Bioallied Sci. 2012 August; 4(Suppl 2): S353–S357.

12. Bass RA, Plummer KD, Anderson EF. The effect of surface disinfectants on a dental cast. J Prosthet Dent 1992; 67: 723-725.
13. Stern MA, Johnson GH, Toolson LB. An evaluation of dental stones after repeated exposure to spray disinfectant. Part 1: abrasion and compressive strength. J Prosthet Dent 1991; 65: 713-718.
14. Ivanovski S, Savage NW, Brockhurst PJ et al. Disinfection of dental stone casts: antimicrobial effects and physical property alterations. Dent Mater 1995; 11: 19–23.
15. Pereira RP, Lucas MG, Spolidorio DMP, and Filho JNA. Antimicrobial activity of disinfectant agents incorporated into type IV dental stone. Gerodontology 2012 Jun; 29(2): 267-74.
16. Al-Jabrah O, Al-Shumailan Y, Al-Rashdan M. Antimicrobial effect of 4 disinfectants on alginate, polyether, and polyvinyl siloxane impression materials. Int J Prosthodont 2007; 20, (3): 299–307.
17. Badrian H, Ghasemi E, Khalighinejad N, Hosseini N. The Effect of Three Different Disinfection Materials on Alginate Impression by Spray Method, ISRN Dentistry, Volume 2012, Article ID 695151, 5 pages (ivsl)
18. Dychdala GR. In: Block S. Disinfection. Sterilization and Preservation. 4th ed. Philadelphia: Lea and Febiger; 1991. :133-5.
19. Resnick L, Veren K, Salahuddin SZ, Tondreau S, Markham D. Stability and inactivation of HTLV-III/LAV under clinical and laboratory conditions. J Amer Medi Assoc 1986; 255:1887-91.
20. Bloomfield SF, Smith-Burchnell CA, Dalgleish AG. Evaluation of hypochlorite-releasing disinfectants against the human immunodeficiency virus (HIV). J Hospital Infection 1990; 15:273-8.
21. Bond WW, Favero MS, Peterson NJ, Ebert JW. Inactivation of hepatitis B virus by intermediate to high level disinfectant chemicals. J Clini Microbiology 1983; 18:535-8.
22. Death JE, Coates D. Effect of pH on sporicidal and microbiocidal activity of buffered mixtures of alcohol and sodium hypochlorite. J Clini Pathology 1979; 32:148-53.
23. Rueggeberg FA, Beall FE, Kelly NT, Schuster GS. Sodium hypochlorite disinfection of irreversible hydrocolloid impression material. J Prosthet Dent 1992; 67:628-31.
24. Look JO, Clay DJ, Gong K, Messer HH. Preliminary results from disinfection of irreversible hydrocolloid impressions. J Prosthet Dent 1990; 63:701-07.
25. Beyerle M,Hensley OH. Bradley DV Jr, Schwartz RS, Hilton TJ. Immersion disinfection of irreversible hydrocolloid impressions with sodium hypochlorite. Part 1: Microbiology. International J Prosthodont 1994; 7:234-8.
26. Mc Neill MRJ, Coulter WA, Hussey DL. Disinfection of irreversible hydrocolloid impressions: a comparative study. Int J Prosthodont 1992; **5**:563-7.
27. Breault LG, Paul JR, Hondrum SO et al. Die stone disinfection: incorporation of sodium hypochlorite. J Prosthodont 1998; 7: 13–16.
28. Sarma AC, Neiman R. A study of the effect of disinfectant chemicals on physical properties of die stone. Quintessence Int 1990; 21: 53–59.
29. Berko RY. Effect of Madacide disinfectant solution on some of physical and mechanical properties of dental stone. A master thesis, University of Baghdad 2001.
30. Tarik EM, Al-Ameer SS, The effect of storage time and disinfection method on the activity of some dental stone disinfectants. J Bagh Coll Dent 2005; 17(3): 8-12
31. Michael J, Khamas AM, Al-Azzawi S.Compressive strength and surface roughness of die stone cast after repeated disinfection with sodium hypochlorite solution. J Bagh College Dent 2010; 22(3), 37.
32. Lucas MG, Arioli-Filho JN, Nogueira SS, Batista AD, & Pereira RP. Effect of Incorporation of Disinfectant Solutions on Setting Time, Linear Dimensional Stability, and Detail Reproduction in Dental Stone Casts. J Prosthodont 2009; 18: 521–526.
33. Abdullah MA. Surface detail, compressive strength, and dimensional accuracy of gypsum casts after repeated immersion in hypochlorite solution. J Prosthet Dent 2006;95:462-8
34. Abass SM, Nassif RA, Khalaf BS. Influence of SOLO disinfectant on some properties of different denture lining materials. J Bagh Coll Dent 2012; 24(3):36-41.
35. Council on Dental Therapeutics Council on Prosthetic Services and Dental Laboratory Relations. Guidelines for infection control in the dental office and the commercial dental laboratory. JADA 1985:110; 969-72.
36. Johansson EG, Erhardson S, Wictorin L. Influence of stone mixing agents, impression materials and lubricants on surface hardness and dimension of a dental stone die material. Acta Odont Scand 1975; 33: 17-25.
37. American Dental Association. Council on Dental Materials and Devices. Revised American Dental Association Specification No.19 for non-aqueous, dental elastomeric dental impression materials. JADA 1977; 94:733-41.
38. Patrick Naylor W. Infection control in fixed prosthodontics. Dent Clin N Am 1992; 36:809-31.
39. Hussain SM, Tredwin CJ, Nesbit M, Moles DR. The effect of disinfection on iireversible hydrocolloid and type III gypsum casts. J Prosthodont Restor Dent 2006; 11:52-4.
40. Vandewalie KS, Charlton DG, Schwartz RS, Reagan SE, Koeppen RG. Immersion disinfection of irreversible hydrocolloid impressions with sodium hypochlorite. Part II: Effect on gypsum. Int J Prosthodont 1994; 7:315-22.
41. Hall BD, Muñoz-Viveros CA, Naylor WP, Jenny Sy, Effects of a Chemical Disinfectant on the Physical Properties of Dental Stones. Int J Prosthodont 2004; 17: 65–71.
42. Duke P, Moore BK, Haug SP, Andres CJ. Study of the physical properties of type IV gypsum, resin-containing, and epoxy die materials. J Prosthet Dent 2000; 83: 466–73.
43. Mazzetto Mo, Maia campos G, Roselino RB. [Medical rugosity (Ra) of the surface of stone models from alginate impressions using two processes: Manual spatulation and Vacuum mechanical spatulation]. Rev odontol Univ SaoPaulo.1990;4(3):228-33.
44. Schelb E. Using a syringe to make void-free casts from elastomeric impressions. J Prosthet Dent 1988; 60:121-2.
45. Rudd KD, Morrow RM, Brawn CE, Powell JM. Rahe AJ. Comparision of effects of tap water and slurry water on gypsum casts. J Prosthet Dent 1970; 24(5):563-70

46. Abass SM. Effect of microwave disinfection on some properties of gypsum products. J Bagh Coll Dent 2009; 21(3):47-52.

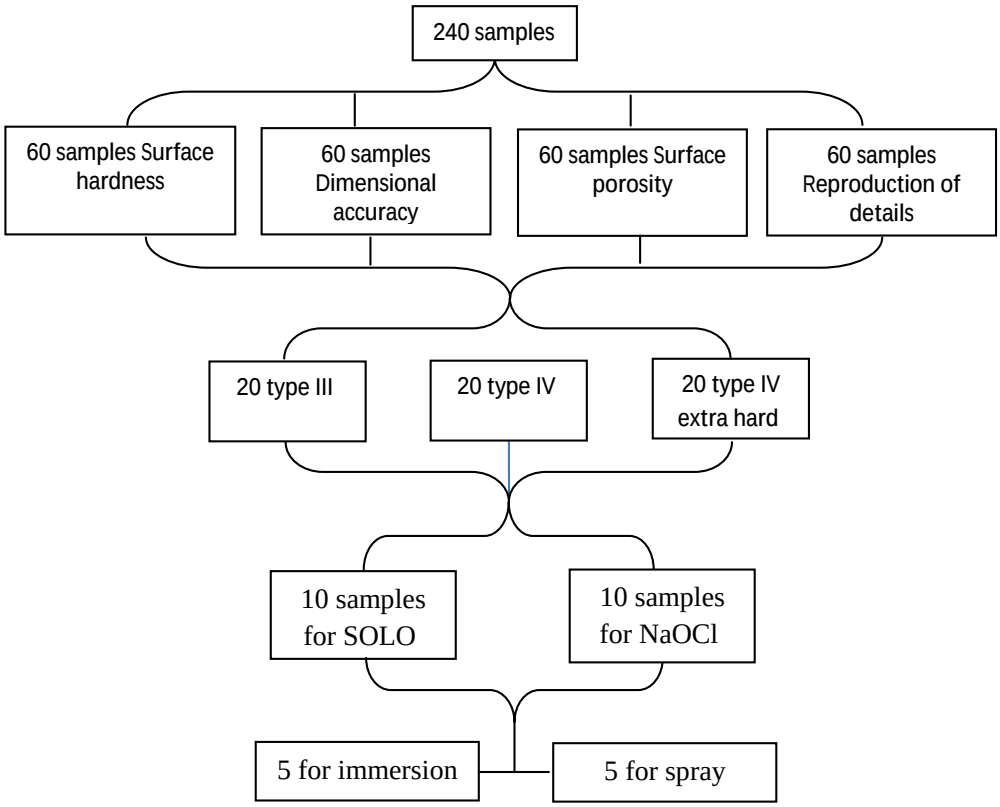

Figure 1. Grouping of the samples

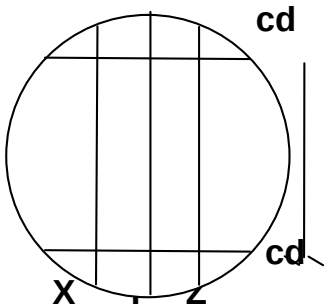

Figure 2. Diagram of die for dimensional accuracy

Table 1: Mean and Standard Deviation for Surface Hardness of the tested groups

Type of the stone	Type of the disinfection	method of disinfection	Before treatment		After treatment	
			Mean	Std. Devi.	Mean	Std. Devi.
Type III	SOLO	spray	10.79	1.40	11.22	1.93
		immersion	12.05	.28	12.73	1.36
	NaOCl	spray	12.12 a	.00	12.12 a	.00
		immersion	11.97	1.10	12.11	1.58
Type IV	SOLO	spray	16.41	1.60	16.35	1.06
		immersion	15.85	1.84	16.62	2.97
	NaOCl	spray	12.40	.63	12.97	.77
		immersion	18.13	1.93	18.75	1.04
Type IV extra hard	SOLO	spray	23.63	1.87	26.53	1.89
		immersion	21.70	1.25	22.82	3.08
	NaOCl	spray	23.39	2.62	24.07	2.69
		immersion	20.94	2.22	21.14	1.53

Table 2: Paired Sample T-Test Surface Hardness of the tested groups

Type of the stone	Type of the disinfection	method of disinfection	t	Sig.
Type III	SOLO	spray	-1.06	.348
		immersion	-1.23	.284
	NaOCl	spray	-	-
		immersion	-.20	.845
Type IV	SOLO	spray	.10	.922
		immersion	-1.06	.348
	NaOCl	spray	-1.0 0	.374
		immersion	-1.53	.199
Type IV extra hard	SOLO	spray	-3.90	.017
		immersion	-1.16	.307
	NaOCl	spray	-1.62	.179
		immersion	-.335	.754

a. The correlation and t cannot be computed because the standard error of the difference is 0.

Table 3: Mean and Standard Deviation for Surface porosity of the tested groups

Type of the stone	Type of the disinfection	method of disinfection	Before treatment		After treatment	
			Mean	Std. Devi.	Mean	Std. Devi.
Type III	SOLO	spray	7.20a	1.09	7.20 a	1.09
		immersion	7.80	1.09	8.00	1.41
	NaOCl	spray	4.80	3.27	5.40	2.60
		immersion	7.00	5.38	7.60	5.02
Type IV	SOLO	spray	3.00	2.12	4.40	2.30
		immersion	8.80 a	3.03	8.80 a	3.03
	NaOCl	spray	5.40	3.28	5.60	2.07
		immersion	6.60	4.92	7.60	4.15
Type IV extra hard	SOLO	spray	5.40	1.34	8.0	1.41
		immersion	9.60	3.97	12.20	3.03
	NaOCl	spray	7.20	5.06	8.80	4.38
		immersion	4.60	1.94	11.20	2.58

Table 4: Paired Sample T-Test Surface porosity of the tested groups

Type of the stone	Type of the disinfection	method of disinfection	t	Sig.
Type III	SOLO	spray	-	-
		immersion	-1.00	.36
	NaOCl	spray	-1.50	.20
		immersion	-1.50	.20
Type IV	SOLO	spray	-1.60	.18
		immersion	-	-
	NaOCl	spray	-.20	.84
		immersion	-1.58	.18
Type IV extra hard	SOLO	spray	-2.52	.06
		immersion	-3.83	.01
	NaOCl	spray	-2.35	.07
		immersion	-8.12	.001

a. The correlation and t cannot be computed because the standard error of the difference is 0.

Table 5: Mean and Standard Deviation for dimensional accuracy of the tested groups

Type of the stone	Type of the disinfection	method of disinfection	Before treatment		After treatment	
			Mean	Std. Devi.	Mean	Std. Devi.
Type III	SOLO	spray	19.76	.055	19.73	.049
		immersion	19.68	.018	19.72	.036
	NaOCl	spray	19.724	.061	19.66	.04604
		immersion	19.74	.023	19.66	.074
Type IV	SOLO	spray	19.65	.075	19.69	.087
		immersion	19.69	.053	19.67	.052
	NaOCl	spray	19.71	.038	19.72	.023
		immersion	19.71	.079	19.7	.02
Type IV extra hard	SOLO	spray	19.71	.071	19.71	.02
		immersion	19.71	.048	19.70	.033
	NaOCl	spray	19.66	.035	19.67	.069
		immersion	19.70	.043	19.66	.028

Table 6: Paired Sample T-Test of dimensional accuracy of the tested groups

Type of the stone	Type of the disinfection	method of disinfection	t	Sig
Type III	SOLO	spray	.72	.50
		immersion	-2.56	.06
	NaOCl	spray	1.32	.25
		immersion	2.60	.05
Type IV	SOLO	spray	-.85	.44
		immersion	.72	.50
	NaOCl	spray	-.40	.70
		immersion	.39	.71
Type IV extra hard	SOLO	spray	.00	1
		immersion	.14	.89
	NaOCl	spray	-.13	.90
		immersion	1.51	.20

Table 7: Score of the reproduction of details

Type of the stone	Type of the disinfection	method of disinfection	scores
Type III	**SOLO**	**spray**	Score 1
		immersion	Score 1
	NaOCl	**spray**	Score 1
		immersion	Score 1
Type IV	**SOLO**	**spray**	Score 1
		immersion	Score 1
	NaOCl	**spray**	Score 1
		immersion	Score 1
Type IV extra hard	**SOLO**	**spray**	Score 1
		immersion	Score 1
	NaOCl	**spray**	Score 1
		immersion	Score 1