Research Article

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Comparative Evaluation of the Dimensional Stability of Heat Cured Acrylic Resin after Repeated Microwave and Chemical Disinfection

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ABSTRACT

Background: A common practice for avoiding cross infection is the sterilization of all items contaminated directly or indirectly with blood or saliva.

Aim: To evaluate and compare the dimensional stability of heat cure acrylic resin , when subjected to repeated microwave and chemical disinfection for the purpose of disinfection"

Materials and Methods: This study was carried out in the department of prosthodontics at Dr. D.Y.Patil dental college and hospital,pune. "To evaluate and compare the dimensional stability of the maxillary heat cured denture base after disinfection from microwave and chemical disinfectant at 0, 7th ,15th, 30th day." The cast with the record bases were tested at 3 points. Point A , point B at hamular notches and point C at the deepest point in the palate with the help of the. REICHERT ,OPTICAL MICROSCOPE (AUSTRIA ,SR.NO.363798).

Results: When multivariate ANOVA test was applied it shows there is no significant difference between the three groups.

Conclusion: There is no significant change in the dimensional accuracy of acrylic resin samples of test groups when compared to control group (C) on 7th, 15th, and 30th day after disinfection.

Keywords: Dimensional accuracy, acrylic resin, microwave, chemical disinfection.

INTRODUCTION

The increased prevalence of some infectious diseases, ie. Hepatitis B, AIDS, etc, alerted the public opinion to infection control during dental service. A common practice for avoiding cross infection is the sterilization of all items contaminated directly or indirectly with blood or saliva. This can be easily carried out in other disciplines of dentistry, but is sometimes difficult in prosthodontics . Impressions, trays, casts, and prostheses are all potential sources of cross contamination to and from patients, clinical personnel, and dental technicians.In prosthodontics, prosthesis has been identified as a source of cross contamination between patient and the dental personnel. Presence of denture stomatitis among patients has been reported, and acrylic resin dentures are important predisposing factors, as the prosthesis may act as a reservoir of infection.[1-3]

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If disinfection procedure is carried out routinely by the patient, occurrence of such pathologies can be prevented. This happens because reservoir of infection is destroyed, help the patient to maintain good oral health. Therefore improved barrier techniques in handling of dental prosthesis are necessary to protect the patients and dental personnel from bacterial and viral infection that can be transmitted through procedures associated with dental care. This creates a "need" for a disinfection procedure which is efficient, safe, easy and fast to render prosthodontic service more comprehensively.

By definition

STERILIZATION :

"the process of completely eliminating microbial viability"

Sterilization methods used in dentistry include:"

1. **Heat**

a. Dry heat (ie, 160 ◦ c for *1* hour)
b. Autoclave with steam at 120 ◦ c at15 psi pressure for 30 minutes
c. Unsaturated chemical vapour (ie, at 127 ◦ c and 25 psi for 20 minutes)
d. Boiling water for 30 minutes

2. Chemical

A . liquid (ie, immersion in alkaline glutaraldebyde 2% for 10 hours, immersion
1% solution hypochlorite for 10 hours)

b. gaseous (ethylene-oxide)

By definition

DISINFECTION:

"the act of disinfecting , using specialized cleaning techniques that destroy or prevent growth of organisms capable of infection".

Disinfectant *are* the agents used to accomplishing disinfection.

In dental literature numerous methods have been advocated for the purpose disinfection , chemical disinfectant solutions are recommended for immersion of dental prosthesis which includes ;

(a) immersion in 2% alkaline glutaraldehyde for 10 minutes,
(b) immersion in 5.25% sodium hypochlorite for 10 to 30minutes,
(c) immersion in 3% aqueous formaldehyde for 30 minutes.

L.R. pinto et.al [4] in their studies have proved that after repetitive disinfection cycles there was considerable decrease in hardness ,and increase in the roughness of the heat cure. **MaT, Johnson GH 1997** [5] in separate studies recommended the use of 5.25% sodium hypochlorite for 10min, for the purpose of disinfection of acrylic prosthesis. resin irrespective of the chemical used for disinfection.

Microwaves energy is claimed to be an alternative to these traditional sterilization-disinfection methods. **Silva MM, Vergani CE[6], et al and Dovigo LN, Pavarina AC[7] in their studies** have shown that the exposure of contaminated items to microwave energy is lethal to many microorganisms. However, the method by which sterilization occurs is obscure.

Some investigators believe sterilization is the result of dielectric heating, while others feel that intracellular changes occur.Microwave sterilization of metallic objects demands a specially designed oven with a radar-absorbent material to reduce reflection of the waves back to the magnetron, and a device that provides rotation in the horizontal and vertical planes to counteract the effect of "cold spots" lacking microwave energy.

Rohrer and Bulard' [8] 1985 first reported on microwave sterilization of various dental instruments and the effect of microwave sterilization on acrylic resin dentures. They found that contaminated dentures can be sterilized in a short time. However, little information is available concerning the effect of disinfection methods upon the physical and mechanical properties of denture base resins.

The purpose of this study is to evaluate and compare dimensional stability of heat cure maxillary acrylic resin denture base when subjected to repeated microwave energy and chemicals disinfectant for the purpose of disinfection

AIM AND OBJECTIVES

AIM

"To evaluate and compare the dimensional stability of heat cure acrylic resin , when subjected to repeated microwave and chemical disinfection for the purpose of disinfection".

OBJECTIVES

1. To evaluate the dimensional stability of the denture base on the cast at posterior palatal seal area after repeated Irradiation by microwave for the purpose of disinfection on daily bases and measured on 7th day,15th day,30th day .

2.To evaluate the dimensional stability of denture base on the cast at posterior palatal seal area after subjecting it to disinfection by a chemical disinfectant(sodium hypochlorite 5.25%) on daily bases and tested on 7th day,15th day,30day .

3. To compare the dimensional stability of the denture base on the cast at posterior palatal seal area after disinfection by microwave and chemical disinfectant for the purpose of disinfection on daily bases and measured on 7th day,15th day,30th day

MATERIALS AND METHODS

This study was carried out in the department of prosthodontics at Dr.D.Y.Patil dental college and hospital , pune.

"To evaluate and compare the dimensional stability of the maxillary heat cured denture base after disinfection from microwave and chemical disinfectant at 0, 7th ,15th, 30th day."

A. For disinfection

1.Microwave used (LG convection microwave, Fig 1)
2.sodium hypoclorite(5.25% , (Fig 2)

B. For testing

Equipment used

REICHERT, OPTICAL MICROSCOPE (AUSTRIA ,SR.NO.363798, Fig 3)

The method consist of preparing various test specimen and disinfecting them with microwave (345W for 6 minutes) and chemical disinfectant (5.25% of sodium hypochlorite for 10 minutes)

1. Preparation of the acrylic test specimen
2. Preparation of record bases for dimensional accuracy
3. Disinfection with sodium hypochlorite and microwave
4. Measurement of dimensional accuracy at point A, B and C

1. Preparation of acrylic test samples

All samples were fabricated using the following criteria:

A Preparation of gypsum molds to obtain the specimens: The metal dies were used to prepare dental stone molds in two parts, which accurately fit together to form a lumen of same dimensions. The molds were made as follows:

1). **B Preparation of the maxillary acrylic heat cure record bases**

A standard maxillary edentulous silicone mould was selected for pouring the stone cast (ultra stone, kalabhai) .A mechanical mixer was used with water powder ratio according to the manufacturer instruction and a total number of 30 stone cast were poured. Vacuum press sheet of 4mm thickness was selected and adapted over the stone cast for the standard thickness of the record bases. Stone cast with adapted vaccume sheets were flasked in the conventional brass flask a Mould was prepared for Heat cure acrylic resin .

Mixing, packing, curing, finishing and polishing of the samples were carried in the similar way as mentioned previously. Deepest part of the hamular notch in the cast was then marked bilaterally and the stone cast with acrylic heat cure record base was trimmed in the model trimmer, this was done to measure the discrepancy in the posterior palatal seal area.

2) **Disinfection** of the test samples was carried out once on a daily bases for 30 day with

a. Immersion in Sodium hypochlorite (5.25% for 10 min).

b. Microwave (immersed in 150 ml of water at 345W for 6 min)

The samples were stored in distilled water in between the disinfection cycles.

3) **Testing: Measurement of dimensional accuracy**.

The cast with the record bases were tested at 3 points. Point A , point B at hamular notches and point C at the deepest point in the palate with the help of the. REICHERT ,OPTICAL MICROSCOPE (AUSTRIA ,SR.NO.363798)

10 samples of control (group C)
10 samples of sodium hypochlorite (group S)
10 samples of microwave disinfection (group M)

All were measured at three points on 0 day, 7th day, 15th day, 30th day.

Then results were compared between control and the two protocols and also among two protocols.

RESULTS

Groups in the study are:

Control group (C)
Sodium hypochlorite(S)
Microwave group (M)

Table 1a: Measurements of dimensional stability at 0 day after disinfection

SR. NO.	SAMPLE ID.	Dimensional Stability Checked On 0th Day, µm		
	control	A	B	C
1		00	321.2	00
2		00	352.0	00
3		00	360.8	00
4		00	354.2	00
5		00	280.8	00
6		00	390.0	00
7		00	310.3	00
8		00	270.6	00
9		00	316.8	00
10		00	280.8	00
	Mean	--	**323.75**	--

Table 1b: Measurements of dimensional stability at 7th day after disinfection

SR. NO.	SAMPLE ID.	Dimensional Stability Checked On 7th Day After Disinfection., µm		
		A	B	C
1	Group S- Sodium Hypochloride (5.25%)	20.9	407	00
2		17.6	327.8	00
3		00	611.6	16.5
4		17.5	445.5	00
5		00	137.5	00
6		19.8	616	00
7		00	354.2	00
8		78.1	354.2	00

9		00	464.2	00
10		00	42.80	00
	Mean	--	**379.18**	--
11	Control	00	233.2	00
12		00	343.2	00
13		00	324.5	00
14		00	445.5	00
15		00	228.8	00
16		00	418.0	00
17		00	288.2	00
18		00	269.5	00
19		00	412.5	00
20		15.4	286.0	00
	Mean	--	**324.94**	--
	Group M (Microwave)			
21		14.0	412.5	00
22		00	242	00
23		00	282.5	00
24		00	522.5	00
25		00	263.0	00
26		00	230.0	00
27		00	283.8	00
28		00	355.3	00
29		00	250.8	00
30		00	495.3	00
	Mean	--	333.7	--

Table 1c: Measurements of dimensional stability at 15th day after disinfection.

SR. NO.	SAMPLE ID.	Dimensional Stability On 15th Day After Disinfection., µm		
	Group S- Sodium Hypochloride (5.25%)	A	B	C
1		00	379	00
2		00	317	00
3		00	469	16.5
4		00	705	00
5		00	349	00
6		00	352	00
7		00	714	44
8		00	216	00
9		50.6	380	00
10		00	415	00
	Mean	-	429.6	-
11	Control	00	308	00
12		00	395	00

13		00	381	00
14		00	342	00
15		00	349	00
16		00	341	00
17		00	306	00
18		00	271	00
19		00	317	00
20		00	338	00
	Mean	-	334.8	-

21	Microwave	00	372	00
22		00	249	00
23		00	317	19.8
24		00	477	00
25		00	326	00
26		00	308	00
27		00	292	00
28		00	365	00
29		00	310	00
30		00	369	00
	Mean	-	338.5	-

Table 1d: Measurements of dimensional stability at 30th day after disinfection

SR. NO.	SAMPLE ID.	Dimensional Stability Checked On 30th Day After Disinfection, µm		
		A	B	C
1	Group S- Sodium Hypochloride (5.25%) 1	00	631.2	00
2	2	00	349.5	00
3	3	00	456.0	16.5
4	4	17.5	712.4	00
5	5	00	419.0	00
6	6	00	382.1	00
7	7	00	355.1	00
8	8	00	307.8	00
9	9	00	376.3	00
10	10	19.8	549.4	00
	Mean	--	**453.88**	--
11	Control 1	00	270.6	00
12	2	00	352.0	00
13	3	00	360.8	00
14	4	00	354.2	00
15	5	00	316.8	00
16	6	00	390.0	00
17	7	00	310.3	00

18	8	00	321.2	00
19	9	00	316.8	00
20	10	00	536.8	00
	Mean	--	**352.95**	--

21	Group M (Microwave)	00	451.0	00
22		00	341.0	00
23		00	439.6	00
24		00	523.6	00
25		00	369.8	00
26		00	319.2	00
27		00	313.5	00
28		00	366.3	00
29		00	327.8	00
30		00	403.2	00
	Mean	--	**385.51**	--

RESULTS

Study groups are-

1. **Group S**– 5.25% sodium hypochlorite disinfection
2. **Group C**- control – without disinfection
3. **Group M-**microwave disinfection

Comparison within the study group

Table 2: Comparison of Dimensional Stability Checked on Day 0 after Disinfection in study groups

Testing of hypothesis –using multivariate ANOVA test

Hypothesis; there is no significant difference in mean dimensional stability at point A,B, C

Dimensional Stability (µm)	Group C	Group S	Group M	F Value	P Value
	Mean ± SD (n=10)	Mean ± SD (n=10)	Mean ± SD (n=10)		
A	0 ± 0	0 ± 0	0 ± 0	0	>0.05
B	323.75 ± 39.77	323.75 ± 39.77	323.75 ± 39.77	0	>0.05
C	0 ± 0	0 ± 0	0 ± 0	0	>0.05

RESULT; There is no significant difference in the dimensional stability of the record bases at point A, B and C , hence all group are same.

Table 3: Comparison of Dimensional Stability Checked on Day 7 after Disinfection in study groups (Fig 5)

Testing of hypothesis –using multivariate ANOVA test

Hypothesis; there is no significant difference in mean dimensional stability at point A,B, C

Dimensional Stability (µm)	Group C	Group S	Group M	F Value	P Value
	Mean ± SD (n=10)	Mean ± SD (n=10)	Mean ± SD (n=10)		
A	1.54 ± 4.86	15.39 ± 23.98	1.40 ± 4.42	3.13	>0.05
B	324.94 ± 78.03	376.08 ± 181.92	333.77 ± 107.79	0.44	>0.05
C	0 ± 0	1.65 ± 5.21	0 ± 0	1	>0.05

RESULT; There is no significant difference in the dimensional stability of the record bases at point A, B and C , as the p value is more than 0.05

Table 4: Comparison of Dimensional Stability Checked on Day 15 after Disinfection in study groups

Testing of hypothesis –using multivariate ANOVA test

Hypothesis; there is no significant difference in mean dimensional stability at point A,B, C

Dimensional Stability (µm)	Group C	Group S	Group M	F Value	P Value
	Mean ± SD (n=10)	Mean ± SD (n=10)	Mean ± SD (n=10)		
A	0 ± 0	5.06 ± 16	0 ± 0	1	>0.05
B	324.8 ± 36.51	429.6 ± 161.36	338.5 ± 61.89	2.77	>0.05
C	0 ± 0	6.05 ± 14.30	1.98 ± 6.26	1.17	>0.05

RESULT; There is no significant difference in the dimensional stability of the record bases at point A, B and C , as the p value is more than 0.05

Table 5: Comparison of Dimensional Stability Checked on Day 30 after Disinfection in study groups

Testing of hypothesis –using multivariate ANOVA test

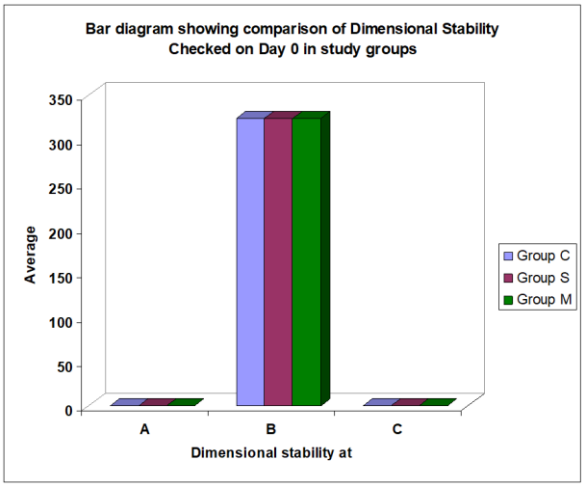
Hypothesis; there is no significant difference in mean dimensional stability at point A,B, C

Dimensional Stability (µm)	Group C	Group S	Group M	F Value	P Value
	Mean ± SD (n=10)	Mean ± SD (n=10)	Mean ± SD (n=10)		
A	0 ± 0	3.73 ± 7.88	0 ± 0	2.24	>0.05
B	352.95 ± 72.61	453.88 ± ± 134.07	385.5 ± 68.39	2.85	>0.05
C	0 ± 0	1.65 ± 5.21	0 ± 0	1	>0.05

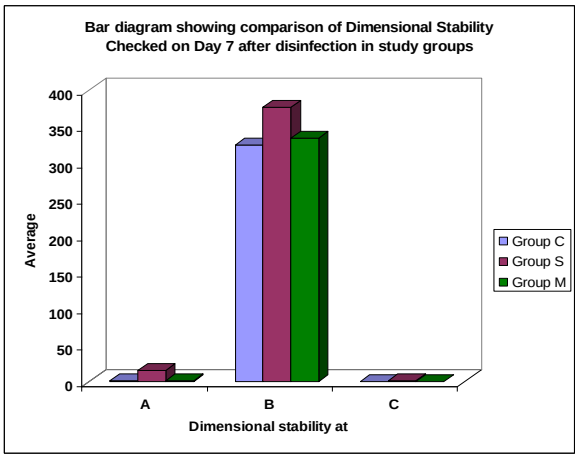
RESULT; There is no significant difference in the dimensional stability of the record bases at point A, B and C , as the p value is more than 0.05

GRAPHS

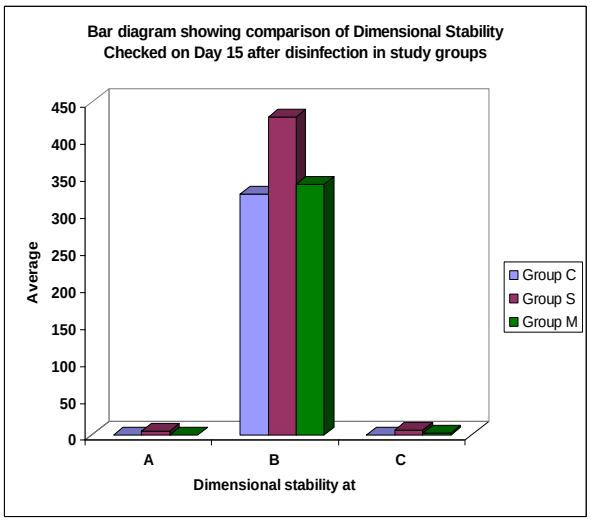
Graph 1



Graph 2



Graph 3



Graph 4

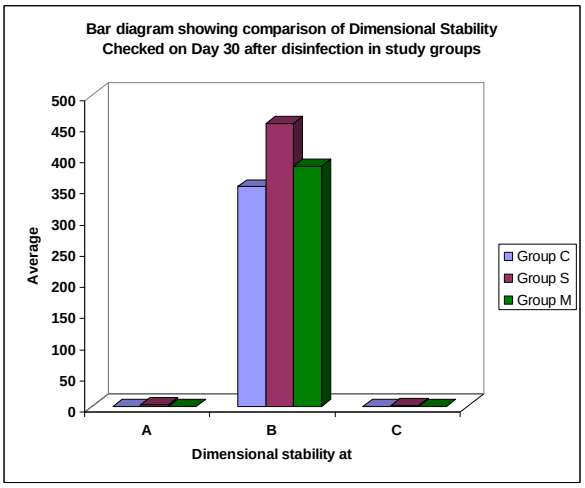


Fig 1: LG convection microwave

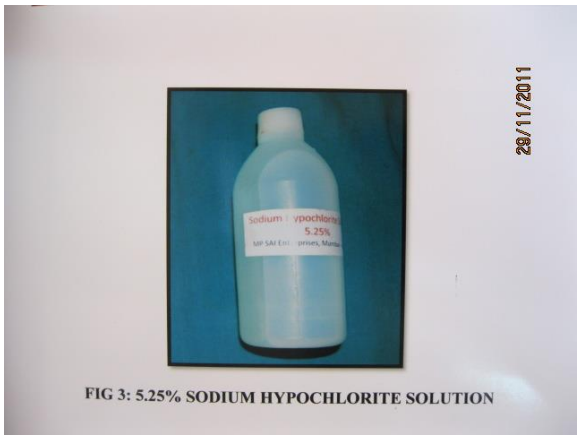
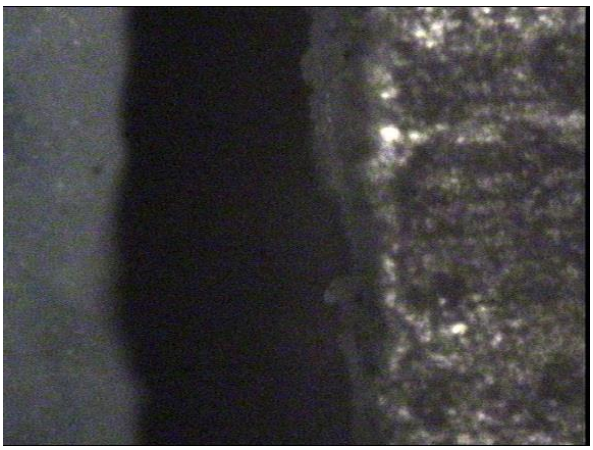


Fig 2: sodium hypoclorite(5.25%)

Fig 3: Reichert ,optical microscope (austria ,sr.no.363798)

Fig 4: Preparation of the maxillary acrylic heat cure record bases



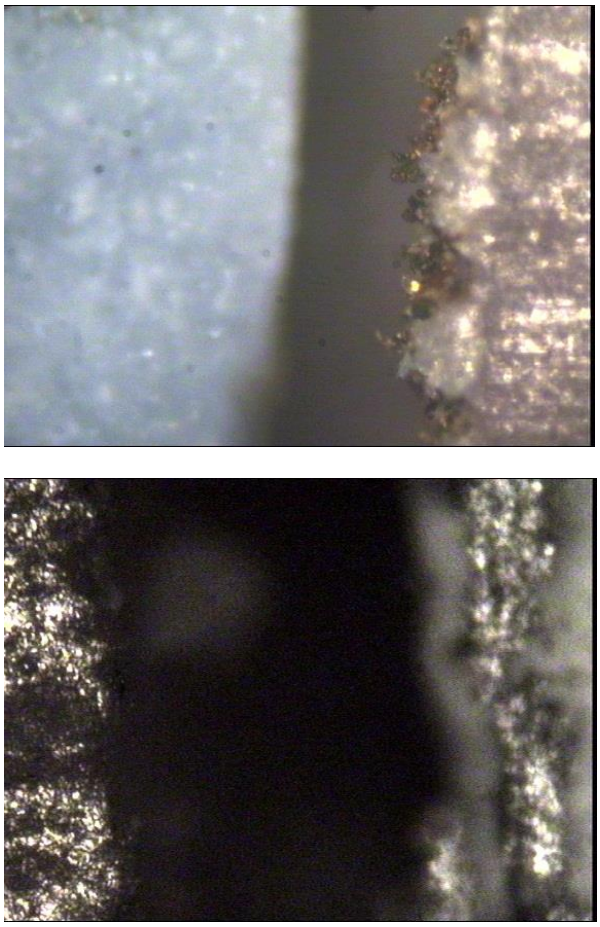


Fig 5: Optical microwave picture of control , Microwave and Sodium hypochlorite group at 7 day on point B.

DISCUSSION

In the present study two method of disinfections are compared in terms of their effect on the dimensional stability on the maxillary acrylic heat cured record base and impact strength on the specimens of specified dimension when disinfected on a daily bases and tested 0 day, 7th day ,15th day,30th day.

Dimensional stability

Table 1. shows the readings of dimensional stability

Table 1a- shows readings on the 0 day which is taken as a base line data before any disinfection procedure, dimensional accuracy were measured at point A,B and C in microns .It was observed that the mean value at point A and C were zero, which means there was absolutely no measurable gap between the cast and the acrylic denture base. At point B the mean was 323.75 micron, this may be because damming was not done, and hence reading was taken as a base line data for further comparison.

Table 1 b, 1.c, 1.d, shows the readings of dimensional accuracy of maxillary record base at point A,B and C on the 7th day, 15th day, 30th day after disinfection.

Table 2 shows the shows the measurement of dimensional stability on 0th day at point A,B and C, the mean and standard deviation at point A in control group is 0 , sodium hypochlorite group is 0 and microwave group is 0

Mean and standard deviation values at point B in control group is 323.75 ± 39.77, sodium hypochlorite group is 323.75 ± 39.77 and microwave group is 323.75 ± 39.77.

Mean and standard deviation values at point C in control group 0 ± 0,sodium hypochlorite is 0 ± 0,and microwave group is 0 ± 0.

When multivariate ANOVA test was applied it shows there is no significant difference between the three groups as the p value is more than (0.05), that is all group are same.

Table 3 shows the measurement of dimensional stability on 7th day at point A,B and C, the mean and standard deviation at point A in control group is 1.54 ± 4.86 , sodium hypochlorite group is 15.39 ± 23.98 and microwave group is 1.40 ± 4.42

Mean and standard deviation values at point B in control group is 324.94 ± 78.03, sodium hypochlorite group is 376.08 ± 181.92 and microwave group is 333.77 ± 107.79.

Mean and standard deviation values at point C in control group 0 ± 0,sodium hypochlorite is 1.65 ± 5.21,and microwave group is 0 ± 0.

When multivariate ANOVA test was applied it shows there is no significant difference between the three groups as the p value is more than (0.05)

Table 4. shows the readings on the 15th day after disinfection

shows the measurement of dimensional stability at point A,B and C, the mean and standard deviation at

point A in control group is 0 ± 0 , sodium hypochlorite group is 5.06 ± 16 and microwave group is 0 ± 0.

Mean and standard deviation values at point B in control group is 324.8 ± 36.51, sodium hypochlorite group is 429.6 ± 161.36 and microwave group is 338.5 ± 61.89.

Mean and standard deviation values at point C in control group 0 ± 0, sodium hypochlorite is 6.05 ± 14.30,and microwave group is 1.98 ± 6.26 .

When multivariate ANOVA test was applied it shows there is no significant difference between the three groups.

Table 5,shows the readings on the 30th day after disinfection

shows the measurement of dimensional stability at point A,B and C, the mean and standard deviation at point A in control group is 0 ± 0 , sodium hypochlorite group is 3.73 ± 7.88and microwave group is 0 ± 0.

Mean and standard deviation values at point B in control group is 352.95 ± 72.61, sodium hypochlorite group is 453.88 ± 134.07 and microwave group is 385.5 ± 68.39

Mean and standard deviation values at point C in control group 0 ± 0, sodium hypochlorite is 1.65 ± 5.21 ,and microwave group is 1.98 ± 6.26 .

When multivariate ANOVA test was applied it shows there is no significant difference between the three groups.

Fleck et al [9](2007) recommended a power – time cycle of 345W for 6min to achieve disinfection of acrylic dentures without any dimensional change.

Consani RL, Azevedo DD[10,11], 2008 studied the effect of 5 microwave disinfection cycles on the dimensional stability of the maxillary record base and concluded that microwave disinfection does not alter the dimensional stability .

The long term disinfection procedure with sodium hypochlorite and microwave and their effect on dimensional stability is not been studied extensively, in the limits of this study and the data gathered it can be stated that neither sodium hypochlorite nor microwave changes the dimensional stability significantly over a period of 30 days when disinfected once on a daily bases with the recommended disinfection protocols.

CONCLUSION

1. There is no change in the dimensional accuracy of acrylic resin samples of microwave group (M) when compared to control group (C) on 7th, 15th, and 30th day after disinfection.

2. There is marginal change in the dimensional accuracy of acrylic resin samples of sodium hypochlorite group (S) when compared to control group (C), but it's not significant when tested on 7th, 15th, and 30th day after disinfection.

3. There is marginal change in the dimensional accuracy of acrylic resin samples of sodium hypochlorite group (S) when compared to microwave group (M), but it's not significant when tested on 7th, 15th, and 30th day after disinfection.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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