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ORIGINAL RESEARCH

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Promising Role of Calcium Hypochlorite as a Disinfectant: An *in vitro* Evaluation Regarding its Effect on Type V Dental Stone

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ABSTRACT

Aim: The current study has been chosen to evaluate the efficacy of calcium hypochlorite as a disinfecting additive for the gypsum products and its effect on compressive and tensile strength of the set material. It is hypothesized that, the addition of calcium hypochlorite to type V dental stone in sufficient quantity to disinfect the material would have no deleterious effect on compressive or tensile strength.

Materials and methods: Total of 160 samples made up of type V dental stone were divided broadly into two groups of 80 samples each for the sake of compressive and tensile strength testing in dry and wet conditions: Out of each group, 10 samples without addition of any disinfectant (0% calcium hypochlorite) was compared with other group of 30 samples after adding disinfectant, i.e. each subgroup containing 10 samples each (0.5, 1.0 and 1.5% calcium hypochlorite).

Conclusion: Within limitations of this *in vitro* study it is assumed to prepare type V dental stone that contains a disinfectant, has adequate compressive strength and tensile strength, and can significantly act against a resistant species like *Bacillus subtilis*.

Clinical significance: When calcium hypochlorite was added to dental stone, extra mixing water was required to produce a material of nearly same pouring consistency. The samples, which were put to microbiological tests, showed effective action of disinfectant on *Bacillus subtilis.* No deleterious effect on compressive or tensile strength could be found after putting the selected samples with calcium hypochlorite.

Keywords: *Bacillus subtilis*, Calcium hypochlorite, Dental stone, Disinfection.

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INTRODUCTION

It is aptly confessed that, 'Mouth is the mirror of health'. As the oral environment is a suitable culture media for a huge number of microorganisms, there is potential risk involved for the personnel involved in treating this. The entire staff is routinely exposed to numerous viral and bacterial pathogens, which have implications to cause serious illness or death. At present much care has been reserved towards prevention of AIDS and hepatitis B transmission in dental office as well as laboratory. Although, primarily blood has been implicated in the transmission of AIDS, this virus (HIV) has also been isolated from saliva of infected individual.[1-4]

According to the 'Centers for Disease Control (CDC)', blood and saliva should be thoroughly and carefully cleaned from material that had been used in the mouth (e.g. impression, bite registration, etc.). Special care should be taken before polishing and grinding intraoral devices. Contaminated materials, impressions and intraoral devices should be cleaned and disinfected before being handled in the dental laboratory and placed in a patient's mouth.[5]

Although it seems that, the chance of cross contamination is small when cast impressions are disinfected prior to pouring, it has been reported that critical steps in infection control is often missed. It is evident, then that, although methods of disinfecting impression may be effective, they are not always performed, thereby leaving dental personnel at risk. Back up procedures should be used in all laboratories which include those casts that may not have been properly disinfected prior to pouring stone.[6]

In this study, we selected calcium hypochlorite as a disinfectant because, it has many properties like, an ideal disinfectant, including a broad spectrum antimicrobial activity, rapid bacterial action, reasonable persistence in treated portable water, ease of use, solubility in water, relative stability, relative nontoxicity, at use concentration, no poisonous residuals, no color, no staining and low cost. The active species is undissociated hypochlorous acid (HOCl). It was chosen in favor of sodium hypochlorite (liquid bleach), because of its more clinical stability and had greater available chlorine and lesser chemical effect on properties of dental stone.[7]

The aim was to find out the scope of developing a disinfectant with enough disinfecting ability in a dental set up. The objective was to find out the lowest concentration of calcium hypochlorite, which might be accepted as a standard to meet the challenges of newly emerging infection control protocol in preventive dentistry.

MATERIALS AND METHODS

Testing of Consistency of Materials

Two 10 mm diameter circular holes were cut into opposite side of a casting ring 4 cm high × 3 cm in diameter (Shah Engineering Works, Ahmedabad, India). It was then placed over the sprue former (Prime Dental Co, India), and secured to the center of a 20 × 15 cm ceramic tile with a small amount of boxing wax (Prime Dental Co, Mumbai, India). The tile was fastened to the vibrator. Then type V dental stone (Dentofl-HX, ISO: 6873-Type V, Prevest, Denpro Ltd, Digiana, Jammu, India) (Fig. 1), was mixed for 60 seconds and vibrated into the cylinder with the exit holes covered. Two minutes from the start of mixing, the holes in the cylinder were uncovered and the assembly was then vibrated for 10 seconds, allowing the stone to flow from the assembly. The slump of the material was allowed to reach its initial set and then the cylinder and sprue former were removed (Fig. 2). The length of slump was measured 5 times and average distance was measured with a measuring scale.[8]

Microbiological Testing

A maxillary 2nd premolar typodont tooth (Pyrax polymars, Roorkee, India) was embedded in a block of plaster of Paris to the gingival extent of the crown and allowed to set. Irreversible hydrocolloid impressions (septodont) were taken on the typodont tooth using small boat shaped structures as impression trays made up of addition silicones (3M ESPE) (Figs 3 and 4). The impression was wicked dry with disposable wipe. Then 0.2 ml buffer (0.05M HCl, 0.1M NaCl, 0.01M $MgCl_2$) (Fig. 5A){Magnesium chloride (Burgoyne burbridges and Co, India) (see Fig. 1) and Hydrochloric acid, Sodium chloride, distilled water and electronic weighing machine from biochemical laboratory, BJ Medical College, Ahmedabad, India} was added into it. *Bacillus subtilis* {culture media, pipette and microbiological

Fig. 2: Test of consistency by measuring the length of slump

Fig. 1: Materials used for experiment (Type V Dental Stone, calcium hypochlorite, magnesium chloride)

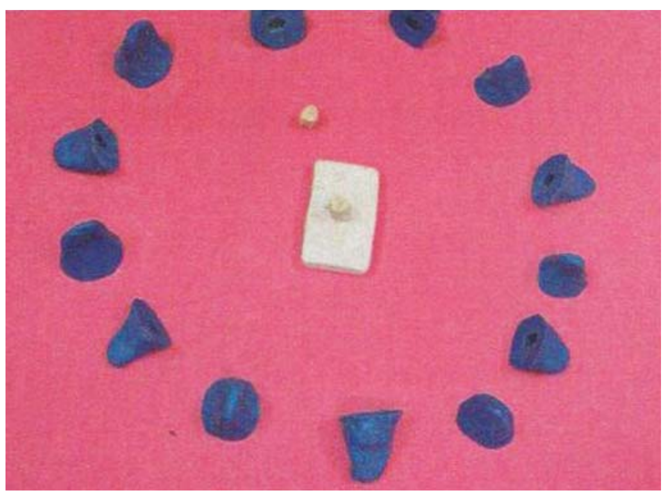

Fig. 3: Typodont premolar and boat-shaped specimens prepared for impression making

Fig. 4: Alginate impression over typodont premolar

Fig. 5A: Chemical (0.05M HCl, 0.1M NaCl, 0.01M $MgCl_2$) used as buffer for growth of *Bacillus subtilis*

Fig. 5B: Different concentration of disinfectants [1.5% $Ca(OCl)_2$ 1.0% Ca $(OCl)_2$, 0.5% $Ca(OCl)_2$]

apparatus from BJ Medical College, Microbiology Lab, Ahmedabad, India} was incubated into it (Fig. 6). After 5 minutes at ambient temperature, the said solution was removed and the impression wicked dry again.[9] Within 1 minute, a stone solution containing calcium hypochlorite (0, 0.5, 1, and 1.5% solutions) (Sidifine chem. Ltd, Mumbai, India) (Figs 1 and 5B) was mixed and poured into the impression and allowed to set for 1 hour.

Fig. 6: Specimens prepared of type V dental stone and its incubation

Method followed by the Microbiologist

Large gram positive/ gram variable bacilli culture was taken from prepared media (Fig. 7). It was found to be catalase positive. The catalase test with 3% hydrogen peroxide rules out clostridial species due to absence of bubbling. Voges-Pros Kaues test was employed on it which was found to be positive.[10] Citrate was added into it which is again positive. Maltose was added on to it, which showed negative result confirming the presence of *Bacillus subtilis.* Peptone water was added to watch the turbidity and the same was compared with McFarland standard.[10] Calcium hypochlorite was added in different concentrations to all samples with the help of pre-sterilized pippetting tips (Fig. 8). All the disinfected samples were put into peptone water and checked for turbidity after 18 hours at the incubation temperature of 37°C. No turbidity was visible after that. For further confirmation, blind subculture in blood agar was done for 18 hours at 37°C and checked for growth.

Strength Testing

Cylindrical molds of 10 mm in height and 5 mm in diameter were prepared with wax and vibrated after putting dental

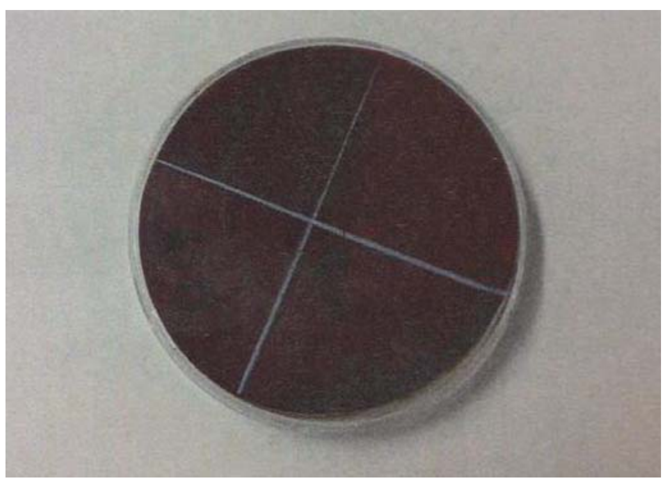

Fig. 7: Culture media of *Bacillus subtilis*

Fig. 8: Inoculation of *Bacillus subtilis* into the prepared specimen

stone into it. Total no. of specimens was 160. They were divided into two broad groups, e.g. 80 for dry strength testing and others for wet strength testing. Again each group was subdivided for compressive strength and tensile strength testing, which were compared before and after adding any disinfectant (Fig. 6).

For wet strength testing, specimens were stored in air, at room temperature (30° ± 4°C) and (70 ± 10%) relative humidity until they were crushed at 1 hour from the start of mixing. For dry strength testing, specimens were stored under the same conditions for 24 hours and then incubated at 37°C for 7 days. For compressive strength testing, the samples of above dimensions were placed vertically in an unconfined compression test apparatus (Department of Biomechanics, LD Engineering College, Ahmedabad, India) for CBR (California bearing ratio) test (D2-54) (Figs 9A to D).

CBR = The force required to press soil or aggregate specimen for a certain distance divided by the force required to press a standard specimen.[11,12]

The standard is specified by National Physical Laboratory (NPL), New Delhi India. In this case the standard was '3.21 division in dial gauge = 1 kg force'. This measuring instrument was chosen because of small size of specimens. The samples were compressed till crushed and readings were taken for each.

Calculation: Measured force (In kg wt.) = Number of division counted on dial gauge at break point/3.21.

Measured surface area = $10 \times 5 = 50\ mm^2 = 0.00005\ m^2$

Measured stress = Force/Area

By above method, stress was calculated in relation to strain, which in turn gives us measure of compressive strength.

For tensile strength testing, similar preparations of specimens were made and two groups were prepared for wet and dry tensile strength testing. The samples were put

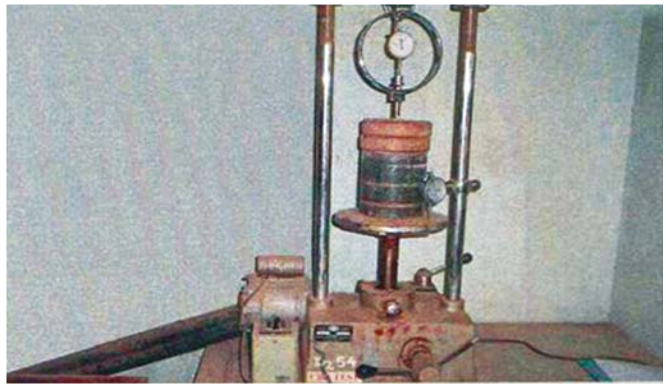

Fig. 9A: California bearing ratio (CBR) testing machine for compressive strength testing

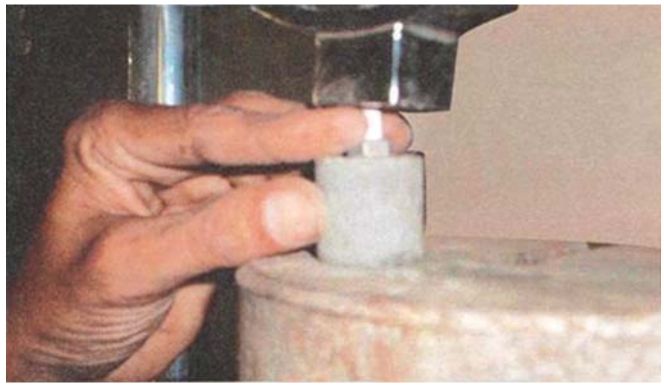

Fig. 9B: Close view of vertical placement of specimen.

Fig. 9C: Compressive strength testing with dial gauge attached

Fig. 9D: Compressive strength testing till failure of bond into the tensile strength tester (Alekh plastics testing centre, Vatva, Ahmedabad) and crushed until failure of the bond (Figs 10A to C).

RESULTS

When calcium hypochlorite was added to dental stone, extra mixing water was required to produce a material of nearly same pouring consistency (Table 1). After microbiological testing, effective action of disinfectant was shown on

Fig. 10A: Tensile strength tester

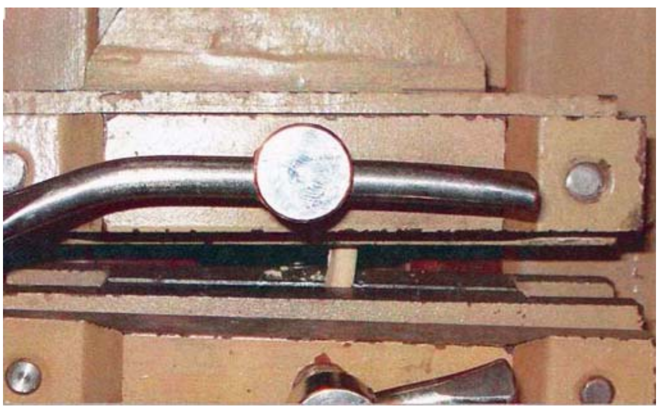

Fig. 10B: Close view of specimen, placed inside Tensile strength tester

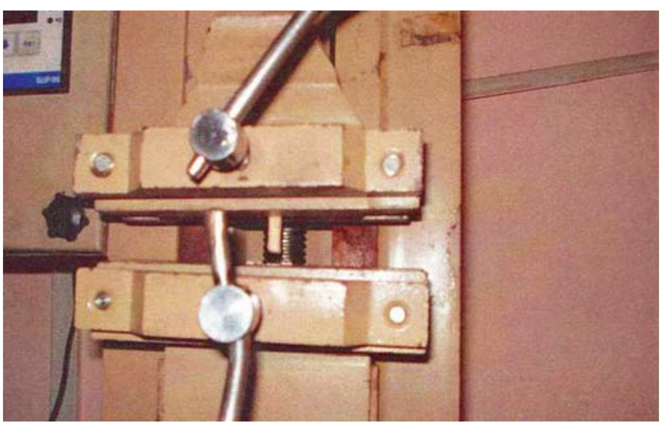

Fig. 10C: Specimen after bond failure

Table 1: Consistency data for control and experimental type V dental stone

Dentoflo-HX	*Percentage of calcium hypochlorite*	*Water (ml)*	*Consistency ± SD (mm)*
50 gm	0	11	145.55 ± 1.20
50 gm	0.5	12.5	145 ± 2.70
50 gm	1.0	12.5	144 ± 3.45
50 gm	1.5	12.5	145 ± 2.63

Bacillus subtilis at all concentrations (Table 2). Dry compressive strength (DCS) (Tables 3A and B), wet compressive strength (WCS)) (Tables 4A and B), dry tensile strength (DTS))(Tables 5A and B) and wet tensile strength (WTS) (Tables 6A and B) were compared. These values were put into statistical analysis through one-way ANOVA (Table 3). In our observations, we analyzed data according to 95% of confidence interval. Hence, $p > 0.05$ is considered as statistically insignificant.

DISCUSSION

In prosthodontics, the sources of transmission may be impression trays, impression materials before and after making impressions, gypsum casts, bite blocks, try-ins and prostheses. Thus, a vicious cycle of cross-contamination ensures spread of infection exposing dentists, dental surgery staff, laboratory personnel, patient to patient transmission and finally, spread of disease.[4]

Potential cross-contamination through impression materials like alginate, polyether and polyvinylsiloxane materials has been evaluated. It was opined that, simple rinsing of impressions in sterile water reduced the number of microorganisms significantly, but could not decontaminate the impressions. Alginate impressions produced significantly higher levels of contamination than polyvinylsiloxane and polyether impressions from the same individual ($p < 0.05$).[13]

It is therefore desirable to have an economic and convenient measure of control of contamination. In this work, calcium hypochlorite is chosen as an alternative because of its well known disinfection properties. It is also hypothesized that the calcium salt would have less effect on structure and properties of calcium sulfate-dihydrate compared to sodium hypochlorite. The first observed effect of calcium hypochlorite was an increase in water requirement of the material, which led to set gypsum with greater porosity.

The other overall trend was that, the more the disinfectant was added, the weaker the compressive and tensile strength. This is consistent with what is known in general about dental stones, in that, inorganic additives

Table 2: Microbiological data after *Bacillus subtilis* inoculation into typodont premolar tooth merged within irreversible hydrocolloid impression

Percentage of calcium hypochlorite	*Inoculation of Bacillus subtilis culture*	*Addition of buffer of 0.05 M HCl, 0.01 MNaCl, 0.01 M $MgCl_2$*	*Time allowed for action of disinfectant*	*Result showing presence/ absence of Bacillus subtilis*
0	Yes	Yes	1 hour	*Present*
0.5	Yes	Yes	1 hour	Absent
1.0	Yes	Yes	1 hour	Absent
1.5	Yes	Yes	1 hour	Absent

Table 3: Overall comparison of compressive and tensile strength of dental stone (mean ± SD)

Percentage of calcium hypochlorite	*Dry compressive strength (KPa)*	*Wet compressive strength (KPa)*	*Dry tensile strength (KPa)*	*Wet tensile strength (KPa)*
0	377.57 ± 21.82	246.73 ± 37.63	82.24 ± 12.04	34.27 ± 6.73
0.5	382.02 ± 10.02	245.27 ± 14.93	84.50 ± 10.47	34.40 ± 5.62
1.0	383.67 ± 11.36	243.22 ± 19.48	84.02 ± 11.56	34.45 ± 4.65
1.5	379.02 ± 11.09	246.40 ± 21.99	85.32 ± 9.95	31.30 ± 3.62

reduce their strength.[14] However, the current study could not find any change, neither in compressive nor in tensile strength after adding calcium hypochlorite.

The control specimens were compared with this organism-induced solution for further investigations. This agrees with the findings for dental casts made from impressions contaminated with bacteria can be a medium for cross-contamination.[7,15] The current sample contained minimum of 35.0% available chlorine (see Fig. 1). This amount of chlorine was found to be enough to remove whole *Bacillus subtilis* strains.

Calcium hypochlorite and it's use in health care facilities has been strongly advocated by WA Rutala and DJ Weber. Hypochlorites formed from calcium hypochlorite, are lethal to most microbes, although viruses and vegetative bacteria are more susceptible than endospore forming bacteria, fungi, and protozoa.[16]

It is found that the weakest stones are clearly much stronger than the strongest plasters.[17] However, this difference is greater in case of compressive strength than in tensile strength. Plaster is 35 to 40% as strong as stone in compression, but 65 to 70% as strong in tension. This ratio applies to the materials both in wet and dry state. However, the distinction between stones and die stones is not so clear with respect to strength properties. The strongest die stones are stronger than the strongest stones, both in tension and compression; at the same time there is some overlapping between the two groups. The weakest die stones are no stronger than the strongest stones. In our study, we are in agreement with these findings and hence preferred the type V dental stone as our testing material which may be a standard for comparison among gypsum products.

Repeated immersion in tap water or slurry water is strongly discouraged in literature.[18] When soaking or rinsing is necessary, the cast should be rinsed in water saturated with calcium sulfate, not in tap water. On this very basis, we preferred a disinfectant containing calcium as its component rather than water. Abdulla MA also agreed with the notion that, repeated immersion of type III and IV stone specimens in slurry with distilled water and 0.525% sodium hypochlorite, alongwith drying in air, caused a significant increase in linear dimension and a significant decrease in wet compressive strength.[19] But he stated that, though both solutions caused some degree of damage to surface details for type III and IV stones, the difference was not significant. Study on influence of different methods of chemical disinfection on physical properties of type IV and V dies also provided with same result. Chemical disinfectants did not cause significant dimensional alterations in these dies; superficial texture was altered according to disinfection method utilized. But immersion in disinfectant solution during 30 minutes, as well as the addition of disinfectant to the gypsum during preparation , reduced the compression resistance of dies.[20] Another author showed that, there are significant difference among brands of impression materials and that those should be considered during selection of an appropriate disinfectant.[21] Contradictory reviews opined that, surface roughness of stone casts was adversely affected by using the disinfectant solutions as mixing water substitutes. Gum Arabic and calcium hydroxide additives can yield a harder stone surface without compromising other surface properties.[22]

They also reported greater surface deterioration following addition of sodium hypochlorite as disinfectant. But one author disputed this claim by concluding that, using aqueous solutions of either sodium or calcium hypochlorite disinfectants by substituting water in mixing dental stone, it is possible to obtain a dental stone cast with comparable

Table 3A: DCS before (0% calcium hypochlorite) and after addition (0.5, 1.0 and 1.5% calcium hypochlorite)

	% of calcium hypochlorite	Sample size N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
		Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Force (N) analysis	0	10	18.8786	1.09098	0.34500	18.0981	19.6590	17.13	20.25
	0.50	10	19.0981	0.50181	0.15869	18.7391	19.4570	18.24	19.84
	1.00	10	19.1835	0.56808	0.17964	18.7772	19.5899	18.25	19.87
	1.50	10	19.4110	0.53251	0.16840	19.0301	19.7919	18.38	20.20
	Total	40		0.71413	0.11291	18.9144	19.3712	17.13	20.25
Stress (N/M^2) analysis	0	10		19.1428	6900.62565	361959.7303	393180.3297	342679.10	404984.40
	0.50	10	382020.4000	377570.0300	3170.45563	374848.3311	389192.4689	364715.00	396715.00
	1.00	10	383670.7520	11361.57694	3592.84610	375543.1695	391798.3345	364984.42	397429.78
	1.50	10	379019.9740	11098.91270	3509.16990	–54954.5935	1532994.5415	367695.28	3897705.42
	Total	40	470570.2890	555954.28220	87904.09033	292767.4836	648373.0944	342679.10	3897705.42

DCS: Dry compressive strength

Table 3B: Statistical analysis (one-way ANOVA) of DCS

		Sum of squares	df	Mean square	F	Sig.
Force (N) analysis	Between groups	1.454	3	0.485	0.946	0.428
	Within groups	18.435	36	0.512		
	Total	19.889	39			
Stress (N/M^2) analysis	Between groups	961068939233.931	3	320356313077.977	1.040	0.387
	Within groups	11093252452825.640	36	308145901467.379		
	Total	12054321392059.570	39			

Table 4A: WCS before (0% calcium hypochlorite) and after addition of (0.5, 1.0 and 1.5%) calcium hypochlorite

	% of calcium hypochlorite	Sample size N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
		Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Force (N) analysis	0	10	12.3366	1.88164	0.59503	10.9905	13.6826	9.97	16.20
	0.50	10	12.2547	0.75081	0.23743	11.7176	12.7918	11.21	13.58
	1.00	10	12.1610	0.97434	0.30811	11.4640	12.8580	10.60	13.83
	1.50	10	12.3201	1.09985	0.34780	11.5333	13.1068	10.53	13.93
	Total	40	12.2681	1.20427	0.19041	11.8829	12.6532	9.97	16.20
Stress (N/M^2) analysis	0	10	246731.0000	37632.79393	11900.53435	219810.1210	273651.8790	199400.00	323987.00
	0.50	10	245274.6200	14931.59068	4721.78356	234593.2035	255956.0365	224291.00	271580.00
	1.00	10	243220.3340	19486.88832	6162.29516	229280.2539	257160.4141	211965.82	276581.58
	1.50	10	246400.9520	21996.97152	6956.05316	230665.2665	262136.6375	210589.60	278571.58
	Total	40	245406.7265	24072.78805	3806.24199	237707.8754	253105.5776	199400.00	323987.00

WCS: Wet compressive strength

Table 4B: Statistical analysis (one-way ANOVA) of WCS

		Sum of squares	*df*	*Mean square*	*F*	*Sig.*
Force (N) analysis	Between groups	0.190	3	0.063	0.041	0.989
	Within groups	56.370	36	1.566		
	Total	56.560	39			
Stress (N/M^2) analysis	Between groups	75399489.391	3	25133163.130	0.040	0.989
	Within groups	22525066364.800	36	625696287.912		
	Total	22600465854.190	39			

Table 5A: DTS before (0% calcium hypochlorite) and after addition of (0.5, 1.0 and 1.5%) calcium hypochlorite

	% of calcium hypochlorite	*Sample size N*	*Mean*	*Std. deviation*	*Std. error*	*95% confidence interval for mean*		*Minimum*	*Maximum*
		Lower bound	*Upper bound*	*Lower bound*	*Upper bound*	*Lower bound*	*Upper bound*	*Lower bound*	*Upper bound*
Force (N) analysis	0	10	4.1121	0.60193	0.19035	3.6816	4.5427	3.12	4.98
	0.50	10	4.2251	0.52344	0.16553	3.8506	4.5995	3.36	4.98
	1.00	10	4.2011	0.57840	0.18291	3.7873	4.6148	3.24	4.99
	1.50	10	4.2665	0.49786	0.15744	3.9103	4.6226	3.74	5.00
	Total	40	4.2012	0.53340	0.08434	4.0306	4.3718	3.12	5.00
Stress (N/M^2) analysis	0	10	82243.6900	12040.28745	3807.47320	73630.5872	90856.7928	62305.30	99688.47
	0.50	10	84500.1746	10470.44340	3311.04493	77010.0706	91990.2786	67227.56	99688.47
	1.00	10	84021.6648	11568.05921	3658.14152	75746.3738	92296.9558	64751.17	99704.63
	1.50	10	85329.7668	9957.12426	3148.71916	78206.8692	92452.6644	74766.36	99969.16
	Total	40	84023.8241	10668.76582	1686.87999	80611.7872	87435.8609	62305.30	99969.16

DTS: Dry tensile strength

Table 5B: Statistical analysis (one-way ANOVA) of DTS

		Sum of squares	*df*	*Mean square*	*F*	*Sig.*
Force (N) analysis	Between groups	0.128	3	0.043	0.140	0.936
	Within groups	10.968	36	0.305		
	Total	11.096	39			
Stress (N/M^2) analysis	Between groups	51012782.111	3	17004260.704	0.140	0.936
	Within groups	4388067218.321	36	121890756.065		
	Total	4439080000.431	39			

Df: Degrees of freedom,

$$F = \frac{\text{Estimate of population variance based on between samples variance}}{\text{Estimate of population variance based on within samples variance}}$$

Sig: Significance

Table 6A: WTS before (0% calcium hypochlorite) and after addition of (0.5,1.0 and 1.5%) calcium hypochlorite

	% of calcium hypochlorite	Sample size N	Mean	Std. deviation	Std. error	95% confidence interval for mean		Minimum	Maximum
		Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
Force (N) analysis	0	10	1.7134	0.33649	0.10641	1.4727	1.9541	1.25	2.18
	0.50	10	1.7218	0.28102	0.08887	1.5208	1.9228	1.25	2.18
	1.00	10	1.7227	0.23258	0.07355	1.5563	1.8891	1.24	2.00
	1.50	10	1.5649	0.18103	0.05725	1.4354	1.6944	1.37	1.97
	Total	40	1.6807	0.26268	0.04153	1.5967	1.7647	1.24	2.18
Stress (N/M^2) analysis	0	10	34268.9137	6731.28337	2128.61870	29453.6436	39084.1837	24922.12	43623.71
	0.50	10	34436.4174	5620.36345	1777.31498	30415.8516	38456.9832	24922.12	43609.13
	1.00	10	34453.8902	4651.66498	1470.98563	31126.2895	37781.4909	24717.90	40011.46
	1.50	10	31297.3250	3620.65418	1144.95138	28707.2650	33887.3850	27358.51	39409.18
	Total	40	33614.1366	5254.03111	830.73526	31933.8159	35294.4572	24717.90	43623.71

WTS: Wet tensile strength

Table 6B: Statistical analysis (one-way ANOVA) of WTS

		Sum of squares	df	Mean square	F	Sig.
Force (N) analysis	Between groups	0.179	3	0.060	0.857	0.472
	Within groups	2.512	36	0.070		
	Total	2.691	39			
Stress (N/M^2) analysis	Between groups	71776808.372	3	23925602.791	0.857	0.472
	Within groups	1004812063.539	36	27911446.209		
	Total	1076588871.910	39			

Df: Degrees of freedom,

$$F = \frac{\text{Estimate of population variance based on between samples variance}}{\text{Estimate of population variance based on within samples variance}}$$

Sig: Significance

properties to conventional dental stone.[23] Centers for Disease Control (CDC) cited chloramine-T as an alternative disinfectant to sodium hypochlorite.[24] After going into all details, we preferred calcium hypochlorite to sodium hypochlorite to remain on the safer side, because the role of calcium hypochlorite (on alteration of strength) has never been disputed by any of the authors till now.

Twomy et al described in an identical manner. However, they did not explain the preference of bacteriophage phi29 over *Bacillus subtilis* species. We elaborated the microbiological and strength testing exclusively for a tropical country like India. However, most of the results were in agreement with them.[25]

The limitations of this study were that, it was tested on a specific microbe presuming its behavior on others. The amount of available chlorine may also defer from manufacturer to manufacturer. Environmental effects like temperature and humidity may differ from one place to another. Again we were able to test only two properties of dental stone namely, compressive and tensile strength leaving aside all other physical properties. However, despite all these limitations, the result proves the disinfectant ability of calcium hypochlorite, specifically on dental stone.

CONCLUSION

The following conclusions were derived from the present study.

1. Calcium hypochlorite can act as a suitable disinfectant for type V dental stone, which may be helpful to dentists as well as laboratory personnel. To meet this requirements, it may be safer to choose the lowest concentration of calcium hypochlorite, i.e. 0.5% as a standard disinfectant for dental stone.
2. This disinfectant has no clinically significant adverse effect on tensile or compressive strength.

CLINICAL SIGNIFICANCE

Calcium hypochlorite can be an effective disinfectant in a dental laboratory set up with minimal adverse effect on the properties of type V dental stone.

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