Antibacterial Efficacy and Effect of Chlorhexidine Mixed with Irreversible Hydrocolloid for Dental Impressions: A Randomized Controlled Trial

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This study aimed to evaluate whether chlorhexidine mixed with irreversible hydrocolloid powder decreases microbial contamination during impression taking without affecting the resulting casts. Twenty volunteers were randomly divided into two groups (n = 10) according to the liquid used for impression taking in conjunction with irreversible hydrocolloid: 0.12% chlorhexidine or water. Surface roughness and dimensional stability of the casts were evaluated. Chlorhexidine mixed with irreversible hydrocolloid decreased the percentage of microorganisms when compared with water ($P < .001$) but did not affect the surface quality or dimensional stability of the casts. Mixing chlorhexidine with irreversible hydrocolloid powder is an alternative method to prevent contamination without sacrificing impression quality. *Int J Prosthodont 2014;27:363–365. doi: 10.11607/ijp.3688*

The most commonly used techniques to eliminate contamination of dental impressions are the application of antibacterial agents via spray or immersion.[1] These methods show successful results on the impression surface; however, uncertainty remains regarding the presence of microorganisms in the body of the impressions.[2] The incorporation of a disinfectant such as chlorhexidine—a tissue-compatible and effective antibacterial agent[3]—into dental impressions may offer an alternative method to prevent contamination. Such an approach would be time-effective and promote universal compliance.[4] Therefore, the aim of this study was to evaluate whether chlorhexidine mixed with irreversible hydrocolloid (IH) powder decreases microbial contamination during impression taking without affecting the accuracy of the resulting casts. The null hypothesis was that the addition of chlorhexidine would produce no significant differences regarding microbial contamination or dimensional accuracy of the casts.

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Materials and Methods

This clinical study had a triple-blinded (patient, dentist, and microbial analyst) and completely randomized design. The study was approved by the local ethics committee (190/2011) and performed according to the CONSORT statement (Fig 1). The oral health of the volunteers was assessed. Sample size calculation (n = 8) was performed assuming that the Mann-Whitney test would be used with a study power of 80% ($\alpha = 5\%$).[5] To account for potential losses during the experiment, 20 volunteers were selected.

The patients (Table 1) were randomly divided into two groups (n = 10) according to the liquid used (chlorhexidine or water) with IH powder (Hydrogum, Zhemarck), using a computer-generated random numbers table. The IH impression material was mixed following a standard proportion of powder and liquid, using either deionized distilled water or 0.12% chlorhexidine. The sequence of treatments was concealed in sealed envelopes.

Saliva samples were collected before and after impression taking. After the maxillary impressions were taken, a piece was cut from the palatal area (10 mm in diameter and 2 mm in thickness).[4] Each sample was processed and inoculated on specific media and incubated at 37°C for 24 to 96 hours. The colony-forming units were counted and assessed as the percentage reduction of microorganisms. All measurements were carried out under the same conditions by a blind examiner.

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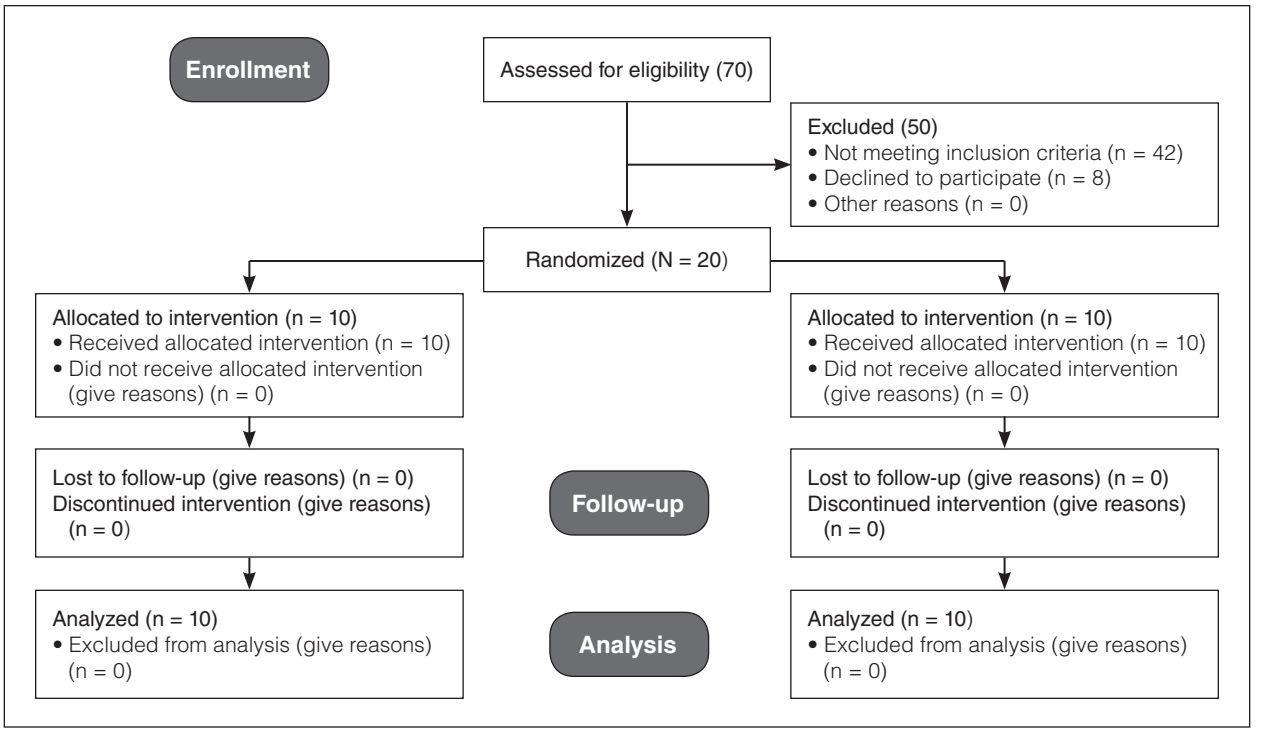

Fig 1 Flowchart showing the study procedures.

Table 1 Inclusion and Exclusion Criteria

Inclusion criteria	Exclusion criteria
Adults of either sex	Gingivitis or periodontitis
Age: 40 to 65 y	Active caries lesions
> 8 teeth in each arch	Use of antibiotics, antimicrobials, antiseptic mouthwashes, or orthodontic appliances
Normal salivary flow rate	Smokers

To assess the dimensional stability of the casts, a metal master template containing two circular columns on a platform was used as a reference point (control).[5] Impressions were poured (Durone IV, Dentsply). Measurements of the inner and outer distance of the pillars of the casts were compared to the control using a digital caliper. Surface roughness was measured using a profilometer (Surfcorder SE 1700, Kozaka). Five readings were taken for each sample, and the mean value was calculated.

The Mann-Whitney *U* test, two-way analysis of variance, and Student-Newman-Keuls test were used for analysis of the microorganism count, dimensional stability, and surface roughness, respectively ($P < .05$).

Results

IH impressions mixed with chlorhexidine (Table 2) showed lower total microorganisms ($P < .001$), *Candida* species ($P = .015$), and streptococci counts ($P = .01$). The saliva samples collected after taking the impressions using chlorhexidine were less contaminated ($P = .001$) than the baseline saliva samples. There were no statistically significant differences in terms of surface quality or dimensional accuracy (Table 3).

Discussion

The results showed that the use of chlorhexidine solution as a water substitute during impression taking led to a decreased percentage of microorganisms without affecting surface quality or dimensional stability of the resulting casts. Therefore, the null hypothesis was rejected.

Two previous in vitro studies have investigated the use of chlorhexidine to prevent contamination of dental impressions. Rosen and Touyz[2] mixed chlorhexidine with IH powder and reported positive results with an increased but clinically acceptable working time. In a separate study, the same authors[3] mixed chlorhexidine disinfectant solution with pre-set IH powder and subsequently soaked the IH material in the same

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Table 2 Mean (SD) Counts of Total Microorganisms, Total Streptococci, and *Candida* (CFU)

	Microorganisms			*Candida*			Streptococci		
	Saliva**			Saliva**			Saliva**		
	Before Tx	After Tx	IH*	Before Tx	After Tx	IH*	Before Tx	After Tx	IH*
Treatment									
Chlorhexidine	5.6×10^7 (0.2×10^7)	0.06×10^7 (0.03×10^7)	0.04×10^3 (0.04×10^3)	3.1×10^2 (4.9×10^2)	0.75×10^2 (1.8×10^2)	0 (0)	2.1×10^6 (2.1×10^6)	0.05×10^6 (0.05×10^6)	0 (0)
Water	5.2×10^7 (2.6×10^7)	2.9×10^7 (2.1×10^7)	4.2×10^3 (2.4×10^3)	8.2×10^2 (7.7×10^2)	2.9×10^2 (3.6×10^2)	0.3×10^2 (1.2×10^2)	2.3×10^6 (0.1×10^6)	1.0×106 (0.8×10^6)	1.4×10^3 (0.9×10^3)

CFU = Colony-forming units.
*Irreversible hydrocolloid impression; $P < .001$.
**$P < .05$.

Table 3 Mean (SD) Dimensional Stability (mm) and Surface Roughness (R_a, μm)*

		Dimensional stability			
	R_a	Large diameter	Small diameter	Inner distance	Outer distance
Water	0.057 (0.006)	11.3 (0.006)	8.00 (0.008)	14.30 (0.008)	33.49 (0.007)
Chlorhexidine	0.058 (0.007)	11.3 (0.008)	7.99 (0.008)	14.29 (0.004)	33.50 (0.007)

*Dimensions of the control template: large diameter = 11.3 mm; small diameter = 8 mm; inner distance between pillars = 14.3 mm; outer distance between pillars = 33.5 mm.

chlorhexidine disinfectant, again with positive results. Both studies recommended the use of chlorhexidine as a water substitute. Their results are in agreement with those of the present study, with the additional finding that this protocol had no negative effects on the dimensional accuracy of the casts. It should be noted that there is an additional cost involved in the substitution of water for chlorhexidine; however, the current authors believe that the disinfection benefits observed are worth the increased cost.

The concentration used in this study offers safe but effective levels of antibacterial activity and is available on a prescription basis for treating gingivitis. The use of chlorhexidine mixed with IH powder is advantageous compared to the use of hypochlorite, which tends to deteriorate the hydrocolloid surface.[4] In addition, the chlorhexidine is present within the impression material, allowing internal disinfection.[1,4]

Conclusions

Chlorhexidine mixed with IH powder as a water substitute during impression taking offers decreased microbial contamination with no negative alterations of the resulting casts, thus providing an easy method for controlling cross-infection.

Acknowledgments

The authors reported no conflicts of interest related to this study.

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