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Conducts of disinfection, pouring and storage of irreversible hydrocolloid impressions by undergraduate students

Condutas de desinfecção, vazamento e acondicionamento de moldes de hidrocolóide irreversível por alunos de graduação

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Resumo

Introdução: A obtenção de modelos odontológicos que representam com precisão os tecidos moldados requer do profissional muita atenção, principalmente quando se utiliza o hidrocolóide irreversível como material de moldagem. **Objetivo:** Avaliar as condutas dos alunos de graduação em Odontologia em diferentes estágios sobre os procedimentos de desinfecção de moldes de hidrocolóide irreversível, vazamento e acondicionamento dos modelos odontológicos. **Material e método:** Trata-se de um estudo observacional, transversal e descritivo, com amostra censitária constituída por 89 alunos matriculados nos estágios supervisionados I, II, III e IV. A coleta de dados foi realizada por meio de um formulário estruturado contendo 8 questões. Os dados foram analisados com nível de significância de 5%. **Resultado:** A maioria dos graduandos (88,8%) realizavam o procedimento de desinfecção, sendo o método de desinfecção mais utilizado (64,6%) o spray de hipoclorito de sódio a 1% acondicionado em recipiente fechado. O tempo de desinfeção por 10 minutos foi o mais relatado (86,1%). Os alunos dos estágios iniciais apresentaram melhores condutas referente a proporção água/gesso, quando comparados com os alunos dos estágios finais. Em todos os estágios as condutas de vazamento e acondicionamento do conjunto molde e modelo durante a reação de presa foram negligenciadas. Verificou-se associação estatisticamente significativa entre o estágio cursado e o método de desinfecção, proporção água/pó e método de vazamento dos moldes ($p<0,05$). **Conclusão:** Os alunos apresentam condutas adequadas de desinfeção, no entanto devem ser estimulados a utilizar a prática clínica baseada em evidências a fim de melhorar as condutas de vazamento e acondicionamento dos moldes de hidrocolóide irreversível.

Descritores: Sulfato de cálcio; desinfecção; odontologia.

Abstract

Introduction: Obtaining dental models that accurately represent the molded oral tissue requires professional attention, especially when using irreversible hydrocolloid as a molding material. **Objective:** To evaluate the conducts of undergraduate dental students at different internships for the disinfecting procedures, pouring, and storage of irreversible hydrocolloid impressions. **Material and method:** This is an observational, cross-sectional and descriptive study with a census sample of 89 students enrolled in the supervised internships I, II, III and IV. Data collection was performed using a structured questionnaire containing eight questions. Data were analyzed at the 5% significance level. **Result:** Most of the students (88.8%) performed the disinfection procedure, for which the most widely used method (64.6%) was the application of sodium hypochlorite 1% spray stored in a sealed container. The most common disinfection time was 10 minutes (86.1%). Students in the early internships performed better in regard to the proportion of water/plaster to be used compared with students in the final internships. At all internships, pouring and storage of the ensemble of mold and model were neglected during the setting reaction. There was a statistically significant association between the stage and the disinfection method, the ratio of water/powder and pouring of the model ($p<0.05$). **Conclusion:** Students exhibited appropriate conduct of disinfection; however, they should be encouraged to use evidence-based clinical practices in order to improve the procedures of pouring and storage of irreversible hydrocolloid molds.

Descriptors: Calcium sulfate; disinfection; dentistry.

INTRODUCTION

Obtaining dental models that accurately represent molded oral tissues requires professional attention and compliance with clinical and laboratory procedures, especially when using irreversible hydrocolloid as a molding material[1]. This material is characterized as unstable when considering the need to disinfect it, because it has a structure similar to agar polysaccharides that are known as excellent substrates for microorganisms[2,3], as well as its hydrophilic nature allows greater retention of bacteria, being checked two to five times larger when compared to elastomeric impression[3,4]. The possibility of contamination between the patient and the dental team by manipulating molds and models, makes it essential to carry out disinfection of the molds as cross-infection control measures[5-7]. However, it is necessary that the physico-chemical properties of the molding material, such as the ability to reproduce detail, the dimensional stability and the degree of wetting, are not changed[8,9]. It is important to consider the correct selection of the disinfection method to achieve the goal of cross-infection control, without negatively impacting the dental work[10].

In addition to the care taken with the mold, the gypsum also deserves special attention, particularly regarding the ratio of the water/powder to the manipulation of hemihydrate calcium sulfate, type of water used, the method for manipulating the mixture, as well as, the technique for pouring of the irreversible hydrocolloid and the storage of the set mold and model during the setting reaction[8].

Therefore, care must be taken during the dental students' academic training to ensure clinical practice based on scientific evidence and contributes to the achievement of proper molds and quality models. This study aims to evaluate the conduct of undergraduate dental students at different internships supervised about disinfection procedures of irreversible hydrocolloid, pouring molds, and storage of molds/dental models.

MATERIAL AND METHOD

This study is observational, cross-sectional and analytical. The population consisted of undergraduate dental students of the Federal University of Piauí, Brazil, enrolled in the second semester of 2013, in the disciplines internships supervised I, II, III and IV. This study was approved by the local Ethics Committee (CAAE - 15939214.7.0000.5214), taking into account the Resolution 466/12 of the National Health Council (CNS), which regulates guidelines and standards for research involving human subjects.

The sample was a census type. All students enrolled in supervised internships were invited to participate. Those who agreed signed a consent form ensuring strict confidentiality as to the collected information.

Data collection was performed by means of a structured questionnaire devised by Souza et al.[8] containing eight questions that addressed the conducts of undergraduates by the following criteria: carrying out disinfection of irreversible hydrocolloid; the method used for disinfection and the disinfection time; the ratio of water/gypsum, the type of water used and conduits related to the manipulation of the gypsum; the technique for pouring of gypsum in the irreversible hydrocolloid mold; and the method used for storage of the set mold and model during the setting reaction.

The processing and analysis of data were performed using the SSPS® program for Windows, version 18.0 (SPSS Inc., Chicago, USA). The frequencies of variables were expressed in absolute numbers (n) and percentages (%). Bivariate analysis was performed to evaluate the association between the internship of the course and the independent variables of the study. For this, we used the chi-square test and Fisher's exact test. The significance level was 5%.

RESULT

Eighty-nine students participated in the survey (response rate: 98.8%), including 21 enrolled on supervised internship I, 15 students of the internship II, 37 students of the supervised internship III and 16 enrolled on internship IV. The results showed that the conducts disinfection of irreversible hydrocolloid molds were better the more advanced the internship coursed by the student (Table 1), it was observed that 88.8% of the students performed the disinfection procedure. The most common method of disinfection (64.6%) was sodium hypochlorite 1% sprayed on the mold surface and placed in a closed container. For students in all internships, the disinfection time of 10 minutes was the most reported (86.1%). An association between the internship coursed and the disinfection method used was observed ($p = 0.01$).

It was found that students at the initial stages (I and II) showed better conduits regarding the proportion of water/powder for manipulation of the gypsum compared to the students at the final stages (III and IV). There was a statistically significant association ($p < 0.001$) (Table 2).

It was observed that students at all internships (I, II, III and IV), neglected the type of water used and the conducts related to the manipulation of gypsum, the technique for pouring of gypsum in the irreversible hydrocolloid mold, and storage of the set mold and model during the setting reaction (Table 2).

DISCUSSION

This study allows an evaluation of the conducts of undergraduate dental students in the procedures for disinfection of irreversible hydrocolloid, pouring of gypsum in the mold and storage of dental models, since, all study subjects had received prior training on dental materials and procedures clinical molding, as well as, they were in clinical supervised training.

Irreversible hydrocolloids are routinely used in clinical dental practice; however, they require proper disinfection because their structure is similar to agar polysaccharides, which are known to be excellent substrates for microorganisms[2,3]. The hydrophilic nature of this impression material allows greater retention of bacteria (two to five times greater than that with elastomer molds)[3,4]. Therefore, it is necessary the implementation protocols disinfection of dental impressions during graduation, as a basic requirement for the control of cross infection[8]. In this study, it was found that the disinfection conducts of irreversible hydrocolloid molds were better the more advanced the internship coursed by the student. This outcome

Table 1. Conducts of disinfection of irreversible hydrocolloid impressions performed by dental students enrolled in supervised internships I, II, III and IV, Teresina, Piauí, 2014

Variables	Category	Internship I	Internship II	Internship III	Internship IV	TOTAL
		n (%)	n (%)	n (%)	n (%)	
Disinfection of irreversible hydrocolloid molds	No	5 (5.6%)	1 (1.1%)	4 (4.5%)	0 (0.0%)	**11.2%**
	Yes	16(18.0%)	14 (15.7%)	33 (37.1%)	16 (18.0%)	**88.8%**
	TOTAL	21 (23.6%)	15 (16.8%)	37 (41.6%)	16 (18.0%)	**100%**
			p = 0.149*			
Disinfection method of irreversible hydrocolloid molds	2% glutaraldehyde sprayed in a closed container	0 (0.0%)	0 (0.0%)	5 (6.3%)	0 (0.0%)	**6.3%**
	Sodium hypochlorite 1% sprayed in a closed container	7 (8.9%)	13 (16.5%)	17 (21.5%)	14 (17.7%)	**64.6%**
	Immersion 2% glutaraldehyde	0 (0.0%)	0 (0.0%)	1 (1.3%)	0 (0.0%)	**1.3%**
	Immersion sodium hypochlorite 1%	9 (11.4%)	1 (1.3%)	8 (10.1%)	2 (2.5%)	**25.3%**
	Others	0 (0.0%)	0 (0.0%)	2 (2.5%)	0 (0.0%)	**2.5%**
	Total	16 (20.3%)	14 (17.8%)	33 (41.7%)	16 (20.2%)	**100%**
			p = 0.01*			
Disinfection time of irreversible hydrocolloid molds	10 minutes	13 (16.5%)	14 (17.7%)	27 (34.2%)	14 (17.7%)	**86.1%**
	30 minutes	2 (2.5%)	0 (0.0%)	2 (2.5%)	0 (0.0%)	**5.0%**
	Others	1 (1.3%)	0 (0.0%)	4 (5.1%)	2 (2.5%)	**8.9%**
	Total	16 (20.3%)	14 (17.7%)	33 (41.8%)	16 (20.2%)	**100%**
			p = 0.593*			

* Fisher's exact test ($p < 0.05$).

attests for the progression of learning and the increased perception of the use of biosecurity measures in infection control.

The disinfection of dental molds should be performed using methods and specific disinfecting solutions for each type of material. Due to the hydrophilic nature of irreversible hydrocolloids, a smaller contact time with the disinfectant solution is recommended to prevent dimensional changes and ensure the reproduction of details in a stone model[5,11-13]. In this study, most students who performed disinfection of molds followed the recommendations established by the American Dental Association (ADA), indicating a disinfection time not exceeding 30 minutes[14].

Among the available disinfectants, the ADA recommends, for disinfection of irreversible hydrocolloid, that glutaraldehyde solutions at 2% and 1% hypochlorite be applied to the surface of dental impressions by the spray and immersion methods[15]. From a microbiological standpoint, the use of the immersion technique is most effective when compared with the spray method; however, the immersion can cause dimensional changes of the hydrocolloid mold, due to the imbibition of the disinfecting agent[9].

The proportion of water / powder is a relevant factor in determining the physical and mechanical properties of the final gypsum product. The increase in this ratio is associated with a reduced setting expansion of gypsum; an extended setting time due to formation of crystallization nuclei per unit volumes[16]; and a reduced resistance of gypsum compression by increasing porosity after evaporation of the excess water and minor intermingling of the gypsum crystals by reducing the density of the crystallization nuclei[16-19]. Reducing the ratio of the water / powder interferes with the flow of the gypsum in the details of the dental mold, leading to less dissolving of the hemihydrate calcium sulfate, difficulty in crystal coalescence and increased setting expansion of the gypsum[16-18].

The determination of the ratio of water/powder must follow the manufacturer's recommendations. The weighing of the powder and the use of a graduated cylinder are suitable for obtaining adequate water volume[16,20]. However, the precise control of this relationship is often overlooked by clinicians, who randomly mix these substances due to greater demands on their time and the impracticality of using a scale and a graduated cylinder at the clinical level[16,21]. In this study it was found that undergraduates at the early stages (I and II) showed better use of the proportion of water /powder for manipulation of gypsum when compared with students of the final stages (III and IV). This inferiority of the final internship students is

Table 2. Conducts of pouring and storage of irreversible hydrocolloid impressions performed by dental students enrolled in supervised stages I, II, III and IV, Teresina, Piauí, 2014

Variables	Category	Internship I	Internship II	Internship III	Internship IV	TOTAL
		n (%)	n (%)	n (%)	n (%)	
Ratio of water/powder	Aleatory	3 (3.4%)	3 (3.4%)	24 (27.0%)	13 (14.6%)	**48.4%**
	Weight / volume	18 (20.2%)	12 (13.4%)	13 (14.6%)	3 (3.4%)	**51.6%**
	TOTAL	21 (23.6%)	15 (16.8%)	37 (41.6%)	16 (18.0%)	**100%**
p < 0,001**						
Type of water used in the manipulation of the gypsum	Tap	20 (22.5%)	15 (16.8%)	36 (40.5%)	16 (18.0%)	**97.8%**
	Distilled	1 (1.1%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	**2.2%**
	Total	21 (23.6%)	15 (16.8%)	37 (41.6%)	16 (18.0%)	**100%**
p = 1.00*						
Type of manipulation for gypsum	Manual	20 (22.5%)	15 (16.8%)	37 (41.6%)	16 (18.0%)	**98.9%**
	Mechanical	1 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1.1%**
	Total	21 (23.6%)	15 (16.8%)	37 (41.6%)	16 (18.0%)	**100%**
p = 0.84*						
Technique for pouring of gypsum	Manual	16 (18.0%)	2 (2.2%)	30 (33.7%)	14 (15.7%)	**69.6%**
	Automatic vibrator	5 (5.6%)	13 (14.6%)	7 (7.9%)	2 (2.3%)	**30.4%**
	Total	21 (23.6%)	15 (16.8%)	37 (41.6%)	16 (18.0%)	**100%**
P < 0.001*						
Storage of the set mold and model during the setting reaction	Outdoors	21 (23.6%)	15 (16.8%)	36 (40.5%)	16 (18.0%)	**98.9%**
	Humidifier box	0 (0.0%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	**1.1%**
	Total	21 (23.6%)	15 (16.8%)	37 (41.6%)	16 (18.0%)	**100%**
p = 1.00*						

* Fisher's exact test (p < 0.05). ** Chi-square test (p < 0.05).

shown in the making of models with inferior mechanical properties and poor accuracy due to the decreased resistance and increased hygroscopic setting expansion, respectively[22].

The type of water used in the manipulation of the gypsum also influences the physical and chemical properties of the final gypsum product. The large amount of chemicals present in the water can interfere with the setting reaction of gypsum[8,20,23]. This research showed that the majority of students enrolled in supervised internships used tap water for manipulation of dental plaster, which was justified by the ease of obtaining the tap water. However, to obtain a mixture with improved properties, the students need to use distilled water, because the presence of salts in the tap water can interfere with the setting reaction time[8,23].

Another variable that affects the compressive strength and the tensile property of gypsum is the time and the type of manipulation used for mixing the particles of the hemihydrate with water. The handling time of the mixture is related to the setting reaction speed of the material; thus, an increase of the time may lead to rupture of the newly formed gypsum crystals, which results in creating more crystallization nuclei and thus reduces the setting time. As a result, a smaller interlace in the gypsum final product can be observed[22,24]. Regarding the type of manipulation for gypsum, the best properties of gypsum are associated with mechanical manipulation, because it allows a more homogenous mixture to be obtained with lower incorporation of air bubbles and less mixing is required. It is recommended of 20 to 30 seconds of mechanical manipulation under vacuum, while with manual manipulation, the water and the powder must be mixed vigorously for 60 seconds[1,21,22].

In this study, it was found that the majority of dental students perform manual manipulation to obtain the plaster models. This type of manipulation reduces tensile strength by a greater incorporation of bubbles, and may be critical in obtaining long and slender models[22]; however, manual manipulation can be used when the tensile strength is not critical to the model[22].

Another important step in making quality plaster models is the technique for pouring of gypsum in dental molds. In this study, a negative association was found between the plaster leakage method and the level of the supervised internship, because the manual technique of pouring of gypsum in the irreversible hydrocolloid molds as practiced by the majority of students is not recommended

in the literature. The most effective auxiliary method for making plaster models is to use an automatic vibrator of high frequency and low amplitude[1,20,22,25]. This method minimizes air entrapment and prevents porosities, which are responsible for irregularities in the model surface and reduced resistance. The use of the vibrator enables the proper outflow, plaster compaction into the details of the dental mold[8] and is associated with an increase of 6% to 8% in gypsum strength, when compared to the manual technique of pouring[26].

Obtaining accurate models is also associated with the correct storage of the set mold and model during the setting reaction. The irreversible hydrocolloid is very sensitive to environmental conditions because of their propensity to suffer syneresis and imbibition[27]. Proper storage of the mold is related to lower distortion of the dental model[27,28]. Scaranelo et al.[28] showed that the use of the humidifier box, which maintains an atmosphere of 100% relative humidity, allowed the gypsum poured into the irreversible hydrocolloid mold to remain stable during the prey, thus reducing the dimensional changes of the model compared with the setting reaction of the mold set and model outdoors. Therefore, in environmental conditions that are not controlled, the irreversible hydrocolloid loses water to the environment, and to compensate for this loss, it absorbs water from the gypsum surface during the prey, causing distortion.

This study found that students at all levels of supervised internships do not use the humidifier box, an ideal means of storage for the set mold and model during the setting reaction. The teaching institution is equipped with a humidifier box but the lack of information on the importance of this step for the quality of the gypsum model favors its non-use.

Among the limitations of the study is the self-reported nature of the researched information that cannot indicate accurately the effective clinical practice of the students enrolled in supervised internships. However, results based on self-reported data are considered valid when anonymity is assured, criterion that was used in this study.

CONCLUSION

Conduct of disinfection of irreversible hydrocolloid molds practiced by dental students of supervised internships are suitable, which shows the progression of learning and the perception of the importance of biosecurity measures in infection control. However, the procedures for pouring of gypsum in the irreversible hydrocolloid mold and storage of the molds and models were neglected at all internships. There is a need to inform and stimulate clinical practice based on scientific evidence.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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