

# How to avoid cross contamination during handling resin composites with spatulas

Como evitar a contaminação cruzada durante a manipulação de resinas compostas com espátulas

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## ABSTRACT

Incremental technique for resin composite restorations requires multiple physical contacts between spatulas, tooth cavities and the restorative material recipient. Thus, the decontamination of the tip's of spatula by chemical agents between each resin composite increment placement is important to reduce chances of potential cross-contamination. Objectives: To evaluate the efficacy of different solutions for decontamination of tips of spatula used in restorative procedures and to establish a decontamination standard protocol. Material and Methods: Spatulas were sterilized in autoclave at 127°C for 20 minutes and then contaminated with: 1) a suspension of half 1.0 MacFarland scale turbidity of different microorganisms, 2) the pool of equal amounts of these microorganisms; except for the control group. Decontamination techniques consisted of rubbing the tip of the

spatulas (1 to 5 consecutive times) using a 2ml 70% ethanol or 2% glutaraldehyde embedded gauze. After decontamination, spatulas were immersed in thioglycolate broth and incubated for 48 hours at 37°C. Broth with visible microbial detection was submitted to bacterial identification by Gram stain. Results: Low uniformity of rubbings number was observed to eliminate different microorganisms due to different tested disinfectant agents. Four or five rubbings were needed to decontamination of the tested microorganisms using 70% ethanol. Three rubbings using 2% glutaraldehyde were able to eliminate tested microorganisms. Conclusion: The results demonstrated that 70% ethanol by friction, counting four or five rubbings, was effective to decontaminate spatula's tip.

Key-words: Dental instruments, microbiological analysis, disinfection, resin composite.

## INTRODUCTION

Composite resin usage in Restorative Dentistry became a reality due to a great improvement on physical, mechanical and optical properties plus the considerable development of adhesion techniques (1-3). In addition, patients' demand for aesthetic restorative dental materials requires matching the natural shade of the teeth (1). Resin composite is an aesthetic material and can also avoid tooth structure loss with minor cavity preparations; it has been used for the restoration of anterior and posterior teeth which caused their large spread in rehabilitation techniques (2).

During the clinical dental procedure with resin composites sterilized spatulas are used to collect resin from its recipient and place the material's increment into the prepared cavity until complete fulfillment (3,4). Since this procedure is repeated many times until completion of the restoration, there is the chance of contamination of the spatula's tip due to the presence of diversified micro flora in the oral cavity. Then, the dental professional is advised to follow recommended infection control strategies in health care settings by the use of effective decontamination, disinfection and sterilization protocols (5).

The use of decontamination procedures with chemical solutions can be a promising cost-effective technique, reducing spatulas contamination during composite increment placement and, consequently, reducing chances of contamination of the resin recipient that may decrease possibility of cross-contamination (6).

The purposes of this study were to evaluate the efficacy of different chemical solutions for decontamination of metallic spatula's tip and to establish scientific basement for a decontamination standard protocol implementation during restorative procedures with resin composite.

## MATERIAL AND METHODS

### Spatulas preparation

Spatulas for resin composites insertion (#1/2, SSWhite, São Paulo, Brazil) were selected, appropriately packed and sterilized in autoclave at 127°C for 20 minutes (Fig. 1A). Contamination procedures were accomplished by immersion in different solutions, containing: a) suspensions of half 1.0 MacFarland

scale turbidity of different standard indicative microorganisms (*Micrococcus luteus*, *Staphylococcus aureus*, *Streptococcus mutans*, *Lactobacillus brevis*, *Escherichia coli*, *Candida albicans*); b) the pool of equal amounts of these microorganisms.

In aseptic conditions (sheeted flow chamber) each spatula tip was immersed in 1 ml of the selected suspension (each microorganism or pool) for one minute (Fig. 1B), and then left under a sterile glass plate for five minutes.

**Decontamination techniques**

Two disinfectant agents were used to evaluate decontamination techniques: 70% ethanol and 2% glutaraldehyde. A unique researcher executed the decontamination of spatula's tip by rubbing it with sterile gauze drenched with 2 ml of the chosen agent (Fig. 1C).

Groups of spatulas were established in accordance to the number of rubbing times and the selected disinfectant agent (Table 1). In the control group, the spatula's tip did not suffer any type of decontamination. Five repetitions were established for each group (n=5). In the first group, spatula's tip just suffered one friction with gauze drenched by one of the disinfectants. For second, third, fourth and fifth groups the spatula's tip were rubbed by two, three, four and five times, respectively.

**Table 1** - Experimental design.

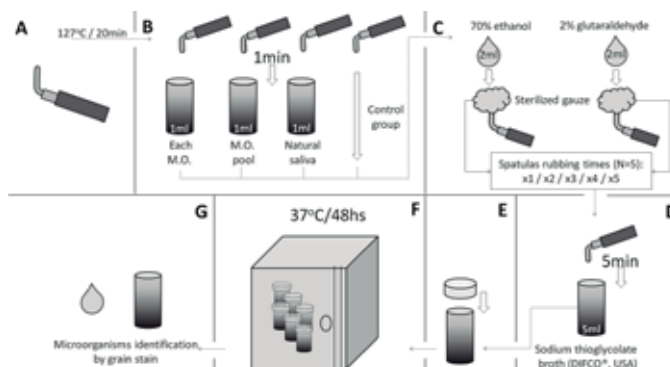
Number of rubbings	Disinfectant agents	
	70% ethanol (E)	2% glutaraldehyde (G)
0	Control group (no decontamination)	
1	Group 1E	Group 1G
2	Group 2E	Group 2G
3	Group 3E	Group 3G
4	Group 4E	Group 4G
5	Group 5E	Group 5G

**Microbiological analysis**

Spatulas were immersed in 5 mL of sodium thioglycolate broth (DIFCO®, USA) for five minutes after decontamination process (Fig. 1D) and then they were taken off from test tubes that were closed with sterilized cork (Fig. 1E) and incubated for 48 hours at 37°C (Fig. 1F).

After the incubation period, the samples with visible microbial detection (with culture broth turbidity) were submitted to colorful and morphologic characteristics identification by Gram stain (6) (Fig. 1G). This process allowed the identification of microorganisms resistance to decontamination techniques used. The microorganisms were identified in agreement with their micro and macroscopic characteristics by selective culture broth development and by biochemistry tests (7).

The collected data were tabulated and plotted according to the occurrence specifying their percents and their descriptive analysis.



**Figure 1**- Sequence demonstration of the method development (A - G)

**RESULTS**

The results of the antimicrobial activity of the disinfectants on spatulas for resin composites are presented in Table 2. There were microbial growths in all control groups.

The 70% ethanol antimicrobial activity showed that there were needed four or five rubbings to the instrumental decontamination, in exception of those spatulas contaminated with *L. brevis* and *C. albicans*, where five rubbings, maximum number purposed, showed inefficient.

The 2% glutaraldehyde showed to be more effective disinfectant than 70% ethanol for all standard microorganisms and pool since were needed just three rubbings to decontamination in the most of the groups, except for *E.coli* where five rubbings were not sufficient to disinfect the spatula.

**Table 2** - Antimicrobial activity on spatula's tip for composite resins after decontamination with 70% ethanol and 2% glutaraldehyde.

Microorganisms	70% ethanol					2% glutaraldehyde				
	G1E	G2E	G3E	G4E	G5E	G1G	G2G	G3G	G4G	G5G
M. luteus	+	+	+	-	-	+	+	+	-	-
Staph.aureus	+	+	+	-	-	-	-	-	-	-
Strep. mutans	+	+	+	-	-	-	-	-	-	-
Lact. brevis	+	+	+	+	+	+	+	-	-	-
E.coli	+	+	+	+	-	+	+	+	+	+
C. albicans	+	+	+	+	+	+	+	-	-	-
Pool	+	+	+	-	-	-	-	-	-	-

Legend: + microbial growth; - no microbial growth

**DISCUSSION**

Restorative clinical procedures possess high risks of microorganisms contamination. The handling of contaminated spatula tip to collect a new resin composite portion in the recipient can contaminate the resin tube that may become a reservoir of pathogens transmission during subsequent practice (6).

Heat sterilization of critical and semi-critical instrumentals continues to be the safest and preferred means for processing between patients (8). The disinfection process, however, eliminates dangerous microorganisms over unanimated surfaces by using a great variety of chemical solutions. Disinfectant levels destined to surfaces decontamination are determined by their risk to constitute reservoirs of pathogenic microorganisms. In

semi-critical conditions, as the contaminated spatulas, the medium level disinfection is indicated. The World Health Organization (9) recommends 1% sodium hypochlorite or 2% glutaraldehyde (30 minutes' immersion) and 70% ethanol (gauze friction) for disinfection of dental instrumentals.

Among the factors that alter disinfectants activity it should be considered the contamination degree (amount of microorganisms and their resistance), the disinfectant solution concentration, the exposure time and the presence of biological debris (10). Alcohols are medium level disinfectants, in agreement with the American Food and Drug Administration (11). Its antimicrobial activity is conditioned to the 70% ethanol concentration that dehydrates the microorganism cellular wall, allowing free passage to its interior and consequent proteins denaturing (12).

By using 70% ethanol, even after five rubbing repetitions it was not possible to decontaminate the spatula's tip inoculated with a suspension of *L. brevis* and *C. albicans*. For the other microorganisms there were necessary four or five rubbing repetitions with alcohol to decontaminate. The results of this study suggest the possibility of using ethanol for disinfection of spatula's tip, although it was not possible to establish a definitive protocol in relation to the number of requested rubbings for complete disinfection. However, only one of five test tubes of *C. albicans* group showed microbial growth after five rubbings with ethanol. Thus, should be considered the possibility of mistake occurrence in some method steps such as when the gauzes were drenched with each disinfectant or during rubbings execution.

According to research, the ideal surface disinfectants are the same ones for disinfection by immersion, except glutaraldehyde (5,13). Glutaraldehyde (2%) is considered a chemical sterilizing agent or a high level disinfectant due to its biocide action since it shows potent bactericidal, fungicidal, mycobactericidal, sporicidal and virucidal activities (14,15). However, its highly aggressive action on human tissues raises a question about the indication for disinfection during a clinical procedure (14). The material inherent toxicity characteristics rises the importance to reduce occupational exposure to this agent by correct skin protection and by the adoption of clinical measures to avoid product steam inhalation (9,14,15). In this study, although glutaraldehyde effectiveness had been proved for spatulas decontamination (three rubbing repetitions with 2% glutaraldehyde were able to eliminate the tested microorganisms), it was used just for comparison with 70% ethanol.

The pool of microorganisms was used as an attempt to represent similar inoculums to the one found in mouth environment. Either 70% ethanol or 2% glutaraldehyde were effective on disinfection of the spatula's tip contaminated with the pool. The 70% ethanol required four rubbing repetitions, while 2% glutaraldehyde was effective with only one rubbing action.

The rubbing technique selected for this study was designed to combine disinfection effectiveness and time economy. In addition, it can be considered a low cost alternative and applicable during restorative procedure using composite resins. Based on the developed methodology and according to the limitations of this study, it was possible to conclude, on the antimicrobial activity basis, that 70% alcohol and 2% glutaraldehyde are effective disinfectant agents for decontamination of spatula's tip on almost all evaluated microorganisms. Then, gauze friction with ethanol,

during four or five rubbing repetitions, can be used during clinical procedures for disinfection of spatula's tip avoiding the contamination the recipient of resin composite.

## CONCLUSION

The results demonstrated that 70% ethanol by friction, counting four or five rubbings, was effective to decontaminate spatula's tip.

## CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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## RESUMO

A técnica incremental para restaurações de resina composta requer vários contatos físicos entre as espátulas, o preparo cavitário e a embalagem do material restaurador. Assim, a descontaminação da ponta da espátula por meio de agentes químicos entre cada inserção de um novo incremento de resina composta é importante para reduzir as chances de uma potencial de contaminação cruzada. Objetivos: Avaliar a eficácia de diferentes soluções para descontaminação das pontas das espátulas utilizadas em procedimentos restauradores e estabelecer um protocolo padrão de descontaminação. Material e Métodos: espátulas foram esterilizadas em autoclave a 127 °C durante 20 minutos e, em seguida, contaminadas com: 1) uma suspensão de diferentes microorganismos com turbidez equivalente ao padrão 1,0 da escala de McFarland, 2) pool de quantidades iguais destes microrganismos; exceto para o grupo de controle. As técnicas de descontaminação consistiram em esfregar a ponta das espátulas (1

a 5 vezes consecutivas) utilizando 2 ml de álcool 70% ou 2% de glutaraldeído embebidos em gazes. Após a descontaminação, as espátulas foram imersas em caldo de tioglicolato e incubadas durante 48 horas a 37 °C. O caldo com visível detecção microbiana foi submetido à identificação bacteriana pela coloração de Gram. Resultados: Baixa uniformidade do esfregado foi observada para a eliminação de diferentes microrganismos, devido aos diferentes agentes desinfetantes testados. Quatro ou cinco esfregaços foram necessários para a descontaminação dos microrganismos testados usando álcool 70%. Três esfregaços na espátula usando glutaraldeído a 2% foram capazes de eliminar os microrganismos testados. Conclusão: Os resultados demonstraram que o álcool 70% por fricção, contando quatro ou cinco esfregaços na espátula com gazes embebida nas soluções desinfetantes, foi eficaz para descontaminar a ponta da espátula.

Palavras-chaves: instrumentos odontológicos, análise microbológica, desinfecção, resina composta

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