

# Preliminary study on antimicrobial efficiency of some common chemical substances with a disinfecting character on impression materials used in implant-prosthetic rehabilitation

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## ABSTRACT

**Purpose.** Starting from a very recent event on the market of disinfectants, where for many years very diluted disinfectant products were marketed in Romania, the antimicrobial activity being non-existent, we tried, on the basis of simple experiments, to study the antimicrobial efficiency of the active substances of some common products used on impression materials in implant-prosthetic rehabilitation, but also in classical dental prosthetics and in orthodontics and dentofacial orthopedics, products approved and used in the European Union.

**Material and method.** 7 decontamination and/or disinfectant products were tested for qualitative screening for the sensitivity to different microbial strains as well as for quantitative testing of antimicrobial activity.

**Results and discussions.** The study results for the two objectives are influenced by the active substances of the tested products.

**Conclusions.** Decontamination of dental impressions must also become a certainty in implant-prosthetic rehabilitation, in classical dental prosthetics and in orthodontics and dentofacial orthopedics even if this work is disregarded and ignored by many practitioners.

**Keywords:** chemical substances, disinfectant character, active substances, implant-prosthetic rehabilitation

## INTRODUCTION

The present study, although only a preliminary one, attempts, on the basis of simple clinical and microbiological experiments, to determine the antimicrobial effectiveness of some

chemical disinfectant substances on standard impression materials, commonly used in implant-prosthetic rehabilitation, in classical dental prosthetics, as well as in orthodontics and dentofacial orthopedics. In fact, we are talking about existing active substances, which are

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present in standardized products, approved and used in the European Union. We did not use the trade names of these products to respect what we could define not only discretion but also professional equidistance, especially since we have chosen a less used medical procedure in implant-prosthetic rehabilitation, namely impressions decontamination, and indications of these substances with disinfecting potential have not always been recommended for this procedure (Table 1).

From our point of view, the decontamination of dental impressions in implant-prosthetic rehabilitation, and in classical dental prosthetics, as well as in orthodontics and dentofacial orthopedics should become mandatory in the technological flow of realization of implant-retained prosthetic restorations of any kind, but also of fixed and mobile classical prosthetic restorations, as well as of orthodontic appliances.

Unfortunately, this procedure is considered by many practitioners in Romania (dental practitioners, dental nurses and dental technicians) as a slowing down and even useless procedure that unnecessarily complicates these technological flows (1-6).

## PURPOSE

The purpose of this study is to test a series of decontamination, disinfection and even cold sterilization products approved and used in the European Union in dentistry, including implant-prosthetic rehabilitation, classical dental prosthetics and orthodontics and dentofacial orthopedics. These products are based on various active substances, their instructions being varied, starting from the decontamination and disinfection of manual and rotary instruments, even dental impressions, antiseptication of the skin and ending with the decontamination and disinfection of the surfaces. The present study can provide only some information on the antimicrobial efficacy of these active substances; the choice indication of the products used may contradict the purpose for which we have used these substances (1-6).

## MATERIAL AND METHOD

To carry out this study, we took into account several decontamination and/or disinfectant products approved and used in the European Union, which are presented in the table below (Table 1). As mentioned above, in order to avoid

commercial controversy, we will not specify the names of products used in this study, but we will use the generic name of “disinfectant product”.

The used products are based on the following active substances: quaternary ammonium salts (most commonly used), alcohols, peroxides (peracetic acid) and halogenated compounds (sodium hypochlorite). We did not enter products with the glutaraldehyde as active substance, this chemical having a recognized allergenic and carcinogenic potential for users (7-17).

**TABLE 1.** Substances with antimicrobial potential used in this study

Label	Active substance	Use
Disinfectant Product no. 1	Alcohols	For surfaces decontamination and disinfection
Disinfectant Product no. 2	Alcohols	Hands antiseptic
Disinfectant Product no. 3	Alcohols	For the decontamination and disinfection of dental and medical devices surfaces
Disinfectant Product no. 4	Peracetic acid	For high level disinfection/cold sterilization of manual and rotary instruments
Disinfectant Product no. 5	Quaternary Ammonium Salts	Instruments and dental impression decontamination
Disinfectant Product no. 6	Quaternary Ammonium Salts	For decontamination and disinfection of manual and rotary instruments
Disinfectant Product no. 7	Sodium Hypochlorite	Detergent/disinfectant for pavements

Two phases were followed, namely:

### 1. Qualitative screening of susceptibility of different microbial strains to substances with potential anti-infective action.

It was done by a method adapted to the diffusometry method, namely the distribution of the chemical compound in a spot on Muller-Hinton broth seeded with a microbial suspension.

The bacterial inoculum was a suspension in sterile physiological water with a density of 0.5 McFarland. The volume distributed in the spot was 10 µl of the test product. After seeding, the plates were allowed to stand at room temperature for adsorption of the solution drop in the medium, after which they were incubated at 37°C (with thermostat) with the lid down for 24 hours. The bactericidal effect of the compound (inhibition of bacterial growth) was quantified by the occurrence of an inhibition zone (clear area) around the spot.

## 2. Quantitative testing of antimicrobial activity in order to determine quantitative parameters of antimicrobial activity on clinically isolated bacterial strains

Quantitative testing was performed by the serial microdilution method in liquid broth (Muller Hinton), using 96-well plates to determine the minimum inhibitory concentration of the MMI (Minimum Inhibitory Concentration), the minimum amount of chemical compound capable of inhibiting the growth of microbial cells. In a volume of 100  $\mu$ l of broth, serial binary dilutions of the stock solution of the compound were made. 100  $\mu$ l of liquid broth and 100  $\mu$ l of chemical compound were pipetted into the first well. From the first well, 100  $\mu$ l was transferred to the second well, the previous procedure was repeated and 100  $\mu$ l was transferred to the third well and thereafter to the last well in which 100  $\mu$ l was transferred without the addition of the chemical compound. Subsequently, the wells were seeded with 20 ml of microbial suspension 0.5 MacFarland density. Microbial suspensions were carried out in sterile physiological water from 24-hour cultures. At each test, a control microbial culture (a row of wells containing only inoculated growth medium with microbial suspension) and a control of medium sterility were used. After incubating the plates at 37° C for 24 hours, optical density was read on the spectrophotometer (wavelength used 620 nm). In the growth control well, the medium was cloudy as a result of microbial growth. The sterility control well did not show any bacterial growth, the liquid content remaining clear, transparent. The concentration of chemical compound corresponding to the last well in which culture development was no longer observed was C.M.I. ( $\mu$ g/ml) for the compound.

## RESULTS AND DISCUSSIONS

Following the completion of microbiological studies, it was found that:

For the **first stage** of the study, the qualitative analysis of antimicrobial activity of these selected products existing in the specialized market was highlighted by obtaining inhibition areas around the substance spot (Fig. 1). **Disinfectant Product no. 2** (according to Table 1, with the active substance based on alcohols and with the main indication hands antiseptic) showed the lowest inhibition area, followed by **Disinfectant Product no. 4** (according to Table 1, compound based on peracetic acid, being rec-

ommended for high level disinfection/cold sterilization) (7-17).

For the **second stage** of the study, quantitative testing of antimicrobial activity largely tests first stage but also complements it as meaning that among substances with antimicrobial effect, **Disinfectant Product no. 2** (according to Table 1, having the active substance on the basis of alcohols and with an indication of choice antiseptic action on hands) has the lowest antimicrobial potential, followed by **Disinfectant Product no. 4** (according to Table 1, peracetic acid compound, recommended for high level disinfection/cold sterilization) while **Disinfectant Product no. 5** (according to Table 1, quaternary compound based on ammonium salt with the indication of choice dental impression decontamination and instrument disinfection) and **Disinfectant Product no. 6** (according to Table 1, compound based on quaternary ammonium salts having the indication of choice for manual and rotary instrument decontamination and disinfection) destroyed all microbial strains tested. **Disinfectant Product no. 7** (according to Table 1, compound based on sodium hypochlorite having the indication of choice detergent-disinfectant of surfaces) and **Disinfectant Product no. 1** (according to Table 1, compound based on alcohols with the indication of choice for decontamination and disinfection of surfaces) exhibit medium antimicrobial activity.



**FIGURE 1.** Highlighting the inhibitory activity of some substances with antimicrobial potential.

## CONCLUSIONS

Following the results obtained, we were able to conclude on several aspects, we think very interesting, as follows:

The infectious risk in implant-prosthetic rehabilitation, in classical dental prosthetics, as well as in orthodontics and dentofacial orthopedics, due to the non-decontamination of dental impressions, models, occlusion rims, wax patterns, and prosthetic restorations is real, is not invented, medical staff who manipulates these products (dentists, cabinet assistants, dental technicians) being exposed to infectious diseases, whether or not classified as professional illnesses.

Decontamination of dental impressions must also become a certainty in implant-prosthetic rehabilitation, in classical dental prosthetics and in orthodontics and dentofacial orthopedics, even though this work is disregarded and ignored by many practitioners (both those in the clinical compartment and those from the dental laboratory).

Most recommended disinfecting and/or sterilizing chemicals for the decontamination of

dental impressions in implant-prosthetic rehabilitation, classical dental prosthetics as well as in orthodontics and dentofacial orthopedics would be indicated to have the active ingredient based on quaternary salts of ammonium, alcohols and/or halogenated compounds.

Always when the decontamination of dental impressions, models and/or prosthetic intermediate parts is carried out both in the implant-prosthetic rehabilitation, but also in the classical dental prosthesis and orthodontics and dentofacial orthopedics, the user must wear appropriate protective equipment: mask, gloves and goggles.

Not always the manufacturers' recommendations in the package leaflet are in line with reality in practice.

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