Evaluation of gutta-percha points decontamination through different disinfection methods

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ABSTRACT

Susceptibility to bacterial growth in gutta-percha (GP) cones and their decontamination by four different chemical substances were assessed. Six GP cones were selected from a clinical environment and taken to Brain Heart Infusion (BHI) growth medium with the aid of sterile tweezers to assess bacterial growth. Other twelve cones were divided into four groups of three cones each: Group 1 with 2.5% sodium hypochlorite; Group 2 with 70% alcohol; Group 3 with 2% chlorhexidine gel; and Group 4 with 0.12% chlorhexidine. Each cone was submerged in its respective substance for 1 minute, dried with sterile gauze and inserted into BHI culture, so as to allow assessment of the presence or absence of contamination. Results showed that gutta-percha cones had no contamination, regardless of being subjected or not to decontamination. Thus, it is concluded that there is no need for decontamination of gutta-percha cones, as long as the aseptic chain of endodontic treatment is respected.

Keywords: Decontamination. Root canal filling. Root canal irrigants.

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Introduction

Endodontic treatment is a result of a series of technical steps ranging from correct selection of the case to be treated to root canal filling. The basis of treatment are interdependent and aimed at one single purpose: favoring success of endodontic therapy.[1]

Appropriate and hermetic root canal filling should be consisted of crowning of endodontic treatment. The root canal should be filled throughout, with an effective and biologically compatible sealing.[2]

Although all stages comprising endodontic treatment are important, root canal filling is an unquestionably highlighted stage of endodontic therapy. An empty or poorly filled root canal tends to behave as a real test tube, collecting tissue fluids and inflammatory exudate coming from the periapex. Inside the tube-like structure, those substances find an environment conducive to stagnation, where they can easily decompose, and thus produce toxic products harmful to living tissues, thereby posing a risk to endodontic treatment.[1] Endodontic filling major objective is to achieve hermetic root canal filling throughout, thus preventing percolation of fluids from periapical tissues which could cause reinfection of the root canal system.[1-3]

The literature reports several studies conducted with a view to detecting the causes of endodontic treatment failure which is usually associated with inadequate root canal filling.[4-7]

Dow and Ingle[8] assessed potential failures resulting from treatment and filling of the root canal system, and concluded that approximately 60% of failures were related to incomplete or unsatisfactory filling.

The same conclusion can be reached conversely, that is, the same studies have shown that successful treatment is directly related to proper root canals filling.

University studies assessing the outcomes of endodontic treatment have shown high success rates.[9] On the other hand, retrospective, transverse studies reveal success rates in approximately 50% of cases. As a result, significant improvements in treatment modalities, such as those that occur with the use of endodontic material, seem necessary.

Despite attempts made to improve the characteristics of filling material, root canal system filling crucially depends on elimination or accentuated reduction of microorganisms in the root canal by means of chemical and mechanical preparation.[10] To this end, the clinician must rigorously take aseptic precautions into consideration, so as to prevent contamination of endodontic instruments and filling material and, thus, prevent cross-infection of root canals.[10,11]

Although gutta-percha cones[10,11] are considered the material of choice for root canal filling , they have the disadvantage of not withstanding conventional sterilization processes by wet or dry heat. For this reason, they are marketed packed in closed boxes and usually unsterilized. Therefore, in order not to break the aseptic chain, the gutta-percha cones require quick decontamination at the time of use.

Nevertheless, according to some authors discussing about gutta-percha cones, quick decontamination of this filling material in the dental office is unnecessary due to the existence of several studies showing that the gutta-percha cones may be free of microorganisms as from their original package.[12-14] This hypothesis was partially supported by the potential antimicrobial activity of gutta-percha cones attributed to zinc oxide[15,16] and recognized antiseptic action of the sealer used as supplementary material in root canal filling.[17]

In spite of the aforementioned differences, a number of methods aimed at quick decontamination of filling material in the dental office are described in the literature, including the use of the following chemicals: polyvinylpyrrolidone-iodine,[18] glutaraldehyde,[19,20] ethyl alcohol,[12,21] sodium hypochlorite,[21-23] hydrogen peroxide,[11] and chlorhexidine.[23] No consensus has been reached on the best method to be used for this purpose.

Thus, the objective of this study was to assess the decontamination capacity of gutta-percha cones through different solutions at different time intervals and concentrations.

Material and methods

This is an observational cross-sectional study assessing the contamination of gutta-percha (GP) cones used at UNIFOR dental clinic, in addition to possible means of disinfecting them.

Experimental groups

A total of 18 GP cones (Odous de Deus, Belo Horizonte, Brazil) used at UNIFOR dental clinic were assessed. The cones were divided into four experimental groups with three GP cones each, with a view to testing decontamination substances, and six GP cones to assess residual contamination. GP cones were taken out of a storage boxat UNIFOR dental clinic.

Assessment of substances for decontamination of GP cones

Gutta-percha cones were divided into experimental groups according to the substance used for potential decontamination (Table 1).

The GP cones were individually submerged in disinfectant for one minute. Specimens were then removed from the tested substances with the aid of sterile tweezers and subjected to drying carried out with sterile gauze. Subsequently, the GP cones were transferred to test tubes containing 5ml of Brain Heart Infusion (BHI, Difco Laboratories, Detroit, MI, USA) (Fig 1). The entire experiment was performed by means of aseptic technique for cell culture.

Manipulation of GP cones was performed with sterile gloves exchanged every time a different GP cone was assessed. Each test tube contained only one GP cone.

Tubes containing the GP cones were incubated in a bacteriological oven of which temperature was

Table 1. Experimental groups.

Group	Substance	n
Group 1	2.5% Sodium hypochlorite	3
Group 2	70% Alcohol	3
Group 3	2% Chlorhexidine gel	3
Group 4	0,12% Liquid chlorhexidine	3
Group 5	No chemical substance	6

Figure 1. GP cones in test tubes with 5ml of BHI.

set at 37°C for 48 hours. By the end of this period, tubes were assessed for the presence or absence of turbidity in the culture medium (BHI). Cases with turbid culture medium led to the conclusion that cone contamination had persisted, in other words, the GP cone decontamination method was inefficient. On the other hand, cases with a clear culture medium led to the conclusion that the GP cone decontamination method was effective.

Assessment of residual contamination of GP cones

Six GP cones taken out of a storage box at UNIFOR dental clinic were transferred with the aid of sterile tweezers to a test tube filled with 5ml of BHI. Tubes were incubated in a bacteriological oven with temperature set at 37°C for 48 hours. By the end of this period, tubes were assessed for the presence or absence of turbidity in the culture medium (BHI). In the event of turbidity, cultures of the bacteria present were performed, in addition to their assessment and identification.

Results

Experiments carried out with GP cones showed absence of contamination in all assessed groups. Additionally, aseptic chain maintenance was confirmed when GP cones were submerged directly in BHI, that is, even when no chemical antiseptic substance was used, GP cones showed no turbidity in the culture medium (Table 2).

Discussion

This study assessed the effectiveness of disinfection of GP cones used at UNIFOR dental clinic. Samples were submerged for one minute into four different substances (2.5%, sodium hypochlorite, 70% alcohol, 2% chlorhexidine gel, and 0.12%. liquid chlorhexidine). Bacterial growth microbiological assessment was carried out in BHI broth and blood agar medium.

GP cones were directly taken out of their original package. Previous contamination was absent when GP cones were submerged into the studied solutions. Although contamination in particular was not the subject of investigation, it is a known fact that the dental clinic is conducive to contamination, as it is an environment with a significant amount of pathogenic microorganisms, thus posing a high risk to dentists and patients. The second experiment with six GP cones carried out with the aid of sterile tweezers revealed absence of turbidity.

The components of GP cones are zinc oxide (ZnO), barium sulfate ($BaSO_4$), gutta-percha and waxes or resins.[14] ZnO has the basic properties of fine oxide particles, with deodorizing and antibacterial action. For those reasons, it is added to several types of material, including cotton, rubber, and food packaging. Strong antibacterial action of fine particles compared to bulk material is not inherent to ZnO, as it is found in other types of material as well, such as silver. ZnO is widely used to treat a variety of skin conditions, in addition to being found in products such as baby powder and creams for treating diaper rash, calamine lotion, dandruff shampoos, ointments and antiseptic drugs. It is also found in zinc oxide tapes used by athletes as a bandage to prevent damage to soft tissues during workouts.

The culture media used (BHI broth and blood agar) allow cultivation of a wide variety of microorganisms. Some bacteria growing in those media are as follows: *Streptococcus pyogenes, Staphylococcus aureus, pneumococcus, meningococcus, enterobacteriaceae*, yeast, and fungi.

Table 2. Study groups assessed for quality of decontamination.

Group	Substance	Contamination
Group 1	2,5% Sodium hypochlorite	None
Group 2	70% Alcohol	None
Group 3	2% Chlorhexidine gel	None
Group 4	0. 12% Liquid chlorhexidine liquid	None
Group 5	No chemical substance	None

Sodium hypochlorite is widely used in Endodontics as root canal irrigating solution . It is rather cheap and easily found in the market. It might even be obtained by diluting bleach sold in supermarkets. Nevertheless, it has some disadvantages, such as sensitivity to light and temperature, thus requiring storage precautions to be taken, so as to avoid it to lose its effectiveness. The findings of the present study corroborate the literature reviewed, as it has been proved the antimicrobial action of sodium hypochlorite in all samples disinfected.[20]

70% ethyl alcohol acts against vegetative bacteria, enveloped viruses (e.g. viruses causing influenza, hepatitis B and C, as well as AIDS), mycobacteria and fungi. On the other hand, it is not effective against nonenveloped viruses and spores (e.g. hepatitis A virus and rhinovirus), thus characterized as disinfectant and antiseptic substance, but without sterilizing properties.

Maniglia-Ferreira et al[24] found that the 2% chlorhexidine gel requires one minute for correct decontamination of GP cones. That same study, the authors found that liquid chlorhexidine requires s shorter time (15 seconds) for decontamination. Time for immersion in disinfectant solutions was one minute in the present study. Contamination was absent in the 18 GP cones studied.

The risk of cross-contamination and potential endodontic risk of manipulating contaminated GP cones are the rationale behind seeking effective disinfecting protocols aimed at eliminating microorganisms present in GP cones.

Ideally, cross-infection control procedures carried out by disinfection of GP cones should be a routine in the dental office. However, neither the literature, nor the results of the present study demonstrate the latter should be adopted.

Conclusion

The methods employed by the present study lead to the conclusion that there is no need for decontamination procedures regarding GP cones, even though aseptic protocols should be carried out throughout endodontic treatment.

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