EVALUATION OF DISINFECTION OF GUTTA-PERCHA CONES USING DIFFERENT CHEMICAL SOLUTIONS

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ABSTRACT

Background: Disinfection and sterilization of obturating materials in the root canal is necessary for the successful root canal therapy. Various disinfectants have been used to sterilize and disinfect gutta-percha including sodium hypochlorite (NaOCl), chlorohexidine (CHx), etc. Effectiveness of peracetic acid over NaOCl is documented in literature, but no study to date has shown the effect of peracetic acid disinfection on gutta-percha surface.

Aim: This study aims to evaluate and compare the efficacy of 3% NaOCl, 1% peracetic acid, 0.5% octenisept in disinfecting gutta-percha cones and to analyze surface alterations of gutta-percha cones after chemical disinfection.

Materials and Methods: One hundred and twenty gutta-percha cones were immersed in bacterial suspensions of Staphylococcus aureus and Escherichia coli for 5 min. Cones were then immersed in 3% NaOCl, 1% peracetic acid, 0.5% octenisept for 1 and 5 min. After disinfection, cones were incubated in Mueller Hinton Broth at 37°C for 7 days. Samples were observed at 24 h interval and those showing turbidity were subcultured. For morphologic evaluation, cones were immersed in disinfecting solutions for 1 and 5 min, dried on a paper pad for 10 min and analyzed under scanning electron microscope. Data was analyzed using Pearson Chi² square test.

Results: One percent of peracetic acid was found to be most effective disinfectant. Surface alterations were found in all the groups.

Conclusion: The outcome of this study confirmed the efficacy of 1% peracetic acid in the disinfection of gutta-percha cones.

KEYWORDS: Gutta-Percha Cones, Disinfection, Sodium Hypochlorite (NaOCl), Chlorohexidine, Staphylococcus Aureus.

INTRODUCTION - The primary objective of root canal therapy is to eliminate or reduce microorganisms in the root canal. This can be attained by following strict asepsis during endodontic therapy. Even though gutta-percha cones are manufactured under aseptic conditions, they can be contaminated by handling, aerosols, and during the storage process. Sodium hypochlorite (NaOCl) is a broad-spectrum antimicrobial agent. Various studies have shown the effectiveness of 5.25% NaOCl in eliminating most microorganisms. In a study, it was concluded that NaOCl and chlorhexidine used in gutta-percha decontamination, increase the surface free energy, promoting high interaction between gutta-percha/resilon and sealers. Lee evaluated the changes in tensile strength and elongation rate of gutta-percha cones after storage in...
NaOCl. Peracetic acid is a high-level disinfectant which has antibacterial, antifungal, sporicidal, and antiviral properties even at low concentrations. It is a powerful oxidizing agent which disintegrates into acetic acid and hydrogen peroxide, which will fall apart to oxygen, water, and carbon dioxide, leaving no residue. Its oxidation potential outranges that of chlorine and chlorine dioxide.

One percent of peracetic acid has been evaluated for calcium hydroxide removal from the root canals. The use of low concentration peracetic acid has also been recommended as an intracanal irrigant to remove the smear layer.

Octenidine dihydrochloride is a cationic surfactant and bis-decane derivative, used in concentrations of 0.1–2.0%. It is similar in its action to the quaternary ammonium compounds but is of somewhat broader spectrum of activity. Octenisept consists of octenidine dihydrochloride and 2-phenoxyethanol in 1:20 ratio. It is an antiseptic for skin burns, wound, and mouthrinses.

Currently, there is no study in the literature on changes in gutta-percha topography after peracetic acid and octenisept disinfection. Furthermore, there is no study which has compared these three disinfectants for gutta-percha disinfection. Hence, the aim of this investigation was to evaluate disinfection of gutta-percha cones and their surface alterations using 3% NaOCl, 1% peracetic acid, and 0.5% octenisept.

**MATERIALS AND METHODS**

One hundred and twenty gutta percha cones of size 70 (Dentsply, Maillefer) used in this study were divided into various groups depending upon the type of solution - 3% NaOCl (Asian Acrylates, Mumbai, Maharashtra, India), 1% peracetic acid (Leo Chemicals, Bengaluru, Karnataka, India), 0.5% octenisept (Leo Chemicals, Bengaluru, Karnataka, India), time of exposure to each solution (1 and 5 min) and type of microorganism (Escherichia coli and Staphylococcus aureus).

- **Group 1A**: 20 cones of gutta-percha were contaminated with *E. coli*. 10 cones were immersed in 3% NaOCl for 1 min and 10 cones for 5 min.
- **Group 1B**: 20 cones of gutta-percha were contaminated with *S. aureus*. 10 cones were immersed in 3% NaOCl for 1 min and 10 cones for 5 min.
- **Group 2A**: 20 cones were contaminated with *E. Coli*. 10 cones were immersed in 1% peracetic acid for 1 min and 10 cones for 5 min.
- **Group 2B**: 20 cones of gutta-percha were contaminated with *S. aureus*. 10 cones were immersed in 1% peracetic acid for 1 min and 10 cones for 5 min.
- **Group 3A**: 20 cones of gutta-percha were contaminated with *E. coli*. 10 cones were immersed in 0.5% octenisept for 1 min and 10 cones for 5 min.
- **Group 3B**: 20 cones of gutta-percha were contaminated with *S. aureus*. 10 cones were immersed in 0.5% octenisept for 1 min and 10 cones for 5 min.

Positive control: 6 gutta-percha cones contaminated with bacterial suspension and then immersed in sterile water. Negative control: 6 uncontaminated samples, immersed in the respective disinfectant solution for 1 min. After disinfecting, samples were incubated at 37°C for 7 days in test tubes containing Mueller Hinton Broth (10 ml). Test tubes were observed at 24 h interval. Samples showing turbidity were sub cultured to confirm bacterial colony. Pearson Chi-square test was used to analyze data. For evaluating effect of different
disinfectants on gutta-percha cone surface, they were immersed in the disinfectant solution for 1 and 5 min, dried on a paper pad for 10 min and analyzed by scanning electron microscope for surface topography at ×100 and ×500 magnification. Number of samples showing turbidity was analyzed using Chi-square test. A \( P < 0.05 \) was considered statistically significant.

### RESULTS

Positive control group showed turbidity while negative control group showed no growth. There was no statistically significant difference in the different groups contaminated with either \( E. \) coli or \( S. \) aureus for both 1 and 5 min except Octenisept. Octenisept was least effective for 1 min for \( E. \) coli group. None of the samples disinfected with peracetic acid showed turbidity. Gutta-percha samples disinfected with hypochlorite for 1 min for \( E. \) coli group showed turbidity in 2 of 10 tubes. Hence, 1% peracetic acid was found to be most effective followed by NaOCl. Octenisept was least effective in disinfection [Table 1]. Topographic examination of gutta-percha cones revealed surface changes and deposits after disinfection. All the samples had shown surface changes except control group. NaOCl disinfection had shown surface deposits after 1 min. Five minutes immersion showed cluster of crystals. Gutta-percha cones disinfected with peracetic acid had granular deposits. Octenisept disinfection showed no surface deposits, though surface irregularity was evident.

### DISCUSSION

Guttapercha cannot be sterilized by conventional methods because of its thermoplasticity. Hence, various chemical disinfectants such as alcohol, povidone iodine, NaOCl, and chlorhexidine, MTAD have been studied for its disinfection.\(^\text{12, 13}\) NaOCl has been widely used as an endodontic irrigant and has a sterilizing action on artificially contaminated cones. It is found to be effective in disinfecting the gutta-percha cones in different concentrations by many investigators.\(^\text{5, 14}\) Peracetic acid-based disinfectant is commonly used in the food industry, for water or sewage treatment, decontamination, and sterilization of thermosensitive medical and hospital equipment and devices. Peracetic acid is effective against bacteria, fungi, viruses and spores.\(^\text{8}\) It is not inactivated in the presence of organic material, does not leave residues and does not produce harmful byproduct. It releases free oxygen and hydroxyl radicals decomposing in oxygen, water, and acetic acid.\(^\text{15}\) In a study, 2% peracetic acid was found to be effective against the biofilms of microbes including \( \text{Bacillus subtilis} \) spores on gutta-percha cones at 1 min of exposure time.\(^\text{16}\) Octenidine dihydrochloride, a bipyridine antimicrobial compound, has been developed as an antiplaque agent for use in mouthrinses.\(^\text{17}\) It has been suggested as an alternative endodontic irrigant based on its antimicrobial effects and low cytotoxicity.\(^\text{18}\) This study, evaluated antimicrobial effect of chemical disinfectants against \( E. \) coli and \( S. \) aureus because in dental operatory the natural contamination of gutta-percha cones consists mainly of these vegetative bacterial cells rather than resistant microorganisms.\(^\text{19}\) As per the results of this study, 1% peracetic acid was most effective followed by NaOCl. Octenisept was least effective as most of the samples had shown turbidity. There was no statistically significant difference
between different groups except Octenisept 1 min disinfection which was least effective for *E. coli*. Statistically insignificant results in this study could be attributed to the small sample size. In a study, Sahinkesen *et al*. found, 5.25% NaOCl and 2% CHX to be more effective than octenisept for gutta-percha disinfection.\(^{20}\) Subha *et al*. found 1% peracetic acid to be more effective than 3% NaOCl in gutta-percha and resilon disinfection.\(^{21}\) Changes in the surface topography of gutta-percha were observed with all disinfectants as crystal deposits, granular deposits, or surface irregularity. Various studies have evaluated the effect of chloride crystals deposited on gutta-percha surface on its mechanical properties and different methods to remove such deposits.\(^{22,\ 23}\) However, no study in the literature evaluated the effect of peracetic acid and octenisept on gutta-percha topography. However, this study should be carried further to evaluate the effect of peracetic acid on mechanical properties of gutta-percha and obturation seal for clinical relevance.

**CONCLUSION**

Within the limitations of this study, it can be concluded that 1% peracetic acid is effective in rapid disinfection of gutta-percha. Gutta-percha surface topography changes with peracetic acid disinfection which should be evaluated in further studies.

**Table 1:** Comparison of disinfection with various disinfectants at different timings on gutta-percha: Percentage of samples showing turbidity.

<table>
<thead>
<tr>
<th>Subgroup Parameter</th>
<th>Microorganism</th>
<th>Escherichia coli (Group A)</th>
<th>Staphylococcus aureus (Group B)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>1 min</td>
<td>5 min</td>
</tr>
<tr>
<td>Group (n=120)</td>
<td>Disinfectant</td>
<td></td>
<td></td>
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<tr>
<td>Group 1 (n=40)</td>
<td>Hypochlorite</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Group 2 (n=40)</td>
<td>Peracetic acid</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Group 3 (n=40)</td>
<td>Octenisept</td>
<td>40</td>
<td>10</td>
</tr>
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REFERENCES


