Title: Current trends in use of intracanal medications in dental care facilities: questionnaire-based survey on training dental hygienists at educational institutions.

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Clinical Report

Current Trends in Use of Intracanal Medications in Dental Care Facilities: Questionnaire-based Survey on Training Dental Hygienists at Educational Institutions

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Abstract

The success of root canal therapy is dependent not only on removal of infected pulp (pulpectomy) followed by root canal enlargement, but also on the pharmacological effects of intracanal medications. Various intracanal medications are used. Formaldehyde preparations such as formocresol were common in the past, but these are no longer used in Europe or the US due to the biological toxicity of formaldehyde. In this study, a questionnaire was used to determine current trends in the use of intracanal medications at dental care facilities where dental hygiene students undergo practical training. The questionnaire comprised questions regarding the types of frequently used intracanal medications and their methods of application at dental care facilities in Saitama and Shizuoka prefectures. The results indicated that calcium hydroxide preparations were more commonly used in Europe or the US. However, these results also revealed that formaldehyde preparations were frequently used, which slightly differs from the scenario in Europe and the US. This study revealed that multiple intracanal medications were used for root canal therapy. Furthermore, it was also observed that cotton plugs were generally used as applicator tips for intracanal medications, whereas the use of absorbent paper points was relatively uncommon. The results suggest that the cost of absorbent paper points needs to be reduced.

Key words: Intracanal medications — Dental care facilities — Questionnaire

Introduction

Successful root canal therapy requires cleaning and disinfection of the root canal after sufficient canal preparation and obturation. Root canal preparation involves the
removal of most pulp tissue remnants and infected material; however, a small amount of dental pulp debris and bacteria remains in cases of abnormal root morphology or when there are many lateral canals. Not all bacteria can be removed, and pulp tissue remnants and bacteria can invade the dentin even if the root canal is prepared with the utmost caution. One report suggested that no cleaning effect is exerted on the root canal wall because it is protected by a smear layer. Root canal therapy is thus dependent on the pharmacological effects of intracanal medications in addition to adequate canal preparation.

One criterion for the selection of an intracanal medication is its disinfectant effect, while another is its analgesic/sedating effect. Formaldehyde and phenolic preparations are widely used as intracanal medications; however, there has been a decreasing trend in the use of formaldehyde preparations ever since the biological toxicity of formaldehyde was confirmed.

Calcium hydroxide preparations offer an alternative to formaldehyde preparations. They have commonly been used for direct pulp capping or root canal filling for a long time as their strong alkalinity exerts an antibacterial effect. In addition, their use as a selective drug to treat persistent apical periodontitis has also been emphasized.

However, few studies have investigated trends in the use of intracanal medications at dental care facilities. In particular, few reports have investigated the type of intracanal medications used. Moreover, to our knowledge, no studies have investigated how such medication is applied. Therefore, the aim of this study was to investigate the clinical application of intracanal medications at dental care facilities where dental hygiene students undergo practical training.

Materials and Methods

Aspiring dental hygienists who had completed their clinical training at dental care facilities in Saitama and Shizuoka prefectures were included. An anonymous questionnaire was administered to the participants. Investigations were performed in 2009 and 2010, and 94 students were targeted. The number of practice facilities surveyed was 22 in 2009 and 23 in 2010; the number of surveyed facilities varied each year. Moreover, this questionnaire was also answered by individual dentists who had supervised the training. The results were then added together, as multiple dentists were present at some facilities and instructing dentists changed annually at some facilities. The questionnaire comprised questions concerning the following issues: 1) type of frequently used intracanal medication; and 2) method of application by individual instructing dentists at dental care facilities where practical training was being conducted. The survey was conducted in accordance with the provisions of the Ethics Committee of each institute.

Results

Eighty-one responses were received (response ratio, 82.6%). As specifically listed in Table 1, the number of respondents was 25 in 2009 and 56 in 2010. However, the sample sizes were 50 for 2009 and 56 for 2010 (Table 2); this was because in 2009, some students were receiving practical training at

<table>
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<th>Table 1 Questions</th>
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<tr>
<td>Q1 What was intracanal medication most frequently used?</td>
</tr>
<tr>
<td>a. Calcium hydroxide</td>
</tr>
<tr>
<td>b. Paraformaldehyde (Periodon®)</td>
</tr>
<tr>
<td>c. Formocresol (FC)</td>
</tr>
<tr>
<td>d. Formalin Guaiacol (FG)</td>
</tr>
<tr>
<td>e. Creodont®</td>
</tr>
<tr>
<td>f. Methocol®</td>
</tr>
<tr>
<td>g. Other (Specific name)</td>
</tr>
<tr>
<td>Q2 What was method of this application?</td>
</tr>
<tr>
<td>a. Cotton plug</td>
</tr>
<tr>
<td>b. Paper point</td>
</tr>
<tr>
<td>c. Other</td>
</tr>
</tbody>
</table>
Current Trends in Intracanal Medications

more than one institute. Moreover, as this study conducted a simple comparison of type of frequently used intracanal medication (disinfectant) and its method of application to the root canal, the results were not divided by the year in which the survey was conducted. The number of responses in 2009 and 2010 were totaled and displayed as percentages of the entire sample.

The results of the questionnaire were as follows.

1. **Frequently used intracanal medication/disinfectant** (Fig. 1)

The most frequently used intracanal medications included calcium hydroxide preparations (87.7%), followed by paraformaldehyde preparations (Periodon®, 74.5%; formocresol, 71.7%; formalin guaiacol, 65.1%), and phenolic preparations (Creodon® and Methocol®, 53.8%).

### Table 2 Number of samples

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of samples</th>
</tr>
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<tr>
<td>2009</td>
<td>50</td>
</tr>
<tr>
<td>2010</td>
<td>56</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
</tr>
</tbody>
</table>

2. **Method of application** (Fig. 2)

Intracanal medication was most frequently applied using cotton plugs (77.4%). Absorbent paper points were used by 13.2% of respondents, while other applicators were used by 9.4% respondents. The combined use of cotton plugs and paper points was also reported, as was the use of a spiral filler (Lentulo®).

### Discussion

1. **Intracanal medicament**

The most frequently used intracanal medications were calcium hydroxide preparations...
(87.7%), followed by paraformaldehyde preparations (Periodon®, 74.5%; formocresol, 71.7%; formalin guaiacol, 65.1%), and phenolic preparations (Creodon® and Methocol®, 53.8%). The rate of use of formaldehyde preparations was high. A questionnaire concerning the use of intracanal medications by 738 American endodontists showed that the usage rate for calcium hydroxide preparations was extremely high at 90.0%. Compared to this, the usage rate for formaldehyde preparations here was low at 13.2%. Another questionnaire administered to the endodontic departments of 212 dental universities in 35 countries in Europe showed that 95.7% of respondents used calcium hydroxide preparations as an intracanal medication, whereas only 3.2% used formocresol.

Many types of disinfectant can be clinically applied during endodontic treatment. Formalin cresol (Buckley, 1904) and PBSC paste (Grossman, 1951) were commonly used in the past. Usually, intracanal medications are developed to function as strong disinfectants. However, emphasis has recently been placed on the development of nonirritant medications to promote host comfort and avoid possible detrimental effects on the surrounding tissues. One advantage of formaldehyde preparations is that they function as a gaseous dressing, because of which the deeper portions of complex root canals are also disinfected. On the other hand, it has been reported that this gas irritates normal periapical tissue and is distributed throughout the entire body without being localized. Ever since the biological toxicity of formaldehyde has been emphasized, including its association with conditions such as sick house syndrome and carcinogenicity, the use of formaldehyde-based intracanal dressings has decreased in Europe and the US. However, the present investigation revealed that formaldehyde preparations were still commonly used (65–75% of dental practices). In particular, paraformaldehyde preparations are used to induce coagulative necrosis in pulp remnants after pulpectomy, suggesting that it is difficult to secure sufficient treatment time for this procedure.

Calcium hydroxide has been applied to root canals for various purposes such as the apexification of immature teeth and sealing of perforated canals. However, it is a strongly alkaline preparation with a pH value of 12.4 and high antibacterial activity. Recently, its use as an intracanal medication has increased. In addition, calcium hydroxide is suggested to be useful for destroying anaerobic bacteria, which are frequently detected in highly-infected root canals. Taken together, the use of formaldehyde preparations as intracanal medications has decreased, while the use of calcium hydroxide for the same purpose has increased in Europe and the US. The results of this investigation show that the same concept is gaining momentum at Japanese dental institutions.

Phenol preparations such as Creodon® and Methocol® were used by 53.8% of respondents, and these were apparently applied with the expectation of achieving analgesic/sedative effects in cases where pain was present or was likely to develop.

The idea of single-visit endodontic treatment is becoming mainstream in Europe and the US, even for infected root canals. In Japan, although the idea of single-visit endodontic treatment is acknowledged, dentists prefer to thoroughly sterilize infected root canals over multiple visits with the aim of reducing the possibility of infection following a pulpectomy, a trend which was observed in the present study also.

2. Application of intracanal medication

The results of this investigation showed that cotton plugs were most frequently used to apply intracanal medications (77.4%), whereas absorbent paper points were used at a low rate (13.2%). The use of paper points is very common in Europe and the US. In comparison to this, the lower rate of 13.2% for use of paper points in this study appears to reflect concerns regarding medical costs.

Endodontic treatment commonly involves antisepsis; therefore, the instruments used have to be sterilized. In addition, rubber dam
isolation of the tooth being treated is essential to avoid salivary contamination. However, there are reports that this technique is less frequently used in Japan.\(^{23}\) Japanese dental care focuses on a decrease in treatment costs and shorter treatment periods. Therefore, it appears that in future the cost of absorbent paper points needs to be reduced.

**Conclusion**

This investigation showed that intracanal medications used during endodontic treatment varied among dental care facilities. Calcium hydroxide preparations were the most frequently used, followed by formaldehyde preparations. Although the usefulness of calcium hydroxide preparations is widely recognized at dental care institutions where dental hygiene students undergo practical training, this study confirmed that formaldehyde preparations are still frequently used. In addition, the use of cotton plugs for the application of intracanal medications remains common.

The results suggest that the cost of absorbent paper points needs to be reduced.

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