Evaluation of Periapical Leakage of Root Canal Filling Material during Re-Treatment Procedure; an in-Vitro Experimental Study

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Abstract

Background: Re-root canal treatment remains the first choice of treatment in failed root canal treatments. Most of the dental practitioners prefer and employ softening of root canal filling material for the procedure without knowing the basic knowledge of their properties. To soften the root canal filling material, most commonly used material is chloroform which is cytotoxic and a potential carcinogen. Softened material due to its increased flow extrudes from apical foramen of a tooth which was evaluated through this study.

Objectives: This in-vitro experiment was performed to confirm the extrusion of softened material through apical foramen of a tooth which was evaluated through this study.

Materials and methods: Single rooted mandibular premolar teeth (n= 40) extracted for orthodontic treatment without any marked curvature (≤ 15º), without internal or external resorption were selected. Root canal treatment performed in all the specimens and incubated for 30 days in 100% humidity at 37°C. Randomly allocated specimens into two groups (n=20) went through the process of re-root canal treatment. Gutta Percha was removed with Hedstrom files with and without chloroform for each group and the extrusion of softened material through apical foramen was observed.

Results: Frequency of the material extruded for both the protocols tested for group A was 25% and for group B was 0%. Fissure Exact test applied for the nominal variable (extrusion) for both groups by keeping the p value (0.05) through SPSS version 16. A significant result was obtained through statistical test.

Conclusion: Softening agent causes extrusion of material through periapical foramen.

Key words: Chloroform, Dental Material, Hedstrom files, Periapical leakage, Re-treatment, Softening agent.

Introduction

Failure of root canal treatment (RCT) is mainly due to insufficient cleaning of root canals, inappropriate obturation (sealing) and leakage from crown of the tooth.1 Successful re-treatment requires removal of all the filled material and debridement of the canals from any potential necrotic tissue or bacteria. Complications encountered during the procedures include paresthesia due to leakage of filling material from the apical area, orofacial swellings and emphysema which occur due to introduction of air in peri-apical area and local tissue necrosis.2 Extrusion of routinely used disinfectant sodium hypochlorite (NaOCl) in peri-apical area produces severe ailments which is much lighter than chloroform.2 Aim of endodontic treatment is maintenance of functions of a tooth.3 Reduction of infection to minimum with periapical healing is the criteria for evaluation of an endodontic successful...
Causes of periapical pathosis are mainly of two types: one is exogenously introduced into the root canal system from outside. It may be a contamination through oral fluids, instruments or even through the products used to treat or debride the root canal system. Re-treatment not only depends upon the tooth structure and variations but skills of the operator. Studies show that 25–35% endodontically treated teeth show periapical radiolucency. Secondly, a variety of pulp tissue irritating agents including hydrogen peroxide, alcohol and chloroform are in use as a part of contemporary dental practice. Majority of these materials are lacking any biocompatibility and are toxic in nature thus by understanding the properties of dental materials one should be benefitted and can save others too. Chloroform, although an excellent solvent, is highly toxic and has carcinogenic potential; its clinical use has been prohibited in humans’ since 1976. Under the Proposed Guidelines for Carcinogen Risk Assessment (U.S. EPA, 1996; U.S. EPA, 1999), chloroform is likely to be carcinogenic to humans by all routes of exposure and high-exposure leads to cytotoxicity and regenerative hyperplasia in susceptible tissues.

Aim of this observational experiment is to evaluate the extrusion of softened root canal material through apical foramina of specimens, softened with and without chloroform by using H files. No such study was found in literature specially designed to address this issue which leads to failure of treatment and putting patient in a worse position than before.

**Material and Methods**

Single rooted teeth 40 in numbers, without any marked curvature (≤ 15°), without internal or external resorption, extracted mandibular premolar teeth which were extracted for orthodontic treatment protocol were selected. Some specimens were obtained from the patients who extracted their teeth by their own will due to time and expenses restraints for proper treatment. Specimens were collected from different dental care units of Peshawar and Islamabad including own practices. All the specimens were collected in closed plastic containers having 2.5% NaOCl solution.

**Sterilization of specimens:** Specimens were kept in 2.5% NaOCl solution for a week and then after cleaning and washing with normal saline they were sterilized by autoclave at 121°C for 30 minutes.

**Inclusion of specimens:** Teeth were evaluated radiographically for internal resorption, single root canals, and fully formed apices. Specimens selected were forty in number (20 in each group) for the experiment. To address the confounders due to anomalies in the crown of the tooth all the teeth were decoronated.

**Procedure:** All the specimens were treated endodontically through a standard protocol using crown down procedure. All the specimens were kept in an incubator for a period of 30 days at 37°C in 100% humidity.

**Randomization:** Specimens were randomly divided into two groups as group A and group B through masking. Masking was established through keeping the specimens in envelops which were stored in a container in such a way that only the ends of envelops were visible to the person performing the process of randomization.

**Control of confounders:** Root canal filling material from the tooth during re- RCT if allowed to spill at the area under the fixed tooth was a potential confounder of this study. This was controlled by the use of rubber dam to fix the tooth in it, in order to prevent the spillage of material over the coronal area. Thus the only the material which now comes through apical foramen will be present at the tissue which was placed under the tooth.

**Re-root canal treatment and evaluation of extrusion of material through apical foramina of specimens:** All the specimens were fixed in a rubber dam (Figure 1).

**Figure 1: Rubber dam for placement of tooth**

Teeth of group A were fixed in a fixed vice, temporary filling was removed and a drop of chloroform was introduced in the specimen by a disposable syringe of 5 ml in which chloroform was filled up to 2 ml. An H file of #30 was then introduced into the root canal and manipulated in an up and down motion till it felt resistance. Another drop of chloroform was introduced in to the specimen and again H file was used to
remove the GP points. Material extrusion out of the apical foramen was noted by placing a white tissue paper under the tooth fixed in vice. When it reached near the apical portion of the root canal a close observation was kept on the apical foramen and the white color tissue paper which was placed under the working area of fixed tooth (Figure 2) and noted in tabulated form. Same process was performed with the specimens of group B without using chloroform and observations recorded.

Statistical analysis: Data was entered and analyzed on SPSS version 16. Frequencies were calculated and Fisher Exact test was employed for statistical significance between two groups. P value of $\leq 0.05$ was considered as statistically significant value.

Figure 2: Fixation of tooth in a fixed vice and position of white tissue paper underneath

Results

Among total of 40 samples (20 each group), frequency of the material extruded was different for both the protocols tested; for group A it was 25% and for group B it was 0%. Fissure exact test showed a significant difference between 2 groups with p value of 0.04 (Table 1).

<table>
<thead>
<tr>
<th>Table 1: Frequency of Extrusion in Two Groups</th>
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<tbody>
<tr>
<td>Extrusion</td>
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<tr>
<td>Treatment with</td>
</tr>
<tr>
<td>Chloroform (n 20)</td>
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<td>H files alone (n 20)</td>
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Discussion

Results from the present in vitro study confirmed that there were more chances of periapical extrusion of materials through apical foramina when chloroform was used. Results of this study were found to be consistent with other studies.\(^{10}\) Extrusion of material in periapical tissues causes flare-ups in endodontically treated teeth.\(^{11}\) More apical extrusion was reported in a comparative study for pro taper when compared with manual instruments which demonstrated the effectiveness of H files in removal of root canal filling material and this is in accordance with the present study.\(^{12}\) Apical extrusion with softening agents was found more in a comparative study with rotary instruments and hand instruments. For softening eucalyptol 0.1ml was used which also indicates avoidance from chloroform even in experimental studies.\(^{13}\) Thus confirmation of both the aspects discussed in the current study was obvious.

Different instruments and techniques were reported in literature regarding the removal of gutta percha and sealers. Heated instruments (thermal), Hedstrom files, Gates Glidden drills, rotary instruments (mechanical) and solvents (chemical) in combination with mechanical instrumentations or a combination of all these also shows lack of guidelines for removal of gutta percha even in the most developed countries.\(^{14}\) Repetition of studies for better techniques and instrument for removal of gp points and sealers supports the lack of material on the issue of confirmed protocol for removal of filled material in a root canal system.\(^{15}\)

Most effective instrument for the removal of GP points was found to be H files.\(^{16}\) The H-files without any aid were found to be the best when compared with other devices as documented by another study in which five different devices and techniques were compared with a sample size of one hundred and twenty specimens.\(^{17}\) This provides a strong support for this study.

Moreover large amounts of chloroform can cause sores when chloroform comes in direct contact with skin.\(^{18}\) Chloroform, although an excellent solvent, is highly toxic and has carcinogen potential; its clinical use has been prohibited in human since 1976.\(^{19}\) Under the Proposed Guidelines for Carcinogen Risk Assessment, chloroform is likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissue.\(^{13}\) Substances placed in the tooth pulp chamber have access to periapical tissue and the circulatory system, and has been reported by researchers.\(^{20}\)

The theory that sustained cell proliferation to replace cells killed by toxicity, viral, or other insults such as physical abrasion of tissues can be a significant risk
factor for cancer is plausible and generally accepted.²¹ Chloroform used in root canals can illicit such reactions at any stage of treatment.¹ That is how science of dental materials serves.

**Conclusion**

Within the limitations of this study softened root canal material extrusion is evident and significant than non-softened material.

**Recommendations:** Further trials with modern equipment and techniques are recommended to ascertain the extrusion of material in a more natural way.

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**Conflict of interest**

This study has no conflict of interest as declared by any author.

**References**
