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Research Report

Root canal cleanliness between mangosteen peel extract irrigant and NaOCl 2.5%

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ABSTRACT

Background: *Preparation, one of the stages in root canal treatment, always produces debris as a result of instrumentation on root canal walls. Debris consists of organic and inorganic materials. Irrigation need to be performed in every preparation so that debris and microorganisms can be removed from root canal walls through flushing mechanism. NaOCl 2.5% is the most popular irrigant used in root canal treatment. However, NaOCl 2.5% only works on organic tissue. Mangosteen peel extract contains various active compounds, such as saponin. Saponin acts as surfactant so as to lower the surface tension and remove debris from the root canal walls.* ***Purpose:*** *to compare the cleanliness of root canal walls following irrigation with NaOCl 2.5% and mangosteen peel extract.* ***Methods:*** *Eighteen mandible premolar extracted for orthodontics necessity were used in this study. The teeth were divided into three groups, in which each group consists of six teeth. All of them were instrumented with ProTaper for Hand Use and irrigated. Group 1 used aquadest as irrigant, group 2 used NaOCl 2.5%, and group 3 used mangosteen peel extract 400 ug/ml. The roots were split longitudinally into halves and in 1/3 of apex. The surface of the canal walls were examined using scanning electron microscope. Photomicrographs were scored by three independent observers and statistically tested.* ***Results:*** *There were significant differences between three groups ($p<0.05$). Group 3, irrigated with mangosteen peel extract 400 ug/ml, had the smallest median score.* ***Conclusion****: Mangosteen peel extract is more effective than NaOCl 2.5% in cleaning root canal wall from debris.*

Keyword*: root canal; irrigation; mangosteen peel extract; sodium hypochlorite; debris*

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INTRODUCTION

Preparation is one of the most important stage in root canal treatment, which aims to clear the root canal from necrotic tissue, vital tissue, infected dentin, and conditioned the root canal wall before obturation.[1,2] Endodontic devices that rub against the root canal wall can form layers of debris containing organic and inorganic particles, such as necrotic tissue, dentin, pulp tissue residue, odontoblast residue, and microorganisms.[3,4] Debris that is left behind will protect the biofilm attached to the root canal wall, a good place for bacterial growth, reducing the attachment of the root canal filling material to the dentine and may cause microleakage.[3,5]

Irrigation measures must be taken in every root canal preparation, with the aim of removing debris and microorganisms from the root canal through flushing mechanism.[6] The ideal irrigation material should have the ability to dissolve the smear layer, be antibacterial, non-carcinogenic, non-toxic, non-antigenic, have no side effects on dentin or do not affect the sealing of the filler, economical price, easy to use, and do not cause tooth discoloration.[4]

One of the most common irrigation materials used in the root canal is NaOCl 2.5%. However, the main drawback of this solution is its ability to only work in organic tissue so that it cannot clean the root canals thoroughly. Other deficiencies, which are cytotoxic and destructive when in contact with vital soft tissue, cause changes in the characteristics of dentin, odor and discomfort, corrosive to metal objects.[4,6]

Currently, natural products are often used again because they are generally safer and have fewer side effects.[7] The use of herbal products is also widely used in endodontics, such as root canal irrigation. This is because herbal alternatives are easily available, inexpensive, retain better shelf life, and low toxicity.[8]

Mangosteen (*Garcinia mangostana* Linn) is a fruit plant that grows and spread in Indonesia. Mangosteen peel extract

has various pharmacological activities because it contains various active compounds, such as saponins, steroids / triterpenoids, xanthones, flavonoids, tannins, alkaloids.[9]

Saponins are natural detergents.[10] This compound has properties as a surfactant so as to lower the surface tension from the root canal wall and dissolve impurities.[11] Based on research conducted by Ramayanti, the effective concentration of mangosteen peel extract to clean the root canal wall is 400 ug/ml.[12] Based on this background, the authors wanted to compare mangosteen peel extract with 2.5% NaOCl against cleanliness of the root canal wall.

MATERIALS AND METHODS

Mangosteen peel was obtained from Materia Medica, Batu, Malang, which was dried for ± 3 days. Mangosteen peel extraction was done by maceration method using ethanol 96%. After that, screening was performed. The filtrate formed was concentrated by using an evaporator to obtain crude mangosteen peel extract which was thick brown in color. The extract was diluted with aquadest to obtain 400 ug / ml mangosteen peel extract.

Dilution of NaOCl solution is done by adding 100 ml *aquadest* to 100 ml of 5% NaOCl solution so that it is obtained 2.5% NaOCl solution, as much as 200 ml. There were 18 mandible premolar extracted for orthodontics in this study. Then the sample soaked in saline solution and divided into 3 groups, in which each groups consists of 6 samples.

Making access opening was performed by using endo access bur. The working length of a tooth is determined by measuring the tooth length minus 1 mm. All samples were prepared by using crown-down pressureless technique using ProTapper for Hand Use up to F3 and irrigation techniques using tools that have been designed in such a way with Maxi-Probe needle No. 28

At each change instrument, 3 ml root canal was irrigated with a pressure 1 atm. Group I, the irrigation material used was aquadest, group II used NaOCl 2.5%, while group III used mangosteen peel extract 400 ug/ml. After that, the root canals were dried with paper points 3 times and covered with temporary lifts.

The cutting of a sample was conducted by making a crust first at buccal and lingual teeth used a diamond bur. The sample was split into two parts by using chisels and mallets, then cutting was performed in 1/3 of apical (4 mm from the apex). The sample that had been cut was given a code, placed in the sample holder, and coated gold. Observations were made by using a Scanning Electron Microscope (SEM) with 1000x magnification.

Evaluation of photomicrographs is carried out with transparent plastic (size 16 cm x 12 cm) which have been divided into 768 small boxes. The assessment was carried out by 3 different observers, who had previously agreed on how to score for each photo. Each small box where debris that found counted, and propagated by the total number of small boxes. The results obtained in the form of a percentage are then converted to a score form. The score used for debris evaluation was as follows:[13] score 1: little or no debris covering <25% of the specimen; score 2: little or moderate debris that covers 25-50% of the specimen; score 3: moderate or many debris covering 50-75% of the specimen; score 4: lots of debris covering >75% of the specimen.

To know the validity of the study data was used Friedman test. Overall group differences can be known by the Kruskal-Wallis test, while Mann-Whitney test to determine the pairwise differences of each group. The control median test was to find out the median of each study group.

RESULTS

The results of sample observations using SEM can be seen in Figure 1. The results of Friedman test for the group aquadest, NaOCl 2.5%, and mangosteen peel extract each were 0.607, 0.223, and 0.368. The three values were greater than 0.05 ($p > 0.05$), indicate there was no significant difference between three observers thus the data was valid.

Kruskal-Wallis test gave a result 0.001 ($p < 0.05$), which means that there were significant differences between the

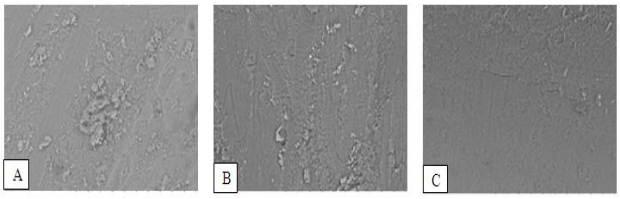

Figure 1. SEM photoshoot with 1000x magnification. (A) Root canal wall surfaces irrigated with aquadest, (B) root canal wall surfaces irrigated with 2.5% NaOCl, and (C) root canal wall surfaces irrigated with mangosteen peel extract 400 ug / ml.

Table 1. The results of Mann-Whitney test

Treatment	Aquadest	NaOCl 2.5%	Mangoosteen peel extract
Aquadest		P=0.021	P=0.002
NaOCl 2.5%			P=0.001
Mangosteen peel extract			

Table 2. The results of the median control test

Group	Median
Aquadest	3
NaOCl 2.5%	2
Mangosteen peel extract	1

three study groups. The results of Mann-Whitney test can be seen in Table 1. All values shown in Table 1 were less than 0.05 ($p < 0.05$). This showed that there were significant differences between each group, such as aquadest compared to 2.5% NaOCl, aquadest compared to mangosteen peel extract, and 2.5% NaOCl compared to mangosteen peel extract.

From the results of the median control test that can be seen in Table 2, it showed that mangosteen peel extract has a median score 1, which is the smallest value compared to other study groups. This means that 400 ug / ml mangosteen peel extract gives the best results in cleaning the root canal wall compared to other groups.

DISCUSSION

Root canal cleanliness is a state of debris on the surface of a root canal wall. If debris is found in the root canal wall less, then the root canal is in a sense increasingly clean. The opposite is true. Debris on the surface of the root canal wall can consist of organic and inorganic materials, such as the remaining pulp tissue and dentin.

In the sample group irrigated with mangosteen peel extract, debris was found to be little or almost none. One of the active compounds in mangosteen peel extract that plays a part in cleaning the root canal is saponin because of its surfactant ability.

Saponin has two components, namely the hydrophilic component (in the form of a sugar group) which is easily soluble in water and the hydrophobic component (in the form of a steroid or triterpenoid) which is easily soluble in oil or impurities. The existence of these two components makes saponin able to be adsorbed at different interface surfaces, thereby reducing surface tension and allowing the formation of emulsions.[10]

The saponin acts in cleaning the root canal wall from debris, that is the hydrophilic part of the saponin will interact with water, while the hydrophobic part will bind with debris. The surfactant molecules can interact and form a structure called a misele. In this structure, the hydrophilic head part leads out and the hydrophobic tail part leads into the center of the misele so that the debris appears to be encased in a collection of surfactant molecules, which then can dissolves in water. The hydrophobic part of the saponin converts debris into smaller particles making it easier to form an emulsion with water. The hydrophilic part is dissolved in water, forming foam, binding particles to form an emulsion.[11]

Saponin can lower surface tension so that debris in the form of organic or inorganic materials can be separated from the root canal wall and dissolve in water. Through the flow back and forth or the flushing mechanism from the irrigation action, the debris can be removed from the root canal.

The group irrigated with 2.5% NaOCl, debris was still found in significant amounts on the surface in the root canal wall. NaOCl 2.5% only works in organic tissue by reacting with fatty acids and amino acids. Saponification reaction of 2.5% NaOCl will degrade fatty acids into fatty acid salts (soap) and glycerol (alcohol) thereby reducing surface tension. The neutralization reaction 2.5% NaOCl will convert amino acids into water and salt. In addition, 2.5% NaOCl also contains a component of HOCl, which if in contact with amino acids will produce water and chloramine, which can cause interference with cells.[14]

In this study, the sample used was non-vital teeth that were still intact so that most debris in the root canal wall were inorganic tissue derived from dentin. NaOCl 2.5% can dissolve collagen components from dentine of root canals and other organic pulp tissue, but cannot dissolve inorganic tissue. Therefore, 2.5% NaOCl can only clean the root canal from organic debris, but cannot completely clean debris.

The irrigated aquadest group, the root canal wall surface was dirtiest compared to the other groups. This is because aquadest does not have the ability as a surfactant so it is not able to dissolve debris in the root canal wall. In this case, the ability to aquadest clean the root canal is limited to the mechanical effect of the irrigation action itself, namely the flow back and forth.

CONCLUSION

The conclusion of the results study is that mangosteen peel extract can clean the root canal walls from debris better than 2.5% NaOCl.

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