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Original Research

Determination of chelating ability of chitosan in different acids

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***ABSTRACT*:**

Background: Chitosan is a natural substance recognized for its properties of biocompatibility and biodegradability. The present study was conducted to determine chelating ability of chitosan in different acids. **Materials & Methods:** The present study was conducted on 20 freshly extracted non carious periodontally weak mandibular central incisors. Teeth were sectioned 3dentin slices of 1 mm of thickness each were obtained. The 0.2% chitosan solutions were distributed to 4 groups. Dentin microhardness was evaluated in each solution. **Results:** In group I, specimens were solubilized in 1% acetic acid, group II were solubilized in 3.3% citric acid, group III were solubilized in 0.00145% hydrochloric acid, and group IV were solubilized in distilled water (control). The ability to reduce dentin microhardness of the solutions were 42.5 in group I, 53.1 in group II, 57.2 in group III and 88.7 in group IV. The difference was significant (P< 0.05). **Conclusion:** Authors concluded that chitosan solubilized in acetic acid, followed by chitosan in citric acid, provided a greater reducing effect compared to distilled water.

Key words: Acids, chitosan, Citric acid

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INTRODUCTION

The objective of cleaning the root canal system is to eradicate aggressive and irritating agents such as microorganisms, their products and vital and necrotic pulp tissue remnants. Endodontic instrumentation, using manual or mechanized techniques, produces smear layer on the root canal walls and smear plugs into dentinal tubules.[1]

Eick et al[2] in 1970 first reported the presence of a smear layer as made up of particles of size from 0.5 to 1.5 µm achieving an overall thickness of 2-5 µm. A systematic review and meta-analysis of leakage studies concluded that the removal of the smear layer improves the fluid tight seal of the root canal system.

Chitosan is a natural substance recognized for its properties of biocompatibility, biodegradability, bioadhesion, and nontoxicity to the human cell.[3] It is obtained by the deacetylation of chitin, a substance extracted from crustacean shells such as crab and shrimp. After cellulose, it is the most abundant substance in nature, making its use ecologically interesting. It also presents low cost, in addition to a high chelating capacity for different metallic ions.[4] Chitosan presents remarkable chelating ability for several metal ions. The studies specifically directed to the chelation of calcium ions showed that chitosan removes the smear layer from the walls of the root canal similar to ethylenediamine tetraacetic acid (EDTA) and citric acid, but without promoting erosion of the root dentin.[5] The present study was conducted to determine chelating ability of chitosan in different acids.

MATERIALS & METHODS

The present study was conducted in the department of Endodontics. It comprised of 20 freshly extracted non carious periodontally weak mandibular central incisors.

Teeth were sectioned 3dentin slices of 1 mm of thickness each were obtained from the cervical third. The first slice was discarded, and the cervical surface of the second and

third slices was polished with 400-, 500-, and 600-grit wet sandpaper. Each slice was divided into 2quadrants, using a scalpel blade and the visual aid of a magnifying glass; thus obtaining 4 specimens per tooth, which were treated with 50 µL of solution for 5 minutes.

The 0.2% chitosan solutions were distributed to 4 groups. In group I were solubilized in 1% acetic acid, group II were solubilized in 3.3% citric acid, group III were solubilized in 0.00145% hydrochloric acid, and group IV were solubilized in distilled water (control). The specimen was rinsed in distilled water, dried with gauze, and subjected to the Knoop microhardness tester. Dentin microhardness was evaluated in each solution. Results were tabulated and subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of specimens

Groups	Group I	Group II	Group III	Group IV
Agent	1% acetic acid	3.3% citric acid	0.00145% HCL	distilled water

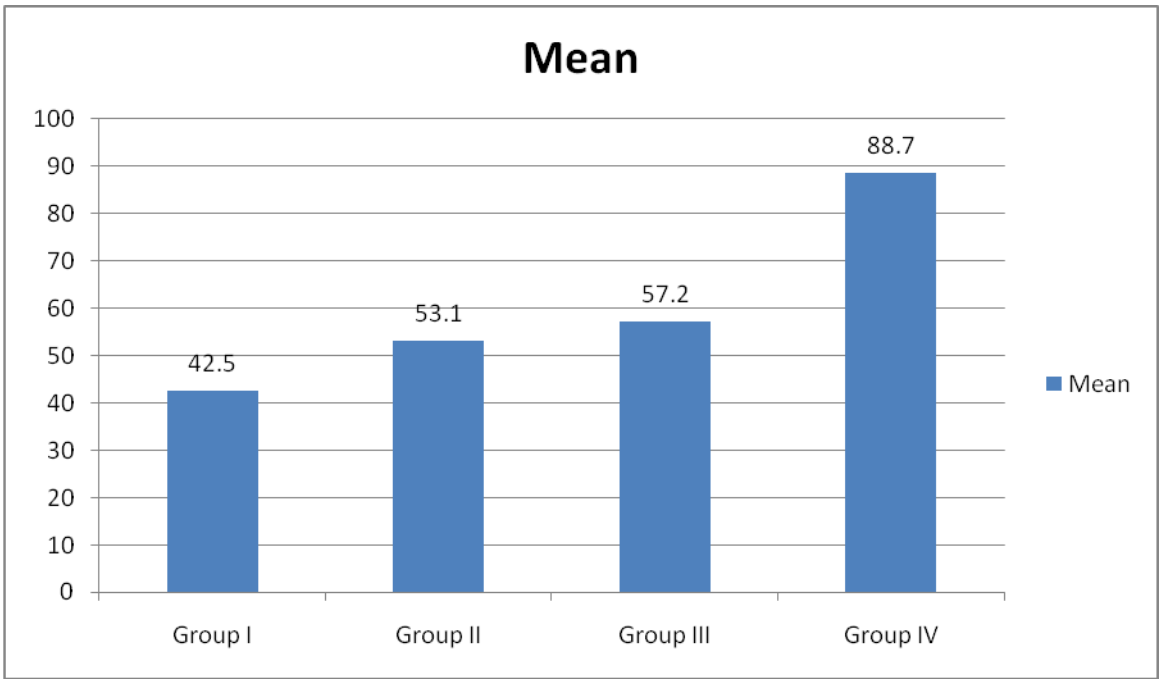
Table I shows that in group I, specimens were solubilized in 1% acetic acid, group II were solubilized in 3.3% citric acid, group III were solubilized in 0.00145% hydrochloric acid, and group IV were solubilized in distilled water (control).

Table II Evaluation of dentin microhardness

Group	Mean	P value
Group I	42.5	0.021
Group II	53.1	
Group III	57.2	
Group IV	88.7	

Table II, graph I shows that the ability to reduce dentin microhardness of the solutions were 42.5 in group I, 53.1 in group II, 57.2 in group III and 88.7 in group IV. The difference was significant (P< 0.05).

Graph I Dentin microhardness



DISCUSSION

The efficiency of the chelating agent depends on not only its concentration and application time but also the volume of solution available. The concentration of the solution was based on previous work, which showed that 0.2% chitosan completely removes the smear layer from the dentin walls, promotes unobstructed tubules, without causing erosion of peritubular dentin. 0.2% chitosan reduces dentin microhardness similar to 15% EDTA solution. The previous studies provided the basis for the hypothesis that the chitosan solution could be a very feasible substitute for EDTA since this acid attacks the periapical tissues, besides being considered a pollutant to the environment.[6] The present study was conducted to determine chelating ability of chitosan in different acids.

We included 20 freshly extracted non carious periodontally weak mandibular central incisors. in group I, specimens were solubilized in 1% acetic acid, group II were solubilized in 3.3% citric acid, group III were solubilized in 0.00145% hydrochloric acid, and group IV were solubilized in distilled water (control).

Silva et al[7] conducted a study in which the effect of solutions of 0.2% chitosan, 15% EDTA and 10% citric acid on the microhardness of root dentin was evaluated. The other 3 roots had the canals instrumented and irrigated at the end of the biomechanical preparation with the test solutions, and then examined by scanning electron microscopy (SEM) for qualitative analysis. All solutions reduced the microhardness of root dentin in a way that was statistically similar to each other ($p>0.05$) but significantly different from the control ($p>0.05$). The SEM micrographs showed that the three solutions removed smear layer from the middle third of the root canal. In conclusion, 0.2% chitosan, 15% EDTA and 10% citric acid showed similar effects in reducing dentin microhardness.

We found that the ability to reduce dentin microhardness of the solutions were 42.5 in group I, 53.1 in group II, 57.2 in group III and 88.7 in group IV. Silva et al[8] in their study divided the cervical region of maxillary central incisors into four quadrants, resulting in eight specimens, which were treated with 50 μL of solution for 5 min according to their group (n = 10): GI – 0.2% chitosan solubilized in 1% acetic acid; GII – 0.2% chitosan solubilized in 3.3% citric acid; GIII – 0.2% chitosan solubilized in 0.00145% hydrochloric acid; and GIV – 0.2% chitosan solubilized in 0.00112% nitric acid. A control was made from the chelating properties of the following acids: GV – 3.3% citric acid, GVI – 0.00145% hydrochloric acid, GVII – 0.00112% nitric acid, and GVIII – control (distilled water). Afterward, they were subjected to the Knoop microhardness tester with a load of 10 g for 15 s, resulting in three indentations of the root canal toward the cement. Chitosan solubilized in acetic acid provided best results than the other groups. Similar results were observed in the colorimetric analysis.

CONCLUSION

Authors concluded that chitosan solubilized in acetic acid, followed by chitosan in citric acid, provided a greater reducing effect compared to distilled water.

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