Original Research Paper

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Effect of Phytic acid on the tissue dissolving ability of Sodium hypochlorite: An ex-vivo study.

Abstract:

Aim: To evaluate the effect of Phytic acid on the pulp dissolving ability of sodium hypochlorite (Naocl).

Methodology: Pulp tissue was collected from patients undergoing root canal treatment using barbed broach and stored in 10% formalin. The tissue was then divided into fragments of equal weight and immersed in solutions consisting of 5.25 % Naocl and mixture of 1:1(w/w) Phytic acid and 5.25% Naocl for a period of 30 minutes. Tissue fragments were removed and weighed again. The difference between the initial and final weight was used to calculate weight loss there by representing tissue dissolving ability of each solution used.

Results: No significant difference was found in the tissue dissolving ability for both the tested groups. ($P<0.05$).

Conclusion: Addition of Phytic acid did not alter the pulp dissolving ability of Naocl.

Key words: Sodium hypochlorite, Phytic acid, Pulp tissue, dissolving ability

Introduction:

In root canal treatment, the intention of biomechanical preparation is to ultimately decrease the microbial load and necrotic tissue remnants in the teeth.[1] The intricate anatomy of root canal decreases the effectiveness of mechanical preparation (use of hand &rotary files) to around 50-60%.The remaining area which contains pulp tissue remnants contribute to failures in root canal treatment. Hence irrigation with proper irrigating solutions should be done in addition to mechanical preparation for better outcome.[2]

One such irrigating solution which is regularly used in root canal procedures is Sodium hypochlorite .The applications of hypochlorite which makes its popular in endodontics are its antimicrobial activity and tissue dissolution capacity. [3,4,5,6,7,8,9] As it has nominal effect on smear layer dissolution, demineralizing agents are proposed to be used along with it in root canal treatment. The frequently used demineralizing agent is Ethylene diamine tetra acetic acid (EDTA). [10, 11, 12] The mixture of sodium hypochlorite and EDTA is advised as a effective irrigating protocol in endodontics.[13] But EDTA has fewer disadvantages like it is not readily biodegradable and so it causes damage to periapical tissue on extrusion [14.15.16]. And also on interacting with sodium hypochlorite in presence of dentin, it reduces the tissue dissolving property of hypochlorite.17So the quest for advanced chelating agent lead to introduction of "PHYTIC ACID".

Phytic acid (myo-inositol[1, 2, 3, 4, 5, 6] hexa hydrogen phosphate) is the predominant storage form of phosphorous in plant foods like cereals, nuts, legumes and vegetables. It is a efficient chelating agent for multivalent cations like calcium, magnesium and iron due to its multiple negative charges. This property makes it as a substitute for EDTA to function as a root chelating agent. Compared to EDTA Phytic acid shows

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nominal toxic effects as it is extracted from nature. Also it causes slighter damage to surrounding periapical tissue on extrusion beyond apex as it is readily biodegradable. The nominal effect of Phytic acid on the micro hardness of dentin when compared to EDTA is well documented. [18, 19] Several studies were done to prove the interactions of sodium hypochlorite and EDTA.[14, 15, 16, 17] But fewer studies were conducted to find out the interactions of Phytic acid with sodium hypochlorite.

So the aim of this study was to evaluate the effect of Phytic acid on the tissue dissolving ability of Sodium hypochlorite.

Materials and Methods:

Preparation of solutions :

5.25% W/V sodium hypochlorite was readily available.10 ml of this solution was taken.

Combination of Phytic acid and Sodium hypochlorite was prepared by mixing 5ml of each solution (1% Phytic acid & 5.25% Sodium hypochlorite)and vortexing them at 230c.

Pulp dissolving ability :

Pulp tissue was collected from the patients who visit the department of endodontics for the root canal treatment procedure, using a barbed broach. Tissue was stored in 10% formalin until use. The entire pulp tissue collected was removed and placed over a filter paper to remove moisture. The tissue was divided into 20 fragments of equal size using electronic balance available in the department of microbiology.

10 fragments were exposed to 5.25% sodium hypochlorite solution alone(Group I) and remaining 10 fragments were exposed to mixture of 1% Phytic acid and 5.25 % sodium hypochlorite(Group II) for a time period of 30min.The fragments were then removed and placed over a filter paper for 3 minutes to remove any excess moisture. The final sample weight was measured in the electronic balance. The difference between the initial and final weights was used to calculate the weight loss there by representing the dissolving ability of each substance/mixture. Values of both pre weight and post weight were taken on average of 3 times to minimize errors.

Statistical analysis :

The mean and standard deviation values for the pulp tissue weights before and after the dissolving test are calculated. A Student's t-test for paired samples was used to compare the sample weights before and after immersion in each substance. An ANOVA followed by a Turkey's Test was used to compare the dissolving ability of the various substances or mixtures. A p-value <0.05 will be considered as statistically significant.

Results:

The mean and standard deviation values for the pulp tissue weights before and after the dissolving test are shown in Table 1. The reduction in pulp tissue weight in each of the tested groups is shown in Table.

2. The results showed that there was no statistically significant difference in tissue dissolving ability between the two groups.

	N	Before*	After*
Group I 5.25% Naocl	10	27.45(±2.26^{A})	0^{B}
Group II 5.25%Naocl &1%Phytic acid	10	26.96(±3.32^{A})	0^{B}

Table1.Mean and standard deviation values for the pulp tissue weight (inmg) before and after the dissolving test.

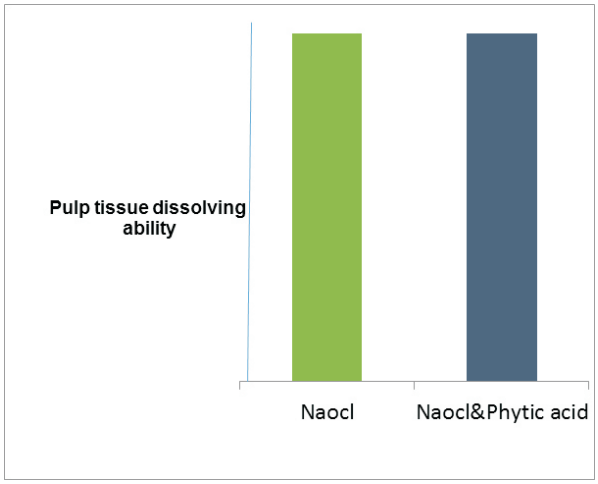
*Different uppercase letters in the same row represent statistical difference between groups

	N	Weightreduction(mg)	% Reduction	*
Group I 5.25% Naocl	10	27.45(±2.26)	100.00	A
Group II 5.25%Naocl &1%Phytic acid	10	26.96(±3.32)	100.00	A

Table 2. Mean and standard deviation tissue dissolution values (express edinabsolute weight loss and a sapercentage) after exposure to the indicated solutions

The same uppercase letters in the column indicate that there was no statistically significant difference between two groups.

Graph 1. Mean and standard deviation tissue dissolution values among the two groups.



Discussion:

The success of endodontic treatment depends on the efficiency of irrigation along with biomechanical preparation. Till today no single irrigant is able to disinfect the root canal completely.[1,2] Among all the irrigants available in the field of endodontics sodium hypochlorite is the commonly used. The reason for this is its commendable action on organic tissues which meet the criteria of ideal requirements of irrigant. The dissolving ability of sodium hypochlorite is due to the release of hypochlorite ion, which depends on several factors. The effect of concentration & volume of Naocl, temperature, time, frequency of a gitation, the amount of & surface area of organic tissue on the tissue dissolving ability is very well documented in the literature.[3,4,5,6,7] Other solutions how much ever they show their action on organic tissues, unfortunately they couldn't come par with sodium hypochlorite.[9]

But sodium hypochlorite has limited action on inorganic tissues. To overcome this sodium hypochlorite is combined with demineralizing agent which dissolves inorganic tissues. [10, 11, 12] But demineralizing agents like EDTA are shown to reduce the tissue dissolving ability of hypochlorite.[14, 15, 16, 17]

In the present study a newer chelating agent phytic acid is used instead of EDTA. It was first recognised by In Pfeffer in 1872. Other names are inositol hexakisphosphate (IP6), inositol polyphosphate, or phytate when in salt form. Apart from chelating property phytic acid has several other applications in dentistry in dental cements, oral care products, etching, implant and regenerative procedures. Phytic acid effect on inorganic tissues is similar to EDTA which is the commonly used chelating agent. Furthermore it is biodegradable, causing less irritation in periapical region, compared to EDTA.[18, 19]

In the present study human pulp tissue which was collected from patients is used to determine tissue dissolving property unlike other studies which used animal tissues and bovine pulp tissue .This will mimic in vivo conditions more precisely and the inference is more relevant which can be applied clinically.[4,5,6]

The present study evaluated whether addition of Phytic acid is effecting the tissue dissolving ability of sodium hypochlorite or not. 5.25 % Naocl is used in the present study as it is shown to have maximum tissue dissolving potential.6 Similar concentrations of Naocl is taken in both groups (Naocl alone and combination of phytic acid and Naocl) to minimize concentration dependent dissolving ability differences and pulp tissue is exposed to these groups for equal period of time as increase in time one group will cause more dissolution of organic tissue in that group.5 Similarly 1% Phytic acid is taken in the present study as it is evident that at this concentration Phytic acid can effectively chelates the inorganic tissues.[18] Weight of pulp tissue before dissolving and after dissolving is measured three times to avoid errors in weight difference.[4]

The results showed that there was no statistically significant difference in the tissue dissolving ability of sodium hypochlorite before and after addition of phytic acid. The reason for this could be atrributed to fact that phytic acid unlike EDTA might not be altering the free chlorine availability of hypochlorite solution, which is the key ingredient in its tissue dissolving property.[17] Further studies are required to know the free chlorine availability of sodium hypochlorite after addition of phytic acid.

Even though Phytic acid is not causing any additive effect when combined with sodium hypochlorite, it is undoubtedly considered as an alternative to EDTA as it is not altering the tissue dissolving property of Naocl and moreover it is biocompatible. The combination of Naocl plus Phytic acid

will become the popular irrigating regime in future endodontics with proper further investigation.

Conclusion:

The results of the present study concluded that addition of phytic acid does not alter the tissue dissolving ability of Sodium hypochlorite unlike Ethyelenediamine tetra acetic acid (EDTA).

Hence Phytic acid can be considered as effective alternate chelating agent for EDTA.

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