PROANTHOCYANIDINE EXTRACT AS A NEUTRALIZER FOR SODIUM HYPOCHLORITE – A LABORATORY STUDY

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ABSTRACT

Aim - The aim of this study was to evaluate the 5% Proanthocyanidin extract required to neutralize various concentrations of Sodium Hypochlorite, and compare it to 5% Sodium thiosulphate and 10% Sodium Ascorbate.

Methodology - In Group 1, 1 ml of different concentrations of Sodium Hypochlorite (NaOCl) was taken in 10 test tubes. SG 1: 0.5 % NaOCl, SG 2: 1% NaOCl, SG 3: 2.5% NaOCl, SG 4: 4% NaOCl, SG 5: 5.25% NaOCl. 0.5ml of 5% Sodium Thiosulfate (ST) was added to each test tube, followed by 1 ml of Crystal Violet (CV) die and 1ml of Concentrated HCl. If the color of Crystal Violet persisted, the volume of ST was noted down. If not, ST was added in 0.1 ml increments along with 1ml HCl and 1 ml CV until the color of CV persisted. In Group 2 and Group 3the same process was repeated with 5% Proanthrocyanidine solution (PA) and 10% Sodium Ascorbate (SA), and the volume of PA required for different Sub Groups was noted down.

Results–1ml, 1.2 ml, 2.1 ml, 2.8ml and 3.4 ml of PA was required to neutralize .5%, 1%, 3%, 4% and 5% NaOCl respectively, which was less than the volume required for both ST (1ml, 1.5ml, 2.4ml, 3.1ml, 3.5 ml) and SA (1.1ml, 1.7ml, 4.3ml, 5.1ml, 5.5ml) at all concentrations of NaOCl.

Conclusion – Due to its efficient neutralizing action, as well as its Dentine Crosslinking properties, PA can prove to be an efficient neutralizing agent for NaOCl.

Key Words – Proanthocyanidine, Sodium Hypochlorite, Sodium Thiosulphate, Sodium Ascorbate, Resin Sealers

INTRODUCTION

The main objective of root canal treatment is to decrease the microbial load and to facilitate periapical healing & prevent reinfection. But the root-canal system has a complex anatomy that consists isthmuses and cul-de-sacs, andorganic and inorganic residues cannot be completely removed and often persist. Hence, the selection of the irrigating solution is critical to the treatment outcome as it can reach even the areas which are inaccessible to mechanical instrumentation.

An ideal irrigant should have excellent tissue dissolving properties and should be capable of eliminating microbes in the biofilm. Over the years various irrigating solutions have been used by endodontistsbut Sodium Hypochlorite (NaOCl) continues to be the gold standard in endodontics due to its unique combination of unmatched tissue dissolving property, profound antimicrobial action and economic viability[1,2,3].

In recent years resin sealers have gained popularity as they produce a monoblock effect in which the core material, sealing agent, and the root canal dentin form a single cohesive unit[4]. The residue of sodium hypochlorite prevents bonding of sealers to dentine resulting in microleakage[5]. Also, resin cements are an important tool for the endodontist and are commonly used for post cementation. Previous studies have shown that persistence of NaOCl in canals has a profound effect on the bond strength between the dentin and the cement[6]. Hence it should be flushed or neutralised completely, using anti-oxidants such as 5% sodium thiosulphate[7,8].

Naturally existing antioxidants such as grape seeds contain oligomericproanthocyanidin complexes. Studies have found that the application of proanthocyanidin extract solution (PA) has the capacity to drastically increase the Resin-dentin bond strength[9].

Hence the following study was carried out to evaluate the efficiency of PA extract to neutralize 1 ml of various concentrations of NaOCl, and compare it to commonly used neutralizing agents Sodium Thiosulphate (ST) and Sodium Ascorbate (SA).

METHODOLOGY

Preparation of 5% PA Solution

4gm pure PA extract was taken from capsules (Zenith Nutrition, Bangalore, Ind) and mixed with 80ml of distilled water, in a sterile beaker. The solution was stirred vigorously by a glass stirrer, and was used immediately, not allowing the PA extract to precipitate.

Neutralization Reaction

1 ml of 0.5% NaOCl was taken in 3 test tubes and using a pipette 1ml PA solution was added to each. Then 0.1ml ConcentratedHCl& 0.5 ml 2% crystal violet dye (CV) was added to each test tube and the test tube was gently shaken.If Crystal violet color persisted,the value was noted as the final reading. If the color disappeared the same experiment was repeated with 0.1ml increments in volume of PAs, and the volume at which the color persisted was noted down. Fresh NaOCl solution was used for each increment. Once the final reading was recorded for all three test tubes, the average was recorded as the final volume.

The same experimental setup was repeated for 1%, 3%, 4%, 5%NaOCl and also 5% Sodium Thiosulphate solution and 10% Sodium Ascorbate solutions and final volumes for each noted down.

RESULTSAND DISCUSSION

PA solution required the least volume to neutralize 1ml of SH at all concentrations (Table 1). A Reddish brown precipitate was observed, the quantity of which increased with increase in the concentration of SH.

A 'neutralization reaction' takes place when an acid and a base react to produce Salt and water. It can be represented as, Acid + base ⇋ salt + water

In the current study the above was used to find the amount PA solution required to neutralize 1ml of various concentrations of NaOCl.ConcentratedHCl was used as the catalyst while Crystal Violet dye was used as the indicator. When Crystal Violet dye is added to a test tube which containsNaOCl, the crystals of the dye are bleached by NaOCl resulting in loss of color. On the other hand if the color of Crystal Violet persists, it shows that all of the NaOCl in the solution has been neutralized.

Sodium hypochlorite (NaOCl) is the most common irrigant used in root canal therapy[2]. It acts as a solvent for organic tissues transforming them into fatty acid salts (soap) and glycerol (alcohol).Hypochlorous acid, a substance present in sodium hypochlorite solution, when in contact with organic tissue acts as a solvent and forms chloramines that interfere with cell metabolism[10].In this study 0.5%, 1%, 3%, 4% and 5%NaOCl was tested because these are most used in clinical practice[11].

There is an overwhelming amount of literature showing that NaOCl has a negative effect on bonding to dentine. Perdigaoet al[12] assessed the effect of 10% commercial NaOCl gel on the dentine shear bond strengths and ultra-morphology of two total-etch adhesive systems (Prime&Bond NT and Single Bond). Results demonstrated that the increase in the NaOCl application time resulted in a progressive decrease in shear bond strengths for both dentine adhesives. Frankenbergeret al[13] compared the dentine bond strength and marginal adaptation of direct composite resins with and without additional NaOCl treatment after the etching process. They found that after hypochlorite treatment, dentine bond strength and marginal adaptation decreased significantly.

In the root canal, sodium hypochlorite breaks down to chloramines and protein derived radical intermediates. These have an adverse effect on the Pyridinoline cross links that occur in Type I and type II collagen, resulting in a less structurally stable collagen matrix. The presence of these residual reactive free radicals may also compete with the propagating vinyl free radicals generated during light activation of the adhesive resulting in pre-mature chain termination and incomplete polymerization[14]. The generation of oxygen bubbles at the resin-dentin interface may also interfere with resin infiltration into the tubules and intertubular dentin[15].So it is desirable to completely neutralize the residual NaOCl from the root canal prior to the use of a resin cement or sealer.

The most common strategy today involves the use of reducing agents such as 10 % Sodium ascorbate and 5% Sodium thiosulphate as neutralizing agents.In a study conducted Lai SCNet al[16], they found that the application of 10% Sodium Ascorbate after NaOCl treatment showed a statistically significant improvement in the bond strength in a single bottle adhesive system.In the current study 3.5 ml of Sodium Thiosulphate and 5.5 ml of Sodium Ascorbatewas able to completely neutralize 1ml of 5% NaOCl.

But the interference of NaOCl to bonding occurs not only due to the presence of free radicals, but also due to micro structural damage to collagen fibers[16].Hence it might be desirable to use a neutralizing agent that also has a dentine cross linking action.

Proanthocyanidins are naturally occurring plant metabolites widely avalable in fruits, vegetables, nuts, seeds, flowers, and bark. These are a group of simple polyphenols known as flavanoids and are found in large concentrations in Grape seeds. PAs have free radical scavenging activity and anti-bacterial, anti-inflammatory, anti-viral and anti-cariogenic properties[17]. They have shown to be effective dentine crosslinking agents[18].

A study by V SujathaManimaranet al[19] found that the reduction in bond strength caused by NaOCl can be reversed by the application of 5% PA solution and that it is significantly more effective than 10% Sodium Ascorbate.In the current study also 5% PA solution proved to be the most efficient reagent and required the least volume to completely neutralize NaOCl at all concentrations.

CONCLUSION

Due to its efficient neutralizing action, as well as its Dentine Crosslinking properties, PA can prove to be an efficient neutralizing agent for NaOCl. Further research is required regarding its clinical viability and also the nature of the precipitate formed.

Table 1 – Volumes of different agents required to neutralize various concentrations of Sodium Hypochlorite

	0.5% NaOCl	1% NaOCl	3% NaOCl	4% NaOCl	5% NaOCl
PA	1.0 ml	1.2 ml	2.1 ml	2.8 ml	3.4 ml
Sodium Thiosulphate	1.0 ml	1.5 ml	2.4 ml	3.1 ml	3.5 ml
Sodium Ascorbate	1.1 ml	1.7 ml	4.3 ml	5.1 ml	5.5 ml

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