



EVALUATION OF SURFACE TENSION OF THREE ROOT CANAL SEALERS USING PENDANT DROP METHOD

Dental Science

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ABSTRACT

The aim of this study was to evaluate the surface tension values of established and potential endodontic sealers. Densities of zinc oxide eugenol, AH Plus and Bioceramic sealers were calculated using pendant drop method. Surface tension was evaluated using rame hart goniometer with DROP image analyser software [Finn Knut Hansen 1990-2006]. The results show that surface tension of zinc oxide eugenol was the least followed by AH plus and Bioceramic sealer. Bioceramic sealer showed the highest surface tension of 47.8 Nm. From other studies it is known that bioceramic sealer has the highest dentinal tubular penetration. Various factors like dentin roughness, wetness, type of irrigant used, viscosity, hydrophilicity of root canal sealers, temperature, dentinal tubule texture and density etc influence the penetration of sealers. Further studies are needed to evaluate the role of surface tension of root canal sealers as a potent influencer in dentinal tubule penetration for endodontic success.

KEYWORDS

surface tension, pendant drop, root canal sealers, goniometer.

INTRODUCTION

In endodontics the most commonly used filling method involves gutta percha with root canal sealers. Root canal sealers play a pivotal role in endodontic success by sealing the void space between the core material and dentinal wall, effectively penetrating and sealing the accessory canals and also acts as a lubricant thus preventing secondary infection [1]. Various factors influence the dentinal tubule penetration and overall sealing scenario of root canal sealers like composition of the sealer, flow, bond strength, dentinal tubule diameter and orientation, rate of insertion of material [2], physicochemical properties of dentin [3,4,5], etc. An important factor influencing the flow, wettability, adhesion and penetration of root canal sealer is the surface tension of the sealer. Surface tension is defined as 'the force between molecules that produces a tendency for the liquid surface area to decrease. This force tends to limit the adhesion and penetration ability of the liquid. It has inverse relationship with wettability [6,7] that is when the surface tension is low, wettability will be high and in turn penetration and adhesion will be high. Having an array of endodontic sealers available in the market makes the decision for ideal sealer always difficult. Though many studies have been done on the various entities like sealer penetration, contact angle, microleakage, shrinkage, influence of irrigants, instruments used during biomechanical preparation, smear layer presence etc for the success of endodontic treatment. Evaluation of surface tension of sealers which influences the flow, wettability, penetration and adhesion have not yet been studied.

This study aims at finding the missing strength of sealers that is the surface tension among three endodontic sealers Zinc oxide eugenol (with grossman formula), AH plus Dentsply and Bioceramic sealer (smart paste bio). Zinc oxide eugenol which is the gold standard for sealer, AH Plus which is near to gold standard in Resin based sealers and recently introduced calcium silico phosphate based bioceramic sealer (smart paste bio). Surface tension is evaluated to find out its influence in sealer penetration and adhesion to create an effective monoblock.

MATERIALS AND METHODS

Densitometer was used to determine the density of experimental sealers. Weight of 2ml syringe was calculated. Sealers were mixed according to the manufacturers instructions and mass was calculated for 1ml of the sealer. Density was calculated from the formula $\text{density} = \frac{\text{mass}}{\text{volume}}$. Surface tension was calculated using pendant drop method [figure 1] in rame hart goniometer [figure 1.2] with DROP image analyser software. Fitting the drop to the shape method was used for surface tension calculation. Five values were taken for each sealer and mean of it was determined.

RESULTS

Mean value of surface tension as determined by rame hart goniometer

using pendant drop method with DROP image analyser software is given in table 1. The unit of surface tension is Nm/m.

DISCUSSION

Requirement for an ideal root canal sealer includes it being tacky which helps for good adhesion between it and the canal wall when set, creating a hermetic seal [8]. Low surface tension decreases contact angle thereby increasing the wettability which in turn favours good sealer penetration and adhesion to dentinal tubules [9,10,11,12].

Surface tension is measured by pendant drop technique at room temperatures to nullify any discrepancy due to temperature. Geometry of a drop was analyzed optically using DROP image analyser software [Finn Knut Hansen 1990-2006]. Pendant Drop method was used in the study because of high accuracy, ability to trace to national standards, apparatus cleanliness does not affect the measurement, small volume can be used to measure surface tension [13].

The reason for selecting Zinc oxide Eugenol sealer is that it is the gold standard still even with the introduction of a plethora of root canal sealers. AH plus though has improved composition still lacks the ability to create monoblock effect and the recently introduced bioceramic sealer has promising composition with setting in the presence of water. It is a known factor that dentinal tubule contains water and irrigants which we use also influence the adhesion of the sealer to the dentin.

From the results of this study, it is seen that Zinc oxide eugenol (25.13 Nm/m) has low surface tension followed by AH Plus (33 Nm/m) and Bioceramic sealer (47.8 Nm/m), which in turn predicts the wetting and dentinal tubule penetration to be high for Zinc Oxide Eugenol followed by AH Plus and Bioceramic (Smart seal bio) sealers. Studies done by Jardim Del Monaco R et al, Wang Y et al reveal that Bioceramic sealers have better dentinal tubule penetration than AH PLUS sealer [14,15], while studies done by SK Arikalta et al say AH Plus has better dentinal tubule penetration and interfacial adaptation than Bioceramic sealer [16] while studies done by Afaf Al Hadad et al reveals equal dentinal tubule penetration [17]. In the same way bioceramic sealer has superior wetting than AH plus sealer as studied by Jung-Hong Ha et al [20]. Studies done by S. Pawar et al, Srinidhi. V. Ballullaya et al state that bioceramic sealer has better adhesion and adaptation than AH plus and Zinc Oxide eugenol sealer [18,19] whereas studies done by Ola M Sakr et al state that bioceramic sealer has more dye leakage than AH 26 sealer [21].

Though the surface tension is low for Zinc Oxide Eugenol and AH Plus sealers, their sealer penetration adaptation, dye leakage are comparatively low than Bioceramic sealer. The reason for this variation may be the method of biomechanical preparation, dentin surface roughness, dentin tubule orientation and diameter, irrigants

used, force of condensation etc. This study suggests for studies on surface tension of sealers to explore its role as a potential influencer in dentinal tubule penetration and adaptation which again is foremost for endodontic success.

Limitations

In all the studies mentioned as references, different bioceramic sealers from different companies were used. Therefore, culminating the results under a broad category, bioceramic sealers will result in false impact about the sealer. More studies have to be carried out on these sealers to find out the ideal root canal sealer.

Table 1. Surface Tension of experimental sealers in Nm/m

Sealer	Surface tension values Nm/m
Zinc oxide eugenol	25.13
AH plus	33
Bioceramic	47.8



Figure 1 Pendant Drop of Sealer



Figure 1.2 Rame Hart Goniometer

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