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EFFECT OF ADDITION OF CHITOSAN NANOPARTICLES ON FILM THICKNESS OF DIFFERENT ROOT CANAL SEALERS

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ABSTRACT

Introduction: The aim of this study to evaluate the effect of addition of chitosan nanoparticles to (Guttaflowbioseal, MTA fillapex and Adseal) on film thickness.

Methods: Digital calliper was used to measure film thickness, The samples were classified into six groups according to type of sealer; group1: Guttaflowbioseal, group2: Guttaflowbioseal + Chitosan NP, group3: MTAfillapex, group4: MTAfillapex + Chitosan NP, group5: Adseal, group6: Adseal + Chitosan NP. Film thickness teste was evaluated before and after addition of chitosan nanoparticles. The results were compared and statistically analyzed.

Results showed that For Adseal groups, there was no statistically significant difference (p=0.426), However for Guttaflowbioseal groups and MTAfillapex groups there were statistically significant difference(p=0.032), Without nanoparticles Guttaflowbioseal had highest film thickness followed by Adseal while MTAfillapex showed least value, With nanoparticles MTAfillapex had highest followed by Guttaflowbioseal while Adseal showed least value.

Conclusion: The addition of Chitosan nanoparticles increased film thickness of MTAfillapex and Adseal, but decreased film thickness of Guttaflowbioseal.

Key words: Chitosan Nanoparticles, Film Thickness, Adseal, MTAfillapex, Guttaflow Bioseal

INTRODUCTION

Nanotechnology has been used extensively nowadays. Nanotechnology is used to manipulate and analyse chemical bonds, molecules and atoms present between different types of compounds [(1)]. Dental field used nanotechnology as nano dentistry. Nanomaterials are materials in which component size ranges from 0 to 100 nm. Nanomaterials may be found in the form of atoms, grains, fibres, or films, or as nanoholes. These nanomaterials have improved physical, chemical and biological properties as compared to the original material [(2)]. Nanodentistry implies the application of nanomaterials in

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diagnosis and treatment to improve comprehensive oral health. The addition of nanoparticles lead to improve handling and physical properties of sealers. When introduced nanoparticles into root canals, a nanocomposite structure of calcium silicate and hydroxyapatite is formed which called hydration reaction[2]. Nanotechnology has been extended to endodontic field as well. Nanoparticles improve fluidity and hydration process and fill empty spaces which improve seal of root canal.

MATERIALS AND METHODS

I. Materials

1) Guttaflow bioseal*

2) MTA fillapex**

3) Adseal***

4) Chitosan nanoparticles (Chitosan NP)****

Sealer's preparation

Guttaflowbioseal was prepared by mixing catalyst and base according to manufacturer's instructions and it was used in group I. Guttaflowbioseal +chitosan NP Guttaflowbioseal was prepared by mixing catalyst and base according to manufacturer's instructions. Then, 1ml of Guttaflowbioseal sealer was mixed with 0.1 gm of Chitosan NP to achieve homogenous mix of Guttaflowbioseal-Chitosan NP (GF-CNP).GF-CNP was used in group II. MTA fillapex was prepared by mixing catalyst and base according to manufacturer's instructions and it was used in group III. MTA fillapex +chitosan NP MTA fillapex was prepared by mixing catalyst and base according to manufacturer's instructions. Then, 1ml of MTA fillapex sealer was mixed with 0.1gm of Chitosan NP to achieve homogenous mix of MTA fillapex-Chitosan NP (MF-CNP). MF-CNP was used in group IV. Adseal was prepared by mixing catalyst and base according to manufacturer's instructions and it was used in group V. Adseal +Chitosan NP was prepared by mixing catalyst and base according to manufacturer's instructions. Then, 1ml of adseal sealer was mixed with 0.1gm of Chitosan NP to achieve homogenous mix of Adseal-Chitosan NP (AD-CNP).AD-CNP was used in group VI.

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II. Methods

The film thickness was measured according to ISO, two glass slabs were placed together and their combined thickness was evaluated. Film thickness was measured using a digital calliper, following that, 0.05 mL of the mixed sealer was placed between the slabs and 180 s after the start of mixing, a 150 N load was applied to the surface of the glass slab. Finally, 10 min after the start of mixing, the thickness of two glass slab and sealer was measured. The film thickness of sealer was the difference between the thickness of the superimposed slabs with and without the sealer samples. Measurements were repeated five times for each material evaluated [3-6].

RESULTS

As shown in Figure 1 and Table 1, Within Adseal groups, Mean value of film thickness of sealer with NP addition (0.20±0.07) was higher than the sealer without NP (0.17±0.06), The difference was not significant statistically (p=0.426). Within Guttaflowbioseal groups, Mean value of film thickness of sealer with NP addition (0.56±0.28) showed a significantly less value than sealer without (0.23±0.14) (p=0.032). Within MTAfillapex, Mean value of film thickness of sealer with NP addition (0.44±0.11) showed a significantly higher value than without NP (0.15±0.04) (p=0.001).

Table (1): Mean and standard deviation (SD) values for film thickness (mm) with and without NP addition. ($p \leq 0.05$)

Groups	Film thickness(Mean±SD)		p-value
	Without NP	With NP	
Adseal	0.17±0.06	0.20±0.07	0.426
Guttaflowbioseal	0.56±0.28	0.23±0.14	0.032*
MTAfillapex	0.15±0.04	0.44±0.11	0.001*

; significant

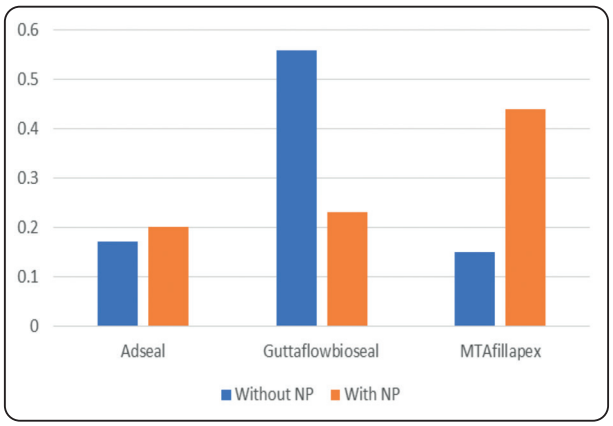

Fig. (1) Bar chart showing values for film thickness (mm) with and without NP addition.

As shown in Figure 2 and Table 2, for sealers without nanoparticles, Guttaflowbioseal group showed the highest mean value (0.56±0.28) followed by Adseal group (0.17±0.06) while MTAfillapex group showed the lowest mean value (0.15±0.04). There was a significant difference between different groups (p<0.001).

Table (2): Mean and standard deviation (SD) values for film thickness (mm) of different materials without NP addition.

	Film thickness (Mean ± SD) Without NP	p-value
Adseal	0.17±0.06	0.426
Guttaflowbioseal	.56±0.28	0.032*
MTAfillapex	0.15±0.04	0.001*

Significant (p<0.05)

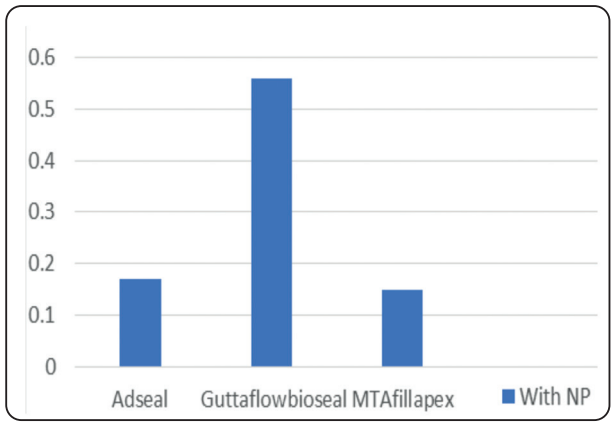

Fig. (2): Bar chart showing values for film thickness (mm) of different materials without NP addition.

As shown in Figure 3 and Table 3, for sealers with nanoparticles, MTAfillapex group showed the highest mean value (0.44±0.11) followed by Guttaflowbioseal group (0.23±0.14) while Adseal group showed the lowest mean value (0.20±0.07). There was a significant difference between different groups (p<0.001).

Table (3): Mean and standard deviation (SD) values for film thickness (mm) of different materials with NP addition.

Groups	Film thickness (Mean±SD) With NP	p-value
Adseal	0.20±0.07	0.426
Guttaflowbioseal	0.23±0.14	0.032*
MTAfillapex	0.44±0.11	0.001*

Significant (p<0.05)

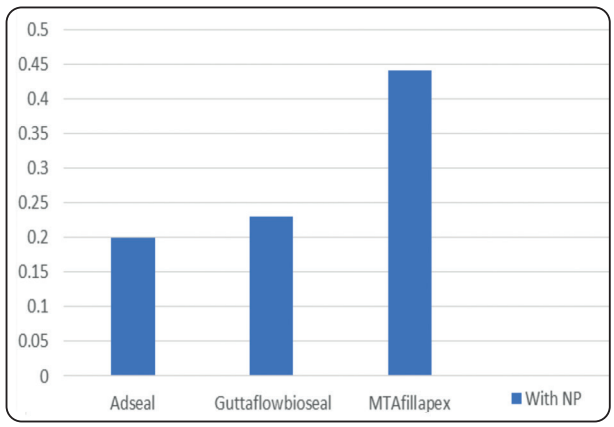

Fig. (3): Bar chart showing values for film thickness (mm) of different materials with NP addition.

DISCUSSION

The addition of nanoparticles in dental materials mainly aims to improve mechanical, biological and physical properties [7][8]. The physical tests performed in this study followed the specification no. 57 ANSI/ ADA and ISO 6876, which allow reproducibility and further comparison between studies [8]. Film thickness tests provide information about the volume of the sealer in the root canal after obturation. Some root canal sealers were dissolved in oral fluids or suffering from shrinkage after final setting, SO a thin film thickness is mostly recommended. ISO 6876 (2012) recommends that a root canal sealers should not have film thickness more than 50 μm. Therefore, there were no root canal sealers tested in accordance with this specification [8][9].

Film thickness determine seal of root canal system when dental materials used for obturation. In current study showed increased film thickness for Adseal and MTAfillapex when adding chitosan nanoparticles, this mean that type and number of these nanoparticles interfere with this property [6]. This increase in film thickness is most likely related to high viscosity presented by these sealers [8]. However, the addition of chitosan nanoparticles decreased film thickness for guttaflowbioseal sealer.

CONCLUSION:

Addition of chitosan nanoparticles increased film thickness of Adseal and MTAfillapex, decreased film thickness of guttaflowbioseal.

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