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Original Research Article

A Comparison of Solubility of Endosequence Root Repair Material Fast Set Putty and Mineral Trioxide Aggregate: An in Vitro Study

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Abstract

Aim: The aim of this study is to compare the Solubility of Endosequence root repair material fast set putty and Mineral Trioxide Aggregate Angelus (MTA-Angelus). ***Methods and Material:*** Solubility was determined by preparing stainless steel ring molds which were filled with cements corresponding to two groups (n = 5). Samples were transferred to bottles containing 10 ml of distilled water and stored at 37°C for 1, 7, and 21 days. Solubility was measured as the difference between the initial weight and the weight at the end of each storage period. Results were analyzed using Mann Whitney U test and Wilcoxon signed rank sum test. ***Results:*** The results showed weight loss with time for both materials. The solubility of ERRM and MTA on 21 days was more compared to its solubility after 1 and 7 days. ***Conclusions:*** There was no significant difference in solubility between endosequence root repair material and mineral trioxide aggregate.

Keywords: Endosequence root repair material, Mineral trioxide aggregate angelus, Root end filling material, Solubility.

INTRODUCTION

Most endodontic failures occur as a result of leakage of irritants from pathologically involved root canals [1]. An annual estimation of endodontic procedures suggests that approximately 5.5% of all treatments performed involve root end surgery and root perforation repair[2]. Root end filling materials should create a seal, thus avoiding bacterial infiltration and diffusion of bacterial toxins from the root canal system to periradicular tissues [3]. Amongst other desirable properties it should also be dimensionally stable, non-absorbable, not affected by the presence of moisture, and insoluble [4, 5]. Lack of solubility has been mentioned as one of the ideal characteristics of root-end filling material [6]. ISO 6876 standard places the acceptable limit of weight loss for solubility test at 3% [7].

Several materials have been used as root repair and root end filling materials. Therefore, these materials include amalgam, resin composites, ethoxybenzoic acid cements, Cavit, glass ionomer cements, gutta-percha, zinc oxide eugenol cements, polycarboxylate cements, and Mineral Trioxide Aggregate (MTA) [8]. But ever since the advent of MTA in 1990 the changes have been revolutionary as MTA has shown to have excellent bonding strength, shown to form dentin bridge and has virtually corrected all the problems associated with earlier materials [9]. However, MTA has exhibited specific disadvantages of long setting time and difficult handling characteristics [10].

However the mankind always strives for perfection and so do the researchers who have led to the development of new material like Endosequence Bioceramic Root Repair Material (ERRM) used for perforation repair, apical surgery, apical plug, and pulp capping. It is a premixed cement that is available as a paste, condensable putty and, more recently, a syringable fast set putty that sets in 20 minutes with easier handling and application when compared to MTA [9]. Solubility is the mass loss of a material during a period of immersion in water. Moreover, solubility may be a cause of disintegration or degradation of the root-end filling material, thereby leaving spaces that may provide gaps for bacterial colonization and their passage in periapical tissue [11]. Studies done by Poggio *et al.*, [12], Torabinejad *et al.*, [13] and Danesh *et al.*, [14] have established low or no solubility of mineral trioxide aggregate (MTA). No studies have reported solubility of ERRM. Therefore, the aim of this study is to evaluate the solubility of ERRM in comparison to MTA over a period of 1, 7, and 21 days.

MATERIALS AND METHODS

Solubility of Angelus MTA (Angelus, Londrina, Brasil) and Endosequence root repair material fast set putty (BRASSELER, USA) (Table-1), in distilled water were evaluated after 1, 7 and 21 days storage period.

Table-1: Chemical composition of MTA Angelus and ERRM fast set putty

Material	Composition	Manufacturer
MTA ANGELUS	Tri Calcium Silicate Dicalcium Silicate Tri Calcium Aluminate Tri Calcium Oxide Bismuth Oxide	ANGELUS, LONDRINA, BRASIL
ERRM FAST SET PUTTY	Calcium Silicates Monobasic Calcium Phosphate Tantalum Oxide Zirconium Oxide Proprietary Fillers Thickening Agents.	BRASSELER, USA

Circular stainless steel ring molds with an internal diameter of 15 ± 0.1 mm and a height of 1.5 ± 0.1 mm were used for sample preparation (Figure 1A). The ring molds were filled with test materials/cements corresponding to two groups (n = 5). The discs were placed in 100% humidity for 24 hours. Then, it was stored individually in plastic bottles containing 10 ml of distilled water at 37°C (Figure-1B).

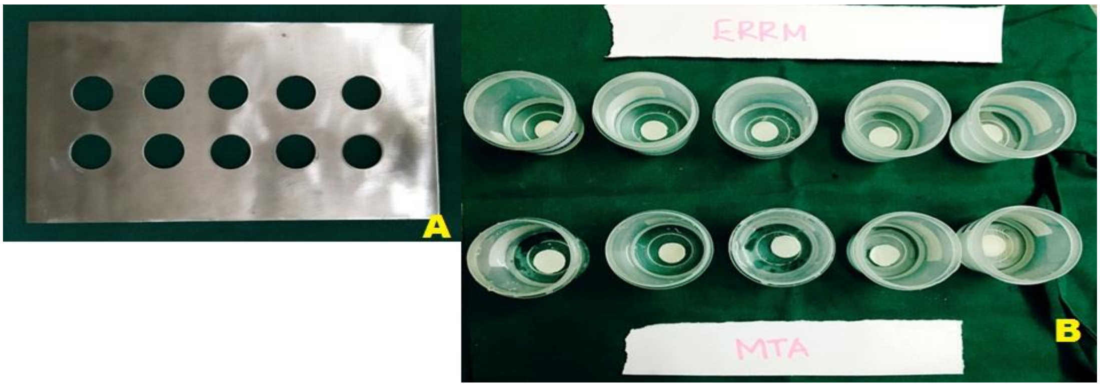
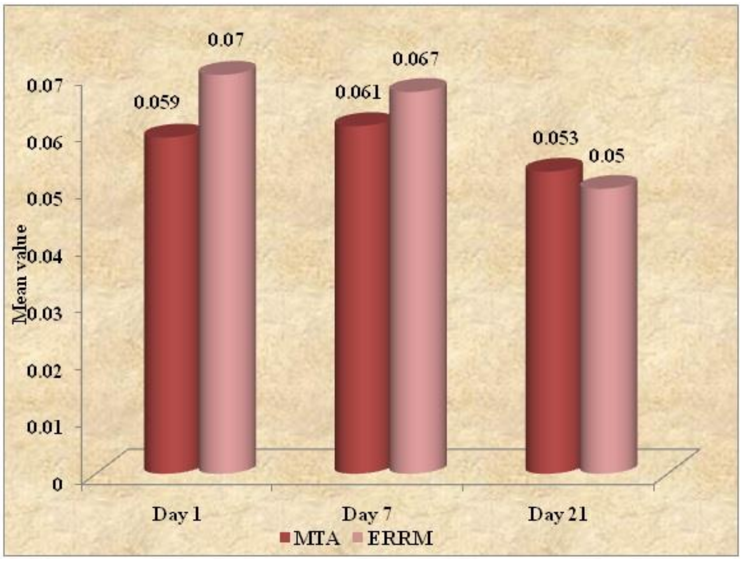


Fig-1A & B: Stainless steel ring molds and samples in distilled water

Before every testing period (1, 7, 21 days), the discs were desiccated using a desiccation container and placed in an oven with a constant temperature of 37°C for 1 hour. Then, each disc was weighed to the nearest microgram. After weighing, each disc was returned to the same container. The water in the containers was neither changed nor was there any addition during the test periods. Mixing and weighing of the samples were performed by a single operator at 23 ± 2°C and a relative humidity of 50 ± 5%. Data was analyzed using Wilcoxon signed rank sum test and Mann-Whitney U test.

RESULTS

The results showed weight loss with time for both materials the total weight loss of ERRM was 0.187 mg on 21 days, while MTA had a total weight loss of 0.173 mg.



The solubility of ERRM on 21 days was more compared to its solubility after 1 and 7 days. Similarly, MTA showed more solubility on 21 days compared to 1 and 7 days as shown in Table-2.

Table-2: Mean values and standard deviation of solubility of MTA and ERRM after 1, 7, and 21 days

Duration	Group	N	Mean	Std. Deviation
Day 1	MTA	5	.059	.011
	ERRM	5	.070	.009
Day 7	MTA	5	.061	.006
	ERRM	5	.067	.006
21st day	MTA	5	.053	.008
	ERRM	5	.050	.009

DISCUSSION

Root-end filling materials are usually in contact with periradicular tissue fluid until they are eventually covered by fibrous connective tissue or cementoid [15].

Lack of solubility has also been stated as an ideal characteristic for root-end filling materials [16]. Solubility is the mass loss of a material during a period of immersion in water. Moreover, solubility may be a cause of disintegration or degradation of the root-end filling material, thereby leaving spaces that may provide gaps for bacterial colonization and their passage in periapical tissue [17].

In the current study, solubility was determined following the method outlined by Torabinejad, *et al.*, [13]. The degree of solubility of test materials was determined by a modified method of the American Dental Association (ADA) specification #30.

Solubility was measured as the difference between the initial weight and the weight at the end of each storage period. Consequently, a low solubility in distilled water as proposed in the Standard of the International Standard Organisation (ISO) 6876: 2001 is required [18].

Mineral trioxide aggregate is a bioactive cement originally designed as an endodontic repair and root-end filling material with favourable physical properties and setting characteristics. Angelus MTA (Angelus, Londrina, Brasil) has an initial setting time of less than 10 min, and a final setting time of less than 24 min was used in the current study [19].

In the current study, endosequence root repair material was more soluble than MTA in distilled water, Nevertheless, this increase was not statistically significant.

The difference in the degree of solubility between both materials can be attributed to a difference in composition. MTA-Angelus has low solubility because of an insoluble matrix of crystalline silica within itself that preserve its integrity even in the presence of water [20].

For MTA, difference between day 7 to day 21 p value was 0.046. For ERRM difference between day 1 to day 21 and day 7 to day 21 p value was 0.043 and 0.041 respectively, with a increase in the solubility of both the materials on 21 days.

The solubilization of the MTA observed after 21 days most likely occurred because the bismuth oxide used as a radiopacifier increased the porosity of the material, thus also increasing its solubility, as reported in previous studies [21]. Different investigators reported different degrees of solubility for MTA. Nonetheless, most of them declared that MTA has low or no solubility [16]. There are no studies done on solubility of endosequence root repair material. EndoSequence Root Repair Material contains many of the same characteristics as BC sealer, with similar chemical composition .study done by poggio *et al.*, showed Endosequence BC sealer showed higher solubility as a result of hydrophilic nanosized particles being present which increases their surface area and allows more liquid molecules to come into contact with them which can be compared with the current study [22].

However, Literature contains conflicting results: Viapiana *et al.*, [23] found high solubility of MTA-Fillapex, while Zhou *et al.*, [24] reported that solubility of the bioceramic sealer EndoSequence BC is consistent with ISO 6876:2001. The discrepancy between the results of these authors may be attributed to variations in the methods used to dry the samples after having subjected them to solubility testing. Although the methodology for ascertaining solubility closely mimics clinical situation, yet the results can only be partly transferred to a clinical situation. Only a part of the cements are exposed to the periapical fluids as against the study conditions where the surface area exposed to the aqueous environment is much greater [12]. All the materials were tested for solubility after they completely set; therefore, these test conditions differ from any clinical situation where the materials are used before their initial setting. As pointed out by Kaplan *et al.*, [25] sealers when used in endodontic therapy come in contact with periapical fluids immediately; however, they are not completely immersed in it. A similar clinical scenario can be correlated to the use of root-end filling materials.

CONCLUSION

Within the limitations of the current study, it was found that there was no significant difference in solubility between endosequence root repair material and mineral trioxide aggregate.

There was significant difference between the time period of both MTA and ERRM which showed more solubility towards the end of study as compared to 1 and 7 days.

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