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Original Research

Assessment of comparison of pH and calcium ion release in newer calcium silicate-based root canal sealers

[1]Dr. Tangutoori Trinath, [2]Dr. Altamash Khan Airani, [3]Dr. Nimitha Maria Jimmy, [4]Dr. K Hari Nikhita, [5]Ankit Laikara, [6]Dr. Azeem. H

[1]Senior Resident, Government Dental College & Hospital, Hyderabad, Telangana, India;
[2]Senior Lecturer, Department of Conservative Dentistry and Endodontics, College of Dental Sciences, Davanagere, Karnataka, India;
[3]Consultant Endodontist, Medical Trust Hospital, Kochi, Kerala, India;
[4]General Dental Surgeon, Nellore, Andhra Pradesh, India;
[5]2nd year BDS, R.R. Dental College and Hospital, Udaipur, Rajasthan, India;
[6]Assistant Professor, Department of Conservative Dentistry and Endodontics, MES Dental College, Malappuram, Kerala, India

ABSTRACT:
Background: The success of root canal therapy in endodontic practice mainly depends on obtaining a hermetic fluid tight seal at the apical end. The present study was conducted to assess comparison of pH and calcium ion release in newer calcium silicate-based root canal sealers. **Materials & Methods:** The present study comprised of polyethylene tubes which were cut into 40 tubes of equal sizes; with each tube measuring 10 mm length × 1 mm diameter.. The polyethylene tubes were divided into 4 groups according to the materials with which they were filled. Group I (n = 10) control group, Group II (n = 10) sealapex, Group III (n = 10) mineral trioxide aggregate (MTA) fillapex, and Group IV (n = 10) White MTA. **Results:** The mean pH recorded at 24 hours was 6.90, 8.32, 8.31 and 8.50, at 7 days was 6.91, 8.40, 8.63 and 8.40, at 28 days was 6.84, 8.32, 8.72 and 8.56 in group I, II, III and IV respectively. The difference was significant (P< 0.05). The mean calcium ion release (ppm) was 0.04, 9.04, 5.76 and 14.72 at 24 hours, 0.04, 8.23, 10.31 and 8.92 at 7 days, 0.04, 7.25, 18.58 and 10.72 at 28 days in group I, II, III and IV respectively. The difference was significant (P< 0.05). **Conclusion:** Calcium silicate based sealers exhibited a higher pH and calcium ion release than calcium hydroxide-based sealer. Although at 24 h, MTA Fillapex showed the least Ca++ release but over longer time intervals, i.e., 7 days and 28 days, MTA Fillapex showed significantly higher pH and calcium ion release than White MTA and Sealapex.
Key words: Calcium silicate, Fillapex, Sealapex.

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Corresponding author: Dr. Tangutoori Trinath, Senior Resident, Government Dental College & Hospital, Hyderabad, Telangana, India

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INTRODUCTION

The success of root canal therapy in endodontic practice mainly depends on obtaining a hermetic fluid tight seal at the apical end. According to Ostavik, sealer has an important role to play in sealing the root canal system with entombment of remaining microorganisms and filling of inaccessible areas of prepared canals.[1] The introduction of sealers with therapeutic properties applied in endodontics conceivably created prospective of a higher success rate of root canal treatment.[1]

The introduction of calcium silicate-based materials in endodontics has been an explicit discovery for use in blood and moisture-field periapical surgeries. With the advent of mineral trioxide aggregate in 1993 by Torabinejad, several calcium silicate- and bioceramic-based materials have been marketed. Bioceramic sealers such as EndoSequence BC Sealer, EndoSeal MTA, and MTA Fillapex have been appreciated for

their favorable physicobiological properties.[2] Calcium silicate-based cements have been developed as root-end filling materials mainly due to its hydraulic property which allows it to set even when in contact with tissue fluid and blood.

To overcome these drawbacks, sealers-containing MTA were introduced, the latest among which is MTA Fillapex.[3] According to the manufactures, the composition of this sealer is basically MTA incorporated with salicylate resin, natural resin, bismuth, and silica. Their good handling property makes them easier to be used in the canal as a sealer. However, there is limited research regarding the physiochemical and biological properties of MTA Fillapex.[4] Although several Ca^{++} based sealers are available in the market, the presence of diffuse Ca^{++} compounds in the composition of an endodontic sealer does not ensure the release of Ca^{++} and hydroxyl (OH^{-}) ions after setting.[5] During setting, the ions may not be released, or other components in the sealer may inactivate calcium hydroxide. Hence, it is necessary to evaluate pH and Ca^{++} release of these materials to analyze their alkalinization ability and induction of mineralization.[6] The present study was conducted to assess comparison of pH and calcium ion release in newer calcium silicate-based root canal sealers.

MATERIALS & METHODS

The present study comprised of polyethylene tubes which were cut into 40 tubes of equal sizes; with each tube measuring 10 mm length × 1 mm diameter. The tubes were pre-weighted using digital weighing balance machine to allow a similar weight of each tube. The polyethylene tubes were divided into 4 groups according to the materials with which they were filled. Group I (n = 10) control group, Group II (n = 10) sealapex, Group III (n = 10) mineral trioxide aggregate (MTA) fillapex, and Group IV (n = 10) White MTA. The tubes after being packed with the respective sealers were placed inside polypropylene flasks containing 10 ml of deionized water. The flask was closed and stored at a constant temperature of 37°C during all the evaluation period. At 24 hours, 7 days and 1 month, pH and calcium ion released was measured using pH meter and atomic absorption spectrophotometer, respectively. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Mean pH values in all groups

Groups	24 hours	7 days	28 days	P value
Group I	6.90	6.91	6.84	0.04
Group II	8.32	8.40	8.32	0.02
Group III	8.31	8.63	8.72	0.01
Group IV	8.50	8.40	8.56	0.05

Table I, graph I shows that mean pH recorded at 24 hours was 6.90, 8.32, 8.31 and 8.50, at 7 days was 6.91, 8.40, 8.63 and 8.40, at 28 days was 6.84, 8.32, 8.72 and 8.56 in group I, II, III and IV respectively. The difference was significant (P< 0.05).

Graph I Mean pH values in all groups

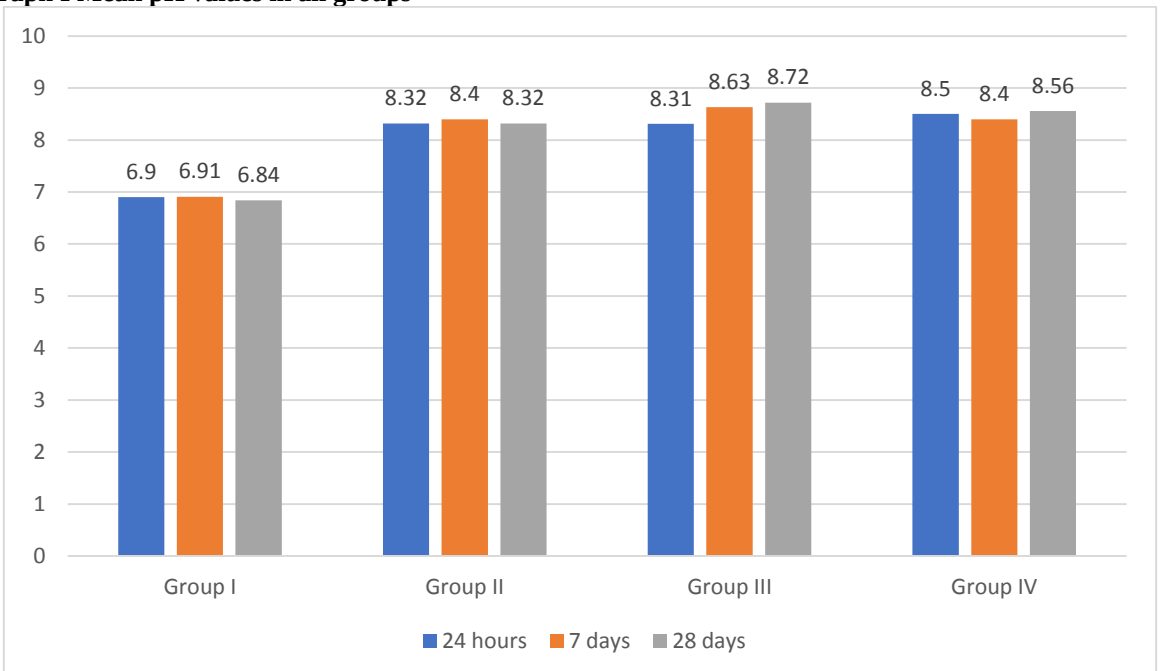
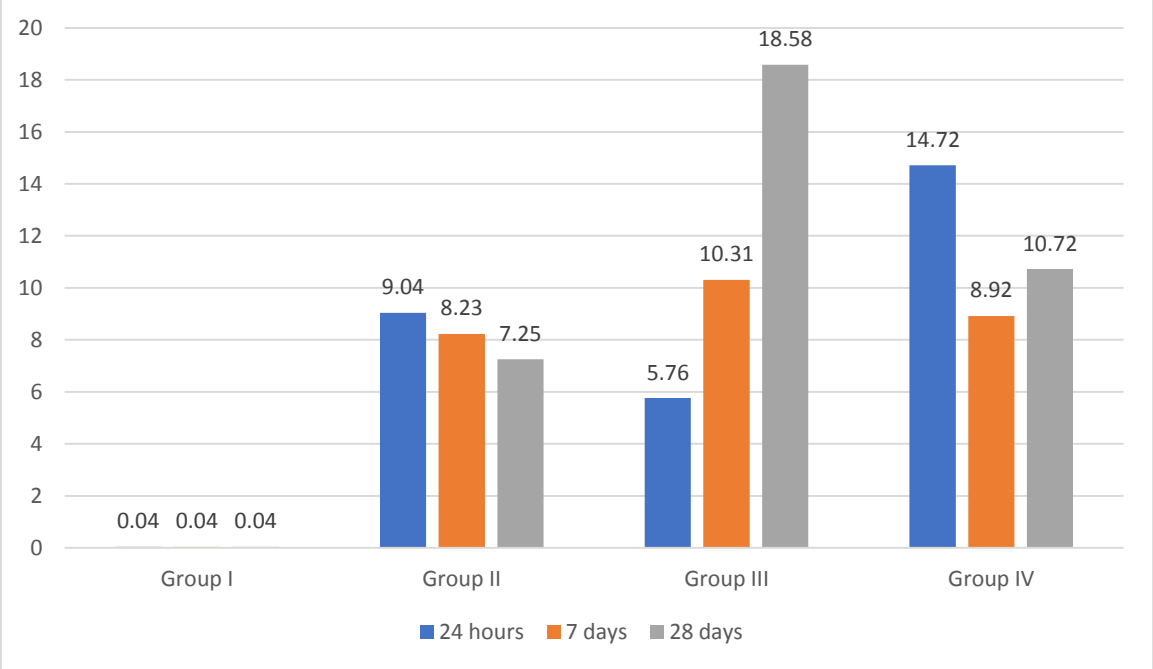


Table II Mean calcium ion release values (ppm)

Groups	24 hours	7 days	28 days	P value
Group I	0.04	0.04	0.04	1
Group II	9.04	8.23	7.25	0.04
Group III	5.76	10.31	18.58	0.01
Group IV	14.72	8.92	10.72	0.02

Table II, graph II shows that mean calcium ion release (ppm) was 0.04, 9.04, 5.76 and 14.72 at 24 hours, 0.04, 8.23, 10.31 and 8.92 at 7 days, 0.04, 7.25, 18.58 and 10.72 at 28 days in group I, II, III and IV respectively. The difference was significant (P< 0.05).

Graph II Mean calcium ion release values (ppm)



DISCUSSION

The success rate of a conventional root canal treatment is very high and nearly approaching 95%. On occasional reinfections, nonsurgical retreatment is performed.[7,8] However, when there is failure of nonsurgical root canal treatment or when retreatment is not advised, treatment by a surgical approach involving root-end resection, retrograde cavity preparation, and filling is indicated to obtain a good apical seal and resolve persistent infections.[9] Calcium silicate cements such as mineral trioxide aggregate (MTA) and other Portland-based cements have also shown promising results regarding biocompatibility and sealing ability.[10] Another notable feature and a booming interest in the potential clinical applications of hydraulic calcium silicate cements is their bioactivity that influences the surrounding environment. The present study was conducted to assess comparison of pH and calcium ion release in newer calcium silicate-based root canal sealers.[11,12] The present study was conducted to assess comparison of pH and calcium ion release in newer calcium silicate-based root canal sealers.

In present study, the mean pH recorded at 24 hours was 6.90, 8.32, 8.31 and 8.50, at 7 days was 6.91, 8.40, 8.63 and 8.40, at 28 days was 6.84, 8.32, 8.72 and 8.56 in group I, II, III and IV respectively. Douza et al[13] evaluate the physicochemical properties, pH, calcium ion release, and dimensional stability of the experimental cement, and compare the results with commercially available ProRoot MTA (Dentsply). An independent sample test was used to analyze the data. Mean initial pH (immediately after mixing) of the experimental cement was 10.42 ± 0.04 which was higher than that of MTA. However, there was a significant increase in pH of MTA at 1 day, 2 days, and 7 days. Presence of calcium chloride favored the release of calcium ions which was significantly increased in the experimental group at 24 hours. At the end of 30 days, MTA showed a significant expansion when compared to the experimental cement ($p < 0.001$).

We found that mean calcium ion release (ppm) was 0.04, 9.04, 5.76 and 14.72 at 24 hours, 0.04, 8.23, 10.31 and 8.92 at 7 days, 0.04, 7.25, 18.58 and 10.72 at 28 days in group I, II, III and IV respectively. Shashank et al[14] compared and evaluated pH and calcium ion release in newer calcium silicate-based root canal sealers. At 24 h, White MTA showed the highest pH (8.52) and highest calcium (Ca++) release (14.7). At 7 days and 28 days, MTA fillapex showed

significantly higher pH (8.64; 8.7) and Ca++ release (10.30; 18.60) than the other two groups.

Samiei et al[15] assessed the antimicrobial activity of MTA with silver nanoparticles with favorable results. Silver nanoparticles (Ag NPs) are one of the most widely used nanoparticles, most notably serving as an antimicrobial agent for medical applications. Small-sized Ag NPs can inhibit the growth of nitrifying bacteria more than that by silver ions at the same total silver concentrations size of the particle was also related to antimicrobial activity; the smaller particles give more bactericidal effects compared to larger particles.

CONCLUSION

Authors found that Calcium silicate based sealers exhibited a higher pH and calcium ion release than calcium hydroxide-based sealer. Although at 24 h, MTA Fillapex showed the least Ca++ release but over longer time intervals, i.e., 7 days and 28 days, MTA Fillapex showed significantly higher pH and calcium ion release than White MTA and Sealapex.

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