International Journal of Research in Health and Allied Sciences

Journal home page: www.ijrhas.com

Official Publication of "Society for Scientific Research and Studies" [Regd.]

ISSN: 2455-7803

ORIGINAL RESEARCH

Assessment of effect of Portland cement accelerators on the pH and antimicrobial activity of white Portland cement and white Pro Root mineral trioxide aggregate

[1]Nikita Mehta, [2]Uzma Talath, [3]Aashima Anand, [4]Syed Wali Ahmed, [5]Rajiv Kumar Yelisela, [6]Amit Kumar

[1]MDS (Conservative Dentistry & Endodontics), Panchkula, Haryana, India
[2]Assistant Professor, Department of Biochemistry, SS Institute of Medical Science and Research Center, Davanagere, Karnataka, India
[3]MDS (Conservative Dentistry & Endodontics), Chandigarh, Punjab, India
[4]Consultant, Endodontist and private practitioner (True care Multispeciality dental clinic), Hyderabad, Telangana, India
[5]MDS (Conservative Dentistry and Endodontics), DEIC, RBSK, Government, Hospital, Eluru, Andhra Pradesh, India
[6]Department of dentistry (Conservative Dentistry and Endodontics), All India institute of medical Sciences, Patna, Bihar, India

ABSTRACT:
Background: MTA is composed of fine hydrophilic particles; its main components are tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide, and other mineral oxides. The present study was conducted to compare the effect of Portland cement accelerators on the pH and antimicrobial activity of white Portland cement and white ProRoot mineral trioxide aggregate. **Materials & Methods:** 60plastic tubes were filled with the test material and immersed in deionized water. The pH of the water was measured at 0, 10, 30, 60 minutes and 24 hours using pH meter. The antimicrobial activity of the cement was evaluated using agar-diffusion test. The plates containing BHI agar were inoculated with microorganisms Pseudomonas aeruginosa (ATCC 27853), Streptococcus sanguis (ATCC 10556), Enterococcus faecalis (ATCC 29212) and Candida albicans (ATCC 5314) (HiMedia). **Results:** Themean pH in group I was 11.5, in group II was 11.3, in group III was 11.1, in group IV was 10.6, in group V was 10.5, in group VI was 11.6, in group VII was 11.9, in group VIII was 12.5, in group IX was 10.6 and in group X was 10.4. The difference was significant ($P< 0.05$).There was significant difference in antimicrobial activity of P. aeruginosa, E. faecalis, S. sanguis and C. albicans in all groups ($P< 0.05$). **Conclusion:** The use of 15% calcium chloride revealed enhanced antimicrobial activity of WPC and WMTA due to its high pH values.
Key words: mineral trioxide aggregate,

Received: 22 January, 2023 Accepted: 28 February, 2023

Corresponding Author: Nikita Mehta, MDS (Conservative Dentistry & Endodontics), Panchkula, Haryana, India

This article may be cited as: Mehta N, Talath U, Anand A, Ahmed SW, Yelisela RK, Kumar A. Assessment of effect of Portland cement accelerators on the pH and antimicrobial activity of white Portland cement and white Pro Root mineral trioxide aggregate. Int J Res Health Allied Sci 2023; 9(2):15-18.

INTRODUCTION

The quest for newer materials is never ending in the field of restorative dentistry and endodontics. Efforts to develop a new material with "ideal" characteristics lead to the introduction of mineral trioxide aggregate (MTA) in 1993.[1] MTA was recommended initially as a root-end filling material; however, its use has been subsequently expanded to pulp capping, pulpotomy, apexogenesis, apical barrier formation in teeth with open apexes, repair of root perforations, and as root canal filling material.[2]

MTA is composed of fine hydrophilic particles; its main components are tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide, and other mineral oxides.The original formulation, grey MTA, was introduced first; however, white MTA was developed later as this version improved esthetics. MTA powder sets in presence of water and results in

formation of a colloidal gel, which solidifies to a hard structure in approximately 3-4hours.[3,4]
Pro Root MTA is marketed as grey coloured and white coloured preparation; both are 75% Portland cement, 20% bismuth oxide and 5% gypsum by weight. MTA is composed primarily of tricalcium silicate, dicalcium silicate and bismuth oxide, which on hydration produces a silicate hydrate gel and calcium hydroxide, thus rendering the material biocompatible.[5] Although incredibly useful, MTA could be even more so if it could set faster in certain conditions. Considering the similarity between MTA and Portland cements, several studies have shown that addition of several PC accelerators reduced the initial setting time of MTA.[6,7]The present study was conducted to compare the effect of Portland cement accelerators on the pH and antimicrobial activity of white Portland cement and white ProRoot mineral trioxide aggregate.

MATERIALS & METHODS

The present comprised of 60 plastic tubes were filled with the test material and immersed in deionized water. In group I, white portland cement was mixed with deionized water while in group VIwhite MTA was mixed with deionized water. In group II and group VII, 10% calcium chloride was mixed with white portland cement and white MTA respectively. In group III and group VIII, 15% calcium chloride was added to white portland cement and white MTA respectively. Group IV and group IX included amixture of 25% calcium nitrite and 1% calcium nitrate mixed with white portland cement and white MTA respectively. Group V and group X consisted of a mixture of 40% calcium nitrite and 8% calcium nitrate mixed with white Portland cement and White MTA respectively.Group I and group VI served as control groups.
Fifty Polyethylene tubes measuring 10 mm in length and 2mm in diameter were taken and pH was evaluated using a pH meter. The antimicrobial efficacy of the prepared samples was tested using agar diffusion assay.Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I: Comparison of pH

Groups	Mean (48 hours)	P value
Group I	11.5	0.01
Group II	11.3	
Group III	11.1	
Group IV	10.6	
Group V	10.5	
Group VI	11.6	
Group VII	11.9	
Group VIII	12.5	
Group IX	10.6	
Group X	10.4	

Table I shows that mean pH in group I was 11.5, in group II was 11.3, in group III was 11.1, in group IV was 10.6, in group V was 10.5, in group VI was 11.6, in group VII was 11.9, in group VIII was 12.5, in group IX was 10.6 and in group X was 10.4. The difference was significant (P< 0.05).

Table II Assessment of antimicrobial activity

Groups	P.aeruginosa	E. faecalis	S.sanguis	C.albicans	P value
Group I	5.2	0	1.5	4.3	0.05
Group II	10.6	4.7	2.3	5.8	
Group III	11.3	6.2	3.8	6.1	
Group IV	4.3	0	1.2	3.2	
Group V	6.7	0	1.7	4.8	
Group VI	4.2	0	2.6	3.1	
Group VII	10.6	2.5	4.2	6.7	
Group VIII	12.1	2.9	5.4	8.0	
Group IX	10.8	0	2.8	4.5	
Group X	6.7	0	2.5	4.2	

There was significant difference in antimicrobial activity of P. aeruginosa, E. faecalis, S. sanguis and C. albicans in all groups (P< 0.05).

DISCUSSION

MTA is a biocompatible material, promotes cementum formation and apical root closure, it is an effective material in preventing leakage, as perforation repair and root-end filling material. Hydrophilic nature of MTA enables it to set in the presence of moisture.[8,9] The pH of MTA is approximately 12.5 and is similar to that of calcium hydroxide, a material with proven antibacterial activity.Despite its favorable properties, MTA presents some shortcomings like long setting time.[10] A shorter setting time would be beneficial because it would allow less time for contaminants in the oral environment to adversely affect the material, allow safer placement of restorative material over it (pulp capping), and also shorten the period when washout of cement can occur. It is thus of interest to attempt to use chemicals to accelerate the setting time of MTA.[11] Also, MTA has low compressive strength compared with most other materials, a reason for its limited application in restorative dentistry as this parameter is of major significance for indication of MTA as coronal restorative material.[12,13]The present study was conducted to compare the effect of Portland cement accelerators on the pH and antimicrobial activity of white Portland cement and white ProRoot mineral trioxide aggregate.

We found that mean pH in group I was 11.5, in group II was 11.3, in group III was 11.1, in group IV was 10.6, in group V was 10.5, in group VI was 11.6, in group VII was 11.9, in group VIII was 12.5, in group IX was 10.6 and in group X was 10.4. Srivastava et al[14]evaluated and compared the effect of accelerators on the pH and antimicrobial activity of white Portland cement and white mineral trioxide aggregate. Fifty Plastic tubes were filled with the test material and immersed in deionized water. The pH of the water was measured at 0, 10, 30, 60 minutes and 24 hours using pH meter. The antimicrobial activity of the cement was evaluated using agar-diffusion test. The plates containing BHI agar were inoculated with microorganisms Pseudomonas aeruginosa (ATCC 27853), Streptococcus sanguis (ATCC 10556), Enterococcus faecalis (ATCC 29212) and Candida albicans (ATCC 5314) (HiMedia). Subsequently, wells were prepared and immediately filled with test materials and incubated at 37°C for 24 hours and 48 hours. The diameters of the zone of inhibition were measured at 24 hours and 48 hours. The results showed that the maximum pH values were obtained when 15% calcium chloride was used as an accelerator with both WMTA and WPC. The antimicrobial activity of WPC and WMTA mixed with 10% and 15% calcium chloride was superior to the control group for all the tested microorganisms.

We found that there was significant difference in antimicrobial activity of P. aeruginosa, E. faecalis, S. sanguis and C. albicans in all groups ($P < 0.05$). Ghazvini et al[15]in vitro study measured and compared pH and phosphate and calcium ions release of a new endodontic material (CEM cement), mineral trioxide aggregate (MTA), and Portland cement (PC) using UV-visible technique, atomic absorption spectrophotometry methods, and pH meter, respectively.Each material was placed in a plastic tube (n=10) and immersed in a glass flask containing deionized water. Half of the samples were tested for determining pH and released ions after 1h, 3h, 24h, 48h, 7d and 28d. Remaining samples (n=5), were evaluated after 28days. Results indicated that all materials were highly alkaline and released calcium and low concentration of phosphate ions in all the time intervals. CEM cement released considerably higher concentration of phosphate during the first hour ($P<0.05$).

Camilleri et al[16]evaluated the biocompatibility of mineral trioxide aggregate and accelerated Portland cement and their eluants by assessing cell metabolic function and proliferation.The chemical constitution of grey and white Portland cement, grey and white mineral trioxide aggregate (MTA) and accelerated Portland cement produced by excluding gypsum from the manufacturing process (Aalborg White) was determined using both energy dispersive analysis with X-ray and X-ray diffraction analysis. Biocompatibility of the materials was assessed using a direct test method where cell proliferation was measured quantitatively using Alamar Blue dye and an indirect test method where cells were grown on material elutions and cell proliferation was assessed using methyltetrazolium assay as recommended by the International standard guidelines, ISO 10993-Part 5 for in vitro testing.The chemical constitution of all the materials tested was similar. Indirect studies of the eluants showed an increase in cell activity after 24 h compared with the control in culture medium ($P<0.05$). Direct cell contact with the cements resulted in a fall in cell viability for all time points studied ($P<0.001$).

The limitation the study is small sample size.

CONCLUSION

Authors found that the use of 15% calcium chloride revealed enhanced antimicrobial activity of WPC and WMTA due to its high pH values.

REFERENCES

1. Parirokh M, Torabinejad M. Mineral trioxide aggregate: A comprehensive literature review-Part I: Chemical, physical, and antibacterial properties. J Endod. 2010;36:16–27.
2. Roberts HW, Toth JM, Berzins DW, Charlton DG. Mineral trioxide aggregate material use in endodontic treatment: A review of the literature. Dent Mater. 2008;24:149–64.
3. Kang JY, Lee BN, Son HJ, Koh JT, Kang SS, Son HH, et al. Biocompatibility of mineral trioxide aggregate mixed with hydration accelerators. J Endod. 2013;39:497–500.
4. Walker MP, Diliberto A, Lee C. Effect of setting conditions on mineral trioxide aggregate flexural strength. J Endod. 2006;32:334–6.

5. Storm B, Eichmiller, Tordik PA, Goodell GG. Setting expansion of gray and white mineral trioxide aggregate and Portland cement. J Endod. 2008;34:80–2.
6. Torabinejad M, Hong CU, Pitt TR, Kettering JD. Cytotoxicity of four root end filling materials. J Endod. 1995;21:489–92.
7. Kogan P, He J, Glickman GN, Watanabe I. The effect of various additives on setting properties of MTA. J Endod. 2006;32:569–72.
8. Gandolfi MG, Siboni F, Polimeni A, Bossu M, Riccitiello F, Rengo S, et al. In Vitro screening of the apatite-forming ability, biointeractivity and physical properties of a Tricalcium silicate material for Endodontics and Restorative Dentistry. Den J. 2013;1:41–60.
9. Bortoluzzi EA, Broon NJ, Bramante CM, Felippe WT, Tanomaru Filho M. The influence of calcium chloride on the setting time, solubility, disintegration and pH of mineral trioxide aggregate and white Portland cement with a radiopacifier. J Endod. 2009;35:550–4.
10. Wiltbank KB, Scwartz SA, Schindler WG. Effect of selected accelerants on the physical properties of Mineral trioxide aggregate and Portland cement. J Endod. 2007;33:1235–8.
11. Ding SJ, Kao CT, Shie MY, Hung CJ, Huang TH. The physical and cytological properties of white MTA mixed with Na 2 HPO 4 as an accelerant. J Endod. 2008;34:748–51.
12. Ber BS, Hatton JF, Stewart GP. Chemical modification of Proroot MTA to improve handling characteristics and decrease setting time. J Endod. 2007;33:1231–4.
13. Camilleri J. Modification of mineral trioxide aggregate. Physical and mechanical properties. Int Endod J. 2008;41:843–9.
14. Srivastava S, Taneja S, Kumar M, Kochhar R. Effect of accelerants on the pH and antimicrobial activity of White Portland cement and White MTA-An in vitro study. Endodontology. 2015 Dec;27(2):152-7.
15. Ghazvini SA, Tabrizi MA, Kobarfard F, Baghban AA, Asgary S. Ion release and pH of a new endodontic cement, MTA and Portland cement. Iran Endod J 2009;4(2):74-7.
16. Camilleri J, Montesin FE, Silvio LD, Ford TRP. The chemical constitution and biocompatibility of accelerated Portland cement for endodontic use. Int Endod J 2005;38:834-42.