Original Research

An All-Inclusive Evaluation of Overall Success of Mineral Trioxide Aggregate and Formocresol Usages in Pulpal Treatments of Primary Teeth: An (in Vivo) Original Research Study

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Abstract

Background and Aim: Pulp diseases are extremely disturbing and common finding in pediatric patients. It is highly advisable to address/manage these conditions at earliest so as to avoid any possible future complications. This in vivo study was conducted to assess the clinical success rates of mineral trioxide aggregate and formocresol in pulpal treatments of primary teeth.

Materials& Methods: Mineral trioxide aggregate and formocresol was assessed clinically for their performances and outcomes. Total 30 pediatric patients were included in the study. One deciduous molar (with involved pulp) per patient considered. Pulpal therapy was initiated carefully after removal of soft caries and tooth portion. Group 1 has 15 primary molars treated with formocresol while Group 2 has 15 primary molars treated with mineral trioxide aggregate. Patients were reevaluated in their post-operative phases for clinical outcomes and performances. The treatment intervention was declared successful of failed. Patients were checked at prefixed post-operative period of 2, 4, 6, 8, 10 months. Results were put in spread sheet and subjected to basic statistical analysis. P value less than 0.05 was taken as significant ($p<0.05$).

Statistical Analysis and Results: Statistical analysis was completed by using statistical software Statistical Package for the Social Sciences. All patients were in the age range of 6 to 9 years. In the age group of 6 years, there were 5 male and 3 female patients. P value was highly significant for that (0.01). For Group 1, P value was highly significant at the timings of 4, 6, 10 months. There was an increasing pattern of success of formocresol therapy was noted with increasing post-operative timings. For Group 2, P value was highly significant at the timings of 2, 4, 8 months. Maximum 13 out of 15 patients/primary tooth showed successful pulp treatment in 10 months post-operative time. Evaluation amongst all studied Groups was completed using one-way ANOVA which gave highly significant results.

Conclusion: Authors concluded that formocresol and MTA both have clinically satisfactory results however, the Mineral Trioxide Aggregate exhibited higher success rates than formocresol. Nevertheless, the implications of this study must be correlated clinically while judging overall success rate. Authors also presume some long term future studies to be executed to validate and confirm our results.

Key Words: Formocresol,Mineral Trioxide Aggregate, Pediatric, Primary Teeth, Pulp Therapy, Pain, Analgesia.

Introduction

Literature has well evidenced about the therapeutic approaches experimented by various researchers to manage primary pulp. Pulpotomy is common procedure which is indicated for primary pulp diseases.[1-5]MTA stimulates the development of dentinal bridge in contact with dental pulp tissue. The dentin creation outcome of MTA may be a consequence of its sealing properties, of its biocompatibility and alkalinity. The outcome of formocresol on pulp tissue is measured by the quantity of formocresol that diffuses into the tissue. Both, Mineral trioxide aggregate and formocresol is recommended in the indicated clinical situations. Both have their own advantages and disadvantages.[6-10]None of the materials is seems to be idea and perfect for such pulpal conditions. Several researchers have been conducted to find out the best regime. However, research and exploration in these regards is still continued. mineral Trioxide Aggregate is a newer material which has several advantages over traditional formocresol intervention. Researchers have also proven that overall success of any material solely depends upon various factors like host responses, patient age, infectious load, quality of mechanical intervention, operator skill and patient cooperation.[11-15]This in vivo study was conducted to assess the clinical success rates of mineral trioxide aggregate and formocresol in pulpal treatments of primary teeth.

Materials & Methods

This study was designed and conducted to meet predefined objectives. Here, mineral trioxide aggregate and formocresol was assessed clinically for their performances and outcomes. Both of the tested materials were used on endodontically involved primary posterior teeth. Total 30 pediatric patients were included in the study. Both male and female subjects were studied in detail. The study procedure and other interrelated details had also been explained to the legal guardian of all kids. Informed and signed consent was also obtained from all patients. Systematic sampling procedure was employed for accurate selection of sample/patients. Inclusion criteria included 1) posterior primary teeth with carious exposure of pulp 2) symptomatic posterior primary teeth with obvious pain and discomfort 3) cooperative patients. Exclusion criteria included 1) uncooperative patients 2) kids who exhibit tantrum 3) patients who were mentally retarded and physically handicapped 4) primary teeth with extensive caries with grossly decayed crown part 5) primary teeth with prominent peri-apical lesion or abscess which require immediate extraction 6) radiographic validation of pulp stone or internal resorption. Teeth with hopeless prognosis were extracted with surgeon’s assistance. Consequently, all bony sockets were also condensed rationally. Initially, authors had examined and separated total 50 patients from regular OPD however after application of the strict inclusion and exclusion criteria, this number reduced to 30. One deciduous molar (with involved pulp) per patient considered. Pulpal therapy was initiated carefully after removal of soft caries and tooth portion. After amputation of coronal pulp, confined bleeding was controlled effectively. Pulpotomy was accomplished very judiciously. For evaluating clinical success rates, sample teeth were divided into two study groups. Group 1 has 15primary molars treated with formocresol while Group 2 has 15primary molars treated with mineral trioxide aggregate. In group 1, sterile cotton with formocresol was sited over the root canal openings for five minutes roughly. MTA paste was prepared by mingling MTA powder with sterile water at a3:1 ratio precisely as per manufacturer's directions. In group 2, mineral trioxide aggregate was placed over the canals. Patients were reevaluated in their post-operative phases for clinical outcomes and performances. This assessment was attempted by two independent assessors. Based on their joint decisions, the treatment intervention was declared successful of failed. Patients were checked at prefixed post-operative period of 2, 4, 6, 8, 10 months. Results were put in spread sheet and subjected to basic statistical analysis. P value less than 0.05was taken as significant ($p<0.05$).

Statistical Analysis and Results

All the calculated data and inferences were sent for statistical assessment using statistical software Statistical Package for the Social Sciences version 22 (IBM Inc., Armonk, New York, USA). The consequential particulars was subjected to particular statistical tests to obtain p values, mean, standard deviation, chi- square test, standard error and 95% CI. Initial presumptions of the study were very imperative. Table 1 and Graph 1 showed that all patients were in the age range of 6 to 9 years. Total 4 age groups were considered with 17 male and 13 female patients. In the age group of 6 years, therewere5 male and 3 female patients. P value was highly significant for that (0.01). Minimum 6patientswere seen in the age group of 8, 9 years. For age group 9 years, p value was highly significant (0.02). Table 2 explains about the fundamental statistical explanations displaying mean, standard deviation, standard error, 95% coefficient of interval, Pearson Chi-Square Value and Level of Significance (p value). It is for Group 1, formocresol: n=15. Estimations were checked at 2, 4, 6, 8, 10 months intervals. P value was highly significant at the timings of 4, 6, 10 months. There was an increasing pattern of success of formocresol therapy was noted with increasing post-operative timings. Therefore,

formocresol showed a fair success of pulp therapy in the experimented teeth. Maximum 12 out of 15 patients/primary tooth showed successful pulp treatment in 10 months post-operative time. Table 3 explains about the fundamental statistical explanations displaying mean, standard deviation, standard error, 95% coefficient of interval, Pearson Chi-Square Value and Level of Significance (p value). It is for Group 2, Mineral Trioxide Aggregate: n=15. Estimations were checked at 2, 4, 6, 8, 10 months intervals. P value was highly significant at the timings of 2, 4, 8 months. There was an increasing pattern of success of MTA therapy was noted with increasing post-operative timings. Therefore, MTA showed a legitimate success of pulp therapy in the experimented teeth. Maximum 13 out of 15 patients/primary tooth showed successful pulp treatment in 10 months post-operative time. Table 4 illustrated about the evaluation amongst all studied Groups using one-way ANOVA. The ANOVA assessment gave highly significant results.

Table 1: Age &Gender wise allocation of patients

Age Groups (Yrs)	Male	Female	Total	P value
6	5	3	8	0.01*
7	6	4	10	0.20
8	4	2	6	0.06
9	2	4	6	0.02*
Total	17	13	30	***Significant**

Table 2: Fundamental statistical explanations displaying mean, standard deviation, standard error, 95% coefficient of interval, Pearson Chi-Square Value and Level of Significance (p value)[for Group 1:Formocresol: n=15]2, 4, 6, 8, 10 months

Time/Months	Success [n]	Mean	Std. Dev.	Std. Err.	95% CI	Pearson Chi-Square Value	df	Level of Sig. (p value)
2	08	0.938	0.839	0.536	1.18	1.930	1.0	0.50
4	09	0.582	0.203	0.653	1.02	1.363	2.0	0.01*
6	10	0.603	0.453	0.802	1.35	2.534	1.0	0.02*
8	11	0.712	0.103	0.035	1.13	1.930	1.0	0.90
10	12	0.134	0.373	0.734	1.50	2.210	1.0	0.01*
***p<0.05 [Sig]**								

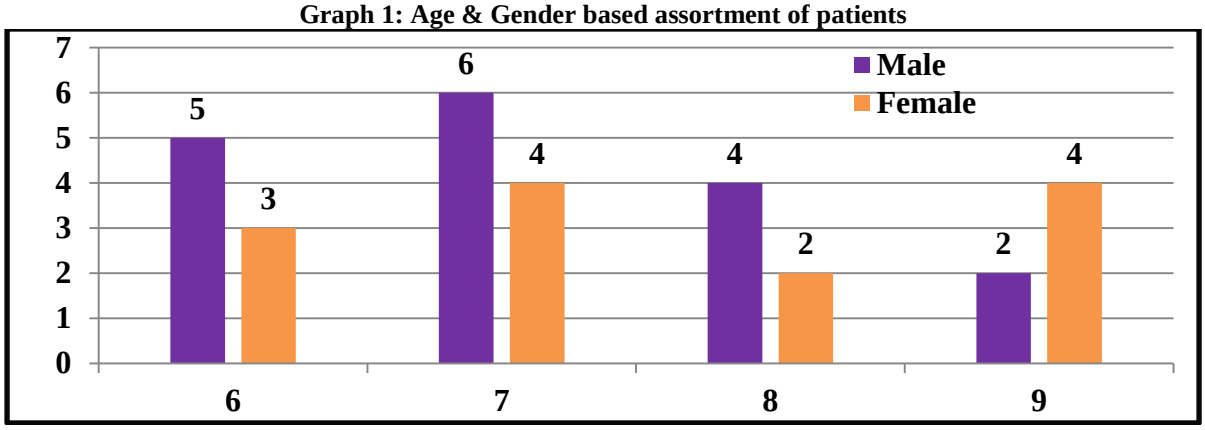
Table 3: Fundamental statistical explanations displaying mean, standard deviation, standard error, 95% coefficient of interval, Pearson Chi-Square Value and Level of Significance (p value)[for Group 2:Mineral Trioxide Aggregate: n=15]2, 4, 6, 8, 10 months

Time/Months	Success [n]	Mean	Std. Dev.	Std. Err.	95% CI	Pearson Chi-Square Value	df	Level of Sig. (p value)
2	10	0.243	0.847	0.746	1.24	1.139	1.0	0.02*
4	11	0.930	0.783	0.603	1.23	1.670	1.0	0.01*
6	11	0.612	0.726	0.136	1.23	1.493	1.0	0.09
8	12	0.594	0.103	0.635	1.44	1.983	2.0	0.01*
10	13	0.139	0.323	0.748	1.95	1.630	2.0	0.10
***p<0.05 [Sig]**								

Table 4: Evaluation amongst all studied Groups using one-way ANOVA

Variables	Degree of Freedom	Sum of Squares ∑	Mean Sum of Squares m∑	F	Level of Sig. (p)
Between Groups	3	2.054	1.238	1.1	0.002*
Within Groups	18	2.039	0.125	-	
Cumulative	121.42	12.577	*p<0.05 significant		

Graph 1: Age & Gender based assortment of patients



Discussion

Literature has well evidenced about the significant role of formocresol and mineral trioxide aggregate in primary molar pulpotomy. Peng and associates studied about the meta analysis on the evaluation of the formocresol versus mineral trioxide aggregate in primary molar pulpotomy.[16] Their results were highly comparable with present study inferences. Eidelman and other co-workers have experimented about the Mineral trioxide aggregate vs formocresol in pulpotomized primary molars. They also confirmed about the high success rate of Mineral trioxide aggregate. These were in accordance with our study's results.[17] Zurn and other pioneer workers have conducted a randomized controlled trial on Light-cured calcium hydroxide vs formocresol in human primary molar pulpotomies. Their results were highly imperative and significant.[18] Landis and other researchers have experimented about the measurement of observer agreement for categorical data. Biometrics.[19] Maroto and others have studied in the literature about the Dentin bridge formation after mineral trioxide aggregate (MTA) pulpotomies in primary teeth. They also stated the imperative role of Mineral trioxide aggregate.[20]Aeinehchi and other pioneer workers have performed a Randomized controlled trial in detail about the mineral trioxide aggregate and formocresol for the pulpotomy in primary molar teeth. Their inferences and results were highly similar to our results and outcomes.[21]Noorollahian and other researchers have experimented about the Comparison of mineral trioxide aggregate and formocresol as pulp medicaments for pulpotomies in primary molars.[22]Markovicand associates also performed similar stdy.[23] Marghalani and coworkers have studied in detail about the Clinical and radiographic success of mineral trioxide aggregate compared with formocresol as a pulpotomy treatment in primary molars.[24] Several similar recent studies also confirmed the significant role of mineral trioxide aggregate in managing the pulp diseases in primary teeth.[25,26,27]

Conclusion

Within the limitations of the present study, authors stated that formocresol and MTA both have clinically satisfactory performances for management of pulpally involved primary teeth. Nevertheless, the Mineral Trioxide Aggregate exhibited higher success rates than formocresol. However, the inferences of this study must be correlated sensibly while assessing overall success rate of comparable circumstances. Additionally, both of the experimented materials have their limitations with predictable precautions. Authors also assume some long term future studies to be conducted to authenticate and verify our results.

References

1. Loh A, O'Hoy P, Tran X, Charles R, Hughes A, Kubo K, et al. Evidence-based assessment: Evaluation of the formocresol versus ferric sulfate primary molar pulpotomy. Pediatr Dent. 2004;26:401–9.

2. Ranly D, Garcia-Godoy F. Current and potential pulp therapies for primary and young permanent teeth. J Dent. 2000;28:153–61.
3. Schwartz R, Mauger M, Clement D, Walker W. Mineral trioxide aggregate: A new material for endodontics. J Am Dent Assoc. 1999;130:967–75.
4. Islam I, Chng HK, Yap AU. Comparison of the physical and mechanical properties of MTA and Portland cement. J Endod. 2006;32:193–7.
5. Camilleri J, Montesin FE, Brady K, Sweeney R, Curtis RV, Pitt Ford TR. The constitutes of mineral trioxide aggregate. Dent Mater. 2005;21:297–303.
6. Holland R, de Souza V, Nery MJ, et al. Reaction of rat connective tissue to implanted dentin tubes filled with mineral trioxide aggregate or calcium hydroxide. Braz Dent J. 2001;12:3–8.
7. Torabinejad M, Pitt Ford T, McKendry D, Abedi H, Miller D, Kariyawasam S. Histologic assessment of mineral trioxide aggregate as a root-end filling in monkeys. J Endod. 1997;23:225–9.
8. Sluyk S, Moon P, Hartwell G. Evaluation of setting properties and retention characteristics of MTA when used as a furcation perforation repair material. J Endod. 1998;24:768–71.]
9. Fogel HM, Peikoff MD. Microleakage of root-end filling materials. J Endod. 2001;27:456–8.
10. Weldon JK, Pashley DH, Loushine RJ, Weller RN, Kimbrough WF. Sealing ability of mineral trioxide aggregate and super-EBA when used as furcation repair materials: A longitudinal study. J Endod. 2002;28:467–70.
11. Koh ET, McDonald F, Pitt Ford TR, Torabinejad M. Cellular response to mineral trioxide aggregate. J Endod. 1998;24:543–7.
12. Agamy HA, Bakry NS, Mounir MM, Avery DR. Comparison of mineral trioxide aggregate and formocresol as pulp-capping agents in pulpotomized primary teeth. Pediatr Dent. 2004;26:302–9.
13. Jabbarifar SE, Khademi AA, Ghasemi D. Success rate of formocresol versus mineral trioxide aggregate in human primary molar tooth. J Res Med Sci. 2004;6:55–8.
14. Farsi N, Alamoudi N, Balto K, Mushayt A. Success of mineral trioxide aggregate in pulpotomized primary molars. J ClinPediatr Dent. 2005;29:307–11.
15. Naik S, Hegde A. Mineral trioxide aggregate as a pulpotomy agent in primary molars: An in vivo study. J Indian SocPedodPrev Dent. 2005;23:13–6.
16. Peng L, Ye L, Tan H, Zhou X. Evaluation of the formocresol versus mineral trioxide aggregate primary molar pulpotomy: A meta-analysis. Oral Surg Oral Med Oral Pathol Oral RadiolEndod. 2006;102:e40–4.
17. Eidelman E, Holan G, Fuks AB. Mineral trioxide aggregate vsformocresol in pulpotomized primary molars: A preliminary report. Pediatr Dent. 2001;23:15–8.
18. Zurn D, Seale NS. Light-cured calcium hydroxide vsformocresol in human primary molar pulpotomies: A randomized controlled trial. Pediatr Dent. 2008;30:34–41.
19. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33:159–74.
20. Maroto M, Barberia E, Planellis P, Garcia Godoy F. Dentin bridge formation after mineral trioxide aggregate (MTA) pulpotomies in primary teeth. Am J Dent. 2005;18:151–4.]
21. Aeinehchi M, Dadvand S, Fayazi S, Bayat-Movahed S. Randomized controlled trial of mineral trioxide aggregate and formocresol for the pulpotomy in primary molar teeth. IntEndod J. 2007;40:261–7.
22. Noorollahian H. Comparison of mineral trioxide aggregate and formocresol as pulp medicaments for pulpotomies in primary molars. Br Dent J. 2008;204(11):E20.
23. Markovic D, Zivojinovic V, Vucetic M. Evaluation of three pulpotomy medicaments in primary teeth. Pediatr Dent. 2005;3:133–8.
24. Marghalani AA, Omar S, Chen JW. Clinical and radiographic success of mineral trioxide aggregate compared with formocresol as a pulpotomy treatment in primary molars: a systematic review and meta-analysis. J Am Dent Assoc. 2014 Jul;145(7):714-21.
25. ElSebaai A, Wahba AH, Grawish ME, Elkalla IH. Calcium Hydroxide Paste, Mineral Trioxide Aggregate, and Formocresol as Direct Pulp Capping Agents in Primary Molars: A Randomized Controlled Clinical Trial. Pediatr Dent. 2022 Nov 15;44(6):411-417.
26. ElSebaai A, Wahba AH, Grawish ME, Elkalla IH. Calcium Hydroxide Paste, Mineral Trioxide Aggregate, and Formocresol as Direct Pulp Capping Agents in Primary Molars: A Randomized Controlled Clinical Trial. Pediatr Dent. 2022 Nov 15;44(6):411-417.
27. Shirvani A, Asgary S. Mineral trioxide aggregate versus formocresolpulpotomy: a systematic review and meta-analysis of randomized clinical trials. Clin Oral Investig. 2014 May;18(4):1023-1030.