ORIGINAL ARTICLE

Pre-Operative Pain'- A Clinical Indicator to Govern the Choice of Pulpotomy Agent in Primary Teeth: A Retrospective Study

Palwasha Babar[1]	**BDS, MDS, CHPE**
Saqib Naeem Siddique[2]	**BDS, FCPS**
Abul Khair Zalan[3]	**BDS, MDS**
Zainab Ilyas[4]	**BDS**
Sidra Munir[5]	**BDS**
Anika Gul[6]	**BDS**

OBJECTIVE: To evaluate the effect of pre-operative pain on the success of pulpotomy in primary teeth and to assess whether formocresol (FC) or MTA performs better in patients with pre-operative pain.

METHODOLOGY: Data was collected retrospectively from the records of Department of Pediatric Dentistry, Children Hospital, Islamabad. Only patients with complete pre-operative and one-year follow-up clinical and radiographic records were included. A total of 60 teeth were selected for the study on which pulpotomy was performed. Among the selected teeth, thirty teeth were symptomatic at time of treatment and thirty were asymptomatic. Fifteen teeth in each group were treated with FC and fifteen with MTA as pulpotomy medicament.

RESULTS: After one-year, the clinical and radiographic success of pulpotomized teeth with positive history of pain was found to be 70% and 53.3% respectively. Among the teeth with positive pre-operative pain, 60% of the teeth treated with FC and 80% of the teeth treated with MTA showed clinical success. The radiographic success rate was found to be 33.3% and 73.3% for FC and MTA respectively.

CONCLUSION: The results from the current study suggest the presence of pre-operative pain negatively affects the success of pulpotomy in primary molars and could be used as an important clinical indicator to govern the choice of pulpotomy agent in clinical practice.

KEYWORDS: Pulpotomy, Formocresol, Mineral trioxide aggregate, Primary teeth.

HOW TO CITE: Babar P, Siddique SN, Zalan AK, Ilyas Z, Munir S, Gul A. Pre-operative pain'- A clinical indicator to govern the choice of pulpotomy agent in primary teeth: a retrospective study. J Pak Dent Assoc 2023;32(2):31-35.

DOI: https://doi.org/10.25301/JPDA.322.31

Received: 28 April 2023, Accepted: 01 July 2023

INTRODUCTION

Pulpotomy is the most frequently used vital pulp therapy procedure in carious primary teeth where caries removal results in pulpal exposure.[1] It involves amputation of the coronal pulp and placement of a medicament over the radicular pulp stumps in order to promote healing. It is based on the rationale that the healthy radicular pulp is capable of healing after removal of the affected coronal pulp tissue.

The ideal pulpotomy agent should be bactericidal, biocompatible, promote healing of the remaining pulp, not interfere with the normal physiologic root resorption and preserve the radicular pulp health clinically and radiographically.[2]

Formocresol (FC) was the first pulpotomy agent to be used in primary teeth in 1930.[3] FC contains formaldehyde which is a known carcinogen.[4] This has raised concerns regarding its use in dentistry. Additionally at histological level, FC does not produce a favorable pulpal response.[5] It causes chronic inflammation within the pulp which may initiate root resorption that is commonly associated with teeth treated with FC.

1. Assistant Professor, Department of Operative and Pediatric Dentistry, University College of Dentistry, The University of Lahore.
2. Assistant Professor, Department of Operative and Pediatric Dentistry, University College of Dentistry, The University of Lahore.
3. Demonstrator, Department of Operative and Pediatric Dentistry, School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad.
4. MDS Postgraduate Resident Prosthodontics, Department of Prosthodontics, School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad
5. FCPS II, Postgraduate Resident Operative Dentistry & Endodontics, Department of Operative Dentistry & Endodontics, School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad.
6. FCPS II, Postgraduate Resident Orthodontics, Department of Orthodontics, Sardar Begum Dental College, Peshawar.

Corresponding author: "Dr. Abul Khair Zalan" < zalanjan@yahoo.com >

In 1995, Torabinejad introduced Mineral Trioxide Aggregate (MTA). Its excellent biocompatibility, high pH, sealing ability and high compressive strength makes it an ideal choice for pulpotomy agent.[6] It stimulates cytokines production and induces hard tissue barrier formation by virtue of its dentinogenic and antimicrobial properties.[7] MTA has the ability to heal the tissue and cause regeneration which has brought a revolution in the modern endodontic approach. Based on the recent clinical studies, MTA appears to be the new gold standard for pulp-capping and pulpotomy procedures.[8]

Management of deep carious lesions poses a challenge to the pediatric dentist. Diagnosis of pulp inflammation is the key to the success of pulp therapy as the degree of the inflammation determines the repair and regeneration capacity of the pulp-dentine complex.[9] Inflammation is a response by the pulp to eliminate pathogens. In order to make accurate diagnosis, patient's history and clinical signs and symptoms must be correlated.[10] There are five main parameters in history to aid in diagnosis if a patient presents with complain of pain; localization, commencement, intensity, provocation and duration.[11] History of pain is an important diagnostic tool to assess the reversible and irreversible inflammation of the pulp with transient, stimulated pain associated with reversible pulpitis and intense, lingering pain of spontaneous origin associated with irreversible pulpitis.[12] The American Academy of Pediatric Dentistry recommends the use of both FC and MTA as pulpotomy agent and advocates the use of the medicament based on individual preferences.[13] The routine use of MTA however, has been limited due to its high cost.[14] The current study aims to evaluate if presence of pre-operative pain affects the success of pulpotomy and if either FC or MTA performs better in patients with positive history of pain. Both clinical and radiographic parameters were evaluated at one year follow-up. This is a variable which has never been accounted for in the studies on pulpotomy in primary teeth.

METHODOLOGY

It is a retrospective study conducted in Children Hospital, Pakistan Institute of Medical Sciences (PIMS), Islamabad. Data was collected retrospectively from the patient records of Department of Pediatric Dentistry, Children Hospital, Pakistan Institute of Medical Sciences (PIMS), Islamabad. Approval from the institutional Ethical Review Board was taken. The study Records of the children aged between 4-8 years meeting the following criteria were selected:

- Patients with complete pre-operative and one-year follow-up clinical and radiographic records.
- No significant medical history.
- One-visit pulpotomy with either FC or MTA was performed.

The children with incomplete records and non-standardized radiographs were excluded. The sample size was calculated using WHO sample size calculator. A quota sampling of total 60 teeth was done from the data which met the inclusion and exclusion criteria. 30 of the selected teeth were symptomatic i.e., a positive history of pre-operative pain was associated with the pulpotomized tooth, 15 of which had been treated with FC and 15 with MTA. Similarly, 30 asymptomatic teeth i.e., no history of pre-operative pain associated with the pulpotomized tooth were selected of which 15 had been treated with FC and 15 with MTA.

Pre-operative and one-year follow-up clinical and radiographic findings for each selected tooth were noted on a proforma and statistically analyzed. Both clinical and radiographic outcomes were determined. The teeth were recorded as clinically successful if they were asymptomatic at one-year follow-up i.e., having no signs and symptoms such as history of spontaneous or nocturnal pain, tenderness on percussion or palpation, abscess formation, swelling/fistula and/or mobility. If any of these were present, the tooth was recorded as failure. The follow-up radiographs were evaluated for external or internal root resorption, periapical or furcation radiolucency and periodontal ligament (PDL) widening. If any of these were present, the tooth was recorded as failure.

Data was analyzed using Statistical Package for Social Sciences (SPSS version 23). Chi-square test was applied to compare the effect of pre-op pain on the clinical and radiographic success. Uni-variant analysis was done to compare the clinical and radiographic outcomes of both the agents in the respective groups. p-value <0.05 was considered significant.

RESULTS

The age of the patients included in the study was 4-8 years with a mean of 4.9 years (SD+ 1.18). The overall success rate of the pulpotomized teeth at the end of 1 year was 78.3% clinically and 65% radiographically. The results showed a positive association between pre-operative (pre-op) pain and clinical and radiographic success at the end of 12 months. The clinical success rate of pulpotomy in teeth without pre-op pain was 86.7% (n=26) while it was found to be 70% (n=21) in those with positive history of pre-op pain with a p-value of 0.117 which is statistically not significant. The radiographic success of the teeth without pre-op pain was found to be 76.7% (n=23) while it was 53.3% (n=16) in teeth with positive history of

pain. The p-value was calculated to be 0.058 which is marginally significant. The results are summarized in Table 1.

Table 1: Clinical and Radiographic Success in FC and MTA groups

	Clinical Outcome				Radiographic Outcome			
	Pre-op pain Absent		Pre-op pain Present		Pre-op pain Absent		Pre-op pain Present	
	Success	Failure	Success	Failure	Success	Failure	Success	Failure
FC	13 (86.7%)	2 (13.3%)	9 (60%)	6 (40%)	12 (80.0%)	3 (20.0%)	5 (33.3%)	10 (66.7%)
MTA	13 (86.7%)	2 (13.3%)	12 (80.0%)	3 (20.0%)	11 (73.3%)	4 (26.7%)	11 (73.3%)	4 (26.7%)

[Pre-Op=Pre-Operative, FC=Formocresol, MTA=Mineral-trioxide Aggregate]

In patients with pre-op pain, FC treated teeth showed 60% (n=9/15) success while MTA treated teeth showed 80% success (n=12/15) as shown in Figure 1. The p-value was calculated to be 0.232 which is not statistically significant.

The radiographic success rate was found to be 33.3% (n=5/15) and 73.3% (n=12/15) for FC and MTA respectively in patients with pre-op pain as shown in Figure 2. The p-value was calculated to be 0.028 which is statistically significant.

Figure 1: Clinical success rate of FC and MTA in patients with and without pre-op pain

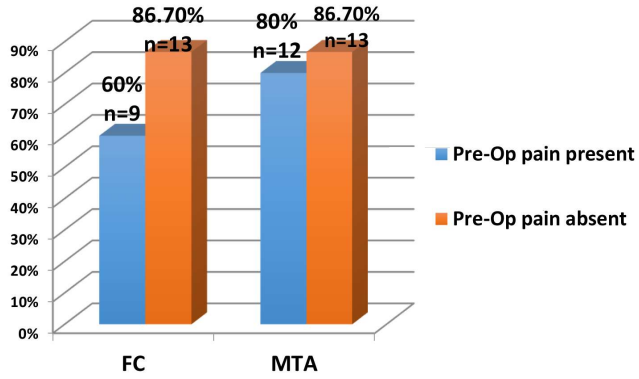
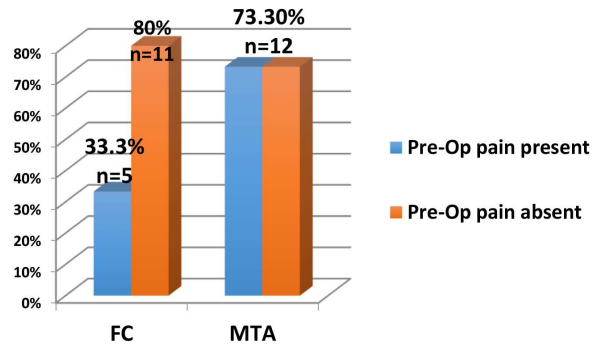


Figure 2: Radiographic success rate of FC and MTA in patients with and without pre-op pain



Root resorption was associated with 20% (n=6/30) teeth without pre-op pain while it was observed in 36.7% (n=11/30) teeth with positive history of pre-op pain. It was noted that 53.3% (n=8/15) of the teeth with pre-op pain, which were treated with FC showed root resorption while it was observed in only 20% (n=3/15) of the teeth treated with MTA. The p-value was calculated to be 0.058 which was marginally significant statistically.

DISCUSSION

One of the main goals in pediatric dentistry is to retain the primary teeth in the mouth until they exfoliate on their due time.1 Over the years, researchers have tried to search for an ideal pulpotomy agent which is capable of healing the residual pulp.[15] MTA has revolutionized modern endodontics with its regenerative properties. Multiple clinical trials have proven its success over FC which was considered a gold-standard agent for pulpotomy in primary molars.[16] It meets all the requirements of an ideal pulpotomy agent. Among the many factors reported in the literature regarding the failure of pulpotomy in primary teeth, the main are undiagnosed inflammation of the radicular pulp, lack of isolation and incomplete removal of the coronal pulp.[17] One of the most significant factor leading to failure is the incorrect diagnosis of inflamed radicular pulp.[18] The probable cause of internal resorption is the misdiagnosis of the existing inflammation in the pulpal tissue present before the procedure rather than the exposure to the pulpotomy medicament. This inflammation continues, resulting in failure of the pulpotomy. The current study aimed to find if pre-operative pain could serve as a clinical indicator for the choice of pulpotomy agent. As shown in Table 1, irrespective of the pulpotomy agent used, the clinical success of teeth with positive history of pain was found to be 70% while teeth without any history of pain showed a success of 86.7%. Similarly, the radiographic success of teeth with history of pain was 53.3% while teeth without any pain showed 76.6% success. Although statistically insignificant, this shows that the presence of pain adversely affects the outcome of pulpotomy. Pain is a cardinal sign of inflammation.[19] As a thorough history of pain depends on the subjective findings reported by the patient and/or parents, the patient/parents might not recall or report the precise history of pain itself. This accurate history of pain is imperative to differentiate reversible and irreversible type of pulpitis.[12] The misreporting may result in erroneous diagnosis by the clinician. It is proposed that a sub-clinical inflammation might be present in the radicular pulp of the teeth with positive history of pre-operative pain which may progress resulting in failure of pulpotomy. This is possibly the reason that the teeth with history of pre-op pain performed

poorly both clinically and radiographically than the teeth without any pain.

The results of the study demonstrate that the success rate of MTA was better than FC, both clinically and radiographically, which is in accordance with the current literature.20 However, the use of MTA in primary teeth has been limited due to its high cost.[14]

Exploring the association of the pulpotomy agent used with the presence of pre-operative pain, it was observed that MTA performed better than FC in symptomatic teeth. Pulp has the innate potential to repair.[21] Cho and colleagues[22] while studying the prognostic factors of pulp therapy proposed that the outcome depends on the degree of pulp inflammation, so the choice of pulp capping material holds utmost importance. MTA stimulates reparative dentinogenesis by recruiting the cytokines and growth-factors which mediate repair of the pulp-dentine complex.[23] Extrapolating these evidences, MTA suppresses any residual inflammation and promotes healing of the radicular pulpal tissue. As formocresol lacks these properties, the sub-clinical inflammation, which may be present in symptomatic teeth, progresses and results in failure of the pulpotomy. In the teeth without history of any pain, FC gives comparable results to MTA as shown in Figures 1 and 2.

Root resorption is a common cause of failure in pulpotomized teeth.1 More root resorption was associated with teeth with positive history of pre-operative pain and among these teeth, MTA treated teeth showed better success. This observation further supports the hypothesis that MTA performs better in symptomatic teeth.

The results of this study show that the presence of pre-operative pain could serve as a clinical indicator of an underlying sub-clinical inflammation and therefore warrants the use of a bio-inductive agent, such as MTA, which has the potential to combat any residual inflammation, if present. In the light of the findings of this study, the higher cost of MTA is justified in symptomatic cases as it will be more cost effective in the long run to avoid the expensive re-treatment or pre-mature loss of tooth.

One of the limitations of our study was the choice of final restoration performed. As one of the factors in the success of pulpotomy procedure is the choice of permanent restoration and non-standardization can result in bias. Another limitation can be the subjective nature of pain with which the patient presented, which can result in case selection bias. Although the sample size was sufficient, it is premature to draw a conclusion, because of the short follow-up period. This study might provide a base for further research with large sample size and longer follow-up periods.

There are several factors which need to be taken into account and should be considered in future research including tooth specific factors (tooth type), operator factors (experience and specialty), technical factors (type of permanent restoration). This will help other researchers and clinicians to improve the outcomes.

CONCLUSION

The results from the current study suggest the presence of pre-operative pain negatively affects the success of pulpotomy in primary molars and could be used as an important clinical indicator to predict the health of the remaining radicular pulp. The presence of pre-operative pain indicates possible underlying inflammation which will yield better outcome when treated with a bioactive material such as MTA which has regenerative properties rather than FC, which also justifies its high cost.

Pre-operative pain is a variable which has never been accounted for in the previous studies on pulpotomy in primary teeth. The study offers scientific evidence for revisiting practice guidelines for pulpotomy in primary teeth. More research with larger sample size and longer follow-up period should be carried out in this regard.

ACKNOWLEDGEMENT

None

DISCLAIMER

None

CONFLICT OF INTEREST

None to declare

FUNDING DISCLOSURE

None to declare

REFERENCES

1. Dhar V, Marghalani AA, Crystal YO, Kumar A, Ritwik P, Tulunoglu O, Graham L. Use of Vital Pulp Therapies in Primary Teeth with Deep Caries Lesions. Pediatr Dent. 2017;39:146-159.

2. Gizani S, Seremidi K, Stratigaki E, Tong HJ, Duggal M, Kloukos D. Vital Pulp Therapy in Primary Teeth with Deep Caries: An Umbrella Review. Pediatr Dent. 2021;43:426-437.

3. Sweet CA. Procedure for treatment of exposed and pulpless deciduous teeth. J Am Dent Assoc. 1930;17:1150-3. *https://doi.org/10.14219/jada.archive.1930.0158*

4. National Toxicology Program. NTP 12th Report on Carcinogens. Rep Carcinog. 2011;12:iii-499.

5. Ahuja S, Surabhi K, Gandhi K, Kapoor R, Malhotra R, Kumar D. Comparative Evaluation of Success of Biodentine and Mineral Trioxide Aggregate with Formocresol as Pulpotomy Medicaments in Primary Molars: An In Vivo Study. Int J Clin Pediatr Dent. 2020;13:167-173. *https://doi.org/10.5005/jp-journals-10005-1740*

6. Parirokh M, Torabinejad M, Dummer PMH. Mineral trioxide aggregate and other bioactive endodontic cements: an updated overview - part I: vital pulp therapy. Int Endod J. 2018;51:177-205 *https://doi.org/10.1111/iej.12841*

7. Kunert M, Lukomska-Szymanska M. Bio-Inductive Materials in Direct and Indirect Pulp Capping-A Review Article. Materials (Basel). 2020;13:1204.
https://doi.org/10.3390/ma13051204

8. Li Y, Sui B, Dahl C, Bergeron B, Shipman P, Niu L, Chen J, Tay FR. Pulpotomy for carious pulp exposures in permanent teeth: A systematic review and meta-analysis. J Dent. 2019;84:1-8. *https://doi.org/10.1016/j.jdent.2019.03.010*

9. Zanini M, Meyer E, Simon S. Pulp Inflammation Diagnosis from Clinical to Inflammatory Mediators: A Systematic Review. J Endod. 2017;43:1033-51.
https://doi.org/10.1016/j.joen.2017.02.009

10. Naseri M, Khayat A, Zamaheni S, Shojaeian S. Correlation between Histological Status of the Pulp and Its Response to Sensibility Tests. Iran Endod J. 2017;12:20-24.

11. Gopakumar R, Gopakumar M. Diagnostic aids in pediatric dentistry. Int J Clin Dent. 2011;4:1-7.
https://doi.org/10.5005/jp-journals-10005-1073

12. Jain P. Clinical diagnosis in endodontics. Clin Dent Revi. 2019;3:1-4.
https://doi.org/10.1007/s41894-019-0049-5

13. Pulp therapy for primary and immature permanent teeth. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: Am Academy Pediatric Dent; 2021:399-407

14. Smaïl-Faugeron V, Glenny AM, Courson F, Durieux P, Muller-Bolla M, Fron Chabouis H. Pulp treatment for extensive decay in primary teeth. Cochrane Database Syst Rev. 2018;5:CD003220. *https://doi.org/10.1002/14651858.CD003220.pub3*

15. Carti O, Oznurhan F. Evaluation and comparison of mineral trioxide aggregate and biodentine in primary tooth pulpotomy: Clinical and radiographic study. Niger J Clin Pract. 2017;20:1604-9. Carti O, Oznurhan F.

16. Ghoniem N, Vaidyanathan V, Zealand CM, Sushynski JM, Mettlach SM, Botero TM et al. Mineral trioxide aggregate and diluted formocresol pulpotomy: Prospective and retrospective study outcomes. J Mich Dent Assoc. 2018;100:40-65.

17. Jayam C, Mitra M, Mishra J, Bhattacharya B, Jana B. Evaluation and comparison of white mineral trioxide aggregate and formocresol medicaments in primary tooth pulpotomy: clinical and radiographic study. J Indian Soc Pedod Prev Dent. 2014;32:13-8. *https://doi.org/10.4103/0970-4388.127043*

18. Ozmen B, Bayrak S. Comparative evaluation of ankaferd blood stopper, ferric sulfate, and formocresol as pulpotomy agent in primary teeth: A clinical study. Niger J Clin Pract. 2017;20:832-8.

19. Botting RM, Botting JH. Pathogenesis and mechanisms of inflammation and pain. Clin Drug Investig. 2000;19:1-7. *https://doi.org/10.2165/00044011-200019002-00001*

20. Coll JA, Seale NS, Vargas K, Marghalani AA, Al Shamali S, Graham L. Primary Tooth Vital Pulp Therapy: A Systematic Review and Meta-analysis. Pediatr Dent. 2017;39:16-123.

21. Lundy FT, Irwin CR, McLean DF, Linden GJ, El Karim IA. Natural Antimicrobials in the Dental Pulp. J Endod. 2020;46:S2-S9. *https://doi.org/10.1016/j.joen.2020.06.021*

22. Cho SY, Seo DG, Lee SJ, Lee J, Lee SJ, Jung IY. Prognostic factors for clinical outcomes according to time after direct pulp capping. J Endod. 2013;39:327-31.
https://doi.org/10.1016/j.joen.2012.11.034

23. Duarte MA, Marciano MA, Vivan RR, Tanomaru Filho M, Tanomaru JM, Camilleri J. Tricalcium silicate-based cements: properties and modifications. Braz. Oral Res. 2018;32(suppl 1):e70. *https://doi.org/10.1590/1807-3107bor-2018.vol32.0070*