

CLINICAL AND RADIOGRAPHICAL EFFICACY OF FORMOCRESOL AND MINERAL TRIOXIDE AGGREGATE PULPOTOMY AMONG PRIMARY MOLARS

Original Research

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ABSTRACT

Background: Pulpotomy is a commonly performed procedure in paediatric dentistry aimed at preserving the health and function of primary teeth affected by pulpitis. Traditionally, Formocresol has been widely used due to its antibacterial properties; however, concerns regarding its potential toxicity and long-term effects on dental tissues have led to the exploration of alternative materials. Mineral Trioxide Aggregate (MTA) has emerged as a promising option due to its biocompatibility and regenerative capabilities, which may offer better clinical and radiographical outcomes. Understanding the comparative effectiveness of these materials is crucial for optimizing treatment protocols and improving patient outcomes in paediatric dental care.

Objective: To determine the clinical and radiographical efficacy of Formocresol and Mineral Trioxide Aggregate pulpotomy among primary molars

Methods: A quasi-experimental interventional study was conducted at Sandeman Provincial Hospital, Quetta, from October 2021 to October 2023. A total of 382 patients presenting with postoperative pain were randomly divided into two groups, with 191 individuals in each group. Group A received Formocresol, while Group B was treated with Mineral Trioxide Aggregate (MTA). Clinical parameters, including pain, tenderness, and swelling, were evaluated at baseline, 1 month, 3 months, and 6 months post-treatment using the Visual Analog Scale (VAS). Periapical radiographs were also taken at these intervals to monitor pulp healing and surrounding structures. Data was collected and analysed using SPSS version 26.0.

Results: Out of 382 patients, with male 195 (51.04%) and 187 (48.9%) were female. Patients were divided into 2 groups. At the 6-month follow-up, 4(2.09%) of patients in Group A experienced pain, whereas no patients in Group B reported pain. Periapical radiolucency was observed in 23(12.04%) of patients in Group A at 6 months compared to only 7(3.66%) in Group B. t-tests indicated that Group B (MTA) had significantly better clinical and radiographical outcomes compared to Group A (Formocresol) at all follow-up intervals ($p < 0.05$).

Conclusion: MTA demonstrates superior clinical and radiographical efficacy compared to Formocresol in pulpotomy procedures for primary molars.

Keywords: biocompatibility, clinical efficacy, dental pulp therapy, formocresol, mineral trioxide aggregate, paediatric dentistry, periapical healing, primary molars, pulpotomy procedure, radiographical outcomes, tooth vitality, Visual analogue scale.

INTRODUCTION

Pulpotomy is a common dental procedure performed in pediatric dentistry to manage pulpally involved primary molars. Among the various materials used for pulpotomy, Formocresol and Mineral Trioxide Aggregate (MTA) have emerged as popular choices due to their clinical and radiographical efficacy. Formocresol has been traditionally used because of its antibacterial properties and ease of use (1). However, concerns regarding its potential toxicity and the long-term effects on dental tissues have prompted the exploration of alternative materials such as MTA, which is known for its biocompatibility and regenerative properties (2). Recent studies have indicated that MTA may provide superior outcomes in terms of pulp healing and maintaining tooth vitality compared to Formocresol (3). The effectiveness of these two materials can be assessed through various clinical parameters, including pain relief, absence of clinical symptoms, and radiographical evaluation of the periapical area (4). This article aims to compare the clinical and radiographical outcomes of pulpotomy using Formocresol and MTA in primary molars, thus providing insight into their efficacy and helping practitioners make informed decisions in pediatric dental care.

In this context, understanding the differences in outcomes associated with these materials is crucial for optimizing treatment protocols and enhancing patient care (5). Moreover, ongoing research continues to shed light on the long-term implications of these materials on pediatric dental health (6). This study contributes to the existing literature by providing a comprehensive analysis of both materials in a clinical setting, emphasizing the importance of evidence-based practice in pediatric dentistry (7). As dental practitioners strive to improve treatment outcomes, the need for reliable materials that promote successful pulp therapy is paramount (8). The following sections will discuss the methodology, results, and implications of this comparative study, with an emphasis on the clinical significance of the findings (9). Ultimately, this research aims to provide a clearer understanding of how Formocresol and MTA stack up against each other in terms of efficacy, paving the way for better clinical decisions (10). This article evaluates the clinical and radiographical efficacy of Formocresol and Mineral Trioxide Aggregate (MTA) in pulpotomy procedures for primary molars. Understanding the comparative effectiveness of these materials is crucial for optimizing pediatric dental treatment outcomes and ensuring the long-term health of primary teeth in children.

METHODS

This quasi-experimental study was conducted on 382 patients referred to the Operative Department for pulpotomy of primary teeth at Bolan Medical, between October 2021 and October 2023, over a period of two years. Consecutive sampling was performed, and the study received ethical clearance from the Ethical Committee of Sandeman Provincial Hospital Quetta, Pakistan. Written informed consent was obtained from all patients and their guardians. The sample size was calculated using the WHO sample size calculator, with a 95% confidence interval, a 5% margin of error, and a caries prevalence rate of 46.2% among primary teeth, resulting in a total sample size of 382. The study population consisted of children aged 5 to 10 years, of both genders, who required pulpotomy treatment for their primary molars. A total of 382 primary molars were randomly assigned to two groups, with 191 patients in each group: Group A received Formocresol, while Group B was treated with Mineral Trioxide Aggregate (MTA). Children aged 5 to 10 years with primary molars showing symptoms of pulpitis but without abscesses or sinus tracts were included. Additionally, only those with no known allergies to Formocresol and MTA were enrolled, with informed consent secured from their guardians. The exclusion criteria comprised children with systemic diseases contraindicating dental procedures, a history of endodontic treatment on the same tooth, presence of abscess or periapical pathology, and teeth with extensive carious lesions that compromised tooth structure.

The materials used included commercially available Formocresol for Group A and Mineral Trioxide Aggregate for Group B. Other necessary materials such as local anesthetic, rubber dams, dental instruments, and radiographic materials were also utilized. Clinical and radiographical examinations were carried out preoperatively to confirm the eligibility of the teeth for pulpotomy. Randomization was performed using a computer-generated sequence, ensuring unbiased group allocation. The pulpotomy procedure involved administering local anesthesia and placing a rubber dam. Caries were removed, and the coronal pulp was accessed. In Group A, the coronal pulp was amputated, and Formocresol was applied to the pulp stump for 5 minutes before sealing with a zinc oxide eugenol (ZOE) base. In Group B, after pulp amputation, MTA was placed directly on the pulp stump and allowed to set before being sealed with ZOE. Postoperative

instructions were provided to guardians for the care and follow-up of the treated teeth. Clinical parameters, including pain, tenderness, and swelling, were assessed at baseline and at 1, 3, and 6 months post-treatment, using the Visual Analog Scale (VAS). Periapical radiographs were also taken at the same intervals to evaluate pulp healing and the condition of the surrounding structures. Data collection was entered and analyzed using SPSS version 26.0. Statistical analysis involved chi-square tests for categorical variables and t-tests for continuous variables to compare outcomes between the two groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The results of the study demonstrated that Mineral Trioxide Aggregate (MTA) showed significantly better clinical and radiographical outcomes compared to Formocresol in the treatment of primary molars. At the 6-month follow-up, only 7 (3.66%) patients in the MTA group exhibited periapical radiolucency, whereas 23 (12.04%) patients in the Formocresol group showed similar findings, indicating superior healing in the MTA group. Additionally, the success rate for MTA remained consistently high, with 172 (90%) of cases showing positive outcomes at 6 months, while the success rate for Formocresol decreased to 137 (71.7%). Statistical analysis using chi-square and t-tests confirmed that these differences were significant ($p < 0.05$), highlighting the greater efficacy of MTA over Formocresol in promoting pulp healing and reducing complications.

Table 1 Demographic Characteristics of Respondents

Variables	Male	Female	p value
Group A	98(51.3%)	93(48.7%)	0.43
Group B	97(50.8%)	94(49.2%)	0.12
Total	195 (51.04%)	187 (48.9%)	

A total of 382 primary molars were included in the study, with 191 molars in Group A (Formocresol) and 191 molars in Group B (Mineral Trioxide Aggregate [MTA]). The demographic characteristics, including age (5 to 10 years) and gender distribution, were comparable between both groups, ensuring balanced representation for analysis.

Table 2 Demographic Characteristics of Respondents

Variables	Group A	Group B	p value
1 Month	29(15.1%)	14(7.32%)	0.06
3 Month	19(9.9%)	3(1.5%)	0.02
6 months	4(2.09%)	0(0%)	0.00

Clinical assessments were conducted at baseline, 1 month, 3 months, and 6 months post-treatment. At 1 month 29(15.1%) of patients in Group A reported pain, compared to 14(7.32%) in Group B. By 3 months, pain was reported by 19(9.9%) of Group A and 3(1.5%) of Group B. At the 6-month follow-up, 4(2.09%) of patients in Group A experienced pain, whereas no patients in Group B reported pain.

Table 3 Tenderness and Swelling

	1 Month	3 Months	6 Months
Group A - Tenderness	38 (19.89%)	-	19 (9.9%)
Group B - Tenderness	9 (4.7%)	Resolved	Resolved
Group A - Swelling	3 (0.157%)	-	-
Group B - Swelling	None	None	None

Tenderness was observed in 38 (19.89%) of Group A patients at 1 month, decreasing to 19(9.9%) at 6 months. In Group B, tenderness was present in 9 (4.7%) at 1 month and resolved completely by the 3-month follow-up. Swelling was noted in 3(0.157%) of Group A patients at 1 month, while no swelling was recorded in Group B at any follow-up point.

Table 4 Radiographical Outcomes

	3 Months	6 Months	Test Used
Group A - Radiographical Success Rate	149 (78.01%)	137 (71.7%)	Chi-square test
Group B - Radiographical Success Rate	178 (93.19%)	172 (90.0%)	Chi-square test
Group A - Periapical Radiolucency	-	23 (12.04%)	T-test
Group B - Periapical Radiolucency	-	7 (3.66%)	T-test
Overall Comparison	-	MTA>Formocresol	Statistical Analysis

Radiographic evaluations were conducted at regular intervals to assess pulp healing and periapical conditions. At the 3-month mark, the radiographical success rate for Group A (Formocresol) was 78.01% (149 cases), while Group B (MTA) showed a higher success rate of 93.19% (178 cases). By the 6-month follow-up, Group A's success rate decreased to 71.7% (137 cases), whereas Group B maintained a success rate of 90.0% (172 cases). Additionally, periapical radiolucency was observed in 12.04% (23 patients) of Group A at 6 months, compared to only 3.66% (7 patients) in Group B, indicating significantly better healing outcomes for Group B. Statistical analysis using chi-square and t-tests confirmed that MTA (Group B) had significantly superior clinical and radiographical results compared to Formocresol (Group A) across all follow-up intervals ($p < 0.05$).

DISCUSSION

This study aimed to compare the clinical and radiographical efficacy of Formocresol and Mineral Trioxide Aggregate (MTA) in pulpotomy procedures for primary molars. With a total sample size of 382, the findings indicated that MTA provided superior outcomes in both clinical and radiographical assessments compared to Formocresol. Clinically, Group B (MTA) demonstrated better pain relief and a quicker resolution of tenderness and swelling compared to Group A (Formocresol). Radiographically, MTA showed a higher success rate and improved healing outcomes when compared to Formocresol. These results align with previous studies suggesting that MTA promotes better healing due to its biocompatibility and regenerative properties (13). The data showed that patients in Group B experienced significantly less pain and tenderness compared to those in Group A at all follow-up intervals, specifically at 1, 3, and 6 months. At the 6-month mark, pain was reported in only 8% of patients in Group A, while no patients in Group B reported pain. The resolution of tenderness and swelling was also significantly better in Group B, with no instances of these symptoms reported by the 6-month follow-up. This aligns with existing literature that highlights MTA's ability to facilitate pulp healing and reduce the inflammatory response typically associated with Formocresol (14).

Radiographical assessments revealed that Group B had a success rate of 93% at the 3-month interval, which decreased slightly to 90% at 6 months, indicating sustained efficacy. In contrast, Group A's success rate was 78% at 3 months but dropped to 72% at 6 months, showing a decline in effectiveness over time. This trend is consistent with findings from other studies that suggest MTA not only offers immediate benefits but also supports long-term pulp vitality and health (16). Additionally, the incidence of periapical radiolucency was significantly lower in Group B, with only 4% of patients showing radiolucency at 6 months compared to 12% in Group A. This difference highlights MTA's role in reducing complications associated with pulp therapy (17). Although this study provides valuable insights, certain limitations should be noted. The sample size, while adequate, was drawn from a single institution, which may limit the generalizability of the findings. Moreover, the study only assessed outcomes up to 6 months, and long-term follow-up is needed to further understand the durability and effectiveness of these materials beyond this timeframe.

CONCLUSION

MTA demonstrated superior clinical and radiographical efficacy compared to Formocresol in pulpotomy procedures for primary molars. The findings support the growing preference for MTA in pediatric dentistry due to its favorable healing properties and lower complication rates. Future studies are recommended to explore long-term outcomes and evaluate the effectiveness of these materials across diverse populations.

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