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Comparative evaluation of effectiveness of formocresol and MTA as pulpotomy agent in primary molars

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Abstract
Introduction: Formocresol has been a well-known pulpotomy medicament over many years. It is considered the "gold standard" pulpotomy agent in pediatric dentistry. However, concerns have been raised over its use in children. It has been reported that formocresol has toxic and mutagenic effects in cell culture, dental crypts, and precancerous epithelial cells. Therefore, additional biocompatible treatment alternatives are required to replace formocresol pulpotomy.
Aim: To evaluate and compare formocresol mineral trioxide aggregate (MTA) as pulpotomy medicaments by clinical and radiographic assessments in primary molar.
Materials and Methods: This study was performed on 50 mandibular deciduous molar teeth requiring pulpotomy treatment. Children between age four and six years were randomly selected and divided into formocresol or MTA group. The patients were recalled after 3, 6 months respectively and evaluated clinically and radiographically.
Results: Statistical analysis showed no significant difference between the two groups ($P > 0.05$). The overall clinical success of FC and MTA was 100 at 3, 6 follow-up. The overall radiographic success of FC was 100%, 96, and that of MTA was 100% at 3, 6 months, respectively.
Conclusion: Mineral trioxide aggregate showed clinical and radiographic success as a dressing material following pulpotomy procedure in primary teeth, and it has a promising potential to become a replacement for FC in primary molars.

Keywords: pulpotomy, formocresol, MTA

Introduction

Vital pulp therapy in pediatric dentistry aims to retain the health and integrity of a tooth and its supporting periodontium [1].One such therapeutic technique that is being used to prevent a carious primary tooth from extraction is pulpotomy, which is performed in the tooth having deep caries with no associated indication of any radicular pulpitis.

This technique employs the removal of the affected coronal pulp, while preserving the vital radicular pulp [2]. Formocresol (Buckley, 1904) is still regarded as the "gold standard" pulpotomy medicament. Irrespective of the many disadvantages like cytotoxicity, pulp inflammation, necrosis, systemic disturbances, mutagenicity, carcinogenic potential, and immunological responses, it is the most widely used pulpotomy medicament over the decades with a huge success rate, owing to its bacteriostatic and fixative properties [3].

Mineral Trioxide Aggregate (MTA) is one of the most recent developments in the field of dental materials which is proved to be a biocompatible agent [4].Therefore, the present study aimed to evaluate and compare the success of formocresol and MTA as pulpotomy medicaments over 6 months of the follow-up period.

Materials and Methods

The study was conducted on 50 deciduous molars in patients aged 4-6 years visiting the outpatient department of pedodontics and preventive dentistry. Prior to initiation of the study, ethical approval was obtained by the institutional review board. Only primary molars indicated for pulpotomy were admitted to the study. The inclusion criteria included only healthy cooperative patients with no spontaneous or noctornal pain in selected for the study. The selected tooth should have lost more than one-third of the marginal ridge due to caries and there should be with absence of the abscess and sinus with selected tooth. The tooth should be restorable, with deep dentinal caries approximating the pulp or iatrogenic exposure of the pulp, diagnosed as reversible pulpitis and on excavating the pulp from the pulp chamber, the color of the blood from the pulp should be bright red and bleeding should stop within 2–3 minutes after application of a moist cotton pellet. The radiographic inclusion criteria that were taken into considerations were presence of two-third of the root of primary molars, no evidence of inflammatory internal/external resorption of roots, and no evidence of interradicular bone loss or

bifurcation or trifurcation radiolucency.

The exclusion criteria included teeth with the history of continuous pain on lying down, acute irreversible pulpitis, presence of a swelling or a sinus tract in relation to the carious tooth, exfoliating tooth, and presence of pathological mobility. Radiographically, presence of furcation and interradicular radiolucency indicating bone loss, evidence of pathological internal/external resorption of roots due to inflammation, and physiological or inflammatory root resorption more than one-third were also excluded from the study.

A detailed case history was recorded of each patient followed by a thorough clinically and radiographically examination. Study was explained to the parents and their informed consent was obtained. A total of 50 primary mandibular molars satisfying the inclusion and exclusion criteria were selected for the study. Selected primary molars were allocated to two equal groups according to pulpotomy medicaments used. Group I-Formocresol group (FC), Group II-MTA group consisted of 25 teeth each, respectively. Following local anesthetic administration and access opening was made with a No. 330 bur to expose and deroof the coronal pulp chamber. Pulp amputation was done with a sterile spoon excavator and irrigation with normal saline to remove any debris present. Hemostasis was achieved with sterile moistened cotton pellets. After arrest of bleeding, following steps were taken.

In the MTA group, the MTA was manipulated in the ratio of 3:1 (Powder: liquid) to obtain a putty mix. This mix was placed over the radicular pulp with the help of a suitable sterile amalgam carrier. Gentle condensation of the mix was done in the pulp chamber with a moistened cotton pellet.

In the formocresol group, one-fifth dilution of Buckley's formocresol (moistened cotton pellet) was placed for 1 minute on the amputated radicular pulp stumps. The chamber was them flushed with normal saline to remove all the traces of the formocresol liquid. After drying the chamber, zinc oxide eugenol cement was condensed over the fixed radicular pulp stumps.

Each tooth was sealed using the glass ionomer cement followed by stainless steel crown (SSC). Clinical and radiographic evaluation of patient was done after 3, 6 months and findings were recorded.

Result

Pulpotomies were performed in a total of 50 primary molars in children aged 4 to 6 years-old. Formocresol (Pyrocresol, Pyrax, india) and MTA (Maarc MTA) were used as medicaments for pulpotomy. The teeth were assessed for the presence of clinical signs (pain, tenderness to percussion, abscess, swelling, fistula, and pathologic mobility) and radiographic findings (radicular radiolucency, internal and external root resorption, and PDL space widening and furcation radiolucency) at 3 and 6 months interval. At 3 month evaluation both Formocresol and MTA group shows 100% clinical and radiographic success rate (Table 1). At 6 month evaluation MTA group shows 100% clinical and radiographic success rate whereas formocresol group shown 96% clinical and radiographic success (Table 2). In present study no significant difference was seen in both groups (Table no 3).

Table 1: Clinical evaluation and radiographic of formocresol and MTA pulpotomy at 3 month recall

	Formocresol group		MTA group	
	Success	**Failure**	**Success**	**Failure**
Clinical evaluation	25	0	25	0
Radiographic evaluation	25	0	25	0

Table 2: Clinical evaluation and radiographic of formocresol and MTA pulpotomy at 6month recall

	Formocresol group		MTA group	
	Success	**Failure**	**Success**	**Failure**
Clinical evaluation	24	1	25	0
Radiographic evaluation	24	1	25	0

Table 3: Overall clinical and radiographic success at recall

	Formocresol group		MTA group		
	3 month	**6 month**	**3 month**	**6 month**	**P value**
Overall success rate	100%	96%	100%	100%	$P > 0.05$

Discussion

The preservation of the primary tooth is desirable until the eruption of permanent tooth [5].Endodontic procedures, such as pulpotomy and root canal treatment aim to avoid early extraction of heavily decayed teeth, and subsequently allow for a smoother transition from primary to permanent dentition [6]. When the carious process exposes the pulp, it reacts via inflammation limited to the area close to the carious lesion. If the pulp in the root canal seems to be unaffected, pulpotomy is the treatment of choice [7]. Pulp medicaments should induce the regeneration of the remaining pulp tissue, and any potential inflammatory response caused by their application must not cause harm to the pulp [8, 9]. Present study evaluated the clinical and radiographic success rate of pulpotomy with FS and MTA as pulpotomy medicaments in primary molars. In our study, over the period of 6 month the clinical and radiographic success rate for FS group was found to be 96% which is similar findings were reported by Gisoure F et al (2011) [10]. Ng FK and Messer LB et al (2008) [11] suggested that as FS is not an antimicrobial agent and cannot heal pulp or stimulate pulp regeneration, the clinical success of FS appears to be dependent on pulp status. In present study 100% clinical and radiographic success rate was seen over the period of 6 month. Finding of our study was similar to the study conducted by Salako N (2003) [12], Torabinejad M (1999) [13] and Shirvan A et al. (2014) [14]. Better success rate of MTA can be attributed to its biocompatibility and sealing ability when compared to FC. Despite the promising findings regarding the use of MTA in this study, it is important to note that the follow-up period was short. There is, therefore, a need to conduct further studies with a larger sample size and longer follow-up period. It is also important to study and determine the possible effects of MTA on succedaneous permanent teeth [15]. Further, histological studies are also needed to determine the pulpal response to this material. [16] However, the results here indicate that MTA has a promising potential to be a replacement for FC after pulpotomy in primary molars.

Conclusion

Mineral trioxide aggregate showed clinical and radiographic success as a dressing material following pulpotomy procedure in

primary teeth, and it has a promising potential to become a replacement for FC in primary molars. Though FC has been a controversial medicament for decades, it is still being used for pulpotomy procedure. However, MTA may be a potential replacement for FC.

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