



Clinical and Radiographic Evaluation of Success of Two commercially Available Pulpotomy Agents in Primary Teeth: An *in vivo* Study

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ABSTRACT

Aim: The aim of this study is to evaluate and compare Biodentine and mineral trioxide aggregate (MTA) as pulpotomy agents by clinical and radiological assessments in primary teeth.

Materials and methods: In this study, 90 decayed primary molars indicated for pulpotomy were chosen and are divided into two groups. Soft enamel and dentinal caries were removed using spoon excavator. Access opening was done using high-speed cool water handpiece. Normal saline was used to irrigate pulp chamber, later saline moistened cotton pellet was used to obtain hemostasis in both groups. Restorations were placed in respective groups and immediate postoperative radiographs were taken. Follow-ups were done at every 3 months intervals, i.e., 3, 6, 9, and 12 months respectively.

Results: Statistical evaluation was carried out by using paired t-test which showed no significant difference between the two groups ($p \geq 0.05$) with high success rate of 95.5%.

Conclusion: Pulpotomy with MTA and Biodentine is a reliable biological method for pulp treatment of primary teeth.

Clinical significance: Mineral trioxide aggregate and Biodentine could be considered as a reliable biological method for pulpotomy of primary teeth.

Keywords: Biodentine, Mineral trioxide aggregate, Primary teeth, Pulpotomy.

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INTRODUCTION

Preservation of arch space is one of the primary objectives of pediatric dentistry and premature loss of primary teeth may cause aberration of the arch length, resulting in mesial drift of the permanent teeth and consequent malocclusion.¹

Formocresol is regarded as the "gold standard" and was first introduced by Sweet as a pulp medicament in 1904 and since 1930 it has been the treatment of choice for primary molar vital pulpotomy. But concerns have been expressed about formocresol pulpotomy because of carcinogenic and mutagenic potential.²

Mineral trioxide aggregate (MTA), a new material currently being used in pulp therapy, has been demonstrated to have multifaceted use in dentistry. Mineral trioxide aggregate's approval in 1998 by US Food and Drug Administration led to more widespread use. Mineral trioxide aggregate is composed of dicalcium silicate, tricalcium aluminate, tricalcium silicate, and tetracalcium aluminoferrite.³ It allows regeneration of apical periodontium with the formation of barrier supplement of new cementum. From the various studies published confirming its utility in various clinical applications, ProRoot MTA is one of the materials impossible to replace.⁴⁻⁶

A new experimental calcium silicate-based restorative cement has been developed, put on the market under the name of Biodentine (Septodont, Saint Maur des Fosses, France).⁷⁻⁹ As MTA and Portland's cements, Biodentine is a calcium-based cement that exhibits excellent sealing properties better than MTA.¹⁰

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The aim of the present study was to compare MTA, a highly successful material and considered as new gold standard material, with a new material, Biodentine, to clinically and radiographically evaluate as pulpotomy agents in the primary molar teeth at 3, 6, 9, and 12 months intervals.

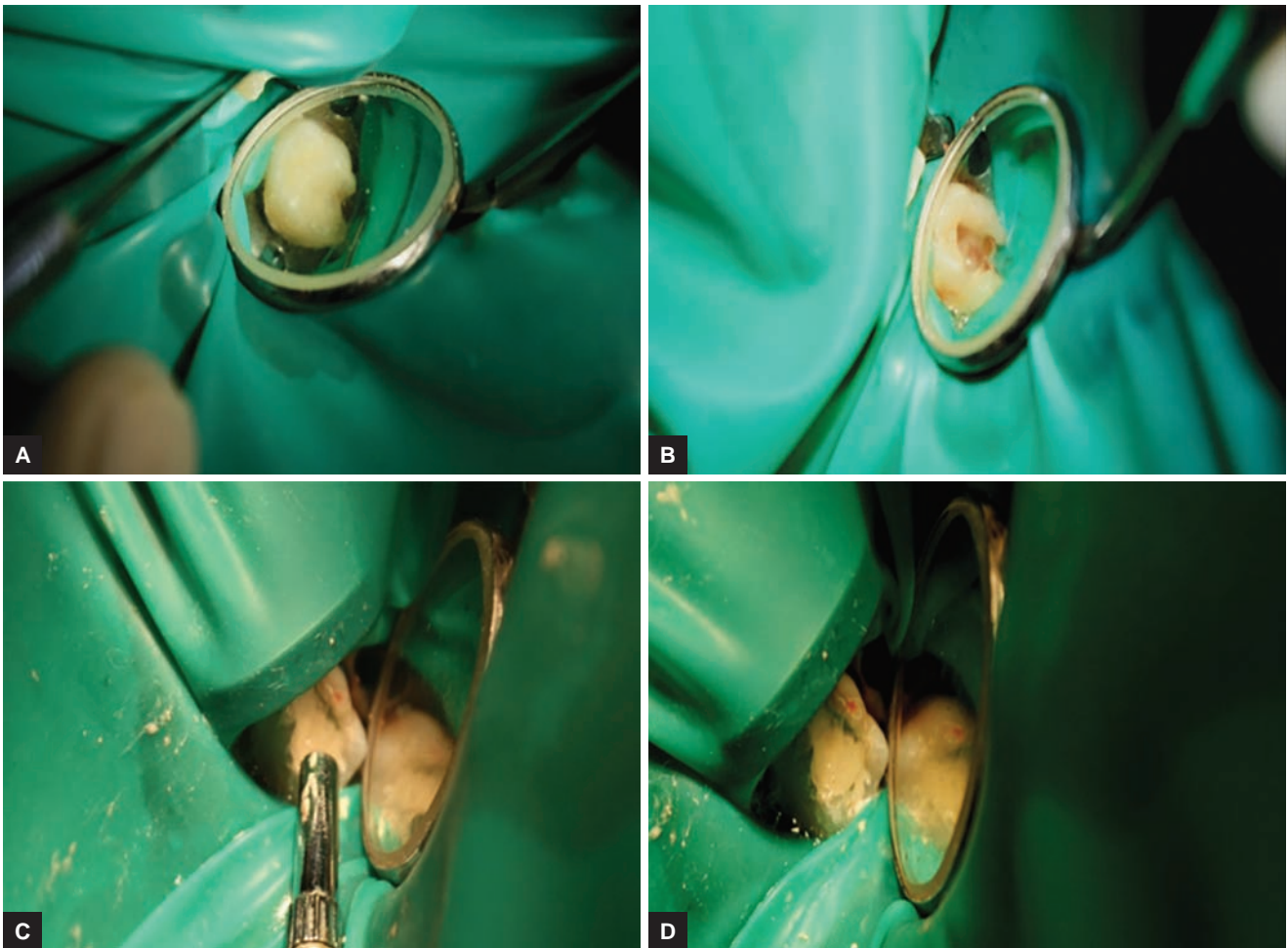
MATERIALS AND METHODS

The study was conducted on children who attended Department of Pediatric and Preventive Dentistry, Panineeya Institute of Dental Sciences and Research Center, Hyderabad. The treatment protocols and possible outcome of the treatment was explained to the parents or guardians and written consent was obtained as approved by the Institutional Scientific and Ethical Review Committee. The study was conducted on children of age 4 to 9 years of both sexes on 90 primary molar teeth which were randomly divided into either Biodentine (Septodont LOT.No-BOT B06312) or MTA group (ProRoot LOT.No-110043740) requiring pulpotomy treatment. Diagnostic and treatment protocols, as well as re-call observations, were performed under the guidance of experienced faculty. For

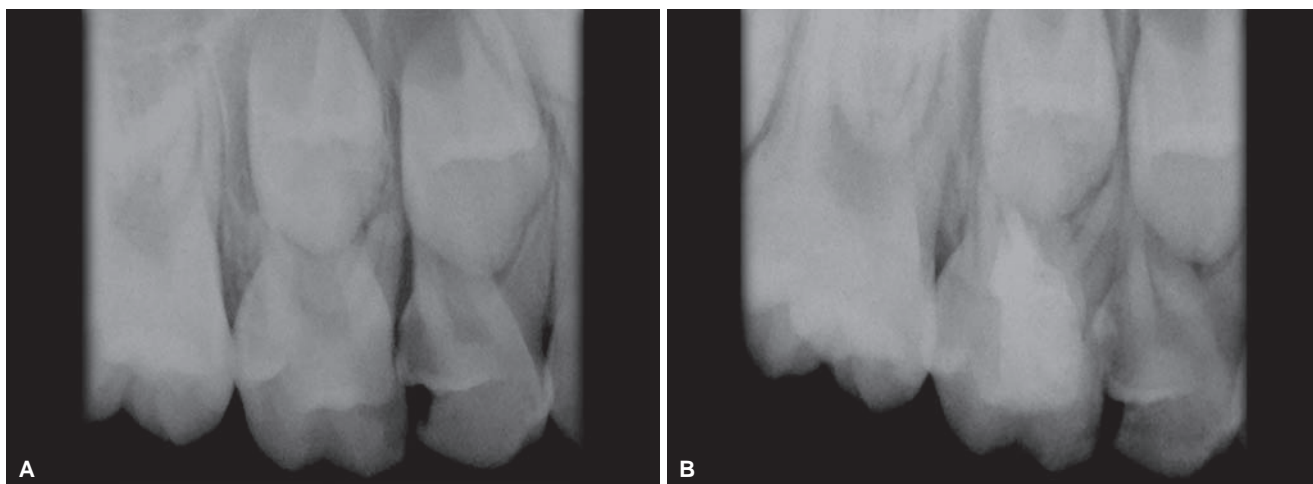
standardization of X-ray films, XCP dental film holder has been used.

The study was done on maxillary and mandibular right and left primary 1st and 2nd molars. After the preoperative radiographs were taken, the tooth which required pulpotomy treatment was anesthetized and rubber dam isolation was done. Soft enamel and dentinal caries were removed using spoon excavator. Access opening was done with bur no. A total of 330 using high-speed cool water handpiece. Sharp spoon excavator was used to remove coronal pulp tissue. Normal saline was used to irrigate pulp chamber; later saline moistened cotton pellet was used to obtain hemostasis in both groups.

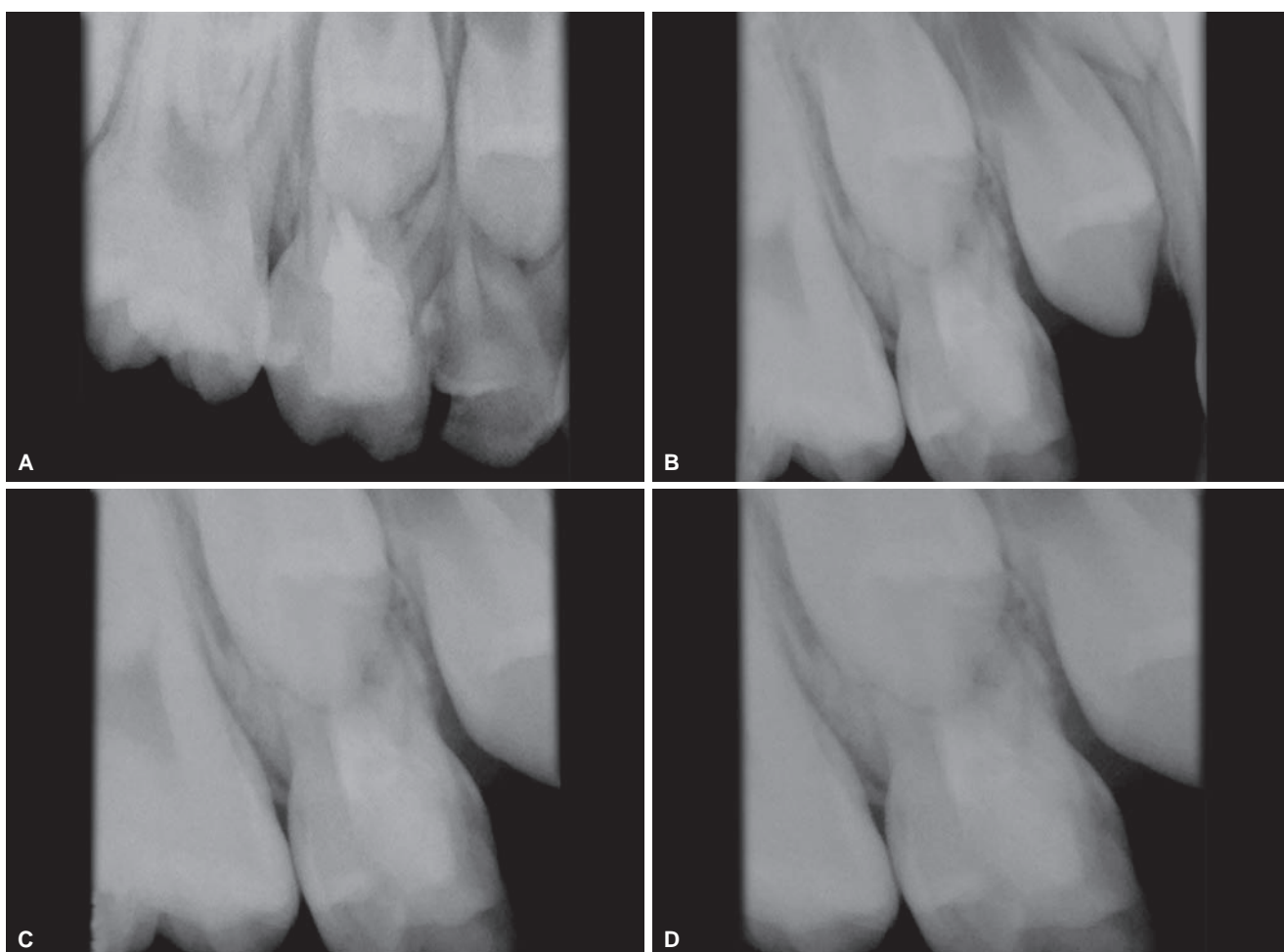
In the group I MTA, the MTA paste was obtained by mixing powder and distilled water in the ratio 3:1 to obtain a putty consistency. Approximately 2 mm thick layer of MTA was placed inside the pulp chamber and condensed with saline moistened cotton pellet. Temporary restoration was given with thick layer of zinc oxide/eugenol mix. As MTA has longer setting time, patients were recalled after 24 hours for permanent restoration with Fuji IX glass ionomer cement (GIC) followed by stainless steel crown (Figs 1 to 3).



Figs 1A to D: Steps of clinical procedure (MTA group): (A) Preoperative photograph; (B) removal of pulp tissue; (C) MTA placement into the pulp chamber; and (D) final restoration



Figs 2A and B: Radiographs of MTA: (A) Preoperative; and (B) postoperative



Figs 3A to D: Radiographs of MTA follow-up: (A) 3 Months follow-up; (B) 6 months follow-up; (C) 9 months follow-up; and (D) 12 months follow-up

In the group II (Biodentine), before the Biodentine capsule was opened, it was tapped gently on a hard surface to diffuse the powder. Five drops of liquid from the single-dose dispenser are transferred into the capsule and placed in triturator for 30 seconds. The material was recovered with the aid of the manufacturer supplied spatula. To place the material inside the pulp chamber, an

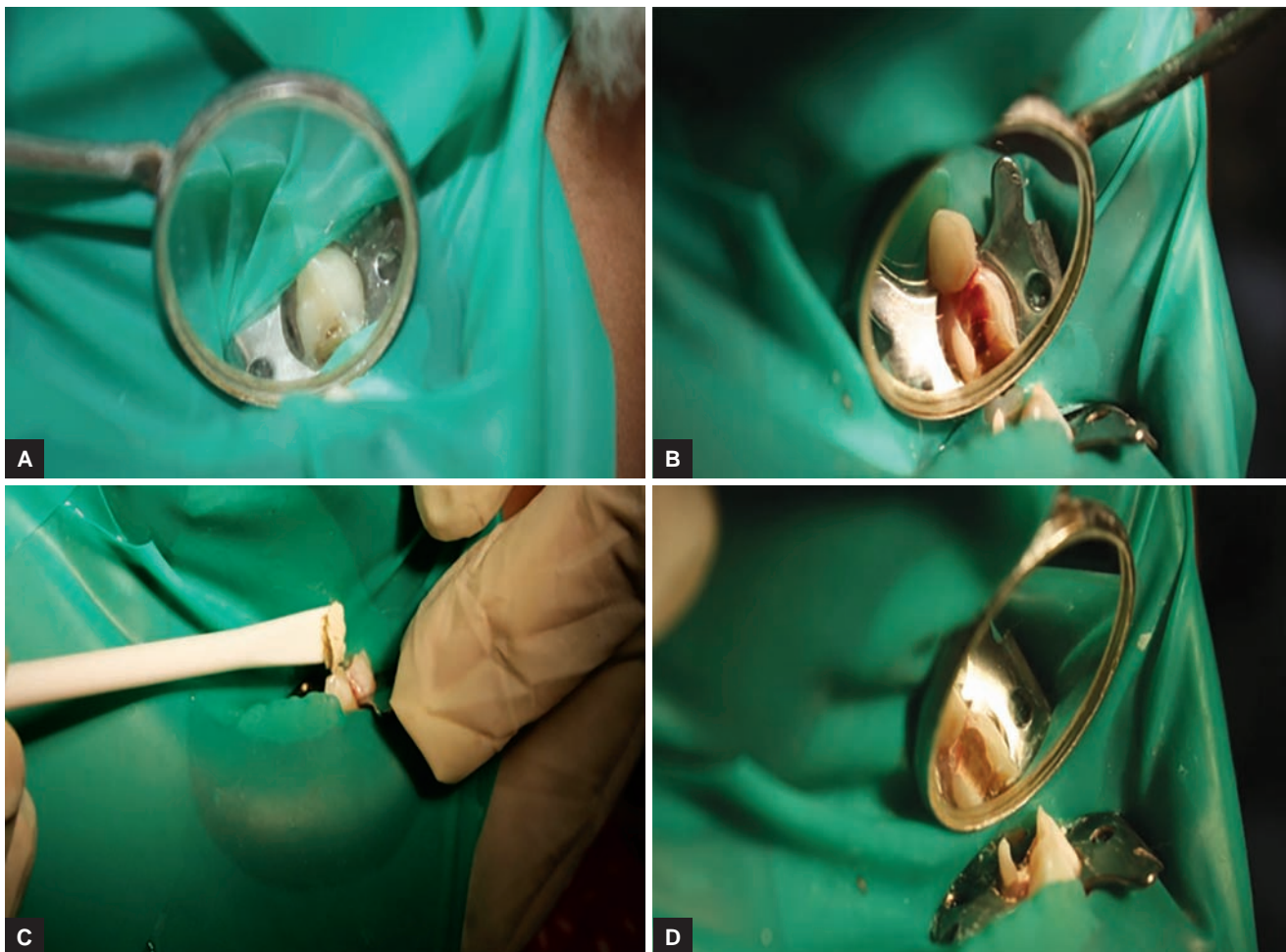
amalgam carrier or spatula was used. A plugger or cotton pellet was used without excessive compression. A radiograph was taken after removing the rubber dam. A layer of zinc oxide/eugenol thick mix was placed in the pulp chamber as temporary restoration. Patients were recalled after 24 hours for permanent restoration with Fuji IX GIC followed by stainless steel crown. Finally, the patients

were recalled after 1, 3, 6, 9 and 12 months for clinical and radiographic evaluation. Teeth were considered to be clinical success in the absence of pain, tenderness on percussion, swelling and/or fistula, pathologic tooth mobility. Radiographic success was based on the absence of radiolucency in furcation/periapical area, internal or

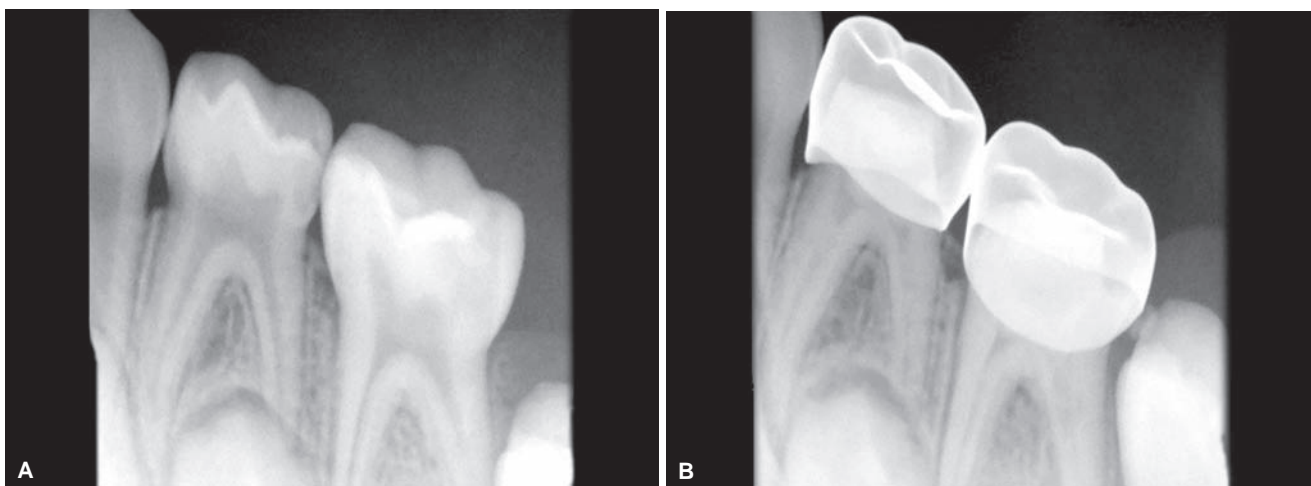
external root resorption, and widening of periodontal space (Figs 4 to 6).

RESULTS

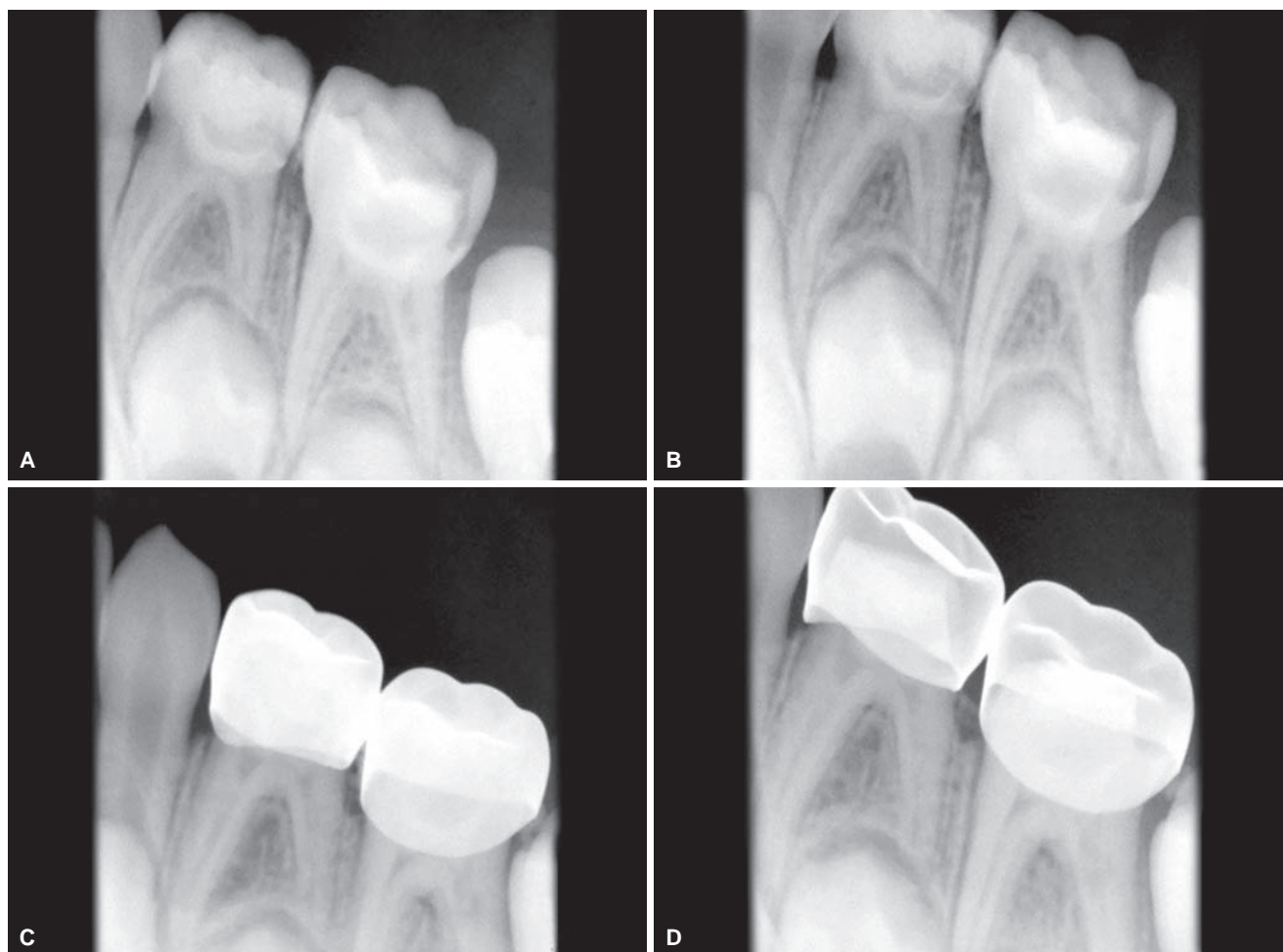
In the group I, a total of 45 teeth were treated with MTA pulpotomy. At the end of 12 months one tooth was lost



Figs 4A to D: Clinical procedure of Biodentine group: (A) Preoperative photograph; (B) removal of coronal pulp tissue; (C) biodentine placement into pulp chamber; and (D) final restoration



Figs 5A and B: Radiographs of MTA group: (A) Preoperative; and (B) postoperative



Figs 6A to D: Radiographs of Biodentine follow-up: (A) 3 months follow-up; (B) 6 months follow-up; (C) 9 months follow-up; and (D) 12 months follow-up

Table 1: Clinical evaluation of treatment groups using paired t-test

Treatment groups	Clinical evaluation	3 months	6 months	9 months	12 months	p-value		
						3 vs 6	3 vs 9	3 vs 12
MTA	No pain	45	45	45	44	≥ 0.05	≥ 0.05	≥ 0.05
	No percussion	45	45	45	44	≥ 0.05	≥ 0.05	≥ 0.05
	No abscess	45	45	45	44	≥ 0.05	≥ 0.05	≥ 0.05
	No mobility	45	45	45	45	≥ 0.05	≥ 0.05	≥ 0.05
Biodentine	No pain	45	45	44	44	≥ 0.05	≥ 0.05	≥ 0.05
	No percussion	45	45	44	44	≥ 0.05	≥ 0.05	≥ 0.05
	No abscess	45	45	44	44	≥ 0.05	≥ 0.05	≥ 0.05
	No mobility	45	45	45	44	≥ 0.05	≥ 0.05	≥ 0.05

to follow-up. Hence, 44 teeth were clinically and radiographically evaluated at the end of 12 months. In the group II, a total of 45 teeth were treated with Biodentine pulpotomy. At the end of 9 months one tooth was lost to follow-up. Hence, 44 teeth were clinically and radiographically evaluated at the end of 12 months. On 3, 6, and 9 months clinical evaluation, MTA group has showed 100% success rate without any failure of clinical signs and symptoms. One patient complained about pain, percussion sensitivity, and abscess at 12 months, so the patient was excluded from the study which was considered as

a failure of the study and followed by pulpectomy treatment. At the end of 12 months, the success rate of MTA group was 95.5% (Table 1).

On radiographic evaluation, the MTA group has showed 100% success rate without any failure at 3, 6, and 9 months interval. At 12 months evaluation, one tooth in MTA group showed interradicular radiolucency and periodontal ligament widening.

On 3 and 6 months of clinical evaluation, Biodentine group has showed 100% success rate without any failure of clinical signs and symptoms. One patient complained

Table 2: Radiographic evaluation of treatment groups using paired t-test

Treatment groups	Radiographic evaluation	3 months	6 months	9 months	12 months	p-value		
						3 vs 6	3 vs 9	3 vs 12
MTA	No inter radicular radiolucency	45	45	45	44	≥0.05	≥0.05	≥0.05
	No external/internal resorption	45	45	45	45	≥0.05	≥0.05	≥0.05
	No periodontal ligament widening	45	45	45	44	≥0.05	≥0.05	≥0.05
Biodentine	No inter radicular radiolucency	45	45	44	44	≥0.05	≥0.05	≥0.05
	No external/internal resorption	45	45	45	44	≥0.05	≥0.05	≥0.05
	No pdl widening	45	45	44	44	≥0.05	≥0.05	≥0.05

about pain, percussion sensitivity, and abscess at the end of 9 months and was excluded from the study which was considered as a failure of the study and followed by pulpectomy treatment. So at the end of 12 months, only 44 patients participated in the Biodentine group. Biodentine group has showed 95.5% success rate at the end of 12 months (Table 2).

On radiographic evaluation, Biodentine group has showed 100% success rate without any failure at 3 and 6 months. At 9 months follow-up, one tooth has shown interradicular radiolucency and periodontal ligament widening at the end of 9 months. Radiographically, Biodentine has showed 95.5% success rate at the end of 12 months. At the end of 12 months, statistical analysis was done using paired t-test, which revealed no significant difference between MTA and Biodentine groups ($p \geq 0.05$).

DISCUSSION

For many years formocresol has been considered as the gold standard pulpotomy agent for primary teeth. Several studies have reported the use of formocresol because of its toxicity and carcinogenicity. This has led to several investigations looking at the alternatives for formocresol, including enamel matrix derived, bone morphogenic proteins, MTA, and Biodentine. In the current study, clinical success and radiographic effects of new materials, i.e., MTA and Biodentine were evaluated when used as a pulpotomy medicament.

Torabinejad and White¹¹ conducted a study in which MTA was compared to formocresol as pulpotomy agent in primary teeth for a period of 30 months. The author reported the drawbacks of MTA that include discoloration potential, difficult in handling characteristics, long setting time, high material cost, an absence of solvent, and the difficulty of its removal after curing.¹²

Biodentine is a new calcium silicate material similar to MTA.¹³ It is biocompatible¹⁴ and capable of inducing the opposition of reactionary dentin by stimulating odontoblast activity¹⁵ and exhibits reparative dentin formation.¹⁶

A disadvantage of Biodentine is, however, visible on the picture: The radiopacity of the cement is very similar to that of dentin, so that the Biodentine layer is not easily

differentiated from dentin under the radiographically readily visible composite filling.

On 3, 6, and 9 months clinical evaluation, the MTA group has showed 100% success rate without any failure of clinical signs and symptoms. One patient complained about pain, percussion sensitivity, and abscess at 12 months and that patient was excluded from the study, which was considered as a failure of the study and followed by pulpectomy treatment. At the end of 12 months, the success rate of MTA group was 95.5%. On radiographic evaluation, MTA group has showed 100% success rate without any failure at 3, 6, and 9 months interval. At 12 months evaluation, one tooth in MTA group showed interradicular radiolucency and periodontal ligament widening.

On 3 to 6 months of clinical evaluation of Biodentine group, the result has showed 100% success rate without any failure of clinical signs and symptoms. One patient complained about pain, percussion sensitivity, and abscess at the end of 9 months and was excluded from the study which was considered as a failure of the study and followed by pulpectomy treatment. So at the end of 12 months only 44 patients participated in the Biodentine group. Biodentine group has showed 95.5% success rate at the end of 12 months. On radiographic evaluation, Biodentine group has showed 100% success rate without any failure at 3 and 6 months. At 9 months follow-up, one tooth has shown interradicular radiolucency and periodontal ligament widening at the end of 9 months. Radiographically, Biodentine has showed 95.5% success rate at the end of 12 months.

Clinically and radiographically, MTA and Biodentine have shown success rate of 95.5% with no significant statistical difference ($p \geq 0.05$) between both treatment groups for the observation period of 3, 6, and 9 months. The common clinical failure in the present study in both MTA and Biodentine groups was pain, percussion sensitivity, and abscess. The radiographic failure was attributed to interradicular radiolucency and periodontal ligament widening, or any procedural errors that included manipulation of material (mixing time), delay in placement of material into the pulp chamber, and insufficient material placement.

CONCLUSION

- The current study shows high success rate with MTA and Biodentine as a pulpotomy agent in primary teeth for the period of observation.
- Pulpotomy with MTA and Biodentine is a reliable biological method for pulp treatment of primary teeth.
- Further histological evaluation is required for the evaluation of both MTA and Biodentine as pulpotomy agents in primary teeth.

CLINICAL SIGNIFICANCE

Mineral trioxide aggregate and Biodentine have been considered as most favorable materials of choice for pulpotomy in primary teeth as they have shown a high success rate of 95.5%.

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