

# Comparison of Three Treatment Techniques for Deep Carious Lesions in Primary Teeth: An *In Vivo* Study

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## ABSTRACT

**Aims:** To evaluate and compare three different treatment modalities in the management of deep carious lesions in primary molars.

**Material and methods:** A total of 60 primary molars from patients aged 4–9 years were randomly divided into three groups with 20 samples each. Sample in Group I received indirect pulp therapy with Mineral Trioxide Aggregate [MTA] as lining material, Group II received the modified Hall technique, and Group III MTA pulpotomy. The patients were evaluated at 1, 3, 6, and 9 months as per evaluation criteria for success or failure of the same. A Chi-square test was used for proportions and for comparison between groups.

**Results:** Clinically, the success rate for the modified Hall technique and MTA pulpotomy was higher than indirect pulp therapy. Radiographically, the modified Hall technique had the highest success rate of 100 percent among the indirect pulp therapy and MTA pulpotomy. This success rate was however not statistically significant.

**Conclusion:** All three techniques had promising results clinically and radiographically. Since the results were not statistically significant, conservative treatment like Modified Hall's technique can be preferred over the surgical approach [MTA Pulpotomy].

**Clinical significance:** This study compares newer techniques called Hall's technique with traditional techniques like indirect pulp capping and MTA pulpotomy. Hall's technique is a quick and noninvasive procedure, which involves fitting the crown and seating it over the tooth without any caries removal/ tooth preparation and no local anesthesia is being practiced. In the present study Hall's technique showed higher rates of success compared to the other two procedures.

**Keywords:** Hall technique, Indirect pulp capping, Mineral Trioxide Aggregate, Primary dentition, Pulpotomy, Stainless steel crown, Rampant caries.

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## INTRODUCTION

Dental caries is a chronic multifactorial microbial disease that is most prevalent worldwide affecting the primary and permanent dentition.<sup>1</sup> In children, early childhood caries has been a major problem and it deserves significant attention as conservation of the primary teeth till their normal exfoliation is a must for normal vocal function and facial growth of the kid.<sup>2</sup> Thus protection of primary teeth with deep multisurface caries needs appropriate vital pulp therapy. There are various concepts for treatment of deep carious lesions of which most preferred therapeutic approaches are indirect pulp capping [IPT] and pulpotomy. However, in recent years, more conservative approaches to recognize and prevent oral ailments at the initial stage in order to reduce invasive surgery have emerged. The advantage of minimally invasive treatments are that there is conservation of tooth structure and also retains maximum thickness of dentin in the floor of the cavity which reduce harm to pulp tissue.<sup>3</sup> The modified Hall technique is one such minimally invasive technique which is expected to be managing carious primary molars by cementing preformed metal crowns over them. The technique does not require local anesthesia, caries removal or any tooth preparation.<sup>4</sup> Hall procedure is named after Dr Norna Hall, a general dental specialist from Scotland, who developed the technique. The Hall technique is a quick and noninvasive process of fitting a stainless steel crown over the tooth with no caries removal, no tooth preparation and no local anesthesia is needed for the procedure.<sup>5</sup>

The objective of the present research was to differentiate the clinical and radiographic success rate of indirect pulp therapy, modified Hall technique and pulpotomy in managing deep caries in primary teeth.

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**Conflict of interest:** None

## MATERIALS AND METHODS

The present randomized double-blind clinical trial was conducted in the Department of Pedodontics and Preventive Dentistry, Sri Venkata Sai Institute of Dental Sciences, Mahabubnagar, Telangana India. The ethical approval was obtained from the Institutional Ethics Committee. [SVSIDS/Pedo/1/2014] A total of 60 primary molars were selected from children aged between 4 and 9 years reporting to department and randomly allocated to three groups with 20 samples in each group using systematic randomization

with parallel design. The primary molars were selected regardless of maxillary or mandibular jaws. The inclusion and exclusion criteria are defined in Table 1. The three groups in the present study were provided with different procedures. A flowchart explains the study design in Flowchart 1.

Group I: indirect pulp therapy

Group II: modified Hall technique

Group III: mineral Trioxide Aggregate (ProRoot, DENTSPLY)

**Pulpotomy**

The nature of the study was explained to parents and patients following which a written Informed consent was obtained. Preoperative radiographs were also taken.

**Clinical Procedure**

*Group I*

After administration of local anesthesia with 5% Xylocaine spray and /or 2% lidocaine injection [block for mandibular teeth], quadrant wise isolation was done with rubber dam; and dental caries was excavated with a high speed carbide fissure bur [#245]. Caries was excavated totally from the cavosurface margins and all lateral walls of the cavity preparation with carbide burs #2 to #8 at low speed. Judicious removal of soft deep carious dentine lying directly over the pulp region was done with care using a Mollifier' spoon excavator to avoid pulpal exposure and the cavity was rigorously cleansed with phosphate-buffered saline. After complete removal of soft caries, cavity was washed with saline and dried with cotton rolls. According to manufactures instructions Pro Root MTA [Mineral Trioxide Aggregate] was mixed and placed as lining material, subsequently, posterior GIC was placed to achieve optimum external coronal seal.

*Group II*

No local anesthesia was given for primary molars belonging to this group. Evident food particles or detritus was taken out from the lesions but no cavity was treated and no tooth preparation was done. The correct size of stainless steel crowns for the

denticulation was chosen that is, covering all ends and giving the feel of spring-back. Then, the tooth was rinsed and dried, and the crown was contoured, crimped, and if the length of the crown was too long it was trimmed and finally filled with glass ionomer luting cement and placed over the molar. The patient was told to bite down firmly on the tongue blade rolled with gauze piece until the crown will be pushed down over the dentition, if the child is incapable or hesitant to bite down on the stainless steel crown; finger pressure was used with thumb and other four fingers supporting the lower border of the mandible to seat the crown. Once cement sets, excess cement was removed and postfitting instructions provided. If the contacts were too tight separators were placed and the child was recalled after 24 hours. If the desired space was not achieved even after placing the separators or in the event of difficulty in placement of crown for proximal surfaces of the first primary molar teeth, then it was trimmed to open the contact points which would ensure appropriate placement of pre formed metal crown.

*Group III*

After attaining local anesthesia [infiltration for upper teeth and block for lower teeth] and maintaining good isolation with rubber dam and caries removal was done at the enamel-dentine junction. Excavation of caries was done and complete removal of roof of pulp chamber was done with a safe ended bur. Amputation of coronal pulpal tissue was done with sharp sterilized spoon excavator and large round bur in a slow hand piece. Bleeding was then checked and Initial radicular pulpal hemostasis was achieved by gentle application of sterile cotton pellet moistened with saline. MTA was mixed according to manufacturer's instructions and placed over the radicular pulp with a carrier. Intermediate restorative material was placed and recalled after a week time followed by a definitive restoration to achieve optimum external coronal seal [stainless steel crown].

After completion of respective treatments, patients were recalled after 1 month, 3 months, 6 months, and 9 months for clinical and radiographical evaluation [i.e., 1, 3, 6, and 9 months]. Clinical success was described as absence of pain [on percussion], fistula, sinus opening or pathological mobility. Radiographic success was interpreted as the absence of pathologic root resorption, normal periodontal ligament space, absence of periapical, and/or bifurcation radiolucency.

All the results obtained were tabulated and subjected to statistical analysis using chi-square test. Statistical Package for Social Sciences was [IBM SPSS Statistics for Windows, Version 22.0 Armonk, NY: IBM Corp] used for analysis.

**RESULTS**

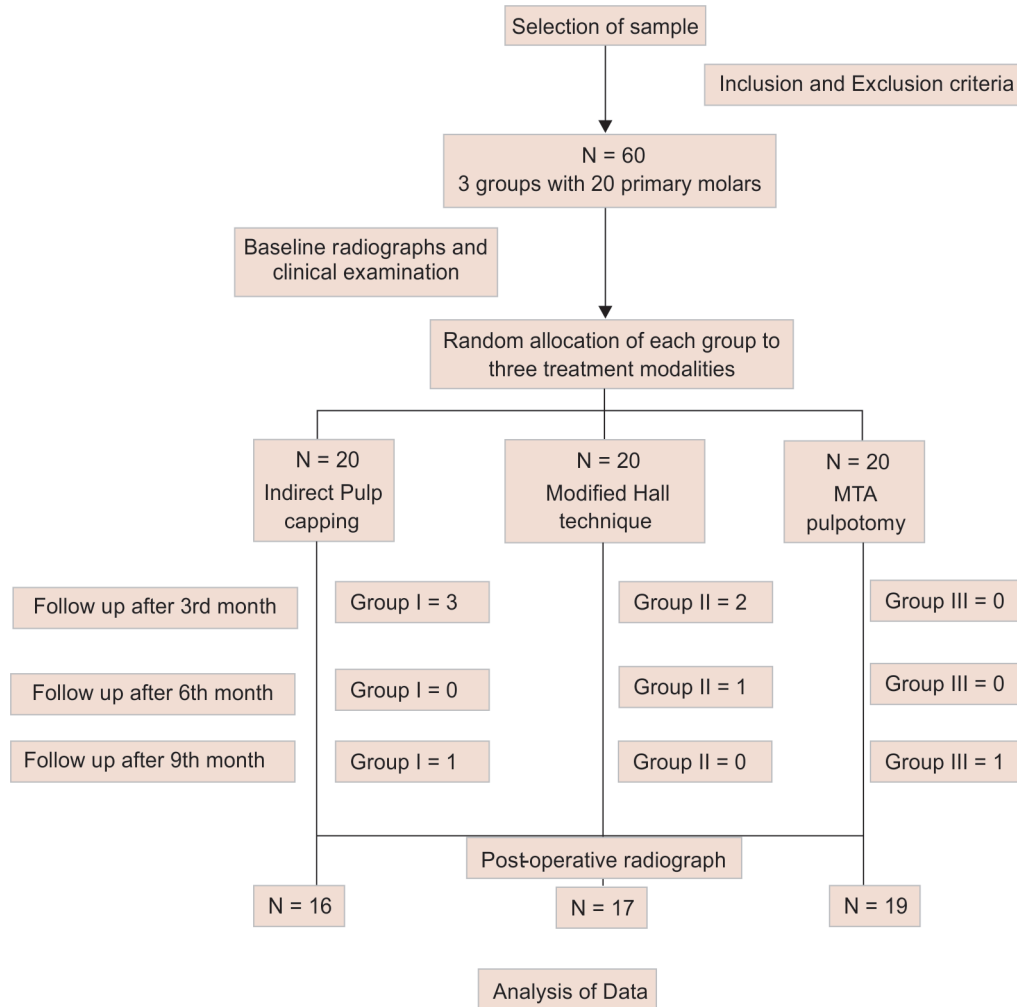
The groups were followed over for a time period 1, 3, 6, and 9 months. Flowchart 1 shows the distribution of sample across different age groups. Tooth selected were primary 1<sup>st</sup> and 2<sup>nd</sup> molars from age-group of 4 to 9 years. The success rates according to clinical and radiographic parameters are summarized in Tables 3. There were four dropouts from group I, three from group II, and one from group III at the end of 9 months. Clinically no failures were reported for any group at 3 months and at the 6<sup>th</sup> month follow-up. However, post 6<sup>th</sup> month up to 9<sup>th</sup> month there was one failure in group I. The difference in treatment outcomes between groups was not statistically significant [p > 0.05]. In addition, the intergroup comparison according to clinical parameters between group I, group II, and group III was not statistically significant. Clinically one

**Table 1:** Inclusion and exclusion criteria

	<i>Inclusion criteria</i>	<i>Exclusion criteria</i>
Patient	<ul style="list-style-type: none"> <li>• Fit and healthy</li> <li>• No history of systemic illness</li> <li>• Parental consent to participate in study</li> </ul>	<ul style="list-style-type: none"> <li>• Medically compromised</li> <li>• Special children</li> <li>• Not willing to participate</li> </ul>
Primary Molars	<ul style="list-style-type: none"> <li>• Deep carious lesion</li> <li>• Absence of nocturnal pain</li> <li>• Tooth which is restorable</li> <li>• No pain on percussion</li> <li>• Absence of tooth mobility</li> <li>• No clinical evidence of pulpal degeneration (e.g., draining sinus)</li> <li>• Absence of coronal destruction that precludes restorability</li> <li>• Hemorrhage from the amputation site is controlled with wet cotton pellet ≤5 min</li> <li>• Absence of swelling or alveolar abscess formation</li> </ul>	<p><b>Clinical criteria</b></p> <ul style="list-style-type: none"> <li>• History of unprovoked toothache</li> <li>• Presence of fistula or swelling</li> <li>• Evidence of necrotic/irreversibly damaged pulp</li> <li>• Uncontrolled pulpal hemorrhage</li> </ul> <p><b>Radiographic criteria</b></p> <ul style="list-style-type: none"> <li>• Internal or external resorption, widening of periodontal ligament space</li> <li>• Physiologic resorption more than 1/3<sup>rd</sup> of the tooth root.</li> </ul>



**Flowchart 1:** Methodology of the study



tooth from group I showed clinical signs of pathology unlike tooth in group II and group III which had no pathology.

Postoperative radiographic evaluation did not reveal failure in any of the treatment groups up to 6<sup>th</sup> months, however, in the 9<sup>th</sup> month radiographic findings were observed in one tooth in group I (Figs 1A–C). Periodontal ligament widening and periapical abscess was observed in one tooth in group III (Figs 2A–C). This difference in the treatment outcomes between any of the groups was not statistically significant [ $p > 0.05$ ]. Radiographic examination did reveal a pathology in one tooth for group I and group III, respectively, however, the intergroup comparison was not statistically significant.

## DISCUSSION

Extensive decay and its rapid progression to pulp in primary teeth remains a serious problem in Pediatric dental practice. Management of these deep carious primary molars is a usual yet demanding facet of dental care for young children. Most common and traditionally elected procedures for vital deep caries in primary teeth are IPT and pulpotomy.<sup>2</sup> With newer techniques backed by ample evidence do exist, a quick and noninvasive procedure called as Hall’s Technique, which involves fitting the crown and seating it above the indentation without

any caries removal/ tooth preparation and no local anesthesia is being practiced.<sup>5,6</sup>

The three treatment modalities used in the present randomized trial are IPT using MTA as the medicament [group I], the modified Hall technique [MHT] [group II] and pulpotomy using MTA as medicament [group III]. MTA was preferred in group I and group III since previous studies have revealed that MTA prevents micro leakage, has excellent sealing ability, is biocompatible, mimics dentinogenic properties, and is superior to calcium hydroxide as medicament in primary teeth.<sup>7,8</sup>

IPT was performed by standard protocol after administering local anesthesia and placement of rubber dam.<sup>12</sup> Over a period of 9<sup>th</sup> months, a total of 16 patients were followed [3 patients were lost to follow up by 6<sup>th</sup> month and 1 patient at 9<sup>th</sup> month] and after 9<sup>th</sup> month one patient had clinical signs with radiographic findings [providing about 94 percent success in IPT group which was similar to results reported in literature.<sup>9-12</sup>

The success could be attributed to factors like superior properties of MTA, proper isolation techniques, adequate sealing of the cavity and properties of Glass Ionomer Cement [fluoride release, self-adhesion]. In the present study parameters, the failure of one tooth [upper primary first molar] in IPT could be due to its anatomical location in dental arch and deeper carious lesions clinically where the intact barrier of secondary dentin protecting

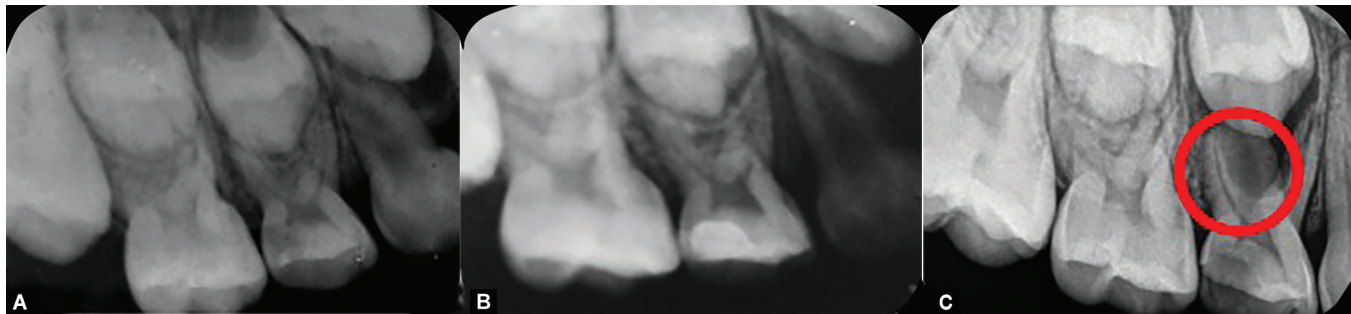
**Table 2:** Radiographic evaluation of all three groups after 1, 3, 6, and 9 months

	*Dropouts	PR		PLW		BR		PA		$\chi^2$	p value
		P	A	P	A	P	A	P	A		
1 month to 3 months											
Group I	3	0	17	0	17	0	17	0	17	0.822	p = 322
Group II	2	0	18	0	18	0	18	0	18		
Group III	0	0	20	0	20	0	20	0	20		
3 months to 6 months											
Group I	0	0	17	0	17	0	17	0	17	0.823	p = 0.38
Group II	1	0	17	0	17	0	17	0	17		
Group III	0	0	20	0	20	0	20	0	20		
6 months to 9 months											
Group I	1	1	15	1	15	1	15	1	15	0.72	p = 0.48
Group II	0	0	17	0	17	0	17	0	17		
Group III	1	0	19	1	19	0	19	1	19		

PR, Pathological Resorption; PLW, Pathological Ligament Widening; BR, Bifurcation Radiolucency; PA, Periapical Abscess; level of significance at  $p < 0.05$

\*study participants at start of study  $N = 20$

P–present; A–absent



**Figs 1A to C:** Pre- and postoperative radiograph for indirect pulp capping in primary molars

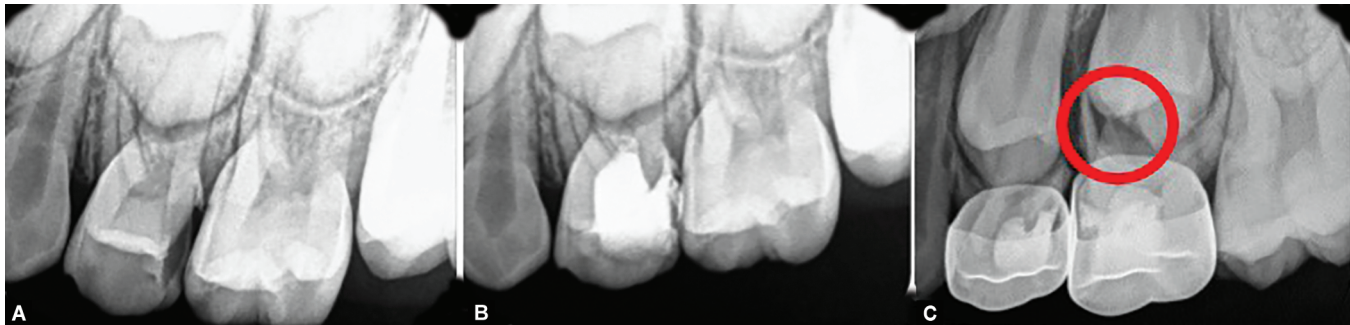
the pulp could actually be a perforated mass of irregularly calcified and carious material.<sup>13</sup> In addition, Farooq et al. reported that first primary molars and specifically the maxillary failed more often than the second primary molars following IPT.<sup>14</sup>

When compared to group I, excluding the dropouts, group II had no patients with any clinical signs and radiographic findings thereby reporting 100 percent success (Figs 2A–C). This was in accordance with studies conducted by Nicola Innes et al., W.E. van Amerongen et al., Fontanna et al., where they have demonstrated 97% success for Hall technique for pulpal health and restoration longevity than conventional restorations. They have also concluded that Hall’s technique was chosen over the drill and fill treatment by the majority of children, care givers & GDPs.<sup>15</sup> Another advantage with this technique is that fear and anxiety are minimized. Since, this technique does not require local anesthesia, or tooth preparation and no caries removal, this is well accepted by children above five years of age.

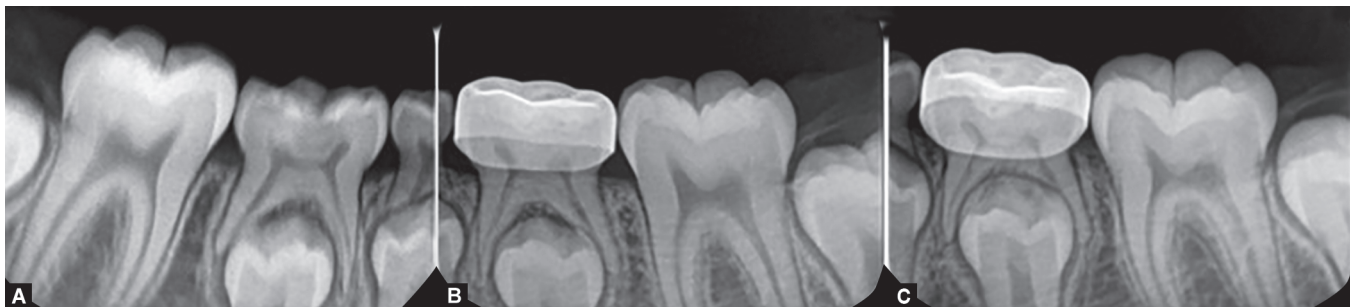
For group III, pulpotomy procedures like access opening, excavation and achieving hemostasis was done according to procedures performed by various authors.<sup>16,17</sup> MTA as a medicament was introduced as alternative to formocresol keeping in mind the beneficial characteristic of MTA. Studies conducted in the past also advocate MTA as a medicament in primary molar.<sup>7</sup> In the present study out of 20 teeth treated by MTA Pulpotomy,

all teeth were successful at the end of one month. During follow up one patient dropped out at the end of 6<sup>th</sup> month, resulting in 19 teeth followed through for 9 months. At the end of 9 months there was one radiographic failure indicating 100 percent success clinically and about 95 percent success radiographically (Figs 3A–C). This was similar to results obtained by Agamy et al, Naik and Hegde, Farsi et al.<sup>18–20</sup> Success rate could be attributed to properties of the material and time taken to complete the procedure. Unlike formocresol, MTA eliminates the possibility of dislodgement of clot thereby resulting in bleeding, since MTA is directly applied without a cotton pellet.<sup>21</sup> Also internal root resorption and pulpal inflammation [direct contact of Zinc Oxide Eugenol as base] is a common sequel after formocresol or ferric sulfate pulpotoomies in primary teeth which was not observed with MTA in the present study.<sup>22,23</sup> The present study also did not find any evidence of pulp canal obliteration which is a more common consequence of MTA pulpotoomies.<sup>4,6</sup> The failed tooth [radiographically] in group III was a first primary molar with proximal caries. Probable reasons for failure can be attributed to presence of irreversibly affected radicular pulp, diagnosing which is beyond the scope of current techniques.

The present study showed good clinical and radiographic outcome with all the three techniques. The difference in the rate of clinical and radiographic success in the three groups was not



Figs 2A to C: Pre- and postoperative radiograph of primary molar treated by MTA pulpotomy



Figs 3A to C: Pre- and postoperative radiograph of primary molar treated by Hall's technique

statistically significant [ $p > 0.05$ ]. Though MHT showed slightly superior results than IPT and pulpotomy there was no statistical difference attributed to any group hence conservative treatment approaches in a child for the treatment of deep caries in primary teeth can be utilized.

The limitations of our study are shorter duration of follow up, smaller sample size. As radiographs are two dimensional and are not gold standard techniques. Therefore, histological follow ups and further studies are required to evaluate these three techniques concurrently.

## CONCLUSION

From the present study it can be concluded that:

- All the three techniques showed promising results clinically and radiographically. Although modified Hall technique has shown superior results over IPT and Pulpotomy there was no statistical significance noted between all the three groups.
- As there was no statistical significance between all the three groups, present study showed nonsurgical approaches [IPT and Hall technique] appears to be better treatment approaches than surgical approach [pulpotomy] in terms of cost and duration of procedures and acceptance by the children.
- Further studies using larger samples and longer evaluation periods are recommended.

## CLINICAL SIGNIFICANCE

The Hall's technique used in the present was found to be very helpful in treating uncooperative children suffering from dental caries which do not involve the pulp. Since no anesthesia is used and the procedure is painless, it can be recommended for children with caries affecting primary molars. However, case selection is the most important criteria for good prognosis.

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