

Esthetic Restorative Options for Pulpotomized Primary Molars: A Review of Literature

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Objective: The goal of this manuscript was to review the existing literature in regards to esthetic options to restore pulpotomized primary molars. **Study design:** A pubmed literature search has been performed and all relevant studies were assessed. **Results:** Two laboratory, 3 retrospective and 4 prospective clinical studies were found, reviewed and analyzed. **Conclusions:** Based on the limited information available, we concluded that tooth colored and bonded restorations showed promising results as alternative materials to replace stainless steel crowns after pulpotomies in primary molars. Hybrid composites tend to perform better than compomers. Resin modified glass ionomer cements demonstrated excellent marginal seal and retention. More long-term follow up studies are necessary until more definitive recommendations can be made.

Keywords: Tooth colored materials, amalgam, microleakage.

J Clin Pediatr Dent 36(2): 123–126, 2011

INTRODUCTION

Pulpotomy has been considered the treatment of choice following vital, iatrogenic, carious and traumatic pulp exposed primary molars.^{1,2} Access opening of the pulp chamber has to be such as to prevent leaving tissue tags that could decrease the success of the pulpotomy.³ After coronal pulp amputation, hemostasis is obtained and a pulp medication is applied, with the purpose of preserving the vitality of the radicular pulp. Regardless of the medicament being used, restoration of pulpotomized primary molars consists of filling up the empty pulp chamber with a zinc-oxide eugenol based material followed by a well sealed restoration. The “gold standard” and most widely recommended type of restoration to meet that purpose has been a stainless steel

crown (SSC) which protects the weakened cavity walls and prevents marginal microleakage.^{1,5}

In today’s reality, the demand for esthetics has grown significantly for adults and children alike. In a recent study, pediatric dentists in the United States (US) were inquired about parental attitude towards restorative materials for their children’s teeth.⁶ That survey revealed that the main concern parents have is esthetics (57%) followed by cost (23%), toxicity (17%) and durability (3%) of the materials. Moreover, when SSCs were to be used, 87% of parents demonstrated dissatisfaction. It was also mentioned that about 70% of the inquired pediatric dentists felt some parental pressure to use tooth colored materials and avoid placement of SSC to restore Class II lesions. It is interesting to notice that 43% of those dentists did change their professional preference in order to comply with the parental desire for esthetics. In another study conducted in a pediatric dental practice in Israel, parents and children were asked about their preferences between amalgam and a tooth colored restoration for primary teeth.⁷ Almost 50% of the parents preferred tooth colored restorations, but a large group of them (40%) did not show any favoritism. When the young patients were asked about their inclinations between amalgam and tooth colored restorations, the latter were significantly preferred by children older than 7 years. In a similar study, performed in a university-based dental clinic in the US, children’s selection were in agreement with Peretz and Ram’s findings.⁷ In this study, boys and girls preferred SSC more than amalgam, Caucasians selected mainly tooth colored restorations while African-Americans equally like SSC and resin-based restorations.⁸

Excellent esthetic appearance with acceptable longevity has been obtained for resin-based crowns (strip crowns) for decayed and/or fractured anterior primary incisors.^{9,10} Veneer

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SSCs have also gained popularity with good esthetics when the utilization of strip crowns is no longer indicated (severely subgingivally decayed teeth and when severe tooth discoloration due to trauma or root canal treatment is present). So far, efforts have also been made to create a more esthetic solution for the unpleasant “silver colored” SSCs on posterior teeth. Unfortunately, the utilization of veneer SSCs for that purpose did not result in a pleasant outcome in the long run. Chipping of the facing showing the metal underneath as well as a visible metal line around the gingival margins were undesirable findings. Furthermore, due to their bulbous shape, significantly more natural tooth structure had to be removed in order to fit and adapt these crowns, making them mainly indicated for cases after pulpotomy and/or pulpectomy where the risk for pulp exposure when preparing the tooth does not exist.¹¹

A considerable amount of literature exists to support the success of SSCs to restore severely decayed and/or pulp-tomized primary molars.^{1,4,5} Nevertheless, iatrogenic or caries pulp exposures may also occur when preparing ideal or conservative Class II restorations. If pulpotomy is performed but only minimal to moderate tooth structure has been lost, can esthetic materials be used as an alternative to SSCs to restore these teeth without compromising the long term success of the treatment? The purpose of this manuscript was to review the existing literature in regards to clinical and laboratory studies which investigated alternative restorative solutions for pulp-tomized primary molars.

Background

When performing restorations in children, several factors should be considered prior to selecting the material to be used. Among those are the patient’s caries risk assessment, his/hers age and behavior, the remaining tooth structure (restorability), the longevity of the tooth, the treatment conditions (sedation, general anesthesia or conventional treatment), federal regulations and type of clinic (public health or private).¹² In addition, knowledge and understanding the physical properties of the materials and their indications and contraindications are of fundamental importance.¹³ The training obtained at the dental school and/or during advanced education may also influence this type of decision. Educators in the US contraindicate the use of tooth colored restorations for large restorations, multi-surface cavity preparations and after pulpotomies and pulpectomies in primary molars.¹⁴ Conversely, Brazilian and European teachers do not share the same opinion.^{15,16} When clinicians were asked about their preferences, American pediatric dentists shared the same view as their instructors.¹² When reviewing the American Academy of Pediatric Dentistry¹ restorative guidelines after pulpotomies, the following statement is found: “the most effective restoration after pulpotomies in primary molars has been shown to be SSC. However, if there is sufficient supporting enamel remaining, amalgam or composite resin can provide a functional alternative when a primary tooth has a life span of 2 years or less.” This was based on the few clinical studies published on the topic.^{17,18}

The concept of conservative restorations of primary molars after pulpotomy is not new. In 1988, a “sandwich style” restorative design including a zinc-oxide eugenol (ZOE) based material, a glass ionomer cement followed by an occluso-proximal composite layer has been suggested.¹⁹ This model was indicated for selected cases only: when significant tooth structure has remained, when at least 2 complete walls of tooth structure are left and when only one proximal surface is involved, having its gingival margin still in enamel. Although promising and well thought, that design was not tested clinically.

Laboratory studies

In vitro studies tested some of the desired physical properties an ideal restoration should have to function in an area under high masticatory forces: resistance to fracture and sealing ability.^{20,21} El Kalla and Garcia-Godoy²⁰ restored pulp-tomized molars with amalgam, compomer and hybrid composite using different bonding agents. After submitting the restorations to thermocycling and cuspal fracture resistance, they concluded that bonded restorations of pulp-tomized primary molars may be an alternative restorative option to SSCs. Guelmann *et al*²¹ checked the marginal seal of various restorative materials in two-surface preparations after pulpotomy. Significantly better results were obtained for resin-based restorations when compared to SSCs, glass ionomer, amalgam or ZOE. The most reasonable explanation why SSCs did not result in leakage free gingival margins was given to the fact that the extracted teeth may have had some of their proximal margins below the cemento-enamel junction and the SSC’s margin was not long enough to cover it. Taking into consideration the long term successful performance of SSCs and the fact that laboratory study conclusions cannot always be extrapolated to clinical practice, the gingival extension of proximal restorations should be carefully examined for complete coverage by the SSC margins before cementation. A clinical example of this theory is illustrated on Figure 1.

Retrospective clinical studies

Three retrospective studies performed in private pediatric dental practices were published: one with a single operator and two with two operators, all having formocresol as the pulp medicament.^{17,18,22} One of the studies by Holan *et al* compared amalgam restorations to SSCs.¹⁷ A positive correlation was found between the number of tooth surfaces involved and the failure rate for amalgam restorations. Even though SSCs performed better, the study concluded that pulp-tomized primary molars can be successfully restored with one surface amalgam if their natural exfoliation is expected after not more than 2 years. The other two studies had the pulp-tomized molars restored with resin-based materials.^{18,22} Guelmann *et al*¹⁸ concluded that the overall success rate for resin-based restorations (78%) was inferior to that of SSCs. When proximal surfaces were involved, the failure rate (26%) was comparable to that reported for amalgam (23%).¹⁷ That study also compared two different bases

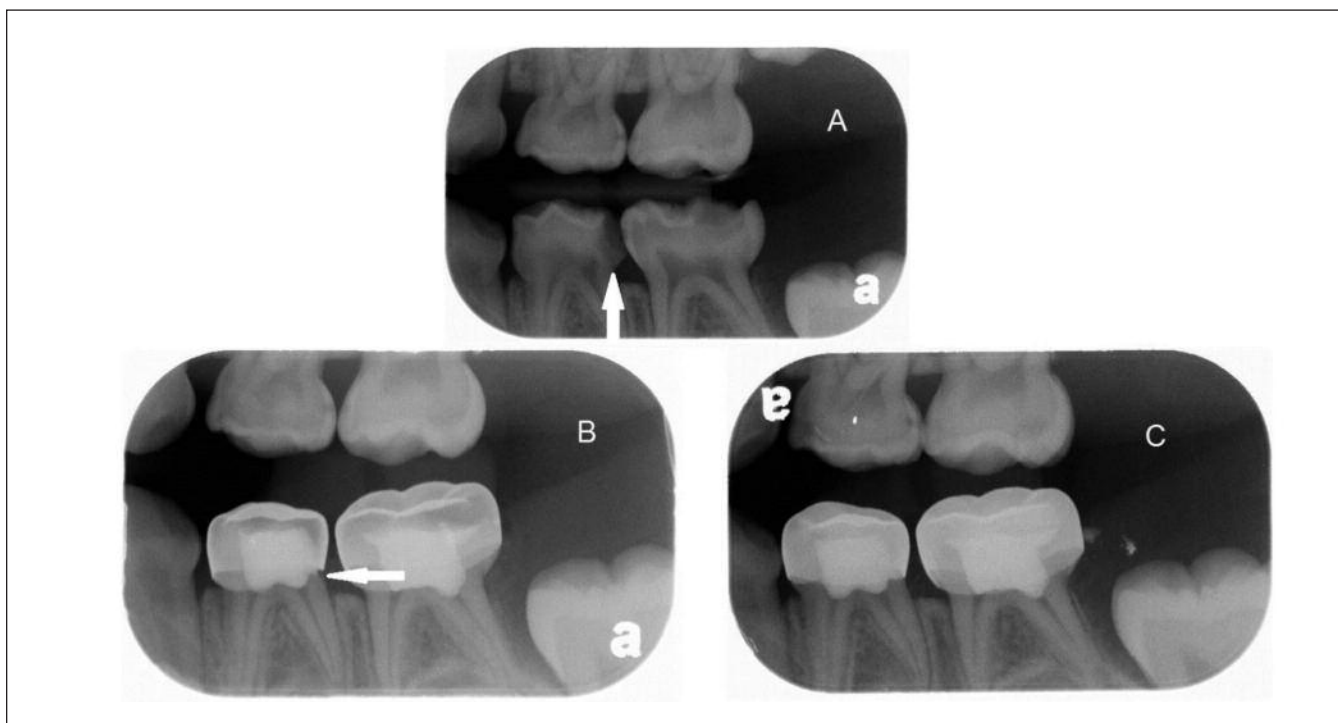


Figure 1. **A)** Preoperative view of a mandibular left first primary molar with deep proximal caries lesion having its proximal gingival margin extended below the cemento-enamel junction; **B)** Selected stainless steel crown is tested prior to cementation. Crown margin showed incomplete coverage of the distal gingival margin of the preparation (see arrow); **C)** After additional occlusal reduction of the tooth, a tight adaptation was obtained and cementation with glass ionomer cement was performed.

under the final restoration: ZOE and ZOE covered by a resin-modified glass ionomer cement (RMGIC). Regardless of the base material used, all one surface restorations were successful. Although a higher success rate was found for the ZOE + RMGIC group, these findings were not statistically significant. It is important to emphasize that none of the restorations needed replacement (average of 21 months follow-up) and no post-operative sensitivity was reported.

Caceda²² used a fast setting ZOE base under the final composite restoration in order to avoid the questionable polymerization interference of the eugenol. He performed single and multi-surface restorations and no failures were observed during the evaluation period (12 to 54 months).

Prospective clinical studies

Three clinical studies related to post-pulpotomy coronal restorations and one study evaluating the success of different restorative materials after pulpectomy in primary molars were found in a search of the literature.²³⁻²⁶ The first one evaluated the performance of mainly Class II restorations where pulpotomized primary molars received either a hybrid composite restoration or a compomer.²³ Each patient received at least 1 pair of restoration with both materials. After 24 months, the authors found that significantly more failures were found with compomer restorations (17%), compared to composite (2%). The reasons for failure were attributed to coronal microleakage. Atieh,²⁴ on a randomized clinical trial, assessed the survival rates of SSCs and of sandwich restorations (RMGIC and a resin-based material) after diluted formocresol pulpotomies. The success rate of both materials

over a two-year period was considered excellent (>90%). The authors concluded that the sandwich restoration can be considered a reasonable alternative for SSC. Sakai *et al*²⁵ randomized the pulp medicament, MTA *versus* Portland Cement, but all the teeth were restored with a RMGIC. After 24 months, all the restorations were successful. The authors concluded that the type of restorative material was not a discriminating factor between the two groups in the present study. In addition, they emphasized that the absence of evidence for RMGIC as a restorative material after pulpotomies should not be misinterpreted as evidence for its lack of efficacy.

Zulfikaroglu *et al*²⁶ used resin-based materials (compomers and hybrid resin) and amalgam to restore 75 pulpectomized primary molars for a period of 12 months. Several bonding agent combinations were used. All restorations were performed over Class II preparations with no teeth needing a mesio-occluso-distal restoration or a SSC. Clinical and radiographic evaluations of the restorations were blindly performed at short periods of time using the USPH Service clinical rating system. After 1 year, only 61 restorations (81%) were considered successful. The hybrid material group performed best (1 failure). The authors concluded that due to the high failure rate, mainly resulting from coronal leakage, these types of restorations could not be considered suitable alternative solutions for SSCs until longer follow-up results are obtained. Interesting to notice was the fact that failures were more common in the mandible than in the maxilla and mainly affected the first primary molars. These findings are also in agreement with those of Holan *et al*¹⁷

CONCLUSIONS

Based on the limited information available in the literature, the following observations can be obtained from this review:

1. Tooth colored and bonded restorations showed promising results as alternative materials to replace SSCs after pulpotomies in primary molars;
2. Hybrid composites tend to perform better than comonomers;
3. RMGIC demonstrated excellent marginal seal and retention;
4. When esthetic concerns are expressed by parents, informed consent with explanation about material limitations should be given;
5. Additional long term studies are necessary to further assess the success with these alternative materials until more definitive recommendations can be made.

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