

Permanent Versus Temporary Restorations After Emergency Pulpotomies in Primary Molars

Marcio Guelmann, DDS¹ Jodi Fair, DMD² Enrique Bimstein, CD³

Abstract

Purpose: The purpose of this retrospective study was to determine if immediate placement of a stainless steel crown (SSC) after emergency pulpotomies in primary molars would result in a better outcome when compared to different temporary restorations.

Methods: Records of 94 emergency pulpotomies in primary molars performed at a university pediatric graduate dental clinic between July 2001 and June 2004 were analyzed. Inclusion criteria included: (1) teeth with a positive history of spontaneous or elicited pain; (2) deep caries with close approximation to the pulp; (3) absence of clinical and radiographic signs of pulpal degeneration; (4) abnormal mobility; or (5) swelling. Pulpotomized teeth were temporarily restored with a zinc oxide eugenol-based temporary restoration (IRM) covered with Ketac Molar or with a permanent restoration (SSC). The time interval between emergency and definitive treatment or recall, age, gender, tooth type, and arch were the variables analyzed in the study. Success was determined by record (progress notes and radiographs) verification of SSC placement in case of a temporary restoration and by confirmation of crown presence during recall exam. Data from emergency pulpotomies restored only with IRM was added to the study and included in the statistical analysis.

Results: Superior clinical success was obtained when emergency pulpotomies were restored with SSC (86%) when compared to IRM only (61%) or IRM and Ketac Molar combined (77%). Statistical significance was obtained in favor of SSC when survival analysis was performed ($P < .001$). No statistically significant difference was found for any of the other variables ($P > .05$).

Conclusions: Immediate placement of an SSC tended to improve the chances for success when emergency pulpotomies are performed. (*Pediatr Dent* 2005;27:478-481)

KEYWORDS: EMERGENCY PULPOTOMIES, TEMPORARY RESTORATIONS, STAINLESS STEEL CROWNS

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Pulpotomy is the treatment of choice for carious exposed vital pulps in primary teeth.¹ Formocresol is the most commonly used pulp medicament,^{2,3} and it should be followed by immediate placement of a durable, stress-resistant restoration, like a stainless steel crown (SSC).⁴ Success rates using this technique vary between 70% to 100%.^{5,6} Pulpotomies, however, may not be performed under ideal conditions (ie, in emergency treatments) when:

1. a positive history of pain is present;
2. placement of an immediate definitive restoration is not possible due to:
 - a. lack of time;
 - b. uncooperative behavior;
 - c. financial limitations.

Under these conditions, a significant decrease in success rate (53%) was observed in the short-term (3 months) observation and was attributed to the inflamed status of the pulp and uncertain diagnosis during the pulpotomy procedure. The high failure rate after a year (69%), however, was attributed to microleakage of the temporary restorative material.⁷

The long-term success of a restoration depends mainly on its capacity of preventing marginal microleakage. Farooq et al⁸ demonstrated that the immediate placement of an

¹Dr. Guelmann is associate professor and chair, and ³Dr. Bimstein is professor, Department of Pediatric Dentistry, University of Florida, Gainesville, Fla; ²Dr. Fair is a resident, Department of Pediatric Dentistry, New Jersey Dental School, Newark, NJ, and was formerly a dental student at the University of Florida.
Correspond with Dr. Guelmann is mguelmann@dental.ufl.edu

Table 1. Data Distribution by Visit

Emergency treatment				
Restoration type	No. of patients	Male	Female	No. of teeth
IRM	185	104	81	216
Ketac Molar	41	20	21	48
Stainless steel crown (SSC)	43	25	18	46
Total	262	147	115	310
Second appointment or recall (SSC cases)				
Restoration type	No. of patients	Male	Female	No. of teeth
IRM	59 (32%)	30	29	64
Ketac Molar	13 (31%)	7	6	13
SSC	20 (46%)	13	7	21
Total	92	50	42	98

SSC after pulpotomy in primary molars significantly improved the success rate when compared to a zinc oxide eugenol-based temporary restoration (IRM). A recent study achieved the same conclusion when the outcome of primary molar pulpectomies was examined.⁹

Based on poor sealing results of zinc-oxide eugenol restorations,¹⁰⁻¹⁴ the use of glass ionomer materials in combination with IRM has been suggested.¹¹ This is due to glass ionomer's advantages of chemical bonding to tooth structure and high release of fluoride. New reinforced glass ionomer materials have been indicated as long-term temporary restorations and have been utilized for atraumatic restorative techniques (ART) in undeveloped countries. Long-term results for this technique had presented excellent results for occlusal surfaces, but with lower success rates when proximal surfaces were involved.¹⁵⁻¹⁶

Guelmann et al⁷ recommended immediate placement of SSCs after emergency pulpotomies in primary molars when low patient compliance is expected. With this recommendation in mind, clinical guidelines were modified for emergency pulpotomies at the Graduate Pediatric Dental Clinic at the University of Florida, Gainesville, Fla: whenever possible, an SSC should be placed. If for any reason a temporary restoration has to be placed, a "sandwich" restoration combining IRM (Dentsply Caulk, Mildford, Del) and a reinforced glass ionomer material (Ketac Molar, 3M Espe Dental Products, St. Paul, Minn) is to be performed.

Therefore, the purpose of this study was to assess if immediate placement of an SSC after emergency pulpotomies in primary molars would result in a higher successful treatment rate when compared to different temporary restorations.

Methods

After approval of the Institutional Review Board of the University of Florida, records of 94 emergency pulpotomies performed in primary molars by pediatric dental

residents under faculty supervision during July 2001 and June 2004 were reviewed. Inclusion criteria was the same as previously reported⁷ and included restorable primary molars with deep caries, positive history of elicited or spontaneous pain, and absence of abnormal mobility, sinus tract, and swelling. Radiographically, caries was in close approximation to the pulp, and no furcation radiolucencies or internal/external resorption were observed.

Treatment was explained to the parents, and consent was obtained. After anesthesia and rubber dam isolation, caries re-

moval and coronal access were obtained, and coronal pulp amputation was completed. After normal hemostasis time (2 to 3 minutes), cotton pellets moistened with formocresol (Buckley's solution) were placed in the pulp chamber and left there for approximately 5 minutes. Teeth were restored immediately with a definitive restoration, IRM+SSC, or temporarily with IRM+Ketac Molar. The decision on the type of restorative material to be used after pulpotomy completion was up to the clinician in agreement with the attending faculty.

Variables analyzed were: (1) patient age; (2) patient gender; (3) tooth type; (4) tooth arch; (5) restoration type; (6) intervals in days between emergency; and (7) definitive treatment. When teeth were immediately restored with an SSC, interval time was measured between emergency treatment and the closest recall appointment when crown presence could be verified by charting records and by normal radiographic appearance on a periapical or bitewing radiograph. For Ketac Molar restorations, a review of the record of absence of clinical and radiographic pathology at the follow-up appointment determined the placement of an SSC.

Failure criteria used for pulpotomy—which indicted the need for pulpectomy or extraction—was the same as previously published⁷ and included: (1) presence of internal root resorption; (2) furcation radiolucency; (3) periapical bone destruction; (4) pain; (5) swelling; or (6) sinus tract. Success was established by verification of records of SSC placement in case of a temporary restoration and by confirmation of crown presence during the recall exam as previously explained.

Since a review of the progress notes and radiographic assessment were performed by the same investigators involved in the first study,⁷ a review of success and failure criteria was conducted to ensure standardization prior to records' evaluation.

Data from a preliminary study, where emergency pulpotomies were performed under the same conditions and

teeth temporarily restored with IRM only, were included for comparison. Data was analyzed using *t* test, chi-square, and survival analysis. Significance was set at .05.

Results

Out of 310 emergency pulpotomies (94 from the current study and 216 from the previous one⁷), only 98 (32%) were available for analysis in a second examination. Data distribution per visit is displayed on Table 1. Patients' age varied between 2.2 and 10.9 years, with a mean age of 5.6 years (5.96 for the IRM-only group, 4.92 for the Ketac Molar group and 5.24 for the SSC group). Interval between treatments (or recall appointments) varied between 8 to 866 days, with the mean interval time of 256 days.

The success rate for the type of restorative material and its outcome by interval between appointments is summarized on Table 2. Outcome distribution for age, gender, tooth type, and arch are shown in Table 3. No statistically significant difference in success rate for any of these variables was found ($P > .05$). For overall outcome, although not statistically significant ($P = .07$), pulpotomies

immediately restored with SSCs demonstrated a higher clinical success rate (86%) when compared with the ones restored with temporary restorations (77% for Ketac Molar and 61% for IRM). When survival analysis was performed, a statistically significant difference was found between the groups. The survival estimate median for the IRM only and for Ketac Molar restorations was similar (168 and 173 days, respectively), whereas for the SSC it was 410 days ($P < .001$).

Discussion

As observed during the first study,⁷ patient compliance to continue treatment and follow-up persisted to be a problem. Although less than 50% of the patients treated with SSCs returned for their recall appointment (Table 1), the clinical success obtained (86%) was comparable to the results obtained for formocresol pulpotomies when performed during routine caries treatment or traumatic pulp exposures.^{17,18} Regardless of the type of restorative material used (Table 2), however, a high failure rate during the first 90 days posttreatment was a constant finding.

This supported the suggested hypothesis that misdiagnosis of the pulp status during the emergency pulpotomy procedure might be the reason for the short-term negative outcome.⁷

The survival analysis performed in this study provided an answer to an important clinical question: For how long can a pulpotomized tooth be left with a temporary restoration without compromising the treatment? The answer is less than 6 months, regardless of the temporary material used (IRM only or IRM and Ketac Molar combined). The number of tooth surfaces involved in a long-term temporary restoration, however, may have some effect in the outcome of the treatment. Yu et al¹⁶ compared conventional cavity preparations and ART technique using glass ionomer restorations (Ketac Molar and Fuji IX, GC Corp, Tokyo, Japan) for primary molars with amalgam. For the glass ionomer restorations, independent of the cavity preparation technique used, a higher failure rate was found for Class II restorations. On the other hand, good clinical results after 1 year were obtained when Ketac Molar and

Table 2. Outcome of Restoration Type by Interval (Days) Between Appointments*

Restoration type	0-90		91-180		181-360		>360		Total	
	S	F	S	F	S	F	S	F	S	F
IRM only	8	7	17	6	10	3	4	9	39	25
IRM+Ketac Molar	1	1	5	1	4	0	0	1	10	3
Stainless steel crown	1	1	1	0	5	0	11	0	18	3

*S=success; F=failure.

Table 3. Treatment Outcome Based on Number of Teeth

Variable	Restoration type			Outcome	
	IRM	Ketac Molar	Stainless steel crown	Success	Failure
Age (ys)					
<6	42	11	14	50	17
>6	22	2	7	17	14
Gender					
Male	33	7	13	37	16
Female	31	6	8	30	15
Tooth type					
1st molar	29	6	11	29	17
2nd molar	35	7	10	38	14
Arch					
Maxilla	16	4	9	20	9
Mandible	48	9	12	47	22
Overall treatment outcome ($P = .0668$)					
Success	39(61%)	10(77%)	18(86%)	67	
Failure	25(39%)	3(23%)	3(14%)	31	

Dyract were compared for Class II conventional restorations in primary teeth.¹⁹

Explanations for the discrepancy in the results could be attributed to the operating conditions (rotary vs hand instrumentation, rubber dam or cotton roll isolation) and the size of the restoration. After a pulpotomy procedure, the size of the cavity is generally larger than a conventional ideal Class I or II preparation. This fact may have some negative effect on the long-term sealing ability of the restoration. When comparing in vitro studies, a universal conclusion can be obtained for the poor performance of IRM-only restorations as a cavity sealing material.¹⁰⁻¹⁴ Contradictory results were found, however, when IRM was combined with a glass ionomer material for temporary restorations.^{11,14}

During this study, patient's behavior, treatment conditions (sedation vs conventional) and the number of tooth surfaces restored were not evaluated. The authors do not believe that these variables influenced the method of restoration used (temporary restoration or an SSC), but a conclusive statement could not be made. During the original study,⁷ IRM only was used to temporarily restore the treated teeth, regardless of treatment conditions.

Thus, taking into consideration the clinical significance of this study finding, the immediate placement of SSCs after emergency pulpotomies in primary molars is justified.

Conclusion

Immediate placement of a stainless steel crown tended to improve the chances for positive outcome when emergency pulpotomies are performed.

References

1. American Academy of Pediatric Dentistry. Reference Manual. *Pediatr Dent* 2004;26:116.
2. Primosch RE, Glomb TA, Jerrell RG. Primary tooth pulp therapy as taught in predoctoral pediatric dental programs in the United States. *Pediatr Dent* 1997;19:118-122.
3. Fuks AB. Current concepts in vital primary pulp therapy. *Eur J Paediatr Dent* 2002;3:115-120.
4. Seale NS. The use of stainless steel crowns. *Pediatr Dent* 2002;24:501-505.
5. Rolling I, Thylstrup A. A 3-year clinical follow-up study of pulpotomized primary molars treated with formocresol technique. *Scand J Dent Res* 1975;83:47-53.
6. Loh A, O'Hoy P, Tran X, Charles R, Hughes A, Kubo K, Messer LB. Evidence-based assessment: Evaluation of the formocresol vs ferric sulfate primary molar pulpotomy. *Pediatr Dent* 2004;26:401-409.
7. Guelmann M, Fair J, Turner C, Coutts FJ. The success of emergency pulpotomies in primary molars. *Pediatr Dent* 2002;24:217-220.
8. Farooq NS, Coll JA, Kuwabara A, Shelton P. Success rates of formocresol pulpotomy and indirect pulp therapy in the treatment of deep dentinal caries in primary teeth. *Pediatr Dent* 2000;22:278-286.
9. Moskovitz M, Sammara E, Holan G. Success rate of root canal treatment in primary molars. *J Dent* 2005;33:41-47.
10. Anderson RW, Powell BJ, Pashley DH. Microleakage of IRM used to restore endodontic access preparations. *Endod Dent Traumatol* 1990;6:137-141.
11. Barthel CR, Strobach A, Briedigkeit H, Göbel UB, Roulet JF. Leakage in roots coronally sealed with different temporary fillings. *J Endod* 1999;25:731-734.
12. Barkhordar RA, Stark M. Sealing ability of intermediate restorations and cavity design used in endodontics. *Oral Surg Oral Med Oral Pathol* 1990;69:99-101.
13. Mayer T, Eickholz P. Microleakage of temporary restorations after thermocycling and mechanical loading. *J Endod* 1997;23:320-322.
14. Guelmann M, Bookmyer KL, Villalta P, Garcia-Godoy F. Microleakage of restorative techniques for pulpotomized primary molars. *J Dent Child* 2004;71:209-211.
15. de Souza EM, Cefaly DF, Terada RS, Rodrigues CC, de Lima Navarro MF. Clinical evaluation of the ART technique using high density and resin-modified glass ionomer cements. *Oral Health Prev Dent*. 2003;3:201-207.
16. Yu C, Gao XJ, Deng DM, Yip HK, Smales RJ. Survival of glass ionomer restorations placed in primary molars using atraumatic restorative treatment (ART) and conventional cavity preparations: 2-year results. *Int Dent J* 2004;54:42-46.
17. Holan G, Fuks AB, Keltz N. Success rate of formocresol pulpotomy in primary molars restored with stainless steel crown vs amalgam. *Pediatr Dent* 2002;24:212-216.
18. Holan G, Eidelman E, Fuks AB. Long-term evaluation of pulpotomy in primary molars using mineral trioxide aggregate or formocresol. *Pediatr Dent* 2005;27:129-136.
19. Marks LAM, van Amerongen WE, Borgmeijer PJ, Groen HJ, Martens LC. Ketac Molar vs Dyract Class II restorations in primary molars: 12-month clinical results. *J Dent Child* 2000;67:37-41.