Current Trends in Pulp Therapy: A Survey Analyzing Pulpotomy Techniques Taught in Pediatric Dental Residency Programs

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ABSTRACT

Purpose: The study's purpose was to survey directors of pediatric dental residency programs in order to evaluate the materials currently being taught and used for pulpotomy procedures for primary teeth in educational and clinical settings.

Methods: A web-based survey was emailed to all graduate pediatric dental residency program directors in the United States.

Results: Seventy one emails were sent to program directors, 47 responded but only 39 respondents (55%) were included in the study. Results suggested a slight decrease in utilization of formocresol 1:5 dilution (P<.01) and an increase in both ferric sulfate (P<.05) and mineral trioxide aggregate (MTA; P<.02) utilization for primary tooth pulpotomy procedures. The most common reasons for elimination of formocresol (18% of respondents) were systemic health concerns and carcinogenicity, in addition to evidence-based literature. Even though 25% of respondents have begun to use MTA for primary pulpotomy procedures, the most common reason for utilization of other medicaments over MTA was its higher cost.

Conclusions: With 82% of graduate pediatric dental residency programs still utilizing formocresol 1:5 dilution for pulpotomy procedures in primary teeth, there has been no major shift away from its clinical use, in spite of increased usage of newer medicaments over the last 5 years. (J Dent Child 2013;80(1):31-5)

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For ormocresol was introduced in 1904, and continues to provide excellent clinical results as a primary tooth pulpotomy medicament with a success rates ranging from 70-97%.^{1,2} Since concerns have been raised regarding its safety in humans (formaldehyde, one of its major constituents, may be distributed systemically after a pulpotomy³), some practitioners are selecting other materials for primary tooth pulpotomies.⁴ Various studies have shown that formocresol is comparable to other agents such as ferric sulfate and calcium hydroxide as a pulpotomy medicament.^{5,6} Fuks et al.⁷ documented superior results with ferric sulfate compared to formocresol, with clinical success rates of 93% and 84% respectively. Ferric sulfate, however, has been reported to cause an increased amount of negative outcomes associated with primary tooth pulpotomies, including internal root resorption and calcific metamorphosis.⁷

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Several other materials used for primary tooth pulpotomy procedures have also been investigated over time. These include calcium hydroxide,^{2,6,8,9} zinc oxide eugenol (ZOE),^{10,11} sodium hypochlorite,¹² eugenol free bases,13 lasers,10,14 electrosurgery,15,16 and mineral trioxide aggregate (MTA).^{2,8,10,13,17-19} Yet, according to Fuks,18 calcium hydroxide has been proven less clinically successful versus formocresol for primary tooth pulpotomy procedures. In a study by Vargas et al.,¹² sodium hypochlorite pulpotomies were compared to ferric sulfate pulpotomies; at 6 months post-operatively, both medicaments showed a clinical success rate of 100%. Radiographic success rates were 91% for sodium hypochlorite and only 68% for ferric sulfate. Nonetheless, a variety of chemical medicaments have been shown to produce varying degrees of success for primary tooth pulpotomy procedures.

Current research with lasers for primary tooth pulpotomy procedures have demonstrated mixed results. Saltzman et al.¹⁰ conducted a study comparing diode laser / MTA pulpotomies with formocresol / ZOE pulpotomies: clinical success rates favored the latter. Liu¹⁴ found that the Nd:Yag laser demonstrated a clinical success rate of 97% and a radiographic success rate of 94%, compared to 85% and 78% success rates, respectively for formocresol. Moreover, lasers have been shown to provide another means of successfully performing pulpotomy procedures in primary teeth.

MTA is commonly used for apexification, root perforation repair during root canal therapy, repair of root resorption, root end filling, pulp capping, and, most recently for pulpotomies. ^{2,10,13,17-19} A recent investigation studied the outcomes of MTA and ferric sulfate as pulpotomy medicaments in primary teeth, and the results showed that higher success rates were reported for MTA versus combined ferric sulfate – MTA pulpotomies (90% and 73% respectively).¹³ Peng et al.¹⁷ reported that MTA pulpotomies yielded lower failure rates and less internal resorption than formocresol.

Over the past few decades, many studies in predoctoral pediatric dental programs have been conducted to evaluate the success of various medicaments used for pulpotomy procedures.²⁰⁻²² It was found that a 1:5 dilution of formocresol was the most commonly utilized medicament for pulp therapy in the primary dentition, confirming that formocresol continues to be the most frequently used medicament, even when compared to other medicaments for primary tooth pulpotomies.¹⁸ There are, however, suggestions of a trend away from formocresol and an increase in ferric sulfate usage.²³ Considering the abundance of information for and against the various pulpotomy medicaments available for pediatric dentists to use, it is necessary to ascertain what is currently being taught in postgraduate dental education relative to pulpotomy procedures in primary teeth.

The purpose of the present study was to survey directors of graduate pediatric dental residency programs to determine: (1) what materials are currently being taught in the curriculum, and used for pulpotomy procedures in primary teeth in and (2) if there has been any change in medicament preference over the last 5 years.

METHODS

This study was approved by the Institutional Review Board of Indiana University, Indianapolis, Ind. A webbased survey, created using SurveyMonkey software (SurveyMonkey, Palo Alto, Calif), was distributed to all graduate pediatric dental residency program directors in the United States. The survey assessed the clinical utilization of medicaments currently being used for pulpotomy procedures in primary teeth as well as any changes in usage of materials over the past 5 years. Medicaments and techniques evaluated were: formocresol, ferric sulfate; mineral trioxide aggregate; calcium hydroxide; sodium hypochlorite; ZOE; eugenol-free bases; intermediate restorative material; resin-modified glass ionomer; compomers; electrosurgery; and diode lasers. The rationale of program directors for using and/or phasing out certain medicaments was also collected.

The survey responses were summarized using frequencies and percentages for most of the questionnaire items and means/standard deviations/ranges for other items. Paired t tests were used to compare the changes in material usage between 5 years ago and today.

RESULTS

Seventy one program directors were sent the survey and 47 responded. Eight respondents were excluded from the study due to failure to complete the survey in its entirety, therefore 39 directors were included, resulting in a response rate of 55%.

A statistically significant decrease in the amount of formocresol 1:5 dilution (P<.01) being utilized in pediatric dental residency programs over the last 5 years was found (Figure). Seven respondents (18%) stated that they had completely eliminated the use of formocresol. The most common reasons given included systemic health concerns, carcinogenicity, and reliance on reports from evidence-based literature. There has also been a statistically significant increase in the amount of ferric sulfate (P < .05) and MTA (P < .02) utilization in the last 5 years. Cost was given as the most frequent limiting factor in the use of MTA followed by reliance in evidence based dentistry, less familiarity with MTA, longer procedure time, technique sensitivity, and biocompatibility. Although not statistically significant, increased utilization has also been noted for electrosurgery (P=.32) and lasers (P=.16).

DISCUSSION

The use of alternative medicaments for primary tooth pulpotomies is becoming more common in both clinical and research settings.^{7,8,10,13,17-19,24} Eighteen percent of the programs no longer use formocresol, citing systemic health concerns and evidence-based literature as their rationale. The transition away from formocresol was encouraged due to the effects of formaldehyde and tricresol on the nasal mucosa and airways.⁴ Laboratory studies have shown that formaldehyde is taken up rapidly by mucous membranes and tricresol can increase the permeability of cell membranes. As a result, higher rates of nasal tumors, such as nasopharyngeal carcinoma, were reported with the use of formocresol.²⁵ This medicament may be carcinogenic, cytotoxic, mutagenic, and potentially produce immune sensitization.²⁴

The potential systemic effects of formocresol have been shown to be minimal based upon a recent study that examined formocresol levels in the bloodstream of children having pulpotomies under general anesthesia. Formaldehyde was undetectable above baseline plasma concentration, and cresol was undetectable in all samples.²⁶ Despite the lack of complete consensus in the scientific literature, it appears that a significant number of pediatric dental residency program directors are still primarily using formocresol for pulpotomy procedures. In the last 5 years, however, some have chosen to transition to other materials that may be more biocompatible, such as ferric sulfate, MTA, lasers, or using no medicament when completing pulp therapy in the primary dentition.

Ten respondents (25%) stated they have begun using MTA for primary tooth pulpotomy procedures in their programs. Although limited, perhaps there has been a shift in the use of MTA due to its biocompatibility and success rate in some published studies.^{8,13,17,18,27} Randomized controlled clinical trials have found that both MTA and formocresol appeared to be comparable in their clinical success or MTA performed better, although the latter difference was not statistically significant due to small sample sizes.¹⁸ Issues discouraging the use of



Figure. Percent utilization change from 2006-2011.

MTA by residency programs, based upon this survey's results, were its cost (87%), support from evidence-based dentistry (29%), and less familiarity with MTA (26%).

This study found an increase in the utilization of lasers and electrosurgery over a 5-year period; however, this was not statistically significant (P>.05). These results are consistent with the marketing information by various laser and electrosurgery manufacturers and some initial studies that found comparable results to formocresol and MTA.^{10,15,16} Increased research regarding the use of lasers and electrosurgery for pulpotomies in the primary and permanent dentition could provide additional evidence for a transition toward use of these methods in the future.

Further research, including randomized controlled clinical trials and histological analysis of teeth treated with each of these treatment modalities, may lead to greater awareness and acceptance of a universally accepted alternative treatment.

CONCLUSIONS

Based on this study results, the following conclusions can be made:

- 1. There has been a statistically significant decrease in utilization of formocresol 1:5 dilution in pediatric dental residency programs over the last 5 years.
- 2. There has been a statistically significant increase in utilization of ferric sulfate and mineral trioxide aggregate in pediatric dental residency programs over the last 5 years.
- 3. The most common reasons for elimination of for-mocresol from pediatric dental residency programs over the last 5 years are systemic health concerns and guidance supplied by the evidencebased literature.
- 4. The most reported barrier for MTA usage in pediatric dental residency programs over the last 5 years is cost of the material.

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