

# Concentration of formocresol used by pediatric dentists in primary tooth pulpotomy

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## Abstract

Diluted formocresol is the most widely recommended primary tooth pulpotomy medicament, but it is not commercially available. This investigation surveyed practicing pediatric dentists about the concentration of formocresol that they use to perform pulpotomies and, if they use diluted formocresol, where they obtain it. Eight-hundred-and-six surveys were sent to a randomly selected sample of practicing pediatric dentists, and 422 were returned for a 52% response rate. Eighty-four percent of the respondents use formocresol for their primary tooth pulpotomies. Of those, 69% use full strength, 27% use diluted and 4% don't know. Sources of diluted formocresol for those who use the diluted form include: 34% who buy it that way, 58% who dilute it themselves and 8% who have the pharmacy dilute it. The majority of pediatric dentists who use formocresol for primary tooth pulpotomies use a full strength formulation. (*Pediatr Dent* 24:157-159, 2002)

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Formocresol, though the center of much controversy during the past 20 years, is still the most widely used medicament for primary tooth pulpotomies. The composition varies greatly, with such diverse formulations available as Buckley's formula composed of 19% formaldehyde, 35% cresol, 17.5% glycerin and Sultan brand composed of 48.5% formaldehyde, 48.5% cresol and 3% glycerine.<sup>1</sup> The formocresol pulpotomy technique has remained virtually unchanged since Berger recommended the one-appointment, five-minute technique in 1965.<sup>2</sup> The only two changes have involved removal of the formocresol from the pulp paste and dilution of the formocresol. The first reports recommending a dilution of formocresol for use in pulpotomies came more than 25 years ago. Loos and Han, in 1971, reported comparable tissue fixations with 1:5 dilution as with full strength in rats.<sup>3</sup>

This study was followed by Morowa and others in 1975, who reported an effective result with 1:5 dilution in a clinical study in children.<sup>4</sup> Since then the 1:5 dilution has gradually come to be accepted as the standard, and is the most widely taught technique in dental schools. Primosh (1997), in a survey of primary tooth pulp therapy as taught in predoctoral pediatric dental programs in the United States, concluded that a 1:5 dilution of formocresol applied

for five minutes is the preferred technique in a pulpotomy procedure.<sup>5</sup> In addition, major predoctoral pediatric dental textbooks recommend a 1:5 dilution of Buckley's formocresol in primary tooth pulpotomy.<sup>6-8</sup> Finally, the 1:5 dilution has been the gold standard for studies in the literature where formocresol pulpotomies are compared with other pulpotomy techniques.<sup>9-11</sup> Despite this long history and recommendations for the use of a diluted formula of formocresol, it does not appear to be available commercially. If the diluted form is not commercially available, one must wonder whether or how the practicing community is implementing this recommendation. Therefore, the purpose of this investigation was to determine the concentration of formocresol used for primary tooth pulpotomy by private practicing pediatric dentists who use formocresol.

## Methods

A prepaid postcard survey containing 6 questions inquiring about the use of formocresol for primary tooth pulpotomy was mailed to 25% (806) of the active practicing membership of the American Academy of Pediatric Dentistry (AAPD), selected randomly by district. Survey questions requested information about whether the practitioners used full-strength or diluted formocresol, the brand/formulation

**Table 1. Formulation of Formocresol Used**

Buckley's 19% formaldehyde	Standard 48.5% formaldehyde	Do not know	Other	Total
143 (43%)	155 (46%)	9 (3%)	26 (8%)	333 (100%)

**Table 2. Percentage of Practitioners Who Use Formocresol by the Strength of Formocresol They Use**

Strength of formocresol	Number of respondents	Percentage
Full strength	244	69%
Diluted	97	27%
Do not know	13	4%
Total	354	100%

they use and, if they use diluted formocresol, how the diluted form was obtained. Responses were tabulated as frequencies and analyzed by year of graduation from advanced education program and AAPD district.

### Results

Four hundred and twenty-two questionnaires were returned for a response rate of 52%. The distribution of responses was approximately equal from each AAPD district. Responses to the question, "Do you use formocresol for primary tooth pulpotomies?" indicated that 84% do so. The most frequently identified commercially available brands of formocresol included Sultan, Henry Schein, Moyco/Union Broach and Darby/Superdent.

Two formulations of formocresol were the most consistently reported: Buckley's (19% formaldehyde) identified by 43% of respondents and a Standard formulation (48.5% formaldehyde) identified by 46% of respondents. The remaining 11% either did not know the brand or used brands for which we were unable to identify the formaldehyde concentration (Table 1). Of those who use formocresol for primary tooth pulpotomies (n=354), 69% indicated that they use full strength, 27% diluted, and 4% didn't know (Table 2). Responses to the question "If you are using a dilution, where do you get your diluted formocresol?" indicated that 34% buy it that way, 58% dilute it themselves and 8% have the pharmacy dilute it for them (Table 3).

Analysis of responses for association between use of formocresol and use of diluted versus full strength formocresol by AAPD region and year of graduation from pediatric dentistry program yielded no significant associations. Respondents provided 107 comments, and several trends seemed to emerge. Two components of the technique that appeared to be assumptions by the respondents to "simulate" dilution were blotting the pellet dry (n=30) and reducing the length of application time (n=10). Several commented that they had previously diluted their formocresol, but due to poor results, had returned to using full strength.

### Discussion

The majority of pediatric dentists are not only still using formocresol for primary tooth pulpotomy, but they are also still using full-strength formocresol, either knowingly or unknowingly. The responses to this survey indicate that there is as much confusion among practitioners about formocresol as there is variation in their technique. It is interesting that more than two-thirds of the respondents know, and reported, that they are using full strength formocresol in spite of the fact that the standard technique accepted today recommends the diluted form.

What is unknown is whether they are using full strength because they don't know of the dilution recommendation, they know, but are reluctant to change, or they know a diluted product is not commercially available. Some clearly think that the diluted form is commercially available, as one-third of those who responded that they use diluted assume they are buying it that way.

For those who dilute it themselves, there is some doubt as to the concentration of their end product, based on their comments and the fact that they may be starting with one of two formulations that have dramatically different concentrations of formaldehyde. Respondents for whom a brand / formulation could be identified were almost evenly divided between using Buckley's formulation with 19% formaldehyde and the Standard formulation with 48.5% formaldehyde. The technique of formocresol pulpotomy is clearly not a standard technique with respect to the concentration of the medicament applied.

These two commercially available products have very different concentrations of formaldehyde (19% versus 48.5%) and would yield the same difference in concentration in diluted form. One must wonder why there are two such different formulations available and what rationale a practitioner would use to choose one over the other. Buckley's formocresol (19% formaldehyde and 35% cresol) is the formulation identified in major pediatric textbooks and by the investigators in the majority of previously reported studies researching the outcome of both full strength and diluted formocresol pulpotomies.<sup>2-4,6-15</sup> Why did this more concentrated second formulation (formaldehyde 48.5% and cresol 48.5%) become commercially available and widely used? Half the respondents in this survey who use full strength formocresol reported using this more concentrated form. Directions available to create the recommended 1:5 dilution of formocresol start with Buckley's formulation.<sup>7,8</sup>

**Table 3. Respondents' Reported Sources of Diluted Formocresol**

Buy it that way	32	34%
Dilute it myself	55	58%
Pharmacy dilutes it	8	8%
Total	95	100%

Another major concern is how a protocol that is taught as the standard of care in all contemporary pediatric dentistry textbooks recommends a medicament which is not commercially available. It is unrealistic then to expect compliance from the practicing community. The results of this survey indicate that diluted formocresol is not widely used. Only 2% of the total sample that use formocresol (8 of 354) are using a predictably accurate dilution—those who have it diluted by the pharmacy. Another 16% are diluting it themselves with apparently variable results. Fully 78% of those practitioners who use formocresol are using a full strength formulation, because those who think they are buying a diluted form (32) are actually using full strength.

### Conclusions

The majority of pediatric dentists who use formocresol for primary tooth pulpotomy are using the full strength formulation.

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