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Clinical evaluation of pulpotomies with ZOE as the vehicle for glutaraldehyde

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Abstract

The purpose of this study was to evaluate clinically and radiographically pulpotomies in human primary teeth treated with glutaraldehyde (GA) incorporated into the ZOE subbase without prior 5-min cotton pellet application. Thirty-five cariously exposed primary molars of 35 children 4 to 9 years old were pulpotomized and based with ZOE into which 2% unbuffered GA had been incorporated. Clinical and radiographic follow up varied from 6 to 24 months. No clinical or radiographic signs of failure were observed in 51.4% of the cases, while 48.6% of the teeth showed internal root resorption, furcation lesion, and/or fistulous tract. This high rate of failure indicates that the procedure using low concentrations of GA is inadvisable.

Because formocresol is strongly toxic, is distributed systemically, and causes immunological, biochemical, mutagenic, teratogenic, and perhaps carcinogenic alterations in the host,[1] alternative chemicals have been proposed for the pulpotomy treatment (s'Gravenmade 1975; Ranly and Lazzari 1983). One of these, glutaraldehyde, a standard fixative used in electron microscopy, has been evaluated in laboratory and clinical investigations.[2] Although glutaraldehyde has not been approved by the American Dental Association as a pulpal therapeutic agent, in vitro analyses have demonstrated that glutaraldehyde is an excellent fixative (Ranly and Lazzari 1983; Nelson et al. 1979) and the trials in animals (Fuks et al. 1986; Davis et al. 1982) and humans[3] have been promising. A recent study (Seow and Thong 1986) has shown that glutaraldehyde did not produce polymorphonuclear leukocytes (PMN) lysis at high concentrations, nor did it cause activation of PMN adherence at low concentrations. These findings suggest that glutaraldehyde is not as likely to cause inflammatory destruction of pulpal tissues as is formocresol, eugenol, or calcium hydroxide (Seow and Thong 1986).

The traditional method of applying formocresol to the amputation site has been a moistened cotton pellet (McDonald and Avery 1983). In some situations it also is incorporated in the zinc oxide and eugenol cement (ZOE) which is used as a base over the fixed radicular tissue (Berson and Good 1982).

In human and monkey teeth, diffusion of formocresol from cement alone effected pulp changes comparable to those observed following treatment with a formocresol-moistened pellet.[4]

A histologic study of monkey teeth treated with a ZOE dressing containing glutaraldehyde suggested that pulp might be fixed adequately by this protocol (Tagger and Tagger 1984). An in vitro study demonstrated that 25% of the 2% glutaraldehyde solution incorporated into ZOE had diffused into the incubation solution after 25 days (Ranly and Garcia-Godoy 1985).

The purpose of this study was to evaluate clinically and radiographically pulpotomies in human primary teeth treated with glutaraldehyde just incorporated into the ZOE, eliminating the 5-min moistened cotton pellet application.

[1] Loos et al. 1973; Block et al. 1978; Rolling and Lambjerg-Hansen 1978; Pruhs et al. 1977; Myers et al. 1983; Lewis and Chestner 1983.

[2] Nelson et al. 1979; Kopel et al. 1980; Garcia-Godoy 1983, 1986; Fuks et al. 1986.

[3] Kopel et al. 1980; Garcia-Godoy 1983, 1986.

[4] Mejare et al. 1976; Garcia-Godoy 1981, 1984.

TABLE 1. Evaluation of Pulpotomies

Time in Months After Treatment	*Clinical Status at the Last Treatment*		*Total*
	Success	*Failure*	
1–6	8	4	12
7–12	4	5	9
13–24	6	8	14
Total	18 (51.4%)	17 (48.6%)	35 (100%)

FIG 1. Second primary molar treated with glutaraldehyde in ZOE. A. immediate postoperative radiograph; B. 8-month postoperative radiograph. Note the extensive furcation pathology.

Methods and Materials

The sample consisted of 35 children 4 to 9 years old with 35 cariously exposed primary molars. The pulps of all teeth used in the study were judged to be cariously exposed by both clinical and radiographic examination. All clinical procedures were performed by one of the authors (FGG) in a private pediatric dental practice in Santo Domingo, Dominican Republic. The criteria used for selection of the teeth included in the study were: (1) radiographically and clinically symptomless pulp exposure by caries; (2) no clinical or radiographic evidence of extensive pulp degeneration; (3) the possibility of proper restoration of the tooth; (4) pulp tissue which exhibited light red blood when exposed using a bur in a high-speed handpiece (and blood flow easily arrested with a dry cotton pellet); and (5) a cooperative patient.

The teeth to be treated were anesthetized and the teeth isolated with a rubber dam. Using a bur in a high-speed handpiece, the preparation for a stainless steel crown was performed. All caries was removed before exposing the pulp. At this time, the teeth were irrigated with plain water and a conventional pulpotomy technique was performed with a high-speed bur. After coronal pulp amputation, the blood color and flow were evaluated. Hemostasis then was promoted with dry cotton pellets using slight pressure. The dry cotton pellets were removed and a fast setting ZOE[a] containing 1 drop of eugenol and 1 drop of 2% unbuffered glutaraldehyde with glycerol was placed in the pulp chamber contacting the pulpal stumps. A stainless steel crown was cemented immediately.

[a] IRM—LD Caulk Co; Milford, DE.

At regular 6-month intervals following the treatment, clinical and radiographic examinations were made. The treatment was considered a failure if 1 or more of the following signs was present: internal root resorption, furcation and/or periapical bone destruction, pain, swelling, sinus tract, and/or mobility. Clinical and radiographic follow up varied from 6 to 24 months.

Results

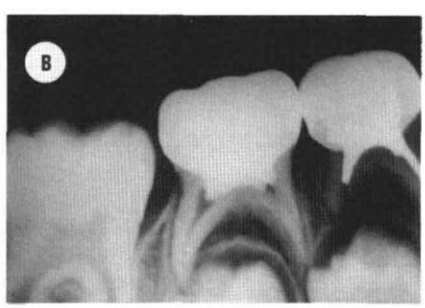
All 35 teeth were available for clinical and radiographic evaluation at periods from 6 to 24 months.

Table 1 presents the rate of clinical and radiographic success at the time the tooth was last examined. Seventeen teeth (48.6%) showed signs of failure (internal resorption, furcation/periapical pathology, and/or sinus tract, Figs 1, 2) at different postoperative periods. No clinical or radiographic signs of failure were observed in 18 teeth (51.4%).

Discussion

The present study demonstrates that the pulpotomy treatment utilizing 2% glutaraldehyde incorporated into the ZOE is not as effective as when the glutaraldehyde is applied for 5 min in a cotton pellet. One reason for this difference could be that the 2% glutaraldehyde solution is not the most appropriate concentration to adequately expose the pulp by this modality. Another explanation might be that the eugenol diffused from the ZOE faster than glutaraldehyde and had more effect on the pulp. Such speculation is supported by the reports of internal resorption and total necrosis found after pulpotomies with plain

FIG 2. Second primary molar treated with glutaraldehyde in ZOE. A. immediate postoperative radiograph; B. 6-month postoperative radiograph. Note the internal resorption in the distal root canal.



ZOE (Garcia-Godoy 1981; Magnusson 1971). The clinical and radiographic characteristics of the pulpotomized teeth in the present study resemble the ZOE pulpotomies (Garcia-Godoy 1981; Magnusson 1971) more than 5-min glutaraldehyde pulpotomy.[5]

The present clinical study conducted in humans using a 2% glutaraldehyde concentration does not support the histologic evaluation in monkeys of other authors reporting the pulpotomies with 5% glutaraldehyde just incorporated into the ZOE (Tagger and Tagger 1984). The high rate of failure recorded in the present human study using a similar protocol indicates that the the procedure with a 2% glutaraldehyde concentration is inadvisable.

Further studies are necessary to determine whether pulpotomies in human primary teeth treated with stronger concentrations of glutaraldehyde incorporated into the ZOE might produce a higher clinical and radiographic success rate.

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