Clinical and Histological Evaluation of Three Different Antiseptics Used in the Treatment of Abscessed Primary Molars

The primary teeth are used for the mechanical preparation of the child's digestion and assimilation, during one of his most active periods of growth. At the same time, these teeth stimulate the growth of the jaws through mastication. The primary teeth also serve a cosmetic function by improving the appearance and the speech of the child.

There is a direct time relationship between loss of a primary tooth and the eruption of its permanent successor. This time interval may be disturbed by early extraction. The retention of the deciduous dentition until its normal time of exfoliation is acknowledged to be of great importance to the child. The retention of the deeply carious second molar in a preschool child (before eruption of the first permanent molar) is one of the most valuable services that can be provided for the child.1,3

The progress of dental caries leads to destruction of enamel and dentin which enables bacteria to enter the pulp chambers and root canals. Untreated carious lesions of primary molars most commonly develop abscesses of the bifurcation area, whereas the carious process in permanent molars tends to develop periapical abscesses.4 Winter, presented a histological study in which abscessed deciduous molars were examined for accessory canals.5 He found that accessory canals were present in about 29% of the examined molars.

Pulp Treatment Techniques
Various techniques have been suggested for maintaining primary teeth in healthy condition until exfoliation. The most familiar techniques are: direct and indirect pulp capping, vital and non-vital pulpotomy and pulpectomy. The pulpotomy technique has been the procedure of choice for treating primary teeth.5,7

1. Pulp Capping
A) Indirect Pulp Capping
It is defined as "The application of therapeutic materials to an area of infected dentin over the pulp, in a deep cavity where the pulp is not actually exposed". It is indicated only in symptomless vital teeth.8

B) Direct Pulp Capping
The technique and the materials used are the same as in indirect pulp capping, but the therapeutic material is applied over traumatically exposed vital pulp to induce calcific repair. This technique is not highly recommended for primary teeth because the application of calcium hydroxide directly to the pulp generally initiates a process of internal resorption.9

2. Pulpotomy
Pulpotomy is the treatment of choice in treating deciduous teeth. It can be used in the treatment of vital, partially vital and non-vital deciduous teeth. Different techniques and medicaments have been used depending upon the vitality of the treated teeth.10

A) Vital Pulpotomy
It is indicated in cases with carious or mechanical exposures in vital primary teeth. After removal of the coronal pulp tissue, a dressing or medicament is placed over the pulp stumps. The clinical
success experienced with these materials is possibly related to the drug’s germicidal action and fixation qualities rather than to its ability to promote healing.\textsuperscript{11}

B) Devitalizing Pulpotomy or Two-Visit-Pulpotomy
It is recommended in cases of vital deciduous teeth with persistent bleeding which cannot be controlled or in cases where a local anesthetic cannot be administered. It is performed using a devitalizing paste.\textsuperscript{12}

C) Non-Vital Pulpotomy
It is also named “two-visit-pulpotomy” or “mortal pulpotomy”. It is indicated in non-vital primary teeth with pus at the exposure site or in the coronal part of the pulp chamber, for teeth with pathological mobility, fistula and with facial cellulities.\textsuperscript{13}

3. Pulpectomy
King et al.\textsuperscript{14} noted that pulpectomy is more difficult to be performed in primary molars due to the complicated anatomy of root canals and the proximity of the permanent tooth germ. Magnusson\textsuperscript{15} added that it is difficult to find a root canal filling material which is compatible with physiological root resorption.

The purpose of this study was to evaluate the two-visit-pulpotomy technique (mortal pulpotomy) on abscessed deciduous molars, clinically as well as histologically, using three different types of medications: 1/5 Dilution of formocresol, Camphorated parachlorophenol and Pulpery.

Materials and Methods
This study was carried out on 126 pulpally involved second mandibular primary molar teeth in children, ranging from four to six years of age. The selected sample was gathered from the regular dental patients attending the Pediatric Clinics at the Faculty of Dentistry, Alexandria University.

Criteria of Selection
Pulpotomies were performed on teeth of subjects who were free of any systemic diseases which might affect the response of the pulp to the treatment. These were blood, heart and renal diseases, diabetes mellitus, or any other systemic disease. All teeth had buccal swelling in various stages of parulis formation, and some of them had draining fistulae, pathological mobility or a combination of these signs. Teeth with perforated pulpal floors, excessive destruction that is not amenable to restoration, caries penetrating the roots and cases with root resorptions extending for more than one third of the root length) were excluded from the study.

Pulpotomies were performed on one tooth or more for each child. The treated teeth were divided into three groups according to the medicament used in the treatment.

1. Group I: 43 teeth were treated with formocresol. Formocresol composition\textsuperscript{16}: Formaldehyde: 19 ml., Cresol: 35 ml., Glycerin: 25 ml. and Water: 21 ml.

2. Group II: 41 teeth were treated with camphorated parachlorophenol (CMCP) whose composition was of 35% parachlorophenol in camphor.\textsuperscript{17}

3. Group III: 42 teeth were treated with pulpery whose composition was of Procaine hydrochloride\textsuperscript{18}: 4.1 g., Phenol: 20.5 g., Beechwood creosote: 28.65 g. and Eugenol: 16.25 g.

Clinical Procedures
- Non-vital pulpotomies were performed on 126 primary second mandibular molars in two visits; 10-14 days apart.
- A preoperative periapical X-ray was taken to evaluate the condition of the tooth and surrounding tissues.
- The standardized two-visit-pulpotomy technique was performed as follows.

First Visit
- The mandibular nerve was blocked with local anesthetic solution.
- Partial isolation using cotton rolls and saliva ejector.
- Removal of the dental caries and the overhanging enamel was planned to provide good access to the coronal pulp, using a high-speed fissure bur.
- The pulp horns were located by a fissure bur on a high-speed handpiece and cuts were made between the pulp horns to remove the pulp chamber roof.
- All debris were removed using a large spoon excavator and the coronal part of the pulp was washed with saline and dried.
- A cotton pellet containing the medicament was placed in the pulp chamber after squeezing the excess of the medicament.
- The pellet was covered by intermediate restorative material (IRM\textsuperscript{19} Dentsply Caulk, Milford, DE).
- Abscessed tissue was curetted from the
bifurcation area with a sterile spoon-shaped excavator. Access to the abscess was reached from the swollen gingival crevice. Care was taken to avoid encroachment of the instrument on the permanent tooth bud.

- The buccal wound site was covered with a sterile (2 x 2 inch) gauze pad to absorb blood and to exert pressure on the wound.
- The child was re-appointed after 10-14 days to complete the final treatment.

**Second Visit (After 10 - 14 Days)**
- Partial isolation with cotton rolls and saliva ejector. The IRM and the cotton pellet were removed and the pulp chamber was dried.
- Placement of a paste consisting of zinc oxide eugenol with a drop of the medicament used in the first visit. The mix was placed in the pulp chamber and condensed with an amalgam condenser and a moist cotton pellet. This paste occupied half of the pulp chamber. The second half of the pulp chamber was filled by IRM cement and the permanent restoration (a stainless steel crown 3M™, ESPE™, St. Paul, MN) was placed on the tooth.

If at this second visit, the patient was still complaining of sustained signs, the case was excluded from the study, extraction carried out and a space maintainer was fabricated and fitted for the child.

**Re-Examination**
After treatment, regular clinical re-examination was carried out every six months for a period of 18 months. Success cases were considered according to the following conditions: Normal tooth mobility, lack of sensitivity to percussion, lack of patient complaints (discomfort) and normal appearance of surrounding soft tissue without pathological radiographic changes.

Cases with clinical evidence of pain on eating and/or tenderness on percussion and/or persistence or appearance of sinus tract and/or presence of intraoral or extraoral swellings were considered a failure.

The results of the three different groups were recorded, tabulated and statistically compared.

**Histological Procedures**
Ten cases of each group were randomly selected and after obtaining parents’ consent were examined histologically on the first appointment and after one year postoperatively.

- **On the First Appointment:** Mandibular nerve was blocked by a local anesthetic solution. A No. 12 curved disposable scalpel blade on a Bard-Parker handle was used to incise and remove horizontal elliptical layer of mucosa and submucosa from the area immediately buccal to the bifurcation lesion (5x3 mm). A small hemostat was used to grasp the anterior loose end of the tissue, and tissue scissors were used to separate the distal attachment. A “2 x 2 inch” sterile gauze pad was placed over the buccal wound. Specimens were preserved in 10% formalin for about one week, then the specimens were dehydrated in ascending alcohol (50%, 70%, 90% and 100%), for two hours in each concentration. Specimens were cleared with xylol, and embedded in wax. Paraffin blocks were prepared, sectioned (4 fl thick) and stained with haematoxylin and eosin (H & E). Specimens of soft tissues were submitted to histological examination using a light microscope and the results were recorded.

- **After One Year Postoperatively:** The mandibular nerve was blocked. A key cutaneous surgical punch biopsy instrument that was two millimeters in diameter was used to cut through mucosa just buccal to the bifurcation area and to cut the tissue until encountering bony resistance. A sterile excavator was used to detach the lingual wall of the bifurcation area. A “2 x 2 inch” inch sterile gauze was placed over the buccal wound. Specimens were treated and examined as above mentioned.

**Results**

1. **Clinical Results**
Two-visit non-vital pulpotomies were performed on 126 second mandibular primary molars, in patients ranging in age from four to six years. Only 108 molars were re-examined after 6, 12 and 18 months. Eighteen molar cases did not show up for re-evaluation. At the end of the clinical study, patients’ charts and clinical data were analyzed.

The variables which were used in the evaluation of the treatment success were: Improvement of tooth mobility, lack of percussion response, lack of history of patients’ discomfort, normal appearance of adjacent soft tissue and positive differences noted in radiographic findings.

Failure was considered in cases with clinical evidence of pain on eating, tenderness on percussion, excessive tooth mobility and persistence or appearance of sinus tract or presence of intraoral or extraoral swelling.
The results were tabulated into three groups according to the used material. Statistical analysis was done using Chi-square test ($X^2$) for testing the differences between variables. The test was considered significant if the probability of error was less than 5% ($P < 0.05$).

Table (1) shows the success rate of the two-visit non-vital pulpotomy using three different materials, after 6, 12 and 18 months of treatment. Group I: Diluted Formocresol, Group II: Camphorated Parachlorophenol, Group III Pulperyl.

<table>
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<th>Groups</th>
<th>After 18 Months</th>
<th>After 12 Months</th>
<th>After 6 Months</th>
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<td></td>
<td>Failure</td>
<td>Success</td>
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<td>7</td>
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<td>8</td>
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<td>28</td>
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<td>8</td>
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<td>27</td>
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<td>0.554</td>
<td>0.308</td>
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Table (1) shows the success rate of the two-visit non-vital pulpotomy using three different materials, after 6, 12 and 18 months. It was found that the success rate decreases with time in the three groups:

In group I (using the diluted formocresol) success rate decreased from 94.6% after 6 months to 83.8% and 81% after 12 and 18 months, respectively. In group II (using camphorated parachlorophenol) the success rate was 91.8%, 83.3% and 77.8% after 6, 12 and 18 months, respectively. In group III (using Pulperyl) the success rate was 94.3%, 82.0% and 74.5% after 6, 12 and 18 months, respectively.

Using the Chi-square test, it was found that there were no statistically significant differences at 5% level between the three groups, after 6, 12 and 18 months.

2. Histological Results

(A) Histological findings at the Time of Treatment

Light microscopic examination of the tissues taken from the bifurcation lesion of primary molars revealed a mixed inflammatory response, including a mucosa of stratified squamous epithelium having a tendency to hyperplastic (Fig. 1), with chronic proliferative inflammation (Fig. 2) and acute inflammation (Fig. 3).

(B) One-Year Postoperative Histologic Findings

As a result of the three different materials used, different tissue reactions were observed and compared (Figs. 4-12).
Discussion

Conservative treatment of the pulpally involved primary teeth is often necessary to avoid premature loss of deciduous teeth. Premature extractions may lead to loss of space and subsequent problems concerning the development of malocclusion.21 The primary tooth is accepted as the guide and guard for the permanent dentition and it is considered to be the best space maintainer. In the present study, 126 abscessed primary second mandibular molars were treated by two-visit non-vital pulpotomy technique, using three different medicaments (diluted formocresol, camphorated parachlorophenol and pulperyl).

This study showed that non-vital pulpotomy technique using diluted formocresol, camphorated parachlorophenol and pulperyl was after 18 months of treatment successful in 81%, 77.8%, and 74.5%, respectively. The results suggest that the technique is a practical alternative to extraction and space-maintaining. This is in agreement with Coll et al.22, who stated that the tooth is the best space maintainer in primary dentition, and pulp treatment with an adequate filling material would be ideal for primary teeth and necrotic pulps, abscesses, fistulae and mobility that otherwise would be indicated for extraction.

The results of the present study showed that the used technique with the three medicaments can be used as an alternative to pulpectomies in deciduous molars as the success rate was found to be acceptable. Similarly, Hobson23 found that techniques requiring instrumentation in the canals would be unsuitable for infected primary molars and the operative procedures should be confined to the pulp chamber. On the other hand, Barr et al.24, Coll et al.25 and Rifkin26 found that pulpectomy in infected deciduous molars may provide an alternative to tooth extraction and space maintenance.

In the present study, the success rate of the teeth treated using diluted formocresol in group I, decreased from 94.6% to 83.8%, to 81%, after 6, 12 and 18 months, respectively. This was probably due to the diffusion of formocresol throughout the root canal into the periodontal structures, acting as an irritant.27 Formocresol, generally has no healing properties in histological terms, although pulpotomy may be considered clinically successful.28 Velind29, reported only five failures out of 363 pulpotomies after two and a half years of treatment.

In group II using camphorated parachlorophenol,
the success rate of the teeth treated decreased from 91.8% to 83.3%, to 77.8% after 6, 12 and 18 months, respectively. Parachlorophenol was found to be an extremely active antibacterial agent while camphor reduces its irritation potential and allows tissue healing.

A higher rate of success was reported by Sobanska [30], who reported a 93.7% success after four years of treating 60 cases with the same material.

In group III using pulperl (containing beechwood creosote), the success rate of the teeth treated decreased from 94.3% to 82%, to 74.5%, after 6, 12 and 18 months, respectively. This material was found to be successful as it eliminates most of the infecting organisms, except alpha-Streptococci and causes no pain.31 This is in accordance with Hobson [32] who found that the rate of success was 74% after treating non-vital deciduous molars with beechwood creosote.

In the present study, the success rate of the teeth treated with the three different materials decreased with increasing the observation period. This was found to be in accordance with the findings of Mejare [33], Boeve and Germant.34

Comparison of the obtained clinical results from the three different materials in this study showed that the success rate at the end of the study period (i.e. 18 months) was 81% for formocresol, 78% for camphorated parachlorophenol and 74.5% for pulperl. This indicates that the best clinical results were obtained with formocresol, although the difference between tested groups was not statistically significant.

In the present study, the degree of improved mobility (as measured on a scale from 1-3), changed from 86.5% to 81% to 78.5% after 6, 12 and 18 months of follow-up in group I, from 86% to 83.5% to 80.5% in group II, and from 88.5% to 92.5% to 74.5% in group III of patients. Andrew [35], in a study stated that the number of teeth which exhibited mobility did not show such a great reduction, but the fact that many of the roots were undergoing resorption must be taken into account.

In this study, the percentage of the sensitivity to percussion changed from 97.3% to 90% to 81% after 6, 12 and 18 months, respectively in group I. In group II it was reduced from 97.25% to 86% to 83.5% and from 94.2% to 83.7% to 80% in group III of patients.

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In this study, patient’s discomfort changed from 97.3% to 90% to 85.8% in group I, from 100% to 89% to 83.5% in group II, and from 97%, 88.5% to 80% in group III of patients, after 6, 12 and 18 months, respectively. According to Full [36], the clinical evidences showed that of 166 teeth have remained functional and symptomless following non vital pulpotomy treatment. Only 12 of the treated teeth needed to be extracted because of recurrence of pain.
As for the soft tissue condition, the results of the present study showed that the improvement of soft tissue condition decreased with time as the percentage changed from 94.6% to 83.8% to 83.8% in group I, from 91.8% to 85.3% to 78% in group II and from 94.2% to 82.5% to 74.5% in group III, after a follow-up period of 6, 12 and 18 months, respectively.

In this study, the size of furcation radiolucency was found to be stable in the majority of the treated cases, as the results after 18 months were 67%, 66.75% and 63%, for groups I, II and III, respectively. Comparatively, 87% of the 31 subjects returning every six months for follow-up, for a period of 5 years, chosen by Meyer and Sayegh20, exhibited radiographic elimination or arrested rarefaction of the bifurcation lesion.

As for the histological part of this study, observations of the specimens taken at the time of the first pulpotomy visit, demonstrated that furcation lesions associated with pulp degeneration in a primary molar were of mixed nature. Various inflammatory reactions were seen in the same biopsy specimen with granulomatous inflammation as the predominant type. Stratified squamous epithelium which has a tendency to be hyperplastic, lining granulomatous tissue, with the presence of acute and chronic inflammatory cells.

In the same specimens, the inflammatory cells were mixed with giant cells of the multinucleated type, with the presence of central collection of serous exudate. This is in accordance with the findings of Myers et al.37, who studied the histopathology of furcation lesions associated with pulp degeneration in primary molars and concluded that radiolucent furcation lesions were mixed and dynamic and may be classified as furcation granulomas. Similarly, it was found by Cardoso and Michelli38 that it was difficult to classify the periapical lesions on deciduous and permanent teeth as granulomas, abscesses or cysts, because the lesions were mixed but mostly could be called granulomas. Several lesions were clearly abscesses but many were combinations. They also found that deciduous teeth were more rapidly involved than permanent ones.

The postoperative findings of this study were in agreement with Meyer and Sayegh20, who found that all the eight postoperative biopsy specimens showed evidence of new collagen Formation and concluded that curettement of the bifurcation abscess reduces the concentration of the irritant and the repair of the bifurcation area is initiated.

Comparison of the histological results of the three groups showed that there was healing in the bifurcation lesions of most treated molars. The camphorated parachlorophenol showed to be the best, followed by pulperyl, and lastly the diluted formocresol. Camphorated parachlorophenol was found to be less irritating to the bifurcation tissues and allowed healing of the tissues more rapidly.

In the present study, it was observed that there was no correlation between clinical and histological findings. The clinical success rate after 18 months was 81%, 77.8% and 74.5%, for formocresol, camphorated parachlorophenol and pulperyl groups, respectively. This was not in correlation with the histological findings, demonstrating that camphorated parachlorophenol and pulperyl showed better results than formocresol. This is in accordance with Hobson33, Kennedy et al.38 and Seltzer et al.39 as they all found that there is no correlation between the clinical signs and symptoms, and the histological picture.

Conclusions
From the results of the present study, it is concluded that:
• A combination of two-visit non-vital pulpotomy with curettement of the bifurcation area is a successful treatment for abscessed primary molars.
• This technique can be used as an alternative to extraction and space maintaining and is recommended to maintain a badly decayed second primary molar, especially before the eruption of the permanent molars.
• There was no statistically significant difference between the clinical results of the used three materials at the 5% level of significance.
• There was no correlation between the clinical and the histological findings, as the best clinical results were found in cases treated with diluted formocresol, while the best histological results were found in cases treated with camphorated parachlorophenol.

Recommendations
From the results of this study, it is recommended that:
• It is preferred to use a less toxic and less irritant antiseptic to both the patient and the dentist, nevertheless to be as effective as the materials already used.
• The use of two-visit non-vital pulpotomy in combination with surgical drainage and curettement of the bifurcation abscess in primary second molars allows better wound healing before eruption of the first permanent molar.
• More investigations must be carried out for a
longer period of time to evaluate the effect of these different materials on the surrounding tissues and the succedaneous teeth.

References