Success Rate of Ferric Sulfate Pulpotomy Under Different Levels of Sedation

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Introduction

Pulpotomy in primary teeth is defined as the removal of the coronal pulp and preserving the vitality of the radicular portion to maintain teeth integrity in order to allow phonation, esthetics and masticatory function until exfoliation [1,2]. According to the clinical guidelines of the American Academy of Pediatric Dentistry, pulpotomy is performed in a primary tooth with extensive caries and pulp exposure with no evidence of radicular pathology [3]. A wide range of medicaments and techniques with varying success rates have been used for pulpotomy including formcresol, ferric sulfate, calcium hydroxide, laser application and MTA [4,5].

Until the introduction of MTA in 1993, Formocresol had been the gold standard material for pulpotomy treatments in primary teeth [1,3]. Due to concerns regarding possible mutagenic, carcinogenic and toxic effects of formocresol; despite its high success rate, availability and cost effectiveness; the use of this pulpotomy medicament has been a matter of considerable debate [6]. Consequently other pulpotomy medicaments have been introduced over the years including Ferric Sulfate which are less toxic than formocresol but have similar success rates of about 84% to 92% [6,7]. Also due to its low cost, ease of use and short time of effectiveness, ferric sulfate has become a popular medicament of choice in comparison to formocresol [10].

In addition to the role of medicaments and techniques in determining other factors including the correct diagnosis, caries excavation method, the sealing ability of the final restoration, operator experience and the patient's level of cooperation have been proposed to affect the outcome of this procedure [8,9].

For some uncooperative patients, the treatment of early childhood caries which require pulpotomy procedure are sometimes accomplished using general anesthesia or oral sedation [11] and as such, this study aims to compare the clinical success rate of ferric sulfate pulpotomy completed under different levels of sedation namely deep (under general anesthesia), moderate (under oral sedation) and mild/no sedation (with or without the use of nitrous oxide as a mild sedative agent).

Objectives

The goal of this study was to determine if there is a statistically significant difference in the clinical success of pulpotomy performed under general/deep anesthesia, oral/moderate sedation or under mild/no sedation (with or without the use of nitrous oxide as the sedative agent) using ferric sulfate. All treated teeth were followed for one year.

Subjects

The target population of this study consisted of the dental charts of children aged 3 to 8 years who received pulpotomy treatment from July 1, 2014 to June 30, 2018. All teeth were subsequently restored using stainless steel crowns.

Data recorded from children not meeting the age criteria or the above time period was not considered for the purposes of this study. Immunocompromised patients or the ones with certain conditions like bleeding disorders, dentinogenesis imperfecta or amelogenesis imperfecta affecting the success of pulpotomy were excluded from the study.

There was no exclusion criteria on the basis of ethnicity, gender, or race or whether the teeth had received any prior restoration/treatment. The sample contained 3822 electronic Montefiore dental health records obtained within a four-year timespan. No patient identifiers were included as part of this study.

Study Design and Methods

This study was a retrospective chart review on the pulpotomy procedures performed using Ferric Sulfate on primary teeth in pediatric patients aged 3 to 8 who presented to Montefiore Medical Center in a 4 year period spanning from July 1, 2014 to June 30, 2018. We collected data pertaining to demographic information, pulpotomy medicament and whether the procedure was performed under general/deep anesthesia, oral/moderate sedation or under mild/no sedation (with/without the use of nitrous oxide).

A single dentist examiner reviewed records associated with the ADA Code for pulpotomy, D3220 obtained from July 1, 2014 to June 30, 2018 and ADA codes for periodic oral evaluation, D0120 and/or limited oral evaluation, D0140 within one year of the pulpotomy procedure.

The inclusion criteria was defined as the following: patients aged between 3 and 8 years who had at least one primary molar which was treated by pulpotomy and stainless steel crown as the final restoration, and who had referred back to the clinic at 6 month and/or one year recall visits or for emergency visit(s) related to the treated teeth within one year of the procedure.

The clinical success of pulpotomy within one year of treatment was defined by the absence of spontaneous or nocturnal pain, abscess, fistula or pathologic mobility. The presence of any of the above mentioned symptoms and/or extraction of the pulpotomy treated teeth for any reason other than normal exfoliation within one year of treatment were regarded as failure.

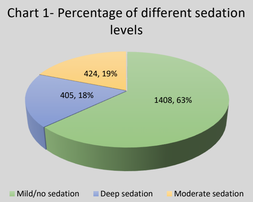
Results

A total of 3822 charts were reviewed and based on the inclusion criteria, 2309 pulpotomy outcomes were further analyzed. At the end of a 12-month follow up period, 1916 (83%) of the pulpotomy procedures were judged successful and 393 (17%) had failed (Table 1).

Total	Success	Failure
2309	1916 (83%)	393 (17%)

Table 1. Success rate of pulpotomy

The sedation levels under which the pulpotomy procedures were performed fall into three different categories. 405 (18%) cases were completed under deep sedation, 424 (18%) under moderate sedation and 1,480 (64%) under mild/no sedation (Chart 1).



Results

Based on the findings of the study, sedation level affects the odds of success of pulpotomy. Statistically significant differences were found in success rate of the procedure as noted in table 1.

	Success	Failure	Total
Deep Sedation	347	58	405
Moderate Sedation	348	76	424
Mild/No sedation	1221	259	1480

Table 1. Pulpotomy procedure outcomes

Using deep sedation as reference, the odds of success reduces between 28 – 36% for mild/no and moderate sedations (Table 3). The odds ratio (OR) associated with mild/no sedation is 0.72 (95% Confidence Interval: 0.50, 1.03); p = 0.075. The OR associated with moderate sedation is 0.64 (95% CI: 0.42, 0.99); p = 0.043. Completion of pulpotomy under moderate sedation has the lowest odds of being successful.

Sedation level	Odds Ratio (95% CI)	P-value
Deep Sedation	---	---
Moderate Sedation	0.64 (0.42, 0.99)	0.043
Mild/No sedation	0.72 (0.50, 1.03)	0.075

Table 3. Effect of sedation on success of pulpotomy

Discussion

The overall success of pulpotomy in the present study (83%) was found to be comparable to the success rates reported in the literature for ferric sulfate pulpotomy (from 84% to 92%) [6,7]. One year follow up revealed that the procedure was most successful when performed under deep sedation followed by mild/no sedation and moderate sedation, respectively. The difference between the success of pulpotomy performed under deep sedation was found to be statistically significant with pulpotomy performed under moderate sedation having the lowest odds of success.

Pulpotomy is highly technique sensitive and its outcome depends on many factors including diagnosis accuracy, caries excavation method, pulp dressing material, quality of the final restoration and operator experience [12]. The higher success rate of the procedure when performed under deep sedation can be attributed to proper isolation and seal of the final restoration that can be achieved when the behavior of the pediatric patient during the procedure does not adversely affect the outcome. Pulpotomy performed under moderate sedation is associated with the lowest success rate according to the results of our study. This may be attributed to the fact that the patients selected to receive comprehensive treatment under oral sedation often have high levels of anxiety and are not able to cooperate with treatment. As a result, given the fact that many of these patients are not fully sedated during the procedure, the untoward movement of head and difficulty in achieving ideal isolation could negatively impact the pulpotomy outcomes.

In contrast, cooperative children are often treated under mild/no sedation who are better able to tolerate the pulpotomy procedure.

Conclusions

The findings of the study support the hypothesis that there is a statistically significant difference in the success of pulpotomy performed under different levels of sedation.

The success of this procedure was the highest under general anesthesia/ deep sedation during which proper isolation can be achieved and untoward movements of the patient's head/body are absent/minimized.

Multiple factors can affect the outcome of pulpotomy including diagnosis accuracy, caries excavation method, operator's experience level, isolation technique, pulp dressing material and patient's behavior during the procedure.

Pulpotomy had the least success rate when performed under oral sedation during which many of the above variables can have a negative effect on the outcome of the procedure as full sedation is not often achieved and the patient is not able to cooperate during treatment.

Limitations of the study include the following:

- Confounders: operators' skill level, patient behavior, isolation method, proximity of the caries to the pulp, diagnosis accuracy, genetics and oral hygiene.
- Biases: grader reliability, inter-operator or examiner differences, charting errors.

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