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Fracture Prevention through Strategic Endodontic Reductions: Implications for Clinical Practice

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Abstract: Pulpectomy is a common dental treatment for infected or inflamed primary teeth, aimed at preserving tooth function and preventing fractures. Where cases were 65 of pulpectomy performed under local or general anesthesia were evaluated. Survival outcomes and fracture prevention were assessed using Kaplan-Meier estimators and Cox regression models, analyzing variables such as age, sex, anesthesia type, and root canal materials. Most treated teeth had severe caries (77%) and were molars (68%). Radiographic findings showed no pathology in 46% of cases, while 40% presented periapical radiolucency. Treatment success was high at 94%, with only 5% of teeth developing fractures. Stainless steel crowns were used in nearly 88% of cases as the final restoration, so finally we concloude that Pulpectomy is an effective procedure to maintain primary teeth, minimize fractures, and ensure patient satisfaction. Proper case selection and restoration techniques contribute to improved treatment outcomes in pediatric dental care.

Keywords: Endodontic reduction; pulpectomy procedure; post–operative pain; infected pulp; fracture prevention.

INTRODUCTION

The dentition is usually affected by dental caries, so at an early age, it is considered a serious challenge for clinicians to avoid tooth loss [Abanto, J. *et al*., 2011]. The premature loss of teeth leads to space problems since the tooth is a natural space maintainer, as well as phonetic alterations, reduced chewing strength, occlusion problems, and the development of parafunctional habits [Ahmed, H. M. A. 2013]. Pulp therapy is one of the measures developed to prevent the extraction of decayed teeth. The choice of the appropriate technique is determined by clinical and radiographic judgment. Pulpectomy is the most common treatment for temporary teeth with extensive caries, although pulpectomies have an "undoubted clinical record" with reported success rates between 83 and 100%. [Al-Eheideb, A., & Herman, N. 2004; Soxman, J. A. 2021; Amin, M. *et al*., 2016; Angwaravong, O., & Panitvisai, P. 2009]

Pulpectomy operation is essential to manage dental trauma, especially in situations at complex crown fractures. This procedure aims to retain the life of the tooth and stimulate root formation. A study has demonstrated that performing pulpectomy on primary molars can lead to a significant rate of tooth survival, particularly when paired with pharmaceutical behavior correction among people exhibiting negative behavior. [Ayhan, H. *et al*., 1996; Blumer, S. *et al*., 2017; Bowen, J. L. *et al*., 2012; Casas, M. J. *et al*., 2004; Chen, Y. *et al*., 2020; Clark, T. G. *et al*., 2003; Çolak, H. *et al*., 2013; Coll, J. A. *et al*., 1985]

Furthermore, there is compelling data indicating that both partial and total pulpotomy procedures have a high percentage of success in treating teeth with complex crown fractures [Coll, J. A., & Sadrian, R. 1996]. As a result, pulpotomy is considered a more favorable treatment choice compared to pulp capping. The effectiveness of pulpectomy in treating traumatized permanent teeth is greatly influenced by factors like the existence of the dentine bridge, along with the clinician's expertise [Coll, J. A. *et al*., 2020]. This highlights the necessity of selecting appropriate cases and providing continual training to achieve better outcomes. [Dannewitz, B. *et al*., 2006; Dunston, B., & Coll, J. A. 2008]

A clinical study of 100 caried primary incisors radiographically reported success rates of 91% for pulpectomy. In recent years, the concepts of measurement and reporting of healthcare results

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have evolved in the search for evidence that can validate therapeutic procedures. It has been agreed that the evidence needed to base treatments cannot be derived from an indiscriminate search among all available studies, with the discrepancies in the level of evidence they provide [El Batawi, H. Y. 2014; Forsyth, A. R. *et al*., 2012; Gonzalez, L. P. *et al*., 2012]. Due to that, this study aimed to determine the importance of pulpectomy procedures as an endodontic reduction as in the prevention of fractures. Additionally, this study assessed clinical factors that affect tooth survival following pulpectomy treatment.

METHODOLOGY

We conducted a cross-sectional study of dental patients who underwent pulpotomy under general and local anesthesia, aged 5-25 years, which included treatment, evaluation, and diagnosis data for patients with severe caries before and after the procedure for 65 patients from dental clinics in several hospitals in Iraq during the period between July 2022 and October 2023. Demographics were recorded before surgery and distributed to patients in terms of age, gender, symptoms and determining the level of caries prevalence and severity on the teeth, which were classified using the ICDAS SCALE, which is represented as a visual recording that is evaluated with degrees ranging from 0 to 6, where 0 represents no caries, degrees between (1-3) represent mild caries degrees, degrees between (4-5) represent the presence of caries in the teeth of a moderate degree, and a degree of 6 represents the degree of severe caries.

Outcomes of Pulpectomy

The exact measurement of each root's working length is determined using an electronic apex locator (EAL). Endodontic K-files were used to form and purify the canals, while a regular saline solution was used to flush them. Following complete preparation, the canals were sealed with Vitapex or zinc oxide eugenol (ZOE) and dried with sterile paper tips. The injured tooth was successfully repaired with a stainless-steel crown. As a coping strategy, a tooth with an irreparable crown was rebuilt using options such as glass ionomer, resin composite, or amalgam. Both a computerized database and traditional data collection techniques were used in the study to determine which teeth were chosen to be included. Through the use of an electronic dental records program, the teeth that received treatment in 2022 and 2023 were identified. During this screening, treatment codes created especially for pulp therapy were used.

A qualified and standardized examiner evaluated each tooth's radiography data prior to treatment by looking at a pre-operative radiograph in a darkened room with a fluorescent light box. To determine the extent of tooth damage and the severity of fractures, clinical and radiographic evaluations were performed on each patient using the Ellis classification system. Ellis Class I, which involves a simple fracture in the tooth's enamel; Ellis Class II, which involves a moderate fracture that extends from the enamel into the dentin layer but does not reach the pulp; and Ellis Class III, which involves a severe fracture that extends to the pulp, are the three classes into which the classification is separated.

RESULTS

TABLE 1: distribution of clinical outcomes in terms of age and sex.

Variables	Number of cases [65]	Percentage [%]
Age, years		
5 – 10	28	43.08%
11 – 15	16	24.62%
16 – 20	14	21.54%
21 – 25	7	10.77%
Sex, (M/F)		
Male	44	67.69%
Female	21	32.31%

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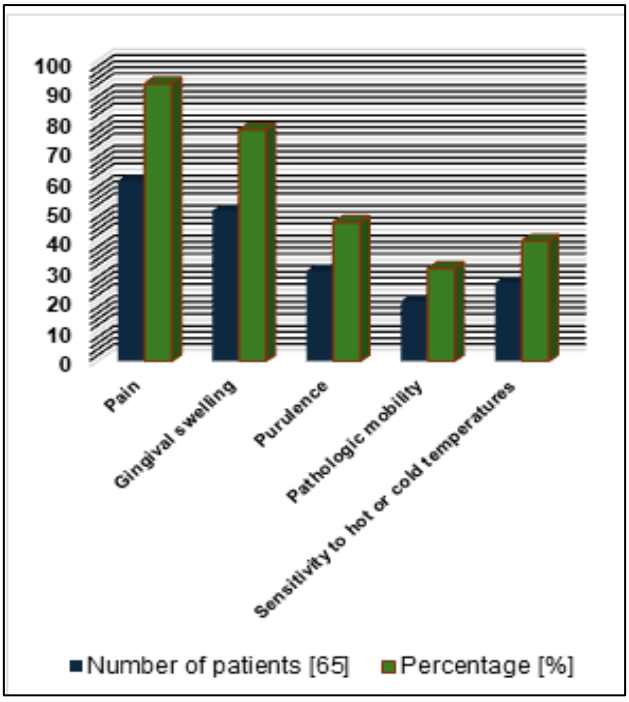

Figure 1: Determine main symptoms prevalent in the patients with dental caries.

Table 2: Classification of degree of caries related to teeth at patients who underwent pulpectomy by icdas scale.

Items	Number of cases [65]	Percentage [%]
Mild caries [Abanto, J. *et al*., 2011; Ahmed, H. M. A. 2013; Al-Eheideb, A., & Herman, N. 2021]	5	7.69%
Moderate caries [Soxman, J. A. 2021; Amin, M. *et al*., 2016]	10	15.38%
Severe caries [Angwaravong, O., & Panitvisai, P. 2009]	50	76.92%

Table 3: Distribution of tooth characteristics at patients who underwent pulpectomy.

Tooth characteristics	Number of cases [65]	Percentage [%]
Dental arch, n (%)		
Maxillary	42	64.62%
Mandibular	23	35.38%
Tooth type, n (%)		
Anterior	29	44.62%
Posterior	36	55.38%
Molar type, n (%)		
First molar	44	67.69%
Second molar	21	32.31%
Location, n (%)		
Upper molar	26	40.0%
Lower molar	39	60.0%

Table 4: Identify diagnoses data of preoperative radiographic findings.

Preoperative radiographic findings	Number of cases [65]	Percentage [%]
Pathology, n (%)		
No	30	46.15%
Widened PDL space	9	13.85%
Radiolucency at the periapical tissue or furcation	26	40.0%
Pathologic root resorption, n (%)		
No root resorption	61	93.85%

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Root resorption	4	6.15%

Table 5: Enrollment treatment findings of pulpectomy procedure.

Variables	Number of cases [65]	Percentage [%]
Anesthesia used		
Local (LA)	44	67.69%
General (GA)	21	32.31%
Root canal filling materials, n (%)		
Zinc oxide eugenol	20	30.77%
Vitapex	45	69.23%
Final restorations, n (%)		
Stainless steel crown	57	87.69%
Coping	8	12.31%
Treatment success, n (%)		
Success rates	61	93.85%
Failure rate	4	6.15%
Patient Satisfaction		
Excellent	62	95.38%
Good	3	4.62%
Poor	1	1.54%

Table 6: Distribution of post–operative results on patients in terms of degree of pain and complications.

Items	*Number of cases [65]*	*Percentage [%]*
Pain levels		
No pain	61	93.85%
With pain	4	6.15%
Mild	2	3.08%
Moderate	1	1.54%
Severe	1	1.54%
Complications		
Severe pain	1	1.54%
Swelling	0	0.00%
Infection	2	3.08%
Bleeding	1	1.54%
Damage to surrounding teeth	0	0.0%

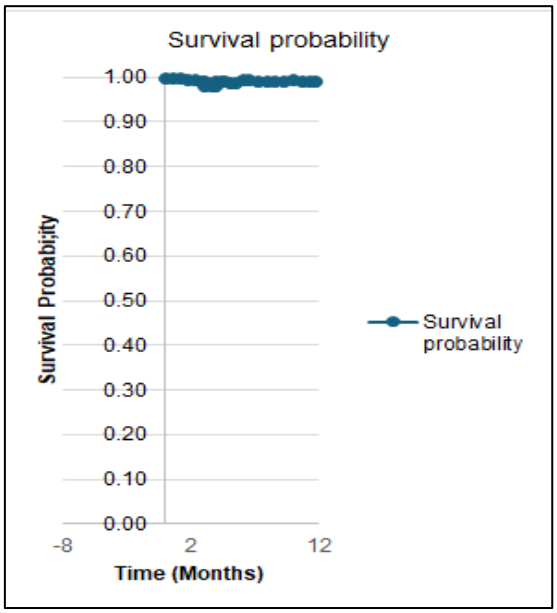

Figure 2: A conducting kaplan - meier survival curve of patients treated by pulpectomy procedure.

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Table 7: Categorizing the extent of damages in tooth structures through tooth fracture assessment into different levels by the ellis classification system.

Classifications	*Number of cases [65]*	*Percentage [%]*
Teeth without fractures	62	95.38%
Teeth with fractures	3	4.62%
Ellis class I	2	3.08%
Ellis Class II	1	1.54%
Ellis Class III	0	0.0%

DISCUSSION

This research gathered patient- and tooth-related factors from both the general anesthesia (GA) and local anesthesia (LA) environments. The usage frequency of Vitapex for filling teeth was much higher in comparison to the LA group [HAIR JUNIOR, J.F. *et al*., 1998]. ZOE is mixed manually and inserted in the canals by [Lee, H. J. *et al*., 2015] a lentulo spiral drill. However, Vitapex is a pre-mixed paste available in a syringe, making it easy to inject into the canals. Research in the USA revealed that root canal filling with Vitapex is a more convenient and time-saving procedure than filling with ZOE. This can lead to a decrease in the overall operation time for the subjects. Hence, Vitapex was frequently used for pulpectomy procedures [Lin, L., & Huang, G. T. 2013]. To similar with last studies, our study revealed that Root canal filling with Zinc oxide eugenol had 30.77% of total participants, while Vitapex had 69.23% of total participants.

Researchers defined teeth treated with pulp and exhibiting signs of pathological resorption nor bone rarefaction of postoperative radiographs as failures, irrespective of the clinical manifestations or extent of disease [Lin, Y. T., & Lin, Y. T. J. 2015; Misal, U. S. *et al*., 2016; Needleman, H. L. *et al*., 2008]. Payne *et al*. [Ng, Y. L. *et al*., 2011] state that doctors can consider a little amount of pathological root resorption and radiolucency in primary teeth following pulpectomy as acceptable as long as there are no clinical signs or symptoms present. Instead of quickly removing or treating these teeth, practitioners typically choose to monitor the impacted teeth within the oral cavity to further assessment at the next recall appointment. The parents are urged to contact the dentist if any symptoms arise [Ozalp, N. U. R. H. A. N. *et al*., 2005; Payne, R. G. *et al*., 1993; Pramila, R. *et al*., 2016]. In terms of current results, we found that no pathology includes 46.15%, Widened PDL space and/or discontinuity of lamina dura had 13.85%, and Radiolucency at the periapical tissue or furcation was 40%. Pathologic root resorption included no root resorption with 61 cases and root resorption with 4 cases. Although pulpectomy was the recommended therapy for teeth with diseased pulp tissue, some dentists choose to perform pulpectomy on primary teeth as a way to reduce endodontic treatments. This might be attributed to the dentists' disposition towards pulpectomy therapy. Based on a survey conducted on the teaching of pulp treatment at dental schools in the United States, it was found that only 88% of all institutions taught and performed pulpectomy procedures on primary teeth. Most dentists are likely acquainted with endodontic therapy in primary teeth and may see pulpectomy as less dependent on specific procedures and more reliable compared to other techniques, particularly when doing treatment under general anesthesia or local anesthesia. [Rawson, T. H. *et al*., 2019; Schroth, R. J. *et al*., 2016]

Also, pulpectomy is regarded as a procedure requiring additional time, potentially impacting the total duration for the operation. Time is a crucial factor to consider when the use of (GA) and (LA) for performing treatment. Previous investigations have revealed an association among extended exposure to general anesthesia (GA) and a higher probability of post-operative problems and delayed recovery [Smaïl-Faugeron, V. *et al*., 2013]. In addition, a longer overall duration of general anesthesia (GA) also leads to a decline in the efficiency of operating room use, an increase in the waiting time to be treated under GA, and puts a strain on the resources of the healthcare system. Therefore, pulpectomy is excluded in complete dental therapy in some contexts [Tang, Y., & Xu, W. 2017]. The current study showcased the elevated rates of success in carrying out a pulpectomy at primary teeth using either general anesthesia (GA) or local anesthesia (LA), showing that a pulpectomy yields a positive outcome in both situations. Due to that, the success rate of the pulpectomy procedure shown 93.85%, and the failure rate was 6.15%, where patient satisfaction had excellent results involved 95.38% of patients. In terms of the VAS scale, current results found

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that the rate of patients with no pain after pulpectomy was 93.85%, while mild pain was 3.08% of patients.

According to pulpectomy's impact of pulpectomy on the improvement of fracture prevention, recent studies showed that pulpectomy is crucial in preserving the structural integrity of teeth after traumatic injuries, particularly in patients with complicated crown fractures. These studies have demonstrated that both partial and coronal pulpectomy procedures are highly effective in preserving the vitality of the pulp and promoting ongoing root development. As a result, pulpectomy leads to successful outcomes in permanent as well as primary teeth. The rate of success of pulpectomy in treating injured permanent teeth have been shown to be about 81%. The presence of the dentine bridge and the level of expertise of the physician are key factors that influence the results. In addition, pulpectomy has proven to be effective at treating acute exposure to pulp for tusked species, like as the babirusa, demonstrating its adaptability and efficacy in many circumstances [Trairatvorakul, C., & Chunlasikaiwan, S. 2008; Wankhade, A. D. *et al*., 2013; Waterhouse, P. J., & Whitworth, J. M. 2015]. In summary, pulpectomy is a highly beneficial therapeutic treatment for severe dental injuries, as it prevents fractures and promotes the long-term well-being of damaged teeth. Due to that, our study indicated that teeth without fractures had 95.38% of total patients, teeth with fractures were classified into Ellis Class I with 3.08% of patients, Ellis Class II was 1.54% of patients, and Ellis Class III had 0%.

CONCLUSION

Pulpectomy plays an effective procedure which removes the of pulp the tooth in the treatment of infection or inflammation, which maintains a healthy tooth structure, which prevents a lot of damage to teeth, leads to fractures, and ensures the overall health and strength of the tooth.

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