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Emergency endodontic care for permanent teeth in children: Patterns, treatment outcomes, and challenges in Trinidad, West Indies

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Highlights

- Data on patterns and outcomes of emergency treatment for pulpally involved permanent teeth in children is limited. This information is essential for guiding clinicians on potential issues in endodontic care.
- The majority of cases involving emergency endodontic treatment of permanent teeth in children remain untreated.
- This study highlights the need for timely treatment of endodontically involved permanent teeth following emergency management to improve tooth retention.

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Abstract

Aim: The aim of this study was to assess the patterns and treatment outcomes of permanent teeth requiring emergency endodontic care in children and to highlight the challenges encountered in obtaining this care at the Child Dental Health Unit, School of Dentistry, University of the West Indies, St. Augustine, Trinidad. **Methods:** This study was conducted through a retrospective analysis of pediatric patients requiring emergency endodontic treatment of permanent teeth at the Child Dental Health Unit clinic from January 2016 to December 2019. Data were collected via file record reviews and telephone interviews with the patients' parents or caregivers, using standardized questions. The collected data included the patient's age, sex, tooth involved, reasons for endodontic treatment, type of treatment provided, stage of endodontic treatment attained, and completion time. The data were then formatted and analyzed using descriptive statistical methods. **Results:** A total of 6887 patients attended the Child Dental Health Unit for emergency care, of which 5% required endodontic treatment in permanent teeth. Among these, 60.5% of cases were female and 39.5% were male, with a mean age of 12.1 years. The majority of cases (77.3%) were due to caries, while 22.7% were due to trauma. Molar teeth were the most commonly treated, but only 42.9% of all emergency endodontic treatments on permanent teeth were completed. The primary reason for the non-completion of endodontic treatment was lengthy patient wait times for follow-up appointments. **Conclusions:** The majority of emergency endodontic cases were not completed, primarily due to delays or lack of recall by dental students and vocational trainees. Lengthy waiting times resulted in an increased need for tooth extractions. Existing services require evaluation to ensure prompt treatment, preventing delayed care, recurrent pain, infection, and tooth loss.

Keywords: Emergency Treatment; Pediatric Dentistry; Permanent Dentition; Root Canal Therapy; Treatment Outcomes

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INTRODUCTION

Endodontic therapy is a viable and successful treatment option for the preservation of severely compromised permanent teeth due to decay and trauma.[1,2] This therapy helps limit the need for the extensive and expensive restorative and orthodontic treatment required to correct the resultant problems.[3] This is particularly significant in the growing patient, as early loss of permanent teeth can lead to problems with masticatory function, occlusion and facial disharmony.[4]

In Trinidad and Tobago, dental care for children is provided through the public health system and at private dental clinics. Services within the public health system are offered at no cost to the patient but are often limited to preventive measures, simple operative treatment and exodontia. Emergency management for permanent teeth typically involves the prescription of analgesics, antibiotics, and, when applicable, exodontia.

The University of the West Indies School of Dentistry, Child Dental Health Unit, receives and treats patients up to the age of 16 years. These patients are often self-referred, referred by local dental clinics in the public health system or private dental offices, as there are either minimal or no costs attached to the dental treatment received and the Unit offers a wider range of treatment services than in the public health system. There is however limited access to specialist treatment and adjunctive services like sedation or general anesthesia.

The patients attending for emergency care at the Child Dental Health Unit are usually treated by either first year dental vocational trainees or senior dental undergraduate students who subsequently arrange for the continuity of care for these cases. It was observed however, that cases needing permanent tooth root canal therapy following emergency treatment, remained incomplete and patients often re-attended with repeat infection or required extraction of the affected teeth.

A previous study[5] done at the Unit revealed a significant percentage of children attended for emergency treatment related to caries and dental trauma. Many of the cases were in the mixed dentition, from lower socio-economic backgrounds and required complex treatment.

There is no information available to date about the pattern of emergency endodontic treatment and the treatment outcomes of these patients once they were seen. This study aimed to highlight the patterns and treatment outcomes of permanent teeth requiring emergency endodontic care in children and examine the challenges encountered in obtaining this care at a dental school clinic in Trinidad. This information can guide clinicians in optimizing emergency endodontic treatment strategies and improving oral health outcomes for pediatric patients. The null hypothesis is that most of the emergency endodontic treatment of permanent teeth in children is completed within 6 months of initiation.

METHODS

The study was approved by the University of the West Indies, Campus Research Ethics Committee (Ref: CREC-SA.1000/05/2021) and was carried out in the Child Dental Health Unit, School of Dentistry, Eric Williams Medical Sciences Complex, from June 2021 to December 2021. The study approval also included the obtaining of consent via telephone from the parent/guardian following the provision of information about the study.

Study Design

This study was conducted through a retrospective analyzis of pediatric patients who required emergency endodontic treatment of permanent

teeth at the Child Dental Health Unit clinic from January 2016 to December 2019. The research involved reviewing file records and conducting telephone interviews with the patient's parent or guardian using standardized questions. The data obtained was formatted using Excel and later analyzed for frequencies using SPSS.

Data Collection

The Child Dental Health Unit clinical logbook which records all cases attending for emergency treatment, was used to identify potential patients. The inclusion criteria included patients aged 6 to 16 years at the time of treatment, who required endodontic treatment in permanent teeth between January 2016 and December 2019.

The corresponding paper-based patient records were requested, evaluated, and analyzed for patient demographics, including age and gender. The type of tooth was categorized as anterior (central incisor, lateral incisor, canine) or posterior (premolar, molar), and its location was identified as either upper or lower. The reasons for endodontic treatment were documented, with cases classified as due to caries or trauma. The stage of root canal treatment attained was noted, whether it involved sedative dressing, pulp extirpation, cleaning and shaping, or obturation with or without final restoration. The time taken to complete the root canal was recorded, and it was determined whether apexification or extraction was required.

This was followed by telephone interviews with the parent/guardian of the qualifying subjects and the co-investigator (KB) of the study. Once informed consent for participation in the study was obtained, a series of open-ended and close-ended questions were asked including the type of treatment sought elsewhere if any and the reasons given for non-continuance of care. The various reasons were categorized based on parent responses during the interview and file documentation. From parent interviews, reasons included the cost being too expensive to obtain treatment privately, still awaiting an appointment with no follow-up received, the patient losing interest in treatment due to the absence of pain, a preference for extraction due to the numerous visits required for root canal therapy, difficulties with scheduling and attending offered appointments, and reinfection or pain leading to tooth extraction. From the file documentation, additional reasons included the tooth becoming unrestorable and root canal treatment not being considered ideal, with enforced loss recommended after an orthodontic assessment.

Statistical Analysis

The data obtained was formatted using Excel and later analyzed for frequencies using SPSS version 29.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were employed to provide a summary of the variables within the dataset. Chi-square test was used to test associations involving discrete data with the level of significance set at $p<0.001$.

RESULTS

From January 2016 to December 2019, there were 345 emergency cases for endodontic treatment in permanent teeth. This made up 5% of all 6887 recorded emergency patients in the Child Dental Health Unit during this period. 79 (22.9%) case files however could not be located, and 46 patients (13.3%) could not be reached using the given contact information. 220 cases were therefore used for this study.

60.5 % of cases (133/220) were female and 39.5% (87/220) were male. The mean age was 12.1 years. 77.3% (170/220) of cases were due to caries, while 22.7% (50/220) were due to trauma. The teeth involved are shown in Figure 1. Most of the anterior teeth were upper central incisors, 80% (52/65).

The posterior teeth comprised lower molars 69% (107/155), upper molars 26.5% (41/155) and upper premolars 4.5% (7/155).

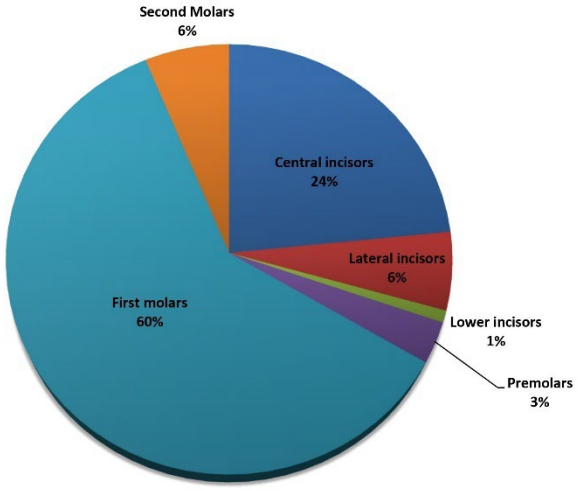

Figure 1. Endodontic treatment received according to tooth type

28.6 % (63/220) of cases continued treatment at the university's clinics with dental students and vocational trainees, 3.6% (8/220) sought care with private general dental practitioners and the remaining 67.7% (149/220) were still awaiting follow-up care with either students or vocational trainees, at the time of audit.

Of the 220 cases included, 33.6 % (74) only received a sedative dressing i.e. LEDERMIX™ (Oz Dent Dental Products Australia) or ODONTOPASTE® (Australian Dental Manufacturing) and an interim temporary restoration for pain relief. 4.5% received pulpectomy only and 31.9% were obturated. 57 (25.9%) cases did not proceed with endodontic treatment and later received extractions. 2.3 % (5/163) of cases required apexification treatment and these were all on anterior teeth (Table 1 and Figure 2).

The cases that proceeded with endodontic treatment (n=163) comprised 38% (62/163) anterior teeth (central and lateral incisors), 2.5% (4/163) premolars and 59.5% (97/163) molars. Only 42.9% (70/163) of all cases were completed. Most of the completed endodontic cases were anterior teeth 60% (42/70). There was statistical significance noted between anterior and posterior teeth and their endodontic treatment completion. ($p<0.001$) (Table 2). The majority of posterior teeth that required endodontic treatment were lower molars. Only 27.8% (27/97) of all molar cases were completed and there was no statistical difference between root canal completion in upper molar and lower molar teeth.

Table 1. Different stages of root canal therapy obtained in the study

Stage of treatment obtained	**(N = 220) (%)**
Sedative dressing with Ledermix/ Odontopaste	74 (33.6 %)
Pulp extirpation, calcium hydroxide and IRM	10 (4.5%)
Canal cleaning and shaping	4 (1.8%)
Obturation with no final restoration	14 (6.4%)
Obturation with final restoration	56 (25.5%)
Apexification	5 (2.3%)
Did not want endodontics - Extraction preferred	57 (25.9%)

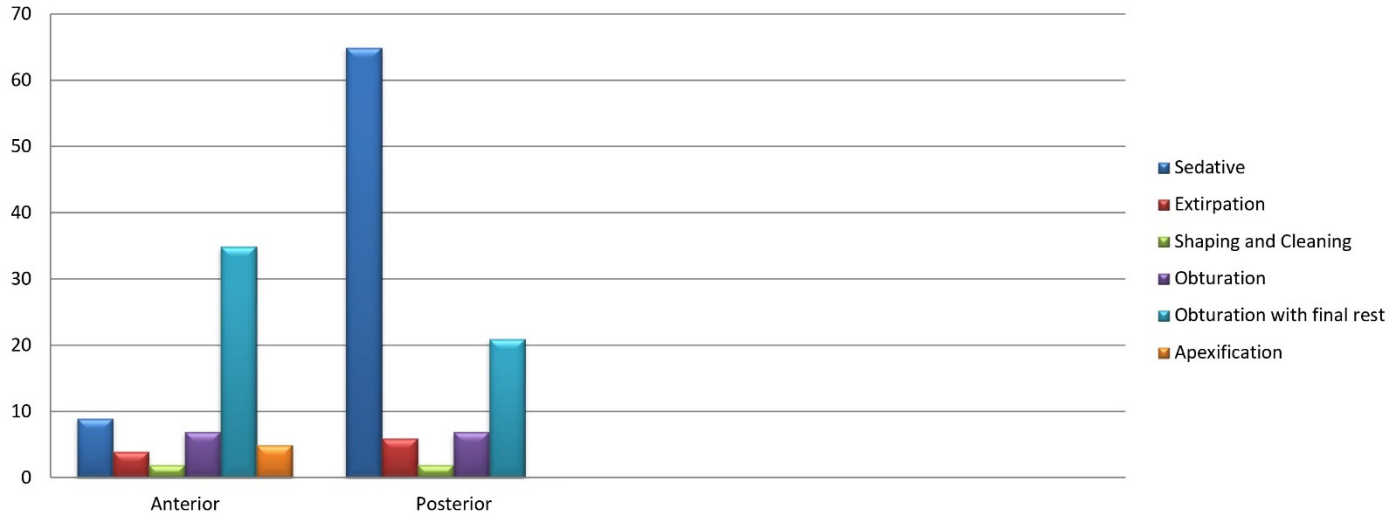

Figure 2. Stages of root canal therapy attained by anterior versus posterior teeth

10% (7/70) of emergency cases sought follow up endodontic care with private general practitioners. All of the endodontic cases completed privately were molars.

The main reasons reported for non-completion of endodontic treatment in this study were the prolonged wait time for follow up appointments and re-infection that led to tooth extraction (Table 3).

The mean waiting time for uncompleted emergency endodontic cases was 3.9 years. However once continued, molar root canal treatment had an average completion time of 3.9 months whereas the average completion time for anterior teeth was 28 days.

Table 2. Pattern of completion status of root canal therapy by tooth type

	Completion Status			
Tooth Type	**Incomplete**	**Complete**	**Total**	**p value**
	(n = 93)	**(n = 70)**	**(n = 163)**	
Anterior	20	42	62	*<0.001*
Posterior	73	28	101	
Tooth Type	**Incomplete**	**Complete**	**Total**	**p value**
	(n =70)	**(n = 27)**	**(n = 163)**	
Upper Molar	23	5	28	0.162
Lower Molar	47	22	69	

Table 3. Reasons for non-completion of root canal therapy

Reason	No of cases (%) (n = 150)
Cost	8 (5.3 %)
Still awaiting appointment with student/vocational trainee	88 (58.7 %)
Reinfection/pain – tooth extracted	19 (12.7%)
Tooth became unrestorable	12 (8%)
RCT not considered ideal-enforced loss recommended	12 (8%)
No pain, patient is no longer interested in treatment	1 (0.7 %)
Too many visits- patient preferred extraction	8 (5.3%)
Unable to attend appointments – problems with scheduling	2 (1.3%)

DISCUSSION

Emergency dental services provide immediate pain relief for patients with endodontic problems resulting from caries and dental trauma. Endodontic therapy allows for preservation of teeth that would otherwise be extracted due to pulpal pathology.[6] Early tooth loss of permanent teeth in a pediatric patient can lead to problems with tipping and supra-eruption of teeth which can require either expensive orthodontic treatment or prosthodontics to correct in the future.

This study makes known information on the pattern of emergency endodontic treatment in permanent teeth of pediatric patients and the treatment outcomes. It also highlights potential challenges faced in providing this care to young patients to mitigate problems associated with early tooth loss.

The prevalence of endodontic treatment reported in several studies[7,8] ranged from 2% to 21%. Five percent of emergency patients who presented to the Child Dental Health Unit from January 2016 to December 2019 required permanent tooth endodontic treatment. This study's findings are comparable to the study[9] conducted at the endodontic clinic of the University of Pennsylvania on patients between the ages of 6 to 12 years old, during the period of June 2017 to June 2020 where 6.7% of patients required endodontic treatment in permanent teeth. This was a significant demand for this nature of treatment. Although not a statistically significant finding, there appeared to be a predominance of females in this study (60.5%) who required endodontic treatment. This was noted to be similar to that found in other studies.[10]

In this study most of the cases that required emergency endodontic treatment were due to carious involvement of the pulp. The molar teeth were most affected by caries and anterior teeth were affected by trauma. The caries prevalence in this population in the 6 – 15 year old age group is considered to be high (33%-62%) which can contribute to the significant demand for emergency endodontic services.[11]

The most frequently affected tooth type was the mandibular first permanent molar and caries was found to be the main etiological factor. This is consistent with the findings of Ajayi et al.[12] who explored the pattern of endodontic therapy in children below the age of 16 years at a teaching hospital and concluded that permanent mandibular molars were more commonly affected compared to permanent maxillary molars and any other tooth type. Specifically, the permanent mandibular first molar required more treatment than the maxillary first molars and mandibular second molars.

There are several factors that can contribute to the high caries susceptibility and risk of pulpal involvement of mandibular first permanent molars. When transitioning to mixed dentition, the mandibular first permanent molars are the first teeth to erupt at the age of 6 years. They therefore have an early exposure to the oral cavity compared to any other permanent tooth counterpart. Parents may also fail to recognize them as permanent teeth as they are not succedaneous. Additionally, their morphology facilitates plaque retention, and these teeth can be found to be affected by hypomineralization. These factors, perhaps coupled with limited preventive measures, particularly fissure sealant use in this population, make them prone to caries development.

The mean age of the patients was found to be 12.1 years. This is significant as, at this age, any consideration for enforced loss of molars specifically the first permanent molars produces less than ideal results in preserving the occlusion and retention of these teeth becomes a more crucial factor to consider.

The finding that more posterior teeth needed endodontic treatment due to caries compared to anterior teeth needing endodontic treatment due to dental trauma in this study, was interestingly opposite to that seen in the Popoola et al.[6] study. This may be explained by the prevalence of reported dental trauma being generally lower in this country (9.5%-13%).[13,14]

The students and vocational trainees completed more emergency endodontic treatment in anterior teeth than in posterior teeth. The average completion time for anterior teeth was 28 days compared to 3.9 months for molar teeth. This disparity could be attributed to the shorter duration and lesser technical complexity involved in treating anterior teeth compared to multi-rooted teeth with more intricate anatomy. It could also be due to the influence of anterior teeth on aesthetics thereby motivating both parent and clinician to ensure treatment completion.

"Delayed treatment" as defined by Wong et al.[15] is incomplete root canal therapy (never obturated) or completion of root canal therapy in a period greater than four months (delayed root canal filling). The mean waiting time for uncompleted emergency endodontic cases in this study was 3.9 years. The main reasons reported for non-completion of endodontic treatment in this study were the prolonged wait time for follow up appointments and re-infection that led to tooth extraction.

Several factors could explain these findings. In the comprehensive care model used at the dental school, stabilization of disease may be required before completing complex treatment. This could delay the completion of root canal therapy by senior undergraduate students and vocational trainees who may have limited availability of clinical treatment sessions.

Root canal therapy is also technique sensitive, and its overall success is dependent on the accuracy of multiple individual steps.[16] During root canal procedures, as reported by Almutairi et al.[17], students experience challenges reaching profound anesthesia, placing rubber dam, taking periapical radiographs using the mesial and distal shift method, access cavity preparation and calculating working length. Each of these steps can ultimately affect the completion of the endodontic therapy.[15,18]

Lengthy wait times can be associated with endodontic flare-ups and inter-appointment emergencies when compared to cases where follow up treatment was received in a prompt manner. Lengthy wait times can lead to the breakdown of interim restorations, causing re-infection, recurrent decay, tooth fracture and questionable restorability that could complicate case management and ultimately lead to tooth loss.

Patient non-compliance with dental treatment together with the absence of pain also increases the likelihood of clinical complications.[19] This study showed that several cases had issues with attendance, length of the procedures or were no longer interested in completing treatment after receiving palliative endodontic care. Several studies[15,20] have shown that an increase in the duration of the procedure and in the number of patient visits are both associated with incomplete endodontic treatment.

Successful endodontic therapy can also be compounded by additional challenges in managing patient behavior in this age group.[20] The need for pharmacological behavior management, including nitrous oxide, conscious sedation and general anesthesia may be crucial to attaining patient cooperation and facilitating treatment by alleviating fear and anxiety in young patients.[9] The limited access to such adjunctive services as well as specialist or postgraduate endodontic services at the dental school facility, add to the myriad of challenges that students and vocational trainees may face in providing and completing emergency endodontic treatment in permanent teeth in children with minimal delay.

Twenty five percent of children who had emergency endodontic treatment of their permanent teeth later required extraction. This outcome is not considered ideal and can reflect a less than adequate use of resources by the dental school unit to provide this type of emergency service. A closer review of the services provided and treatment protocols at the unit should be done. More robust patient selection criteria and associated treatment counseling should be considered.

In this setting, given the numerous challenges, perhaps vital pulp therapy (VPT) can also be considered as an alternative to non-surgical root canal therapy. In recent times, there have been notable progressions in the use and application of bioactive hydrophilic calcium silicate cements, including Biodentine, mineral trioxide aggregate, calcium-enriched mixture, and bioceramics, for utilization in VPT procedures. These materials have also been reported to have a clinical success rate of over 85% when used as the medicament of choice even in irreversibly inflamed permanent teeth.[21]

Pulpotomy procedures are comparatively simpler, cost-effective and entail fewer dental appointments than conventional non-surgical root canal therapy. The latter can be particularly advantageous for pediatric patients especially where resources are limited to provide timely emergency endodontic treatment.

There were several limitations in this study. Over one third of cases who attended for emergency endodontic treatment were excluded due to unavailability of case files or inability to contact the patients which could have impacted significantly on data findings. Given the length of time elapsed in many cases, there may have been recall bias by parents. The etiology of the tooth's pulp status i.e. symptomatic irreversible pulpitis, symptomatic periapical periodontitis, was not always recorded in the patient files so any association between pulp status and likelihood of root canal completion could not be obtained.

Given the paucity of completed emergency endodontic treatment of permanent teeth in this study and the unfavourable treatment outcomes, a review of the services provided and treatment protocols at this clinic are required. Consideration can be given to the use of vital pulp therapies where applicable. These strategies could decrease treatment complexity, completion time and treatment cost as well as improve long-term tooth retention.

CONCLUSIONS

The prevalence of emergency endodontic treatment on permanent teeth among the children examined in this study was 5% and dental caries was found to be the main etiological factor. Anterior teeth endodontics were completed by student and vocational trainees more than posterior teeth. Long waiting times for completion of emergency endodontic treatment by students and vocational trainees, particularly molars, are likely to lead to an increase in unfavorable outcomes especially tooth extraction.

To improve treatment outcomes greater consideration should be made in patient selection, parent education and the chosen endodontic therapy. The use of VPT in permanent teeth and more robust patient recall systems may reduce waiting times for treatment. These approaches can limit the problems associated with delayed endodontic care and increase tooth retention.

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Declarations

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Ethics Statement: *The study was approved by the University of the West Indies, Campus Research Ethics Committee (Ref: CREC-SA.1000/05/2021).*

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