

Research Article

# Clinical Evaluation of Vital Inflamed Pulp Therapy as Treatment Options for Deciduous Molars with Periapical Periodontitis

Yun Liu<sup>1,\*</sup>, Jin Sun<sup>1,2</sup>

<sup>1</sup>Stomatological Healthcare Center, Shenzhen Maternity and Child Healthcare Hospital, Shenzhen, China

<sup>2</sup>Dental Home Department, Shenzhen Stomatology Hospital, Shenzhen, China

## Abstract

Deciduous teeth, owing to their special anatomical structure, are highly vulnerable to apical periodontitis, particularly when afflicted with deep caries or other endodontic diseases. Traditionally, root canal therapy (RCT) has been the gold standard among pediatric dentists all along. Nevertheless, due to its inherent limitations, researchers are actively exploring alternative therapeutic approaches these years. This study introduces a new treatment modality known as vital inflamed pulp therapy (VIPT). The primary aim of this investigation was to assess the practical feasibility and therapeutic efficacy of VIPT in managing apical periodontitis in deciduous teeth comparing to RCT. After rigorous patients evaluation and examination, VIPT was chosen as the preferred treatment plan, followed by one year long-term follow-up observations. The outcomes revealed that most positive seamless healing of the periapical lesion without any complications in VIPT as the ones in RCT. Notably, the development of the permanent tooth embryo remained unaffected and progressed as anticipated. In conclusion, this study validates the therapeutic potential of VIPT in treating apical periodontitis in deciduous teeth, offering a novel approach for managing deciduous tooth diseases. The clinical application of this method is expected to enhance patient experiences and prognostic outcomes in the treatment of deciduous tooth pathologies.

## Keywords

Vital Inflamed Pulp Therapy, Apical Periodontitis, Deciduous Tooth, Root Canal Therapy

## 1. Introduction

The fundamental aim of root canal therapy (RCT) is to meticulously remove the utmost quantity of pulp tissue from the root canal, subsequently filling it with anti-inflammatory and antibacterial medications [1]. Given its acceptable success rate in the treatment of apical periodontitis in deciduous

teeth, RCT remains a preferred treatment option among the majority of pediatric dentists [2, 3]. Despite its widespread application in addressing apical periodontitis in deciduous molars [4, 5], we found that a proportion of parents may reject RCT, because of its complicated procedures, higher costs,

\*Corresponding author: liyun021@139.com (Yun Liu)

† Yun Liu and Jin Sun are co-first authors.

Received: 22 April 2024; Accepted: 10 May 2024; Published: 14 June 2024



low value of deciduous teeth and so on. In addition, many children are afraid of RCT because it requires a lot of sharp shaped instruments. The above reasons have all led to the unsatisfactory progress of RCT. Consequently, pediatric dental researchers are diligently searching for more efficient and child-oriented alternative therapeutic approaches.

In years of clinical experience, we have found that there are many cases of residual viable pulp tissue may persist within the root canal of teeth affected by apical periodontitis. Similar to observations made in permanent teeth [6, 7], we have noticed that when probing the canal orifice or canal in deciduous molars with apical periodontitis, a significant proportion of children experience pain, a clinical indicator suggestive of the presence of viable pulp tissue. It is hypothesized that this tissue may be in an inflammatory state rather than necrotic [8, 9], thus Inspire us that retaining the potential to regain its proliferative and differentiative abilities following the resolution of inflammation, could lead to the reinstatement of pulp function. Therefore, it is of utmost importance that we strive to preserve this viable dental pulp tissue instead of removing all dental pulp, like RCT [10]. Furthermore, several scholars have demonstrated that, in young permanent teeth, preserving pulp tissues can facilitate the ongoing physiological development of roots that have been compromised by apical periodontitis, an approach known as VIPT [6, 11]. However, currently this treatment method is only limited to young permanent teeth. Therefore, we specifically applied this method directly to deciduous teeth to explore its feasibility.

## 2. Materials and Methods

### 2.1. Basic Information

The study was approved by the ethics committee of Research Ethics Committee of Shenzhen Materity and Child Healthcare Hospital (ethics NO. SFYLS[2022]049). 50 molars from 50 children aged 3-8 years according to the previous study [2]. The criteria for case selection in the study were: the presence of occlusion pain/pain to percussion, sinus opening/abscess, mobility $\leq$ 1, bifurcation/periapical radiolucency and root resorption less than one-third.

### 2.2. Study Procedure

Children were diagnosed as periapical periodontitis by inquiry, clinical and radiological examination; they were divided into two groups by random; parents fully understood the experimental procedure and signed the informed consent; treatments were conducted according to the procedure of VIPT group and RCT group; follow-up examinations were conducted at 1 year after treatment with the records of clinical and radiological examination.

### 2.3. Procedure of VIPT Group

The area around tooth with apical periodontitis was disinfected, topical anesthetized (Compound Lidocaine Cream, 5%, Tongfang Pharmaceutical Group Co., LTD, China) and local anesthetized (Articaine Hydrochloride and Epinephrine Tartrate Injection, 1.7 mL/branch, France). A rubber dam (KSK, Japan) was placed. Teeth were removed carries, and pulpotomy was performed to expose all canal orifices. A small amount of blood was observed emanating from the canal orifices, and the child reported mild pain when probed with a size 15 K-file (MANI HANOI, Japan). The pulp chamber and canal orifices were irrigated with 3% sodium hypochlorite (Zhongding, China). A small cotton ball soaked in 3% sodium hypochlorite was placed for 5 minutes, resulting in cessation of bleeding from the canal orifices. The area was then rinsed with saline (Kelun, China), and a layer of iRootBP Plus (Innovative Bioceramix, Canada) thicker than 2mm was placed over the canal orifices and pulp chamber floor. Glass ionomer cement (SHOFU, Japan) was used as a base, followed by the application of light curing composite resin (SHOFU, Japan; 3M ESPE, USA) for restoration. The rubber dam was removed, the tooth were received occlusal examination, adjustment, polishing, and the patient and his parents were informed of postoperative precautions.

### 2.4. Procedure of RCT Group

The preparatory procedure is the same as 2.3. The pulp chamber was accessed and necrotic pulp tissue was removed with a fissure bur. The root length was determined using diagnostic radiographs to guide the treatment. Each canal was gradually enlarged using A size 15 K-file (MANI HANOI, Japan) and Protaper system (Dentsply, Switzerland) gradually larger in size 30. Copious irrigations with 3% sodium hypochlorite were performed between instrument changes to maximize debris removal. The canals were then dried using sterile paper points. Vitapex (Vitapex, Japan) was directly injected into the canals. The restoration is the same as 2.3.

### 2.5. Statistical Analysis

WPS office (12.1.0.15398, WPS Beijing, China) was used for the statistical analysis. The data were expressed as n or %. Z-test was employed for the success rates of two groups at 1 year according to the previous study [2]. A *P*-value less than 0.05 was considered statistically significant.

## 3. Results

### 3.1. Comparison of Clinical Features Between Two Groups

At the follow-up examination at 1 year, in the VIPT group, 3 cases reported occlusion pain/pain to percussion, 7 cases showed sinus opening/abscess, 5 cases had abnormal mobility

(Table 1). Therefore, the clinical success rate of the VIPT group was 72% (Table 2). In the RCT group, 2 cases reported occlusion pain/pain to percussion, 4 cases showed sinus opening/abscess, 2 cases had abnormal mobility, (Table 1). Therefore, the clinical success rate of the RCT group was 84% (Table 2). After statistically analysing, there was no significant difference in clinical success rates between two groups ( $P=0.087$ ) (Table 2).

### 3.2. Comparison of Radiological Features Between Two Groups

At the follow-up examination at 1 year, in the VIPT group, 9 cases still had bifurcation/periapical radiolucency, 7 cases had increased root resorption, 3 cases had permanent tooth embryo incline (Table 1). Therefore, the radiological success rate of the VIPT group was 64% (Table 2). In the RCT group, 8 cases still had bifurcation/periapical radiolucency, 7 cases had increased root resorption, 3 cases had permanent tooth embryo incline (Table 1). Therefore, the radiological success rate of the RCT group was 68% (Table 1). After statistically analysing, there was no significant difference in clinical success rates between two groups ( $P=0.345$ ) (Table 2).

**Table 1.** Clinical and radiological features of two groups after treatment.

	Number (n)	
	VIPT	RCT
Clinical features		
Occlusion pain/pain to percussion	3	2
Sinus opening/abscess	7	4
Abnormal mobility	5	2
Radiological features		
Bifurcation/periapical radiolucency	9	8
Increased root resorption	7	7
Permanent tooth embryo incline	3	3

**Table 2.** Clinical and radiological success of two groups after treatment.

Results	Number (%)		P-value
	VIPT	RCT	
Clinical success	18 (72%)	21 (84%)	0.087
Radiological success	16 (64%)	17 (68%)	0.345

## 4. Discussion

Although RCT is conventionally regarded as the standard treatment for apical periodontitis in deciduous molars, it comes with various disadvantages, including significant cost, a prolonged treatment period, and the necessity for numerous instruments. These factors frequently contribute to a negative treatment experience for children and a low level of acceptance among parents [12]. Especially, Achanta A et al hold the opinion that RCT requires the sharp metal instruments and complex procedures causing psychological and physiological discomfort to children [12]. For this reason, it is critical for us to explore alternative treatment method which both meet the requirement of parents and children from now on.

This study introduce the VIPT applied directly to deciduous teeth with apical periodontitis in order to explore its feasibility. Through the innovative application of VIPT from young permanent teeth, we have achieved acceptable therapeutic outcomes from the results. One year follow-up assessments revealed 72% of the teeth have complete eradication of the occlusion pain/pain to percussion, sinus opening/abscess and abnormal mobility; and 64% have complete eradication of bifurcation/periapical radiolucency, the abscess of increased root resorption and permanent tooth embryo incline. To analyse the results in detail, in clinical success rate, VIPT is 12% lower than RCT, and in radiological success rate, VIPT is 4% lower than RCT. Even though the overall success rate of VIPT is lower than RCT, the positive results of VIPT group have no significant difference compared to the RCT group ( $P=0.087$  &  $0.345$ ). Taking into account the success rates of both groups, compared to the RCT group, the VIPT has more advantages: lower price, shorter dentist operation time, fewer required instruments, higher comfort for children, and higher acceptance by parents.

The characteristic large or open apical foramen in deciduous molars facilitates a robust blood flow within the root canal [13, 14]. This ample blood supply, enriched with antibacterial factors and stem cells, allows most deciduous molars to maintain partial pulp vitality although afflicted with apical periodontitis [15]. Our years of clinical experience have also proven this situation. This biological mechanism underlies the success of VIPT. Nevertheless, the existing researches in this area has predominantly centered on young permanent teeth, and they have achieved most success [16, 17]. In this study, we applied VIPT to deciduous molars and demonstrated its advantages from another perspective.

## 5. Conclusions

Even if RCT is commonly employed for treating apical periodontitis in deciduous molars, this study indications that VIPT could be more suitable for them with residual vital pulp tissue because of its equal therapeutic effect and higher convenience.

## Abbreviations

RCT Root Canal Therapy  
VIPT Vital Inflamed Pulp Therapy

## Author Contributions

**Yun Liu:** Resources, Supervision, Writing-review & editing

**Jin Sun:** Investigation, Methodology, Project implement, Writing-original draft

## Funding

This work is supported by the Health Economics Society of Shenzhen (2023132) and the Hospital Research Fund Project (FYB2022008).

## Data Availability Statement

The data supporting the outcome of this research work has been reported in this manuscript.

## Conflicts of Interest

The authors declare no conflicts of interest.

## References

- [1] Pedrotti D, Bottezzini PA, Casagrande L, Braga MM, Lenzi TL. Root canal filling materials for endodontic treatment of necrotic primary teeth: a network meta-analysis. *Eur Arch Paediatr Dent*. 2023 Apr; 24(2): 151-166. <https://doi.org/10.1007/s40368-022-00766-y> Epub 2022 Nov 24.
- [2] Nakornchai S, Banditsing P, Visetratana N. Clinical evaluation of 3Mix and Vitapex as treatment options for pulpally involved primary molars. *Int J Paediatr Dent*. 2010 May; 20(3): 214-21. <https://doi.org/10.1111/j.1365-263X.2010.01044.x>
- [3] Coll JA, Vargas K, Marghalani AA, Chen CY, AlShamali S, Dhar V, Crystal YO. A Systematic Review and Meta-Analysis of Nonvital Pulp Therapy for Primary Teeth. *Pediatr Dent*. 2020 Jul 15; 42(4): 256-461.
- [4] Yu Y, Zhou X, Zheng LW. [Advanced research on root canal therapy for primary teeth]. *Hua Xi Kou Qiang Yi Xue Za Zhi*. 2020 Apr 1; 38(2): 205-210. Chinese. <https://doi.org/10.7518/hxkq.2020.02.016>
- [5] Tofangchiha M, Ebrahimi A, Adel M, Kermani F, Mohammadi N, Reda R, Testarelli L. In vitro evaluation of Kedo-S and RaCe rotary files compared to hand files in preparing the root canals of primary molar teeth. *Front Biosci (Elite Ed)*. 2022 Jun 2; 14(2): 14. <https://doi.org/10.31083/j.fbe1402014>
- [6] Xiao W, Shi WT, Wang J. Study of vital inflamed pulp therapy in immature permanent teeth with irreversible pulpitis and apical periodontitis. *Zhonghua Kou Qiang Yi Xue Za Zhi*. 2022 Mar 9; 57(3): 287-291. <https://doi.org/10.3760/cma.j.cn112144-20211223-00563>
- [7] Wigler R, Kaufman AY, Lin S, et al. Revascularization: a treatment for permanent teeth with necrotic pulp and incomplete root development [J]. *J Endod*, 2013, 39(3): 319-326. <https://doi.org/10.1016/j.joen.2012.11.014>
- [8] Huang GT, Sonoyama W, Liu Y, et al. The hidden treasure in apical papilla: the potential role in pulp/dentin regeneration and bioroot engineering [J]. *J Endod*, 2008, 34(6): 645-651. <https://doi.org/10.1016/j.joen.2008.03.001>
- [9] Chrepa V, Pitcher B, Henry MA, Diogenes A. Survival of the Apical Papilla and Its Resident Stem Cells in a Case of Advanced Pulpal Necrosis and Apical Periodontitis. *J Endod*. 2017 Apr; 43(4): 561-567. <https://doi.org/10.1016/j.joen.2016.09.024> Epub 2017 Feb 9.
- [10] Zanini M, Meyer E, Simon S. Pulp Inflammation Diagnosis from Clinical to Inflammatory Mediators: A Systematic Review. *J Endod*. 2017 Jul; 43(7): 1033-1051. <https://doi.org/10.1016/j.joen.2017.02.009> Epub 2017 May 17.
- [11] Xiao W, Wang J. Immature permanent teeth with apical periodontitis treated with vital inflamed pulp therapy: report of 3 cases [J]. *Chin J Stomatol Contin Educ*, 2019, 22(5): 299-302.
- [12] Achanta A, Reche A, Dakhale R, Bharate RR. A Comprehensive Review of Lesion Sterilization and Tissue Repair: An Alternative for Pulpectomy in Deciduous Teeth. *Cureus*. 2023 Nov 3; 15(11): e48218. <https://doi.org/10.7759/cureus.48218>
- [13] Alobaid AS, Cortes LM, Lo J, et al. Radiographic and clinical outcomes of the treatment of immature permanent teeth by revascularization or apexification: a pilot retrospective cohort study [J]. *J Endod*, 2014, 40(8): 1063-1070. <https://doi.org/10.1016/j.joen.2014.02.016>
- [14] Alafandy AS, Makieh RE. The difference distance between the apical foramen and the anatomical apex in primary teeth-An in vitro study. *Clin Exp Dent Res*. 2023 Oct; 9(5): 913-921. <https://doi.org/10.1002/cre2.784> Epub 2023 Sep 13.
- [15] Ragab RA, Lattif A, Dokky N. Comparative study between revitalization of necrotic immature permanent anterior teeth with and without platelet rich fibrin: a randomized controlled trial [J]. *J Clin Pediatr Dent*, 2019, 43(2): 78-85. <https://doi.org/10.17796/1053-4625-43.2.2>
- [16] Tsukiboshi M, Ricucci D, Siqueira JF Jr. Mandibular Premolars with Immature Roots and Apical Periodontitis Lesions Treated with Pulpotomy: Report of 3 Cases. *J Endod*. 2017 Sep; 43(9S): S65-S74. <https://doi.org/10.1016/j.joen.2017.06.013>
- [17] Xiao W, Chi Z, Shi W, Wang J. Modified pulpotomy procedure in immature permanent teeth with apical periodontitis: a randomised controlled trial. *BMJ Open*. 2022 Dec 29; 12(12): e057714. <https://doi.org/10.1136/bmjopen-2021-057714>