Submitted: 27 January, 2023 Accepted: 27 March, 2023 Published: 03 March, 2024 DOI:10.22514/jocpd.2024.037

ORIGINAL RESEARCH

Journal of Clinical Pediatric Dentistry

The evaluation of effective rate and pain intensity of root canal treatment in primary teeth—a retrospective study

Binbin Yu[1,2], Shimin Zhao[1,*]

[1]Department of Pediatric Dentistry, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, College of Stomatology, Shanghai Jiao Tong University, 200011 Shanghai, China
[2]National Center for Stomatology, National Clinical Research Center for Oral Diseases, Shanghai Key Laboratory of Stomatology, Shanghai Research Institute of Stomatology, 200011 Shanghai, China

***Correspondence**
doctory0920@outlook.com
(Shimin Zhao)

Abstract

Two-visit root canal treatment for children reduce the time of visits and the by-chair time in comparison with the three-visit root canal treatment. However, it is not clear whether two-visit root canal treatment increase the risk of complications. This study aimed to evaluate the clinical effects and post-operative pain intensity after the root canal treatment between two-visit and three-visit groups in primary molars from children.106 patients were screened for eligibility, of which 74 went back to the preservation visit. Therefore, 74 primary molars from 74 children that diagnosed with chronic pulp and periodontal tissue diseases in the clinics of pediatric dentistry were retrospectively analyzed, in which 37 in the two-visit group and 37 in the three-visit group. The total effective rate and postoperative pain intensity were assessed after treatment and all statistical data were carried out with SPSS software.The average age of children in the two-visit and three-visit groups was 6.4 and 7.0, respectively, with no significant difference ($p = 0.056$). The two-visit group consisted of 59.5% male and 40.5% female children, while the three-visit group consisted of 56.8% male children and 43.2% female children ($p = 0.813$). Two months after treatment, the total effective rate in the three-visit group was 97.30%, a little higher than that in the two-visit group (94.59%), but with no significant difference ($p = 0.201$). Besides, there was also no significant difference in pain intensity between the two-visit and three-visit groups ($p = 0.692$). Therefore, there were no significant difference of total effective rate and pain intensity in root canal treatment between the two-visit and three-visit groups in primary molars from children.

Keywords

Root canal treatment; Total effective rate; Pain intensity; Two-visit; Three-visit

1. Introduction

Childhood caries is considered as a severe public health problem among the worldwide. According to the data in the oral health epidemiology investigation of the third nations, the prevalence rate of caries in 5-year-old children were about 67% in China in 2005 [1]. When caries extended to inflammation or pulp necrosis, it could affect children's growth and future dentition [2], and radical endodontic treatment is the last option to repair the tooth [3].

The main goal of root canal treatment is to maintain the integrity and health of the primary tooth until their physiological exfoliation [4]. This non-vital treatment contains procedure such as isolation of the tooth, access opening, extirpation of the pulp, root preparation, irrigants and drying of the root, as well as obturation of the canals and crown restoration [5]. During the treatment progress, non-reinforced zinc/oxide eugenol (ZOE), iodoform paste, and vitapex (a combination paste of iodoform and calcium hydroxide) are usually used to fill the canals. Single or multiple visits were used to complete the root canal treatment. During the progress, proper root canal shape should be obtained, so an efficient cleaning should be performed [6]. The engine-driven rotary nickel titanium (NiTi) files are commonly used in root canal preparation and could significantly increase the cleaning efficiency.

According to the review reported by M. B. McGuigan, the successful rate of the root canal treatment is over 90% after a range of periods [7]. The different outcome of root canal treatment can be attributed to inconsistencies in methodology and assessment criteria [8]. There are studies comparing the outcome of endodontic treatment carried out over single or multiple visits, and the results showed no significant difference between the two approaches [9]. The clinical end-points can be relied on the patient or clinician reporting. The European Medicines Agency (EMA) strongly stress the importance of patient-reported outcomes in the criteria for assessment of endodontic treatment [10]. The patient-reported outcomes classically included the survival, the function of teeth and the pain intensity.

Pain is a common short-term complication of root canal

treatment, mostly appears in the first 24 h, which had significant influence on the quality of life [11, 12]. Studies have shown that the incidence rate of postoperative pain after root canal treatment range from 3 to 58% [13], and can reach as high as 80% in the first 24 h [14]. Postoperative pain is commonly attributed to acute inflammatory reaction in the periradicular tissues triggered by mechanical, chemical or microbiological injury [15]. Extrusion of debris and irrigating agent can induce postoperative pain and periradicular tissue damage in patients [16]. Previous studies have evaluated postoperative pain after root canal treatment, and demonstrates contrasting results [11, 17, 18]. However, there are no studies reporting the difference of pain intensity between two visits and three visits in the progress of root canal treatment.

Well-filled root canals are considered to provide a three-dimensional seal, which could be against bacteria ingress [19]. The success of root canal treatment was evaluated by clinically symptomless, radiographic healing, and the pain intensity. Therefore, this study aimed to evaluate the clinical effects and the pain intensity of patients in the three-visit and two-visit root canal treatment, in order to provide clinical treatment options for dentists.

2. Materials and methods

106 patients were screened for eligibility, of which 74 went back to the preservation visit. Therefore, 74 primary molars from 74 children that diagnosed with chronic pulp and periodontal tissue diseases in the clinics of pediatric dentistry were retrospectively analyzed. Patients were enrolled from between August 2021 to November 2022.

2.1 The inclusion criteria

① Patients that aged 4 to 11 years. ② Primary molar teeth that caries related to the pulp and the periodontal tissues. ③ Chronic apical periodontitis with or without gingival problems (swelling, redness or sinus tract) and the area of periapical radiolucency $\leq$1 cm. ④ Parents of patients had strong desire to preserve the affected tooth.

2.2 The exclusion criteria

① Patients with other systemic diseases; ② Patients that were allergies to local anesthetic agents; ③ Tooth with mobility; ④ Patients whose tooth had been previously accessed or endodontically treated.

2.3 Endodontic procedures

A single dentist with more than 5-year working experience performed all root canal treatments. The patients were divided into two groups according to the times of visit.

2.3.1 Endodontic procedures of two-visit group

37 primary molars from 37 children were included in the two-visit group. After injections of 0.5 mL articaine hydrochloride and epinephrine tartrate injections for anesthesia, isolation of the tooth, the pulp was removed. Then the root canals were identified and prepared with WaveOne primary files (Dentsply Maillefer, Ballaigues, Switzerland), irrigated with normal saline (0.9% NaCl), and 2.5% sodium hypochlorite (NaOCl) in the 2 mL syringe. A total of 10 mL of 2.5% NaOCl was used for the irrigation of each tooth. The calcium hydroxide was put into the canal and the tooth was sealed temporarily with Glass Ionomer Cement during visits. About 1 week later, in the second visit, the Glass Ionomer Cement was removed and the irrigation was performed again. The root canals were dried and filled with vitapex (Neo Dental, Tokyo, Japan), and the tooth was sealed with resin and crown restoration.

2.3.2 Endodontic procedures of three-visit group

37 primary molars from 37 children were included in the three-visit group. At the first visit, only the pulp was removed after anesthesia by 0.5 mL articaine hydrochloride and epinephrine tartrate injections as well as isolation of the tooth. Then calcium hydroxide was put into the canal and the tooth was sealed temporarily with Glass Ionomer Cement. At the second visit comes the preparation of the root canals with WaveOne primary files and large numbers of irrigation with 0.9% NaCl and 2.5% NaOCl, then the tooth was sealed with Glass Ionomer Cement. A total of 10 mL of 2.5% NaOCl was used for the irrigation of each tooth. The root canals were filled with vitapex and the tooth was sealed with resin and crown restoration in the third visit.

2.4 Criteria for healing assessment

At follow-up, the outcome was categorized as: (1) Excellent prognosis; (2) Effective prognosis; (3) Invalid. Excellent prognosis refers to no abnormal mobility, no sensitivity to percussion, and healthy appearance of the soft tissue (no swelling, redness or sinus tract). Effective prognosis refers to no abnormal mobility, little percussion, and healthy appearance of the soft tissue (no swelling, redness or sinus tract). Invalid refers to persistent pain, swelling or gingival fistula [20, 21].

2.5 Postoperative pain evaluation

Postoperative pain intensity was registered during the treatment progress from the first to the end. Patients recorded pain intensity as none, slight, moderate and severe. Scores from 0 to 3 (0—none, 1—slight, 2—moderate and 3—severe) were attributed to each level of pain [11]. “0” indicates that children had no pain symptoms. “1” indicates that children have mild pain and can relieve without drug therapy. “2” indicates that there is moderate pain in the affected tooth, which can be relieved after drug treatment. “3” indicates that the affected tooth is in severe pain, with no relief after analgesic treatment.

2.6 Statistical analysis

All statistical data were carried out with SPSS 26 software (SPSS Inc., USA). The difference of age between the two groups was assessed using an unpaired t test. Chi square test was used to statistically assess the difference of gender, clinical effects and pain intensity between the two groups. p values $<$

0.05 were considered significant.

3. Results

A total of 74 children, aged 4 to 11 years, were included in the study. They were allocated into two groups, two-visit and the three-visit group. The children in the two-visit group aged from 4.1 to 10.8 years, with an average age of 6.4. The children in the three-visit group aged from 4.8 to 10.0 years, with an average age of 7.0, which showed no significant difference with that in the two-visit group ($p = 0.056$) (Table 1). Besides, the results also showed no significant difference of gender distribution between the two groups. In detail, the two-visit group consisted of 59.5% male and 40.5% female children, while the three-visit group consisted of 56.8% male and 43.2% female children ($p = 0.813$) (Table 2).

TABLE 1. Age of participants.

Age (yr)	Two-visit group	Three-visit group
Mean	6.4	7.0
SD	1.34	1.38
Min	4.1	4.8
Max	10.8	10.0
t-test	1.941	
p-value	0.056^{ns}	

SD: standard deviation; Min = Minimum; Max = Maximum; t = unpaired t test. ^{ns}*: $p > 0.05$ (not significant).*

TABLE 2. Gender distribution of participants.

Gender	Two-visit group	Three-visit group
Male	22 (59.5%)	21 (56.8%)
Female	15 (40.5%)	16 (43.2%)
χ^2	0.056	
p-value	0.813^{ns}	

χ^2*: Chi square test;* ^{ns}*: $p > 0.05$ (not significant).*

After treatment, there were 27 teeth that was excellent prognosis, 8 effective and 2 invalid in the two-visit group, with total effective rate of 94.59%. The number of excellent teeth in the three-visit group was 33, with total effective rate of 97.30%. The effective and invalid teeth in the three-visit group was 3 and 1, respectively. Statistically, the results showed no significant difference of the effective rate in comparison with these two groups ($p = 0.201$) (Table 3).

After treatment, the pain intensity of children was recorded. There were 10 children with 0 grade (no) pain after treatment and 23 with 1 grade (slight) pain which can relieve without analgesic therapy. 4 children had 2 grade (moderate) pain which can be relieved after analgesic therapy. In the three-visit group, there was 11 children with no pain, 24 with slight pain and only 2 had severe pain. There were no children with 3 grade (severe) pain both in the two-visit and three-visit groups. The pain incidence rate in the three-visit group was 70.27%, which was lower than that in the two-visit group (72.97%), but showed no significant difference ($p = 0.692$) (Table 4).

4. Discussion

Outcomes of root canal therapy has been the focus of investigation for many years [22]. Endodontic success is assessed in different functional activities after the treatment of tooth was finished over time [23]. Previous studies have shown that a host of factors contributed to the success or failure of root canal treatment. However, the fundamental biologic principle that determines clinically success of root canal treatment was still unchanged [22]. The present retrospective study was conducted to investigate the factors that can affect the therapeutic effect and the pain intensity of children after root canal therapy.

According to literature, the favorable outcome for root canal treatment can be up to 90% for those without pre-operative apical periodontitis, while 75–80% for those with pre-operative apical periodontitis [9, 24]. Bacteria and their by-products can be leak through the well-filled canal system even in the best root canal treatment [22]. Two types of clinical outcome assessment were applied in clinical medicine, patient or clinician-reported. The outcome in terms of periapical healing and post-treatment disease were the most important indicators for both patients and clinician [25]. However, the bulk of studies still focus on the clinician-reported endpoints [26, 27]. This study investigated the outcome of root canal treatment from the perspective of patients. The outcome indicator includes tooth survival, disease exacerbation or an adverse clinical event [10].

Y.-L. Ng summarized the literature and showed that gender and age had no significant effect on the success rate of root canal therapy [9]. In this study, the gender and age of patients did not show significant difference between the two-visit and three-visit groups, which is consistent with previous studies. Besides, after completely irrigation and effective root canal preparation, the effective rate also showed no significant difference between the two-visit and three-visit treatment, implying that the times of visit is not the factor that affect the treatment outcome. Complete removal of pulp tissue or necrotic material are important for good prognosis of root canal treatment [28]. This can explain why the effective rate of two-visit treatment was not lower than the three-visit group even with little time of irrigating and disinfection, which suggesting that proper operation ensure the successful outcome.

Post-operative pain after root canal treatment may negatively affect the patient's trust and compliance [29, 30]. The incidence of postoperative pain can be caused by many factors, such as age, gender, the instrumentation used in the root canal therapy, the choice of irrigating solution, the determination of working length, the use of analgesic agents, the times of treatment visits, as well as the obturation materials and techniques [13, 31]. Also, the presence of preoperative pain can influence the severity of postoperative pain [32]. This study demonstrated that the pain intensity of the two-visit and three-visit groups showed no significant difference. Maybe the post-obturation pain is related to the root canal filling technique rather than the times of visit.

As reported, the forcing of endodontic files can make a diversity of toxic debris outside the apical and generate pain

TABLE 3. Clinical effects of participants.

Group	Cases	Excellent	Effective	Invalid	Total effective
Two-visit group	37	27 (72.97%)	8 (21.62%)	2 (5.41%)	94.59%
Three-visit group	37	33 (89.19%)	3 (8.11%)	1 (2.70%)	97.30%
χ^2			3.206		
p-value			0.201^{ns}		

^{ns}: $p > 0.05$ *(not significant).*

TABLE 4. Pain intensity of participants.

Group	Cases	0	1	2	Pain incidence
Two-visit group	37	10 (27.03%)	23 (62.16%)	4 (10.81%)	72.97%
Three-visit group	37	11 (29.73%)	24 (64.86%)	2 (5.41%)	70.27%
χ^2			0.736		
p-value			0.692^{ns}		

^{ns}: $p > 0.05$ *(not significant).*

[33]. Studies demonstrated that rotary nickel-titanium files used in the mechanical preparation can lead to less debris and irrigant extrusion apically, thus decreasing the incidence of postoperative pain [31]. A recent meta-analysis also showed that rotary instruments were associated with a lower rate of postoperative pain compared with reciprocating instruments [34]. In this study, the WaveOne files were used in both groups, in order to avoid the inconsistency between the two groups. Besides, the type of an irrigating during instrumentation can lead to different pain intensity, due to the flush debris, smear layer and bacteria out of the canal, which might cause reactions on the pulp and periapical tissues, leading to tissue necrosis [35]. The common irrigating solution used in the root canal therapy was normal saline (0.9% NaCl), NaOCl and hydrogen peroxide. Studies have reported that NaOCl is able to remove the organic portion of the smear layer but not the entire smear layer [36]. In this study, normal saline was alternated flush with 2.5% NaOCl in order to wash the remained debris thoroughly. The results of this study showed that there was no significant difference of pain severity between the two-visit and three-visit groups. Maybe, the protracted treatment just means increased technical difficulties in the progress, without improving the chance for successful healing [25]. The three-visit treatment enhanced the time of visits, the by-chair time and economic cost, which increase the burden of patients. This study showed that the treatment efficiency of root canal is able to solved upon thorough disinfection and elimination of microorganisms, regardless of the numbers of treatment visits [25].

However, there are also limits of this study. First, there should be larger sample sizes to make this study more convincing. Second, this study reported only limited periods after treatment, which might be acceptable for short-term outcome. Further studies still need long time follow up to investigate the outcome of root canal treatment.

5. Conclusions

The outcome of the root canal treatment in primary teeth showed no significant difference between the two-visit and three-visit groups, in terms of clinical effects and pain intensity.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

AUTHOR CONTRIBUTIONS

BBY—collected the data, and performed the writing. SMZ—conceived the idea and analyze the data. All authors read and approved the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the institutional review board of the Shanghai Ninth People's Hospital and was conducted in accordance with the ethical principles originating from the Declaration of Helsinki (SH9H-2023-T39-1). This was a retrospective study and the requirement for informed consent was therefore waived.

ACKNOWLEDGMENT

Not applicable.

FUNDING

This work was supported by Shanghai Sailing Program (21YF1424500) and National Natural Science Foundation of China (82103074).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Chen X, Liu X, Zhong J. Clinical and radiographic evaluation of pulpectomy in primary teeth: a 18-months clinical randomized controlled

trial. Head & Face Medicine. 2017; 13: 12.
[2] Mabangkhru S, Duangthip D, Chu CH, Phonghanyudh A, Jirarattanasopha V. A randomized clinical trial to arrest dentin caries in young children using silver diamine fluoride. Journal of Dentistry. 2020; 99: 103375.
[3] Gadallah L, Hamdy M, El Bardissy A, Abou El Yazeed M. Pulpotomy versus pulpectomy in the treatment of vital pulp exposure in primary incisors. A systematic review and meta-analysis. F1000Research. 2018; 7: 1560.
[4] Shindova M. Root canal filling materials in primary teeth—review. Folia Medica. 2021; 63: 657–662.
[5] Coll JA, Vargas K, Marghalani AA, Chen CY, AlShamali S, Dhar V, *et al.* A systematic review and meta-analysis of nonvital pulp therapy for primary teeth. Pediatric Dentistry. 2020; 42: 256–461.
[6] Del Fabbro M, Corbella S, Sequeira-Byron P, Tsesis I, Rosen E, Lolato A, *et al.* Endodontic procedures for retreatment of periapical lesions. Cochrane Database of Systematic Reviews. 2016; 10: CD005511.
[7] McGuigan MB, Louca C, Duncan HF. The impact of fractured endodontic instruments on treatment outcome. British Dental Journal. 2013; 214: 285–289.
[8] Paik S, Sechrist C, Torabinejad M. Levels of evidence for the outcome of endodontic retreatment. Journal of Endodontics. 2004; 30: 745–750.
[9] Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature—Part 2. Influence of clinical factors. International Endodontic Journal. 2008; 41: 6–31.
[10] Duncan HF, Nagendrababu V, El-Karim IA, Dummer PMH. Outcome measures to assess the effectiveness of endodontic treatment for pulpitis and apical periodontitis for use in the development of European Society of Endodontology (ESE) S3 level clinical practice guidelines: a protocol. International Endodontic Journal. 2021; 54: 646–654.
[11] Ferreira NS, Gollo EKF, Boscato N, Arias A, Silva EJNLD. Postoperative pain after root canal filling with different endodontic sealers: a randomized clinical trial. Brazilian Oral Research. 2020; 34: e069.
[12] Del Fabbro M, Afrashtehfar KI, Corbella S, El-Kabbaney A, Perondi I, Taschieri S. *In vivo* and *in vitro* effectiveness of rotary nickel-titanium *vs*. manual stainless steel instruments for root canal therapy: systematic review and meta-analysis. Journal of Evidence Based Dental Practice. 2018; 18: 59–69.
[13] Sathorn C, Parashos P, Messer H. The prevalence of postoperative pain and flare-up in single- and multiple-visit endodontic treatment: a systematic review. International Endodontic Journal. 2008; 41: 91–99.
[14] Liapis D, De Bruyne MAA, De Moor RJG, Meire MA. Postoperative pain after ultrasonically and laser-activated irrigation during root canal treatment: a randomized clinical trial. International Endodontic Journal. 2021; 54: 1037–1050.
[15] Mostafa MEHAA, El-Shrief YAI, Anous WIO, Hassan MW, Salamah FTA, El Boghdadi RM, *et al*. Postoperative pain following endodontic irrigation using 1.3% versus 5.25% sodium hypochlorite in mandibular molars with necrotic pulps: a randomized double-blind clinical trial. International Endodontic Journal. 2020; 53: 154–166.
[16] Kandemir Demirci G, Miçooğulları Kurt S, Serefoglu B, Kaval ME, Çalışkan MK. The influence of different NiTi instrumentation techniques on postoperative pain after single-visit root canal treatment. Australian Endodontic Journal. 2021; 47: 559–568.
[17] Graunaite I, Skucaite N, Lodiene G, Agentiene I, Machiulskiene V. Effect of resin-based and bioceramic root canal sealers on postoperative pain: a split-mouth randomized controlled trial. Journal of Endodontics. 2018; 44: 689–693.
[18] Jang YE, Kim Y, Kim BS. Influence of preoperative mechanical allodynia on predicting postoperative pain after root canal treatment: a prospective clinical study. Journal of Endodontics. 2021; 47: 770–778.e1.
[19] Sjogren U, Hagglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. Journal of Endodontics. 1990; 16: 498–504.
[20] Fuks AB, Eidelman E, Pauker N. Root fillings with Endoflas in primary teeth: a retrospective study. Journal of Clinical Pediatric Dentistry. 2002; 27: 41–45.
[21] Ng YL, Mann V, Gulabivala K. A prospective study of the factors affecting outcomes of nonsurgical root canal treatment: part 1: periapical health. International Endodontic Journal. 2011; 44: 583–609.
[22] Gillen BM, Looney SW, Gu LS, Loushine BA, Weller RN, Loushine RJ, *et al*. Impact of the quality of coronal restoration versus the quality of root canal fillings on success of root canal treatment: a systematic review and meta-analysis. Journal of Endodontics. 2011; 37: 895–902.
[23] Makanjuola JO, Oderinu OH, Umesi DC. Treatment outcome and root canal preparation techniques: 5-year follow-up. International Dental Journal. 2022; 72: 811–818.
[24] Friedman S, Abitbol S, Lawrence HP. Treatment outcome in endodontics: the Toronto study. phase 1: initial treatment. Journal of Endodontics. 2003; 29: 787–793.
[25] Lee AH, Cheung GS, Wong MC. Long-term outcome of primary non-surgical root canal treatment. Clinical Oral Investigations. 2012; 16: 1607–1617.
[26] Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature—part 1. Effects of study characteristics on probability of success. International Endodontic Journal. 2007; 40: 921–939.
[27] Ng YL, Mann V, Gulabivala K. Tooth survival following non-surgical root canal treatment: a systematic review of the literature. International Endodontic Journal. 2010; 43: 171–189.
[28] Gümüş H, Delikan E. The effect of sonic activation of irrigant on postoperative pain after root canal treatment in primary molar teeth: a randomized, clinical study. Clinical Oral Investigations. 2021; 25: 363–370.
[29] Nabi S, Amin K, Masoodi A, Farooq R, Purra A, Ahangar F. Effect of preoperative ibuprofen in controlling postendodontic pain with and without low-level laser therapy in single visit endodontics: a randomized clinical study. Indian Journal of Dental Research. 2018; 29: 46–50.
[30] Naseri M, Asnaashari M, Moghaddas E, Vatankhah MR. Effect of low-level laser therapy with different locations of irradiation on postoperative endodontic pain in patients with symptomatic irreversible pulpitis: a double-blind randomized controlled trial. Journal of Lasers in Medical Sciences. 2020; 11: 249–254.
[31] Chagas Carvalho Alves N, Raiane Mamede Veloso S, de Andrade Silva S, de Almeida AC, Tavares Velozo Telles C, Romeiro K, *et al*. Influence of occlusal reduction on pain after endodontic treatment: a systematic review and meta-analysis. Scientific Reports. 2021; 11: 14019.
[32] Arias A, de la Macorra JC, Hidalgo JJ, Azabal M. Predictive models of pain following root canal treatment: a prospective clinical study. International Endodontic Journal. 2013; 46: 784–793.
[33] Vieyra JP, J Enriquez FJ, Acosta FO, Guardado JA. Reduction of postendodontic pain after one-visit root canal treatment using three irrigating regimens with different temperature. Nigerian Journal of Clinical Practice. 2019; 22: 34–40.
[34] Hou XM, Su Z, Hou BX. Post endodontic pain following single-visit root canal preparation with rotary vs reciprocating instruments: a meta-analysis of randomized clinical trials. BMC Oral Health. 2017; 17: 86.
[35] Bhasin P, Sharma M, Bindal D, Tomar D, Sarin A, Sharma N. An *in vitro* evaluation of antimicrobial effects of three different root canal irrigating solutions against *enterococcus faecalis* and *streptococcus mutans*. The Journal of Contemporary Dental Practice. 2019; 20: 221–225.
[36] Ayad MF, Bahannan SA, Rosenstiel SF. Influence of irrigant, dowel type, and root-reinforcing material on fracture resistance of thin-walled endodontically treated teeth. Journal of Prosthodontics. 2011; 20: 180–189.

How to cite this article: Binbin Yu, Shimin Zhao. The evaluation of effective rate and pain intensity of root canal treatment in primary teeth—a retrospective study. Journal of Clinical Pediatric Dentistry. 2024; 48(2): 88-92. doi: 10.22514/jocpd.2024.037.