Clinical Outcomes of Endodontic Therapy Of First Permanent Molars Among Children 6-13 years of age: Retrospective Study

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Abstract:

Purpose:

The purpose of this retrospective study was to evaluate the two-year clinical outcomes of endodontic therapy in first permanent molars (FPMs) among children aged 6–13 years and to compare outcomes between vital pulp therapy (VPT) and root canal treatment (RCT), thereby informing evidence-based clinical decision-making in pediatric dentistry.

Methods:

Patient records from the AxiUm system at Rutgers School of Dental Medicine from January 2013 through December 2025 were reviewed. Inclusion criteria included children aged 6–13 years who underwent endodontic treatment on FPMs (#3, #14, #19, #30) with a minimum of two-year follow-up. Teeth were classified as successful if retained without additional intervention during follow-up. Failures were defined as teeth requiring additional endodontic treatment (retreatment) or extraction. Outcomes were analyzed based on initial treatment modality and tooth location.

Results:

A total of 119 teeth met the inclusion criteria. Overall, 72 teeth (60.5%) were classified as successful, while 47 teeth (39.5%) were classified as failures, including 22 (18.5%) requiring retreatment and 43 (36.1%) ultimately extracted. Among teeth treated with VPT (n = 64), 41 (64.1%) were successful, whereas 31 of 55 teeth (56.4%) treated with RCT were successful. The difference in success rates between VPT and RCT was not statistically significant (p = 0.39). Mandibular molars accounted for a higher proportion of extractions (55.2%) compared to maxillary molars (44.8%).

Conclusions:

Vital pulp therapy and root canal treatment demonstrated comparable clinical success rates in the management of first permanent molars in pediatric patients, with no statistically significant difference between the two modalities. Including retreatment as a failure outcome provides a more comprehensive assessment of treatment success. These findings support the use of conservative approaches such as VPT when appropriate case selection and diagnosis are achieved, particularly in complex cases managed within teaching institutions.

Materials &Methods:

This retrospective study was approved by the Institutional Review Board (IRB #Pro2024002384).

Patient records from AxiUm were reviewed for cases treated between January 1, 2013, and December 31, 2025. Inclusion criteria included patients aged 6–13 years who received endodontic treatment on first permanent molars (#3, #14, #19, #30) and had at least 2 years of follow-up.

Endodontic treatment codes included:

- D3220: Therapeutic pulpotomy
- D3222: Partial pulpotomy (apexogenesis)
- D3330: Root canal treatment
- D3110: Direct pulp capping
- D3348: Re-treatment

Follow-up was confirmed using periodic exam (D0120), comprehensive exam code (D0150), limited exam code (D0140), and endodontic recall codes (NJ13998). Extraction codes (D7140, D7210, 41899) were used to identify failures.

The unit of analysis was a single tooth. Teeth were classified as:

Success: Retained without complications at two-year follow-up

Failure: Extracted within two years

Failure: Additional endodontic treatment

Teeth that met the inclusion criteria, including a minimum follow-up period of two years as confirmed by recall and examination codes, were included in the final data analysis. Those who did not meet the minimum follow-up requirement or lacked sufficient documentation were excluded from our study.

Results:

A total of 421 teeth were initially identified. After applying the inclusion criteria, 119 teeth were included in the final analysis. Of these, 72 teeth (60.5%) were classified as successful, remaining functional without further intervention during follow-up. A total of 47 teeth (39.5%) were classified as failures, including 22 teeth (18.5%) that required additional endodontic treatment (retreatment) and 43 teeth (36.1%) that were ultimately extracted. (Figure 1)

Outcomes by Initial Treatment Modality:

Among teeth that underwent initial vital pulp therapy (VPT) (n = 64), 41 teeth (64.1%) demonstrated clinical success with no further intervention required. However, 17 teeth required subsequent endodontic treatment, and a total of 23 teeth were ultimately extracted. Of these extractions, 17 occurred without prior retreatment, while 6 followed additional endodontic intervention (Figure 1).

Among teeth that underwent initial root canal treatment (RCT) (n = 55), 31 teeth (56.4%) were classified as successful. Five teeth required retreatment, and 20 teeth were ultimately extracted. Of these, 19 extractions occurred without retreatment, while 1 occurred after secondary endodontic treatment (Figure 2).

Comparison of Success Rates:

The comparison of success rates between initial treatment modalities is illustrated in Figure 2. The success rate was higher in the VPT group (64.1%) than in the RCT group (56.4%); however, a two-proportion z-test did not show a statistically significant difference (p = 0.39).

Distribution of Extractions by Tooth Location:

The distribution of extractions by tooth location is shown in Figure 3. Mandibular first permanent molars accounted for a greater proportion of extractions (55.2%) than maxillary molars (44.8%), indicating a higher tendency for extraction in mandibular teeth .

Figures:

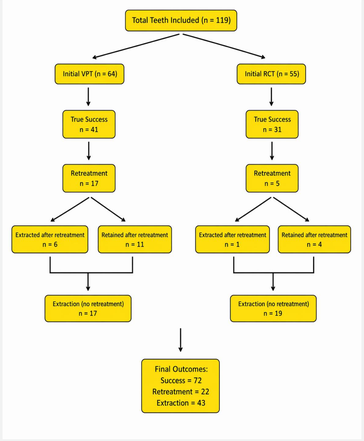

Figure 1:

Figure 1. Treatment pathways and clinical outcomes of first permanent molars following initial vital pulp therapy (VPT) and root canal treatment (RCT).

Distribution of true success, retreatment, and extraction outcomes among 119 teeth. Retreatment was considered a failure outcome. Extraction outcomes are further categorized into extractions without prior retreatment and extractions following retreatment.

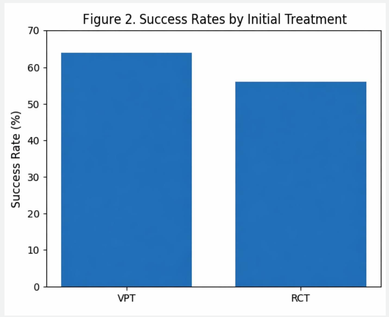

Figure 2. Success rates by initial treatment modality.

Comparison of clinical success rates between teeth treated with vital pulp therapy (VPT) and root canal treatment (RCT). Success was defined as retention of the tooth without need for additional endodontic treatment or extraction during the follow-up period.

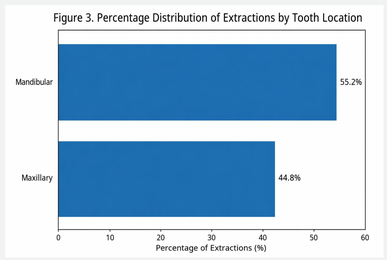

Figure 3. Percentage distribution of extractions by tooth location.

Distribution of extracted first permanent molars by arch location, showing a higher proportion of extractions in mandibular molars (55.2%) compared to maxillary molars (44.8%).

Discussion:

Our study evaluated the clinical outcomes of first permanent molars treated with either initial vital pulp therapy (VPT) or root canal treatment (RCT) in a pediatric population over a two-year follow-up period. Overall, a success rate of 60.5% was observed, with 39.5% of teeth classified as failures requiring retreatment or extraction. These findings demonstrate that endodontic therapy for children's first permanent molars yields moderate overall success, with a substantial proportion of teeth requiring additional intervention.

A major strength of this study is the inclusion of both retreatment and extraction as failure outcomes. Unlike many previous studies that define failure solely as extraction, this approach provides a more comprehensive and clinically relevant assessment of treatment outcomes. Retreatment represents a significant clinical burden, involving additional time, cost, and patient cooperation, even when the tooth is ultimately retained.

When outcomes were analyzed by initial treatment modality, VPT had a higher success rate (64.1%) than RCT (56.4%). However, this difference was not statistically significant (p = 0.39), indicating that both treatment approaches yielded comparable clinical outcomes in this cohort. This suggests that treatment modality alone may not be the primary determinant of success, and that factors such as case selection, pulpal status, and the extent of structural compromise likely play a more significant role.

These findings differ from those of previously published studies reporting higher success rates for vital pulp therapy in immature permanent molars. For example, recent literature has demonstrated favorable outcomes for VPT, supporting its use as a conservative alternative to more invasive procedures. In contrast, the success rates observed in the present study were comparatively lower. This discrepancy may be explained by the clinical setting.

The data were collected from the AxiUm system dental clinics at Rutgers School of Dental Medicine, a university-based teaching institution that receives a high volume of referred cases. Many patients present with advanced caries, extensive structural breakdown, and compromised pulpal conditions, often with a poor initial prognosis. In addition, treatments are performed by dental students and dental residents under faculty supervision, introducing variability in operator experience and technical execution. These factors likely contributed to the lower overall success rates and may explain the absence of a statistically significant difference between VPT and RCT.

Analysis of treatment pathways further demonstrated that a considerable number of teeth initially treated with VPT required subsequent endodontic intervention, and that a proportion ultimately progressed to extraction. Similarly, although RCT is often considered a definitive treatment, a subset of these teeth also failed, requiring retreatment or extraction. These findings emphasize the dynamic nature of disease progression in young permanent molars and highlight the importance of careful case selection and long-term follow-up.

Tooth-based analysis revealed that mandibular first permanent molars exhibited higher failure and extraction rates compared to maxillary molars. This finding is consistent with other published studies and may be attributed to anatomical complexity, earlier eruption timing, higher caries susceptibility, and increased functional load associated with mandibular molars. Additionally, clinical challenges in access and restoration may further contribute to poorer outcomes in these teeth.

The findings on treatment modalities in this study support the concept that conservative approaches, such as vital pulp therapy, may yield outcomes comparable to those of more invasive procedures when appropriately indicated. The absence of a statistically significant difference between VPT and RCT further underscores the importance of case selection, pulpal diagnosis, and clinical judgment in determining treatment success in pediatric patients.

This study has several limitations. As a retrospective analysis, it is subject to variability in documentation and treatment decisions. Differences in operator experience, restorative quality, and patient compliance were not controlled for and may have influenced outcomes. Additionally, coding practices within the AxiUm system may have varied, particularly during its early implementation, potentially leading to inconsistencies in data classification.

Another limitation concerns the clinical setting. Rutgers School of Dental Medicine (RSDM) clinics receive many referred patients who often present for treatment of individual teeth without comprehensive baseline records or complete treatment planning within the institution. This may limit the availability of diagnostic information and hinder the ability to fully assess the treatment context and long-term prognosis. Additionally, as a referral-based center, the clinics see many patients with severely compromised teeth deemed non-restorable or unsuitable for treatment by private providers, which may have influenced the observed treatment outcomes.

Despite these limitations, this study provides valuable insight into real-world clinical outcomes of endodontic therapy in pediatric patients. It highlights the importance of careful case selection, operator skill, and longitudinal follow-up in determining treatment success.

Conclusion:

Within the limitations of this retrospective study, both vital pulp therapy (VPT) and root canal treatment (RCT) demonstrated comparable clinical success rates for managing first permanent molars in pediatric patients, with no statistically significant difference between the two modalities. These findings support the use of conservative approaches such as VPT as a viable alternative to more invasive procedures when appropriate case selection and diagnosis are achieved.

Including retreatment as a failure outcome provides a more comprehensive and clinically relevant assessment of treatment success. The moderate overall success rates observed underscore the complexity of managing compromised first permanent molars, particularly in a referral-based teaching environment such as the dental clinics at Rutgers School of Dental Medicine. Careful case selection, operator skill, and long-term follow-up remain critical to optimizing clinical outcomes.

Clinical Significance:

Vital pulp therapy is a conservative treatment option with outcomes comparable to those of root canal treatment in first permanent molars. In pediatric dental practice, emphasis on accurate diagnosis, appropriate case selection, and close follow-up is essential, particularly in complex cases managed within teaching institutions.

References:

- Bufersen S, Jones J, Shanmugham J, Hsu TY, Rich S, Chogle S, Ziyab AH. Survival of endodontically treated permanent teeth among children: a retrospective cohort study. BMC Oral Health. 2021;21:589.
- Sabbagh HJ, Samara AA, Dhafar W, Turkistani J, Almalik MI, Zaatari R, Bahkali A, Bamashmous N. Comparing oral health-related quality of life and satisfaction: root canal therapy vs. extraction for first permanent molars in children – a case–control study. BMC Oral Health. 2025;25:327.
- Dhafar W, Sabbagh HJ, Albassam A, Turkistani J, Zaatari R, Almalik M, Dafar A, Alhamed S, Bahkali A, Bamashmous N. Outcomes of root canal treatment of first permanent molars among children in Jeddah, Saudi Arabia: A retrospective cohort study. Heliyon. 2022;8:e11104.
- Lee SM, Yu YH, Karabucak B. Endodontic treatments on permanent teeth in pediatric patients aged 6–12 years old. J Dent Sci. 2023;18:1109–1115.
- Chatzidimitriou K, Seremidi K, Balta MG, Katechi V, Petroleka K, Gizani S. Vital Pulp Therapy of Young First Permanent Molars: A Retrospective Study on Radiographic Findings 24 Months Post-treatment. Oral Health Prev Dent. 2023 Nov 2;21:357-364.