

Clinical & Radiographic Outcomes of the Hall Technique Versus Conventional Pulpotomy in Carious Primary Molars

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Background: Successful management of carious primary molars requires predictable clinical and radiographic outcomes while maintaining patient comfort and clinical efficiency. The Hall Technique has been proposed as a minimally invasive alternative to Conventional Pulpotomy; however, direct comparative evidence remains limited.

Aim: To evaluate and compare the clinical success, radiographic success, and chairside treatment time of the Hall Technique and Conventional Pulpotomy in the treatment of carious primary molars.

Materials and Methods: This randomized clinical study included 60 children aged 4–8 years, each contributing one carious primary molar. The teeth were randomly assigned to either the Hall Technique group or the Conventional Pulpotomy group. Clinical and radiographic assessments were conducted at 3, 6, and 12 months. Chairside treatment time was recorded for both interventions. Statistical analysis was performed using appropriate tests, with the level of significance set at $p < 0.05$.

Results: At the end of the 12-month follow-up, both treatment modalities demonstrated high success rates. Clinical success was achieved in 93.3% of teeth treated with the Hall Technique and 90.0% of those treated with Conventional Pulpotomy, while radiographic success was observed in 93.3% and 86.7% of teeth, respectively. These differences were not statistically significant. In contrast, the mean chairside treatment time was significantly shorter for the Hall Technique (11.4 ± 2.1 minutes) compared

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with Conventional Pulpotomy (27.8 ± 3.9 minutes) ($p < 0.001$).

Conclusion: Both the Hall Technique and Conventional Pulpotomy provided comparable clinical and radiographic outcomes over a 12-month period. However, the Hall Technique required significantly less chairside time, supporting its use as a more efficient and child-friendly approach for managing carious primary molars.

Keywords: Chairside treatment time, Clinical success, Conventional pulpotomy, Hall Technique, Pediatric dentistry, Radiographic success.

Introduction

Dental caries affecting primary molars continues to be a major public health concern in pediatric dentistry and is one of the principal causes of dental pain, infection, and early loss of primary teeth in children. Premature loss of primary molars can compromise arch length, masticatory efficiency, and the normal eruption pathway of permanent successors. Consequently, effective management and retention of carious primary molars until their physiological exfoliation remains a primary treatment objective in pediatric dental care [1].

Conventionally, deep carious lesions in vital primary molars have been treated using pulpotomy, a procedure that involves removal of the infected coronal pulp while maintaining the vitality of the radicular pulp tissue. Numerous studies have reported satisfactory clinical and radiographic success for pulpotomy when appropriate case selection, medicament choice, and coronal seal are achieved [2, 3]. However, the procedure is technique-sensitive, time-consuming, and often requires local anesthesia, rubber dam isolation, and good patient cooperation, which can be challenging in young or anxious children.

With the growing emphasis on minimally invasive dentistry, biologically based approaches for managing caries have gained popularity. The Hall Technique, introduced by Norna Hall, offers a non-invasive alternative for the management of carious primary molars. This approach involves cementation of preformed metal crowns over carious teeth without caries

removal, tooth preparation, or local anesthesia. The underlying principle is the biological sealing of carious lesions, which disrupts the metabolic activity of cariogenic microorganisms and arrests disease progression while preserving pulpal vitality [4].

Evidence from randomized controlled trials and systematic reviews suggests that the Hall Technique demonstrates high clinical success rates, improved child acceptability, and reduced chairside time when compared with conventional restorative procedures [4, 5]. Despite these favorable outcomes, most existing literature has focused primarily on clinical performance, with limited emphasis on radiographic parameters such as periradicular health, internal or external root resorption, and furcation radiolucency.

Radiographic assessment is a critical component in determining long-term treatment success for both pulpotomy and the Hall Technique, as it provides objective evidence of pulpal and periapical status. While the radiographic outcomes of pulpotomy have been extensively documented, direct comparative evidence evaluating the radiographic performance of pulpotomy versus the Hall Technique remains sparse [3,6]. Given the fundamental differences in biological rationale, procedural invasiveness, and restorative philosophy between these two approaches, a systematic comparison is warranted.

Therefore, the present study aims to evaluate and compare the clinical and radiographic outcomes of the Hall Technique and

conventional pulpotomy in the management of carious primary molars. Such evidence will assist clinicians in selecting predictable, child-friendly, and minimally invasive treatment strategies based on sound scientific evidence.

Materials and Methods

Study Design and Ethical Approval

The present study was designed as a randomized controlled clinical trial conducted in the Department of Pediatric and Preventive Dentistry. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study, and the protocol was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participating children.

Study Population and Sample Selection

Children aged 4–8 years who reported to the outpatient department with at least one carious primary molar were screened for eligibility. A total of 60 primary molars from 60 children who met the inclusion criteria were selected and randomly allocated to two study groups.

Inclusion Criteria

- Children in good general health
- Presence of at least one primary molar with deep dentinal caries
- Teeth diagnosed as vital, with no history of spontaneous pain
- Absence of clinical signs of pulpal degeneration such as swelling, sinus tract, or abnormal mobility
- Radiographic evidence of caries approximating the pulp without signs of furcation or periapical pathology

Exclusion Criteria

- Non-vital teeth or teeth with irreversible pulpitis
- Radiographic evidence of internal or external root resorption
- Furcation or periapical radiolucency
- Medically compromised children

- Teeth close to exfoliation
- Randomization and Group Allocation

Eligible teeth were randomly allocated into two groups using a computer-generated randomization method:

Group I: Hall Technique

Group II: Conventional pulpotomy

Treatment Procedures

Group I – Hall Technique

No local anesthesia or caries removal was performed. Orthodontic separators were placed where required to create space for crown placement. Preformed metal crowns of appropriate size were selected, filled with glass ionomer luting cement, and seated over the carious primary molars using finger pressure. Excess cement was removed, and occlusion was checked.

Group II – Conventional Pulpotomy

Local anesthesia was administered, followed by rubber dam isolation. Caries was removed, and coronal pulp tissue was extirpated using a sterile excavator. Hemostasis was achieved with a moist cotton pellet. The selected pulpotomy medicament was placed over the radicular pulp stumps, followed by placement of a base material. The tooth was restored with stainless steel crown cemented using glass ionomer cement.

Clinical and Radiographic Evaluation

Patients were recalled at baseline, 3 months, 6 months, and 12 months for evaluation.

Clinical Evaluation Criteria

Absence of spontaneous pain

Absence of swelling or sinus tract

Absence of pathological mobility

Integrity of restoration/crown

Radiographic Evaluation Criteria

Standardized intraoral periapical radiographs were taken using the paralleling technique and evaluated for:

Furcation or periapical radiolucency

Internal or external root resorption

Widening of periodontal ligament space

Treatment success was defined by the absence of both clinical and radiographic signs of failure.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the study variables. Continuous variables, such as chairside treatment time, were expressed as mean, standard deviation (SD), and standard error (SE), while categorical variables, including age group, gender, tooth type, clinical findings, radiographic findings, and treatment success, were presented as frequencies and percentages. The normality of continuous data was assessed using the Shapiro–Wilk test. Intergroup comparisons of continuous variables were performed using the independent Student's *t*-test for normally distributed data. Categorical variables were compared between the Hall Technique and Conventional Pulpotomy groups using the Chi-square test or Fisher's exact test, as appropriate based on expected cell

frequencies. Clinical and radiographic success rates at different follow-up intervals (3, 6, and 12 months) were compared using the Chi-square test. A two-tailed *p*-value of less than 0.05 was considered statistically significant for all analyses, and results were interpreted at a 95% confidence interval.

Results

Table 1 and Figure 1 illustrate the age-wise distribution of the study participants. A total of 60 children were enrolled in the study. The largest proportion of participants was observed in the 4–5 years and 5–6 years age groups, with 17 children each (28.3%). This was followed by the 6–7 years age group, which included 14 children (23.3%), and the 7–8 years age group, comprising 12 children (20.0%).

Within the Hall Technique group, 8 children (26.7%) were aged 4–5 years, 9 (30.0%) were 5–6 years, 7 (23.3%) were 6–7 years, and 6 (20.0%) were 7–8 years. In the Conventional Pulpotomy group, 9 children (30.0%) belonged to the 4–5 years age group, 8 (26.7%) were 5–6 years, 7 (23.3%) were 6–7 years, and 6 (20.0%) were 7–8 years. Overall, the age distribution was similar across both groups, demonstrating that the participants were evenly matched with respect to age at baseline.

Table 1: Distribution of Participants According To Age (Years)

Age (Years)	Hall Technique (n=30)	Conventional Pulpotomy (n=30)	Total (N=60)
4–5	8 (26.7%)	9 (30.0%)	17 (28.3%)
5–6	9 (30.0%)	8 (26.7%)	17 (28.3%)
6–7	7 (23.3%)	7 (23.3%)	14 (23.3%)
7–8	6 (20.0%)	6 (20.0%)	12 (20.0%)
Total	30 (100%)	30 (100%)	60 (100%)

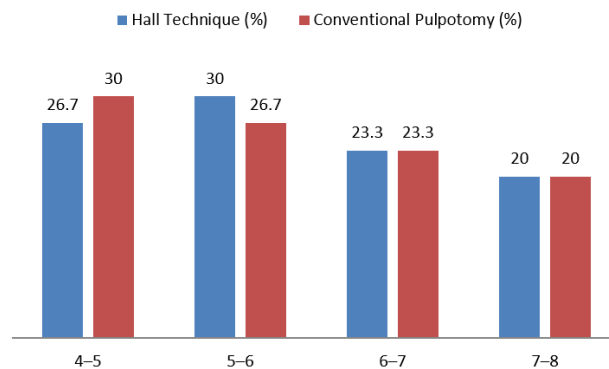


Figure 1: Age-wise Distribution of Study Participants In The Hall Technique & Conventional Pulpotomy groups

Table 2 and Figure 2 depict the gender-wise distribution of the study participants. Among the 60 children enrolled, 33 (55.0%) were male and 27 (45.0%) were female. In the Hall Technique group, males accounted for 17 participants (56.7%), while females comprised 13 participants (43.3%). Likewise, in the

Conventional Pulpotomy group, 16 participants (53.3%) were male and 14 (46.7%) were female. Overall, the gender distribution was comparable between the two groups, reflecting an even and balanced representation of male and female participants at baseline.

Table 2: Distribution According to Gender

Gender	Hall Technique	Conventional Pulpotomy	Total
Male	17 (56.7%)	16 (53.3%)	33 (55.0%)
Female	13 (43.3%)	14 (46.7%)	27 (45.0%)
Total	30	30	60

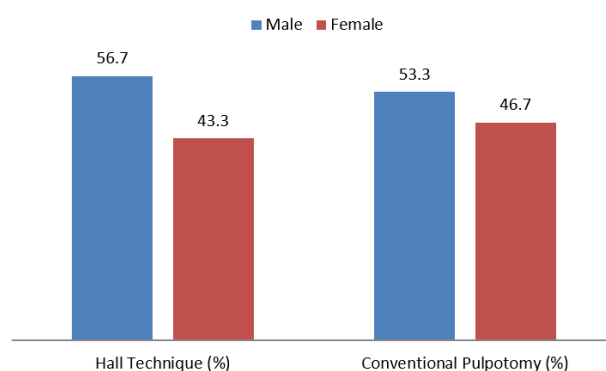


Figure 2: Gender-Wise Distribution of Study Participants In The Hall Technique & Conventional Pulpotomy Groups

Table 3 & Figure 3 depict the distribution of primary molars treated in the study. Of the 60 teeth included, 33 (55.0%) were second primary molars and 27 (45.0%) were first primary molars. In the Hall Technique group, second

primary molars constituted 17 treated teeth (56.7%), while 13 teeth (43.3%) were first primary molars. In the Conventional Pulpotomy group, 16 teeth (53.3%) were second primary molars and 14 (46.7%) were first primary

molars. Overall, the proportion of first and second primary molars was similar in both

groups, indicating an even distribution of tooth types across the two treatment modalities.

Table 3: Distribution Of Treated Primary Molars

Tooth	Hall Technique	Conventional Pulpotomy	Total
First Primary Molar	13 (43.3%)	14 (46.7%)	27 (45.0%)
Second Primary Molar	17 (56.7%)	16 (53.3%)	33 (55.0%)
Total	30	30	60

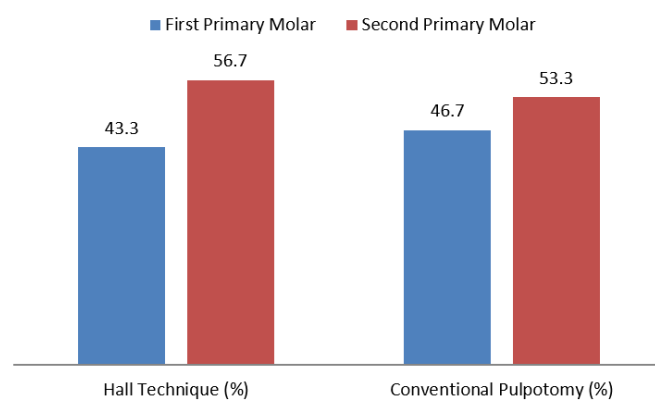


Figure 3: Distribution of First & Second Primary Molars Treated In The Hall Technique & Conventional Pulpotomy groups

Table 4 and Figure 4 present a comparison of the clinical success rates of the Hall Technique and Conventional Pulpotomy across different follow-up intervals. At the 3-month follow-up, clinical success was noted in 29 teeth (96.7%) treated with the Hall Technique and 28 teeth (93.3%) treated with Conventional Pulpotomy. While the success rate was slightly higher in the Hall Technique group, the difference was not statistically significant ($\chi^2 = 0.35$, $p = 0.554$). At the 6-month evaluation, the Hall Technique maintained a success rate of 96.7% (29/30), whereas the Conventional Pulpotomy group showed a success rate of 90.0% (27/30). This

variation was not statistically significant ($\chi^2 = 1.07$, $p = 0.301$). At the 12-month follow-up, favorable clinical outcomes were recorded in 28 teeth (93.3%) in the Hall Technique group and 27 teeth (90.0%) in the Conventional Pulpotomy group, with no statistically significant difference between the two treatment approaches ($\chi^2 = 0.22$, $p = 0.640$). In summary, both treatment methods demonstrated high and comparable clinical success rates throughout the 12-month follow-up period, with no significant differences observed between the groups at any assessment interval.

Table 4: Comparison Of Clinical Success at Different Follow-up Intervals

Follow-up	Hall Technique n (%)	Conventional Pulpotomy n (%)	χ^2	P value
3 Months	29 (96.7%)	28 (93.3%)	0.35	0.554
6 Months	29 (96.7%)	27 (90.0%)	1.07	0.301
12 Months	28 (93.3%)	27 (90.0%)	0.22	0.640

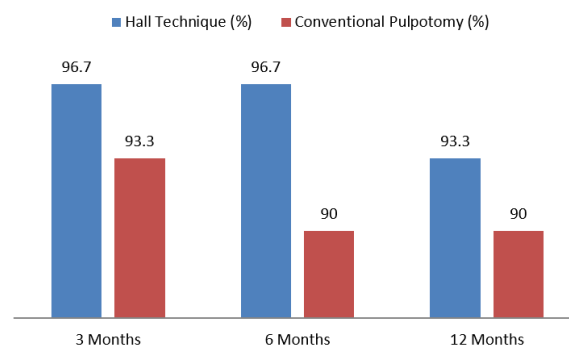
**Figure 4:** Comparison Of Clinical Success Rates Of The Hall Technique & Conventional Pulpotomy At 3, 6 & 12 Months Follow-Up

Table 5 & Figure 5 compare the radiographic success of the Hall Technique and Conventional Pulpotomy at different follow-up intervals. At the 3-month follow-up, radiographic success was observed in 29 (96.7%) teeth treated with the Hall Technique and 28 (93.3%) teeth treated with Conventional Pulpotomy. Although the Hall Technique demonstrated a marginally higher success rate, the difference between the two groups was not statistically significant ($\chi^2 = 0.35$, $p = 0.554$).

At the 6-month follow-up, radiographic success remained 96.7% (29/30) in the Hall Technique group, while 27 (90.0%) teeth in the Conventional Pulpotomy group exhibited successful radiographic outcomes. The difference between the two treatment modalities was not statistically significant ($\chi^2 = 1.07$, $p = 0.301$).

By the 12-month follow-up, radiographic success was achieved in 28 (93.3%) teeth managed with the Hall Technique compared with 26 (86.7%) teeth treated with Conventional Pulpotomy. Although the Hall Technique showed a slightly higher radiographic success rate, the difference remained statistically non-significant ($\chi^2 = 0.74$, $p = 0.389$).

Overall, both treatment modalities demonstrated high radiographic success throughout the study period, with no statistically significant differences observed between the Hall Technique and Conventional Pulpotomy at any follow-up interval, indicating that both approaches were equally effective in maintaining favorable radiographic outcomes over 12 months.

Table 5: Comparison Of Radiographic Success

Follow-up	Hall Technique n (%)	Conventional Pulpotomy n (%)	χ^2	P value
3 Months	29 (96.7%)	28 (93.3%)	0.35	0.554
6 Months	29 (96.7%)	27 (90.0%)	1.07	0.301
12 Months	28 (93.3%)	26 (86.7%)	0.74	0.389

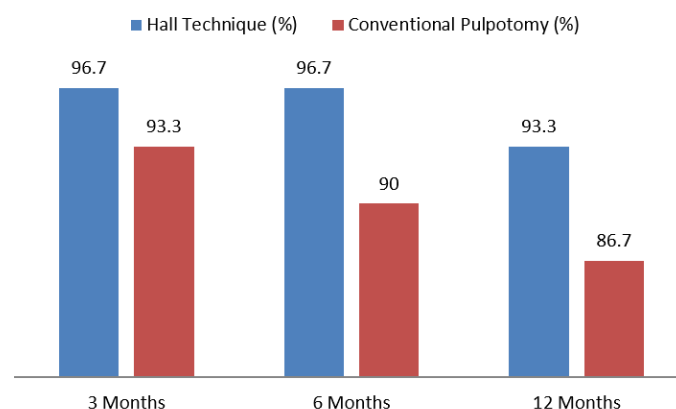
**Figure 5:** Comparison Of Radiographic Success Rates Of The Hall Technique & Conventional Pulpotomy At 3, 6 & 12 Months Follow-Up

Table 6 and Figure 6 present a comparison of clinical findings observed during the follow-up period in the Hall Technique and Conventional Pulpotomy groups. Postoperative pain was reported in 2 teeth (6.7%) treated with the Hall Technique and in 3 teeth (10.0%) treated with Conventional Pulpotomy, with no statistically significant difference between the groups ($p = 0.640$). Swelling was noted in 1 case (3.3%) in the Hall Technique group and in 2 cases (6.7%) in the Conventional Pulpotomy group; this difference was also not statistically significant ($p = 0.554$).

No sinus tract formation was observed in teeth treated with the Hall Technique, whereas 1 tooth (3.3%) in the Conventional Pulpotomy group developed a sinus tract during the follow-up period. This difference was not statistically significant ($p = 0.313$). Pathological mobility

was identified in 1 tooth (3.3%) in the Hall Technique group and in 2 teeth (6.7%) in the Conventional Pulpotomy group, with no significant difference between the groups ($p = 0.554$).

Evaluation of crown integrity showed that 29 crowns (96.7%) remained intact in the Hall Technique group, compared with 28 crowns (93.3%) in the Conventional Pulpotomy group. The difference between the two groups was not statistically significant ($p = 0.554$).

Overall, both treatment approaches were associated with a low frequency of postoperative clinical complications and high crown survival rates during the follow-up period, with no statistically significant differences observed between the Hall Technique and Conventional Pulpotomy groups.

Table 6: Clinical Findings During Follow-up

Clinical Parameter	Hall Technique n (%)	Conventional Pulpotomy n (%)	P value
Pain	2 (6.7%)	3 (10.0%)	0.640
Swelling	1 (3.3%)	2 (6.7%)	0.554
Sinus Tract	0	1 (3.3%)	0.313
Pathological Mobility	1 (3.3%)	2 (6.7%)	0.554
Crown Intact	29 (96.7%)	28 (93.3%)	0.554

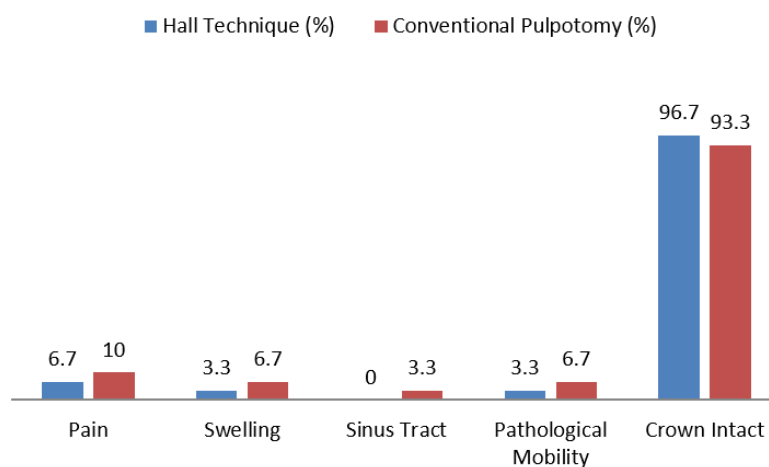
**Figure 6:** Comparison of Postoperative Clinical Findings and Crown Integrity In The Hall Technique & Conventional Pulpotomy Groups During The Follow-Up Period

Table 7 and Figure 7 present a comparison of radiographic findings recorded during the follow-up period in the Hall Technique and Conventional Pulpotomy groups. Furcation radiolucency was observed in 1 tooth (3.3%) treated with the Hall Technique and in 2 teeth (6.7%) treated with Conventional Pulpotomy, with no statistically significant difference between the groups ($p = 0.554$). Internal root resorption was not detected in any tooth in the Hall Technique group, whereas 1 tooth (3.3%) in the Conventional Pulpotomy group showed evidence of internal root resorption during follow-up. This difference was not statistically significant ($p = 0.313$).

External root resorption was identified in 1 tooth (3.3%) in the Hall Technique group and in 2 teeth (6.7%) in the Conventional Pulpotomy

group, with no statistically significant difference between the two treatment modalities ($p = 0.554$). Similarly, widening of the periodontal ligament space was noted in 1 tooth (3.3%) managed with the Hall Technique and in 2 teeth (6.7%) treated with Conventional Pulpotomy; this difference was also not statistically significant ($p = 0.554$).

Overall, radiographic assessment revealed a low frequency of pathological changes in both groups throughout the follow-up period. No statistically significant differences were identified between the Hall Technique and Conventional Pulpotomy for any of the radiographic parameters evaluated, indicating comparable radiographic outcomes for both treatment approaches.

Table 7: Radiographic Findings During Follow-up

Radiographic Finding	Hall Technique n (%)	Conventional Pulpotomy n (%)	P value
Furcation Radiolucency	1 (3.3%)	2 (6.7%)	0.554
Internal Root Resorption	0	1 (3.3%)	0.313
External Root Resorption	1 (3.3%)	2 (6.7%)	0.554
PDL Widening	1 (3.3%)	2 (6.7%)	0.554

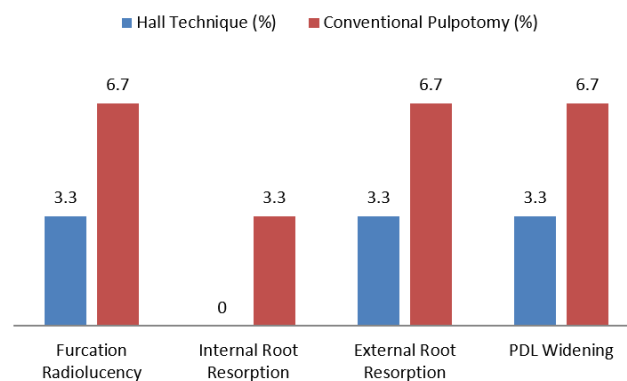
**Figure 7:** Comparison Of Radiographic Findings In The Hall Technique and Conventional Pulpotomy Groups During The Follow-Up Period

Table 8 & Figure 8 outline the overall treatment outcomes of the Hall Technique and Conventional Pulpotomy at the end of the 12-month follow-up period. Successful outcomes were observed in 28 teeth (93.3%) treated with the Hall Technique and in 26 teeth (86.7%) treated with Conventional Pulpotomy. Treatment failure occurred in 2 teeth (6.7%) in the Hall Technique group and in 4 teeth (13.3%) in the Conventional Pulpotomy group.

Although the Hall Technique demonstrated a slightly higher overall success rate and fewer failures than Conventional Pulpotomy, this difference was not statistically significant ($p = 0.389$). These findings indicate that both treatment approaches are effective in the management of carious primary molars, with comparable overall clinical and radiographic success at the 12-month follow-up.

Table 8: Overall Treatment Success

Outcome	Hall Technique	Conventional Pulpotomy	P value
Success	28 (93.3%)	26 (86.7%)	0.389
Failure	2 (6.7%)	4 (13.3%)	
Total	30	30	

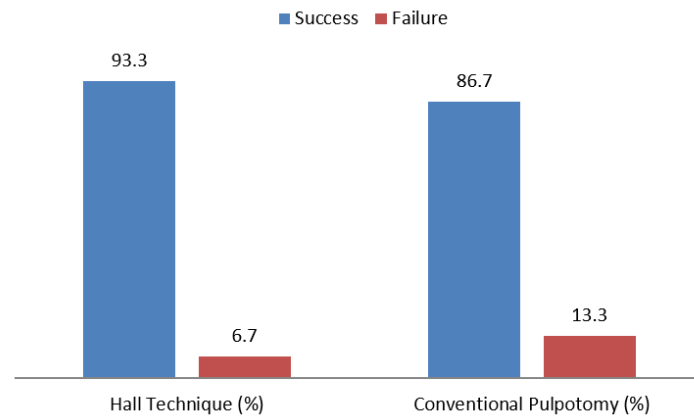


Figure 8: Overall treatment Outcomes Of The Hall Technique & Conventional Pulpotomy At The 12-Month Follow-Up

Table 9 and Figure 9 compare the average chairside treatment time between the Hall Technique and Conventional Pulpotomy. The Hall Technique was completed in a significantly shorter time, with a mean duration of 11.43 ± 2.18 minutes ($SE = 0.40$), whereas Conventional Pulpotomy required a much longer mean treatment time of 27.84 ± 3.92 minutes ($SE = 0.72$).

Evaluation using the independent Student's t-test showed that the difference in treatment

duration between the two groups was highly statistically significant ($t = 20.861$, $p < 0.001$). These results demonstrate that the Hall Technique is considerably more time-efficient than Conventional Pulpotomy, while achieving comparable clinical and radiographic outcomes. The reduced chairside time may contribute to better patient cooperation and improved clinical workflow, particularly when managing young or anxious pediatric patients.

Table 9: Comparison Of Chairside Treatment Time

Group	N	Mean (minutes)	SD	SE	t value	P value	Significance
Hall Technique	30	11.43	2.18	0.40	20.861	<0.001	Significant
Conventional Pulpotomy	30	27.84	3.92	0.72			

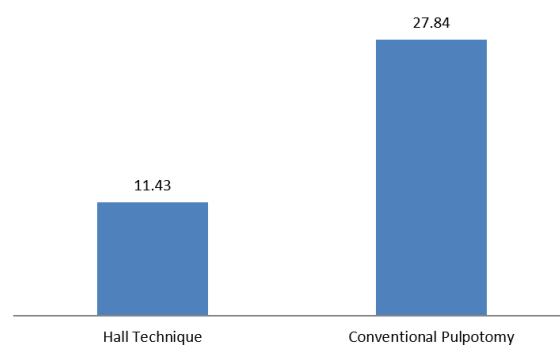


Figure 9: Comparison Of Mean Chairside Treatment Time Between The Hall Technique & Conventional Pulpotomy

Table 10 and Figure 10 provide an overall comparison of the two treatment modalities in

terms of clinical success, radiographic success, and chairside treatment time. The Hall

Technique achieved a clinical success rate of 93.3%, which was marginally higher than the 90.0% observed in the Conventional Pulpotomy group; however, this difference was not statistically significant ($p = 0.640$). Likewise, the radiographic success rate was 93.3% in the Hall Technique group compared with 86.7% in the Conventional Pulpotomy group, with no statistically significant difference between the groups ($p = 0.389$).

In contrast, a statistically significant difference was noted in chairside treatment time. The Hall Technique required mean treatment duration of

11.4 ± 2.1 minutes, whereas Conventional Pulpotomy required 27.8 ± 3.9 minutes. This difference was highly statistically significant ($p < 0.001$), demonstrating that the Hall Technique was considerably more time-efficient.

Overall, these findings indicate that while both treatment approaches yielded comparable clinical and radiographic outcomes, the Hall Technique offered the additional benefit of substantially reduced chairside time, making it a more efficient and child-friendly option for the management of carious primary molars.

Table 10: Overall Comparison Of Both Treatment Modalities

Variable	Hall Technique	Conventional Pulpotomy	P value
Clinical Success	93.3%	90.0%	0.640
Radiographic Success	93.3%	86.7%	0.389
Treatment Time	11.4 ± 2.1 min	27.8 ± 3.9 min	$<0.001^*$

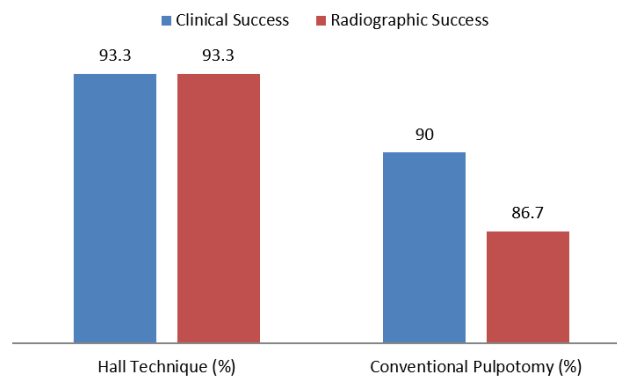


Figure 10: Overall Comparison of the Hall Technique & Conventional Pulpotomy With Respect To Clinical Success, Radiographic success, & Chairside Treatment Time

Discussion

The present study evaluated and compared the clinical and radiographic performance of the Hall Technique and conventional pulpotomy in the treatment of carious primary molars. The findings demonstrated that both treatment modalities yielded favorable outcomes during the follow-up period, with no statistically significant difference between the two groups.

These results indicate that minimally invasive approaches, when applied with appropriate case selection and sound restorative principles, can provide outcomes comparable to conventional pulp therapy.

Conventional pulpotomy has long been considered the gold standard for managing deep carious lesions in vital primary molars. Ranly (1994) [7], in his comprehensive review on

pulpal therapy, highlighted the biological basis and high success rates of pulpotomy when accurate diagnosis and proper hemorrhage control are achieved. Similarly, Sonmez (2008) [8] reported favorable long-term clinical and radiographic outcomes of pulpotomy in primary molars, emphasizing the significance of effective coronal sealing. The satisfactory results observed in the pulpotomy group in the present study are consistent with these findings and further underscore the role of stainless steel crowns in minimizing microleakage and enhancing restoration longevity.

In contrast, the Hall Technique follows a biological and minimally invasive philosophy that focuses on sealing carious lesions without caries excavation. Innes et al. (2011) [9] demonstrated that caries management using preformed metal crowns without local anesthesia or caries removal resulted in high success rates and maintained pulpal health. Subsequent long-term evaluations by Santamaria et al. (2014) [10] further confirmed that sealing caries effectively arrests lesion progression by isolating cariogenic biofilm from its nutrient source. The comparable clinical and radiographic success of the Hall Technique in the present study aligns with these reports, supporting its validity as an alternative to conventional pulp therapy.

Improved child cooperation was a notable advantage of the Hall Technique observed in the present study. Page et al. (2014) [11] reported significantly higher acceptance of the Hall Technique among children and parents, attributed to the avoidance of local anesthesia, rotary instrumentation, and invasive procedures. Reduced treatment time and improved patient comfort enhance its suitability for young or anxious pediatric patients, making it a pragmatic option in routine clinical settings.

Radiographic evaluation remains essential in determining the success of pulp therapy in primary molars. In the present study, no statistically significant differences were detected between the two groups regarding furcation radiolucency, pathological root resorption, or

periodontal ligament changes. Similar conclusions were drawn by Schwendicke et al. (2013) [12], who reported comparable outcomes between conventional and biological caries management strategies. Additionally, Ricketts et al. (2006) [13] emphasized that conservative caries management can achieve radiographic outcomes equivalent to traditional operative methods. However, radiographic changes in primary teeth may take time to manifest, highlighting the importance of long-term follow-up.

The present findings further support the paradigm shift toward minimally invasive dentistry in pediatric care. Mertz-Fairhurst et al. (1998) [14] demonstrated through long-term clinical and microbiological studies that sealed carious lesions exhibit reduced bacterial activity and sustained pulpal vitality. These findings challenge the traditional belief that complete caries removal is mandatory and reinforce the biological rationale behind caries sealing techniques.

Despite the favorable outcomes associated with the Hall Technique, conventional pulpotomy remains indispensable in cases involving pulpal exposure or advanced disease. Seale and Randall (2015) [15] emphasized that treatment decisions should be individualized based on clinical diagnosis, caries extent, child cooperation, and long-term prognosis. Further multicenter randomized clinical trials with extended follow-up until natural exfoliation are warranted to strengthen the evidence base for both treatment modalities.

Limitations of the Study

The study had certain limitations that should be considered when interpreting the results. The sample size was limited, which may affect the generalizability of the findings. The follow-up duration was relatively short, and longer-term studies extending until the natural exfoliation of primary molars are required to better assess long-term success. Radiographic evaluation was limited to two-dimensional intraoral radiographs, which may not detect early or

subtle pathological changes. Additionally, the study was conducted at a single center, and factors such as operator variability, patient oral hygiene, dietary habits, and parental compliance were not fully controlled. Further multicenter studies with larger sample sizes and extended follow-up periods are recommended to validate the findings.

Conclusion

The present study demonstrated that both the Hall Technique and conventional pulpotomy are effective treatment modalities for the management of carious primary molars, showing satisfactory clinical and radiographic outcomes during the follow-up period. The Hall Technique exhibited outcomes comparable to conventional pulpotomy in maintaining pulpal

vitality and periradicular health, with no significant signs of pain, infection, pathological mobility, or radiographic failure.

Owing to its minimally invasive nature, reduced chairside time, and greater acceptance among pediatric patients, the Hall Technique represents a reliable and child-friendly alternative to conventional pulpotomy, particularly in young or anxious children. Conventional pulpotomy, when performed under appropriate clinical conditions, continues to remain a dependable treatment option. Overall, the findings support the use of biologically based, minimally invasive approaches such as the Hall Technique as effective alternatives to conventional pulpal therapy in primary molars, based on proper case selection and clinical judgment.

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