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Comparison of Direct and Indirect Pulp Capping in Deciduous Teeth

Ali M[1]*, Ullah MA[2], Akhter S[3]

AUTHOR'S AFFILIATION

1 **Dr. Mohammad Ali**
Professor & Head
Department of Dentistry
Bangladesh Shishu Hospital & Institute
Dhaka, Bangladesh.
Email: dr.mohammad.ali.35@gmail.com

2 **Dr. Mohammad Anayet Ullah**
Medical Officer, Department of Dentistry
Bangladesh Shishu Hospital & Institute
Dhaka, Bangladesh.

3 **Dr. Shammi Akhter**
Dental Surgeon, Department of Dentistry
Bangladesh Shishu Hospital & Institute
Dhaka, Bangladesh.

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Corresponding author*:

Dr. Mohammad Ali
Professor & Head, Department of Dentistry
Bangladesh Shishu Hospital & Institute
Dhaka, Bangladesh
Email: dr.mohammad.ali.35@gmail.com

ABSTRACT

Background: While both direct pulp capping (DPC) and indirect pulp capping (IPC) are advocated as conservative treatments to preserve pulp vitality in primary teeth, there remains a lack of consensus on their comparative effectiveness in the pediatric population. The purpose of the study was to compare the outcomes of direct versus indirect pulp capping in deciduous teeth.

Methods: This prospective comparative study was conducted at the Department of Dentistry, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh, from January to December 2024. A total of 60 primary molars from 42 children were treated with either direct pulp capping (DPC) or indirect pulp capping (IPC). Procedures were performed under aseptic conditions and completed in a single visit. Follow-up evaluations were carried out at 3, 6, and 12 months. Data were analyzed using SPSS version 25.0. The Chi-square test or Fisher's exact test, as appropriate, was used, with $p < 0.05$ considered statistically significant.

Results: Among 60 primary molars from 42 children, no significant baseline differences were observed between groups. Clinical and radiographic success rates at 3, 6, and 12 months were slightly higher in the IPC group; however, these differences were not statistically significant ($p > 0.05$). At 12 months, the proportion of teeth demonstrating both clinical and radiographic success was comparable between the IPC (83.3%) and DPC (80.0%) groups.

Conclusion: Both direct pulp capping (DPC) and indirect pulp capping (IPC) demonstrate comparable clinical success in deciduous teeth, with a non-significant trend favoring IPC.

Keywords: Direct pulp capping, indirect pulp capping, deciduous teeth.

INTRODUCTION

Preserving the natural tooth structure is essential for reasons that extend beyond aesthetics. Pain and infection are frequently caused by pulp exposure, whether from caries, trauma, or an unintentional lesion sustained during tooth preparation.[1,2] In pediatric dentistry, this issue is particularly critical in cases of early childhood caries.[3] Effective management of severely decayed primary teeth requires a thorough understanding of primary pulp biology[4], as these teeth play a crucial role in maintaining oral function, guiding the eruption of permanent teeth, and preserving arch integrity during key developmental stages. Despite significant progress in caries prevention, dental caries remains a widespread and persistent global health issue.[5] Its rapid progression frequently necessitates substantial reconstruction of affected teeth to enable conservative rehabilitation, avoiding premature extraction or prosthetic solutions.[6] Assessing the clinical status of the pulp beneath deep carious lesions remains challenging, making the diagnosis of pulp vitality

difficult.[7] Traditionally, the management of deep caries often resulted in pulp exposure and subsequent root canal treatment, presenting a clinical dilemma in pediatric dentistry, where choosing between conservative and invasive approaches requires careful judgment.[8]

For extensive caries in primary molars with signs of reversible pulpitis, three main vital pulp therapy options are commonly recommended: indirect pulp capping (IPC), direct pulp capping (DPC), and pulpotomy.[9,10] IPC preserves pulp vitality by leaving some affected dentin to avoid exposure during caries removal, while DPC involves the application of a biocompatible material directly over exposed pulp tissue to maintain its health and function.[11,12] Although the success of DPC was previously questioned due to early failures with calcium hydroxide, recent advancements in biocompatible materials with superior sealing ability and reduced cytotoxicity have renewed interest in this approach for primary teeth.[13-16] Conservative pulp therapies can reduce the need for invasive endodontic procedures; however, their success relies heavily on appropriate case selection and clinical expertise.

While both direct and indirect pulp capping are advocated as conservative options to preserve pulp vitality in primary teeth, there remains a lack of consensus on their comparative effectiveness in pediatric patients. Much of the current literature focuses on permanent dentition or evaluates these techniques independently, with limited head-to-head comparisons in deciduous teeth. Additionally, inconsistencies in materials, methodologies, and outcome assessments further hinder evidence-based clinical decision-making. Thus, the purpose of the study was to compare the outcomes of direct versus indirect pulp capping in deciduous teeth.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Dentistry at Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh, between January and December 2024. All eligible pediatric patients presenting during the study period and meeting the predefined inclusion criteria were consecutively recruited. A total of 42 patients were enrolled, contributing 60 primary molars requiring vital pulp therapy. The sample size was based on the number of eligible cases available during the study period, and all consecutive cases fulfilling the selection criteria were included. Participants were selected according to predefined inclusion and exclusion criteria.

Inclusion Criteria

- Children aged 3 to 7 years with at least one carious primary molar indicated for pulp capping.
- Teeth with deep carious lesions without signs of irreversible pulpitis or periapical pathology.
- Teeth with carious pulp exposure were allocated to the direct pulp capping (DPC) group, whereas teeth with deep carious lesions approximating the pulp without exposure were allocated to the indirect pulp capping (IPC) group.
- Teeth that were restorable following pulp capping treatment.
- Children whose parents or legal guardians provided written informed consent and agreed to comply with follow-up visits.

Exclusion Criteria

- Teeth showing clinical or radiographic evidence of irreversible pulpitis, pulp necrosis, or periapical/furcal pathology.
- Non-restorable teeth or those close to natural exfoliation.
- Children with systemic health conditions affecting healing or those uncooperative during treatment or follow-up.

All procedures were performed under standardized aseptic conditions. In the DPC group, a small pulp exposure was covered with a calcium hydroxide-based material, followed by restoration. In the IPC group, residual caries close to the pulp was left intentionally, covered with a biocompatible liner, and restored without pulp exposure. All restorations were completed in a single visit using appropriate restorative materials to ensure a good seal. Patients were followed up at 3, 6, and 12 months intervals for clinical and radiographic evaluations. Clinical success was defined as the absence of pain, swelling, sinus tract, or abnormal mobility, while radiographic success was determined by the absence of internal or external root resorption, furcation radiolucency, and periodontal ligament widening. Data were recorded and analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive and inferential statistics were applied. The Chi-square test was used to compare categorical variables, and a p-value <0.05 was considered statistically significant.

RESULTS

A total of 42 pediatric patients were enrolled in the study, with 21 patients allocated to the direct pulp capping (DPC) group and 21 patients to the indirect pulp capping (IPC) group. In the DPC group, 7 (33.3%) patients were male and 14 (66.7%) were female, whereas in the IPC group, 8 (38.1%) patients were male and 13 (61.9%) were female. The mean age of the patients was 4.35 ± 0.75 years in the DPC group and 4.55 ± 0.80 years in the IPC group. No statistically significant differences were observed between the two groups with respect to sex distribution or age (p > 0.05) (Table 1).

Table 1: Demographic characteristics of the study participants. (n =21)

Parameter	*DPC (%)	#IPC (%)	p-value
Male	7 (33.3%)	8 (38.1%)	0.75
Female	14 (66.7%)	13 (61.9%)	
Age (years), Mean ± SD	4.35 ± 0.75	4.55 ± 0.80	0.31

*DPC- direct pulp capping; #IPC- indirect pulp capping.

A total of 60 primary molars were included in the study, with 30 teeth allocated to the direct pulp capping (DPC) group and

30 teeth to the indirect pulp capping (IPC) group. In the DPC group, 18 (60.0%) teeth were first primary molars and 12 (40.0%) were second primary molars. In the IPC group, 11 (36.7%) teeth were first primary molars and 19 (63.3%) were second primary molars. Although first primary molars were more common in the DPC group and second primary molars were more common in the IPC group, the difference in tooth type distribution between the groups was not statistically significant (p =0.07) (Table 2).

Table 2: Characteristics of the treated primary molars. (n =30 teeth)

Parameter	*DPC (%)	# IPC (%)	p-value
First Primary Molar	18 (60.0%)	11 (36.7%)	0.07
Second Primary Molar	12 (40.0%)	19 (63.3%)	

*DPC- direct pulp capping; #IPC- indirect pulp capping.

The clinical success rates of DPC and IPC in deciduous teeth at 3, 6, and 12 months post-treatment showed that the IPC group had slightly higher success rates at all intervals—96.7% vs. 93.3% at 3 months, 93.3% vs. 86.7% at 6 months, and 90.0% vs. 83.3% at 12 months intervals. These differences were not statistically significant (p >0.05) (Table 3).

Table 3: Clinical success rates of direct and indirect pulp capping over time. (n = 30)

Time Interval	*DPC (%)	#IPC (%)	p-value
3 months	28 (93.3%)	29 (96.7%)	0.55
6 months	26 (86.7%)	28 (93.3%)	0.39
12 months	25 (83.3%)	27 (90.0%)	0.45

*DPC- direct pulp capping; #IPC- indirect pulp capping.

Radiographic success rates of DPC and IPC in primary teeth at 3, 6, and 12 months also favored IPC slightly—93.3% vs. 90.0% at 3 months, 90.0% vs. 83.3% at 6 months, and 86.7% vs. 80.0% at 12 months. However, these differences were not statistically significant (p >0.05) (Table 4).

Table 4: Radiographic success rates of direct and indirect pulp capping over time. (n = 30)

Time Interval	*DPC (%)	#IPC (%)	p-value
3 months	27 (90.0%)	28 (93.3%)	0.64
6 months	25 (83.3%)	27 (90.0%)	0.45
12 months	24 (80.0%)	26 (86.7%)	0.49

*DPC- direct pulp capping; #IPC- indirect pulp capping.

Overall success rates after 12 months showed that the IPC group had a slightly higher overall success rate of 83.3% compared to 80.0% in the DPC group. Although the IPC group demonstrated a favorable trend, the difference was not statistically significant (p = 1.00) (Table 5).

Table 5: Comparison of overall success between direct and indirect pulp capping. (n = 30)

Outcome	*DPC (%)	#IPC (%)	p-value
Clinically Successful	25 (83.3%)	27 (90.0%)	0.45
Radiographically Successful	24 (80.0%)	26 (86.7%)	0.49
Overall Success	24 (80.0%)	25 (83.3%)	1.00

*DPC- direct pulp capping; #IPC- indirect pulp capping.

DISCUSSION

This study compares the outcomes of direct and indirect pulp capping in deciduous teeth among pediatric patients treated at a tertiary care dental facility in Bangladesh. Vital pulp therapy in primary teeth is critical for preserving function and guiding permanent tooth eruption, particularly in cases of deep carious lesions. The findings reveal high clinical and radiographic success rates for both techniques, with slightly better outcomes observed in the IPC group. These results reinforce the relevance of conservative pulp treatments and emphasize the importance of appropriate case selection and follow-up in achieving favorable long-term outcomes in pediatric dental care.

In this study comparing direct and indirect pulp capping in deciduous teeth, the mean age of participants was similar between groups (4.35 ± 0.75 years for DPC and 4.55 ± 0.80 years for IPC), aligning with Moselhy et al.[16], who reported a comparable age range for children undergoing pulp therapy. A female predominance was observed in both groups, consistent with their findings. First primary molars were more frequently treated in the DPC group (60.0%), while second molars were more common in the IPC group (63.3%), reflecting a similar distribution pattern noted by Moselhy et al.[16] These parallels in age, gender, and tooth type support the representativeness of our sample and strengthen the basis for comparing the clinical outcomes of the two pulp capping techniques.

In the present study, the IPC group consistently showed slightly higher clinical success rates compared to the DPC group at all follow-up intervals, 96.7% compared to 93.3% at 3 months, 93.3% compared to 86.7% at 6 months, and 90.0% compared to 83.3% at 12 months, though these differences were not statistically significant (p >0.05). This trend aligns with the findings of Wassel et al.[17], who also reported superior clinical outcomes with IPC compared to the DPC in primary teeth. The higher success rates observed with IPC may be attributed to its less invasive nature and reduced risk of pulpal exposure, contributing to better preservation of pulpal vitality over time. These findings reinforce IPC as a reliable and effective

alternative to DPC in the management of deep carious lesions in deciduous teeth.

In the current study, IPC demonstrated consistently higher radiographic success rates compared to DPC at all time points, 93.3% vs. 90.0% at 3 months, 90.0% vs. 83.3% at 6 months, and 86.7% vs. 80.0% at 12 months, though the differences were not statistically significant. These findings are in agreement with those reported by Wassel et al.[17] and Moselhy et al.[16], both of whom observed superior radiographic outcomes with IPC compared to DPC group in primary teeth. The improved performance of IPC may be attributed to its conservative approach and reduced risk of pulpal inflammation or exposure, contributing to more favorable periapical healing over time. This supports the growing preference for IPC as a reliable technique for managing deep caries in deciduous dentition.

In the present study, IPC demonstrated a slightly higher overall success rate (83.3%) compared to DPC (80.0%), although the difference was not statistically significant. These findings are in line with those reported by Casagrande et al.[18], who observed high long-term clinical and radiographic success rates of indirect pulp treatment in primary teeth over a 4-year follow-up period. Similarly, Sahin et al.[19] highlighted the consistent success of IPC in primary teeth, regardless of the pulp-capping agent used. The favorable outcomes associated with IPC in our study reinforce its reliability as a conservative approach for managing deep carious lesions in deciduous dentition.

Limitations of the study

This study had some limitations:

- Although the study included 12-month follow-up, longer observation is needed to assess the longevity and late failures of the treatments.
- The study was conducted in a selected tertiary-level hospital.
- The sample was not randomly selected.

CONCLUSION

This study found that both direct and indirect pulp capping in deciduous teeth demonstrate comparable clinical and radiographic success rates over a 12-month period. Although indirect pulp capping showed a slightly higher success trend, the differences were not statistically significant, indicating that both techniques are similarly effective in preserving pulpal health in primary molars.

CONFLICT OF INTEREST

The authors declared no conflicts of interest to disclose.

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This research received no external funding.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on reasonable request from the corresponding author.

REFERENCES

1. Hilton TJ. Keys to clinical success with pulp capping: a review of the literature. Oper Dent. 2009 Sep-Oct;34(5):615-25. doi: 10.2341/09-132-0.
2. Bailleul L, Ceballos L, Doméjean S, Fuentes V. Deep caries and pulp exposures management preferences in permanent teeth: a survey amongst Spanish dentists. Int Endod J. 2025 Feb;58(2):239-256. doi: 10.1111/iej.14159.
3. Kaur N, Srivastava N, Rana V, Kaushik N, Pruthi T, Kankerwal A, et al. Prevalence of early childhood caries among children visiting the outpatient department of a dental hospital in meerut city: an institutional-based cross-sectional study. Cureus. 2024 Dec 3;16(12):e75067. doi: 10.7759/cureus.75067.
4. Smaïl-Faugeron V, Glenny AM, Courson F, Durieux P, Muller-Bolla M, Fron Chabouis H. Pulp treatment for extensive decay in primary teeth. Cochrane Database Syst Rev. 2018 May 31;5(5):CD003220. doi: 10.1002/14651858.CD003220.pub3.
5. Nagdeo KP. The missing piece in chronic disease prevention: dental caries. Prev Chronic Dis. 2025 Aug 7;22:E48. doi: 10.5888/pcd22.250130. PMID: 40774669; PMCID: PMC12335307.
6. Oral Health in America: Advances and Challenges [Internet]. Bethesda (MD): National Institute of Dental and Craniofacial Research (US); 2021 Dec. Section 2A, Oral Health Across the Lifespan: Children. Available from: https://www.ncbi.nlm.nih.gov/books/NBK578299/
7. Asl Aminabadi N, Haji Abbas Oghli F, Mohammadzadeh S, Jamali Z. Correlation between Clinical manifestations, radiographic findings, and operative diagnosis of pulpal status in primary molars in 4–8-year-old children: A cross-sectional study. J Dent Res Dent Clin Dent Prospects. 2025 Sep 30;19(3):185-92. doi: 10.34172/joddd.025.42755.
8. Kunert M, Lukomska-Szymanska M. Bio-Inductive Materials in Direct and Indirect Pulp Capping-A Review Article. Materials (Basel). 2020 Mar 7;13(5):1204. doi: 10.3390/ma13051204.
9. American Academy of Pediatric Dentistry. Pulp therapy for primary and immature permanent teeth. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: Am Acad Pediatr Dent. 2021;399407.
10. Bjørndal L, Simon S, Tomson PL, Duncan HF. Management of deep caries and the exposed pulp. Int Endod J. 2019 Jul;52(7):949-73. doi: 10.1111/iej.13128.
11. Alovisi M, Baldi A, Comba A, Gamerro R, Paolone G, Mandurino M, et al. Long-term evaluation of pulp vitality preservation in direct and indirect pulp capping: a retrospective clinical study. J Clin Med. 2024;13(13):3962. https://doi.org/10.3390/jcm13133962.
12. Drouri S, El Merini H, Sy A, Jabri M. Evaluation of direct and indirect pulp capping with biodentine in vital permanent teeth with deep caries lesions. Cureus. May 202315(5):e39374. doi:10.7759/cureus.39374.

13. Garrocho-Rangel A, Esparza-Villalpando V, Pozos-Guillen A. Outcomes of direct pulp capping in vital primary teeth with cariously and non-cariously exposed pulp: a systematic review. Int J Paediatr Dent. 2020 Sep;30(5):536-546. doi: 10.1111/ipd.12633.

14. Ravi GR, Subramanyam RV. Calcium hydroxide-induced resorption of deciduous teeth: A possible explanation. Dental Hypotheses. 2012 Jul 1;3(3):90-4. doi: 10.4103/2155-8213.103910.

15. Aminabadi NA, Huang B, Samiei M, Agheli S, Jamali Z, Shirazi S. A randomized trial using 3mixtatin compared to MTA in primary molars with inflammatory root resorption: a novel endodontic biomaterial. J Clin Pediatr Dent. 2016;40(2):95-102. doi: 10.17796/1053-4628-40.2.95.

16. Moselhy YH, Elghazawy RK, Wassel MO. Clinical and radiographic evaluation of indirect and direct pulp capping in primary molars using TheraCal (LC): a randomized clinical trial. Egypt Dent J. 2022 Oct 1;68(4):3065-76. doi: 10.21608/edj.2022.149702.2188.

17. Wassel M, Hamdy D, Elghazawy R. Evaluation of four vital pulp therapies for primary molars using a dual-cured tricalcium silicate (TheraCal PT): one-year results of a non-randomized clinical trial. J Clin Pediatr Dent. 2023 Mar;47(2):10-22. doi: 10.22514/jocpd.2023.004.

18. Casagrande L, Bento LW, Dalpian DM, García-Godoy F, de Araujo FB. Indirect pulp treatment in primary teeth: 4-year results. Am J Dent. 2010 Feb;23(1):34-8. PMID: 20437725.

19. Sahin N, Saygili S, Akcay M. Clinical, radiographic, and histological evaluation of three different pulp-capping materials in indirect pulp treatment of primary teeth: a randomized clinical trial. Clin Oral Investig. 2021 Jun;25(6):3945-3955. doi: 10.1007/s00784-020-03724-4.

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