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Outcomes of Hall Technique and Conventional Stainless Steel Crowns in Primary Molars Caries Management: A Scoping Review

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ABSTRAK

Stainless steel crowns (SSC) are widely used in the management of carious primary molars. The Hall Technique (HT) has emerged as a minimally invasive alternative that avoids local anesthesia and caries removal. However, evidence regarding the outcomes of HT compared to conventional SSC (CSSC) placement remains varied. This scoping review aims to map the available evidence on the clinical, radiographic, and patient-related outcomes of the Hall Technique and conventional stainless steel crowns in the management of carious primary molars. A scoping review was conducted following the PRISMA-ScR guidelines using the Population–Concept–Context (PCC) framework. Electronic searches were performed in PubMed, Scopus, and EBSCOhost for articles published between 2014 and 2024. Studies reporting outcomes of HT and/or conventional SSCs (CSSCs) in primary molars were included. Data were charted and synthesized descriptively. Seven studies met the inclusion criteria, comprising randomized controlled trials and observational studies conducted in various clinical settings. The included studies reported favorable clinical and radiographic outcomes for both HT and conventional SSC (CSSC), with variations in follow-up duration, outcome measures, and study design. Patient-related outcomes such as discomfort and acceptability were inconsistently reported. The available evidence indicates that both the Hall Technique and conventional stainless steel crowns demonstrate favorable outcomes in managing carious primary molars. However, heterogeneity in study designs and outcome measures highlights the need for further research with standardized reporting and longer follow-up periods.

Kata Kunci: *Hall technique; Dental caries; Stainless steel crowns; Primary molars; Children*

INTRODUCTION

Dental caries is a biofilm-mediated, sugar-driven, multifactorial, and dynamic disease that results in the phasic demineralization and remineralization of dental hard tissues (Pitts et al., 2017). It is one of the most widespread medical conditions affecting both adults and children (Sztyler et al., 2022). Worldwide, approximately 2 billion people are estimated to have caries in their permanent teeth, while 514 million children are affected by caries in their primary teeth (World Health Organization, 2024).

Restorative management of carious primary molars includes the use of filling materials as well as preformed crowns (PMCs). Stainless steel crowns are widely used and have been reported to demonstrate favorable clinical outcomes, particularly in primary molars requiring post-pulp therapy or management of multisurface carious lesions (Chua et al., 2023). Conventional stainless steel crowns involves carious tissue removal and tooth preparation to allow crown placement, typically performed under local anaesthesia (Innes et al., 2015).

The management of carious primary molars has evolved over time, shifting from traditional approaches involving complete caries removal toward biologic or minimally invasive techniques that emphasize limited or no caries removal prior to restoration placement (Banerjee et al., 2017; Desai et al., 2021; Giacaman et al., 2018; González-Gil et al., 2024; Innes et al., 2019). One notable development in stainless steel crown placement is the Hall technique (HT). Introduced in 2006, the Hall technique involves placing a preformed stainless steel crown over a caries-affected primary molar by sealing the lesion beneath the crown using

glass ionomer luting cement. This technique does not require local anaesthesia, tooth preparation, or carious tissue removal (Seale & Randall, 2015; Innes et al., 2017).

Since the introduction of the Hall technique as a minimally invasive approach to preformed metal crown placement, numerous studies have reported a variety of clinical, radiographic, and patient-related outcomes. However, the existing evidence remains heterogeneous in terms of study design, outcome measures, and follow-up duration. This heterogeneity presents a significant challenge for clinicians and policymakers in determining the most appropriate restorative approach for carious primary molars. Furthermore, despite the increasing adoption of the Hall technique in various clinical settings, there is no comprehensive mapping of the available evidence that systematically compares outcomes between the Hall technique and conventional stainless steel crowns. This gap is particularly urgent given the global burden of early childhood caries and the need for evidence-based, child-friendly treatment approaches that minimize patient discomfort while ensuring optimal clinical outcomes. Without a clear synthesis of existing evidence, clinical decision-making may rely on anecdotal experience or fragmented research findings, potentially compromising the quality of care provided to pediatric patients (Boland et al., 2019; Lipstein et al., 2015; Popejoy et al., 2017; Shay & Lafata, 2015; Thompson et al., 2023).

Therefore, this scoping review aims to map the available literature on outcomes associated with the Hall technique and conventional stainless steel crowns in primary molars, identify patterns in outcome reporting, and highlight gaps to inform future research. The benefits of this research are to provide a comprehensive overview of existing evidence for clinicians in selecting appropriate treatment options, to identify research gaps for future investigations, and to contribute to the development of evidence-based guidelines in pediatric dentistry.

METHODS

This scoping review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. The Population-Concept-Context (PCC) framework was used to guide the review question, which was formulated as: "*What outcomes have been reported for the Hall Technique and conventional stainless steel crowns in the management of carious primary molars?*".

Table 1. PCC framework

PCC	Description of detail
Population (P)	Children with carious primary molars
Concept (C)	Reported clinical, radiographic, and patient-related outcomes of the Hall technique (HT) and conventional stainless steel crowns (CSSC)
Context (C)	Clinical management of primary molar caries

Source: Developed by the author based on the Population-Concept-Context (PCC) framework as recommended by the Joanna Briggs Institute (JBI) for scoping reviews

Electronic database searches were conducted in PubMed, Scopus, and EBSCOhost for articles published from 2014 to 2024. The search strategy used Boolean operators and keywords including "Hall technique", "stainless steel crown", "primary molars", and "children". A manual search of Google Scholar was also performed to identify additional relevant studies. The study selection process is illustrated in the PRISMA-ScR flow diagram (Figure 1).

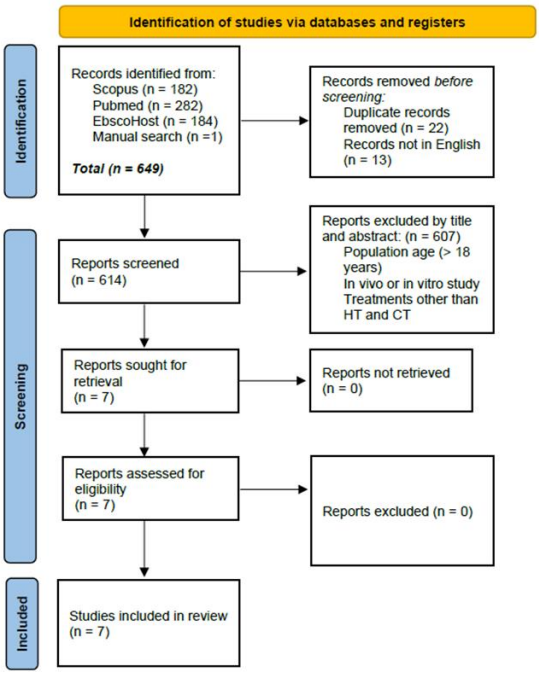

Figure 1. PRISMA-ScR flow diagram for scoping review
Source: Generated by the author based on the study selection process conducted in this scoping review, following the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) guidelines

The following inclusion criteria included: (1) Studies involving children with carious primary molars; (2) Studies reporting outcomes of the Hall Technique and/or conventional stainless steel crowns; (3) Clinical, radiographic, or patient-related outcomes; (4) Original research articles published in peer-reviewed journals; (5) Articles published in English. Meanwhile, the exclusion criteria included: (1) Studies involving adult populations; (2) Primary molar defects due to trauma or developmental conditions unrelated to caries; (3) Other restorative treatments; (4) In vitro studies, case reports, reviews, and conference abstracts; (5) Non-English publications.

The study selection process involved a two-stage screening approach. In the first stage, titles and abstracts of all retrieved records were screened based on the predefined eligibility criteria. Full-text articles were subsequently assessed when eligibility could not be determined from the title or abstract alone. Any discrepancies during the selection process were resolved through discussion and consensus. The overall study selection followed the PRISMA-ScR guidelines.

Data charting was conducted using a standardized extraction form. Extracted data included author, year of publication, study design, country of origin, sample characteristics, intervention details, outcomes assessed, and key findings. The extracted data were synthesized descriptively to map the available evidence on the Hall Technique and conventional stainless steel crowns in primary molars.

RESULTS AND DISCUSSION

The initial database search identified 649 records. After removal of duplicates, 614 articles remained for title and abstract screening. Following full-text assessment, seven studies met the inclusion criteria and were included in this scoping review. The study selection process is summarized in the PRISMA-ScR flow diagram. The included studies were published between 2014 and 2024 and comprised randomized controlled trials and observational studies

conducted across different countries (New Zealand, Nigeria, UAE, USA, Iran, Sudan, and Egypt) and clinical settings.

Considerable heterogeneity was observed across the included studies in terms of study design, follow-up duration, outcome definitions, and reporting practices. Baseline participant characteristics, including sex distribution, were inconsistently reported. Overall, the studies reported generally favorable clinical outcomes for both the Hall Technique (HT) and conventional stainless steel crowns (CSSC) in the management of carious primary molars, with no consistent pattern suggesting marked differences between the two approaches. Patient-centered outcomes such as post-treatment pain or discomfort were reported in only a limited number of studies, limiting comparative interpretation.

Table 2. Summary of Studies Included in the Reviewer

No.	Author, Year	Study design	Country of Origin	Participants	Treatment	Follow-up (months)	Key Outcomes	Conclusion
1.	Boyd et al. (2020)	RCT	New Zealand	570 teeth from 295 children (157 males, 138 females; 3-8 years old)	HT (n = 273) CSSC (n = 177)	12 and 24	The SSC group (regardless of treatment group) had only 26 major failures by 24 month. Higher success rate in the HT group in lesions with caries depth record as P4 at baseline	HT is a viable alternative to CSSC; both yield favorable clinical outcomes. Direct restorations (e.g., GIC) tend to have higher rates of minor failure.
2.	Ayedun et al. (2021)	Split-mouth RCT	Nigeria	50 teeth from 23 children (6 males, 17 females; 3-8 years old)	HT (n = 25) CSSC (n = 25)	3, 6, 9, and 12	No significant differences between HT and CSSC in major/minor failures or radiographic outcomes; HT had significantly shorter chair time (mean ~4.6 min) vs conventional (~28.3 min), p=0.01	Over 12 months, HT performed comparably to CSSC on clinical and radiographic outcomes, with significantly shorter chair time, supporting HT as an effective, child-friendly option, especially in resource-limited settings.
3.	Binladen et al. (2019)	Retrospective cohort	UAE	187 teeth from 65 children (34 females, 31	HT (n = 110) CSSC (n = 77)	6, 8, 12 and 24	At 24 months, success was HT 97.6% (82/84) vs CSSC 93.5%	Both HT and conventional PMCs achieved high clinical and

No.	Author, Year	Study design	Country of Origin	Participants	Treatment	Follow-up (months)	Key Outcomes	Conclusion
				males; 3-14 years old)			(58/62); no difference at 12 months, but 24-month success favored HT (p=0.002) with similar survival times (log-rank p=0.176). Failures: HT 2 (2.4%) vs CSSC 4 (6.5%).	radiographic success; HT showed slightly higher 24-month success, while overall survival time was comparable
4.	Ludwig et al. (2014)	Retrospective study	USA	184 teeth from 95 children (2-10 years old)	HT (n = 67) CSSC (n = 117)	HT: 4-37 months CSSC: 4-119 months	Success: HT 97% (65/67) vs traditional 94% (110/117). Failures were rare (mainly abscess; a few retention losses), mostly within the first 2 years.	HT and traditional SSC placement both achieved high clinical/radiographic success with comparable survival; larger prospective RCTs are needed to define comparative effectiveness.
5.	Ebrahimi et al. (2020)	RCT	Iran	123 teeth from 123 children (4-9 years old)	HT (n = 42) CSSC (n = 39)	6 and 12	No significant differences in clinical/radiographic failures between HT and SSC; HT required less chair time (~8.4 vs 17.3 min; p < 0.001); child discomfort similar, dentist-rated behavior favored SSC. Occlusal changes after HT regressed toward baseline by 6–12 months.	HT achieved outcomes comparable to SSC with significantly shorter treatment time; both were well accepted by parents, supporting HT as an efficient alternative in primary molar caries management.

No.	Author, Year	Study design	Country of Origin	Participants	Treatment	Follow-up (months)	Key Outcomes	Conclusion
6.	Elamin et al. (2019)	RCT	Sudan	212 teeth from 164 children (107 male, 105 female; 5-8 years old)	HT (n = 109) CSSC (n = 103)	6, 12, 18, and 24	HT showed lower mean procedure time (9.1 min) than CSSC (33.9 min); p<0.001, lower postoperative anxiety at immediate and 12-month checks (p<0.001), lower minor failure rate (2.7% vs 5.8%), and better cost-effectiveness in HT (CSSC cost +ICER ≈ $136.56 per survival year).	HT performs comparably to CSSC on survival but with substantially less chair time, lower anxiety, and lower cost, supporting HT as an efficient option in resource-limited settings.
7.	Sharaf et al. (2021)	RCT	Egypt	104 children (51 female, 53 male; 4-8 years old)	HT (n = 52) CSSC (n = 52)	1 week, 1, 6, and 12	At 1 week, 1, 6, and 12 months, no significant clinical or radiographic differences between HT and CSSC. 12-month success: 94.2% (HT) vs 88.5% (CSSC); observed failures were mainly major in both groups.	HT is comparable to CSSC over 12 months for carious primary molars not pulpally involved, supporting HT as a minimally invasive alternative.

Source: Compiled by the author from studies identified through systematic searches in PubMed, Scopus, and EBSCOhost (2014-2024) that met the inclusion criteria for this scoping review

*RCT = Randomized Controlled Trial; HT = Hall Technique; CSSC = Conventional Stainless Steel Crowns

This scoping review mapped the existing literature published over the past decade on the Hall Technique and conventional stainless steel crowns for carious primary molars. Seven studies met the inclusion criteria, representing a mix of randomized controlled trials and observational clinical studies conducted in different practice settings (Boyd et al., 2021; Ayedun et al., 2021; Binladen et al., 2021; Ludwig et al., 2014; Ebrahimi et al., 2020; Elamin et al., 2019; Sharaf et al., 2021).

Rather than forming a uniform body of evidence, these studies varied widely in their objectives, outcome selection, and duration of follow-up. Most investigations concentrated on clinical success or crown performance, while fewer extended their assessment to patient-related or behavioral outcomes. This pattern suggests that research in this field remains largely exploratory, with limited convergence toward standardized evaluation approaches.

Clinical Outcomes and Caries Progression

Across the included studies, favorable clinical outcomes were reported for both the Hall Technique and conventional stainless steel crowns. Observational studies by Ludwig et al. and Binladen et al. described high crown survival rates and limited evidence of caries progression during the reported follow-up periods, suggesting that both approaches can perform well in routine clinical settings (Binladen et al., 2021; Ludwig et al., 2014). However, outcome assessment in these studies was largely descriptive, which limits detailed comparison.

Similar trends were observed in randomized controlled trials. Studies by Boyd et al., Ayedun et al., Ebrahimi et al., Elamin et al., and Sharaf et al. did not demonstrate a consistent or clinically meaningful difference between the two techniques with respect to caries progression or overall treatment success (Boyd et al., 2021; Ayedun et al., 2021; Ebrahimi et al., 2020; Elamin et al., 2019; Sharaf et al., 2021). However, direct comparison across studies remains challenging. Outcome definitions and assessment methods varied substantially, with some studies relying primarily on clinical evaluation, while others incorporated radiographic findings or indirect indicators of failure. Consequently, comparable success rates across studies should be interpreted with caution and should not be regarded as definitive evidence of equivalence.

Post-Treatment Symptoms and Patient-Centered Outcomes

In contrast to clinical performance, patient-centered outcomes were addressed in a more limited and inconsistent manner. Only a small number of studies explicitly reported post-treatment symptoms such as pain, discomfort, or complications, most notably those by Ebrahimi et al., Ayedun et al., and Boyd et al. (Boyd et al., 2021; Ayedun et al., 2021; Ebrahimi et al., 2020). These studies provided additional insight into child behavior, treatment tolerance, or immediate post-operative experience.

Several other studies focused primarily on clinical or radiographic outcomes without detailed consideration of patient experience, as stated in studies by Ludwig et al., Elamin et al., Binladen et al., and Sharaf et al. (Binladen et al., 2021; Ludwig et al., 2014; Elamin et al., 2019; Sharaf et al., 2021). Given that cooperation, comfort, and acceptability are central to treatment success in pediatric dentistry, the limited attention to patient-related outcomes represents a notable gap. This gap restricts meaningful comparison of minimally invasive techniques, particularly those designed to improve the clinical experience of young or anxious children.

Biological Rationale and Clinical Considerations of the Hall Technique

The Hall Technique is frequently framed within a biological approach to caries management, with several studies emphasizing lesion sealing as a means of interrupting cariogenic biofilm activity (Boyd et al., 2021; Ludwig et al., 2014). This concept aligns with contemporary views of caries as a biofilm-mediated disease rather than a condition requiring complete removal of affected tissue.

From a practical standpoint, the avoidance of local anesthesia, tooth preparation, and caries removal may influence treatment delivery in pediatric settings. Studies incorporating behavioral or patient-related observations suggest that these features may affect treatment acceptance, particularly in younger or anxious children (Boyd et al., 2021; Ebrahimi et al., 2020). Nevertheless, because such outcomes were not routinely assessed across studies, the clinical relevance of these procedural advantages cannot be consistently evaluated within the current evidence base.

Limitations and Evidence Gaps

Several methodological limitations emerged during evidence mapping. Reporting of baseline participant characteristics, including sex distribution, was inconsistent, with some studies providing limited demographic detail (Ludwig et al., 2014; Ebrahimi et al., 2020). This limits assessment of population comparability and may influence interpretation of outcomes.

In addition, follow-up duration and outcome definitions varied considerably across studies, reducing opportunities for synthesis beyond descriptive comparison. Long-term outcomes and patient-centered measures were rarely reported. Addressing these gaps through clearer reporting standards, standardized outcome measures, and longer observation periods would strengthen future research and contribute to a more robust understanding of restorative approaches for carious primary molars.

CONCLUSION

This scoping review mapped the existing literature on outcomes associated with the Hall Technique and conventional stainless steel crowns in the management of carious primary molars. The available evidence suggests that both approaches are generally associated with favorable clinical and radiographic outcomes. However, considerable heterogeneity was observed in study design, outcome measures, and follow-up duration across the included studies. Patient-related outcomes were inconsistently reported, and long-term evidence remains limited. These findings highlight important gaps in the current literature and underscore the need for future studies employing standardized outcome definitions, longer follow-up periods, and greater emphasis on patient-centered outcomes to better inform clinical practice and research in pediatric dentistry. Based on these findings, it is recommended that future research prioritize multicenter randomized controlled trials with standardized outcome measures and minimum follow-up of 24 months, while clinicians may consider both techniques as viable options depending on patient cooperation, clinical setting, and resource availability, with the Hall Technique offering advantages in terms of reduced chair time and improved child comfort.

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