

Comparison of the Hall Technique and Conventional Compomer Restorations: A 60-Month Follow-up

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ABSTRACT

Objective: The Hall Technique is one biological strategy for sealing carious lesions with preformed metal crowns in primary molars. This study aimed to compare the Hall Technique's survival rate with conventional compomer restorations in caries management in primary molars for 60 months.

Methods: Children with preformed metal crowns placed with Hall Technique and conventional compomer restorations were invited to Pediatric Dentistry Clinics for a 60-month follow-up. The restorations of these children were evaluated clinically and radiographically. Dental health records of 12 and 24-month follow-up appointments were obtained from the electronic archive. The survival rate of the restorations was evaluated by Kaplan-Meier analysis and the success/failure of the restorations by the Chi-Square test. Restorations with finding such as secondary caries, pulpitis, restoration wear/fracture/loss, crown perforation, inter-radicular radiolucency, and internal root resorption were scored according to major and/or minor failure criteria, while satisfactory ones were scored as successful.

Results: Twenty-six primary molars were included in the study. There was no significant difference in the survival rates of preformed metal crowns placed with the Hall Technique (92.3%) and conventional compomer restorations (84.6%) at 60-month follow-up ($\chi^2 = 2.455$, $p = .48$). The Hall Technique (84.6%) was found significantly more successful clinically and radiographically compared to conventional compomer restorations (23.1%) according to the success or failure criteria in 60-month follow-up ($p < .01$).

Conclusion: The Hall Technique was clinically and radiographically more successful than conventional compomer restorations according to the success or failure criteria at 60-month follow-up. The Hall Technique had a similar survival rate to the conventional compomer restorations as well as low failure findings in caries management in primary molars.

Keywords: Carious dentin, dental caries, Hall Technique, pediatric dentistry, primary molars

1. INTRODUCTION

Cavitated carious lesions are an increasing and constant problem, especially in developing countries (1). The conceptual framework regarding the ideal management of carious lesions changed in the last decades (2). Current guidelines recommend combined techniques that have more preventive and less restorative treatment for the treatment of carious lesions in primary teeth (3,4). Conventional restorative techniques have been replaced by less invasive biological approaches that control the cariogenicity of the biofilm and caries (5).

Hall Technique (HT) is a treatment approach introduced by Dr. Norna Hall, which has the biological approach philosophy and includes sealing caries with preformed metal crowns (PMCs) (6). It is a low-tech option for managing early and moderately active carious lesions in primary molars without any signs or symptoms of pulp involvement (7,8). Food residues and debris are removed from the tooth without local anesthesia, caries excavation, or tooth preparation. The appropriate size PMC is cemented to the tooth (6). When the carious lesion is sealed under PMCs, the caries progression in primary

teeth may arrest or at least slowdown, and the carious primary teeth may be preserved until exfoliation (9,10). During the COVID-19 pandemic, international guidelines have also recommended minimizing aerosol generation procedures to reduce the risk of viral cross-infection. The Hall Technique, one of the biological caries management techniques recommended for this purpose and has a strong recommendation quality, has become more popular (11).

In conventional procedures, if sufficient resistance and retention can be achieved for the success of the restoration after complete caries removal, primary molars can be treated with restorative materials such as resin-modified glass-ionomer cement, resin-based composite, and compomer. In cases where the carious lesion is more extensive, conventional PMCs that require extra tooth preparation can be applied instead of intracoronal restorations (12). Since intracoronal restorative techniques are more sensitive, they may require general anesthesia or sedation depending on the cooperation of the children (13).

Hall Technique is more acceptable than conventional restorations by children and parents for reasons such as causing less anxiety in children, and no need to local anesthesia and drilling (14). Also, the effect of the technique is evident in primary teeth, consistent with studies of the biological approach in managing caries (6). A randomized controlled trial reported that major failure at 23 months was 2% in the Hall Technique and 15% in conventional restorations (14). It also reported a 95% survival rate after 12 months (15) and 73% after 36 months for the Hall Technique (7). Although this technique has been reported to be more successful and acceptable by children and parents, general dental practitioners do not routinely prefer PMCs in their clinical practice (16,17). It was shown that 92.3% of 709 pediatric dentists knew about the Hall Technique, but only 50.6% of them applied it (18).

To date and the best of our knowledge, there are no studies evaluating the survival rate of the Hall Technique for 60 months in comparison to the conventional compomer restoration of primary molars. The primary outcome of this study was the survival rates of conventional compomer restorations compared to the Hall Technique in carious primary molars. The null hypothesis tested was that there was no statistical difference in the survival rate between primary molars restored with the Hall Technique and conventional compomer restorations. The secondary outcomes of the study were the success and failure rates of both treatment techniques.

2. METHODS

2.1. Study Subjects

The Clinical Research Ethics Committee of the Marmara University, Faculty of Dentistry gave study approval (Date: 23.12.2019 /Protocol no: 2019-361). The study was registered in the ClinicalTrials.gov under the identification number NCT04818658. The study was conducted in accordance with the principles of medical research involving human subjects described by the Declaration of Helsinki.

The present study is a cohort study evaluating clinical and radiological follow-up of treated primary molars with two different techniques including the Hall Technique and conventional compomer restorative treatments in the Pediatric Dentistry Clinics, Faculty of Dentistry, Marmara University.

First, dental health records in the electronic archive between January 2016 and January 2017 were scanned by the dental software program (Uni-Dis, SDD, Istanbul, Turkey) in March 2021 and 16 children were found that their primary molars treated with the Hall Technique. Of them, 14 children had also conventional compomer restorations in primary molars. A total of 8 children with 26 teeth met the following inclusion criteria (Figure 1): children who were aged five to eight years at the time of dental treatment; had primary molars treated with both Hall Technique and conventional compomer

restoration; had primary molars with matching caries sizes in radiographic caries scoring for both techniques in the initial indications (Hall Technique = conventional compomer restoration = 2 or 3); have available records for both 12 and 24-month and agree to come 60-month follow-ups. The children were invited to the Pediatric Dentistry Clinics for their approximately 60-month follow-up appointment.

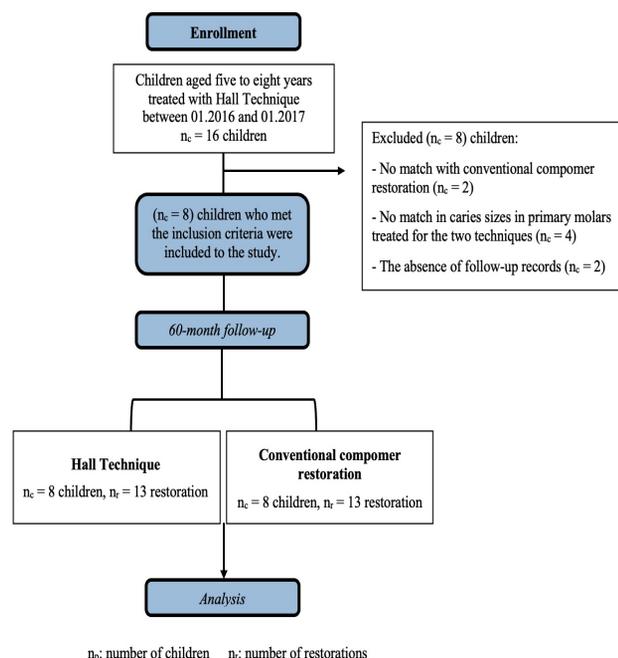


Figure 1. The flowchart diagram presenting the procedure for selecting primary molars for the study

The parents and their children who came to the follow-up appointment participated in the study voluntarily and accepted the informed consent verbally and in writing were selected for the study. Baseline radiographs were examined in terms of the extent of the carious lesion and the absence of pathology in the inter-radicular region (follicle of the successional permanent tooth was assessed in terms of differential diagnosis) by a well-trained pediatric dentist (B.S.Y.) under the supervision of the study director (B.K.). Evaluation of the extent of caries was done by modifying the following radiographic criteria: 0: no radiolucency; 1: radiolucency at the enamel-dentin junction; 2: radiolucency in the outer half of dentin; and 3: inner half of radiolucent dentin (19). The treated molars were classified as score 2 or 3 based on the initial dental record.

The sample size was calculated based on the study of de Menezes Abreu et al. (20) 24 teeth (12 teeth for each group) were calculated to be necessary to obtain the power $(1 - \beta)$ of the test of 85% in the 95% confidence $(1 - \alpha)$ interval.

2.2. Treatment Procedures

Hall Technique procedures have been performed and recorded in the Department of Pediatric Dentistry since the

publication of a treatment protocol by Innes et al. in 2015 (17). PMCs placed using the Hall Technique were cemented at a single visit and no orthodontic elastic was used in any crown. GC Fuji TRIAGE® (GC America, Alsip, IL, USA) glass ionomer cement was used for the cementation of 3M™ ESPE™ Preformed Metal Crowns (3M ESPE, St Paul MN, USA).

For conventional compomer restorations, the infected carious tissue is completely cleaned with a rubber dam, and local anesthesia is applied if necessary. Glasiosite (Voco, Cuxhaven, Germany) compomer was used in conventional restoration.

The children were invited to the control visit and the teeth included in the study were evaluated clinically and radiographically at each follow-up appointment by the same pediatric dentist (B.S.Y.) with four years of clinical experience under the supervision of the study director (B.K.) according to the success or failure criteria reported by Innes et al. (14). Restorations are considered successful if restoration is satisfactory, no additional treatment required, no clinical signs and symptoms of pulpal pathology or exfoliated tooth. Minor failures include restoration wear/fracture/loss (restorable) or crown perforation, secondary caries or new caries, reversible pulpitis treated without requiring extraction or pulpotomy. Major failures include broken tooth down (unrestorable), inter-radicular radiolucency or internal root resorption, signs or symptoms of irreversible pulpitis requiring extraction or pulpotomy.

Moreover, the occlusal vertical dimensions of the children were evaluated pre-treatment, post-treatment, and after 24 months by modifying a previously described technique (21). On the Hall Technique side, with Image J Version 1.42q (NIH, USA) software, a line parallel to the occlusal plane was drawn from the upper canine cusp tip on the lower canine, and the distance of this line to the gingival zenith point of the lower canine was measured. It was noted whether the increase in this distance after 24 months returned to its initial status.

In the survival analysis, the restorations were assessed as successful or failure. Primary molars that did not show major failure were considered to survive.

2.3. Statistical Analyses

Statistical analysis was performed with SPSS for Windows version 22.0 (SPSS Inc., Chicago, IL, USA) and MedCalc statistical software version 19.8 (MedCalc Software Ltd, Ostend, Belgium). Relationships between categorical variables were tested with the Chi-Square (χ^2) test. Bonferroni correction was performed when comparing the success rates of the two groups. The Kaplan-Meier survival analysis using a Mantel-Cox log-rank model was carried out with 95 percent confidence intervals (CI) to evaluate the survival time for each group. The difference between survival curves was determined using the log-rank test. The significance level was assumed at .05.

3. RESULTS

3.1. Study Population Characteristics

The mean age of the children was 6.23 years (standard deviation (SD): ± 0.72). The number of boys and girls was equal. Fifteen of these restorations were performed on the first primary molar and 11 were on the second primary molar (Table 1). All restorations were placed by the same pediatric dentist (B.S.Y.). It was also observed that all treated teeth had dentin caries involving at least 2 surfaces at the beginning of their treatment. The mean of the total follow-up period of the restorations was 59.8 months (SD: ± 3 ; between 52 to 62 months).

Table 1. Distribution of tooth types at baseline per treatment groups

		Hall Technique		Conventional Compomer	
		n	(%)	Restoration n	(%)
Initial	Maxillary first molar (n = 8)	3	(23.1)	5	(38.5)
	Maxillary second molar (n = 6)	4	(30.8)	2	(15.4)
	Mandibular first molar (n = 7)	2	(15.4)	5	(38.5)
	Mandibular second molar (n = 5)	4	(30.8)	1	(7.7)
		$\chi^2 = 0.846$		$\chi^2 = 3.923$	
		$p = .83$		$p = .27$	
$\chi^2 = \text{Chi-square}; * = p < .05$					

3.2. Clinic and Radiographic Assessment

The 12-month, 24-month, and 60-month follow-up results for clinic and radiographic assessment of restorations were summarized in Table 2. At 60-month follow-up, it was determined that there was a statistically significant difference between the groups ($p < .01$). Although the success rate of the Hall Technique decreased to 84.6% after 60 months, it was still statistically more successful than conventional compomer restorations ($p < .01$). When the restorations were compared according to the dental arch they were in, no statistically significant difference was observed between the upper and lower teeth in both techniques (Table 3). When the types of teeth treated were investigated, the success rate in conventional compomer restorations was higher in first primary molars than in second primary molars. However, this difference was not statistically significant ($p = .17$). When the margin fit of PMCs was assessed, it was found that only one (7.7%) tooth (lower second molar) was unsatisfactory at 60-month follow-up. The 60-month evaluation showed the following minor failures: one restorable crown loss in the Hall Technique, four new caries and four restoration loss in conventional compomer restorations (Table 4). There was one conventional compomer restoration with new irreversible pulpitis requiring pulpectomy in the following 12 months. While internal root resorption accompanying inter-radicular radiolucency was observed in one molar treated with Hall Technique, irreversible pulpitis requiring pulpectomy was observed in one molar treated with conventional compomer restorations in the following 24 and 60 months.

Table 2. The clinic and radiographic assessment results of the treatments according to the success or failure criteria

		Successful n (%)	Minor failure n (%)	Major failure n (%)	
12-month	Hall Technique (n = 13)	12 (92.3)	0	1 (7.7)	$\chi^2 = 11.035$ $p = .004^*$
	Conventional Compomer Restoration (n = 13)	7 (53.8)	6 (46.2)	0	
24-month	Hall Technique (n = 13)	12 (92.3)	0	1 (7.7)	$\chi^2 = 12.674$ $p = .002^*$
	Conventional Compomer Restoration (n = 13)	5 (38.5)	7 (53.8)	1 (7.7)	
60-month	Hall Technique (n = 13)	11 (84.6)	1 (7.7)	1 (7.7)	$\chi^2 = 11.397$ $p = .003^*$
	Conventional Compomer Restoration (n = 13)	3 (23.1)	8 (61.5)	2 (15.4)	

$\chi^2 = \text{Chi-square}; * = p < .05$

Table 3. The assessment results of the treatments by tooth type at 60 months

		Successful n (%)	Minor failure n (%)	Major failure n (%)	
Hall Technique	Upper teeth (n = 7)	6 (85.7)	1 (14.3)	0	$\chi^2 = 2.787$ $p = .24$
	Lower teeth (n = 6)	5 (83.3)	0	1 (16.7)	
	First molar (n = 5)	4 (80)	0	1 (20)	$\chi^2 = 2.903$ $p = .23$
	Second molar (n = 8)	7 (87.5)	1 (12.5)	0	
Conventional Compomer Restoration	Upper teeth (n = 7)	1 (14.3)	5 (71.4)	1 (14.3)	$\chi^2 = 0.768$ $p = .68$
	Lower teeth (n = 6)	2 (33.3)	3 (50)	1 (16.7)	
	First molar (n = 10)	3 (30)	5 (50)	2 (20)	$\chi^2 = 3.460$ $p = .17$
	Second molar (n = 3)	0	3 (100)	0	

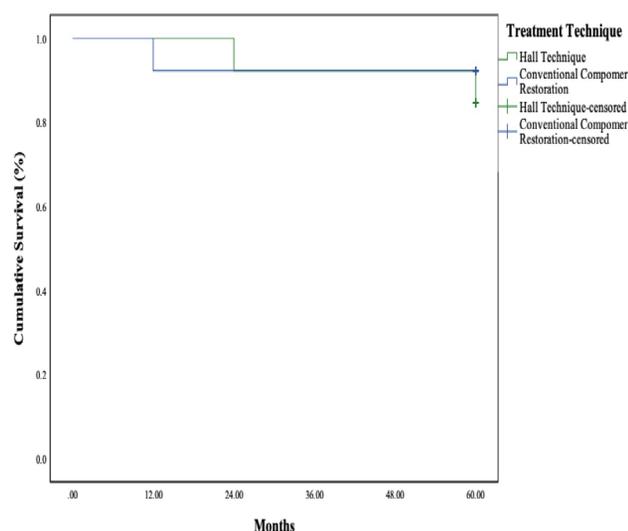
$\chi^2 = \text{Chi-square}; * = p < .05$

Table 4. The status of the restorations at follow-up appointments by the treatment groups

Outcomes		Hall Technique		Conventional Compomer Restoration			
		Months					
		12	24	60	12	24	60
Successful	Satisfactory	12	12	7	7	5	1
	Tooth exfoliated	-	-	4	-	-	2
Minor failure	Caries	-	-	-	4	5	4
	Restoration loss (restorable)	-	-	1	2	2	4
Major failure	Irreversible pulpitis	-	-	-	-	1	2
	Inter-radicular radiolucency	1	1	1	-	-	-
	Internal root resorption	1	1	1	-	-	-

3.3. Survival of Restorations

A Kaplan-Meier survival curve was presented for the 60-month follow-up of the Hall Technique and conventional compomer restorations (Figure 2). The primary molars still at risk of failure at the time were censored. At all follow-up appointments, the mean survival rate of the Hall Technique was 92.3% (SE: ± 7.4), and there was no significant difference in the survival rates of the Hall Technique by tooth type (Table 5). The mean survival rate of conventional compomer restorations at 12, 24, and 60-month follow-ups was 100%, 92.3% (SE: ± 7.4), and 84.6% (SE: ± 10), respectively. Also, there was no significant difference in the survival rates of conventional compomer restorations by tooth types at 24-month and 60-month follow-ups ($\chi^2 = 3.333$, $p = .34$; $\chi^2 = 2.455$, $p = .48$; respectively). The average survival times at 60-month follow-up were 56.3 months (SE: ± 3.5 ; CI 49.3 – 63.2) for the Hall Technique and 57.2 months (SE: ± 3.7 ; CI 49.8 – 64.6) for conventional compomer restorations. There was no statistically significant difference in survival rates between the groups by the log-rank (Mantel-Cox) test ($p = .57$).

**Figure 2.** The survival rates of the two techniques according to the Kaplan-Meier curve**Table 5.** The survival rates of the treatments according to tooth type at 60 months

		Hall Technique n (%)		Conventional Compomer Restoration n (%)	
60-month	Maxillary first molar (n = 8)	3 (100)	$\chi^2 = 0.667$ $p = .88$	4 (80)	$\chi^2 = 2.455$ $p = .48$
	Maxillary second molar (n = 6)	4 (100)		2 (100)	
	Mandibular first molar (n = 7)	0		4 (80)	
	Mandibular second molar (n = 5)	4 (100)		1 (100)	

$\chi^2 = \text{Chi-square}; * = p < .05$

4. DISCUSSION

The philosophy of how to manage dental caries, previously based on complete caries excavation, has changed significantly to the understanding that dentin caries within a selectively isolated environment can be arrested, slowed, and maybe even reversed (22). The effectiveness of the Hall Technique, which was developed as a result of this philosophy, depends on the caries being arrested within an isolated environment when sealed with the PMC (9,23). When the caries is completely sealed, the bacteria cannot reach dietary carbohydrates and the biofilm cannot be metabolized. Since the bacteria cannot produce acids, the cariogenicity of biofilm becomes less (5). In addition, when primary molars were treated with Hall Technique, it has been observed that although the hardness and elastic modulus of tissue was low, the calcium and phosphorus values to support remineralization were higher than the amount in the carious tissue without treatment (24).

The main objective of the present study was to observe whether the Hall Technique or conventional compomer restorations used to restore primary molars showed different survival rates. In this study, the Kaplan-Meier survival curve was used to compare the survival of two different techniques similar to some previous studies comparing the Hall Technique with traditional PMCs (13,15).

The amount and quality of evidence for PMCs fitted using the Hall Technique is increasing (25,26). In retrospective analyzes evaluating the success of PMCs applied with the Hall Technique, the success rate of the Hall Technique was reported 97% at 12 months (13), 97.4% clinically at 20.1 months, 94.9% radiographically at 20.1 months (12), 93.5% at 24 months (27), and 93.4% at 36 months (28). Similar to these studies, the success rate of the Hall Technique in the current study was 92.3% at 12 and 24-month follow-ups; it was also 84.6% at 60-month follow-up and was more successful than conventional compomer restorations. However, the clinic and radiographic success of conventional compomer restorations in this study was 53.8% at a 2-year follow-up and 38.5% at a 5-year follow-up. In the 2-year follow-up study of Santamaria et al., in which the Hall Technique, conventional compomer restorations, and Non-Restorative Caries Treatment were followed in different patients, the success was 67.2% for conventional compomer restorations (29). This success was higher than in the present study. This difference in the success of conventional compomer restorations may be due to the diversity in caries risk in populations. On the other hand, the Hall Technique seals the tooth with PMC and reduces the effect of factors related to individuals such as caries risk factor (30). In support of this view, the success of the Hall Technique is similar in several reported studies (12,13,27-29). The high success of the Hall Technique can be also attributed to the contribution of glass ionomer cement to the remineralization of the carious lesion (31), as well as crown durability and an isolated environment (23). In this study, as in the study of Santamaria et al. (29), PMCs were cemented with GC Fuji TRIAGE glass ionomer cement.

Moreover, the cementation with hydrophilic glass ionomers in the Hall Technique may have tolerated the disadvantage of lack of excellent moisture control (32).

When fitting a PMC with the Hall Technique, orthodontic separator elastics could be used for three or four days to place the crown comfortably in teeth with very tight contact. However, it was shown no relationship between the use of orthodontic separators and the margin fit of PMCs in the Hall Technique (14). In this current study, orthodontic separators were not used, and the margin fit in one (7.7%) PMC was unsatisfactory at 60-month follow-up.

Some studies have shown that the Hall Technique has a negligible effect on the temporomandibular joint, masseter muscle activity, and occlusal vertical dimensions (21,33-36). No signs or symptoms of temporomandibular dysfunction were observed 12 months after the Hall Technique (33). Abu Serdaneh et al. investigated the effect of the Hall Technique on masseter muscle activity by surface electromyography. They reported that the rest activity did not change in the sixth week, the clench activity returned to normal in the second week, and increased in the sixth week with no negative effects (34). After PMC cementation, premature contact may cause an increase in the occlusal vertical dimension but is not a problem in situations such as fitting one single crown. The balanced occlusion usually has been re-established within a few weeks (14,35). Supporting these results, Van der Zee et al. (21) and Kaya et al. (36) reported that occlusal vertical dimensions were spontaneously corrected after almost one month following the cementation of PMC. Children may tolerate occlusal changes more than adults. However, the occlusal vertical dimension was observed to be the same as at initial during follow-up visits in the current study.

According to the study comparing PMCs and conventional restorations (CR) including compomer, composite, glass ionomer, resin-modified glass ionomer, and amalgam referenced in the Cochrane database published in 2015 (25), neither group reported pain or major failure in the short-term. Long-term outcomes of the Hall Technique had a lower risk of major failure and pain, but the evidence was of moderate quality (37). Another study reported that both major (CR: 15%, HT: 2%) and minor (CR: 46%, HT: 5%) failure rates were higher in conventional restorations such as compomer, composite, glass ionomer, resin-modified glass ionomer, amalgam, and fissure sealant at 23 months compared to the Hall Technique (14). In this study, like these findings, major and minor failures in conventional compomer restorations were higher. The reason for the high failure rate of conventional compomer restorations might be the high risk of new or secondary caries due to poor oral hygiene (38).

In a randomized clinical trial comparing PMCs placed using the Hall Technique with conventional PMCs, the survival probability of the Hall Technique at 12-month follow-up was 94.5% (15); in a retrospective study, it was 97% at 15-month follow-up (13). In another retrospective analysis, when PMCs are placed using the Hall Technique on teeth with dentin caries on the approximal surface, the survival rate without

tooth extraction was reported as 86% for three years and 80.5% for five years (7). The present study found a 2-year survival rate of 92.3% in dentin caries treated with the Hall Technique, similar to the study of Elamin et al (15). It is remarkable that the survival rates are higher in the Hall PMCs with no caries removal compared to conventional compomer restorations in where all caries is removed. Also, the 5-year survival of first and second primary molars treated with the Hall Technique was not statistically different, similar to the results of Innes et al (7). Although the difference in survival rates is not statistically significant, there might be a biologically significant difference for practitioners.

When the studies on the Hall Technique were analyzed, it was found successful from all the methods compared such as glass ionomer restoration, conventional PMCs, and non-restorative caries treatment (NRCT) (14,15,39). There are three studies in the literature comparing the Hall Technique with compomer restorations (28,30,40). Santamaria et al. stated that the Hall Technique has a higher success rate at 24 months (30) and a higher survival rate at 33 months (29) compared to NRCT and compomer restorations. Kaptan and Korkmaz (40) also reported that the 1-year survival of the Hall Technique is greater than that of compomer restorations.

It might be thought that the force applied when applying PMC to unprepared teeth, may cause discomfort. However, the acceptability of the Hall Technique to children was researched, it was observed that the method was acceptable and there was no discomfort feeling. Instead of applying force by the dentist, the child's biting the PMC keeps the pain the child feels low and makes the Hall Technique more successful (37).

According to the best of our knowledge, there is no study evaluating the long-term survival rate of up to 60 months of the Hall Technique compared to conventional compomer restorations in the caries management of primary molars. Most of the studies on the Hall Technique have evaluated minor and major failures of the techniques (12,13,37). However, the survival study comparing conventional compomer restorations and the Hall Technique for the longest time is a 2.5-year follow-up study (29). Therefore, in this study, investigating the survival rate of techniques was planned as the primary outcome and investigating the success and failure rate of techniques was a secondary outcome.

In summary, with the limitations of the study, the Hall Technique is a successful minimally invasive treatment option with a high survival rate for managing early and moderately active carious lesions in primary molars. The null hypothesis was accepted because it was observed that the survival rate of conventional compomer restorations was not statistically different from the Hall Technique. In addition, it was observed that the success of conventional compomer restorations decreased compared to the Hall Technique, and major and minor failures increased in the long follow-up period. Minor failures that may seem trivial accelerate the restorative cycle of the tooth and translate into major failures

in the long term and reduce the survival probability of the restoration. In the long term, the Hall Technique should be considered to be a better option than conventional compomer restorations. The small sample size in the study is a limitation of the study. Another limitation of the study is that the caries size was matched only with the radiographic score, without the International Caries Detection and Assessment System criteria in the allocation to the groups. In addition, the retrospective aspect of the study and therefore the small sample size did not allow for strict inclusion criteria regarding the localization of the lesion.

5. CONCLUSION

This cohort study found that the 60-month survival rate of both techniques was similar when comparing conventional compomer restorations with PMCs placed using the Hall Technique. Furthermore, Hall Technique had more successful results with low failure findings in clinical and radiographic assessment.

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Peer-review: Externally peer-reviewed.

Author Contribution:

Research idea: BSY

Design of the study: BSY and BK

Acquisition of data for the study: BSY

Analysis of data for the study: BK

Interpretation of data for the study: BSY and BK

Drafting the manuscript: BSY and BK

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REFERENCES

- [1] Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, Ezzati M, Shibuya K, Salomon JA, Abdalla S, Aboyans V. Disability-adjusted life years 20 (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: A 21 systematic analysis for the global burden of disease study 2010. *Lancet* 2012;380(9859):2197-2223. DOI: 10.1016/S0140-6736(12)61689-4
- [2] Ricketts DN, Pitts NB. Traditional operative treatment options. *Monogr Oral Sci.* 2009;21:164-173. DOI: 10.1159/000224221
- [3] Scottish Dental Clinical Effectiveness Programme. Prevention and management of dental caries in children, dental clinical guidance. Scotland, Dundee: NHS education for Scotland. Published [2010]. Updated [May 2018]. Accessed [16 April 2022]. <http://www.sdcep.org.uk/published-guidance/caries-in-children/>.
- [4] American Academy of Pediatric Dentistry. Guideline on caries-risk assessment and management for infants, children, and adolescents. The Reference Manual of Pediatric Dentistry. Chicago, IL. Published [2013]. Updated [2022]. Accessed

- [16 April 2022]. http://www.aapd.org/media/Policies_Guidelines/G_CariesRiskAssessment.pdf.
- [5] Schwendicke F, Frencken J, Innes N. Current concepts in carious tissue removal. *Curr Oral Health Rep*. 2018;5(3):154-162. DOI: 10.1007/s40496.018.0183-1
- [6] Innes NPT, Evans D. Modern approaches to caries management of the primary dentition. *Br Dent J*. 2013;214(11):559-566. DOI: 10.1038/sj.bdj.2013.529
- [7] Innes NPT, Stirrups DR, Evans DJP, Hall N, Leggate M. A novel technique using preformed metal crowns for managing carious primary molars in general practice – A retrospective analysis. *Br Dent J*. 2006;200(8):451-454. DOI: 10.1038/sj.bdj.4813466
- [8] Hesse D, Araujo MP, Olegario IC, Innes N, Raggio DP, Bonifacio CC. Atraumatic restorative treatment compared to the hall technique for occluso-proximal cavities in primary molars: Study protocol for a randomized controlled trial. *Trials* 2016;17(1):169. DOI: 10.1186/s13063.016.1270-z
- [9] Altoukhi DH, El-Housseiny AA. Hall technique for carious primary molars: A review of the literature. *Dent J (Basel)*. 2020;8(1):E11. DOI: 10.3390/dj8010011
- [10] Badar SB, Tabassum S, Khan FR, Ghafoor R. Effectiveness of hall technique for primary carious molars: A systematic review and meta-analysis. *Int J Clin Pediatr Dent*. 2019;12(5):445–452. DOI: 10.5005/jp-journals-10005-1666
- [11] AlHalabi M, Salami A, Alnuaimi E, Kowash M, Hussein I. Assessment of paediatric dental guidelines and caries management alternatives in the post COVID-19 period. A critical review and clinical recommendations. *Eur Arch Paediatr Dent*. 2020;21:543-556. DOI: 10.1007/s40368.020.00547-5
- [12] Clark W, Geneser M, Owais A, Kanellis M, Qian F. Success rates of hall technique crowns in primary molars: A retrospective pilot study. *Gen Dent*. 2017;65(5):32-35.
- [13] Ludwig KH, Fontana M, LaQuia A, Jeffrey AP, Jeffrey AD. The success of stainless-steel crowns placed with the hall technique. *J Am Dent Assoc*. 2014;145(12):1248-1253. DOI: 10.14219/jada.2014.89
- [14] Innes NP, Evans DJP, Stirrups DR. The hall technique; A randomized controlled clinical trial of a novel method of managing carious primary molars in general dental practice: Acceptability of the technique and outcomes at 23 months. *BMC Oral Health*. 2007;7(1):1-21. DOI: 10.1186/1472-6831-7-18
- [15] Elamin F, Abdelazeem N, Salah I, Mirghani Y, Wong F. A randomized clinical trial comparing hall vs. conventional technique in placing preformed metal crowns from Sudan. *PLoS One* 2019;14(6):e0217740. DOI: 10.1371/journal.pone.0217740
- [16] Threlfall AG, Pilkington L, Milsom KM, Blinkhorn AS, Tickle M. General dental practitioners' views on the use of stainless steel crowns to restore primary molars. *Br Dent J*. 2005;199(7):453-455. DOI: 10.1038/sj.bdj.4812746
- [17] Innes N, Evans D, Stewart M, Keightley A. The hall technique: A minimal intervention, child centered approach to managing the carious primary molar. Published [1 July 2015]. Accessed [16 April 2022]. https://en.wikipedia.org/wiki/File:HallTechGuide_V4.pdf#file.
- [18] Hussein I, AlHalabi M, Kowash M, Salami A, Ouatik N, Yang YM, Duggal M, Chandwani N, Nazzal H, Albadri S, Roberts A. Use of the hall technique by specialist paediatric dentists: A global perspective. *Br Dent J*. 2020;228(1):33-38. DOI: 10.1038/s41415.019.1100-2
- [19] Mejàre I, Axelsson S, Dahlén G, Espelid I, Norlund A, Tranæus S, Twetman S. Caries risk assessment. A systematic review. *Acta Odontol Scand*. 2014;72(2):81-91. DOI: 10.3109/00016.357.2013.822548
- [20] De Menezes Abreu DM, Leal SC, Frencken JE. Self-report of pain in children treated according to the atraumatic restorative treatment and the conventional restorative treatment –A pilot study. *J Clin Pediatr Dent*. 2009;34(2):151-156. DOI: 10.17796/jcpd.34.2.9k67p786l7126263
- [21] Van der Zee V, van Amerongen WE. Short communication: Influence of preformed metal crowns (hall technique) on the occlusal vertical dimension in the primary dentition. *Eur Arch Paediatr Dent*. 2010;11(5):225-227. DOI: 10.1007/BF03262751
- [22] Murray PE, Smith AJ, Windsor LJ, Mjor IA. Remaining dentine thickness and human pulp responses. *Int Endod J*. 2003;36(1):33-43. DOI: 10.1046/j.0143-2885.2003.00609.x
- [23] Tedesco TK, Calvo AF, Pássaro AL, Araujo MP, Ladewig NM, Scarpini S, Lara JS, Braga MM, Gimenez T, Raggio DP. Nonrestorative treatment of initial caries lesion in primary teeth: A systematic review and network meta-analysis. *Acta Odontol Scand*. 2021;80(1):1-8. DOI: 10.1080/00016.357.2021.1928748
- [24] Loch C, van Vuuren LJ, Duncan WJ, Boyd DH, Page LAF. Ultrastructure and properties of primary carious molars treated using the hall technique. *Int J Paediatr Dent*. 2020;31(3):290-298. DOI: 10.1111/ipd.12681
- [25] Innes NP, Ricketts D, Chong LY, Keightley AJ, Lamont T, Santamaria RM. Preformed crowns for decayed primary molar teeth. *Cochrane Database Syst Rev*. 2015;31(12):CD005512. DOI: 10.1002/14651858.CD005512
- [26] Schwendicke F, Walsh T, Lamont T, Al-Yaseen W, Bjørndal L, Clarkson JE, Fontana M, Rossi JG, Göstemeyer G, Levey C, Müller A. Interventions for treating cavitated or dentine carious lesions. *Cochrane Database Syst Rev*. 2018(6):CD013039. DOI: 10.1002/14651858.CD013039
- [27] Binladen H, Halabi MA, Kowash M, Salami AA, Khamis AH, Hussein I. A 24-month retrospective study of preformed metal crowns: The hall technique versus the conventional preparation method. *Eur Arch Paediatr Dent*. 2020;22(1):67-75. DOI: 10.1007/s40368.020.00528-8
- [28] Araujo MP, Innes NP, Bonifácio CC, Hesse D, Olegário IC, Mendes FM, Raggio DP. Atraumatic restorative treatment compared to the hall technique for occluso-proximal carious lesions in primary molars; 36-month follow-up of a randomised control trial in a school setting. *BMC Oral Health*. 2020;20(1):1-18. DOI: 10.1186/s12903.020.01298-x
- [29] Santamaria RM, Innes N, Machiulskiene V, Schmoeckel J, Alkilzy M, Splieth CH. Alternative caries management options for primary molars. *Caries Res*. 2017;51(6):605-614. DOI: 10.1159/000477855
- [30] Santamaria RM, Innes NPT, Machiulskiene V, Evans DJP, Splieth CH. Caries management strategies for primary molars: 1-yr randomized control trial results. *J Dent Res*. 2014;93(11):1062-1069. DOI: 10.1177/002.203.4514550717
- [31] Salas CF, Guglielmi CA, Raggio DP, Mendes FM. Mineral loss on adjacent enamel glass ionomer cements restorations after cariogenic and erosive challenges. *Arch Oral Biol*. 2011;56(10):1014-1019. DOI: 10.1016/j.archoralbio.2011.03.005
- [32] Berg JH. Glass ionomer cements. *Pediatr Dent*. 2002;24(5):430-438.

- [33] Kaya SK, Taran Kinay P, Bakkal M. Temporomandibular dysfunction assessment in children treated with the hall technique: A pilot study. *Int J Paediatr Dent.* 2020;30(4):429-435. DOI: 10.1111/ipd.12620
- [34] Abu Serdaneh S, AlHalabi M, Kowash M, Macefield V, Khamis AH, Salami A, Hussein I. Hall technique crowns and children's masseter muscle activity: A surface electromyography pilot study. *Int J Paediatr Dent.* 2020;30(4):303-313. DOI: 10.1111/ipd.12611
- [35] Nair K, Chikkanarasaiah N, Poovani S, Thumati P. Digital occlusal analysis of vertical dimension and maximum intercuspal position after placement of stainless steel crown using hall technique in children. *Int J Paediatr Dent.* 2020;30(6):805-815. DOI: 10.1111/ipd.12647
- [36] Kaya S, Kinay Taran P, Bakkal M. Hall teknik uygulamasında paslanmaz çelik kuronların neden olduğu oklüzal dikey boyut artışının takibi: Pilot çalışma. *Yeditepe Dent J.* 2018;14(2):37-42. DOI: 10.5505/yeditepe.2018.25743 (Turkish).
- [37] Innes NP, Evans DJ, Stirrups DR. Sealing caries in primary molars: Randomized control trial, 5-year results. *J Dent Res.* 2011;90(12):1405-1410. DOI: 10.1177/0022034511422064
- [38] Burke FJ, Wilson NH, Cheung SW, Mjör IA. Influence of patient factors on age of restorations at failure and reasons for their placement and replacement. *J Dent.* 2001;29(5):317-324. DOI: 10.1016/s0300-5712(01)00022-7
- [39] Chadwick B, Dummer P, Dunstan F. How long do fillings last? *Evid Based Dent.* 2002;3:96-99.
- [40] Kaptan A, Korkmaz E. Evaluation of success of stainless steel crowns placed using the hall technique in children with high caries risk: A randomized clinical trial. *Niger J Clin Pract.* 2021;24(3):425-434. DOI: 10.4103/njcp.njcp_112_20

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