# Modern approaches to caries management of the primary dentition

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PRACTICE

**IN BRIEF**

- Explores the differences between children and adults in the delivery of evidence-based techniques for preventing dental caries.
- Outlines the different approaches to managing dental caries in primary teeth to those used for the carious permanent dentition.
- Describes the Hall technique and its current implementation in the UK.

When prevention of dental caries fails, and a child is exposed to the risk of pain and infection, the disease must be managed to reduce this risk. There is growing evidence supporting more 'biological' and fewer 'surgical' approaches to managing dental caries in primary teeth. These biological methods include partial and stepwise caries removal procedures, as well as techniques where no caries is removed. An overview of clinical trials comparing these biological methods to complete caries removal shows that they perform as well as traditional methods and have the advantage of reducing the incidence of iatrogenic pulpal exposures. The Hall Technique is one biological approach to managing caries in primary molars which involves sealing caries beneath preformed metal (stainless steel) crowns. The crown is cemented over the tooth without caries removal, tooth preparation or use of local anaesthesia. The clinical steps for the Hall Technique are straightforward but, as with all dental care provision, appropriate treatment planning for the procedure requires skill. The Hall Technique offers another method of managing early to moderately advanced, active carious lesions in primary molars, with good evidence of effectiveness and acceptability. This evidence aligns with the positive findings of other studies on biological strategies for managing caries in primary teeth.

## INTRODUCTION

Dentistry for children is not the same as dentistry for adults. The effective prevention and management of dental caries in children presents the oral healthcare team with a different set of challenges (and opportunities), compared with providing care for adults. Although evidence-based techniques for preventing dental caries are available, and the delivery of these interventions might seem at first glance to be similar for children and adults, the reduced autonomy of children means there are important differences, and this paper explores these. Similarly, the limited lifespan of the primary dentition before it is naturally shed presents the opportunity for a different approach to managing dental caries from that used for the carious permanent dentition. A more 'biological', less 'surgical' approach can be used to slow or arrest caries progression in primary teeth such that the tooth exfoliates before causing the child pain or infection. This paper gives an overview of the evidence on biological approaches to caries management in the primary dentition, demonstrating that they perform as well as traditional methods with the advantage of reducing the incidence of iatrogenic pulpal exposures. One particular biological caries management method, the Hall Technique, is described, along with an overview of the current place of the technique in the UK.

## CARIES PREVENTION AND CHILDREN'S ORAL HEALTHCARE

With regard to their oral health, children are extremely vulnerable, being entirely dependent on their parents/carers, who must take full responsibility for the child's oral health until the child is old enough to accept this responsibility for themselves. This involves the parents/carers in more than simply bringing children for appointments with the oral healthcare team. It includes the wider aspects of oral healthcare, such as providing the fundamental home-based caries preventive programmes of best toothbrushing practice and a healthy diet, as well as being role models for children in establishing good habits and attitudes. Children also depend on the oral healthcare team to deliver the four principal evidence-based preventive interventions of toothbrushing (toothpaste) advice, dietary advice, fluoride varnish and fissure sealants, in line with national guidance,[1–3] as well as providing caries management when prevention has failed and, of course, all of this to a high standard. Children and their parent/carers are rarely sufficiently informed to ask for these interventions, neither are they in a position to make any assessment of the quality of the intervention provided; the oral healthcare team looking after the child must shoulder this responsibility.

The imperative for effective caries prevention for children is that adult dental disease begins in childhood.[4] This means that prevention not only ensures children avoid the consequences of unmanaged dental caries (pain and infection), but that in addition, they can progress to adulthood with a healthy dentition (see Fig. 1),

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a positive attitude to taking on the responsibility for maintaining their dentition for themselves, and the ability to accept any necessary dental treatment without anxiety. This is the goal of all members of the oral healthcare team who provide care for children, be they dental hygienists, dental nurses, dental therapists, general practitioners, oral health educators or specialist dentists.

Unfortunately, despite dental caries being a preventable disease, many children in the UK will experience caries in their primary dentition. Recent surveys show 31% of 5-year-olds in England having obvious caries[5] and in Scotland, despite a dramatic reduction from 57.2% in 1998, 33% of 5-year-olds had evidence of the disease in 2012.[6] Dental caries continues to be far too prevalent and, like other diseases associated with social inequality, is heavily skewed towards lower socio-economic groups. Management of the disease is further complicated by the fact that children who have dental caries, tend to have several teeth affected. In England, the 31% of 5-year-old children with the disease had, on average, 3.45 teeth affected,[5] and in Scotland, the 33% of children with obvious dentinal caries had, on average, 4.1 teeth affected.[6] This poses particular challenges for the oral healthcare team; when a child presents with dental caries, it is rarely only a single tooth that needs to be managed.

## Current approaches to managing dental caries in the primary dentition

Caries management for children differs from that for adults. For adults, the management of an active dentinal lesion is generally straightforward. The consequences of leaving the lesion unmanaged can be explained to the patient, who will then usually accept the necessary inconvenience of a restorative intervention for the expected benefit of improved function, aesthetics, and freedom from pain and infection in the future. However, children (enviably), generally live in the present, and can have difficulty accepting the concept of 'let's sort it now, for benefit later'. For the younger child, freedom from pain and infection is their priority, and if they are not currently in pain, then they do not see there is a problem to be managed. This compounds the difficulties faced by the oral healthcare team when providing conventional restorative care for the child. For adult patients, it is accepted that best practice is to manage active dentinal caries lesions with some form of restoration. However, for 5-year-old children the Care Index (the proportion of carious teeth which have been restored) is 14% in England[5] and 13% in Scotland,[6] meaning that only around one out of eight carious primary teeth are restored. For 12-year-old children, with their permanent dentitions, the figures are more positive; in England the Care Index is 47%[7] and in Scotland 53.8%.[8] How much this difference in the proportion of teeth being restored is attributable to the relative importance attached to permanent teeth over primary teeth, and how much is related to the difficulties in providing restorative care for children in primary care, or other factors, is debatable and contentious.

Teaching in UK Dental, and Dental Therapy Schools, on the restorative management of the primary dentition is generally based on the British Society of Paediatric Dentistry guidance, which includes the recommendation that the optimum treatment of caries in primary teeth should be its removal, followed by the placement of a conventional filling to replace lost tooth tissue.[9,10] However, these recommendations are largely based on evidence obtained from studies conducted with selected populations; either in a secondary care or specialist paediatric dental practice setting.[11] The evidence supporting the effectiveness of such care when provided by general dental practitioners (GDPs), in primary care in the UK is less convincing.[12,13]

There are many reasons why the provision of conventional restorative care for the primary dentition in primary care might be problematic. Although development of child dental anxiety is not attributable to a single factor and there is a link between child and maternal anxiety,[14] experiences of dental treatment have been shown to play a significant role.[15–17] Despite very little investigation into children's perceptions of dental treatment, what evidence there is, indicates that they can find a conventional approach (that is complete removal of caries and placement of a restoration) more difficult to accept than less invasive procedures.[18–20] The low levels of provision of these restorations may be compounded by dentists' perception that conventional approaches are ineffective in managing caries in young children.[21]

Fig. 1 The healthy, caries-free and unrestored dentition of a 16-year-old girl

## A biological approach to caries management in the primary dentition

Recently, biologically-orientated strategies for managing dental caries have come back into focus. A number of clinical trials have been carried out looking at incomplete, or no caries removal, in primary teeth and how the outcomes for these techniques compare to complete caries removal. These 'minimal intervention' approaches reduce some of the adverse consequences associated with carrying out restorative treatment, with the advantages of conservation of tooth structure and integrity, maintenance of maximum pulpal floor dentinal thickness (which can reduce the impact on pulpal health[22]), and reduced pulp exposure. In addition, if no vital dentine is being removed, there can be less need for local anaesthesia, which has been shown to reduce children's reported discomfort.[18,19] A recently updated Cochrane systematic review has compared biologically-orientated strategies (stepwise, partial and no-caries removal), with complete caries removal for managing caries in both primary and permanent teeth. Eight trials

**Table 1 Details of the seven randomised or controlled clinical trials where there has been stepwise, partial or no caries removal in primary teeth compared with conventional restorations (search strategy available on request)**

| Author and study design | Participants and teeth | Details of intervention and control | Follow up | Outcome measures and results | Author's conclusions |
|---|---|---|---|---|---|
| **Magnusson[39] (1977)** Randomised parallel group study set in one secondary care site with four operators (Sweden) | 62 children (510 years) 110 primary molars. Seem to be occlusal lesions only | **Intervention** Stepwise (partial caries removal – with re-entry after 46 weeks; temporary – calcium hydroxide, intermediate layer of 'Dropsin' and zinc oxide eugenol cement. **Control** Complete caries removal (restorative material not stated) | 100% follow up at 1 year | Pulp exposure during treatment **Intervention:** First stage: 0/55 (0%) Second stage: 8/55 (14.5%) **Control:** 29/55 (52.7%) | 'Consequently, judged by the clinical criteria used, [stepwise caries removal] with a calcium hydroxide inlay may obviate a considerable number of pulp treatments in primary molars.' |
| **Ribeiro[40] (1991)** Randomised parallel group study (Brazil) | 38 children (711 years) 48 primary molars. Equal Class I and Class II restorations carried out. Caries into dentine 'at least 2 mm wide' | **Intervention** Partial caries removal: removal of carious dentine from enamel-dentine junction (EDJ) but visible, moist, soft dentine not removed from floor or axial walls & immediate placement of definitive composite restoration. **Control** Complete caries removal and placement of composite restoration | 100% follow up at 1 year | Signs/symptoms pulpal pathology **Intervention:** 0/24 (0%) **Control:** 1/24 (4.2%) Longevity of restoration **Intervention & control:** 100% both arms | 'Application of an adhesive restorative system to irreversibly infected dentin did not affect the clinical performance of the restoration.' |
| **Innes[13,26] (2007 and 2011)** Pragmatic, multi-centre split mouth, RCT set in primary care with 17 operators – general dentists (Scotland) | 132 children (310 years) 264 primary molars. Class I (33%) and Class II lesions/restorations (67%) | **Intervention** Hall Technique with 42% of teeth caries radiographically >half way through dentine. **Control** Dentists usual treatment including caries removal 69% GI; 11% composite; 8% amalgam; 5% compomer; 1% PMC; 2% fissure sealant | 94% (124/132) at 2 years and 69% (91/132) at 5 years | Signs/symptoms pulpal pathology At 5 years: p = 0.000488; NNT 8 in favour of intervention. **Intervention:** 2 yrs: 3/128 (2%) 5 yrs: 3/91 (3%) **Control:** 2 yrs: 19/128 (15%) 5 yrs: 15/91 (16.5%) Longevity of restoration At 5 years: p <0.000001; NNT 3 in favour of intervention. **Intervention:** 2 yrs: 6/128 (5%); 5 yrs:4/91 (5%) **Control:** 2 yrs: 57/128 (46%); 5 yrs: 38/91 (42%) | '...sealing-in caries by the Hall Technique statistically, and clinically, significantly outperformed the GDPs' standard restorations. Hall technique outcomes were comparable with those of standard restorations in studies in secondary care. These results strongly support the Hall technique as a predictable restorative option, with low failure and, therefore, re-treatment, rates for managing carious primary molars in a primary care environment.' |
| **Lula[41] (2009)** Parallel group randomised control trial. Secondary care with multiple operators (Brazil) | 30 children (58 years); convenience sample. 36 primary molars. Caries extending into inner half of dentine on radiograph; occlusal and occluso-proximal. Sometimes more than one tooth per child included | **Intervention** Partial caries removal; microbiological samples taken; calcium hydroxide base; restored with composite. **Control** Complete caries removal; microbiological samples taken; calcium hydroxide base; restored with composite | 1 year follow up. Children; 87% (26/30) Teeth; 89% (32/36) Four children and four teeth were lost to follow up, two from each arm | Bacterial growth from dentine samples 'No difference in microbial growth between groups was observed after 36 months for any of the microorganisms studied.' Pulp exposure during treatment **Intervention & control:** 0% both arms Longevity of restoration **Intervention:** 16/16 (100%) **Control:** 15/16 (94%) | 'The results suggest that persistence of bacteria does not seem to be a reason for reopening of cavities in deciduous teeth after partial caries removal.' |
| **Orhan[42] (2010)** Parallel group randomised control trial (Turkey) | 123 children (415 years) 94 mandibular second primary molars with caries extending >three-quarters through dentine radiographically. (Also included 60 mandibular permanent first molars) | **Intervention** Group 1: Partial caries removal and compomer restoration. Group 2: Stepwise caries removal if pulp exposure suspected – calcium hydroxide base, ZOE; re-entry after 3 months; restoration with glass-ionomer base and compomer. **Control** Complete caries removal and compomer restoration | 1 year follow up Teeth; 78% (73/94) | Pulp exposure no statistically significant difference between partial and stepwise caries removal or between stepwise and complete caries removal. **Intervention:** Group 1: 2/31 (6.5%) Group 2: 3/32 (9.4%) **Control:** 6/31 (19%) Signs/ symptoms pulpal pathology (NB unexposed teeth only) **Intervention:** Group 1: 0/29 (0%) Group 2: 1/29 (3%) (lost temporary then abscess 1/29) **Control:** 2/25(8%) (Internal resorption 2/25) | 'Indirect pulp therapy in both primary and young permanent teeth can be used successfully with a 1 or 2 visit approach.' |

Continued on page 562

**Table 1 Details of the seven randomised or controlled clinical trials where there has been stepwise, partial or no caries removal in primary teeth compared with conventional restorations (search strategy available on request)**

Continued from page 561

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|---|---|---|---|---|---|
| **Borges[43] (2012)** Single centre randomised trial set in University Dental Centre (Brazil) | 30 children (59 years) Two unrestored, non-cavitated teeth with occlusal caries into dentine per child | Two arm RCT; each child had two teeth entered to the trial but not clear if one assigned to each arm **Intervention** Rubber dam isolation, cleaned and fissure sealant placed. **Control** Local anaesthesia, rubber dam isolation, high speed access to caries, 'carious tissue' removed and tooth restored with composite | 1 year follow up. Children 87% (26/30) Clinical caries progression or cavitation in sealant group and radiographic progression | Radiographic lesion progression not statistically significant p = 0.12 **Intervention:** 3/26 **Control:** 0/26 Longevity of restoration not statistically significant p = 0.12 **Intervention:** Complete retention 23/26 (88.5%) Partial retention 3/26 (11.5%) Complete sealant loss 0/26 **Control:** Complete retention 26/26 (100%) | 'Fissure sealing and tooth restoration were equally effective in the management of non-cavitated dentine occlusal caries in primary teeth. Invasive procedures can be replaced with the non-drilling approach with no adverse consequences for paediatric patients.' |
| **Phonghanyud[44] (2012)** 'Two standard dental clinics in two hospitals'. Single operator. (Thailand) | 276 children (611 years) Occlusal and/or proximal surface caries extending >one-third through dentine without signs/symptoms of irreversible pulpitis | Three arm RCT **Intervention** Group 1: Partial caries removal at EDJ - spoon excavation Group 2: Complete caries removal – spoon excavation. **Control** Group 3: Complete caries removal – rotary instruments (LA used for five children). All cavities accessed with high speed round bur & teeth restored with glass-ionomer cement (GIC) | 1 year follow up. Children 96% (266/276) clinical and radiographic | Cumulative survival rates of restorations not statistically significant for any groups Group 1 83%, Group 2 83% Group 3 (Control) 89% Pulp survival not statistically significant for any group Group 1 99%, Group 2 100%, Group 3 (Control) 98% However teeth excluded prior to analysis: Group 2 – 1 pulp exposure Group 3 – 2 pulp exposures | 'The clinical and radiographic evaluations after 12 months indicated that partial soft caries removal at EDJ followed by GIC restoration was comparable to that of ART and conventional approaches.' |

of 934 patients (1,372 teeth) with outcomes reported for 1,191 teeth were included in the analyses. The conclusion of the review was that for symptomless and vital teeth, biologically-orientated strategies had clinical advantages over complete caries removal in the management of dentinal caries. Not only were there no differences in restoration longevity or in the numbers of teeth (or patients) experiencing pulpal pathology (pain or infection), but there were significantly less pulp exposures. For partial caries removal in primary teeth, this gave a relative risk of 0.24 [95% CI 0.06 to 0.90], when caries was not completely removed; a 76% reduction in the risk of pulp exposure compared to complete caries removal. In other words, the risk of pulp exposure was reduced by around three quarters when partial caries removal was performed, and there were no additional pain or infection events over the following year.

Table 1 presents an updated, comprehensive overview of randomised control trials (RCT) and controlled trials of primary teeth alone where stepwise, partial and no caries removal has been compared to complete caries removal. This was constructed following an electronic database search up to 15 January 2013 (of MEDLINE via OVID, EMBASE, the Cochrane Oral Health Group's Trials Register and CENTRAL), based on the Cochrane review search strategy, built around key words (including dental caries, dental restoration, ultraconservative, minimal invasion, atraumatic, fissure seal, randomised trial, controlled clinical trial) but limited to primary teeth. The search strategy is available from the contact author. References of all included studies were checked for further studies and systematic reviews, and the references of these also scrutinised. There are seven studies which all compare complete caries removal in some teeth to incomplete (stepwise or partial) or no caries removal in other teeth using randomised or controlled trial designs. There is considerable variation in the interventions, the techniques used, the restorative materials and the outcomes measured in these studies. However, the findings are consistently positive or equivalent for the various minimal caries removal techniques over complete caries removal and this was true for all of the different outcomes measured (pulp exposure during treatment; signs/symptoms of pulp pathology; longevity of restoration; bacterial growth from dentine samples; radiographic lesion progression). However, these techniques all depend on a high quality seal for their effectiveness; even the most perfect Class II cavity preparation will fail if the tooth is restored with a glass-ionomer cement[23] or an inadequately bonded composite. This is demonstrated clearly in Borges' study in Table 1, where fissure sealants were used to seal over non-cavitated dentinal caries and there was radiographic evidence of lesion progression in the three teeth where the sealant had been partially lost.

Biological approaches have advantages for child patients receiving dental care. They are less destructive and potentially less damaging for primary teeth, and offer clinicians more scope for treating their patients with less invasive techniques. The Hall Technique is one of these approaches and background evidence to support its use together with an update on the professions' perception of the technique, and a brief clinical 'how-to' will be presented here.

## THE HALL TECHNIQUE

### Background

The Hall Technique is named after Norna Hall, a GDP, who had initially been

routinely using preformed metal crowns (PMCs, also known as stainless steel crowns) using conventional techniques. She developed a simplified technique where the PMC was cemented over a carious primary molar, with no local anaesthesia, caries removal, or tooth preparation of any kind (see Innes and Evans, 2009[24] for further background). An audit of her records[25] together with an RCT based in primary care,[13] supported her findings, and found the technique to be acceptable to the children, their parents and the GDPs. At five-year follow up,[26] only 3 (3%) of the primary molars managed with the Hall technique had experienced a major failure (irreversible pulpitis, loss of vitality, abscess or unrestorable tooth), compared with 15 (16.5%) of the matched control teeth, managed according to the GDPs usual practice. The GDPs conventional restorations did show high failure rates. However, not only were the Hall crowns more effective than these conventional fillings ($p < 0.001$), the low failure rates of the Hall crowns were comparable with those of standard restorations carried out in studies in secondary care.[11]

## Placing a PMC using the Hall Technique

The following is a brief outline of the method for placing a Hall crown. Full information, including an explanation of indications and contra-indications for placing a Hall crown and with hints and tips, is included in a short illustrated manual, freely available online.[27] Case selection is extremely important; an ideal indication for the Hall Technique would be a primary molar with early to moderately advanced active dentinal caries affecting the proximal surface, and no signs or symptoms (clinically or radiographically), of irreversible pulpal involvement. The child, and their parent, will have given fully informed consent. In the example shown, a 4-year-old girl had a right mandibular first primary molar (84) with caries affecting the occlusal and distal proximal surface (Fig. 2a). Clinical and radiographic examination (Fig. 2b) indicated there was a low risk of irreversible pulpal disease. An orthodontic separator was fitted to the distal part of the tooth (Fig. 2c) to create interproximal space and aid placement of the PMC at the child's next appointment, three days later. After measurement of the occlusal vertical dimension (OVD) at the canines, and removal of the separator (Fig. 2d), different sizes of PMCs were tried until one was found which could be fitted over all the cusps, with a feeling of 'spring back' when pushed as far (but not beyond), the contact points (Fig. 2e). The PMC was then filled with a glass-ionomer luting cement and seated over 84 (Figs 2f) to engage the contact points, following which the child was asked to bite down (Fig. 2g). Excess cement was removed, the child asked to bite down a second time (which pushed the crown further into place) and then pressure kept on the tooth until the cement set. Excess cement was removed

Fig. 2a Four-year-old child with caries on occlusal surface of tooth 84 extending distally

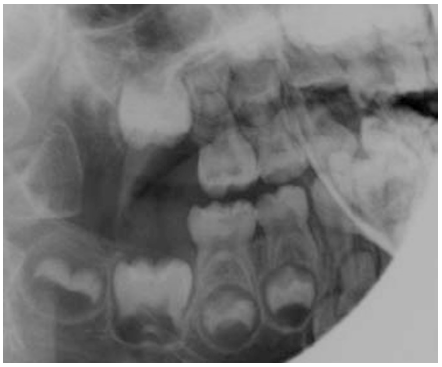

Fig. 2b Lateral oblique radiograph of 84. The lesion is limited to the outer half of the dentine

Fig. 2c Orthodontic separator placed distally to tooth 84

Fig. 2d Tooth 84 following removal of separator


Fig. 2e 'Trying in' to determine correct size of PMC for tooth 84


Fig. 2f Initial seating of PMC on tooth 84


Fig. 2g Child completes seating of PMC by biting down on a cotton wool roll

Fig. 2h Removal of excess cement

Fig. 2i Hall crown fitting completed. Slight changes in occlusion are acceptable at this stage

and the contact points flossed (Fig. 2h). The OVD was remeasured to exclude excessive increase, displacing contacts were checked for, and the child discharged to be reviewed at her next treatment appointment (Fig. 2i).

## Limitations of the Hall Technique

The Hall Technique will not suit every child with carious primary molars. The very anxious, or the very young child, might find placement of a Hall crown more than they can cope with. Others might object to the aesthetics, particularly when placed on maxillary first primary molars. Finally, Hall crowns are not restorations to be used on primary molars as a last resort when all else has failed. For primary molars with signs and/or symptoms of irreversible pulpal involvement, conventional pulp therapy and PMC placement, or extraction, remain the treatment options. Hall crowns should only be fitted after clinical examination *and* radiographic investigation have indicated there is only a very low risk of irreversible pulpal pathology. Hall crowns, like all restorations, require careful follow up after fitting, with prompt management of pulpal pathology if this does develop. Most clinicians will have witnessed the unfortunate situation where a carious primary tooth that has not been treated, eventually disintegrates (usually as a result of both the caries continuing and the body responding to the associated dento-alveolar infection with inflammatory processes). The tooth crumbling away at least limits, to some extent, the duration of chronic infection experienced by the child. However, this already far from ideal situation could be worsened by placement of a PMC over a primary molar with associated sepsis. With the molar protected from breaking up by the PMC, it could, without appropriate management, become a source of chronic infection for an extended period of time. As such, Hall crowns are not the answer to providing oral healthcare for disadvantaged or underserved populations; instead, resource should be invested in oral health improvement programmes.

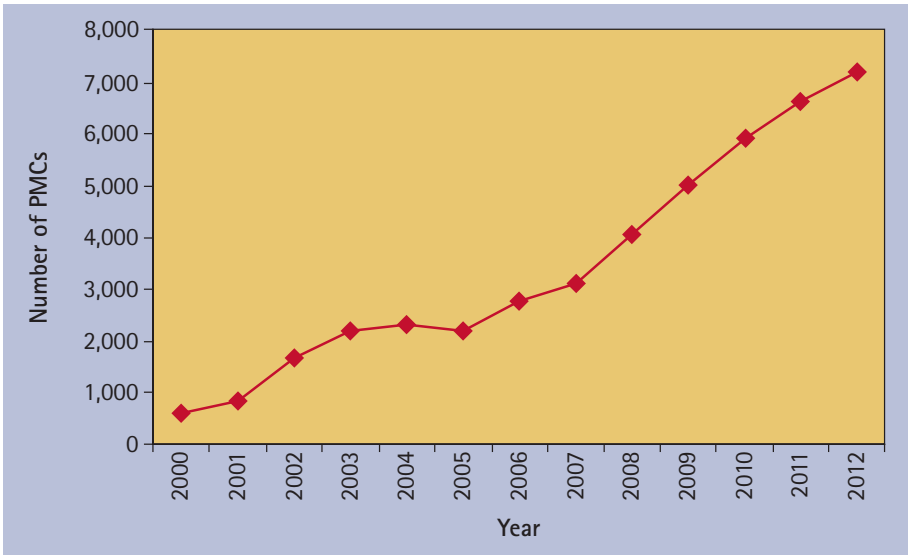


Fig. 3 Data from the SDPD[31] relating to claims for fees for the fitting of PMCs in children

The Hall Technique will not suit every clinician. Clinicians tend to use restorative techniques they feel comfortable with. For some, using a glass-ionomer material to manage proximal lesions in primary molars will remain their treatment of choice, despite overwhelming evidence as to its ineffectiveness for this application.[23] Some will question whether any restorative approach for carious primary molars is effective.[28] Other clinicians may state they are uncomfortable sealing in dental caries, despite high-quality evidence that provided the seal is maintained, this is an effective management method.[29] However, these same clinicians will often use indirect pulp caps as part of their regular clinical practice; an effective, evidence-based technique for managing the deep carious lesion where caries is sealed in over the most vulnerable part of the tooth; directly over the dental pulp.

## Current position of the Hall Technique

Since 2000, the use of PMCs by GDPs in Scotland has been rising steadily. Figures from the Scottish Dental Practice Board, who process all claims for dental procedures carried out under the NHS in Scotland,[30] show the number of claims for placement of PMCs on primary teeth has risen from 599 in 2000 to 7,183 in 2012 (Fig. 3). To determine the extent of the teaching and use on clinics of the Hall Technique, all 16 UK undergraduate dental schools and 18 therapy schools were contacted. Information from course leaders in all 34 Schools was obtained. Fifteen out of 16 dental schools stated that they taught the Hall Technique as a standard part of their undergraduate curriculum. The single dental school where the Hall Technique is not formally taught, 'mention it' within a lecture on conventional PMCs. Similarly, in the same 15 out of 16 of the dental schools, the Hall Technique forms an accepted part of the caries management strategies within the clinic and is used to treat patients. Out of the 18 dental therapy schools, all teach the technique as a standard part of the curriculum and use it with patients. The Hall technique has only had evidence supporting its use for the last five years and it is surprising for a technology to be adopted so widely in teaching in such a short period of time. Despite the integration of the technique by teaching establishments in the UK, the place of the Hall technique in child oral healthcare remains controversial, particularly amongst the wider field of specialists in paediatric dentistry although there is evidence of its growing acceptance in Europe.[32]

The Hall Technique has attracted interest, and a number of commentaries have been published on the RCT that was carried out in Tayside with GDPs, between 2001 and 2009, with 2-year[13] and 5-year[26] results published. In 2008, the *Evidence Based Dentistry* commentary[31] concluded, for the 2-year results, that 'The Hall Technique seems to offer an effective,

non-invasive treatment option for carious primary molar teeth involving two or more surfaces. Sealing in caries in primary molars using Hall PMC seems to improve pulpal health and patient benefit from the smaller cavity size, no need for local anaesthesia and a less traumatic procedure from the point of view of child behaviour management.' The *Journal of Evidence Based Dental Practice*'s 2012 review, which included analysis and evaluation of a systematic review of caries removal in primary teeth,[33] suggested that 'the 5-year data should not be seen as evidence that the Hall Technique is superior to other not yet measured interventions, such as the traditional crown preparation'. However, the conclusion of the review itself, where the Hall Technique was one of three studies included, was that 'this systematic review suggests that minimally invasive techniques ... are the procedures of choice in the arrest of dental caries in the primary dentition'. Also in 2012, the *Pediatric Dentistry* 5-year results commentary[34] stated 'Based on the available inconclusive evidence, provision of preformed metal crowns for primary molars using the Hall Technique cannot be recommended in clinical practice.' Unfortunately, the author of the article did not interpret the findings in reference to outcomes of other restorative studies, the extent of caries involvement for teeth and likely outcomes, or even the general field of restorative paediatric dentistry and failed to note that despite PMCs being used by the paediatric dental community for over 60 years,[35,36] there are no good quality RCTs of conventional crowns *versus* any restorative treatment.[37] In the Hall technique split mouth RCT (see Table 1 for further detail), for the teeth treated, almost half (42%) of the 86% of teeth where radiographs were available, had caries lesions extending over half way through dentine and over two thirds (68%) resulted in a Class II restoration, that is the cohort of teeth were significantly affected by caries.[13] Nevertheless, after five years following treatment with a Hall Crown, the success rate was 97% of the teeth followed up (n = 91 patients; 69%) being free from pain, and infection and 95% not requiring any further treatment. It is difficult to see these results, compared with other studies of restorative treatment[11] and obtained by GDPs without recourse to general anaesthesia or sedation, as indicating anything other than success for the restorations provided.

It is interesting to note the different interpretations and recommendations have been based on the evidence from a single retrospective study, and single RCT of the Hall technique, which seems to be a focus for the controversy that still surrounds biological management strategies for caries. Further investigations into the Hall Technique are currently being carried out which will support or otherwise the evidence from the Scottish work. One international study between Germany and Lithuania is well underway, and in Australia, additional funding has just been granted to continue a community based trial of pre-school children for three years. In New Zealand, a successful, government funded, pilot trial has been completed in one region, with a larger trial investigating generalisability and longer term outcomes planned.

## CONCLUSION

Caries prevention can be extremely effective; many ascribe the dramatic improvement in the oral health of Scottish 5-year-olds over the last eight years (the proportion free from visible caries rising from 44.6% in 2003 to 67% in 2012), as largely due to Childsmile; a preventive programme aimed at reducing inequalities in oral health and supporting access to dental services for children.[38] The programme is centred on nursery and primary school preventive programmes (brushing and fluoride varnishing) and universally-accessible, child-centred NHS dental practices (http://www.child-smile.org.uk). For improving children's oral health, what happens at home, and in the community, is at least as important as what happens in the dental surgery. The Hall Technique is not the answer to the problem of childhood dental caries. Dental cavities are the *consequence* of the disease of dental caries, and should not be confused with the disease itself. Fitting a Hall crown to a child may well manage the problem of the cavity, but it will do nothing to sort the problem of the disease; the child will develop further cavities in other teeth if nothing else changes. However, the Technique does offer another method of managing the early to moderately advanced active dentinal lesion in primary molars, with good evidence of effectiveness, and acceptability to children and parents. This evidence aligns with the positive findings of other studies of biological strategies for managing caries in primary teeth.


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