IN BRIEF

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CPD PAPER

- Highlights problems concerning the low level of restorative care provided for carious primary teeth in general practice.
- Presents audit data from a single GDP of a simplified method of placing preformed metal crowns, which does not involve LA or tooth preparation of any kind.
- Although the technique looks promising, the need for prospective randomised clinical trials before the technique is adopted, is stressed.

A novel technique using preformed metal crowns for managing carious primary molars in general practice – A retrospective analysis

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Background There is a high level of untreated dental decay in primary teeth in Scotland. Despite evidence for the efficacy of preformed metal crowns (PMCs) for the restoration of primary molars, few are placed in general practice, possibly due to the interventive nature of the clinical procedure. There is, however, a novel way of placing PMCs involving no local anaesthesia, no caries removal and no preparation of the tooth: the Hall technique.

Aim To investigate the survival of carious primary teeth treated with PMCs placed using a novel, simplified method – the Hall technique.

Setting General dental practice, in Scotland.

Methods A retrospective analysis of practice records from one general practitioner, from 1988 to 2001. The majority of the 978 PMCs fitted on 259 children, using the Hall technique, were placed when there was clinical evidence of approximal caries into dentine. The Kaplan-Meier approach was used to analyse survival times and the Mantel-Haenszel Log rank test for comparison between tooth types.

Results For all tooth types, the probability of surviving three years without being extracted or the PMC being lost, was 73.4% (95% confidence interval 70.1% to 76.4%), and for five years was 67.6% (95% confidence interval 63.3% to 71.5%). The probability of surviving without extraction alone for three years was 86.0% (95% confidence interval 83.2% to 88.4%), and for five years was 80.5% (95% confidence interval 76.5% to 83.9%).

Conclusion Hall technique restorations placed on primary molars with decay clinically into dentine, by a single operator in general dental practice, have a similar success rate to some other, more conventional, restorative techniques. The technique requires further evaluation through a prospective randomised control clinical trial before its use could be generally recommended.

INTRODUCTION

The management of carious primary molars in children is problematic. Evidence from clinical trials indicates that conventional

restorative techniques using amalgam, composite or compomer materials can be successful.¹⁻¹⁰ However, the majority of these trials were carried out in either secondary care or specialist private practices. A recent evaluation of restorations placed by general dental practitioners in the UK found far less favourable results¹¹ and, in fact, the justification and desirability of even attempting restorative management of carious primary teeth in general dental practice has been questioned.^{11,12}

Currently accepted best practice for the management of carious primary molars involving two or more surfaces is the placement of a preformed metal crown (PMC)^{13,14} and there is evidence to support this approach.¹⁵ However, PMCs are little used in general practice, comprising only 0.4% of all restorations placed in children's teeth in Scotland in 2001.¹⁶ Additionally, primary teeth commonly remain unrestored, especially in the younger child; the care index (the proportion of carious teeth which have been restored) is currently only 9% for 5-year-olds in Scotland.¹⁷ The high levels of dental disease in primary teeth, and its inadequate management, remains a major public health issue for children, and one with a significant impact on their lives; 15% of Scottish children have already had at least one tooth extracted by the age of five years old,¹⁷ and this rises to 42% by the age of eight years.¹⁸ In addition, many children are having to accept toothache as a part of their childhood; with nearly half of all children with decayed primary teeth reported to have attended their general dental practitioner with dental pain.¹⁹ Set against this background, there would seem to be some scope for the investigation of alternative approaches to the management of carious primary teeth. If an alternative technique was found to be simpler and more acceptable to children, their parents and general dental practitioners than the conventional restorative approach, yet just as effective, then it might be more readily applied in the general practice setting.

While carrying out an audit of child dental care in general practice in the Grampian region of Scotland, it became apparent that a general dental practitioner (NH) had been placing PMCs for many years using a novel technique. Standard teaching¹⁴ for the placement of PMCs requires the use of local anaesthetic, complete caries removal and tooth reduction mesially, distally and occlusally. Following this, crowns are crimped, trimmed and polished as necessary before cementation. However, the dental practitioner had been placing the crowns without local anaesthetic, caries removal or any tooth preparation at all. An appropriately sized PMC would

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Table 1 Outcome criteria for the Hall technique

Ascribed success	
Crown present	Date of the last examination before a child was lost to follow up, or if the arbitrary study cut off date of 1 January 2001 was reached with the crown still not 'extracted', 'lost' or 'shed'.
Tooth shed	Tooth shed with no further intervention. As the date at which primary teeth were shed was not recorded, it was decided, in order to allow survival analysis, to assume shedding of first primary molars at 10.0 years of age, and second primary molars at 11.0 years of age.
Ascribed failure	
Crown lost, tooth present	PMC became de-cemented.
Tooth extracted	Tooth required extraction. All symptomatic teeth were extracted. Some teeth were extracted for orthodontic reasons but as this was not recorded in the records at the time, these were all treated as failures.

Table 2 Outcome measures for 978 preformed metal crowns until failure or censor date

Ascribed success	n	%
Crown present	406	42
Tooth shed	336	34
Ascribed failure		
Crown lost, tooth present	124	13
Tooth extracted	112	11

Table 3 Outcome measures for 114 preformed metal crowns which were re-cemented following crown loss, until failure or censor date

Ascribed success	n	%
Crown present	53	46
Tooth shed	29	25
Ascribed failure		
Crown lost, tooth present	19	17
Tooth extracted	13	11

be selected and filled with glass ionomer cement before being seated over the carious primary molar using either finger pressure, or the child's own occlusal force. To avoid confusion, this technique will now be referred to as the Hall technique, and a typical case is shown in Figure 1. The dentist stated that in her experience, the Hall technique was acceptable to patients and parents, quick, and easy to use. It was also her impression that the technique was clinically effective in the management of carious primary molars, and she invited us to review her practice records to determine if this was the case.

AIMS AND OBJECTIVES

To investigate the survival of PMCs, placed by a single practitioner using the Hall technique, on carious primary molars.

MATERIALS AND METHODS

The practice records of a single dental practitioner (NH) were scrutinised by a trained data abstractor for all records relating to the placement of PMCs on primary molars. All PMCs fitted to primary molars during the period of 1 March 1988 until the cut-off date of 1 January 2001 were included in the analysis. During this 13 year period, all PMCs were fitted using the Hall technique, and cemented with glass ionomer cement (AquaCem, Dentsply). Radiographs were not routinely taken and crowns were usually only placed once marginal ridge breakdown due to caries had occurred. Crowns were not placed on any teeth with clinical signs or symptoms of pulpal involvement. The practice patient base was a mixed urban and rural population, with a regional dmft of 1.9 in 1997/98.²⁰

Most children had more than one tooth treated with the Hall technique. However, the data were analysed on the basis of each tooth rather than each child. Data collected included the tooth to which the crown was fitted, the date of fitting and the age of the child at the time. The outcome measure, and the date at which it applied, were also recorded. The outcome measures used are shown in Table 1.

The survival times were analysed using a Kaplan–Meier²¹ non-parametric test, commonly used in medical statistics with right-censored data. This is when there is no possibility of following to failure which, in this study, was when the teeth exfoliated or children were lost to follow up before 'extracted' or 'crown lost' outcomes occurred. The date at which data were censored was taken to be the last time at which the tooth was seen. Comparisons between tooth types were carried out using the Mantel–Haenszel Log rank test.²² Data were entered into a Microsoft Excel spreadsheet and analysed using Unistat (Unistat Ltd, Unistat House, 4 Shirtland Mews, Maida Vale, London W9 3DY) software.

RESULTS

During the study period, 978 PMCs were fitted to 259 children. The mean age of the children when the PMCs were fitted was five years nine months, with the distribution shown in Figure 2. The mean number of PMCs fitted per child was four, and the distribution is shown in Figure 3. The numbers of PMCs allocated to each of the four outcome criteria are shown in Table 2.

The results of the survival analysis are shown in Figure 4. For all tooth types, the probability of the PMCs surviving for three years (tooth not extracted or crown de-cemented), was 73.4% (95% confidence interval 70.1% to 76.4%) and for five years, 67.6% (95% confidence interval 63.3% to 71.5%). Analysis of the data indicated that there was no significant difference in PMC survival on first primary molars compared with second primary molars at three years or at five years.

The probability of a tooth surviving without being extracted (ie excluding crowns becoming de-cemented; 'lost') was 86.0% at three years and 80.5% at five years.

Of the 124 PMCs which became de-cemented, 114 (92%) were re-cemented and the outcome measures for these PMCs are shown in Table 3.

DISCUSSION

The reported success rate of conventional restorations in carious primary molars has ranged between 70%–95% after two years and 50%–93% after three years depending on the material used.^{1–10} The results of a recent systematic review²³ on the longevity of dental restorations in the primary and permanent dentition are shown in Figure 5. When compared with these data, the reported survival rate of the Hall technique (73.4% after three years and 67.6% after five years) would seem better than those reported for glass ionomer materials and broadly equivalent to those reported for composite materials. However, caution has to be exercised when comparing data on longevity of restorations from different clinical trials. Settings for such trials can vary from specialist private practices to community clinics, with very few being run in general dental practice, where the majority of child dental care is provided in the UK. In addition, the outcome measures for ascribing restoration success or failure can vary between different studies. A randomised control clinical trial, of split mouth design would allow a valid comparison to be made of the survival rate of the Hall technique against conventional restorations, and this trial is currently underway.

The similarity between the survival rates for some conventional restorations and the Hall technique is of particular interest as there was no attempt at even partial caries removal when using the Hall technique, the caries simply being sealed in beneath the PMC. There

is indirect evidence in support of this approach for primary molars from studies investigating the effectiveness of partial caries removal, followed by sealing the cavity with a restorative material, which report that caries progression was either arrested or at least significantly slowed down.²⁴⁻²⁷ Again, caution must be exercised when comparing retrospective clinical outcome audit data with data obtained from properly conducted, prospective clinical trials. Arguably, retrospective studies are one of the weaker types of research due to inherent problems with bias, calibration and other factors. Nevertheless, when analysing data in the current outcome audit, care was taken to ensure that whenever there was uncertainty in ascribing failure or censoring the data, the bias was against the intervention. For example, all extractions were recorded as crown failures, although some were for orthodontic reasons, or as part of multiple extractions under general anaesthesia. In addition, the censoring date was taken as the last date a patient was seen with the crown in place, rather than using the conventional practice of taking the middle of the interval between the crown last being recorded as present and a subsequent visit when it was noted to be absent.

Another factor which would tend to bias against the Hall technique is that the practitioner did not routinely use radiography to diagnose caries in children of this age. The PMCs were mainly only fitted to molars where the marginal ridge had fractured, a stage at which a majority of the teeth would have had histological evidence of pulpal involvement.²⁸ In contrast, many of the studies looking at the longevity of conventional restorative techniques did use radiography, which is known to allow caries to be diagnosed at an earlier stage than by visual examination alone,²⁹ and it might be assumed that the samples involved had a higher proportion of relatively early lesions compared with the Hall sample.

As the PMC is fitted with no tooth reduction, the occlusion would have been temporarily propped open. However, Dr Hall stated that the occlusion tended to equilibrate by the next recall appointment and none of her patients reported TMJ pain. Nevertheless, the effect of propping open the bite with a premature unilateral contact, which is inevitable with the Hall technique, will need further investigation through long term follow up with a prospective clinical trial, before any possible adverse consequences can be evaluated.

It could also be argued that the success rate of managing carious primary molars with the Hall technique is comparable with that obtained from a non-restorative approach as reported by Levine *et al.*,¹² and Tickle *et al.*¹¹ However, in these studies, 'failure' was ascribed if the tooth required either extraction or a course of antibiotics; otherwise, the management was described as successful. These are relatively extreme criteria compared with those used in the current study, where failure was ascribed not only if the tooth required extraction, but also if the PMC simply became de-cemented, and crowns in this category formed 53% of the 'failure' group. Of these PMCs, 92% were re-cemented and only 11% of this sample subsequently required extraction. It should also be noted, however, that the proportion of extractions to lost restorations in the 'failure' group for the Hall technique is considerably higher than for the clinical trials¹⁻¹⁰ previously referred to, although incomplete reporting of study results makes it difficult to ascertain accurate figures for some of these trials. Clearly, high quality, prospective randomised clinical trials in primary care are required to investigate the relative merits of the non-restorative, prevention-only approach; the Hall technique, and conventional restorative care.

An apparent advantage of the Hall technique over conventional techniques for managing carious primary molars is that it involves no local anaesthetic injections, caries removal or tooth preparation of any kind. It does, however, require a child to tolerate biting a rigid metal crown into position, through potentially tight contact points, without any local anaesthesia. In this study, all the crowns were fitted by one experienced practitioner (NH). In order to assess

Figs 1a and 1b Management of a carious primary second molar, using the Hall technique

Fig. 2 Distribution of children's ages (in years) at crown fit

Fig. 3 Distribution of numbers of crowns per patient

the generalisability of the technique, a pilot study of the technique has been carried out by the authors and reported in a web-based journal.³⁰ This showed that all patients, and the majority of parents and practitioners found the technique acceptable. However,

Fig. 4 Plot of survival function for crowns

Fig. 5 Estimates of longevity of dental restorations (in permanent and primary teeth) Reprinted with permission from *Evidence Based Dentistry* (Chadwick *et al.* 2002; 3: 96–99), Copyright 2002, Macmillan Publishers Ltd.

it must also be clearly demonstrated that the technique is effective in managing dental caries before its use could be generally recommended. A randomised control clinical trial is currently underway to determine the technique's efficacy and cost effectiveness.

The need for further investigation of alternative techniques for managing carious primary molars, such as a prevention-only approach, or the Hall technique, might be questioned in view of the fact that there are conventional techniques available of proven efficacy, recommended for use, and part of the standard teaching at all dental schools. However, the evidence indicates that these techniques, based on early diagnosis of caries assisted by the use of radiography, followed by conventional restoration involving the use of high speed hand pieces and local anaesthetic injections, are just not being applied in primary care. The carie index for 5-year-olds remains around the 10% level, as it has done for years, and too many children have to cope with dental pain and extractions as a regular part of their childhood. Ideally, all children should have access to high quality preventive and restorative care, but until that time comes, the need for exploration of alternative techniques which are simpler, and more acceptable to children, their parents and dental practitioners, remains.

CONCLUSION

Hall technique restorations placed over primary molars with decay clinically into dentine, by a single operator in general dental practice, have a similar success rate to some other, more conventional, restorative techniques. The technique requires further evaluation through a prospective randomised control clinical trial before its use could be generally recommended.

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