

The Hall Technique 10 years on: Questions and answers

N. P. T. Innes,^{*1} D. J. P. Evans,¹ C. C. Bonifacio,² M. Geneser,³ D. Hesse,² M. Heimer,¹ M. Kanellis,³ V. Machiulskiene,⁴ J. Narbutaitė,⁴ I. C. Olegário,⁵ A. Owais,³ M. P. Araujo,⁵ D. P. Raggio,⁵ C. Splieth,⁶ E. van Amerongen,² K. Weber-Gasparoni³ and R. M. Santamaria⁶

In brief

Discusses the development and acceptance of the Hall Technique.

Provides information on where to find out more about the Hall Technique.

Reports an overview of high quality evidence from randomised control trials supporting use of the Hall Technique in day to day practice.

It is ten years since the first paper on the Hall Technique was published in the *British Dental Journal* and almost 20 years since the technique first came to notice. Dr Norna Hall a (now retired) general dental practitioner from the north of Scotland had, for many years, been managing carious primary molar teeth by cementing preformed metal crowns over them, with no local anaesthesia, tooth preparation or carious tissue removal. This first report, a retrospective analysis of Dr Hall's treatments, caused controversy. How could simply sealing a carious lesion, with all the associated bacteria and decayed tissues, possibly be clinically successful? Since then, growing understanding that caries is essentially a biofilm driven disease rather than an infectious disease, explains why the Hall Technique, and other 'sealing in' carious lesion techniques, are successful. The intervening ten years has seen robust evidence from several randomised control trials that are either completed or underway. These have found the Hall Technique superior to comparator treatments, with success rates (no pain or infection) of 99% (UK study) and 100% (Germany) at one year, 98% and 93% over two years (UK and Germany) and 97% over five years (UK). The Hall Technique is now regarded as one of several biological management options for carious lesions in primary molars. This paper covers commonly asked questions about the Hall Technique and speculates on what lies ahead.

Questions

What is the Hall Technique?

The Hall Technique is a method for using preformed metal (also known as stainless steel) crowns to manage carious primary molar teeth, by seating a correctly sized crown over the tooth and sealing the carious lesion in, using a glass ionomer luting cement. Local anaesthesia is not required, tooth preparation is not carried out, and no carious tissue is removed (Fig. 1).

Although conventional preformed crowns are used to carry out the Hall Technique, and it is simply a different way of using these crowns, crowns fitted this way are usually referred to simply as Hall crowns. More information can be found on Wikipedia (https://en.wikipedia.org/wiki/Hall_Technique, as of 6 March 2017), where there is also a downloadable illustrated PDF manual explaining when to, and how to, carry out the technique from the corresponding author. Table 1 lists the indications and contraindications for the Hall Technique.

usage of crowns was reported in hypothetical case treatment plans, even amongst paediatric dentistry specialists. Tran stated that, 'Mastery of the crown continues to elude thousands of graduating dentists every year who, as a result of their discomfort, shy away from it and rely on huge amalgams to restore primary teeth.'² During an audit of paediatric dental service provision in the north east of Scotland in 1997, one general dental practitioner, Dr Norna Hall (hence the name the Hall Technique) was found to be the only dentist, out of 150 in the regional audit, regularly placing preformed crowns in children. During discussion, it became apparent that Dr Hall was using the crowns in an unconventional way – not placing local anaesthesia, removing caries or preparing the tooth. Dr Hall worked in an area with high levels of caries and low treatment acceptance. She had gradually adapted conventional crown placement to this technique in an attempt to respond to the demand for treatment that was quick, and did not involve local anaesthesia.

How did the Hall Technique come about and when did it start being used?

In the mid-1990s, it was generally accepted that crowns were the most predictable restoration for primary molars, rarely failing. However, in 1996 in Scotland, a total of only 164 crowns were fitted.¹ There is some evidence that this is not a dissimilar situation from other countries. In Australia in 2003, a relatively low

¹School of Dentistry, University of Dundee, Dundee, United Kingdom; ²Department of Cariology, Pedodontiology and Endodontology, Amsterdam, Netherlands; ³College of Dentistry, Iowa City, Iowa, United States; ⁴Faculty of Odontology, Lithuanian University of Health Sciences, Eiveniu 2, Kaunas, Lithuania; ⁵Dental School, Sao Paulo, Brazil; ⁶Zahnmedizin & Kinderzahnheilkunde, Greifswald, Germany

*Correspondence to: Professor Nicola Innes
Email: n.p.innes@dundee.ac.uk

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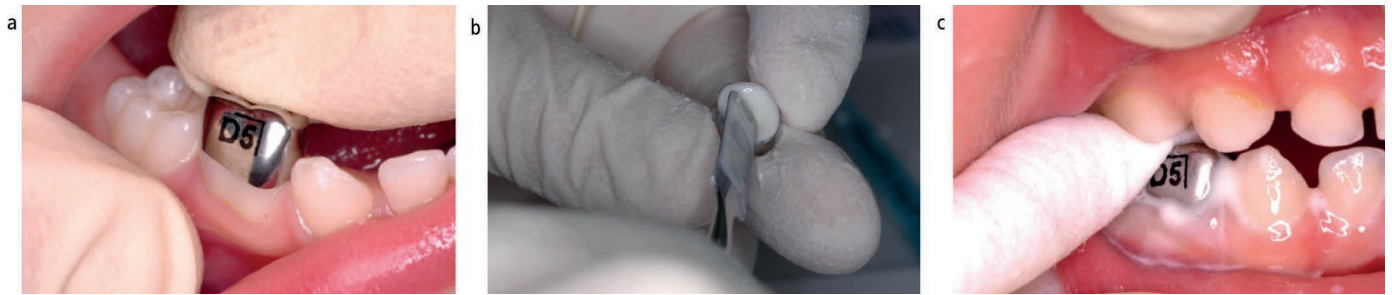


Fig. 1 Series of three photographs showing a crown being fitted to tooth 84 (lower right 1st primary molar). a) Different crowns are tried over the tooth until the correct size is found (covering the cusps and giving a feeling of ‘spring back’. Note that gauze is being used for airway protection. b) The crown is filled with glass ionomer cement. c) The crown is seated over the tooth (there is no local anaesthetic, tooth preparation or caries removal) and, in this case, the child has used their bite force to seat the crown with cotton wool to help distribute the force. The gingiva is blanching as the crown is sitting slightly subgingivally, further improving the seal and preventing the lesion progressing. Same child as Fig. 3

She also found that both crown placement techniques (conventional and Hall Technique) gave similar outcomes and her population found it comfortable and acceptable.³ From her meticulously kept and detailed notes, we were able to collect data and publish a retrospective analysis on the survival of the teeth she had been treating that way (now ten years ago) in the *British Dental Journal*.⁴

How can sealing caries into a tooth be successful?

A Hall Crown is a predictably successful restoration. When a carious lesion is sealed into a tooth, the biofilm (the community of microbes, their products and extracellular polymeric matrix) is physically prevented from accessing nutrition from its main substrate, dietary carbohydrate. This means that the actively carious/cariogenic lesion becomes a non-cariogenic lesion. Like other treatments aimed at managing carious lesions by sealing them in, a Hall crown works by depriving the lesion of fuel and making the environment unfavourable for its progression. The dental pulp lays down reparative dentine, effectively retreating in response to the advancing carious lesion. By sealing in the carious lesion, we are essentially tipping the balance in this race in favour of the pulp, with the aim of arresting the lesion before it advances far enough to cause irreversible inflammation of the dental pulp. It is worth exploring this change in our understanding of dental caries as this underpins the Hall Technique and is at the heart of changes in our management strategies.

The oral biofilm is one of the most complex biofilms of our human microbiome communities, and in health, has biodiversity, balance and stability in its community members.⁵ There is a

Table 1 Indications and contra-indications for (teeth) using the Hall Technique for managing primary molars with caries lesions assessed as at risk of progressing and causing pain/sepsis before exfoliation

Indications include teeth with:	Proximal lesions, cavitated or non-cavitated Occlusal lesions, non-cavitated if the child is unable to accept a fissure sealant Occlusal lesions, cavitated if the child is unable to accept selective caries removal
Contra-indications include teeth with:	Where no ‘clear band of dentine’ can be seen on a radiograph Signs or symptoms of irreversible pulpitis, or dental infection (sepsis) Clinical or radiographic signs of pulpal exposure, or periradicular pathology Crowns/teeth so broken down they would be unrestorable with conventional techniques Children where the airway cannot be managed safely

growing understanding that dental caries is a biofilm-driven disease resulting from a change in the relationship between our bacterial guests (who generally prevent pathogens from colonising us) and ourselves, when our intake of refined carbohydrate becomes excessive. This excessive intake, when it occurs, forces a change from a healthy, symbiotic coexistence, to a dysbiotic, imbalanced association.^{6,7} When environmental conditions change to reduce microbial diversity and stability (for example with an increase in dietary sugar, favouring the proliferation of aciduric and acidogenic species), an imbalance occurs; increased acid production overwhelms the local remineralisation systems, causing demineralisation of tooth tissue, and a carious lesion forms. There are many ways of controlling the demineralisation process, including (but not limited to): removing the biofilm; increasing saliva (quantity and mineralisation potential); adding fluoride; reducing sugar frequency through diet change; and, of course, physically blocking cariogenic biofilm from its substrate.⁸ This is how fissure sealants and crowns placed using the Hall Technique work.

The clinical relevance of this is that once the disease has become established, managing it

does not have to involve surgical eradication of the biofilm, carious tooth tissue and all plaque bacteria to stop the progress of the disease. Instead, maintaining a non-cariogenic biofilm, continually removing the biofilm through toothbrushing with fluoridated toothpaste and allowing tissue to remineralise, or moving a cariogenic biofilm to a non-cariogenic state will all be successful in preventing the ongoing demineralisation of tooth tissue.

Prefomed metal crowns (regardless of method of placement) have consistently been shown to perform better than restorations for the management of dental caries in primary teeth, and this is because of the high quality seal that can predictably be achieved.^{9,10} The Hall Technique can essentially be thought of as an extension of the indirect pulp cap (where the pulp has carious tissue left over it but is sealed in). This approach relies on obtaining a good seal, and a crown placed using the Hall Technique allows that good seal to be achieved, with a high degree of predictability. Whilst it is equally possible to seal a carious lesion into a tooth using a restorative material such as composites or glass ionomers, it is more difficult, especially in a young child, to achieve the same high quality of seal, especially in occluso-proximal cavities.

How well does it work?

Randomised control trials and controlled clinical trials, either completed^{13,11} or underway,¹²⁻¹⁷ have measured the acceptability and clinical success of the Hall Technique. If we measure 'success' as a lack of pain and infection (which is one of the key goals in caring for the child with dental caries) then the data show that after one year, placing a crown in line with the recommended indications (https://en.wikipedia.org/wiki/Hall_Technique – 2 March 2017), a high success rate even in proximal lesions can be expected. These published randomised control trials have found the Hall Technique as good as, or better than, comparator treatments with success rates (no pain or infection) of 99% (UK trial)^{3,11} and 100% (Germany) at one year,¹³ 98% over two years (UK 98% and Germany 93%) and 97% over five years (UK).¹¹ Figure 2 shows a radiograph of a tooth suitable for managing with the Hall Technique, where there appears to be a radiodense zone or 'clear band of dentine' between the carious lesion and the dental pulp. A retrospective analysis of 161 children attending Dundee Dental Hospital found that when the clear band of dentine is used as an indication, there is over a 97% chance of success in treatment over an average of 3 years (range 1-6 years).¹⁸

How do crowns placed using the Hall Technique compare with crowns placed using conventional techniques?

There are no randomised control trials that directly compare Hall Technique-placed crowns with conventionally-placed crowns. However, one retrospective study of a US paediatric practitioner's records has assessed success rates of conventional- and Hall Technique-placed crowns.¹⁹ Success was defined as no further treatment being required, the crown remaining in place and no pulp pathology (assessed clinically and radiographically). There was no statistically significant difference between either method for placing crowns. A total of 65 out of 67 Hall crowns (97%) were successful and 110 of 117 (94%) of conventionally-placed crowns were successful. Another US retrospective study,²⁰ also found high clinical and radiographic success for crowns placed on primary molars using the Hall Technique. At initial follow-up (mean time = 9.9 months), a success rate of 98.9% was observed both clinically (178 of 180 crowns) and radiographically (86 of 87 with radiographs available). At the second follow-up (mean time 20.1 months), 74 of 76 (97.4%) Hall crowns were clinically successful and 37 of 39 (94.9%) were radiographically successful.

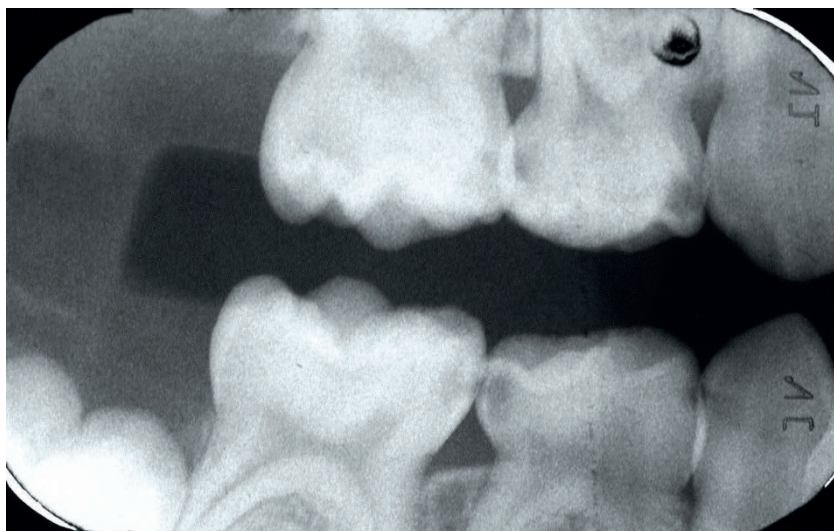


Fig. 2 Radiograph of a 5-year-old child showing tooth 85 (lower right 2nd primary molar) with a mesial carious lesion and tooth 84 (lower right 1st primary molar) with a distal carious lesion extending into dentine. The dentinal lesion is likely to be cavitated and needs to be managed. A 'clear band of dentine' is visible between the advancing edge of the lesion and the dental pulp and fitting a crown at this stage has a high chance of success

The success rate of the Hall Technique is consistently high, and as a treatment option, has been found to be preferred to conventional restorations by children and parents alike. For these reasons, it might be difficult to justify carrying out a direct comparison of full caries removal then conventionally placed crowns with Hall crowns. Given the high success rate and acceptability of the Hall Technique we should also begin to question why we would treat a child more invasively than we need to. Why use local anaesthesia and dental drills (which although generally safe, can be poorly tolerated by some children, and in the case of the high speed handpiece, carry the risk of iatrogenic damage to adjacent teeth), when there is a less invasive option?

What do children and parents think of the Hall Technique?

How well the Hall Technique is accepted by children and parents are questions that are commonly asked. To try to answer these questions, patient-centred outcomes such as discomfort reported by the child, dentist and parent have been investigated, as well as acceptability of the technique to parents. Overall, these studies have found that, when compared with other treatments, children preferred the Hall Technique crown or rated it as similar to other treatments, and parents preferred it to alternative treatments.^{3,21} Parents and dentists also rated the child's behaviour as positive when the Hall Technique was used.²¹

Low levels of child- and dentist-reported discomfort for the child during treatment procedures have been reported when compared with conventional treatment,^{4,21,22} non-restorative approaches and atraumatic restorative treatment. Also, children treated with the Hall Technique showed less negative behaviour compared to children having conventional treatment (using rotary instruments) and dentists considered it an easier, and quicker, procedure.^{3,21}

The final appearance of a metal crown can present a problem for some parents. In one UK study, when questioned about Hall crowns, objections to the appearance were reported by around 5% of parents.²³ However, children do not seem to mind the appearance and commonly report very positively on their crowns, referring to them as their 'special', 'shiny', 'space', 'princess', 'Iron Man', 'pirate' or 'star' tooth.²⁴

What happens to the occlusion when a crown is fitted using the Hall Technique?

One of the concerns with the Hall Technique has been the increase in the occluso-vertical dimension (OVD). Children do not seem to be concerned about this increase and although they appear uncomfortable at first, they seem to accommodate to the disruption in their occlusion quite quickly. Several studies have noted that this OVD increase (Fig. 3) resolves within a few weeks with no detriment^{21,25} and none have found any temporomandibular joint

pain even when parents have been specifically asked about this issue.

In a prospective study of 10 children's occlusions following placement of a Hall crown being fitted,²⁶ clinical photographs, study model and intra-oral measurement follow-ups were carried out at two weeks, six weeks and six months. There was a mean increase in the OVD of 1.1 mm immediately following crown placement. This reduced to 0.3 mm after two weeks, with the dentition appearing to have equilibrated to its pre-crown state, and staying at this level. It appeared that the compensation was mainly (although not completely) from the intrusion of the crowned tooth with some intrusion of the opposing tooth. There is no evidence of damage to the permanent successor.

Who uses the Hall Technique?

The Hall Technique is now being widely used in Australia, Belgium, Brazil, Chile, Germany, India, Netherlands, New Zealand, UAE, UK and the US amongst others. The technique is now taught in all dental schools throughout the UK, New Zealand, in many across Europe, in many graduate paediatric dentistry programmes in the UK, US, Australia, India and some South American and Middle East countries.

It is well accepted that transfer of any new healthcare intervention from research study to clinical practice can take many years.^{27,28} This challenge of speeding up adoption of a new treatment, once evidence has established its effectiveness, is probably the greatest one we face. How do we encourage clinicians to change their current practice and adopt new techniques or perspectives? There has been a great deal of controversy in the past over the use of the Hall Technique with emotion, misinformation and outdated ideas often being used in arguments rather than logic, understanding or evidence.²⁹ However, it seems fair to say that there is now little controversy over its effectiveness, and the fact that it should have a place in our armamentarium for paediatric dentistry. We do a disservice to the patients we care for if we do not offer them all the treatment options that are available.

For practitioners who treat children, and do not use the Hall Technique, the question to be answered is 'Why not?' While unfamiliarity with the Hall Technique is one logical reason, the overall lack of experience and comfort level with placing preformed metal crowns regardless of technique may be another. In 2015, Casamassimo and Seale reported that the average number of stainless steel crowns performed by graduating dental students



Fig. 3 The same child as Fig. 1. Anterior view of the dentition a) before the crown fit and b) 10 days after the crowns were fitted to teeth 84 and 74 (right and left 1st primary molars). Note that the occlusion has returned almost fully to its original state

in the United States was just 2.1 with a range of 0–10.³⁰ With such limited clinical experience in placing crowns it is easy to understand why graduating dentists are more comfortable placing amalgams and composites. It has been documented in the literature that when evaluating the same patient information and radiographs, general dentists are more likely to recommend multi-surface restorations for carious primary molars, while paediatric dentists are more likely to recommend preformed metal crowns.³¹ This is unfortunate since general dentists carry out most dental care for children and the long-term prognosis of these crowns in the primary dentition is superior to multi-surface restorations.^{17,32,33}

Are there aesthetic (white) crowns that the Hall Technique can be used with?

Although the appearance of the tooth due to stainless steel crowns has been found to be acceptable to children,²⁴ some parents do express concern over the aesthetics,^{23,24} and the availability of an aesthetic, tooth-coloured crown would be likely to increase acceptance and use of the technique.

However, in order to cement a crown without any tooth preparation, the crown material must have a certain plasticity and ductility, so that it can pass over the most bulbous part of the tooth without fracturing or permanently deforming, a quality that the preformed metal crowns possess.

Ceramics are one of the most commonly used materials for indirect restorations. However, they have low flexural strength values and fracture with little or no plastic deformation. Unfortunately, composite resins share this same property and this makes them unsuitable materials for placing a crown using the Hall Technique (without prior tooth preparation). Attempts have also been made to produce crowns with white facings overlying the stainless steel substructure but these have generally been found to fail, with the facings fracturing off for reasons similar to the ceramics and composite materials.

Unfortunately, it seems unlikely that there will be a white crown, with the properties required to allow it to be placed using the Hall Technique, in the near future. However, it is generally the parents who do not like the appearance and rarely the child who is being treated.

Why should a clinician choose to place a Hall crown?

Children who have limited ability to cope with restorative dental treatment are one of the main referrals to a paediatric specialist. A conventionally placed preformed crown can work almost perfectly, but it requires local anaesthesia, air rotor instruments to prepare the tooth and often, if a preparation is quite aggressive, a pulpal exposure, or close proximity to the dental pulp necessitates a pulpotomy. In many pre-cooperative children or those with disabilities, this is only possible under sedation or general anaesthesia, which has major impacts on the child, higher risks than chair-side treatment and also much higher costs. Thus, a technique which combines the advantages and high success rates of a crown without the drawbacks of the conventional, more invasive placement technique can reduce referrals to a specialist and many sedation or general anaesthetic events. In addition, the arrest of the carious lesion under the crown is in line with all other non-invasive caries treatments such as lesion inactivation through brushing, fluoride and silver diamine fluoride application.

In conclusion, with adding the Hall Technique to their armamentarium, general and family dentists as well as paediatric dentists gain a highly successful and well-received treatment option. Importantly though, in teeth with a plausible risk of irreversible pulpitis or periradicular periodontitis the Hall Technique should not be employed as an 'easy' way out, as failures will discredit the treating dentist and his/her choice of indication.

What is the impact of the Hall Technique?

Despite marked declines in caries in the past 30 years, dental caries in pre-school children continues to be a major health concern for populations worldwide and is a serious public health problem in disadvantaged communities.³⁴ In this context, the Hall Technique emerges as a change in the management of dental decay in children, since the technique is simple and less invasive, as it does not require local analgesia, carious tissue removal or tooth preparation. It has a reduced treatment time (compared to conventional crowns and to plastic restorations) and has been reported as more acceptable for children. The scientific evidence shows the high success rates as compared to conventional restorations, making it the most cost-effective restorative material³⁵ because it requires less frequent repair or replacement than multi-surface glass

ionomer cement, composite resin, or amalgam, suggesting it becomes one of the treatment methods of choice in the primary dentition to be carried out

With the effectiveness, and ease of placement, of Hall crowns proven, are they the answer to providing high-quality management of caries, in any environment?

The Hall Technique is one of a range of biologically-based options for managing dental caries that the clinician now has at their disposal. Traditionally, preformed stainless steel crowns were used to restore primary molar teeth with multi-surface carious lesions or where pulp therapy had been carried out. One systematic review³³ showed a superior clinical performance for preformed crowns versus amalgam for the restoration of carious lesions in primary teeth, with the failure rates being about three times lower for the crowns than for the amalgam restorations. As described above (Q5), The Hall Technique has also demonstrated high success rates compared to conventional restorations, suggesting that they become a treatment method of choice, for proximal lesions in carious primary molars.

Based on the accumulated evidence, and the relative success rates for managing occluso-proximal lesions, compared with other well-recognised minimally invasive techniques such as the atraumatic restorative technique,³⁶ it might be thought that the Hall Technique would be an obvious choice for use in environments with a lack of facilities and infrastructure, as it does not require an extensive dental armamentarium and is easy to use. However, great caution should be exercised in these situations before recommending the Hall Technique. As with all the biologically-based caries management options, excellence in diagnosis, treatment-planning and follow-up are imperatives for success, arguably more so than with conventional treatment. Even having correctly diagnosed and appropriately treatment-planned (and this should usually involve radiographic examination), Hall crowns are not a 'place and forget' technique. Teeth should show no symptoms of pulpal pathology, such as irreversible pulpitis when a Hall Crown is being considered. If, due to a failure in diagnosis, a Hall crown is inadvertently placed on a tooth with irreversible pulpal disease, or the lesion reaches the pulp and irreversible pulpal disease results, then this needs to be picked up promptly on review, and

attended to, with either pulp therapy through the occlusal surface of the crown, or extraction of the tooth.

What do we see for the Hall Technique over the next 10 years?

It seems that, at the moment, there is little need for further randomised control trials of the Hall Technique compared with a single other treatment option. This might seem strange to say as the question is often raised about the comparison between conventional- and Hall Technique-placed crowns. Whilst it might have been helpful to have had that data whilst the effectiveness of the Hall Technique was being proven, it now seems difficult to justify such a study as the success rates for both techniques are so high. Given that there is evidence that children prefer less invasive treatment, it is questionable what outcome of clinical relevance a study between Hall crowns and conventional crowns would give. Conventional crown placement with local anaesthesia and tooth preparation (or at least reduction of some tooth substance) still has a place in the dental treatment of children, for example, when the tooth needs to be modified to achieve a good crown fit, or a pulp therapy has been carried out and it is desirable to avoid any occlusal trauma. Also, when multiple crowns are being fitted in general anaesthesia cases, the use of conventionally fitted crowns, should be considered, or at least occlusal reduction carried out to avoid multiple crowns increasing the vertical dimension. So, the type of restoration prescribed should always be based on the clinical situation. Firstly, is a crown or a restorative filling material indicated? If a crown is indicated, is there a need to carry out any tooth preparation? Has there been pain/infection necessitating a pulp therapy, or can the Hall Technique be used?

Research is still needed around issues of costs to provide different treatments in various settings and relative costs saved as a result. However, now that the effectiveness of the Hall Technique and its acceptability to children has been shown, the most significant factor will be increasing appropriate use of the technique in practice. To increase the number of practitioners who use the Hall Technique, efforts should be directed in two directions: 1) increased opportunities for practitioners to hear about and learn about the indications for, and how to carry out, the Hall Technique. This could be through additional published research findings, increased course offerings at regional and national meetings, and undoubtedly

increased ongoing social media presence; and 2) integration of the Hall Technique into dental school curricula for predoctoral/undergraduate students. There has been a recent call for more training of general dental practitioners in the placement of stainless steel crowns in the United States.³⁸ In his editorial, Berg states that 'given the inappropriate use of large intra-coronal restorations in primary molars by practitioners who have not had the adequate training to more appropriately place stainless-steel crowns, it is clear there is a need to provide additional training for the general practitioner who intends to see children.' The Hall Technique offers a logical solution to this dilemma.

Conclusion

There is no single treatment option for caries management of the primary dentition. All children, every situation and each child's (and their parents') preferences are different; individual cases need individual care planning. The Hall Technique offers one treatment option amongst others for the management of carious primary molars – a very acceptable option to children, with high success rates especially for occluso-proximal lesions. It has become established as a part of our armamentarium over a relatively short period of time and widespread adoption of the Hall Technique looks extremely promising.

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