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Should Deciduous Teeth be Restored? Reflections of a Cariologist

Abstract: Whether deciduous teeth should be restored has caused controversy for at least 150 years and the argument rages on. Dental caries is a controllable process. The role of operative dentistry and restorations, as far as caries control is concerned, is to make cavitated, uncleanable lesions accessible to plaque control. However, deciduous teeth are exfoliated and perhaps non-operative treatments (plaque control, fluoride, diet) are all that are required to take cavitated teeth pain-free to exfoliation. Are such techniques child-friendly, obviating the need for anaesthesia or the use of handpieces? Alternatively, are they wanton neglect? This paper is written by a cariologist who never treated children, to present alternative managements and rehearse these arguments from a cariological perspective.

Clinical Relevance: This paper might serve as a discussion document for a group of dentists deciding practice policy with regard to the management of caries in deciduous teeth.

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A contemporary view of caries

The *caries process* is a ubiquitous, natural process occurring in the biofilm. This community of micro-organisms is always metabolically active, causing minute fluctuations in pH. Where oral hygiene is poor, sugar intake frequent and/or saliva flow diminished, the consequence may be a net loss of mineral and the formation of a visible *caries lesion* on the tooth surface. The lesion should be regarded as the *sign* or *symptom* of the process. However, with regular disturbance of the biofilm with a fluoride-containing dentifrice and a sensible, but not draconian diet, lesions do not have to form in the first place and established lesions can be arrested at any stage of lesion development.¹

However, in the absence of control, lesions cannot only form, but can progress until the tooth is destroyed and caries is the predominant cause

of premature loss of deciduous teeth. Untreated severe dental caries in pre-school children may affect their body weight, growth and quality of life. It has been reported that, following caries treatment, body weight increased and quality of life improved,² although the evidence is mixed. A recent study suggests that treatment of the caries may not, in fact, influence body growth.³ This study suggests that, while caries activity is a negative predictor for body growth in children, dental intervention does not lead to significant improvement of growth. There appear to be no studies suggesting that untreated, non-severe primary dentition decay cases (non-rampant caries) leads to significant effects on body weight or growth.

What is special about deciduous teeth?

The caries process is the same whether teeth are deciduous or permanent. However, the following are relevant to the discussion:

- Deciduous teeth are temporary: only in the mouth for 6–9 years;

- They are smaller, with broader contacts, the pulp chamber proportionately larger relative to the size of the crown. These dimensions means it takes less time for the lesion to reach the pulp in deciduous compared to permanent teeth;
- Loss of the deciduous second molar may cause crowding of permanent teeth;
- Their owners are immature;
- Their owners rely on parents for care;
- Frightening the child can have serious consequences for subsequent dental care;
- Pain in children is particularly worrying for parents as well as children.

What constitutes the treatment of caries?

Since the caries lesion is a symptom of the process in the biofilm, the main treatment of caries is to manage the biofilm so that a lesion does not form in the first place, or if it does form, it is arrested. Caries control majors on non-operative treatments. Note the use of the word 'treatment' to imply something that is skillful, time-consuming and worthy of payment.

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Is restorative care useful while the poor dental behaviour that caused the need for the fillings persists? Might it be better to achieve excellent cleaning before any operative treatment other than pain relief?⁴ It is interesting that the results of full restorative care under general anaesthesia are disappointing. This is probably the best example of the dentist taking responsibility for solving the problem by mending the teeth. However, new caries lesions develop in a few years' time.⁵⁻⁹ Perhaps this might be predicted, because responsibility for caries control in the young child must rest with the parent.

Who are the stakeholders in caries treatment?

The stakeholders in caries treatment will have valid opinions about what is acceptable, necessary and affordable. These opinions are important. The stakeholders are:

- The child;
- The parent;
- The dental team;
- Those who pay the cost of the management.

What is the role of the dental team in non-operative caries control?

The team is responsible for:

- Diagnosis of caries and assessing risk of progression. Important factors are: the activity of lesions, whether they are cavitated and whether any pulps are irretrievably damaged. A diagnosis of lesion activity is the best predictor of future caries experience.¹⁰ This prediction of caries risk allows the dentist to recommend an appropriate recall interval and choose the least invasive method of managing caries so that teeth exfoliate without symptoms.

- Counselling the parent on home care (oral hygiene and diet) to control caries.
- Provision of fluoride and fissure sealants.

What more might be needed?

Pain is always managed first. Teeth with symptoms of irreversible pulpitis do not settle after caries removal but require removal of the pulp or extraction of the tooth.



Figure 1. Non-restorative cavity treatment (NRCT)? (Courtesy of Rene Gruythuisen and BSL, Springer Media, Houten, the Netherlands.) **(a)** Caries in upper deciduous molars before NRCT. **(b)** Upper deciduous molars 6 months after NRCT. The caries lesions are arrested.

Pain-free, cavitated lesions that are not cleansable will progress because an undisturbed biofilm favours predominance of a cariogenic flora.¹³ Thus, something more may be needed if pain is to be prevented. The condition can be managed in a range of ways¹⁴ and we now enter a controversial area.

The possibilities are:

- No caries removal but open the lesion to allow cleaning;

- Sealing techniques with no caries removal;
- Partial caries removal and restoration and the atraumatic restorative technique;
- Complete caries removal and restoration.

Please note that every option involves non-operative treatment, as discussed above, to control lesion progression. The last three options also involve restorations which aid plaque control because the biofilm will again be at the tooth surface where it can be accessed and disturbed by a toothbrush.

No caries removal, but open the lesion to allow cleaning.

This approach, first advocated by GV Black, was re-examined 5 years ago.¹⁵ It has been called non-restorative cavity treatment (NRCT) because no filling is placed.¹⁶

The rationale is to open the cavity to make it accessible for plaque control rather than to mask caries activity by filling the tooth. When the cavity has been opened, fluoride varnish is applied to the carious dentine or, in a deep and sensitive lesion, a layer of glass ionomer cement is placed on the cavity floor. It may take more than one visit to open a tooth sufficiently, depending on the co-operation of the child. The technique is shown in Figure 1. The parent is shown how to clean away the biofilm regularly with a fluoride-containing toothpaste. In time, the lesion will arrest and the deposition of sclerotic and tertiary dentine is encouraged. Both processes will decrease tooth sensitivity. It is claimed that this management is child-friendly and tolerated by very nervous patients, without the need for a local anaesthetic, and that several carious deciduous teeth can be opened for cleaning in about 10 minutes.

The technique puts the responsibility for caries control with the parent. It is not a case of: 'I will cope with your child's caries by filling the tooth, you do not have to worry'; rather: 'You can control caries by keeping these teeth clean.' Even if the parents' compliance is not perfect, it is claimed that the technique slows down lesion progression so that the teeth may survive until shed. Slowing the process gives time to change parental attitudes. Counselling and/or motivational interviewing is an essential part of the

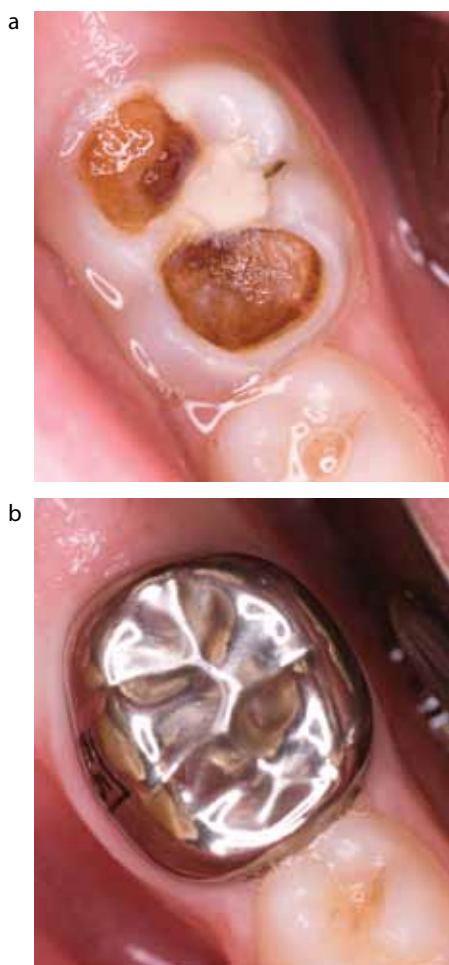


Figure 2. Lower right E before (a) and immediately after (b) fitting a Hall crown. (Courtesy of Nicola Innes and *Dental Update*).

technique.

Sealing in techniques with no caries removal

Fissure sealing over active white spot caries lesions has been practised for many years but, in 2006,¹⁷ a new technique for sealing cavitated lesions with stainless steel crowns was described, which at first seemed to break every rule in the book. A stainless steel crown was cemented, with glass ionomer cement, on to a symptomless deciduous tooth with no local anesthetic, no caries removal and no tooth reduction. The cemented crown was inevitably 'high on the bite' but, in time, the occlusion re-established. One study showed this to happen in 15–30 days.¹⁸ The crowns were shown to be very successful, in a retrospective analysis of the work of the



Figure 3. Indirect pulp capping. (Courtesy of Rene Gruythuysen and BSL, Springer Media, Houten, the Netherlands.) (a) Deep carious second lower deciduous molar before indirect pulp treatment. (b) Same tooth on bitewing. (c) After excavation of the dentine-enamel junction (DEJ). The biomass is still present in the centre of the cavity. (d) Removing biomass with a rotating prophyl brush and fluoride toothpaste only. (e) After removing the biomass. Next the cavity was dried, a resin-modified glass ionomer liner (Vitrebond/3M Espe) was applied, and the cavity was restored with a compomer (Dyract/ Dentsply Caulk). (f) Clinical result after 2 years and 4 months. (g) Radiographic result after 2 years and 4 months

one practitioner in Scotland who devised the technique. These crowns are called Hall crowns after this dentist (Figure 2).¹⁹ Subsequently, a randomized clinical trial of the technique was carried out in general practice. The technique was compared to

conventional intra-coronal restorations. At the operative visit, the Hall crown was preferred to conventional restoration by patients and parents, and two-year results have shown the crown to have a better clinical outcome.²⁰

Why might this technique work? It is known that the microflora in sealed carious dentine changes, with the predominating organisms no longer being cariogenic having been sealed from the oral environment.²¹ This may be important in the apparent arrest of caries progression.

Partial caries removal and restoration

The aim is to remove sufficient carious tissue to enable an effective marginal seal to be obtained before restoring with a bonded adhesive restoration which will inhibit further progression of residual caries. In the indirect pulp capping technique, most soft caries is removed, stopping just prior to exposure. This can be a difficult judgement, but the pulp's capacity to survive is remarkable. Some operators only remove the biofilm in the centre of the cavity with a rotating brush, leaving most of the infected dentine²²(Figure 3). When less caries is removed, teeth are sometimes re-entered following a period of weeks to allow further excavation prior to definitive restoration. This is called stepwise excavation.²¹ Incomplete caries removal, indirect pulp capping and stepwise excavation have all been shown to reduce the risk of pulpal exposure. This seems biologically logical because formation of tubular sclerosis and tertiary dentine are encouraged, both of which reduce the permeability of the dentine. This leaves the micro-organisms stressed and entombed by the seal of the restoration on one side and the reduced permeability of the remaining dentine on the other. The residual flora changes, there are fewer micro-organisms and those that remain are no longer cariogenic. One study has compared complete caries removal, guided by a caries dye, with partial caries removal. Re-entry after three months showed a similar flora, irrespective of the amount of demineralized dentine removed.²³ The atraumatic restorative technique should also be considered. It was originally developed to meet the need for restorative treatment in deprived areas where there was neither electricity nor running water.²⁴ Caries is removed with hand instruments and cavities and adjacent fissures are restored with glass ionomer cement. Class I restorations are reasonably successful but Class II restorations are



Figure 4. Second lower deciduous molar after loss of an ART-filling. The caries lesion is arrested, refilling is not necessary. (Courtesy of Carolien Boon and Nanda Visser).

prone to failure by loss or fracture of the restoration. A recent follow-up study of deciduous molar teeth, where restorations were lost, showed 66% with hard dentine. This makes the point that teeth with lost restorations have not necessarily failed (Figure 4).²⁵ Although the technique was developed for use in situations where there is no electricity, there is no reason why it cannot be used in a conventional dental surgery. There is some evidence that children find the cavity preparation, carried out with very sharp excavators, less stressful than the use of the drill.^{26,27} For this reason, the technique may be advantageous when there is dental fear and behavioural problems.

Complete caries removal and restoration

The aim is to remove all the infected carious tissue and restore the tooth to function. This approach is currently accepted as best practice by the British Society of Paediatric Dentistry,²⁸ but can be demanding of the child and the dentist, involving local anaesthesia, use of high speed handpieces and good moisture control. The complete removal of all soft caries will often expose the pulp and pulp therapy is then required if the tooth is to be saved. Small lesions are managed with intra-coronal restorations but larger lesions are restored, with stainless steel crowns having carried out the necessary tooth reduction.

Do not restore or open the tooth, leave it as it is because teeth are temporary

Many practitioners working within the general dental services in the UK are not restoring deciduous teeth. The proportion of carious teeth treated by restoration, fell in the 5-year-old population in England, from 24% in 1987 to 13% in 1998.²⁹ In Ireland, where there is almost universal water fluoridation, dentists employed in the public services may concentrate resources on preventive treatments and on the treatment of the permanent dentition, rather than restoration of deciduous teeth. This unconventional management in UK and Ireland has worried many paediatric dentists,³⁰ but has given an opportunity to assess the consequences of not restoring deciduous teeth.

In 2002 Levine,³¹ published a retrospective analysis of the records of 481 children managed by a dental practitioner in northern England. The practice policy was to concentrate on preventive treatment but not restore deciduous teeth. Of 1409 carious teeth analysed, 18% gave pain and were extracted or treated restoratively, but the remaining 82% exfoliated without the child attending the practice in pain. The risk factors for pain and infection were shown to be the development of multi-surface lesions in younger patients, disease extending beyond single surfaces, and disease in lower deciduous molars.³² The age at which the subject first presented with decay was a good predictor of outcome, representing the time available before exfoliation for decay to progress and cause symptoms. Retrospective analysis of the dental records of 677 children from the north-west of England, who were regular dental attenders of 50 general dental practitioners, have yielded some challenging results. These children were defined as a high risk group because they had approximal caries in their deciduous teeth.^{33,34} Over 80% of carious deciduous molars and 40% of carious anterior teeth were restored by these 50 practitioners. Twelve percent were extracted as a result of pain or infection and, the younger the child when caries was recorded in a tooth, the more likely was extraction as a result of pain or infection. Over 80% of carious deciduous teeth exfoliated without the child attending the practice complaining



Figure 5. Stainless steel crowns on one side of the arch and the NRCT approach on the other after 14 months. Question: Which technique is easier for the child, the parent? Which technique does the reader think sends the message to the parent that they are in charge? (Courtesy of Rene Gruythuysen and BSL, Springer Media, Houten, the Netherlands.)

of pain, whether filled or unfilled.

A disturbing fact was that, on a patient basis, 48% of the children experienced at least one episode of pain, irrespective of whether the teeth were filled or unfilled. The more teeth that were affected by decay, the more likely it was that pain would be recorded. This result seems to represent a shocking failure of dental care.

On the other hand, a study of nearly 7,000 5-year-olds in Scotland showed sepsis to be related to untreated decay as well as to deprivation.³⁵ Another retrospective study³⁶ analysed data from 5168 carious primary molar teeth from 2654 British children aged 4–5 years at baseline. The idea was to assess the effect of restorative treatment on the likelihood of carious teeth subsequently progressing to either exfoliation or extraction. Results showed filling carious teeth substantially improved the likelihood of subsequent exfoliation without extraction. The jury is out on the unconventional approach of relying on non-operative treatment alone to manage caries but, in view of how common this is in UK and Ireland, there seems an urgent need for a prospective study.

What factors are relevant to choice of management?

It seems that some factors are relevant to the choice of technique. These factors might include:

- Pain might make extraction preferable. The demeanour of the child should also

influence decisions: is the child fragile or robust?

- The size of the lesion and the age at presentation: the younger the child presents with lesions, the worse the outcome.

- A child-friendly and parent friendly approach.

- Avoiding pain/discomfort: some dentists consider techniques avoiding local anaesthesia (eg NRCT and Hall crowns) are helpful when dealing with nervous patients and may avoid treatment-induced anxiety in the first place. The sedation approach is a short-term expedient for getting the job done, but does nothing to help the patient overcome his/her fear in the long term.

- Encouraging behaviour change: all approaches require the parent to take responsibility for changing behaviour (brushing and diet). The open for cleaning approach (NRCT) does this in a particularly obvious way, whereas restoration initially masks the bad behaviour that caused the problem.

- The environment: modifying the environment to lower risk by preventive measures. The aim is to slow lesion progression sufficiently to allow un-restored carious teeth to exfoliate uneventfully.

- Cost effectiveness (time): the time taken in the various techniques is very important because time is money. There seem to be no studies comparing the time taken in the various techniques. Re-restoration of teeth is also expensive.

- Dentist's fees: these are linked to time taken. In the present Health Service system in England, the dentist will dread the patient with a lot of operative work to do as the fee (Unit of Dental Activity) is the same, one filling or ten. On the other side of the coin, how will the private dentist react to a technique which claims to carry out opening and cleaning of an entire dentition in ten minutes, compared with the time taken to restore the same dentition meticulously? There is much more money for the dentist in the latter approach. In both approaches, time must be spent in encouraging behaviour change.

- Skill of dental team: some operators may be more skilled with one technique than another and this may be relevant to the choice of technique.

- How many children are on the waiting list? When can this child be seen again? Time must be shared sensibly.

- Views of patients and parents. Perhaps this is of overriding importance and yet it is rarely assessed in research. The randomized technique is a notable exception. Figure 5 asks challenging questions and, as far as clinical trial of the Hall technique goes, the author knows research provides no answers.

Emotion and anger

This topic has aroused strong feelings over the years, particularly from some Specialist Paediatric dentists who are appalled at the idea of not restoring deciduous teeth³⁷ or not removing carious infected dentine, as in the Hall technique. Others believe that less interventionist treatments are more child-friendly and are equally appalled at potentially over-treating children and risking creating apprehension in the child towards future treatment. However, emotion must not be allowed to argue against the need for prospective scientific evaluation. The author hopes this paper will take some of the heat out of this hot potato so that we can reflect and discuss calmly, quietly and, above all, together.

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References

1. Fejerskov O, Kidd E. Preface: an editor's guide to reading the book. In: *Dental Caries*. Oxford: Blackwell Munksgaard, 2008: pxiii.
2. Sheiham A. Dental caries affects body weight, growth and quality of life in pre-school children. *Br Dent J* 2006; **201**: 625–626.
3. van Gemert-Schriks MC, van Amerongen EW, Aartman IH, Wennink JM, ten Cate JM, de Soet JJ. The influence of dental caries on body growth in prepubertal children. *Clin Oral Investig* 2010; Jan 29. E pub in press.
4. Amin MS, Harrison RL. Understanding parents' oral health behaviours for their young children. *Qual Health Res* 2009;

- 19: 116–127.
5. Almeida AG, Roseman MM, Sheff M, Huntington N, Hughes CV. Future caries susceptibility in children with early childhood caries following treatment under general anesthesia. *Pediatr Dent* 2000; **22**: 302–306.
 6. Clewett JA, Treasure ET. A retrospective study of dental general anaesthesia carried out in children living in North Wales 1995–1998. *Community Dent Health* 2004; **21**: 212–216.
 7. Drummond BK, Davidson LE, Williams SM, Moffat SM, Ayers KM. Outcomes two, three and four years after comprehensive care under general anaesthesia. *N Z Dent J* 2004; **100**: 32–37.
 8. Foster T, Perinpanayagam H, Pfaffenbach A, Certo M. Recurrence of early childhood caries after comprehensive treatment with general anesthesia and follow-up. *J Dent Child* 2006; **73**: 25–30.
 9. Amin MS, Bedard D, Gamble J. Early childhood caries: recurrence after comprehensive dental treatment under general anaesthesia. *Eur Arch Paediatr Dent* 2010; **11**: 269–273.
 10. Hausen H. Caries prediction. In: *Dental Caries*. Fejerskov O, Kidd E, eds. Oxford: Blackwell Munksgaard, 2008: pp527–541.
 11. Department of Health and the British Society for the Study of Community Dentistry. *Delivering Better Oral Health: An Evidence-Based Toolkit for Prevention* 2nd edn, 2009. Gateway Ref:8504.
 12. SDCEP Guide. Prevention and Management of Dental Decay in the Pre-school Child. Scottish Intercollegiate Guidelines Network 2005; www.sign.ac.uk/pdf/sign83.pdf
 13. Takahashi N, Nyvad B. Caries ecology revisited: microbial dynamics and the caries process. *Caries Res* 2008; **42**: 409–418.
 14. Prevention and Management of Dental Caries in Children. <http://www.sdcep.org.uk/index.aspx?o=2332>.
 15. Peretz B, Gluck G. Early childhood caries (ECC): a preventive-conservative treatment mode during a 12-month period. *J Clin Pediatr Dent* 2006; **30**: 191–194.
 16. Gruythuysen RJ. Non-restorative cavity treatment. Managing rather than masking caries activity. *Ned Tijdschr Tandheelkd* 2010; **117**: 173–180.
 17. Innes NPT, Stirrups DR, Evans DJ, 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**: 451–454.
 18. van der Zee V, van Amerongen WE. Influence of preformed metal crowns (Hall Technique) on the occlusal vertical dimension in the primary dentition. *Eur Arch Paediatr Dent* 2010; **11**: 225–227.
 19. Innes N, Evans D, Hall N. The Hall technique for managing carious primary molars. *Dent Update* 2009; **36**: 472–478.
 20. 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**: 18 <http://www.biomedcentral.com/1472-6831/7/18>.
 21. Kidd EAM, Bjorndal L, Beighton D, Fejerskov O. Caries removal and the pulpo-dentinal complex. In: *Dental Caries*. Fejerskov O, Kidd E, eds. Oxford: Blackwell Munksgaard, 2008: pp367–384.
 22. Grythuysen R, van Strijp AJ, Wu MK. Long-term survival of indirect pulp treatment in primary and permanent teeth with clinically diagnosed deep caries lesions. *J Endod* 2010; **36**: 1490–1493.
 23. Lula ECO, Monteiro-Neto V, Alves CMC, Ribeiro CCC. Microbiological analysis after complete or partial caries removal of carious dentin in primary teeth: a randomized clinical trial. *Caries Res* 2009; **43**: 354–358.
 24. Frenken JE, van Amerongen WE. The atraumatic restorative treatment approach. In: *Dental Caries*. Fejerskov O, Kidd E, eds. Oxford: Blackwell Munksgaard, 2008: pp427–441.
 25. Boon CP, Visser NL, Kemoli AM, van Amerongen WE. ART class 11 restoration loss in primary molars: re-restoration or not? *Eur Arch Paediatr Dent* 2010; **11**: 228–231.
 26. van Amerongen WE, Rahimtoola S. Is ART really atraumatic? *Community Dent Oral Epidemiol* 1999; **27**: 431–435.
 27. Schriks MC, van Amerongen WE. Atraumatic perspectives of ART: psychological and physiological aspects of treatment with and without rotary instruments. *Community Dent Oral Epidemiol* 2003; **31**: 15–20.
 28. Fayle SA, Wellbury RR, Roberts JF. British Society of Paediatric Dentistry: a policy document on management of caries in the primary dentition. *Int J Paediatr Dent* 2001; **11**: 153–157.
 29. Nugent ZJ, Pitts NB. Patterns of change and results overview 1985/6–1995/6 from the British Association for the Study of Community Dentistry (BASCD) co-ordinated National Health Services surveys of caries prevalence. *Community Dent Health* 1997; **14**: (Suppl 1): 30–54.
 30. Dugall M. Carious primary teeth in children: can or should they be left unrestored? *Faculty Dent J* 2011; **2**: 8–13.
 31. Levine RS, Pitts NB, Nugent ZJ. The fate of 1587 unrestored carious teeth: a retrospective general dental practice based study from northern England. *Br Dent J* 2002; **193**: 99–103.
 32. Levine RS, Nugent ZJ, Pitts NB. Pain prediction for preventive non-operative management of dentinal caries in primary teeth in general dental practice. *Br Dent J* 2003; **195**: 202–206.
 33. Tickle M, Milsom KM, King D, Kearney-Mitchell P, Blinkhorn A. The fate of the carious primary teeth of children who regularly attend the general dental service. *Br Dent J* 2002; **192**: 219–223.
 34. Milsom KM, Tickle M, Blinkhorn AS. Dental pain and dental treatment of young children attending the general dental service. *Br Dent J* 2002; **192**: 280–284.
 35. Pine CM, Harris RV, Burnside G, Merrett MC. An investigation of the relationship between untreated decayed teeth and dental sepsis in 5-year-old children. *Br Dent J* 2006; **200**: 45–47.
 36. Stephenson J, Chadwick BL, Playle RA, Treasure ET. A competing risk survival analysis model to assess the efficacy of filling carious primary teeth. *Caries Res* 2010; **44**: 285–293.
 37. Curzon ME. Supervised neglect – again! *Eur Arch Paediatr Dent* 2010; **11**: 51–52.