An audit of mineral trioxide aggregate in immature permanent incisors

BARBARA CHADWICK[1], EMMA HINGSTON[1], SIMON HAYES[2] & LINDSAY HUNTER[1]
[1]*Paediatric Dentistry Unit, Cardiff University, UK, and* [2]*Adult Dental Health, School of Dentistry, Cardiff University, UK*
chadwickbl@cardiff.ac.uk

Introduction The conventional treatment for immature non vital incisors is apexification with calcium hydroxide therapy[1], the reported success rate is around 90%[2]. The technique, however, is time consuming requiring multiple treatment visits and radiographs. Mineral trioxide aggregate (MTA) is an alternative treatment, in contrast to the slow and multiple stages required for conventional treatment. MTA sets within 4 hours, effectively producing an instant barrier[3]. The technique has the potential to save time for both patients and clinicians with the added benefit of reducing ionising radiation to the patient. It is also suggested that some of the complications of the conventional technique, for example the incidence of root fracture, may be reduced.
Aim This project was undertaken to determine the success rate of MTA used as an apical barrier in immature incisors in Cardiff.
Standards Currently there is little research with respect to MTA outcomes for non-vital immature teeth. Consequently our standard was set at 90% success rates. This figure is the reported success rates of calcium hydroxide therapy for apexification[2] and is an alternative treatment for these children.
Methods This study was a retrospective audit of paediatric patients (less than 16 years at commencement of treatment). All cases treated since January 2003 when the technique was first used in immature teeth in Cardiff and August 2006 were identified. Patient records and radiographs were reviewed by an experienced clinician to determine: tooth treated previous history, patient age, number of visits to treat, length of follow up, patient symptoms and success rates.
Results A total of 15 patients (ten male) with 17 treated upper central incisors were identified. All cases had a history of dental trauma. In nine cases (ten teeth) MTA was the first line treatment, four cases had previous unsuccessful calcium hydroxide apexification, a single patient (two teeth) was treated following failed calcium hydroxide pulp capping and one case followed a failed apicectomy. Two patients (three teeth) had a sinus at commencement of MTA therapy.

Mean age at treatment planning was 10.9 years (range 7.2–15.7). Eight teeth required two visits to place MTA, eight teeth required three visits; of these two had a sinus at baseline and two lost interim dressings. A single tooth, with chronic infection required four visits. The mean time to completion following treatment planning was 57.8 days (range 24–146 days). Several factors were associated with delays in completing treatment: infection at baseline, missed appointments, treatment waiting time for one clinician, problems with hospital booking system. Mean follow up for cases was 18.5 months (range 4–27). Following MTA final restorations were: six teeth palatal restorations only (one with bleaching), three teeth acid etch composite (one with bleaching), three teeth post-crowned, two teeth bonded crowns, two teeth composite post-system, one tooth had a veneer.

Two of the MTA treatments failed, giving a success rate of 88%. Both of these teeth had large radiolucencies when the MTA was placed that failed to resolve. In one case the radiolucency was identified 5 years after the original traumatic injury and did not respond to treatment, the tooth was extracted. The second case had been treated for over 2 years with calcium hydroxide therapy prior to attempting MTA. The radiographs showed an increasing size of radiolucency from baseline, the tooth was subsequently apicected.

Discussion The teeth treated in this audit were a heterogeneous group; being treated with MTA as a first line treatment and after failure of previous treatment (pulp capping, apexification, apicectomy). Long-standing infection was present in a number of cases and the technique was not standardized. Despite this, 88% of cases were successful. In this small sample, this is very close to the standard set for this audit. The number of visits to complete root canal therapy were reduced compared to conventional treatment but although only one tooth took more than three visits to place MTA the majority of cases still took over a year to complete. Delays were due to difficulties with the hospital booking system or missed appointments by patients, as apposed to difficulties with the MTA.
Action plan To improve success rates further we have instigated the following protocol: the two failed cases both had large radiolucencies, therefore in such cases evidence of periapical healing should be present before MTA is placed, as once set it cannot be removed via the root canal.

References

1 Finucane D, Kinirons M. Non-vital permanent immature incisors: factors that may influence treatment outcome. Endod Dent Traumatol 1999; **15**: 273–277.
2 Mackie IC, Bentley EM, Worthington HV. The closure of open apices in non-vital immature incisor teeth. Brit Dent J 1988; **165**: 169–173.
3 Torabiejad M, Chivian N. Clinical applications of mineral trioxide aggregate. J Endod 1999; **25**: 197–205.

Retention rates of fissure sealants placed under general anaesthetic

PETER DAY, SUSAN KINDELAN, KATY OLDFIELD & ROSEMARY BRYAN
Department of Paediatric Dentistry, Leeds Dental Institute, Leeds, UK
p.f.day@leeds.ac.uk

Introduction It is standard practice at Leeds Dental Institute (LDI) to review children at 3 months following comprehensive dental care under general anaesthetic. At this review appointment treatment provided is reassessed and appropriate preventive advice given prior to discharge back to a general dental practitioner.

In a recent Cochrane review[1], fissure sealants have been shown to be a very effective intervention in preventing caries in permanent molars. The review showed that after 4.5 years the sealed permanent molar teeth of children aged 5–10 years old had a reduction of decay in over 50% of biting surfaces compared to teeth without sealants. It is thus important to take the opportunity at the time of comprehensive dental general anaesthetic to fissure seal any caries free molars to reduce the risk of occlusal caries in this priority group of children. This is especially important when poor patient compliance renders this intervention impossible when the child is awake. It is essential that the fissure sealant is retained to ensure that this protective effect is maintained over time. Feigal[2], on reviewing two studies, concluded that partial loss of sealant leaves a tooth as susceptible to caries as an unsealed control tooth. Fissure sealant retention rates have been reported widely in the literature with one long follow up study reporting 28% complete retention at 15 years[3]. Retention rates for fissure sealants placed under general anaesthetic are difficult to locate in the literature. In a review of outcomes of restorative care under general anaesthetic[4] only 2% of fissure sealants had failed at a 4-year review.
Aim This audit was carried out to assess the retention rates of fissure sealants placed under general anaesthetic at a review appointment.

Standards At this recall appointment a minimum of 95% retention rate should be achieved. Retention rates of between 79% and 92% at 12 months have been reported[1]. In addition Fiegal's review of the literature suggested an approximate 5–10% fissure sealant loss from the occlusal surface per year[2].

Methods Following a review of the literature we elected to use the Simonsen[5] scale for assessment of fissure sealant retention. The scoring system was modified to record the presence of air blows and any catches of the probe by the fissure sealant as FS1: (i) FS0-absent; (ii) FS1-partially present on occlusal surface only; (iii) FS2-intact present on occlusal surface only (buccal and palatal pits present and left unsealed); and (iv) FS3-intact including the palatal and buccal pits and grooves if present.

Training. Prior to the start of the audit SK and KO viewed a sample of clinical photographs showing fissure sealants in different mouths, on different teeth with various levels of retention. Each fissure sealant was scored independently and then the pictures were reviewed by the assessors and agreement reached where any discrepancy arose.

Data collection. A standard data collection sheet was designed. At the review appointment the clinical records were examined to identify which teeth had been fissured sealed and the following information was recorded: date of treatment, operator grade (consultant, specialist registrar or postgraduate student), date of review visit and retention score for fissure sealant.

Examination. The audit was carried out during three dedicated review clinics between January and March 2007 in the paediatric dental department of LDI. Fifty patients were appointed for each review clinic, having been taken sequentially from the waiting list. After the dentists (SK or PD) had carried out a routine dental examination, KO clinically assessed the retention of any fissure sealants placed. This was carried out under standard conditions with a mouth mirror, standard dental overhead examination light, three in one (air and water jet) and dental probe (depending on the co-operation of the child). A score, as described above, was recorded for each fissure sealant placed at the time of general anaesthetic, including those placed over occlusal composite restorations.

Reproducibility. KO re-examined the photographs used for the original training 1 month later, this time alone and with no reference to the original scores. A kappa coefficient reproducibility score was calculated. No patients were involved in estimating intra-examiner reproducibility.

Results Eighty-three of the 150 patients attended for review, 50 of these patients had fissure sealant placed under general anaesthesia and were amenable to a dental examination. Between 1 and 14 fissure sealants were placed per patient and a total of 288 fissure sealants were assessed. The time lapsed between the date of the child's treatment and the date of their review appointment varied from 2 to 12 months with an average of 8.4 months.

Overall retention rate is shown in Fig. 1. Seventy five per cent of teeth assessed had fissure sealants retained on the occlusal surface (FS2 and FS3). Twenty-five per cent of fissure sealants were inadequate buccally, lingually and occlusally (FS1 and FS0) at recall. Figure 2 shows there was no significant difference (χ^2 test) between retention rates according to grade of operator (post-graduate students placed a total of 107 fissure sealants, specialist registrar 123 and consultant 46.

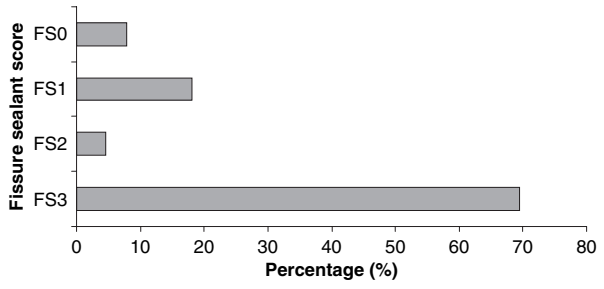

Fig. 1. The overall fissure sealant retention rates according to the modified Simonsen classification.

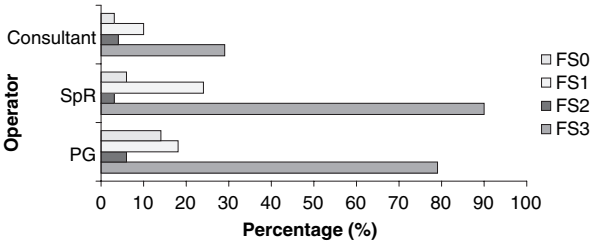

Fig. 2. The difference in fissure sealant retention rates between different operator grades using the modified Simonsen classification.

When retention rates were assessed for permanent versus primary dentition and for particular teeth within the dentition no significant differences were found. A significant difference was found for the retention of upper (84%) compared to lower (58%) primary molars ($P < 0.001$, chi-squared) but this difference per arch was not found in the permanent dentition. Kappa coefficient for intra-assessor reproducibility was 0.8, which shows a good level of agreement.

Discussion Although 150 patients in total were booked to be reviewed following comprehensive dental care under general anaesthetic only 50 were suitable for this audit. There was a high DNA rate. The remaining patients had no fissure sealants placed or were unexaminable and were therefore excluded. It is intended that patients are reviewed at 3 months following comprehensive care under general anaesthetic; however, the mean time to review was 8.4 months. This reflects current pressures within the department of centrally driven waiting times and clinic capacity. This audit data instigated a discussion within the department regarding whether this review appointment can in fact be offered for all patients given that important preventive care and advice is routinely provided prior to the general anaesthetic.

Complete retention (FS3) rates at 8 months were 69% for all fissure sealants placed and a further 23% of sealants were recorded as being partially present (FS2, FS1). Eight per cent of fissure sealants were completely lost (FS0) at this review appointment. These results fall short of the standard we originally set for this audit and therefore we need to examine the reasons for this. Other than poorer retention for lower primary molars there were no other factors relating to grade of clinician, permanent versus primary teeth, molar versus premolar, second primary molar versus first primary molar that were found to have a significant relationship with sealant retention. No robust explanation exists to explain why retention rates for upper primary molars should be significantly better than that for lower primary molars. The importance of retaining fissure sealants cannot be overstated. Consequently if time is spent providing fissure sealants under general anaesthetic optimal retention is essential.

In the LDI sealants placed under general anaesthetic are placed under rubber dam. For the few where this is not possible, cotton wool roll isolation is used. The material used for all cases was opaque Delton (Densply, UK). Routine pumicing of teeth is not used and only teeth with visible plaque are cleaned prior to application of fissure sealant. Therefore although moisture control should be optimal due to the patient being anaesthetized and applied under rubber dam retention rates still need to be improved. It has been shown that the use of dentine bonding agents (DBA) can benefit retention of fissure sealants especially on buccal and

palatal fissures[6]. This technique is now advocated by the BSPD guidelines[7]. This, however, is not standard practice for clinicians at the LDI.

Action plan This audit shows that fissure sealant retention at approximately 8 months review, following application under general anaesthetic, do not meet the current expected standard of 95% retention rate. Therefore the following recommendations are made: (i) to ensure careful application of fissure sealants under optimal moisture control including appropriate cleaning of teeth (either dry brushing or pumice and rotary brush[7]) prior to placement; (ii) routine use of dentine bonding agent[7] for fissure sealant application; and (iii) it is the intention of the group to re-audit fissure sealant retention after the adoption of this new protocol.

References

1 Ahovuo-Saloranta A, Hiiri A, Nordblad A, Worthington H, Makela M. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. Cochrane Database of Systematic Reviews 2004; Art No: CD001830.
2 Feigal RJ. Sealants and preventive restorations: review of effectiveness and clinical changes for improvement. Pediatr Dent 1998; **20**: 85–92.
3 Simonsen RJ. Retention and effectiveness of dental sealant after 15 years. J Am Dent Assoc 1991; **122**: 34–43.
4 Drummond BK, Davidson LE, Williams SM, Moffat SM, Ayers KM. Outcomes two, three and four years after comprehensive care under general anaesthesia. NZ Dent J 2004; **100**: 32–37.
5 Simonsen RJ. Retention and effectiveness of a single application of a white sealant after 10 years. J Am Dent Assoc 1987; **115**: 31–36.
6 Feigal RJ, Musherure P, Gillespie B, Levy-Polack M, Quelhas I, Hebling J. Improved sealant retention with bonding agents: a clinical study of two bottle and single bottle system. J Dent Res 2000; **79**: 1850–1856.
7 Smallridge J, Crawford PJ. Guidelines for the use of fissure sealants including management of the stained fissure in first permanent molars. [www document]. url: http://www.bspd.co.uk 2007; (in press).

The effectiveness of undergraduate and dental therapy students in treating children under local anaesthetic in a dental school setting

PETER DAY & ANDREW SHRIMPTON

Department of Paediatric Dentistry, Leeds Dental Institute, Leeds, UK

p.f.day@leeds.ac.uk

Introduction In 2002 the treatment provided and roles performed by dental therapists in the UK were extended. Therapists can now carry out all treatment on the primary dentition (except pulpectomies) and some treatment on the permanent dentition (simple filling where the caries does not involve the pulp). Consequently their training with respect to clinical experience is similar to undergraduate dental students[1]. Both undergraduates (UG) and dental therapists students (DTS) have limited exposure to paediatric dentistry and therefore it is essential to try and optimize this time[2] and identify appropriate children on which treatment can be carried out for teaching purposes.

Aim To retrospectively audit the effectiveness of DTS and UG in treating children under local anaesthetic in the Paediatric Department, Leeds Dental Institute (LDI).

Standards The authors could find no literature with regards to what level of success could be expected from UG and DTS for providing treatment under local anaesthetic. From the child's and the student's perception a 100% success rate would be beneficial to both. At some point in the student's education, however, realizing that not all children respond to treatment under local anaesthetic is important and will stimulate an awareness of alternative methods of providing treatment.

Table 1. The modified O'Sullivan Scale[3] for quantifying treatment planned and provided.

Score	Treatment
1	Fissure sealant, extraction (1°), premolar extraction (2°)
2	Preventive resin restoration (1 surface), occlusal composite, pulpotomy (1°), molar extraction (2°)
3	Stainless steel crown, Class 2
4	Anterior strip crown
5	Surgical extraction, RCT (2°)

Methods All paediatric patients seen on the undergraduate dental clinic from September 2004 to July 2005 were initially selected and each patient was assessed for suitability for this audit. The selection criteria were: (i) children had to have undergone a primary consultation on one of the consultant clinics and then be placed on the undergraduate waiting list for treatment by students. Patients who went directly for general anaesthetic or those who had previously had treatment at the LDI were excluded; (ii) children had received continuity of care by one student (DTS or UG); and (iii) children had no further appointments with the student (DTS or UG).

If the clinical records met the above criteria the following clinical information was collected: age at initial consultation, gender, proposed initial treatment plan, treatment provided, treatment outcome and operator (therapist or dental student).

The O'Sullivan Scale[3] was modified to take account of modern material and treatment provided on the clinic (Table 1). These modifications are very slightly different to the scale used in other studies investigating oral midazolam[4] to accommodate root canal treatment and the fact that amalgam is rarely used in the department. This scale has the benefit of giving a numerical value to treatment planned or achieved with a higher value indicating an increase in quantity and complexity of treatment.

Treatment outcomes: *success* was defined as a patient who had had all their carious teeth treated under local anaesthetic. A second group that were classified as successful were the planned failures. These were either children who were referred to a DTS who could not fully undertake the treatment plan as some treatment was outside their remit (e.g. the treatment plan included extraction of permanent teeth) or children who were booked for general anaesthetic for extraction of unrestorable teeth but referred to UG or DTS for restoration of other teeth prior to the anaesthetic. The *failure* group were children referred with the intention that all treatment be provided under local anaesthetic by UG or DTS. This group was sub-divided into children needing a general anaesthetic to complete all treatment or requiring referral to a member of staff and/or needing sedation or treatment was incomplete for whatever reason, e.g. patients failing to attend appointments.

Reproducibility of data collection: a random 10% sample of patient's clinical records was reassessed for reproducibility of the data collection. Both inter (PD and AS) and intra-operator (AS) agreement was assessed by collecting the clinical information discussed earlier at a different time point and then comparing it with the original data collection.

Results The study population consisted of 88 children aged between 3 and 14 years. DTS treated 19 patients compared with 69 treated by UG: (i) age: (mean and standard deviation); DTS = 6.9 ± 2.6 years (successful group = 7.2 ± 2.8); UG = 7.4 ± 2.6 years (successful group: 7.5 ± 2.8); (ii) gender: DTS = 11 male, eight female; UG = 37 male, 32 female; and (iii) outcome: using the