Clinical Effectiveness Bulletin

Editor: Chris Deery
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From the Chair It is a great pleasure to introduce the first Clinical Effectiveness Bulletin which has evolved from our former newsletter. This bulletin is the result of an enormous amount of work by Chris Deery and Peter Day.

The Policy and Clinical Effectiveness Committee has been a very successful Committee over the years, leading the initiation and development of a number of guidelines and policy documents. This year has seen the completion of two new guidelines. 'The use of General Anaesthesia in Paediatric Dentistry' will be a useful tool for those having to negotiate their services with Primary Care Trusts and other commissioning bodies. Our other new guideline 'Consent and the use of Physical Intervention in the Dental Care of Children' clarifies some of the confusion around consent for children and answers many questions concerning physical restraint for dental care. We also have a new policy document 'Dental Neglect in Children'. This is very helpful in the present climate when difficult questions are increasingly being asked of us by child protection teams about the role of untreated dental caries in cases of suspected child neglect.

New guidelines currently in production are 'Periodontal Diseases in Children', in collaboration with the British Society of Periodontology, and 'Oral Soft Tissue Lesions in Children'. Our guidelines and policy documents are informative and widely used and we are continuing to make them more robust and involve more people in their development. New ideas and volunteers to join guideline development groups are always welcome!

Deborah Franklin
Chair, BSPD Clinical Effectiveness Committee

From the Editor I hope you have enjoyed this Bulletin. The overall aim was to promote audit within the specialty, and by sharing information, forms and results make our clinical audit more effective in promoting good practice. I encourage people from all aspects of paediatric dentistry to submit reports from their audit projects (see guidance to authors at http://www.bspd.co.uk/clinical.html). I would like to thank our referees, those who submitted audits and Peter Day for his support.

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An audit of mineral trioxide aggregate in immature permanent incisors

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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.

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Retention rates of fissure sealants placed under general anaesthetic

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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.

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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.

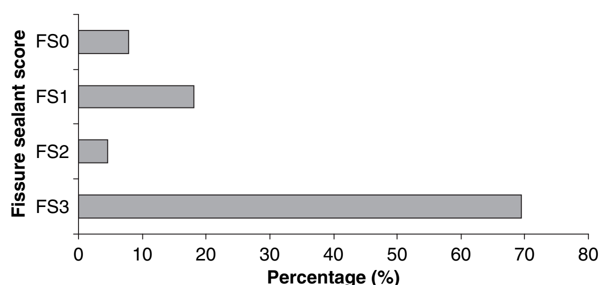

Fig. 1. The overall fissure sealant retention rates according to the modified Simonsen classification.

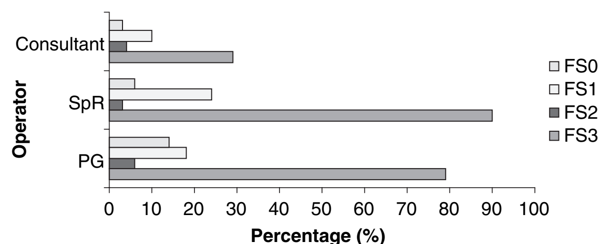

Fig. 2. The difference in fissure sealant retention rates between different operator grades using the modified Simonsen classification.

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

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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.

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

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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

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Table 2. The breakdown of numbers of children for the successful (highlighted) and failure groups for DTS and UG.

Outcome	Group	
	Dental therapist students, $n = 19$	Undergraduate students, $n = 69$
Success	9	29
Planned failure GA†	0	7
Planned failure therapist referral	2	0
Unplanned failure GA†	5	20
Unplanned failure other (sedation, staff)	2	4
Unknown (DNA*/PCA‡)	1	9

*Did not attend the appointment; †general anaesthetic; ‡patient cancelled the appointment.

success criteria defined, 11 of 19 (58%) children successfully completed treatment in the DTS group and 36 of 69 (52%) in the UG group. A more detailed breakdown of the success and failure groups is given in Tables 2 and 3.

Figure 1a,b show the quantity and type of treatment provided by UG and DTS. This treatment is broken down into treatment planned (for all children) and then treatment planned and completed (for those children who successfully completed treatment). Reproducibility of data collection for a random 10% sample was 94% for intra-operator agreement and 86% for inter-operator agreement.

Discussion As the number of patients treated by DTS is small in comparison to UG it is meaningless trying to interpret any difference in the success rates between the two groups. Due to the difference numbers of UG and DTS taught per year, a random sampling of the UG would be required to give equal numbers in each group. It is important that students with limited clinical time maximize their paediatric experience during their training[2]. Students frequently find paediatric dentistry stressful as not only are they learning new clinical techniques but they also have to manage their child patient in a limited time frame of cooperation. Consequently for some students their experiences are negative as despite their best efforts the child is unable to cope with a course of treatment under local anaesthetic. Therefore, it is essential to try and identify appropriate children for treatment by DTS and UG.

This audit shows that both UG and DTS successfully completed all treatment required under local anaesthetic in over 50% of cases. In addition UG and DTS provide similar amounts and types of treatment for their patients. When differences between *successful* and *failure* groups are compared the results help to identify children suitable for treatment by DTS and UG.

Children in the successful group were: (i) older; (ii) required less units of work using the modified O'Sullivan scale. It should be noted, however, that these children still required significant amounts of clinical treatment; (iii) received work on fewer sextants of the mouth. Similar results have been shown for oral midazolam sedation[4] and confirm as more sextants of treatment are need the number of treatment visits increase; and (iv) for the UG group only, those cases that did not involve extraction of permanent teeth.

Table 3. The mean modified O'Sullivan scores[3] for treatment planned and achieved and the number of sextants involved for UG and DTS patients overall and those in the *successful* group.

	Modified O'Sullivan Scores[3]		
	Treatment planned	Treatment completed	Number of sextants
Dental therapy students, overall ($n = 19$)	13 (±7.8)		3.5 (±1.2)
Dental therapy students, successful ($n = 11$)	12 (±7.9)	14.1 (±7.4)	3.2 (±1.5)
Undergraduate student, overall ($n = 69$)	16.6 (±8.4)		4.2 (±1.0)
Undergraduate students, successful ($n = 36$)	14.4 (±8.3)	16.7 (±8.4)	3.9 (±1.2)

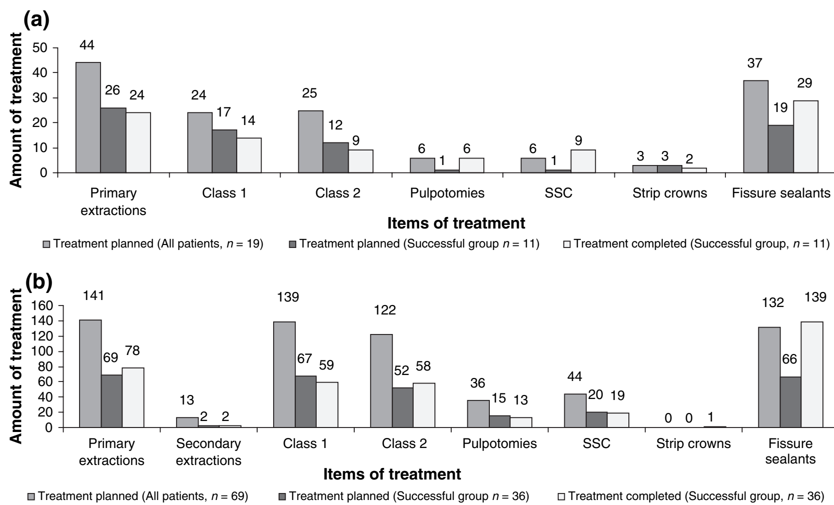

Fig. 1. (a) Dental therapists students treatment planned for all patients and treatment planned and completed for successful group. (b) Undergraduate treatment planned for all patients and treatment planned and completed for successful group.

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Action plan The findings of this study have led to changes in the referral criteria to the UG and DTS treatment clinics. This audit will be repeated in the near future to determine whether the change in referral criteria has made any difference to the proportion of children successfully completing their course of treatment under local anaesthetic.

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Provision of dental care for paediatric oncology patients at Brimingham Children's Hospital

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Introduction Childhood cancer is fortunately rare with the UK incidence rates being in the range of 110–150 per million children per year. One in 500 children will be affected during the first 15 years of life[1]. There has been a large reduction in mortality due to early diagnosis and improved treatment regimes. By the year 2000, one in 900 adults aged 16–34 were survivors of childhood cancer[2].

In 2005, The National Institute for Health and Clinical Excellence published a document; Guidance on Cancer Services *Improving outcomes in children and young people with Cancer*[3]. This evidence-based document acknowledged that cancer treatment can result in acute oral problems such as mucositis and other viral, bacterial and fungal oral infections. Later in life, previous cancer treatment can cause structural anomalies of the developing dentition. The document identified that oncology patients often have inadequate dental input during their illness and are later often lost to dental follow up[3].

Further publications from The United Kingdom Children's Cancer Study Group (UKCCSG) and the Paediatric Oncology Nurses Forum (PONF)[4] included evidence based guidelines about mouth care for children and young people with cancer. The audit was carried out to investigate the current provision of oral health care for these individuals further.

Aims (i) To establish how much need there is for specialist paediatric dental input for paediatric oncology patients at Birmingham Children's Hospital; and (ii) to aid in the planning of future service provision at Birmingham Children's Hospital.

Objectives (i) To determine the number of patients currently regularly attending a dentist; (ii) discover when their last visit to the dentist was; (iii) establish if oral health screening was undertaken before chemotherapy treatment commenced; (iv) ascertain if patients have received specialist paediatric dental input; (v) investigate the barriers to dental care subsequent to a cancer diagnosis; and (vi) explore whether information on the effects of cancer therapy to the oral cavity is provided for the families of individuals requiring cancer therapy.

Standards The recommendations made by NICE 2005 and UKCCSG-PONF 2007 were taken as the gold standard[3,4]:
(i) All patients are screened at the time of cancer diagnosis by a dentist and any required oral health treatment is carried out before commencing cancer therapy. This would be ideally by a dentist linked to the cancer centre; any treatment required should be undertaken by a consultant or specialist paediatric dentist; (ii) information on the effects of cancer therapy on the oral cavity should be given to all cancer patients and their families; (iii) during medical treatment a dental assessment should occur every 3–4 months by a dentist linked to the cancer centre but the patient should also retain registration and communication with the usual dental provider. Any treatment required should be undertaken ideally by a dentist linked to the cancer centre. If this is not available, then oral health treatment by the usual dental provider should occur with clear communication and guidance from the cancer centre; (iv) a named professional should be identified to coordinate care throughout cancer therapy and during the transition to adult services; and (v) there should be clear protocols and referral routes for dental care.

Methods Data were collected in the form of a questionnaire (available at: http://www.bspd.co.uk) from the parents/guardians of children attending the oncology clinic. Following piloting, the questionnaire was distributed to all parents/guardians of children already attending the oncology out-patient department.

Results Fifty-six questionnaires were completed by parents/guardians of children aged 0–16 years over a 4 month period. Of these 80% (45) had acute lymphoblastic leukaemia, 5% (3) chronic myeloid leukaemia and the remaining 15% (8) a mix of other cancer types. The majority of patients 89% (50) were receiving chemotherapy, 9% (5) other chemotherapy and radiation therapy and 2% (1) were being observed. Ninety-one per cent (51) of patient's parents/guardians reported their child to be registered with a general dentist with 86% (48) having attended for an oral examination in the last 12 months. Only 9% (5) reported to have specifically visited a dentist for an oral examination before starting cancer therapy. Twenty-seven per cent (15) were referred by the oncologist during cancer therapy to the dental specialities department for further dental treatment due to specific oral health problems. Four per cent (2) of general dentists were reported to have said they were uncomfortable treating the child due to the medical diagnosis. Thirty-six per cent (20) of families were unsure of the general dentists thoughts and 59% (33) said the general dentist was still happy to see their child. Fifty-two per cent (29) would prefer dental care to occur locally and 25% (14) preferred the hospital with the remainder showing no preference. Eighty-nine per cent (50) had received information regarding care of their child's mouth during cancer therapy and 66% (37) said the effects of the medical treatment on the child's mouth and teeth had been discussed.

Discussion Regular access to general dental services did not meet the gold standard as 9% (5) of patients reported not to have a dentist and only 86% (48) were examined by a dentist in the preceding 12 months. Children were not routinely screened for oral disease or potential causes of infection on the diagnosis of cancer. Only a small number received specific specialist paediatric dental care. These were patients referred during cancer therapy by the oncologist when they were having problems and were often then seen as an emergency. Regular oral assessment by a dentist during cancer therapy did not occur. The families were reasonably well informed regarding oral health care during cancer therapy and the effects cancer therapy may have on their mouth and teeth.

At the present time it was recognized that, unfortunately, not all the gold standard recommendations as created by UKCCSG-PONF[4] could be met within the dental specialities department at Birmingham Children's Hospital due to lack of funding and limited staffing levels.

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Action plan There should be clear protocols and referral routes for follow-up at Birmingham Dental Hospital for oral health care provision on the diagnosis of cancer.

A dental care pathway will be formulated including: (i) children are seen by a dentist before commencing caner therapy to screen for dental disease; (ii) if the child is registered by a primary care dentist this can be done locally. It has been suggested an information leaflet be created for the patients to give to the primary care dentist concerned explaining the need for dental input; (iii) for those patients with no access to a primary care dentist a specific referral form has been designed to refer the patient to the dental specialities department at Birmingham Children's Hospital; and (iv) dental therapy should be in an ordered and planned fashion allowing the child to be dentally fit before commencing cancer therapy therefore reducing the risk of dental infection during this difficult time.

Further audit is recommended at Birmingham Children's Hospital once the recent changes to the primary care dental services have been fully implemented.

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An audit on the presence of a final working length recording for patients undergoing apexification

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Introduction Apexification is defined as a method to induce a calcified barrier in a root with an open apex or continued apical development of an incomplete root in teeth with necrotic pulp[1]. Calcium hydroxide is commonly used for this procedure.

Calcium hydroxide is an irritant if it extrudes beyond the canal. If the material is short within the canal the barrier can form in an undesired location. The location of the calcified barrier is determined by the level at which calcium hydroxide meets vital tissue capable of hard tissue formation. To avoid a hard tissue barrier forming inside the canal the operator should ensure that the entire length of the root canal is filled with calcium hydroxide.

We encountered a small number of patients in the trauma clinic with calcium hydroxide dressings in the canal that were 'less than ideal' which may have affected the outcome of treatment. The majority of these patients had calcium hydroxide placed in the canal without a radiographic working length being established. In teeth with incomplete root formation with a wide open apex, granulation tissue can grow into the root canal especially if there is insufficient calcium hydroxide in the canal. Therefore a periapical radiograph to determine working length is necessary at the start of treatment.

Aim The aim of this audit was to ensure that all patients undergoing apexification in the Department have a final working length recorded by the end of the second treatment appointment for apexification.

Standards

Criteria	Target	Exceptions	Source of evidence
Patients undergoing endodontic treatment in the Department of Paediatric Dentistry should have an established a working length prior to instrumentation	100%	Nil	Mackie *et al.*[2] (3) Strength B

Methods Data were collected retrospectively by the audit lead from case notes of patients who had non-vital permanent incisors with open apices. The patients were undergoing apexification in the Department of Paediatric Dentistry. Data were collected for the first 50 cases treated from January 2004 on a dedicated proforma (hppt://http://www.bspd.co.uk). The staff involved in treating these patients included senior house officers, postgraduate students, specialist registrars, lecturers and consultants.

Results Of the 50 patients included in the study, six did not have a working length established radiographically by the end of the second appointment. Of the six patients who did not have a radiographic working length, four were treated by a postgraduate student and the other two by specialist registrar or lecturer.

Discussion As mentioned earlier, it is essential that a final working length be established prior to instrumentation. The literature shows that the remnants of the Hertwig epithelial root sheath (HERS), under favourable conditions organize the apical mesodermal tissue into root components. Over-instrumentation can disrupt the HERS and affect barrier formation. Overfilling or under filling of the canal with calcium hydroxide can cause irritation or barrier formation in an undesirable location. Hence the importance of a definite working length cannot be over-emphasized. The current audit highlighted that the standard had not been achieved.

Action plan A flow chart outlining the steps involved in the process of apexification has been placed on clinic to ensure that all staff are reminded to obtain a final working length prior to instrumentation. Re-audit carried out after 1 year showed a marked improvement in compliance. Only one patient of 50 did not have a radiographic working length prior to instrumentation.

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Continuing health care in patients treated for childhood malignancies

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Introduction The oral cavity is a site where complications frequently develop as a direct result of the malignancy or as an unwanted effect of treatment[1]. In the United Kingdom there are approximately 1200 new cases of childhood cancer each year. Up to 90% of the paediatric oncology patients may suffer oral

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complications with implications for quality of life during and after therapy[2]. Survival rates following cancer treatment have significantly improved in the last three decades. Dentists are increasingly likely to find that they have children in their care that may have been treated for malignant disease. At the Bristol Children's Hospital (BCH) the patients and parents/carers receive written advice regarding long-term effects of the anti-malignancy treatment they have received. However, patient information leaflets do not include advice regarding the current practices or warnings about the long-term dental effects of treatment.

Aim The current audit was carried out to ascertain the level of oral health knowledge and access to continuing oral health care for patients who have been treated for childhood malignancies at Bristol Children's Hospital.

Standards (i) Patients should have access to dental follow up after treatment for malignancy (NICE Guidelines, 2005)[3]; (ii) fluoride mouthwash should be used by patients over 6 years of age who are at high risk to caries (RCS Guidelines, 2004)[4]; and (iii) high fluoride containing toothpaste must be used by patients over 6 years of age who are at high risk to caries (BSPD publication, 1996)[5].

It was expected that the above standards should be met in 100% of the cases.

Methods A questionnaire relating to oral health awareness and current oral care practices was sent out to children who had undergone treatment for childhood malignancy at the Bristol Children's Hospital between the ages of 4 and 16 years and who were currently in remission. Of 125 questionnaires sent out, 40 were returned, of which 38 were included in the audit. Two questionnaires were excluded, as the forms were incomplete. A copy of the questionnaire is available at http://www.bspd.co.uk.

Results From the sample of 38 patients, six were 6 years of age or younger. Thirty-two children had assistance from their parents in completing the questionnaire. Twelve of thirty eight patients reported they had experienced problems with their teeth or gums as treatment for childhood malignancy had begun, of which five found it difficult to access dental care. Fifteen of thirty-two patients who were over 6 years old used high fluoride toothpaste and 4/32 used a fluoride mouthwash.

Only one patient had received information on the long-term effects of cancer treatment on his/her teeth and this was not provided by Bristol Children's Hospital.

Discussion These results suggest that the NICE and Royal College of Surgeons of England guidelines are not being followed for the children who are being treated for childhood malignancies at the Bristol Children's Hospital. Only one patient had received information on the effects on their oral health, and this was not from United Bristol Healthcare Trust. At least three of the children were not registered with a dentist. This audit shows that patients and their parents/carers do not have easy access to important information about oral health care.

Action plan An information leaflet containing information regarding oral hygiene practices, prevention of decay, monitoring and access to dental care has been produced, and is given all patients prior to discharge. Re-audit is planned after 1 year.

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A prospective audit of paediatric patients attending London Dental Hospitals with dento-alveolar trauma

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Introduction The purpose of this audit was to record the treatment carried for the management of dento-alveolar trauma by health care professionals compared to the gold standard of management as set out in local, national and international guidelines.

Aim The aim was to audit referrals made to the London Dental Hospitals, the source of the referrals and the management received up to the point of attending the dental units.

Standards (i) National guidelines: management and root canal treatment of non-vital immature permanent teeth[1]; treatment of avulsed permanent incisor teeth in children[2]; treatment of traumatically intruded permanent incisor teeth in children[3]; and (ii) International guidelines: Guidelines for the management of traumatic dental injuries I. Fractures and Luxations of permanent teeth[4] and Guidelines for the management of traumatic dental injuries II. Avulsions of permanent teeth [5].

Methods Over a 6-month period, children under the age of 16 years who were referred for the management of dento-alveolar trauma had details of their injuries and their management to date entered on a proforma. The types of injuries were classified into mild, moderate and severe for data analysis (Table 1). Data recorded included: delay in presentation, type of injury sustained, number of Health Care Professionals (HCP) seen and treatment received.

Results Eighty patients were audited of whom 29% were female and 71% male. Thirty-seven per cent of injuries were to primary teeth and 63% to the permanent dentition (Figs 1 and 2). The source of referral were; general dental practitioners = 55%, general medical practitioners = 4%, emergency dental service = 8%, hospital medical service = 24%, community dental service = 9%. Fifty-nine per cent of the injuries were seen in dental units within 24-hours further delay was between 24 and 3 months. The severities of the injuries as defined in Table 1 were mild (37%), moderate (28%) and severe (34%). Referral following

Table 1. Classification of dento-alveolar injuries according to severity[6].

Mild	Moderate	Severe
Enamel infraction Enamel fracture Enamel-dentine fracture Concussion Subluxation (horizontal movement)	Complicated crown fracture Uncomplicated crown-root fracture Root fracture in apical or middle one third without luxation of coronal fragment Subluxation (vertical movement)	Complicated crown-root fracture Root fracture in cervical one-third Root fracture in middle or apical one-third with luxation of coronal fragment Extrusion luxation Intrusion luxation Lateral luxation Avulsions

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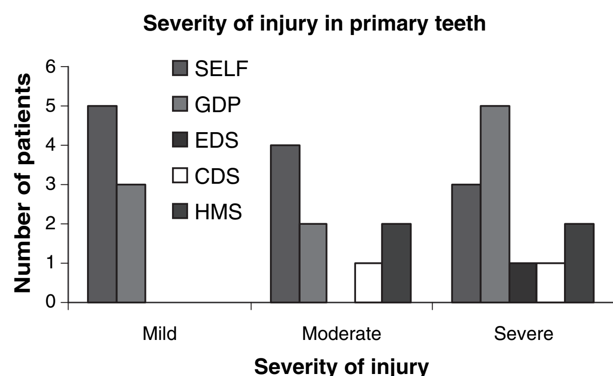

Fig. 1. The number of patients referred from different sources by severity for the primary dentition.
GDP = general dental practitioner; EDS = emergency dental service; CDS = community dental service; HMS = hospital medical service.

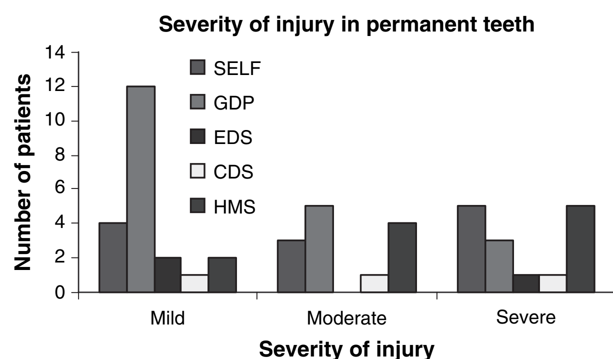

Fig. 2. The number of patients referred from different sources by severity for the permanent dentition.
GDP = general dental practitioner; EDS = emergency dental service; CDS = community dental service; HMS = hospital medical service.

trauma to the primary dentition consisted of mostly severe injuries whilst in the permanent dentition the referral pattern consisted of mild to moderate injuries (Figs 1 and 2). Most of these referrals were from dental colleagues. The management of all trauma was deemed inappropriate in 56% of cases seen by both medical and dental HCP (Fig. 3).

Discussion The results of this audit suggest that, in cases of trauma to a primary tooth, it is the more severe injury types which are being referred to the hospitals for management. However with injuries associated with the permanent teeth all three categories of mild, moderate and severe injury are all being referred to the hospital with a higher percentage in the mild group. This may be due to a lack of knowledge amongst dental colleagues in the primary care setting regarding the acute management of dental trauma (especially mild). A lack of knowledge amongst medical colleagues as to where to refer dento-alveolar patients may also have accounted for a delay in patients receiving specialist dental care. In broad terms, the findings of this audit would suggest that national and international guidelines on initial management of dento-alveolar trauma are not always adhered to in the Pan Thames region.

Action plan (i) Dissemination of information regarding care pathways for children who sustain dento-alveolar injuries; (ii) improving the undergraduate teaching to dental students in the correct management of dental trauma, especially mild trauma; (iii) improving dissemination of trauma guidelines to all HCP, via postgraduate education and Section 63 meetings; and (iv) education of medical colleagues on the initial management of dental trauma and where to refer children who have sustained dento-alveolar trauma.

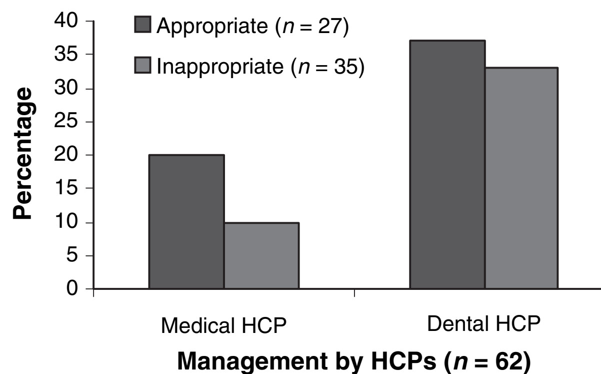

Fig. 3. The appropriateness of management of dento-alveolar trauma and the source of referral.
HCP = health care professional.

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Paediatric dental emergency referral patterns: before and after the new dental service contract

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Introduction Under the 'fee per item' system, children undergoing dental treatment in NHS practice were remunerated under a Capitation Scheme. In this system children were defined as: under the age of 18 years or students under 19 years and in full time education. In April 2006, a new primary dental care remuneration system came into effect, a banding system (Table 1). This applies to both adults and children, with the dentist receiving a fee from the commissioning Primary Care Trust (PCT) for the treatment.

Potentially, these changes may influence the number of patients being referred to the Paediatric Emergency Dental Department for routine work with or without pain. For example, if a young child requires multiple fillings and extractions, the dentist will receive

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Table 1. The different types of bands associated with the new NHS primary dental care contract 2006[1].

Band 1 – this covers preventative dental work, such as scaling and polishing and the provision of oral health advice.
Band 2 – this covers simple treatment, for example fillings and extractions.
Band 3 – this covers complex treatment, such as bridgework, crowns or dentures.
Under this new scheme, patients will make one single payment for their course of NHS treatment. For example, a patient requiring a filling would pay a single Band 2 payment which would cover both the initial examination and the filling.
Patients currently exempt from paying dental costs, such as children, expectant and nursing mothers, and those on income related benefits, will continue to receive free dental care.

one fee regardless of time spent, complexity or quantity of treatment carried out. In 2006, the 'out of hours' Emergency Dental Service (EDS) at Guy's hospital was closed. After consideration of all the changes within the General Dental Service contract and reduction of local emergency services, we suspected that many child patients would struggle to access treatment from their local General Dental Practitioner (GDP). Therefore, we predicted that this would lead to an increase in the numbers of written referrals from GDPs for routine and extensive paediatric dental treatment.

Aims The primary aim was to look at any changes in the written referral pattern of healthcare professionals to the Guys hospital dental emergency clinic following the introduction of the new contract. In addition, the audit sought to record the numbers of casual patients attending the emergency paediatric dental clinic without a written referral.

Standards There are no standards available for the number of written referrals that the department should receive. The authors are not aware of any similar audits or studies published to date. Ideally, the majority of patients should be referred by letter as acute cases that cannot be treated in a practice or community setting. It is expected that a small number of patients will attend as casual patients suffering from acute pain or trauma arriving without a written referral. The Guy's and St Thomas' NHS Foundation Trust criteria states the role of the emergency dental service as 'Guy's provides an emergency service for children with acute pain and infection, bleeding from the mouth or those suffering from dento-alveolar injury requiring urgent care'[2].

Methods This was a retrospective audit. The details of all patients seen and treated in the department including hospital number, referral source and treatment are logged daily in the paediatric emergency daybook. This daybook was used to identify patients that attended during a pre-contract period December 2005 to February 2006 and post-contract period December 2006 to February 2007, so that the new contract implemented on 1st April 2006 was in full use.

From the daybook, patients referred to the department by letter were identified and patient notes subsequently requested. Information from the notes was recorded onto an Excel database; this included patient age, hospital number, age at referral, date of referral, referral source and reason for referral. The data were independently verified by two of the authors to reduce errors.

Results A total of 74 referrals by letter were recorded in the daybook during both the pre- and post-contract period. Of the 74 sets of notes requested, only 62 sets of notes were available for analysis from the dental records department. Inaccuracies in recording patient details in the daybook, prevented the majority of missing notes from being located. Due to the information gained from the daybook, these 12 sets of notes belonged to patients with written referrals in the post-contract period. As they were incomplete, these 12 sets of notes were not been included in the audit. Others notes were unavailable due to misfiling, or were in use on patients currently undergoing treatment.

It was found that of the 62 sets of notes analysed, 32 written patient referrals were made during the pre-contract period, and 30 patient referrals were made during the post-contract period at the same time the following year. A total of 202 casual 'walk-in' patients were seen in the department during the pre-contract period and 289 in the post-contract period. Although the number of referrals by letter was similar pre- and post-contract, we noted the number of casual patients had increased by 43.1% compared with the same period the previous year.

It was noted that there was a reduction of 10% in written trauma referrals, an increase of 7% for caries, an increase of 50% for pathology (e.g. apthous ulerceration) and a reduction of around 50% for facial swelling in the post-contract period (Fig. 2). Overall, post-contract the mean age of children referred to the department was lower for all categories of referral (Fig. 1). For trauma and facial swelling written referrals, the mean age of patients was half of those referrals in the pre-contract period. Children with pathology had a mean age of 2 years post-contract compared to 6 years pre-contract. However, this initial audit had very small numbers of pathology referrals. In the pre-contract period, the majority of written referrals came from GDPs with less than 22% of the written referrals coming from hospital A & E departments. Post-contract all the written referrals were from GDPs (Fig. 2).

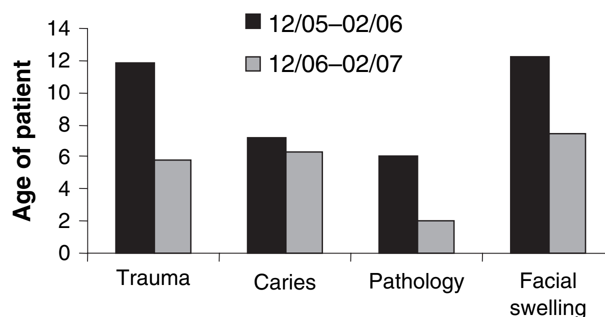

Fig. 1. The mean age of children referred by letter to a specialist paediatric dentistry center according to dental complaint.

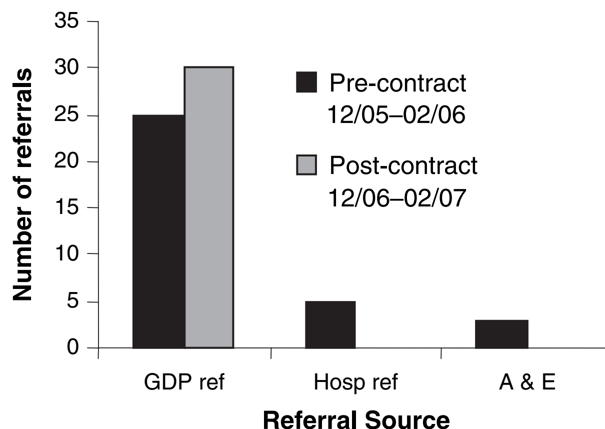

Fig. 2. The distribution of written referrals prior to, and following, the new NHS primary dental care contract 2006 to a specialist paediatric dental centre.

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Discussion The focus of the audit was the patient referrals to the paediatric emergency dental department by letter. Overall, the number of written referrals was small (approximately 30) and similar during both periods. Furthermore, it should be noted that the 12 sets of missing records belonged to patients with written referrals in the post-contract period. Had these notes been included in the study, this would have demonstrated an increase of approximately one third of written referrals; compared to the pre-contract period. It is difficult to explain why the trend regarding referrals for trauma and facial swelling was lower and pathology was higher in the post-contract period. Interestingly, an increase in the number of written referrals for children with caries of a younger average age was noticed. This may suggest that GDPs are reluctant to treat patients below the age of 6 years. However, caution should be exercised in interpreting this finding as the number of written referrals analysed for this audit was small.

It was noted that the majority of the patients attending the paediatric dental emergency clinic were casual attenders; possibly attending on the recommendation of another clinician. In conclusion, a small change in written referrals was noted between the pre- and post-contract time-frames. Due to the small numbers in the audit, it is not possible to determine the significance of this finding. However, the increase of over 40% casual 'walk-in' patients to the department cannot be ignored. The remit of this pilot audit cannot explain this 'snap-shot' increase and further investigation is warranted.

Action plan (i) The Paediatric Dental A & E daybook is crucial to finding patient details. To ensure that all the data required are recorded, we plan to re-design and update the departmental A & E daybook. A departmental meeting has already been held to re-train staff to complete the daybook more accurately and clearly; (ii) we plan to focus the audit data to include 'walk-in' patients to the paediatric dental emergency service to try and identify if they were they advised to attend by their GDP or another source; and (iii) the next stage of the audit cycle will be undertaken prospectively for the period December 2007 to February 2008. Data collection will be carried out daily to avoid the need to request large numbers of records at any one time.

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Referrals made to the dental hygienist from a specialist paediatric dentistry department

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Introduction This was a prospective audit of the referrals made to the dental hygienist in a 6-month period.

Aims The audit sought to determine whether: (i) the referral was appropriate; and (ii) the treatment to be undertaken had been accurately prescribed.

Standards Appropriate referrals were defined as those: (i) outlined in the GDC extended duties for dental hygienists and therapists[1]; (ii) consistent with the local protocol stating that the referral had to be prescribed by a Specialist Paediatric Dentist; and (iii) where the patient must have an increased dental need – e.g. medically compromised, cleft lip and palate, dental anomaly or trauma.

Methods A proforma was used to record the patients referred to the hygienist. Information recorded included: patient age, medical history, dental diagnosis, reason for referral and referring practitioner. To aid the referrals, a quick-fill referral plan was incorporated into the process. The proforma was made available on the clinic and the appointments made. At each patient visit the hygienist and audit lead evaluated the referral, its compliance with the local and national standards and the quality of referral.

Results Fifty patients were referred with a mean age of 10.6 years (range 2–16). Forty six referrals had accurately prescribed the treatment for the hygienist to undertake, leaving four with no treatment plan. Ninety-two per cent were referred by a Specialist in Paediatric Dentistry (Consultant or Associate Specialist), the remaining 8% coming from SpRs in orthodontics. Medically compromised children made up 62% of the referrals. Children with dental anomalies/trauma made up 62% of patients seen. All the treatments that were prescribed were within the remit of a dental hygienist.

Discussion The majority of referrals were appropriate. Clinicians on the whole appeared to be aware that all treatment plans must be written in nature. When this is not the case, patients are kept waiting for their care whilst the hygienist seeks the referring dentist. The main source of inappropriate referral was the orthodontic SpRs, as they did not comply with the local protocol regarding route of referral and created an unfunded service.

Action plan (i) Training sessions will be arranged to ensure all staff are aware of the national and local protocols; (ii) the current and new orthodontic SpRs will be made aware that all referrals to the hygienist must be through a Specialist in Paediatric Dentistry and meet the requirements of the local protocols; (iii) the hygienist will monitor all referrals with the aid of a log diary and feedback to the department; and (iv) the audit is to be repeated implementing these changes.

Reference

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An audit of dento-alveolar trauma presenting to five international specialist paediatric dentistry centres

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Introduction Reporting of the incidence and the prevalence of dento-alveolar trauma varies worldwide. This variation is in part due to the varied methods of data collection[1–6].

Aim The aim of this audit was to any variation in the presentation of dento-alveolar trauma at five international centres with standardized data collection.

Methods A retrospective case record study of clinical records was carried out. Data were collected using a machine readable data collection sheet in Brisbane (B), Melbourne (M), Sydney (S) and Dunedin (D) during student electives from Glasgow Dental School under the supervision of RW. Data were also collected in Glasgow (G) by GW. Dental trauma cases between 2002 and 2006 were included. A total of 858 clinical records were identified. Data collected included: gender, age at trauma, cause of trauma and classification of traumatic injury (WHO classification).

Results At all centres dento-alveolar trauma was more common in males (Fig. 1). Overall there were two age peaks identified at 0–4 years and 8–11 years for children presenting with dento-alveolar trauma, although there was variation between centres (Fig. 2). Most injuries occurred between July and September in Glasgow, January and March in Sydney, October to December in Melbourne and April to June in Dunedin. Allowing for the

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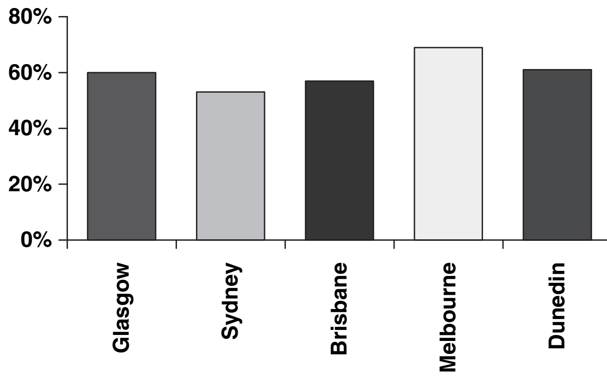

Fig. 1. The percentage of dento-alveolar injuries occurring in males at five specialist paediatric dentistry centres.

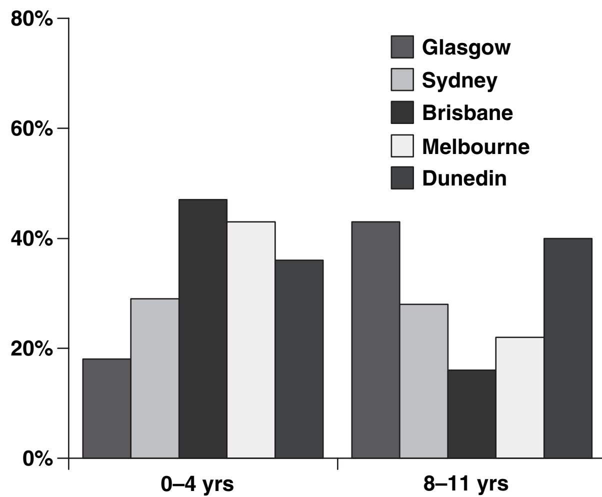

Fig. 2. Percentage of children presenting with dento-alveolar trauma at five specialist paediatric dentistry centres according to age range.

different months in the northern and southern hemispheres these periods mainly equate to summer time and longer daylight hours apart from Dunedin. The cause of the injury was investigated with falls (54% overall) being the most common followed by bicycle injuries (12% overall) and then sport injuries (11% overall). Injuries to the periodontal ligament were the most common form of injury at the different centres: 82% (G), 67% (S), 65% (B), 94% (D) at the different centres. Dental hard tissue injuries occurred in approximately half of the patients: 58% (G), 46% (S), 56% (B), 37% (M), 45% (D).

Discussion A large barrier to collect data for this sample was the wide variation in both quality and quantity of information about the traumatic injuries which was recorded in the patients' case records. This was irrespective of location. The data available, however, have many similarities in the presentation of trauma to the various centres. Injuries were predominantly during summer months in both hemispheres. Standardizing trauma data collection will facilitate future planning of trauma services worldwide. A copy of a standardized collection form is available at http://www.bspd.co.uk.

Action plan To encourage those collecting and presenting dento-alveolar trauma data to do so in a standardized manner to ensure data collection is contemporaneous and comparable between centres.

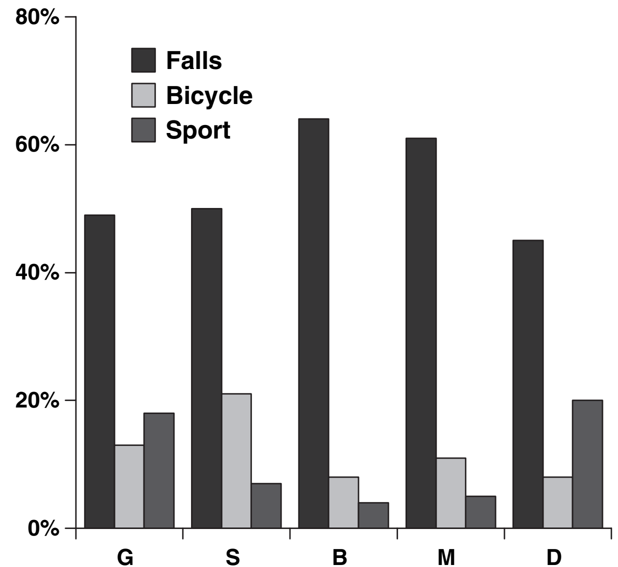

Fig. 3. The proportion of the three most common mechanisms of injury for dento-alveolar trauma presenting at five specialist paediatric dentistry centres.

Acknowledgements Nadia Ahmed, Saimah Ahmed, Richard Alexander, Jamie Cameron, Colin Forbes, Craig Murdoch, Adam Threlfall, Andrew Young and all colleagues in Sydney, Brisbane, Melbourne and Dunedin who collaborated in the project.

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