Further dental treatment needs of children receiving exodontia under general anaesthesia at a teaching hospital in the UK

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Summary. *Objectives.* The aim of this study was to investigate the subsequent dental treatment needs of children who had dental extractions under general anaesthesia (GA) in 1997 in the Day Case Unit at Leeds Dental Institute (LDI), Leeds, UK, and the reasons for repeat dental GAs (DGAs).

Study design. The authors conducted a retrospective longitudinal analysis.

Subjects and methods. Information collected from hospital records for the 6-year period following the first DGA included: reasons for the DGA in 1997 and teeth extracted; the number of subsequent DGAs, reasons and treatment; incidents of and reasons for toothache or swelling after 1997; treatment under local anaesthesia (LA) or inhalation sedation (IS) at LDI during the 6 years following the DGA in 1997.

Results. The study population consisted of 484 children, who received GA exodontia at LDI with a mean age of 6.35 years [95% confidence interval (CI) = 6.1, 6.6] and age range of 1–16 years. The most common reason for extractions at the original DGA in 1997 was dental caries, and the mean number of extractions was 4.24 (95% CI = 4.05, 4.43). Primary teeth extractions accounted for 82% of the cases. In total, 143 children (27.5%) had a record of follow-up treatment at LDI. Of these children, 32% had treatment under LA, 7% under LA and IS, and 15% received preventive care only. The overall repeat rate for DGA was 10.7%, with caries (84%) being the main reason for this. Of the teeth subsequently extracted, 72% were recorded as caries-free or unerupted at the time of the DGA in 1997.

Conclusions. A large proportion of the follow-up visits were to treat newly developed dental disease during the 6 years following the DGA in 1997. A more proactive approach towards preventive care may have resulted in the reduction of the development of new dental disease.

Introduction

Despite advances in preventive dentistry, there is still a high prevalence of dental caries in children in the UK. In most parts of the country, 40% or more of 5-year-old children have dental caries experience, and on average, those with decay have around four or more decayed teeth by this age [1]. Dentistry can be a fearful experience for young children, so many parents see the use of dental general anaesthesia (DGA) as an 'easy option', and prefer DGA to treatment under local anaesthesia (LA).

Over the past 2 decades in UK, there have been a number of initiatives and changes in regulations which have aimed to improve the safety of DGA. Recently, the Department of Health [2] recommended that DGA should be undertaken only when absolutely necessary. Following implementation of the Department of Health recommendations on the provision of DGA services, many studies dealt with the reasons of referral and the need for DGA using data from patient records up to the year 2000 [3-7]. Most authors reported that the main reason for the provision of DGA was the treatment of dental caries and its sequelae. In addition, many studies investigated the quality of the restorative treatment provided under GA [8-12], but there are relatively few studies examining the outcome for children who received exodontia under GA [3,4,13–15].

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This group of children is a particularly vulnerable group requiring careful treatment planning and monitoring, since only dental extractions and no restorative care are provided during the GA. Residual caries left untreated during a DGA, requiring a repeat DGA within 2 years, was reported by Harrison and Nutting in 2000 [15].

Morbidity following extractions under GA is common and has distressing consequences for young patients and their carers. In addition, deaths and critical incidents, although relatively rare, continue to occur in association with general anaesthesia (GA) for dentistry [2]. Therefore, the number of DGAs a child receives, as well as the age at which the first DGA is prescribed, is of great concern. Children who experience extractions of decayed primary teeth under DGA before their fourth birthday have a high risk of having a repeat GA within a short period of time [16].

It has also been reported that the pattern of the child's attendance following the DGA can play a significant role in the risk of a repeat DGA [11,17–19]. Furthermore, several studies have shown that the episodes of oral pain and infection which a child may experience are a sizable problem, and have substantial consequences for the children and their families [20–22]. However, no work has been carried out previously and there do not appear to be any studies reporting on the episodes of pain and infection, and the dental treatment received under LA, inhalation sedation (IS) and GA in the years following the administration of a DGA.

Therefore, it seemed appropriate to carry out a study to investigate the dental treatment provided under LA, IS and GA, and also the number of DGAs a child receives following the administration of the first DGA.

Objective

The aim of this research was to investigate the further dental treatment needs of children who previously received extractions under GA at Leeds Dental Institute (LDI), Leeds, UK, in 1997.

Subjects and methods

In order to obtain the comprehensive information, a retrospective longitudinal record analysis was employed. The study was considered and approved by the Leeds (West) Research Ethics Committee.

Study population

The study population consisted of all paediatric dental patients who had received a DGA at the LDI Day Case Unit during 1997. The criteria for the inclusion of a child in the study group were the following: age between 0 and 16 years; and having received DGA for extractions between 1 January 1997 and 31 December 1997.

The name of every child was marked and recorded. A list of the children was made in an alphabetical order, and each subject was allocated a unique personal code number. The dental records of each child in the study group were collected and the required data as presented in Table 1 was recorded in a file using the SPSS computer program (SPSS Inc., Chicago, IL, USA).

Intra-examiner reproducibility

A random selection of 5% of patients' personal identification numbers was performed using SPSS. Intra-examiner reproducibility was estimated with Kappa statistics for categorical variables and with Bland-Altman [23] plots for continuous variables.

Statistical analysis

Descriptive statistics and the SPSS package were used. The difference in means was calculated for the variables which were normally distributed. A confidence interval (CI) of 95% of the medians and the difference in the medians was used for the variables which were non-parametric [24].

Results

Study population

This study included the children from the 'extractions only outpatient DGA list' at LDI in 1997. In total, 484 children aged between one and 16 years were identified. There were 239 males and 245 females aged from one to 16 years, with a mean age of 6.35 years (95% CI = 6.1, 6.6). The results show that 27.5% of the children were 4 years old or younger.

The majority of the children in this study had no relevant medical history. The remainder had a variety of conditions, the main one being asthma. The most common reason for the administration of the Table 1. Data collected from dental records: (GA) general anaesthetic; (DGA) dental general anaesthetic; and (LDI) Leeds Dental Institute, Leeds, UK.

- 1. Age (according to the child's last birthday), gender and medical history
- 2. Any record of previous DGAs
- 3. Date of the DGA in 1997, the dental conditions related to the provision of the DGA and treatment carried out under GA
- 4. Number of recorded episodes of oral pain and infection, and interval since the DGA in 1997
- 5. The episode of and the reason for oral pain or infection was identified from the clinical notes and recorded. If the episode was toothrelated, the tooth involved was identified and its status at the time of the DGA in 1997 was determined from the dental charting carried out prior to this DGA
- 6. The pattern of child's attendance at LDI following the DGA in 1997, as follows:
 - (a) discharged and no follow-up records;
 - (b) regular follow-up attendance at LDI for review, prevention or operative dental treatment;
 - (c) irregular attendance;
 - (d) occasional visits or missed appointments;
 - (e) casual attendance only when in pain and/or having an infection;
 - (f) did not attend any further allocated appointments; and
 - (g) re-referral by the general dental practitioner
- 7. Follow-up treatment under local analgesia or inhalation sedation at LDI until 31 December 2003, and status of the teeth treated, as charted at the pre-GA assessment appointment in 1997
- 8. Treatment received under repeat DGA until 31 December 2003, number of repeat DGAs, interval between the repeat DGA and the DGA in 1997, and the dental conditions related to the provision of the repeat DGA

DGA in 1997 was treatment of dental caries (90.8%), followed by orthodontic treatment (4.5%), dental trauma (2.9%), molar incisor hypomineralization (MIH) (1%) and other pathology (0.8%). Of the children in the study group, 14.8% had at least one recorded previous DGA.

Treatment received under the DGA in 1997

The mean number of dental extractions per child was 4.24 (95% CI = 4.1, 4.4). The results showed that 5.6% of the children had single tooth extractions, which were mainly caused by acute symptoms.

The majority of children (82%) received extractions of primary teeth only, 11·4% received extractions of permanent teeth only, and 5·6% of children received both primary and permanent teeth extractions. The remaining 1% received removal or replacement of sutures, or extractions of supernumerary teeth. The mean number of primary teeth extracted per child was 4·35 (95% CI = 4·1, 4·6), and that of permanent teeth extracted was 3.0 (95% CI = 2·7, 3·3). At least one first permanent molar was included in the extractions of 69 children (14·2%).

Episodes of oral pain and infection following the DGA in 1997

Child outcome. The results revealed that 70 children (14.5%) of the study group) had presented with a

toothache and/or swelling at least once in the 6 years following the DGA in 1997 (and 4.3% on repeated occasions). Out of the 70 children who were subsequently recorded to have experienced oral pain and infection, 32 (46%) received a repeat DGA. The interval between the DGA in 1997 and the subsequent episodes of oral pain and infection ranged from 0 to 74 months, and the median time elapsed to the first episode was 20 months. The majority of the episodes of oral pain and infection were recorded within the first 3 years following the DGA in 1997, with the highest prevalence of episodes during the third year (Fig. 1).

Tooth outcome. Of the 111 episodes of oral pain and infection recorded, 96 were tooth-related. The majority of the teeth involved in the episodes of oral pain and infection were not related to previously recorded dental caries, since nearly two out of three of the teeth were either caries-free or unerupted at the time of the DGA in 1997 (Fig. 2).

Dental care provided following the DGA in 1997 other than repeat DGA

Immediate disposal of children subsequent to the DGA in 1997. Following the DGA in 1997, 386 children were discharged and no follow-up appointment at LDI was allocated to them. Subsequently, 48 of those previously discharged children re-attended LDI. In total, 143 children (27.5% of the study



Fig. 1. Number of children who reported oral pain and/or infection, and number of children who received a repeat dental general anaesthetic (DGA) during the years following the first DGA in 1997. ■ Repeat DGAs ■ Episodes of oral pain & infection



Fig. 2. Status at the dental general anaesthetic in 1997 of the teeth which were subsequently related to episodes of oral pain and/or infection.

group) had follow-up visits reported in the LDI notes subsequently to their DGA in 1997.

Pattern of attendance at LDI following the DGA in 1997. Of the 143 children who re-attended LDI, 52

attended regularly for prevention or operative dental treatment, 61 attended irregularly (i.e. missed appointments, or made occasional or casual visits to LDI), and 27 were referred back to LDI by their general dental practitioners (GDPs) for dental treatment at LDI months or years after the DGA in 1997. Table 2 shows the difference in patterns of attendance, experience of oral pain and infection, and repeat between children registered and not registered with a GDP.

Restorations and/or extractions under LA/IS at LDI following the DGA in 1997

Child outcome. Of the total number of children in this study group, 67 had a record of subsequent restorations or extractions with or without LA, or under IS at LDI. The number of children and the status at the DGA in 1997 of the teeth (primary and permanent) subsequently treated under LA or IS are shown in Fig. 3.

Only 46 children received treatment under LA, 10 received treatment under IS and LA, and seven children received treatment without LA or IS being recorded. Four children had their treatment abandoned under LA or IS because of apprehensiveness of the child.

Tooth outcome. A total of 193 teeth were restored, and 21 were extracted. The status of these teeth at the time of the DGA in 1997 can be seen in Fig. 4.

Discussion

The study group included the children from the outpatient DGA exodontia list in the year 1997 at LDI. The reasons being, first, to include children from all age groups who received straightforward DGA exodontia, and secondly, the fact that the children from the outpatient exodontia DGA list

Table 2. Children who were immediately discharged from Leeds Dental Institute (LDI), Leeds, UK, and subsequently re-attended after the dental general anaesthetic (DGA) in 1997: (GDP) general dental practitioner.

Children who were discharged	Children registered with a GDP (total number = 267)		Children not registered with a GDP (total number = 119)	
	Number	Percentage	Number	Percentage
Children who re-attended LDI	32	12	16	13.4
Re-referral by GDP	23	8.6	4	3.4
Casual attendance	9	3.4	12	10.0
Experience of oral pain and infection	20	7.5	14	11.8
Repeat DGA	17	6.4	9	7.6

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Fig. 3. Recorded dental status of the teeth which were subsequently treated under local anaesthetic/inhalation sedation (LA/IS) following the initial dental general anaesthetic in 1997: (GDP) general dental practitioner. ■ Carious teeth not planned to be restored; ■ Carious teeth referred to GDP for restoration; ■ Carious teeth planned to be restored under LA/IS; ■ Caries free/restored; □ Unerupted





Fig. 4. Number of teeth, and status at the dental general anaesthetic in 1997 of teeth which were subsequently restored/ extracted under local anaesthetic/inhalation sedation: (GDP) general dental practitioner. ■ Teeth restored; ■ Teeth extracted

were usually referred by their GDPs for extractions under DGA, and thereafter, the majority of the children were discharged with no further follow-up. The decision to provide exodontias only, rather than restorative care under DGA, was based on individual clinical grounds. The year of 1997 was selected as the year preceding the General Dental Council revised guidance of 1998 [25]. It also allowed for 5 years of follow-up, since shorter studies have shown low repeat DGA rates.

The present study group comprised 484 children, which was larger than the groups in the studies by Landes and Bradnock [16], which included 309 children, and Harrison and Nutting [15], but smaller than the studies by Smallridge *et al.*, Holt *et al.*, Grant *et al.* and Holt *et al.* [3,4,6,14]. However, none of the aforementioned studies investigated the further dental treatment needs of those children.

The mean age of individuals in the current study at the first DGA was 6.35 years, which was comparable to other studies [3,4,6,13,18,26]. Interestingly,

27.5% of the children in this study group were 4 years of age or younger, which was similar to the study groups of Smallridge *et al.* in [3] and Holt *et al.* in [14]. These results suggest that nearly one-third of the general anaesthetics which are administered in dental hospitals are provided to children younger than 5 years of age, and that there had been little change over the years from 1990 to 1997.

With regard to the previous DGA experience, only 14.9% of the children had a record of previous DGA, and five children had had more than one previous DGA. This is comparable to the 14% readmission rate reported in a study in London Dental Hospitals for comprehensive dental treatment of medically compromised children [27]. Keniry [13] reported a 17.7% incidence of previous DGA experience in their study group, and Landes and Bradnock [16] reported one of 23%. In both studies, the information on previous DGA experience was collected by means of interviewing the parents of the children, whereas information for this study was collected from the dental records. Therefore, there is a likelihood that there was under-recording of the previous DGA that a child received in this study.

The dental conditions which led to the provision of the DGA in 1997 were most commonly dental caries and its sequelae (90.8%). This agrees with other studies [3,4,6–8,16,28,29]. Orthodontic extractions accounted for 4.5% in this study, which is similar to the figure of 4.2% reported by Landes & Bradnock [16]. In a study by Smallridge *et al.* [3], the reported rate of orthodontic extractions was 10%. This could have been because of a more lax attitude towards orthodontic extractions under DGA during the late 1980s.

In this study, it was found that the mean number of dental extractions per child was 4.24 teeth, similar to the mean of 4.14 teeth reported by Smallridge *et al.* [3]. This shows that the mean number of extractions per child has remained the same in the past decade (1987–1997). However, in the early 1970s in the UK, the mean number of extractions per child under DGA was much lower (i.e. 2.32 teeth), as reported by Keniry [13]. The increase in the mean number of extractions per child in the past decade reflects the policy of a more aggressive prescribing of extractions for exodontia outpatient DGA that has been introduced in dental hospitals since 1990. This was shown by Holt et al., who reported an increase in the mean number of primary and permanent dental extractions of 5.4 and 3.2teeth, respectively, during 1996 and 1997 [14], compared with figures of 3.3 and 0.43 teeth in 1992 [4]. The mean number of primary teeth extracted at LDI was slightly lower compared to the mean reported by Holt et al. in 1999 [14], although the mean age of the present study group (6.35 years) is similar to their group (6.2 years). This could be explained by a higher dental caries experience of the children in London compared to the children in Leeds. However, this could not be supported by the literature, since the mean dmft scores for the 5-year-olds were higher overall in West Yorkshire compared with the London area in 1997 [1]. Taking the above into consideration, it could be assumed that there is a tendency towards a more aggressive prescribing of dental extractions at the London hospitals compared to LDI.

The percentage of children who received extractions of primary teeth only (82%) compares almost exactly to the percentage reported by Holt *et al.* in 1992 [4] (i.e. 83%). Interestingly, the percentages of children who received extractions of permanent teeth only (11.4%), and both primary and permanent teeth (5.6%) were also similar to those reported by the same authors, i.e. 11% and 5%, respectively.

Finally, it is interesting to note that 14.2% of the children in the study group had at least one first permanent molar extracted, which is a high percentage, when compared to the total percentage (17%) of children who received extractions of permanent teeth. The dental conditions which led to these extractions were dental caries for 58 children, orthodontic treatment for six and MIH in five cases.

When comparing the prevalence of episodes of oral pain and/or infection with the prevalence of repeat DGAs over the 6-year period following the DGA in 1997, two-thirds of the episodes as well as two-thirds of these repeats occurred within the first 3 years. This suggests that short-term studies, such as that of Grant *et al.* in 1998 [6], who reported a 0% repeat DGA rate within 18 months, may have considerably underestimated the repeats.

Half of the episodes of oral pain and infection were apparently unavoidable, since the teeth involved were not related to previously recorded dental caries, but were caries-free or unerupted at the time of the DGA in 1997.

In total, 143 children received follow-up dental care at LDI, and 21 of these received prevention only. However, more than half of these children had either subsequently failed booked appointments, attended only when in pain or were re-referred by their GDPs to LDI. Of the children who were discharged, 119 were recorded as not registered with a GDP in the LDI records. Overall percentages of re-attendance did not differ between children who were registered and those who were not registered with a GDP. These results show a somewhat casual approach to dentistry among this group of children, seeking treatment only when in pain.

It is also important to note that only the children who attended LDI were assessed as to their further treatment need. This may have given a biased view of the extent and necessity for further restorations or extractions for the total study group.

Less than half of the children who re-attended LDI received restorations and/or extractions under LA or IS (12% of the total study group). Interestingly, 19 of the children who received treatment under LA or IS also received a repeat DGA. Treatment under LA or IS was recorded as being abandoned because of apprehensiveness of the child, leading to the repeat DGA, for only three of those children. For those children who could cope with dental treatment under LA or IS, the majority of the repeat DGAs were to treat acute symptoms (acute pulpitis or oral infection) as a result of newly developed dental disease or when multiple extractions of premolars and/ or first permanent molars were necessary. There seemed to be reluctance of the children to accept dental extractions (especially of permanent teeth) under LA or IS [23].

The dental treatment received under LA or IS was mainly restorative care (62.5%). Fewer children received dental extractions [21]. It is interesting to note that more than half of the teeth subsequently restored (57.5%) and most of the teeth subsequently extracted under LA or IS (80.9%) were charted as restored, caries-free or unerupted at the time of DGA in 1997.

It can be concluded that a large proportion of the follow-up visits of the children, were to treat newly developed dental disease during the 6 years following the DGA in 1997. A more proactive approach towards preventive care may have resulted in the reduction of the development of new dental disease.

What this paper adds

- This paper investigates the further dental treatment needs of children who previously received extractions under GA.
- In total 27.5% of the study population had a record of follow-up treatment at Leeds Dental institute. Of these children, 15% received preventive care only.
- It highlights the importance of a proactive approach towards preventive care following GA extractions to reduce the risk of new dental caries developing.

Why this paper is important for paediatric dentists

- A large proportion of the follow-up visits of the children, were to treat newly developed dental disease during 6 years following the DGA.
- This article draws attention to the importance of preventive dentistry and the need for the dental education for both child and carers.

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