SCIENTIFIC ARTICLES

The Occurrence of Dental Pain and Extractions over a 3-Year Period in a Cohort of Children Aged 3-6 Years

M. Tickle, PhD; A. S. Blinkhorn, PhD; K. M. Milsom, PhD

Abstract

Objectives: *To describe the occurrence of dental pain and extractions in young children in relation to the caries and restoration history of their primary molar teeth.* ***Methods:*** *A prospective cohort study of 739 children aged 2.8 to 6.2 years attending 50 dental practices in the North West of England followed for 3 years. Incidence rates for pain and extraction in primary molar teeth were calculated for children with and without dental caries. Tooth years at risk of extraction or pain were calculated for each primary molar according to whether they were caries-free, carious and unrestored, or restored.* ***Results:*** *A total of 119 (16.1 percent) children had caries at recruitment and 157 developed caries during follow-up. Each year approximately one in five children with caries, but only one in 100, who was caries-free, presented with dental pain. In the whole population, each year, approximately one in 40 children had a primary molar tooth extracted but in children with caries it was one in 10. In the total cohort, incidence of pain was higher in unrestored carious teeth than restored, but incidence of extraction was higher in restored than in unrestored teeth.* ***Conclusion:*** *The majority of children attending general dental practice remained caries-free and did not experience pain or extraction over 3 years. Children with caries had a substantial risk of developing pain or having an extraction. The study was unable to demonstrate that restoring carious primary molar teeth prevents pain and extraction.*

Key Words: dental caries, child, preschool, pain, tooth extraction, dental restoration

Introduction

Dental caries in the primary dentition remains an international public health problem. In the UK, successive national child dental health surveys have shown little change in caries prevalence in 5-year-old children over the past 20 years (1). In the United States, the National Health and Nutrition Examination Survey data tell a similar story: from 1988-94 to 1999-2002, there was no change in the prevalence of dental caries in primary teeth among children aged 2 to 11 years (2). Our ability to measure caries prevalence and experience is well developed, but our understanding of the impact of the disease on young children and their families is poor. Over recent years, measures of the psychosocial impact of dental conditions have been developed for older children (3), but these are unsuited for studies on very young children because of their cognitive and emotional immaturity. In this age group, proxy measures of the impact of dental conditions on the quality of life, such as pain and dental extraction, are perhaps more appropriate. Dental pain has been shown to affect the everyday lives of children (4), and extraction has been shown to be distressing for young children (5) and their parents (6), and to be closely associated with dental fear and anxiety (7).

It is important to understand how best to treat children with caries to minimize the risk of these adverse events. In the UK, two recently conducted retrospective cohort studies conducted in primary care (8,9) reported tooth-level outcomes of unrestored carious primary teeth in young children. Both independently reported that approximately 80 percent of carious, unrestored primary teeth exfoliated naturally without any symptoms. However, a person-level analysis (10) reported that 48 percent of children with caries experienced at least one episode of pain and 43.3 percent experienced one or more primary teeth extractions because of pain or sepsis. Following the publication of these studies, there has been a debate on how best to manage the dental care of young children with carious primary teeth that calls for more research to improve the evidence base in this field (11-13).

This issue raises important public health questions; as primary teeth are temporary structures, is it more important to measure the impact of the disease than the disease itself? The impact of the disease in this population is affected by the dental care children receive. In the UK, the 2003 Child Dental Health Survey reported that only 6 percent of 5-year-old children were reported to have never visited a dentist (1), and in the United States, both the American Dental Association (14) and the American Academy of Pediatric Dentistry recommend that infants should have their first dental visit by age 1.

To improve our understanding of this issue, we undertook a prospective cohort study of young children

Send correspondence and reprint requests to Professor Martin Tickle, School of Dentistry, University of Manchester, Higher Cambridge Street, Manchester M15 6LP, UK. Tel.: +44-0161-275-6782; Fax: +44-0161-275-6299; e-mail: martin.tickle@manchester.ac.uk. M. Tickle, A. S. Blinkhorn, and K. M. Milsom are with the Oral Health Unit, National Primary Care R&D Centre. K. M. Milsom is with the Halton & St Helens Primary Care Trust. Manuscript received: 1/2/07; accepted for publication: 5/29/07.

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attending general dental practices. The aim of the study was to describe the epidemiology of dental pain and extractions of primary molar teeth in children who attend general dental practices, and then to report these outcomes in terms of whether or not carious teeth were restored.

Method

After receiving appropriate ethical approval for the study, all dentists providing National Health Service (NHS) care to children in four health districts, north Cheshire, south Cheshire, Salford and Trafford, and Bury and Rochdale, in the North West of England were invited to participate in the study. NHS dental care is publicly funded and free to children. A total of 50 dentists responded to the invitation and agreed to provide access to their practices. Each dentist received a fee of £500 to cover the costs of any disruption to the running of the practice.

The study population was drawn from all children born between July 3, 1995, and December 23, 1997, attending the 50 practices. Children in the age band of interest were identified from computer records, and letters inviting parents to enroll their children into the study were sent via the practices. New patients in the relevant age group who attended during the recruitment period were also invited to participate in the study. The recruitment period was between January 22, 2000, and November 22, 2001, and the children were followed up until July 1, 2004.

The investigation was confined to the primary molar teeth. The dentists' diagnoses of caries and the restorative interventions provided were recorded in the children's clinical records. The outcomes of interest, namely pain and extraction, were also recorded from the clinical records. An episode of pain was defined as *a recorded unscheduled visit to the dental surgery as a result of dental or orofacial pain.* The study dentists agreed to follow a protocol to systematically capture caries diagnoses, restorative care provided, and the outcomes of interest. To support the dentists in capturing information according to the protocol, they were provided with a study pack containing easy-to-follow guidelines for recording clinical information. This pack was contained in a folder, which also enclosed each child's clinical record. A research assistant provided a short tutorial on the recording of records according to the protocol at the start of the study. The dentists were asked to record a full clinical dental charting of each child at recruitment and at each visit over the 3-year follow-up period to record:

- new carious lesions: tooth affected and site;
- episodes of restorative care: tooth restored and site;
- episodes of pain including: establishing if the visit was prompted by pain, the reason for the pain, and the tooth that caused the pain; and
- extractions: tooth or teeth involved.

Clinical data from the child's dental records were photocopied in the practices each year. A trained dental nurse transferred all data from the photocopied clinical records to a data abstraction form, from which the data were entered into a computer for analysis.

Person-Level Analysis. At recruitment children were categorized as caries-free or having the disease. A child was coded as having caries at recruitment if any primary molar tooth was recorded as carious and unrestored or as restored by the dentist. In addition, children who had a restoration placed within 3 months of their first examination were recorded as having caries at recruitment. This rule allowed the dentists time to complete and record treatment events that were scheduled following the initial examination.

Crude incidence rates per 100 person years of a child's first episode of dental pain because of caries and first extraction of a carious molar tooth were calculated by dividing the number of pain and extraction events by person years at risk. Person years at risk of pain were measured for children who were recorded as having pain from the date of recruitment until the date of the child's first recorded episode of pain. For those children with no record of pain, person years were measured from the date of recruitment until the date of the child's last recorded dental appointment during the follow-up period. Similarly, to estimate the crude incidence of the first extraction of a molar tooth, person years for those children who experienced an extraction were calculated from the date of recruitment until the date of the first molar tooth extraction. For children who did not have an extraction, person years were calculated from the date of recruitment until the date of the child's last recorded dental appointment during the follow-up period.

Incidence rates were constructed for two groups: children who were caries-free and children recorded as having caries. Children who were caries-free at recruitment, who subsequently developed caries during follow-up, initially contributed person years and pain and extraction events to the caries-free group. After the date that these children were first recorded as having caries, they then contributed person years to the group with caries.

Tooth-Level Analysis. Each of the children's molar teeth was assigned to one of three mutually exclusive states:

- caries-free;
- carious unrestored; and
- restored.

A tooth was considered to be caries-free unless it was recorded as having untreated caries or restored. A caries-free tooth could change states during follow-up to either carious unrestored or restored. A carious unrestored tooth could change states to restored, but once a tooth had a restoration placed, the tooth was considered restored and could not return to another state.

Two outcomes were recorded and analyzed, namely, a child's first episode of dental pain and the first extraction of any primary molar tooth. The cause of each first episode

Table 1
Causes of First Recorded Episodes of Pain (Percent) in All Children Who Were Recorded as Having Experienced Pain

Cause of Pain	% ($n = 115$)
Pain from incisors or canine teeth because of caries or trauma	11.3
Pain from erupting first permanent molar teeth	2.6
Nonspecific pain reported by children who were caries-free	7.0
Pain because of caries in primary molar teeth	79.1

Table 2
Source of the First Episode of Dental Pain in 78 Children Reporting Pain as a Result of Caries in Their Primary Molar Teeth

Tooth Status at Previous Dental Examination	% ($n = 78$)
Caries-free	37
Restored	40
Carious but unrestored	17
Pain unable to be attributed to a specific tooth	6

of pain and each extraction was attributed to a molar tooth that was recorded at the child's previous dental examination as either caries-free, carious unrestored, or restored. In a small number of cases, it was not possible to attribute the source of pain to a restored or unrestored tooth. This occurred when diffuse pain was recorded from a quadrant that contained both restored and unrestored carious teeth.

To assess the outcomes of individual molar teeth, analyses of the incidence the first episode of dental pain and extraction were undertaken for teeth in three states: caries-free, carious unrestored, and restored. In these analyses, tooth years at risk of an episode of dental pain or extraction were calculated separately for each primary molar tooth before being combined to produce total tooth years at risk for caries-free, carious and unrestored, and restored teeth.

To estimate the incidence of extraction events in caries-free molars, tooth years at risk were calculated from the date of recruitment until the date the tooth changed state to being either carious or was extracted. If the tooth remained caries-free and was not extracted, then follow-up ended on the date of the child's last recorded dental visit during the study period. For unrestored carious molar teeth, tooth years of follow-up began either at the date of recruitment or if a caries-free tooth developed caries during follow-up, on the date that the tooth was first recorded as having caries. For all unrestored carious teeth, follow-up ended on the date that the tooth was either extracted or changed states to become restored. If neither of these events occurred, follow-up ended on the date of the child's last recorded dental appointment in the study period. For restored teeth, tooth years were calculated from the date of recruitment or the date that a restoration was first placed, until the date the tooth was extracted; if a tooth was not extracted, follow-up ended on the date of a child's last recorded dental appointment.

Crude incidence rates were calculated by dividing the total number of extraction events in all molars that were caries-free, carious and unrestored, and restored by the total number of tooth years in each of these three states. Sixteen children who had three or more teeth extracted were excluded from this analysis to avoid bias from inclusion of a small number of children with multiple extractions (possibly including balancing extractions), contributing a very large number of events to the analysis. To estimate the crude incidence of the first episode of dental pain in caries-free, carious unrestored, and restored molars, similar methods were used, but tooth years were calculated from study entry until the date a child had his or her first episode of dental pain. Calculations of incidence were conducted for two populations: the whole study population, which includes children who had caries already at recruitment, and the population of children who were recorded as being caries-free at study entry.

Results

The study population consisted of 739 children with an age range of 2.8 to 6.2 years of age. Less than 1 percent of children ($n = 7$) were less than 3 or 6 years old. The majority (49.7 percent, $n = 367$) of children were 3 years of age; the remainder of the study population was made up of similar proportions of children aged 3 (27.5 percent, $n = 203$) and 5 (21.9 percent, $n = 162$) years. In total, 119 (16.1 percent) children had caries at their initial examination and a further 157 developed caries during follow-up.

During the course of the study, 115 children had at least one episode of dental pain recorded. The causes are summarized in Table 1. Of the 91 children who had pain attributed to caries in a primary molar tooth, 39 (42.9 percent) had more than one episode of dental pain, with most episodes being attributable to the same molar tooth. Thirteen (14.3 percent) of these 91 children presented with dental pain at their first dental examination and 78 (85.7 percent) had pain during the follow-up period. For these 78 children, Table 2 describes the source of their first episode of pain; most (82 percent, $n = 64$) of the 78 children had caries recorded in their dental record prior to the onset of pain, but 14 (18 percent) had no previous history of dental caries. Table 3 describes the number of teeth in which caries was restored or left unrestored in the children who had

Table 3
The Restoration Status of Primary Molar Teeth Recorded in the 64 Children Recorded as Having Caries prior to the Onset of Dental Pain

		Number of Children		
Number of Teeth Recorded as Carious	Number of Children	All Carious Molars Restored	All Carious Molars Left Unrestored	Mixed: Some Restored, Some Unrestored
7	2	1	0	1
6	0	0	0	0
5	3	2	0	1
4	13	9	4	0
3	12	10	1	1
2	17	10	5	2
1	17	15	2	0

Table 4
Person-Level Analyses: Number of Episodes, Number of Person Years of Follow-Up, and Crude Incidence Rates for First Episodes of Dental Pain and First Extractions in Caries-Free Children and Children with Caries

Population	Total Number of First Pain Episodes	Person Years at Risk	Crude Incidence Rate of First Pain Episode per 100 Person Years
Caries-free children	14	1378	1.0
Children recorded as having caries	64	341	18.8
Population	**Total Number of First Extractions**	**Person Years at Risk**	**Crude Incidence Rate of First Extraction per 100 Person Years**
Caries-free children	6	1405	0.4
Children recorded as having caries	37	356	10.4

caries recorded in their dental record before the onset of pain ($n = 64$). The table shows that 47 (73.4 percent) children had all of their carious molar teeth restored before the onset of dental pain.

Person-Level Analyses. In the whole population, there were 78 first episodes of dental pain reported in 1,719 person years at risk, a crude incidence rate of 4.5 per 100 person years. The incidence of dental pain, summarized in Table 4, was substantially lower in children who were caries-free (1.0 per 100 person years) compared to children with recorded caries (18.8 per 100 person years).

In the study population, 52 children had one or more primary molar teeth extracted. Some children had multiple teeth extracted; for example, 16 children had three or more teeth extracted. The pattern of dental extractions was different in children with caries compared to children who were caries-free at recruitment. Of the 119 children with caries at recruitment, 31 (26 percent) had extractions; nine of these children had extractions as part of the course of treatment resulting from their first examination and 22 had extractions during the follow-up period. Of the 620 children who were caries-free at their initial visit, 21 (3 percent) had extractions during the follow-up period. In the whole population, 43 children had a first dental extraction in 1,761 person years at risk, a crude incidence for a first extraction of 2.44 per 100 person years. Children who were recorded caries-free at each dental examination very rarely presented at their next examination requiring a tooth to be extracted (incidence rate of 0.4 per 100 person years), whereas this was a relatively common event in children recorded as having caries (10.4 per 100 person years) (Table 4).

Tooth-Level Analyses. The analysis of extractions included 36 children who had one or two molar teeth extracted. Three of these children had their dental extractions during the entry period to the study, leaving 33 children who had 44 molar teeth extracted during the follow-up period. The analysis of dental pain excluded five children for whom it was not possible to attribute the source of their dental pain to an individual tooth.

Table 5 describes for the whole study population, and Table 6 for the children who were caries-free at study entry, pain and extraction events, and total tooth years of follow-up for molars that were caries-free, carious unrestored, and restored. In the whole population, there was a higher crude rate of extraction in restored teeth than unrestored teeth, but the reverse was true for incidence rates of pain (Table 5). In children who were

Table 5
The Incidence of Tooth Extraction and First Episode of Dental Pain because of Caries in Caries-Free, Carious Unrestored, and Restored Primary Molar Teeth in the Whole Study Population ($n = 739$)

	Extraction Analysis*			Pain Analysis†		
Tooth State	Tooth Years at Risk of Extraction	Total Extraction Events	Rate per 100 Tooth Years	Tooth Years at Risk First Dental Pain in a Molar	Total Pain Events	Rate per 100 Tooth Years
Caries-free	12,969	11	0.1	12,725	29	0.2
Carious and unrestored	182	4	2.2	181	13	7.2
Restored	818	29	3.6	626	31	5.0

* Analysis excludes 16 children that had more than three molars extracted.
† Analysis excludes five children with dental pain that could not be attributed to an individual molar tooth.

Table 6
The Incidence of Tooth Extraction and First Episode of Dental Pain because of Caries in Caries-Free, Carious Unrestored, and Restored Molar Teeth in a Population of 620 Children Who Routinely Attended a Dentist but Were Caries-Free at Their First Dental Examination

	Extraction Analysis*			Pain Analysis†		
Tooth State	Tooth Years at Risk of Extraction	Total Extraction Events	Rate per 100 Tooth Years	Tooth Years at Risk First Dental Pain in a Molar	Total Pain Events	Rate per 100 Tooth Years
Caries-free	11889.9	4	0.03	11750.8	18	0.2
Carious and unrestored	70.9	2	2.8	61.4	2	3.3
Restored	255.2	16	6.3	206.0	18	8.7

* Analysis excludes one child that had more than three molars extracted.
† Analysis excludes one child with dental pain that could not be attributed to an individual molar tooth.

caries-free at study entry, higher incidence rates of extraction and first pain episodes were recorded in restored teeth than in carious unrestored teeth (Table 6).

Discussion

All participating children were treated by dentists working according to an NHS contract and were remunerated for the care provided on a capitation basis, receiving a monthly fee for each child under their care. The study was confined to primary molar teeth, because previous studies (8) demonstrated that caries and adverse outcomes occur much more frequently in these teeth than primary incisors and canines, a finding reproduced in this study (Table 1).

The study was conducted in the North West of England, where the whole population prevalence of dental caries in 5-year-olds in 2003-04 was 49 percent; the highest in England (15). In this study, the proportion of children with caries at study entry was 16 percent, and at the end of follow-up, 276 children had caries, which is 37 percent of the study population. Although these prevalence values are not directly comparable to a point prevalence survey of 5-year-old children, because of the differences in age and caries diagnosis, they demonstrate that caries levels in children that regularly attend a dentist are lower than in the general population, a finding reported in other primary care-based studies (1,16).

During follow-up, 115 children had one or more episodes of pain, of which 91 had dental pain that was attributable to caries in a primary molar tooth. On average, this equates to approximately two patients per practice and shows that even in a region with high disease prevalence, it was surprisingly rare for regularly attending young children to present with a toothache. In the study cohort, very few primary molar teeth were left unrestored for long periods; for example, the extraction analysis was based on 182 unrestored carious tooth years compared to 818 restored

tooth years (Table 5). The results of this study, a previous retrospective study (8), and a national survey (17) of dentists' treatment preferences for young children with carious primary molar teeth all indicate that in the UK, dentists leave few carious primary molar teeth unrestored.

Unsurprisingly, dental pain was rare in caries-free children but common in children who had caries; each year, approximately one in five children with caries in their primary molar teeth presented with dental pain from one of their primary molar teeth. Having caries in primary molar teeth at an early age was also a strong risk factor for future dental extractions; 26 percent of children with caries at recruitment had extractions compared to 3 percent in those who were caries-free at recruitment. In children with caries, the incidence rate of the first extraction of a primary molar tooth was 10.4 per 100 person years, indicating that in these children, each year, approximately one in 10 would have an extraction for the first time. While pain and extractions are imperfectly correlated, because of the different influences in dentists' clinical decision making (18), these findings clearly demonstrate that once caries is established in young children, adverse outcomes are common.

The tooth-level follow-up shows that restoring carious molar teeth does not necessarily prevent the occurrence of dental pain or decrease the risk of extraction. Overall, the occurrence of dental extractions was found to be higher in restored than in carious unrestored molar teeth. The story for dental pain was more complex. The majority of children who had dental pain during follow-up had all of their carious molars restored prior to the onset of pain. However, the findings from the tooth-level analysis differed depending upon which population was examined. In the whole population, restored primary molars had a lower occurrence of dental pain, but in children who were caries-free at study entry, restored teeth had a higher occurrence of dental pain.

Our study sheds some light on the seemingly incompatible results reported in previous studies (8,10) in the North West of England, where 80 percent of untreated carious teeth exfoliated without symptoms, yet approximately 50 percent of children in the study population experienced one or more episodes of pain, or had one or more extractions because of pain or sepsis. It may be true that the majority of carious primary molar teeth exfoliate asymptomatically; however, the key outcome measures that have an impact on a child's quality of life are experienced by individuals, not teeth. Once a child contracts dental caries, it develops rapidly, and multiple teeth are affected (unpublished observations). This study demonstrates that once a child has caries, the likelihood of pain and extraction are high. Therefore, in this field, in future intervention studies, person-level outcome measures are more important than tooth-level measures. These findings taken together with the reported caries incidence rates in the same population also point to a future research agenda (unpublished observations). For public health, the results would suggest that prevalence is more important to capture than caries experience, because of the very high risk of pain and extraction once children develop the disease. It also points to the need to concentrate efforts on longitudinal studies in other populations to see if similar patterns are observed. The focus of much of the recent debate in pediatric dentistry has been on improving the evidence base to determine the best way to surgically treat carious primary molar teeth. Randomized controlled trials will remove the selection bias and other sources of confounding and bias that observational studies are subject to and are needed to provide high-quality evidence on how best to manage the restorative care of young children with caries. This study shows that restoring carious primary molar teeth does not prevent adverse outcomes of pain and extraction from occurring, or stop the disease process. Therefore, a more important goal for research should be to determine how best to prevent children from developing caries, preferably through public health means reaching the whole population, rather than how best to treat them once they are compromised by the disease.

In conclusion, this observational study demonstrated that a large majority of young children who regularly attended a dentist remained caries-free and did not experience dental pain or extraction over a 3-year period. However, children who developed the disease had a substantial risk of developing dental pain or having an extraction. The study was unable to demonstrate that restoring carious primary molar teeth prevents pain and extraction.

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References

1. Lader D, Chadwick B, Chestnutt I, Harker R, Morris J, Nuttall N, Pitts N, Steele J, White D. Children's dental health in the United Kingdom, 2003. London: Office for National Statistics; 2004. [cited 2007 Nov 22]. Available from: http://www.statistics.gov.uk/CHILDREN/dentalhealth/downloads/cdh_Summary.pdf
2. Beltran-Aguilar ED, Barker LK, Canto MT, Dye BA, Gooch BF, Griffin SO, Hyman J, Jaramillo F, Kingman A, Nowjack-Raymer R, Selwitz RH, Wu T; Centers for Disease Control and Prevention (CDC). Surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis – United States, 1988-1994 and 1999-2002. MMWR Surveill Summ. 2005 Aug 26;54(3):1-43.
3. Foster Page LA, Thomson WM, Jokovic A, Locker D. Validation of the Child Perceptions Questionnaire (CPQ 11-14). J Dent Res. 2005 Jul;84(7):649-52.
4. Shepherd MA, Nadanovsky P, Sheiham A. The prevalence and impact of dental pain in 8-year-old school children in Harrow, England. Br Dent J. 1999 Jul 10;187(1):38-41.

5. Bridgman CM, Ashby D, Holloway PJ. An investigation of the effects on children of tooth extraction under general anaesthesia in general dental practice. Br Dent J. 1999 Mar 13;186(5):245-7.
6. Amin MS, Harrison RL, Weinstein P. A qualitative look at parents' experience of their child's dental general anaesthesia. Int J Paediatr Dent. 2006 Sept;16(5):309-19.
7. Milsom KM, Tickle M, Humphris GM, Blinkhorn AS. The relationship between anxiety and dental treatment experience in 5-year-old children. Br Dent J. 2003 May 10;194(9):503-6.
8. Tickle M, Milsom KM, Kearney-Mitchel P, Blinkhorn AS. The fate of carious primary teeth of children who regularly attend the general dental service. Br Dent J. 2002;192:219-23.
9. Levine RS, Pitts NB, Nugent JZ. The fate of 1587 unrestored deciduous teeth: a retrospective general practice based study from Northern England. Br Dent J. 2002;193:99-103.
10. Milsom KM, Tickle M, Blinkhorn AS. Dental pain and dental treatment of young children attending the general dental service. Br Dent J. 2002;192:280-4.
11. Milsom KM, Tickle M, King D. Does the dental profession know how to care for the primary dentition? Br Dent J. 2003;195:301-3.
12. Tickle M. Improving the oral health of young children through an evidence-based approach. Community Dent Health. 2006 Mar;23(1):2-4.
13. Duggal M. Providing children with the quality dental care they deserve. Community Dent Health. 2006 Jun;23(2):66-8.
14. ADA Division of Communication. For the dental patient . . . baby's first teeth. J Am Dent Assoc. 2002 Feb;133:255.
15. Pitts NB, Boyles J, Nugent ZJ, Thomas N, Pine CM. The dental caries experience of 5-year-old children in England and Wales (2003/4) and in Scotland (2002/3). Surveys co-ordinated by the British Association for the Study of Community Dentistry. Community Dent Health. 2005 Mar;22(1):46-56.
16. Tickle M, Moulding G, Milsom K, Blinkhorn A. Socioeconomic and geographical influences on primary dental care preferences in a population of young children. Br Dent J. 2000 May 27;188(10):559-62.
17. Tickle M, Threlfall AG, Pilkington L, Milsom KM, Duggal MS, Blinkhorn AS. Approaches taken to the treatment of young children with carious primary teeth: a national cross-sectional survey of general dental practitioners and paediatric specialists in England. Br Dent J. 2007 Jun 28;203(2):E4, discussion 102-3.
18. Threlfall AG, King D, Milsom KM, Blinkhorn AS, Tickle M. General dentist practitioner's views on dental general anaesthesia services. Community Dent Health. 2007 Jun;24(2):93-6.