Orthodontic extractions: a comparative study of inhalation sedation and general anaesthesia

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Objective To compare directly inhalation sedation and general anaesthesia in terms of treatment success rate, various aspects of morbidity and time taken, when used for patients having orthodontic extractions.
Design Patients requiring orthodontic extractions were treated with either inhalation sedation or general anaesthesia. The two groups were matched for age, sex, number of teeth extracted and pre-operative anxiety. Data were collected by questionnaires.
Setting Unit of Paediatric Dentistry at the University Dental Hospital of Manchester.
Subjects All patients referred for orthodontic extractions between November 1994 and May 1996 were invited to take part in the study. Total number of patients = 101.
Interventions Sixty-six patients commenced treatment with inhalation sedation and 35 with general anaesthesia. Routine orthodontic extractions were carried out.
Outcome measures Treatment success rate, various aspects of morbidity and total time taken were measured and compared for the two groups.
Results Treatment success rates were high for both groups. Significantly less morbidity was found to be associated with inhalation sedation and the total time taken was significantly shorter with inhalation sedation than with general anaesthesia.
Conclusions Inhalation sedation is a successful alternative to general anaesthesia for orthodontic extractions with patients experiencing less morbidity and the time taken being shorter.

Inhalation sedation with nitrous oxide and oxygen has been used as a patient management technique in dentistry since the 1940s. The Poswillo Report recommended its use together with local anaesthesia as an alternative to general anaesthesia for dental treatment, especially for children,[1] and a number of studies has found it to be effective especially for orthodontic extractions.[2,3]

The morbidity associated with inhalation sedation has been investigated by a number of authors. In a review of 1,060 episodes of inhalation sedation Jastak and Paravecchio found the commonest side effect to be nausea, occurring in 3.9% of cases, with vomiting occurring in 1.3% of cases.[4] Duncan and Moore reviewed adverse reactions to nitrous oxide sedation and found the commonest to be nausea and vomiting, but considered that inhalation sedation has an extremely low incidence of patient morbidity.[5]

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Since direct comparisons of inhalation sedation and general anaesthesia for orthodontic extractions had not been reported, this investigation aimed to compare these two management methods in terms of success rate, various aspects of morbidity and time taken for treatment.

Materials and methods

The study sample

The study sample consisted of patients referred for orthodontic extractions to the Unit of Paediatric Dentistry at the University Dental Hospital of Manchester between November 1994 and May 1996. All referrals were from dentists working in the General Dental Service and specifically requested the use of general anaesthesia.

Patients referred between November 1994 and November 1995 were invited with an explanatory letter to attend for treatment with inhalation sedation and local anaesthesia, if considered appropriate after assessment and discussion. When the patient attended, a further explanation of the use of inhalation sedation was given and the equipment was demonstrated prior to seeking consent to proceed with the planned extractions at this first visit using this method. The sedation group then consisted of all patients for whom informed consent was obtained and treatment with inhalation sedation was attempted. Patients who failed to complete treatment with inhalation sedation were subsequently treated under general anaesthesia, but were excluded from the comparison group. Patients referred between November 1995 and May 1996 were treated under general anaesthesia and formed the comparison group.

Clinical procedures

Inhalation sedation patients were treated in a specially equipped surgery with a piped gas supply, fixed sedation equipment (Quantiflex MDM, Cyprane Ltd, Yorkshire) and an active scavenging system. All the sedation patients were treated by one operator (AS) who was supported by dental nurses who held the National Certificate in Conscious Sedation.[6] Sedation was administered using the standard technique described by Roberts and Rosenbaum with a maximum concentration of 40% nitrous oxide being used.[7]

The local anaesthetic technique which was employed was designed to avoid nerve block injections, except when lower permanent molars were to be extracted. This approach allowed all premolar extractions to be completed in one visit if that was the patient's wish. Typically when four premolars were to be extracted, topical anaesthetic was first applied with cotton rolls to the buccal mucosa adjacent to the teeth on the right. After 2 minutes slow submucosal buccal infiltrations were given on the right and topical anaesthetic was then applied on the left. While this was taking effect additional local anaesthetic was administered to the right premo-

lars to obtain palatal or lingual anaesthesia. This was achieved by slow injection of small amounts of solution into the interdental papillae, beginning buccally and advancing the needle through the papilla until the palatal or lingual tissue was seen to blanch. The procedure was then repeated on the left side. This technique is well illustrated by Meechan and Welbury.[8]

Post-operatively patients sat in a recovery area supervised by a dental nurse and were given post-operative verbal and written instructions before being discharged home after a standard 15 minutes.

General anaesthesia patients were assessed and topical anaesthetic cream applied to both hands about 1 hour prior to intravenous induction with propofol and inhalational maintenance with oxygen, nitrous oxide and halothane. A weight-related dose of paracetamol oral suspension was given to all patients routinely during the recovery period. A number of different dentists and anaesthetists provided treatment.

Recorded information

In addition to routine clinical note keeping, further information was collected for patients in both groups using three simple questionnaires completed at three points during the pre- and post-operative periods.

- *Pretreatment information* was recorded by one author (AS) who interviewed the patient in the presence of the parent, using a questionnaire which recorded the number and notation of teeth to be extracted, sex and age. In addition an 8-point visual analogue scale was used to measure the patient's anxiety level.[9] With this technique patients are asked to select one of eight cartoon faces to indicate how happy or unhappy they are feeling and scores ranging from 1 (very happy) to 8 (very unhappy) are generated.
- *Immediate post-treatment information.* In the recovery period, prior to discharge, the author (AS) completed a second questionnaire by interviewing the patient. The patient's feelings were again measured on a visual analogue face scale and yes/no responses were recorded for the following simple questions: 'Do you feel sick? Do you have a headache? Is your mouth painful?' Whether or not post-operative vomiting or crying occurred was also observed and recorded.

  Immediately prior to discharge the patient's psychomotor performance was measured using the Bender Motor Gestalt Test,[10] in which the patient is asked to draw straight lines to connect a series of 92 dots, the best score being zero when no misses occur.

  Various time recordings were made during treatment with the two methods. Treatment time was defined as the interval between the patient entering the surgery or theatre and leaving it to enter the recovery area. Recovery time was the interval between entering recovery and discharge home. General anaesthesia patients had an additional recorded time for the period in which they were assessed and then prepared for treatment, after a minimum period of 1 hour.
- *Next day post-treatment information.* Various aspects of morbidity in the 24 hours following treatment were measured with a questionnaire which was given to patients with a stamped return envelope and the request that they complete and return it on the day following treatment. Yes/no answers were requested concerning vomiting, headache, difficulties in eating or swallowing, time off school next day, and the use of analgesics. At the end of this questionnaire space was provided to describe any other post-operative problems which might have occurred. Reminders were sent to patients who had not returned their questionnaires within 2 weeks.

Appropriate statistical comparisons were made using student *t* and chi-squared analysis.

Since this comparative study used two already well established treatment methods, it was not considered appropriate to seek ethical approval for the investigation.

Results

None of the patients who were invited to try treatment with sedation refused to do so. The numbers of patients in the sedation and general anaesthesia groups were 60 and 35 and Table 1 shows that the groups were well matched by sex, age, number of teeth extracted and pre-operative anxiety as measured by the visual analogue face scores, there being no statistically significant differences in these parameters. Next day questionnaires were returned by 93.1% of the sedation and 91.4% of the general anaesthesia patients.

Treatment was completed for 58 of the 60 sedation patients and for all 35 general anaesthesia patients: success rates of 96.7 and 100%. In the sedation group, both patients who failed to complete treatment accepted both sedation and the local anaesthesia but then refused the extractions.

Morbidity in the immediate post-operative period is summarised in Table 2 which compares the incidence of each aspect in the two groups. After both general anaesthesia and sedation a few patients (8.6 and 10.3%) complained of sickness and/or headache but there were no significant differences and in neither group did patients actually vomit.

Significantly fewer patients were tearful after sedation (1.7 v 20.0 %) and fewer reported painful mouths (3.4 v 20.0%).

The immediate post-operative face scores were significantly lower (happier) in the sedation patients: 3.1 ± 1.70 and 4.1 ± 2.08, $P < 0.01$. Psychomotor ability 15 minutes post-operatively was also significantly better for sedation patients with scores of 15.1 ± 9.33 in contrast to 32.3 ± 9.00 for the general anaesthesia patients ($P < 0.0001$).

The times taken to manage patients with the two methods

Table 1 Matched characteristics of sedation and general anaesthesia groups

	Sedation	General anaesthesia
Number of patients	60	35
Age years mean (SD)	11.9 (1.78)	12.3 (1.34)
Male/female	18/40	9/26
Number of extractions mean (SD)	3.2 (1.29)	3.6 (1.17)
Pre-operative face score mean (SD)	4.7 (1.91)	4.2 (1.75)

Table 2 Immediate post-operative morbidity as numbers (percentages) of patients in each group

	Sedation	General anaesthesia	Significance
Nausea	6 (10.3)	3 (8.6)	ns
Headache	6 (10.3)	3 (8.6)	ns
Painful mouth	2 (3.4)	7 (20.0)	$P < 0.0001$
Crying	1 (1.7)	7 (20.0)	$P < 0.01$
Vomiting	0	0	—
Number of patients	58	35	

Table 3 Times (mean ± SD minutes) for management using sedation and general anaesthesia

	Sedation	General anaesthesia	Significance
Pre-anaesthetic assessment and preparation	—	122.5 (17.56)	—
Treatment	22.5 (6.61)	6.8 (2.15)	$P < 0.0001$
Recovery	15.1 (1.54)	24.4 (4.28)	$P < 0.0001$
Total	37.5 (6.61)	153.7 (25.45)	$P < 0.0001$

Table 4 Morbidity in the 24 hours following discharge as numbers (percentages) of patients in each group

	Sedation	General anaesthesia	Significance
Vomited	4/54 (7.4)	3/32 (9.4)	ns
Headache	23/54 (42.6)	16/32 (50.0)	ns
Difficulties in swallowing/eating	30/54 (55.6)	23/32 (71.9)	ns
Use of analgesics	32/50 (64.0)	18/29 (62.2)	ns
*Time off school	24/50 (48.0)	13/24 (54.1)	ns

* Totals reduced because some patients were on holiday during treatment period

were very different and are summarised in Table 3 as the means and standard deviations for each component of their management. Although actual treatment in the surgery took significantly longer with sedation (22.5 v 6.8 minutes), the recovery period was significantly shorter (15.7 v 24.4 minutes) and no pre-treatment preparation period was needed, which for general anaesthesia averaged 122.5 minutes. In total, management with sedation occupied an average of 37.5 minutes of the patient's time in contrast to 153.7 minutes with general anaesthesia.

It should also be noted that treatment was completed in a single visit for all but two sedation patients who needed lower molar extractions necessitating block anaesthesia and two visits.

Table 4 summarises various aspects of morbidity as reported by patients for the 24 hours following discharge. In each group a few patients reported vomiting during this period and the incidences of other minor problems were also considerable. There were no significant differences between sedation and general anaesthesia patients in these assessments of later morbidity and no other problems were reported in answering the final open-ended question.

Discussion

The need to employ alternatives to general anaesthesia for simple dental procedures has been given further impetus by the recent guidance document to dentists from the General Dental Council,[11] the latest in a series of important publications recommending reductions in the traditional use of general anaesthesia.

This study has confirmed that general anaesthesia is only rarely necessary for orthodontic extractions if the alternative approach using inhalation sedation and local anaesthesia is available. In this respect it is important to note that the high success rate in this study was achieved in a group of patients who had been referred specifically for extractions under general anaesthesia. It is also probable that some of the patients would have accepted extractions with local anaesthesia alone, although this possibility did not form part of the investigation.

Comparisons of various aspects of morbidity were made and, where significant differences were demonstrated, these were always in favour of sedation. Fewer sedation patients reported pain in the immediate post-operative period and fewer of them were seen to be distressed.

In terms of convenience to the patient, sedation is better than general anaesthesia because of the greatly reduced preparation and recovery times, the latter being confirmed by a much more rapid return of psychomotor skills. In addition, multiquadrant premolar extractions were routinely completed in one visit using appropriate local anaesthetic infiltration techniques.

The measurements of time taken for treatment using the two methods clearly show that much more 'surgery time' is needed when sedation is used. This is an important factor which must be addressed if sedation services are to be expanded with a concurrent reduction in the use of general anaesthesia.[3]

In summary it is difficult to justify the continuing use of general anaesthesia for orthodontic extractions in older children and adolescents, except in terms of the very limited availability of alternative sedation services. A further paper to be published shortly will examine the use of various management methods by practitioners and the factors which contribute to the persisting use of general anaesthesia.

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