Nitrous oxide inhalation sedation: what do patients, carers and dentists think about it?

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ABSTRACT: Aim To determine the acceptability and efficacy of nitrous oxide inhalation sedation for dental treatment to children and to compare these results with the responses of both the accompanying adult and the treating dentist. Study design A prospective, questionnaire-based survey was used. Methods Fifty consecutive patients (ASA I and II) attending the Department of Paediatric Dentistry, Edinburgh Dental Institute, between 2002 and 2003 for dental treatment using nitrous oxide inhalation sedation were recruited for the study. Each patient, the accompanying adult and the dental sedationist completed a short questionnaire which sought details about the acceptability and efficacy of the sedation technique. Overall behaviour and the outcome of treatment were assessed by the dentist providing sedation using the Frankl and Houpt Behaviour Rating Scales respectively. Results Three sets of questionnaires were completed for fifty patients (M:27; F:23), mean age 10.4 years (range: 5.3-15.8 years). Acceptance of both local analgesia and dental treatment was perceived as greater amongst patients and carers compared with treating dentists ($\chi^2=11.31, P=0.004, 2$ df and $\chi^2=22.52, P<0.001, 2$ df respectively). Furthermore, dentists observed that inhalation sedation helped fewer male patients with local analgesia and fewer female patients with dental treatment ($\chi^2=6.83, P<0.009, 1$ df and $\chi^2=3.85, p<0.050, 1$ df respectively). A greater proportion of dentists observed that patients would manage treatment without sedation and would not require sedation for future dental treatment than both patients and their accompanying carer ($\chi^2=8.00, P<0.018, 2$ df and $\chi^2=18.61, P<0.001, 2$ df respectively). In general, the majority of patients were co-operative and successfully completed dental treatment with inhalation sedation. Conclusion Dentists’ perception of nitrous oxide inhalation sedation was generally less enthusiastic than that of patients and carers. Keywords: Inhalation, Sedation, Acceptability, Efficacy.

Introduction

Anxiety about dental treatment is a well-recognised problem, with several studies demonstrating that fear of invasive procedures, such as injections and the ‘drill’, are the main cause of dental anxiety amongst children [Cuthbert and Melamed, 1982; Bedi et al., 1992; Alvesalo et al., 1993]. The use of conscious sedation as a safe alternative to general anaesthesia (GA) for dental care in anxious patients has been encouraged by various authorities within the UK [General Dental Council, 2000; Royal College of Anaesthetists, 1999; Society for the Advancement of Anaesthesia in Dentistry, 2000]. Nitrous oxide inhalation sedation (RA) has been reported to be an ideal technique for managing paediatric patients with dental anxiety; the majority of studies, however, has focused on mainly orthodontic extractions in the slightly older child patient [Shaw et al., 1996; Shepherd and Hill, 2000]. Furthermore, although at least one study has assessed child and parental satisfaction of treatment with RA [Shaw et al., 1996], there appears to have been no investigation of the perceived efficacy and acceptability of this technique to the dental sedationist. As such, the present study was designed to determine and compare patient, carer and dental operator satisfaction of treatment undertaken using nitrous oxide inhalation sedation.

Materials and methods

Study design. The study was designed as a prospective, questionnaire-based survey, undertaken between October 2002 and January 2003, in the Department of Paediatric Dentistry, Edinburgh Dental Institute. Questionnaires were completed following dental treatment using RA by patients, their accompanying adult and the dentist providing the treatment, herein after the ‘sedationist’. A full
verbal explanation was given to the patient and the carer on the purpose of the questionnaire. Fifty consecutive patients were recruited having been assessed previously by one of the staff specialists in paediatric dentistry.

Clinical technique. An experienced operator/sedationist (n=4) administered RA via a nasal mask using a Quantiflex MDM relative analgesia machine. The nitrous oxide was titrated in 10% increments to the maximum desired level for each individual patient (usually N2O:30%; O2:70%), whilst the clinician provided reassurance and positive reinforcement. Upon completion of dental treatment, the nitrous oxide flow was reduced in 10% increments and finally 100% oxygen was administered for two minutes before the nasal mask was removed. Dental treatment was undertaken according to a predetermined treatment plan.

Questionnaire design. Questionnaires sought details about the acceptability and efficacy of the technique to all parties. The questions are summarised as follows:
- Do you think you/your child/patient
  - needed inhalation sedation?
  - coped with inhalation sedation?
- found that sedation helped with local analgesia (LA) administration?
- found that sedation helped with dental treatment?
- would have managed without inhalation sedation?
- would require inhalation sedation for future dental treatment?

Assessment criteria: behaviour during treatment. The Frankl Behaviour Rating Scale [Hosey and Blinkhorn, 1995] was used to grade the child’s behaviour during treatment (i.e. 1: refusal/distress; 2: poor; 3: fair; 4: good; 5: very good; 6: excellent).

### TABLE 1 - Houpt Behaviour Rating Scale as used in a study on perceptions of nitrous oxide sedation in children.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Aborted</td>
</tr>
<tr>
<td>2</td>
<td>Poor</td>
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<tr>
<td>3</td>
<td>Fair</td>
</tr>
<tr>
<td>4</td>
<td>Good</td>
</tr>
<tr>
<td>5</td>
<td>Very Good</td>
</tr>
<tr>
<td>6</td>
<td>Excellent</td>
</tr>
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The Frankl Behaviour Rating Scale [Hosey and Blinkhorn, 1995] was used to grade the child’s behaviour during treatment (i.e. 1: refusal/distress; 2: poor; 3: fair; 4: good; 5: very good; 6: excellent).

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*Statistically significant difference between dentist and patient groups for 'helped with sedation' ($\chi^2=5.36, P<0.021, 1 df$).
**Statistically significant differences between dentist and both carer and patient groups for (a) 'helped with LA' ($\chi^2=11.51, P<0.004, 2 df$); (b) 'helped with treatment' ($\chi^2=22.52, P<0.001, 2 df$); (c) 'managed without' ($\chi^2=8.00, P<0.018, 2 df$) and (d) 'need again' ($\chi^2=18.61, P<0.001, 2 df$).

### FIG. 1 - Bar graph showing overall comparison of carer, patient and dental sedationist response in a study on perceptions of sedation.

*Statistically significant difference between dentist response for 'helped with LA' ($\chi^2=6.83, P<0.009, 1 df$) and 'helped with treatment' ($\chi^2=3.85, P<0.050, 1 df$). **Statistically significant difference between carer response for 'managed without' ($\chi^2=4.15, P<0.042, 1 df$).
***Statistically significant difference between patients for 'managed without' ($\chi^2=4.74, P<0.030, 1 df$).

### FIG. 2 - Bar graph showing overall comparison of responses of (a) male and (b) female patients as to their perceptions of sedation.

*Statistically significant difference between dentist and patient groups for 'helped with sedation' ($\chi^2=5.36, P<0.021, 1 df$).
### Criteria Intra-group comparisons

<table>
<thead>
<tr>
<th>Criteria</th>
<th>M &lt; 10 years</th>
<th>M &gt; 10 years</th>
<th>F &lt; 10 years</th>
<th>F &gt; 10 years</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>χ²</td>
<td>%</td>
<td>χ²</td>
</tr>
<tr>
<td>Needed sedation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (carer)</td>
<td>C 80</td>
<td>100</td>
<td>P 80</td>
<td>13.64**</td>
</tr>
<tr>
<td>D (dentist)</td>
<td>D 60</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coped with sedation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (carer)</td>
<td>C 70</td>
<td>100</td>
<td>P 70</td>
<td>14.91**</td>
</tr>
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<td>D (dentist)</td>
<td>D 90</td>
<td>76</td>
<td></td>
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<tr>
<td>Helped with LA</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>C (carer)</td>
<td>C 70</td>
<td>100</td>
<td>P 70</td>
<td>NS</td>
</tr>
<tr>
<td>D (dentist)</td>
<td>D 70</td>
<td>65</td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>C (carer)</td>
<td>C 70</td>
<td>100</td>
<td>P 70</td>
<td>NS</td>
</tr>
<tr>
<td>D (dentist)</td>
<td>D 80</td>
<td>71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managed without</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (carer)</td>
<td>C 20</td>
<td>18</td>
<td>P 10</td>
<td>26.09**</td>
</tr>
<tr>
<td>D (dentist)</td>
<td>D 40</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need again</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (carer)</td>
<td>C 80</td>
<td>100</td>
<td>P 80</td>
<td>28.57**</td>
</tr>
<tr>
<td>D (dentist)</td>
<td>D 50</td>
<td>88</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key: M: male; F: female; C: carer; P: patient; D: dentist; NS: no significant difference; * p<0.05; ** p<0.001

Table 2 - Intra-group comparison of carer, patient and dentist response for male and female patients (2 df for all groups) in a study on perceptions of nitrous oxide sedation.

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**Outcome of treatment.** The Houpt Behaviour Rating Scale [Hosey and Blinkhorn, 1995] was used to record the overall behaviour and outcome of treatment (Table 1).

**Data analysis.** Significant differences between patient, carer and dentist responses were defined by χ² analysis. Data were analysed using MINITAB statistical software, Release 13.31.

**Results**

Fifty sets of questionnaires were included in the study. Of the patients, 27 were male, mean age 10.4 (range 5.3-15.1) years and 23 were female, mean age 10.3 (range 6.5-15.8) years. Forty-four carers (88%), 43 patients (86%) and 42 (84%) dentists felt that RA was required for treatment (Fig. 1), with no statistically significant difference in perceived need for sedation between carers, patients or dentists when male and female patient groups were analysed independently (Fig. 2). In younger children (i.e. children less than 10 years), dentists perceived less need for sedation compared with patients and accompanying carers in both male and female patient groups (Table 2). In general, there appeared to be a greater need for sedation in older children of both genders, as perceived by dentists, patients and accompanying carers (Table 3).

In relation to whether patients coped with sedation, fewer dentists (78%) than carers (86%) and patients (90%) felt that the patient coped with RA, although this was statistically significant only between dentist and patient groups (Fig. 1). Comparison of male and female patients individually showed no statistically significant differences between patient, carer and dentist responses (Fig. 2). Dentists perceived that females of all ages and older male patients coped less well with RA, whilst younger male patients were perceived by the treating dentist to cope better (Table 2).
Overall, significantly fewer dentists observed that RA assisted with LA, in those patients receiving it, compared with both patients and their accompanying adult (Fig. 1). Dentists perceived that male patients coped less well with LA compared with females; 67% and 83% of dentists felt that RA was useful in male and female patients respectively (Fig. 2). In relation to age, compared with carers and patients, dentists perceived that older male and female patients coped less well with LA administration under RA, with females of both age groups coping better than males (Table 2).

Some 68% of dentists observed that RA assisted with dental treatment, compared with 90% of both patients and carers (Fig. 1). Dentists also observed that fewer female (61%) than male patients (74%) coped with treatment under RA; in particular, just
over 50% of dentists felt that RA assisted younger female patients, compared with 80% of males of a similar age. This difference was statistically significant (Table 3). Indeed, dentists observed that all of the female and also the older male patients coped less well with dental treatment under RA, compared with the views of the patients themselves and their carers (Table 2).

Regarding whether patients would have managed dental treatment without sedation, dentists appeared to be more confident than either patients or carers (Fig. 1); the same trend was also observed within gender groups for male and female patients (Fig. 2). In general, more dentists than carers and patients observed that both genders of all ages would have managed dental treatment without RA (Table 2). Concerning future need for RA for dental treatment, dentists felt less need than either patients or carers; this trend was statistically significant for both male and female patients of all age groups (Fig. 1 and Table 2). Dentists also perceived less need for RA for future treatment in younger male patients compared with female patients of a similar age and older male patients (Table 3).

**Behaviour during treatment.** In general, behaviour scores for male and female patients were similar, the majority of patients demonstrating good cooperation during their dental treatment (Table 4).

**Outcome of treatment.** Again, there appeared to be little difference in the outcome of treatment between male and female patients, the majority of children demonstrating good/excellent behaviour during RA and allowing completion of dental treatment (Table 5).

## Discussion

Recent guidelines in the UK have stressed the use of competently provided RA as an alternative form of pain and anxiety control to GA for patients requiring dental treatment [General Dental Council, 2000; Royal College of Anaesthetists, 1999; Society for the Advancement of Anaesthesia in Dentistry, 2000]. For paediatric dental patients, RA using titrated doses of nitrous oxide and oxygen is proven in the adolescent requiring orthodontic premolar extractions [Shepherd and Hill, 2000]. Personal observation, however, would suggest that although treatment is completed in a significant proportion of cases, the operator/sedationist perceives difficulties with this technique with, for example, extraction of carious first permanent molar teeth. The present study was therefore designed to establish operator/sedationist perception of the efficacy of dental treatment using RA relative to both the patient and the accompanying carer. Although the sample size was relatively small, the study would appear to give a reasonable representation of the perceived differences between efficacy of RA amongst patient, accompanying carer and the operator/sedationist.

Deciding which patients would benefit from dental treatment under RA is essential to the successful outcome of treatment. In nearly every case, all parties were in agreement that sedation was required for dental treatment, particularly for older patients. Operating dentists, however, observed that younger male patients had less need for RA compared with female patients in the same age range, although this was not statistically significant. In relation to how patients coped, the sedationists observed that patients coped less well with RA compared with the perceptions of the patient themselves and their accompanying carer, although this was not significant.

Other studies investigating the success rate of RA have demonstrated the ability of patients to cope with treatment, although these have made no comment on carer or dentist perception of the child’s ability to cope with the procedure [Shepherd and Hill, 2000; Bryan, 2002]. In relation to age and

### Table 5 - Outcome scores during treatment given as the proportion of subjects' scores in a study of perceptions of nitrous oxide sedation.

<table>
<thead>
<tr>
<th>Group</th>
<th>Score</th>
<th>1 (aborted/no treatment)</th>
<th>2 (poor/treatment interrupted with partial treatment completed)</th>
<th>3 (fair/treatment interrupted but eventually completed)</th>
<th>4 (good/difficult but all treatment performed)</th>
<th>5 (very good/limited crying or movement)</th>
<th>6 (excellent/no crying or movement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>15</td>
<td>19</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>30*</td>
<td>17</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

*statistically significant difference in behaviour score between male and female patients ($\chi^2=6.45, P=0.011$)
gender, dentists observed that female patients (both those less than and more than 10 years of age) coped less well with sedation; in contrast, male patients less than 10 years old were felt to cope better with RA than either the carer or the patient, although this may be due to small numbers. This finding, however, is in agreement with one retrospective study of various pharmacological techniques for RA, which determined that male patients had more effective sedation sessions (80.6%) than female patients (65.1%) [Needleman et al., 1995].

Concerning the use of RA in the assistance of administration of LA, significantly fewer dentists observed that sedation was beneficial (in those patients receiving it), compared with patients and carers, particularly for older, male and female patients. In general, dentists observed that female patients of both age groups coped better with LA than males. Previous workers have highlighted that RA, in addition to various behavioural techniques, may assist with LA in anxious child dental patients [Levitt et al., 2000].

In relation to dental treatment, there was a statistically significant difference between the treating dentists and both the patient and accompanying carer in relation to whether RA assisted with dental treatment. Further analysis confirmed that dentists perceived that female patients coped less well with treatment under sedation, particularly those less than 10 years of age, with only 55% of dentist responses observing that RA assisted with dental treatment. Only in the younger male group did the patient and the carer observe and agree with the treating dentist (i.e. that sedation was less than optimal at assisting with dental care). Whilst treatment was completed in the majority of cases, in just over one third of cases this was either terminated/aborted, partially completed or completed with difficulty. Whilst other studies have observed high success rates for dental treatment (as determined by actual completion of care) using RA, generally these have been studies of older patients requiring orthodontic extractions [Shaw et al., 1996; Blain and Hill, 1998]. In one of these studies, a postoperative postal questionnaire assessment demonstrated that the majority of carers and patients were ‘satisfied’ with treatment using RA; there was, however, no indication from this study of the treating dentists opinion in relation to the success of dental treatment whilst using RA [Shaw et al., 1996].

Overall, more dentists observed that patients would have managed dental treatment without sedation compared with the patients themselves and their carer; in general, the same trend was observed within the gender groups. In addition, dentists observed that younger patients would probably have managed dental treatment without RA. As such, dental personnel within this study appeared to determine less need for sedation for future dental treatment than the patients and carers, particularly for younger males. Perhaps such a difference is due to the fact that dentists are aware of non-pharmacological, behavioural management techniques for the dentally anxious child patient [Hosey, 2002], for example, graded exposure [Ter Horst and De Wit, 1993], systematic desensitisation [Getka and R, 1992], relaxation and distraction [Corah et al., 1979], and hypnosis [Peretz, 1996].

The present study has highlighted deficiencies in the perceived efficacy of RA in the dental care of anxious children, particularly amongst treating dentists in relation to LA administration and actual dental treatment. In addition, recent evidence suggests that RA may pose a potential risk to clinical personnel who is providing this form of sedation on a regular basis [Donaldson and Meechan, 1995; Shaw and Morgan, 1998; Henderson and Matthews, 2000]. Furthermore, not all paediatric patients accept RA and at present there appears to be no proven alternative; for this reason, research into other sedation techniques for paediatric dental patients is of vital importance.

**Conclusion**

The present study suggests that the perception amongst dentists treating patients using nitrous oxide inhalation sedation is generally less enthusiastic than the patients themselves and their accompanying carer.

**References**


