

# Nitrous Oxide Oxygen Inhalation as Safe and Effective Tool for Behavior Management in Pediatric Dentistry

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Pediatric dentists are unique amongst all dental specialties as they are not only responsible for providing dental treatment but are also integral in shaping the behavior of children. Traditionally several nonpharmacologic behavior management techniques have been used to achieve the desired behavior in children in the dental operator. With changing parenting styles and parental perceptions of a comfortable experience of their child during dental visits, pharmacological interventions have gained popularity in recent times.<sup>1</sup> The children with high anxiety, fear, and some special needs children also require some of the pharmacologic methods for anxiety control. However, the use of some of the drugs requires precision in dosage owing to different thresholds and responses to drugs due to individual variations in physiology in each patient. Sometimes the operator remains busy in their clinical work and misses continuous monitoring of vital parameters during the use of pharmacologic methods of anxiety control. This may lead to complications of going into deeper stages of anesthesia and may result in permanent harm. Therefore, the guidelines from many countries suggest the mandatory presence of personnel with advanced training to monitor the patients under sedation in a dental setting.<sup>2,3</sup>

After the discovery of nitrous oxide (N<sub>2</sub>O) in 1772 by Joseph Priestley and the subsequent discovery of its potential as an anesthetic agent in 1844 by Horace Wells, high concentrations of N<sub>2</sub>O were studied till the early 1900s as a potential sedation method.<sup>4</sup> Breitman,<sup>5</sup> Holst,<sup>6</sup> and Langa<sup>7</sup> helped evolve the technique of using concentrations of less than 50% of N<sub>2</sub>O as an anxiolytic or Psychotropic Analgesic Nitrous oxide (PAN). The use of PAN paved the way for this to be a safe means to manage anxiety and pain control in dentistry. In this technique, the protective reflexes remain intact and the patient responds normally to verbal commands and there is minimal effect on the respiratory system.

The specific machines now available for use in dental operatories have several fail-safe mechanisms to ensure that oxygen never falls below 30% during gas delivery.<sup>2</sup> These machines also have a mechanism that allows for 100% oxygen to be administered through a reservoir bag allowing oxygen flush for an emergency.<sup>3</sup> Due to the high safety margin of Nitrous Oxide as a drug, it has become very popular in not only pediatric dentistry but also in several other specialties like Ophthalmology, Otorhinolaryngology, Obstetrics, and Gynecology as a safe anxiolytic agent.

The use of Nitrous Oxide Oxygen is very safe because the child remains awake, responsive, and breaths on his/her own.<sup>8</sup> Several studies have documented the safety and efficacy of inhalation sedation with N<sub>2</sub>O (50–70%) in pediatric groups for dental procedures. A report by Heinrich M et al. suggested the use of self-administered

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N<sub>2</sub>O/O<sub>2</sub> (50:50) mixture for minor painful procedures to be safe and effective in controlling pain in young pediatric patients.<sup>9</sup> Lack of fasting before the procedure, effective anxiolysis, and cooperation gain are some of the benefits observed in the study. Galeotti A et al. evaluated the effectiveness and the acceptability of the nitrous oxide sedation for dental management amongst 472 uncooperative, anxious pediatric patients (aged 4–17 years) and reported it to be an effective and safe method to obtain cooperation, even in preschool children thereby reducing the number of pediatric patient referrals for general anesthesia.<sup>10</sup> Judith L Zier and Meixia Liu concluded Nitrous oxide to be present with minimal adverse events at higher concentrations (70%) even in younger age groups (1–4 years).<sup>11</sup> A detailed systematic review published by Rie S Pedersen et al. included evidence on the application of nitrous oxide for mildly to moderately painful pediatric procedures since 1980 and concluded it to be a safe and effective technique to attain analgesia and sedation during minor, but painful procedures.<sup>12</sup>

As per AAPD guidelines, the patient's responsiveness to ensure that patient is not in deeper planes of anesthesia and is breathing adequately, color to ensure adequate oxygenation and respiratory rate should be continually monitored.<sup>3</sup> The lowest practical concentration of N<sub>2</sub>O should be used. In addition to the pediatric dentist, there should be an assistant monitoring the patient who should have received adequate training and should be capable of monitoring vital signs, assisting in emergency procedures, and administering Basic Life Support (BLS).<sup>13</sup> The dentist should be capable of rescuing the patient from the next plane of sedation and should be BLS trained and capable of administering BLS.

Considering the challenges to infection control post-COVID outbreak, there are several safety features to ensure that there is no cross-contamination in the nitrous delivery systems. There is no direct contact between the patient and the flowmeter or the breathing bag and the one-way non-rebreathing valve ensures that the patient's breath cannot flow to the breathing bag or flowmeter.<sup>13</sup> Disposable nasal hoods can reduce the risk of infection. All components that can be sterilized should be sterilized after each patient use. In certain delivery systems (Porter Breathing Circuit) reusable nasal hoods, the grey coaxial tubing, plastic connectors, and grey breathing bag can be sterilized, however, corrugated mixed gas tubing is not in contact with the patient and can be washed with soap and water.<sup>14</sup> In other systems (Matrix Breathing Circuit), the entire breathing circuit can be autoclaved and manufacturer instructions should be followed.<sup>15</sup> A newer system has recently been introduced recently (Porter Silhouette Low Profile Mask system) where the masks are connected to one meter of single-use tubing and are intended for single patient use only. Literature has proven the satisfactory application of N<sub>2</sub>O inhalation for urgent dental treatment of uncooperative pediatric patients during the pandemic. In a study reported by Ferrazzano et al., 42 uncooperative children attending primary and secondary schools underwent emergency dental treatments with inhalation conscious sedation using nitrous oxide and oxygen during COVID-19. The success rate was 87.1% with no adverse effects.<sup>16</sup> Postdischarge surveys exhibited minimal side effects (vomiting, headache, drowsiness) and none of the children had a fever, showing irritability and excitability.

Keeping in mind the relative safety and minimal side effects, the precision of the delivery system, versatility to use even in pandemic time and effectiveness is reducing anxiety. The dental professionals treating children can safely use Nitrous Oxide Oxygen Inhalation for anxiety control and behavior management in children after obtaining adequate training.

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