

## Sedation in the Dental Office: An Overview



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- The author reports no conflicts of interest associated with this course.

### Introduction – Sedation in the Dental Office

Dental anxiety can be a barrier to the patient to seek dental treatment and a challenge to the treating dental team. An overview of the available pharmacological means to manage the anxious patient in the dental office is presented. The advantages and disadvantages as well as indications and contraindication of each sedation modality are discussed.

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## Overview

Dental anxiety can be a barrier to the patient to seek dental treatment and a challenge to the treating dental team. An overview of the available pharmacological means to manage the anxious patient in the dental office is presented. The advantages and disadvantages as well as indications and contraindication of each sedation modality are discussed.

## Learning Objectives

**Upon completion of this course, the dental professional should be able to:**

- Understand the history of modern sedation in the dental office.
- List the different levels of the sedation continuum and their features.
- Recognize the ADA educational requirements for the various levels of sedation.
- List the different sedation techniques available to the trained dentist.
- Discuss the advantages and disadvantages of each of the sedation techniques.
- Discuss the pre-sedation assessment of patient physical status.

## Introduction

Although the public's opinion of dentistry as a profession has always been mostly favorable, a visit to the dental office has remained a source of fear and anxiety for a substantial number of patients.<sup>1-3</sup> It has been shown that

the percentage of people with dental anxiety in western societies ranges from 4% to 20%.<sup>1-4</sup> While the cause or source of dental anxiety may be influenced by cultural differences, the prevalence of anxiety seems to transcend countries and cultures.<sup>5,6</sup>

Depending on the severity of dental anxiety and/or phobia, it may lead to broken appointments, postponing treatment and in some severe cases, a complete avoidance of professional oral care.<sup>7</sup> Ultimately, severely anxious and fearful patients have increased number of decayed and decreased number of restored or functional teeth.<sup>8</sup> Such patients usually require more extensive and complicated treatment, which causes additional fear and anxiety to the patient and increased stress to the dental team.<sup>9-11</sup>

Regardless of the cause and level of anxiety which may vary among phobic patients, all patients expect and deserve treatment in a safe environment without fears and stress. In a successful practice, the management of patient anxiety is paramount for both the patient and the dental team. As in any other dental procedure, understanding the patient's needs, expectations, fears and apprehension is the first step in successfully managing the patient.

Malamed coined the term 'the pain of fear' to describe a circular relationship between pain and fear, where dental fear ultimately leads to more anxiety.<sup>12</sup> This leads to poor oral health, and the negative effect of dental anxiety on oral health leads to reduced quality of life.<sup>9,13,18</sup> The aim of this article is to provide an overview of conscious sedation in dentistry, and the various techniques available to the dental professional. It is by no means intended to be an instructional guide on the use of sedation in the office.

## History

The contributions of dentistry to the management of pain and anxiety have been well-documented.<sup>20,21</sup> In 1844, Dr. Horace Wells, a dentist from New England, in public demonstration to the staff of the Massachusetts General Hospital, used nitrous oxide to sedate a patient undergoing tooth extraction. The demonstration was deemed

a disaster when the patient cried or moaned during the procedure. Two years later, in 1846, Dr. William T.G. Morton, on the same stage, successfully demonstrated the use of ether during tooth extraction.

Dr. Wells and Dr. Norton are considered the fathers of anesthesia (although official recognition is given to Dr. Wells) for the introduction of nitrous oxide and for the successful use of ether, respectively.<sup>22</sup> It is of note, that twenty years after Dr. Wells' ill-fated demonstration, the use of 100% nitrous oxide was popularized by Dr. William T.G Morton in 1863.<sup>23</sup> The current practice of using a mixture of nitrous oxide and oxygen was introduced by Andrews in 1869.<sup>23</sup>

Over the past decades, the efforts and contributions of many great practitioners led to the modern practice of intravenous sedation in ambulatory settings. The technique of administering multiple drugs to induce sedation by titration was introduced by Niels Bjorn Jorgensen (1945) who is recognized as the father of intravenous sedation in dentistry. This technique deservedly bears his name as the Jorgensen technique.<sup>23</sup>

**Sedation Continuum**

Just as the history of sedation is a continuum of events and discoveries, it is important to understand that sedation itself is a continuum.

The boundaries between the different levels of sedation may not always be evident to the untrained or inexperienced and progression from one level to a higher level may quickly occur as patients do not always respond predictably to any particular sedative agent, i.e., they may respond idiosyncratically. Table 1 summarizes the different levels of sedation continuum and their characteristics.

**Levels of Sedation**

Definitions of sedation and guidelines are published by several dental professional organizations, notably the American Academy of Pediatric Dentistry, the American Association of Oral Maxillofacial Surgeons, and the American Dental Association (ADA). Information on the guidelines can be found on their respective websites.<sup>23-27</sup>

The ADA's guidelines also include the educational requirements needed to qualify a dentist to provide sedation in their office as well as guidelines for teaching sedation to dentists and dental students.<sup>27</sup> Although most state dental boards base their requirements on the ADA guidelines, dentists should contact their respective state board for specific information.

Sedation is defined as the use of a drug or a combination of drugs to depress the central nervous system (CNS), thus reducing the

**Table 1. The Sedation Continuum.**

Level	Responsivness	Airways	Ventilation	Cardiovascular
Minimal	Normal	Not affected	Not affected	No change
Moderate	Purposeful response	Open	Adequate	Maintained
Deep	Repeated painful stimulus	May need assistance	Ventilation may be impaired	Usually maintained
General	No response/not easily aroused	Often needs assistance	Impaired/needs support	May be impaired

awareness of the patient to their surroundings. Depending on the degree of CNS suppression, the sedation may be conscious, deep, or general. Sedation does not control pain and, consequently, does not eliminate the need for the use of local anesthetics.

Conscious sedation is a controlled, pharmacologically induced, minimally depressed level of consciousness that retains the patient's ability to maintain a patent airway independently and continuously and respond appropriately to physical and/or verbal commands. The drugs used should have a wide margin of safety to prevent loss of consciousness.

The following levels of sedation, as well as the education requirement, are promulgated in the ADA guidelines.<sup>26,27</sup>

### **Minimal Sedation (Anxiolysis)**

Minimal sedation is a state of minimally depressed level of consciousness produced by a pharmacologic method that retains the patient's ability to independently and continuously maintain an airway and respond normally to tactile stimulation and verbal commands. Although cognitive function may be modestly impaired, ventilatory and cardiovascular functions are unaffected. Minimal sedation may be achieved with an oral sedative alone or in combination with nitrous oxide/oxygen.

- **Educational Requirements for Minimal Sedation**

In addition to Basic Life Support (BLS) or Health Care Provider (HCP) certification, the dentist must have completed a 14-hour course in nitrous oxide/oxygen sedation technique, including clinical competency. This course is usually completed as part of the dental school curriculum. The use of enteral and/or combined enteral/nitrous oxide/oxygen sedation requires an additional 16 hours of didactic instructions including clinically oriented experience.

### **Moderate Sedation**

Moderate sedation is a drug induced depression of consciousness during which

patients respond purposefully to verbal commands either alone or accompanied by light tactile stimulation (e.g., open, close...). No interventions are required to maintain a patent airway and spontaneous ventilation is adequate. Cardiovascular function is usually maintained. In this state, the reflex response to pain is not considered purposeful.

- **Educational Requirements for Moderate Sedation**

In addition to the nitrous oxide/oxygen course described under minimal sedation, the dentist must complete a minimum of 60 hours of didactic instructions as well as 20 adult clinically oriented cases. The dentist should also demonstrate competency in sedation techniques, airways management, as well as competence in management of deeper level of sedation including the use of reversal agents when warranted.

### **Deep Sedation and General Anesthesia**

Deep sedation is a drug induced loss of consciousness during which patients cannot be easily aroused but respond purposefully following repeated stimulation. The ability to independently maintain ventilatory function is often impaired. Patients may require assistance in maintaining a patent airway and positive pressure ventilation may be required. Cardiovascular function may be impaired.

General anesthesia is a drug induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired, often requiring assistance in maintaining a patent airway. Positive pressure ventilation may be required. Cardiovascular function may be impaired.

- **Educational Requirements for Deep Sedation and General Anesthesia**

Dentists desiring to provide deep sedation and/or general anesthesia in their offices should be trained in an accredited post-graduate residency program such as those in oral and maxillofacial surgery or dentist anesthesiologist programs and show competence in deep sedation or general anesthesia.

## Clinical Considerations

In dentistry the three most common routes of drug administration used to induce a desired level of sedation, alone or in combination, include the enteral route (mainly oral), parenteral route (mostly intravenous), and inhalation (primarily nitrous oxide/oxygen).

### Oral Sedation

Because of convenience, oral sedation is the most common and the most accepted by patients. It is often used for the management of the mild to moderate anxiety and in some cases to assist the patient to have a restful night prior to the appointment. The goal is to produce a lightly sedated, relaxed, more cooperative patient that is easier to manage and not to produce moderate sedation or pain control.

Because of the sedative effect, no matter how mild, it is the responsibility of the dentist to inform the patient of the need of a responsible adult escort to and from the office. Examples of oral sedatives used in dentistry include benzodiazepines such as diazepam (Valium), lorazepam (Ativan), triazolam (Halcion), and midazolam (Versed); and non-benzodiazepines such as zolpidem (Ambien) and zaleplon (Sonata).

- **Advantages**

Compared to other sedation modalities, the cost of oral sedatives to the patient and the dentist is minimal. There are no special techniques, equipment or injections involved, and the dentist does not require extensive advanced training. Oral sedation can be beneficial to patients with medical conditions such as cardiovascular disease, renal/hepatic diseases, epilepsy and diabetes. Nonetheless, it is always advisable to consult the patient's physician to better understand the patient's medical status.<sup>28</sup>

- **Disadvantages**

One of the major disadvantages of oral sedation is the inability to titrate. Because the drug has to travel through the gastrointestinal tract and the portal hepatic circulation, only a small portion of the drug will reach its site of action. The onset of action (30 minutes to 60 minutes) as well as recovery may be delayed. Relying on

patients' compliance, especially providing an escort, may be a problem. Potential common adverse drug effects include nausea and vomiting.

- **Indications**

Oral sedation alone is mainly used in the management of the mild to moderate dental anxiety. It may also be used or as an adjunct to other methods of sedation for the severely anxious. However, in the latter case, the dentist should have additional advanced sedation training beyond the dental school curriculum.

- **Contraindications**

Oral sedatives should be avoided if (1) rapid onset of action and titration are desired - in this case inhalation or intravenous sedation would be a better choice; (2) patient has a history of chronic drug use - it is important to explain to the patient the importance of honest disclosure, as sedation may be ineffective in patients with high tolerance to certain drugs; (3) patient has known allergy to the sedative; (4) patient is pregnant or nursing; (5) patient is being treated for depression and bipolar disorders; and (6) patient has acute narrow-angle glaucoma - avoid benzodiazepines.

### Inhalation Sedation

Inhalation sedation involves the passage of gases to the cardiovascular system via the lungs. Nitrous oxide/oxygen is the most commonly used inhalation anesthetic in dentistry.<sup>29</sup> Indeed, in dentistry, inhalation sedation is synonymous with the use of nitrous oxide/oxygen.<sup>12</sup> Nitrous oxide/oxygen has a long history of safety and in providing conscious sedation to the anxious patient.<sup>29</sup> Although nitrous oxide/oxygen has some analgesic properties, it is not intended as a substitute to local anesthetics.<sup>30-32</sup>

- **Advantages of Nitrous Oxide**

Nitrous oxide/oxygen and other inhalation drugs reach their destination by moving from a high pressure to a low pressure system. Because nitrous oxide is a relatively insoluble gas and does not break down in the body, it is readily available to reach its site of action for peak effect within minutes. The same property allows fast elimination of the drug from the body once the pressure gradient is reversed, thus providing for

quick recovery. Rapid onset can be achieved with intravenous conscious sedation; however, the recovery is delayed.

Nitrous oxide/oxygen is also titratable. Not only does it allow to control of the depth and duration of sedation, but it is unique in its ability especially when immediate need to decrease the level of sedation is desirable, an advantage that intravenous sedation does not provide. Since no injection is needed, it is particularly desirable when anxiety stems from the fear of needles. Nitrous oxide/oxygen may be used without local anesthesia in selected procedures such as dental prophylaxis and scaling. Finally, nitrous oxide/oxygen, if used properly, has very few side effects.

- **Disadvantages of Nitrous Oxide**

Most of the disadvantages of nitrous oxide relate to equipment and the logistics of safe delivery such as operatory space, cost of the equipment, supplies and cost to the patient. Although the cost, compared to intravenous sedation, to the patient is less. Because of its low potency (high minimal alveolar concentration), the nitrous oxide/oxygen may not always produce the desired effects on all patients. As stated above, the effectiveness of nitrous oxide will depend on the patient's willingness to breathe the gas. Finally, chronic exposure of office personnel may lead to serious consequences; however, the risk can be minimized by a proper scavenging system.

- **Indications**

The main indication for the use of nitrous oxide/oxygen sedation is the management of mild to moderate dental anxiety. It is also useful in the management of the medically compromised patients, such as those with cardiovascular diseases. Patients with a severe gag reflex who may not tolerate impressions or radiographs may benefit from the use of nitrous oxide.

- **Contraindications**

Nitrous oxide/oxygen has long been considered safe and the 'ideal' sedative, as long as it is delivered in combination with a constant flow of oxygen (i.e., greater than 30% oxygen concentration). Nitrous oxide is absolutely contraindicated in patients

unable or unwilling to wear a nasal mask or to breathe through the nose. Other contraindications include sinusitis, recent ear surgery, severe psychiatric or personality disorders, and chronic obstructive pulmonary disease - in those patients the respiratory drive is initiated by low oxygen levels as opposed to high CO<sub>2</sub> levels, providing constant high concentration of oxygen during sedation removes the stimulus for breathing.<sup>1-3</sup>

Additional contraindications include claustrophobia, B12 or folate deficiency, patients undergoing bleomycin chemotherapy - patients may be at increased risk of developing respiratory toxicity and failure if exposed to high concentrations of oxygen, pregnancy, especially the first trimester - due to the ability of nitrous oxide to inactivate the enzyme methionine synthase related to DNA production, and because of its effect on the production and function white blood cells, it has been suggested that nitrous oxide should be avoided in immune compromised patients.<sup>4-8,33,34</sup>

## Intravenous Sedation

Intravenous sedation (IV) entails the administration of sedative agents directly into the vascular compartment. The use of IV sedation in a dental office requires additional advanced training beyond the curriculum of dental schools. The most common parenteral sedation technique in the general dental office involves the use of a benzodiazepine (e.g., diazepam or midazolam) alone or in combination with an opioid (e.g., fentanyl or demerol). Because of potential additional risks, other techniques such inhalation should be considered first.

- **Advantages**

A major advantage of IV sedation is that it allows for titration. It provides for rapid onset (20-25 seconds) and shorter recovery compared to oral sedation, but longer than nitrous oxide/oxygen. In an emergency, it provides ready access to a vein. Finally, patients will often have vague or no recollection of the procedure or the length of time they were under treatment.

- **Disadvantages**

The need for access to a peripheral vein and the anticipated pain may alarm the severely anxious patient. The use of nitrous oxide/oxygen as a pre-sedative may prove useful in this situation. A potential concern is local complications at the injection site. Other disadvantages include the need for additional training on the part of the clinician and the need for a responsible adult escort for the patient.

- **Indications**

The principal indication for the use of intravenous sedation is the management of moderate to severe anxiety, where oral and/or nitrous oxide/oxygen may not be effective. It is also indicated when longer, more involved procedures are planned such as impacted third molar extractions or when amnesia is desired.

- **Contraindications**

Intravenous sedation should not be administered by unqualified, i.e., untrained providers. It is also contraindicated during pregnancy and the extremely obese - due to difficulty to maintain patent airways or access to the airways in case of an emergency.

## **Patient Evaluation and Assessment**

Patient evaluation and pre-sedation assessment is crucial in determining the patient's suitability for sedation, for choosing an appropriate technique, and in preventing unwanted complications and emergencies. The pre-sedation assessment starts with a detailed review of the medical and dental histories. Allergies, history of adverse reactions to drugs and prior sedation experiences should be clearly noted. All positive responses by the patient should be clarified further and notated. For example, if the patient answered yes to

asthma, further information about causes, frequency, date of hospitalization if any, and medications should be obtained and noted.

The pre-sedation assessment, especially for patients considered for moderate to deep sedation in the dental office, should also include baseline vital signs, weight, airways evaluation (Mallampatti classification), status of major organ systems, and the patient's American Society of Anesthesiologists (ASA) Physical Status (PS) classification (Table 2).<sup>35</sup> Patients with PS I and PS II are good candidates for sedation in the general dentist office. A patient with PS III may be treated with caution as an outpatient by a well-trained provider.

## **Conclusion**

The prevalence of dental anxiety is considerable. Anxiety and "fear of the dentist" can be an obstacle to the patient to seek dental care and a source of frustration and additional stress to the dentist. The consequences of postponing and avoiding professional care can affect overall oral health and quality of life. Management of the fearful patient can be accomplished, with varying degrees of success, via non-pharmacological and pharmacological means.

**Table 2. The ASA PS classification with examples.**

<b>ASA Classification</b>	<b>Physical Status</b>	<b>Examples</b>
I	Healthy patient	No known systemic disease. Non-smoker.
II	Mild or well-controlled systemic disease	Smokers, healthy pregnant, well-controlled Hypertension, controlled asthma, type II diabetes
III	Multiple or moderate controlled system disease that is not life threatening	Type I Diabetes, stable angina
IV	Poorly controlled systemic disease that is a constant threat to life.	Unstable angina, CHF needing oxygen supplement. Chest pain, recent myocardial infraction.
V	Moribund patient, not expected to survive without intervention	End stage cancer or end stage vital organs
VI	Deceased patient on perfusion support	

## Course Test Preview

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- 1. Nitrous oxide sedation was first introduced to dentistry by:**
  - A. Dr. Horace Wells
  - B. Dr. William T.G Morton
  - C. Dr. Colton
  - D. Dr. Niels Bjorn Jorgensen
  
- 2. The technique of titrating multiple drugs to induce sedation was introduced by:**
  - A. Dr. Horace Wells
  - B. Dr. William T.G Morton
  - C. Dr. Colton
  - D. Dr. Niels Bjorn Jorgensen
  
- 3. The boundaries between different levels of sedation are well demarcated.**
  - A. True
  - B. False
  
- 4. When administering drugs for sedation, it is always possible to predict the level of sedation.**
  - A. True
  - B. False
  
- 5. Minimal sedation can be achieved with:**
  - A. oral sedative alone
  - B. combination of oral sedative and nitrous oxide/oxygen
  - C. none of the above
  - D. both A and B
  
- 6. All of the following are qualification requirements to provide minimal enteral sedation EXCEPT:**
  - A. 14 hours nitrous oxide course
  - B. 16 hours of didactic instructions
  - C. Basic Life Support (BLS)
  - D. Advanced Cardiac Life Support (ACLS)
  
- 7. If during sedation, the patient's consciousness is depressed but the airways are open with adequate ventilation and responds purposefully to verbal command. Which of the following best describes the level of sedation?**
  - A. minimal sedation
  - B. moderate ("conscious") sedation
  - C. deep sedation
  - D. general anesthesia
  
- 8. According to the ADA guidelines on educational requirements, a general dentist who completed a weekend course in IV sedation can provide the level of sedation in question 7.**
  - A. True
  - B. False

9. **A sedated patient responds only to repeated painful stimulation, his airways may need assistance and ventilation may be impaired. This patient is:**
- A. minimal sedated
  - B. moderately medated
  - C. deeply sedated
  - D. under general anesthesia
10. **All of the followings are advantages of oral sedation EXCEPT:**
- A. ease of administration
  - B. no special equipment needed
  - C. ability to titrate
  - D. cost to the patient
11. **Patient escort is optional if oral sedation only is considered.**
- A. True
  - B. False
12. **Benzodiazepines should be avoided in patients with acute narrow-angle glaucoma.**
- A. True
  - B. False
13. **Because of its analgesic properties, nitrous oxide can be an adequate substitute to local anesthetics.**
- A. True
  - B. False
14. **Which of the following techniques allow a relatively rapid increase AND decrease of the level of sedation?**
- A. nitrous oxide/oxygen sedation
  - B. oral sedation
  - C. intravenous sedation
  - D. a combination of B and C
15. **All of the following are true about nitrous oxide EXCEPT:**
- A. titratable
  - B. rapid onset and recovery
  - C. high potency
  - D. All of the above are correct.
16. **Which of the following are advantages of intravenous sedation:**
- A. ability to titrate
  - B. slow onset
  - C. amnesia
  - D. A and C only
17. **Contraindications of intravenous sedation in the general dental office include:**
- A. untrained provider
  - B. pregnant patient
  - C. extremely obese patient
  - D. All of the above.

- 18. The pre-sedation assessment should include:**
- A. review of medical history
  - B. base line vital signs
  - C. ASA status
  - D. Marital status
  - E. All of the above.
- 19. According to the ASA physical status classification, a 34-year-old male heavy smoker with no known systemic disease would be considered:**
- A. ASA I
  - B. ASA II
  - C. ASA III
  - D. ASA IV
- 20. Which of the following ASA physical status would not be good candidate(s) for sedation in the general dentist office?**
- A. ASA I
  - B. ASA II
  - C. ASA III
  - D. ASA IV
  - E. both C and D are not good candidates

## References

1. Nicolas E, Collado V, Faulks D, et al. A national cross-sectional survey of dental anxiety in the French adult population. *BMC Oral Health*. 2007 Oct 10;7:12.
2. Locker D, Shapiro D, Liddell A. Who is dentally anxious? Concordance between measures of dental anxiety. *Community Dent Oral Epidemiol*. 1996 Oct;24(5):346-50.
3. ter Horst G, de Wit CA. Review of behavioural research in dentistry 1987-1992: dental anxiety, dentist-patient relationship, compliance and dental attendance. *Int Dent J*. 1993 Jun;43(3 Suppl 1):265-78.
4. Moore R, Birn H, Kirkegaard E, et al. Prevalence and characteristics of dental anxiety in Danish adults. *Community Dent Oral Epidemiol*. 1993 Oct;21(5):292-6.
5. Malvania EA, Ajithkrishnan CG. Prevalence and socio-demographic correlates of dental anxiety among a group of adult patients attending a dental institution in Vadodara city, Gujarat, India. *Indian J Dent Res*. 2011 Jan-Feb;22(1):179-80. doi: 10.4103/0970-9290.79989.
6. Ekanayake L, Dharmawardena D. Dental anxiety in patients seeking care at the University Dental Hospital in Sri Lanka. *Community Dent Health*. 2003 Jun;20(2):112-6.
7. Berggren U, Meynert G. Dental fear and avoidance: causes, symptoms, and consequences. *J Am Dent Assoc*. 1984 Aug;109(2):247-51.
8. Schuller AA, Willumsen T, Holst D. Are there differences in oral health and oral health behavior between individuals with high and low dental fear? *Community Dent Oral Epidemiol*. 2003 Apr;31(2):116-21.
9. Eitner S, Wichmann M, Paulsen A, et al. Dental anxiety--an epidemiological study on its clinical correlation and effects on oral health. *J Oral Rehabil*. 2006 Aug;33(8):588-93. doi: 10.1111/j.1365-2842.2005.01589.x.
10. Cooper CL, Mallinger M, Kahn RL. Dentistry: what causes it to be a stressful occupation? *Applied Psychology: An International Review*. 1980 July;29(3):307-319. Accessed May 24, 2018.
11. Moore R, Brødsgaard I. Dentists' perceived stress and its relation to perceptions about anxious patients. *Community Dent Oral Epidemiol*. 2001 Feb;29(1):73-80.
12. Malamed SF. *Sedation: a guide to patient management*. 6th edition. St. Louis, MO, Mosby Elsevier, 2018.
13. Locker D, Liddell A. Clinical correlates of dental anxiety among older adults. *Community Dent Oral Epidemiol*. 1992 Dec;20(6):372-5.
14. Doerr PA, Lang WP, Nyquist LV, et al. Factors associated with dental anxiety. *J Am Dent Assoc*. 1998 Aug;129(8):1111-9.
15. Mehrstedt M, John MT, Tönnies S, et al. Oral health-related quality of life in patients with dental anxiety. *Community Dent Oral Epidemiol*. 2007 Oct;35(5):357-63. doi: 10.1111/j.1600-0528.2007.00376.x.
16. Crofts-Barnes NP, Brough E, Wilson KE, et al. Anxiety and quality of life in phobic dental patients. *J Dent Res*. 2010 Mar;89(3):302-6. doi: 10.1177/0022034509360189. Epub 2010 Feb 5.
17. Kumar S, Bhargav P, Patel A, et al. Does dental anxiety influence oral health-related quality of life? Observations from a cross-sectional study among adults in Udaipur district, India. *J Oral Sci*. 2009 Jun;51(2):245-54.
18. Cohen SM, Fiske J, Newton JT. The impact of dental anxiety on daily living. *Br Dent J*. 2000 Oct 14;189(7):385-90.
19. Goldsmith D. The discovery of anesthesia. *Anesth Prog*. 1974 Nov;21(6):174-80.
20. Yagiela JA. Office-based anesthesia in dentistry. Past, present, and future trends. *Dent Clin North Am*. 1999 Apr;43(2):201-15, v.
21. Jacobsohn PH. Horace Wells: discoverer of anesthesia. *Anesth Prog*. 1995;42(3-4):73-5.
22. Jorgensen NB, Hayden J. *Sedation, Local and General Anesthesia in Dentistry*. 3rd edition. Philadelphia, Lea & Febiger, 1980.
23. *Guideline for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures: Update 2016*. *Pediatr Dent*. 2016 Oct 15;38(5):77-106.
24. American Academy of Pediatric Dentistry; American Academy of Pediatric Dentistry Committee

on Sedation and Anesthesia. Guideline on the elective use of minimal, moderate, and deep sedation and general anesthesia for pediatric dental patients. *Pediatr Dent*. 2005-2006;27(7 Suppl):110-8.

25. American Association of Oral and Maxillofacial Surgeons (AAOMS). Parameters of Care: Clinical Practice Guidelines for Oral and Maxillofacial Surgery. 2012. Accessed May 24, 2018.
26. American Dental Association. Guidelines for the Use of Sedation and General Anesthesia by Dentists. Adopted by the ADA House of Delegates. October 2016. Accessed May 24, 2018.
27. American Dental Association. Guidelines for Teaching Pain Control and Sedation to Dentists and Dental Students. Adopted by the ADA House of Delegates. October, 2016. Accessed May 24, 2018.
28. Donaldson M, Gizzarelli G, Chanpong B. Oral sedation: a primer on anxiolysis for the adult patient. *Anesth Prog*. 2007 Fall;54(3):118-28; quiz 129.
29. Becker DE, Rosenberg M. Nitrous oxide and the inhalation anesthetics. *Anesth Prog*. 2008 Winter;55(4):124-30; quiz 131-2. doi: 10.2344/0003-3006-55.4.124.
30. Chapman WP, Arrowood JG, Beecher HK. The analgetic effects of low concentrations of nitrous oxide compared in man with morphine sulphate. *J Clin Invest*. 1943 Nov;22(6):871-5. doi: 10.1172/JCI101461.
31. Castéra L, Nègre I, Samii K, et al. Patient-administered nitrous oxide/oxygen inhalation provides safe and effective analgesia for percutaneous liver biopsy: a randomized placebo-controlled trial. *Am J Gastroenterol*. 2001 May;96(5):1553-7. doi: 10.1111/j.1572-0241.2001.03776.x.
32. Jastak JT, Donaldson D. Nitrous oxide. *Anesth Prog*. 1991 Jul-Oct;38(4-5):142-53.
33. Fleming P, Walker PO, Priest JR. Bleomycin therapy: a contraindication to the use of nitrous oxide-oxygen psychosedation in the dental office. *Pediatr Dent*. 1988 Dec;10(4):345-6.
34. Brodsky JB, Cohen EN. Adverse effects of nitrous oxide. *Med Toxicol*. 1986 Sep-Oct;1(5):362-74.
35. Doyle DJ, Garmon EH. American Society of Anesthesiologists Classification (ASA Class). StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2018-2017 Oct 6.

## About the Author

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Dr. Assaf is a Professor in the Department of Comprehensive Care at Case Western Reserve University School of Dental Medicine as well as the Director of the Advanced Education in General Dentistry program. He received his "Maitrise" in neurophysiology from the University of Bordeaux I, his DDS from the Ohio State University in 1993, and a certificate in Advanced Education in General Dentistry from the United States Air Force. Additionally, Dr. Assaf serves on the editorial board of several online open access journals, and he is the director of Aesthetic Dentistry and several preclinical operative courses at CWRU. He has lectured nationally and internationally on tooth bleaching and adhesive dentistry. He is an active member of the American Dental Association, the American Dental Education Association, and serves as a consultant for the commission on dental accreditation. Dr. Assaf is licensed in Conscious Sedation by the Ohio State Board and maintains an intramural practice in the greater Cleveland area.

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