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SEDATION IN PERIODONTAL AND IMPLANT SURGERY: A COMPREHENSIVE REVIEW

Dentistry

Dr. Trishagni Das* Post-Graduate student, Department of Periodontology, Government Dental College and Hospital, Ahmedabad, Gujarat, India*Corresponding Author

Dr. Nilam A. Brahmbhatt Assistant Professor, Department of Periodontology, Government Dental College and Hospital, Ahmedabad, Gujarat, India

Dr. Sakshee R. Trivedi Assistant Professor, Department of Periodontology, Government Dental College and Hospital, Ahmedabad, Gujarat, India

Dr. Soham Ghosh Post-Graduate student, Department of Periodontology, Government Dental College and Hospital, Ahmedabad, Gujarat, India

ABSTRACT

Sedation is an essential adjunct in periodontics and implantology for controlling anxiety, discomfort, and pain associated with invasive procedures. While local anesthesia effectively blocks nociception, it does not address fear or psychological distress. Sedation improves patient cooperation, facilitates surgical precision, and enhances overall treatment experience. This review summarizes the evolution of procedural sedation, levels of consciousness, pharmacology of commonly used sedatives, procedure-specific protocols, patient monitoring, emergency preparedness, and considerations for special populations. Particular emphasis is placed on benzodiazepines, propofol, dexmedetomidine, nitrous oxide, and volatile anesthetics, as well as their applications in periodontal and implant surgeries. Continuous monitoring with pulse oximetry, capnography, and structured emergency protocols remains fundamental to patient safety. Tailored sedation strategies integrated with profound local anesthesia optimize surgical outcomes and patient satisfaction.

KEYWORDS

INTRODUCTION

Sedation has become an important component of modern periodontal and implant therapy because these procedures often involve extensive flap reflection, grafting, regenerative surgery, and implant placement. Although local anesthesia provides adequate pain control, it does not alleviate anxiety, fear, or dental phobia, which may negatively affect treatment acceptance and patient cooperation. (Cannon, 1929; Pearson, 1978; American Dental Association, Council on Dental Education, 2016; Monheim, 1968; American Dental Association, 2002; Malamed, 2018; Girdler, 2018)

Fear is a response to an immediate threat, whereas anxiety reflects apprehension regarding anticipated danger. Dental anxiety commonly leads to delayed treatment and worsening oral health. Sedation creates a drug-induced state of altered awareness that reduces stress, improves cooperation, and facilitates efficient treatment delivery. (Cannon, 1929; Pearson, 1978)

The American Dental Association classifies sedation into minimal sedation, moderate sedation, deep sedation, and general anesthesia. Minimal sedation allows normal response to verbal commands and maintenance of airway reflexes. Moderate sedation preserves purposeful responses and adequate spontaneous ventilation. Deep sedation requires closer monitoring because patients respond only to repeated or painful stimulation and may experience ventilatory impairment. General anesthesia produces complete unconsciousness with loss of protective reflexes and frequently requires assisted ventilation. (American Dental Association, Council on Dental Education, 2016; American Dental Association, 2002; Malamed, 2018; Girdler, 2018)

The continuum of sedation and corresponding patient responsiveness is summarized in Figure 1.

Historical Development of Procedural Sedation

The development of pain control evolved from ancient mechanical and botanical methods to modern pharmacology. Cocaine was introduced as a local anesthetic in 1884, epinephrine was added in 1903 to prolong anesthetic action, procaine was synthesized in 1904, and lidocaine was introduced in 1949. (Monheim, 1968; Frost, 1985; Nathan et al., 2016)

Dentistry played a major role in procedural sedation. Horace Wells demonstrated nitrous oxide analgesia in 1844, Harry Langa popularized low-dose nitrous oxide–oxygen "relative analgesia" in the 1930s, and Niels Bjorn Jorgensen introduced a multidrug intravenous sedation technique in 1945. These developments shifted practice from complete anesthesia toward controlled modulation of consciousness. (Frost, 1985; Driscoll, 1978; Gillman, 2019; Langa, 1963; Langa, 1968; Drummond-Jackson, 1969)

Factor	Minimal Sedation (Anxiolysis)	Moderate Sedation/ Analgesia (Conscious Sedation)	Deep Sedation/Analgesia	General Anesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation	Purposeful response following repeated or painful stimulation	Unarousable even with painful stimulation
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

Reproduced with permission from American Society of Anesthesiologists House of Delegates: *Continuum of Depth of Sedation: Definition of General Anesthesia and Levels of Sedation/Analgesia.* Park Ridge, IL, American Society of Anesthesiologists: Standards, Guidelines and Statement, 2009.

Figure 1: Sedation Continuum and Levels of Consciousness

Guidelines and Non-Pharmacological Techniques

Non-pharmacological approaches such as iatrosedation, the Tell-Show-Do technique, cognitive behavioural therapy, and audio analgesia may reduce anxiety and improve patient acceptance. (Girdler, 2018; Gardner & Licklider, 1959; Zhou et al., 2022) When pharmacological sedation is required, comprehensive preoperative assessment is essential. The ASA Physical Status Classification System assists in patient selection, with ASA I and II patients generally suitable for outpatient sedation. Fasting guidelines, baseline vital signs, and focused medical evaluation are mandatory. (American Dental Association, Council on Dental Education, 2016; Girdler, 2018; Klein et al., 2021; American Society of Anesthesiologists, 2018)

Appropriate training, emergency equipment, oxygen delivery systems, and monitoring devices are required. Monitoring intensity increases with sedation depth and may include pulse oximetry, blood pressure monitoring, ECG, and capnography. Recovery should be confirmed using validated discharge criteria such as the Modified Aldrete Score. (Klein et al., 2021; American Society of Anesthesiologists, 2018; Becker & Weaver, 2014)

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Rationale for Sedation in Periodontal and Implant Surgery
Sedation reduces anxiety, improves pain control, enhances cooperation, and provides varying degrees of amnesia. By suppressing sympathetic activation, it promotes hemodynamic stability and decreases stress-induced tachycardia and hypertension. (Pourabbas et al., 2019; Ito et al., 2023; Shivananda et al., 2014; Staretz et al., 2004)

Sedation also improves local anesthetic efficacy by reducing catecholamine-mediated resistance to profound anesthesia. During implant surgery, moderate sedation levels reflected by OAA/S scores or BIS monitoring allow optimal surgical conditions while preserving patient responsiveness. (Pourabbas et al., 2019; Ito et al., 2023; Staretz et al., 2004)

Pharmacology of Sedative Agents
Inhalational Sedation
Nitrous oxide remains one of the most widely used inhalational agents because of its rapid onset and recovery resulting from low blood-gas solubility. Although it is a weak anesthetic, it provides excellent anxiolysis and analgesia when administered with oxygen. Modern volatile agents such as sevoflurane and desflurane offer rapid induction and recovery with minimal metabolism. (Frost, 1985; Gillman, 2019; Langa, 1963; Langa, 1968; Guedel, 1937; Franks, 2008; Khan et al., 2014; Temple & Wiles, 2019)

Intravenous Sedation
Intravenous sedation provides rapid onset and precise titration. Propofol is highly lipophilic, produces rapid sedation, and allows quick recovery because of efficient redistribution and metabolism. Midazolam is the most commonly used benzodiazepine, providing anxiolysis, muscle relaxation, and anterograde amnesia with limited cardiovascular effects. Ketamine produces dissociative anesthesia and profound analgesia while preserving respiratory drive. Dexmedetomidine provides cooperative sedation, analgesia, and sympathetic attenuation with minimal respiratory depression. (Pourabbas et al., 2019; Craig et al., 2000; Koparal et al., 2015; Yoon & Kim, 2016; Pollock et al., 2000)

Oral Sedation
Oral sedation is simple, non-invasive, and useful for mild-to-moderate anxiety. Diazepam offers reliable anxiolysis but has a prolonged duration because of active metabolites. Triazolam is preferred for many dental procedures because of rapid onset, shorter action, and predictable recovery. Non-benzodiazepine agents such as zolpidem and zaleplon may also be used for short procedures. (Mulla et al., 2025; Kaufman et al., 1993; Donaldson et al., 2007) A comparison of commonly used sedative agents is presented in Table 1.

Table 1. Comparison of Common Sedative Agents Used in Periodontics and Implantology

Agent	Route	Onset	Duration	Major Advantages	Major Limitations
Nitrous oxide	Inhalational	Rapid	Short	Excellent anxiolysis, rapid recovery	Weak anesthetic
Diazepam	Oral	Slow	Long	Effective anxiolysis	Prolonged recovery
Triazolam	Oral	Rapid	Intermediate	Predictable sedation	Variable response
Midazolam	IV/Oral	Rapid	Short	Amnesia, anxiolysis	Respiratory depression risk
Propofol	IV	Very rapid	Very short	Easy titration, quick recovery	Requires close monitoring
Ketamine	IV	Rapid	Moderate	Preserves airway reflexes	Emergence reactions
Dexmedetomidine	IV	Moderate	Moderate	Minimal respiratory depression	Bradycardia

Procedure-Specific Sedation Protocols
Periodontal Flap Surgery
Routine periodontal surgery can often be performed using oral conscious sedation. Diazepam administered the night before and before surgery remains a commonly described protocol. Midazolam, administered orally or intravenously, provides superior amnesia and faster recovery. (Shivananda et al., 2014; Staretz et al., 2004; Mulla et al., 2025; Kaufman et al., 1993)

Advanced Implant Surgery
Complex and lengthy implant procedures frequently require intravenous sedation. A common approach combines titrated midazolam for anxiolysis and amnesia with continuous propofol infusion to maintain stable sedation and rapid postoperative recovery. (Pourabbas et al., 2019; Ito et al., 2023; Craig et al., 2000; Koparal et al., 2015)

Periodontal Plastic Microsurgery
Microsurgical procedures require exceptional patient immobility. Dexmedetomidine has gained popularity because it preserves spontaneous ventilation and airway tone while providing profound calmness and cooperation. (Ito et al., 2023; Yoon & Kim, 2016)

Management of Hyperactive Gag Reflex
Nitrous oxide may reduce gagging in mild cases, whereas propofol-based intravenous sedation is highly effective in severe cases because of its anti-emetic properties and suppression of pharyngeal reflexes. (Kaufman et al., 1993; Craig et al., 2000; Koparal et al., 2015; Yoon & Kim, 2016) Recommended sedation approaches for common periodontal and implant procedures are summarized in Table 2.

Table 2. Sedation Recommendations According to Periodontal and Implant Procedures

Procedure	Typical Anxiety Level	Recommended Sedation	Monitoring Requirements
Scaling and root planing	Mild	Usually none/minimal sedation	Basic monitoring
Periodontal flap surgery	Mild–Moderate	Oral conscious sedation	Pulse oximetry
Crown lengthening	Moderate	Oral or nitrous oxide sedation	Pulse oximetry
Soft tissue grafting	Moderate	Oral/IV sedation	Pulse oximetry ± capnography
Single implant placement	Moderate	Nitrous oxide or IV sedation	Standard monitoring
Multiple implant placement	Moderate–Severe	IV sedation	Pulse oximetry, BP, ECG
Sinus lift/Bone grafting	Severe	IV sedation/deep sedation	Advanced monitoring
Microsurgery	Moderate	Dexmedetomidine-based IV sedation	Advanced monitoring

Patient Monitoring and Emergency Preparedness
Safe sedation depends on continuous assessment of patient responsiveness and physiologic status. Pulse oximetry provides continuous oxygen saturation monitoring, while capnography detects hypoventilation earlier than pulse oximetry and is therefore particularly valuable during moderate and deep sedation. (Klein et al., 2021; Blayney, 2012; American Society of Anesthesiologists, 2018)

Emergency preparedness should follow the SOAPME framework, ensuring availability of suction, oxygen, airway equipment, medications, monitors, and emergency devices. Airway assessment tools such as Mallampati classification, thyromental distance, and STOP-BANG screening help identify patients at increased risk of airway complications. (Klein et al., 2021; American Society of Anesthesiologists, 2018; Becker & Weaver, 2014)

Rapid recognition and management of emergencies such as laryngospasm are essential. Crisis Resource Management principles emphasizing communication, teamwork, and defined roles improve patient outcomes during adverse events. (American Society of Anesthesiologists, 2018; Becker & Weaver, 2014)

Special Populations
Geriatric Patients
Age-related physiologic changes increase sensitivity to sedatives and prolong recovery. Dose reductions, careful titration, and enhanced

cardiovascular monitoring are therefore recommended. (Eldawlatly et al., 2023)

Medically Compromised Patients

Patients with cardiovascular disease, obstructive sleep apnea, hepatic dysfunction, or renal impairment require individualized drug selection and monitoring because of altered pharmacodynamics and increased risk of complications. (Pourabbas et al., 2019; Eldawlatly et al., 2023; American Society of Anesthesiologists, 2018)

Sedation Failure

Sedation failure may occur because of pharmacogenomic variations, rapid drug metabolism, or heightened sympathetic activity. Escalating doses beyond therapeutic limits should be avoided because it increases the risk of respiratory depression without guaranteeing adequate sedation. (Becker & Reed, 2015)

DISCUSSION

Sedation plays a crucial role in contemporary periodontics and implantology by improving patient acceptance, minimizing anxiety, enhancing local anesthetic effectiveness, and creating optimal surgical conditions. Oral, inhalational, and intravenous techniques can be tailored according to procedural complexity and patient needs. The integration of modern technologies, including computer-controlled local anesthetic delivery systems, further improves patient comfort and may reduce sedative requirements. (Malamed, 2018; Girdler, 2018; Pourabbas et al., 2019; Craig et al., 2000; Yoon & Kim, 2016)

Successful sedation requires comprehensive patient assessment, vigilant monitoring, adherence to evidence-based guidelines, and readiness to manage emergencies. Continuous capnography, structured discharge criteria, and appropriate airway management training are central to safe practice. When individualized to patient characteristics and procedural demands, sedation significantly improves clinical efficiency, safety, and patient satisfaction during periodontal and implant therapy. (Klein et al., 2021; American Society of Anesthesiologists, 2018; Becker & Weaver, 2014)

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