

Intravenous Moderate Sedation as an Adjunct for Periodontal Surgery: A Retrospective Analysis of 964 Cases

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Introduction: Numerous articles have documented the safety of intravenous moderate sedation when used as an adjunct for dental procedures. These articles have traditionally focused on surgical procedures and demonstrate significant differences in duration for periodontal versus oral surgery cases. Periodontal procedures typically last longer than oral surgery procedures, and, when using intravenous moderate sedation, these time differences can be critical because longer procedures require additional medication use and place patients in prolonged periods of altered consciousness.

Case Series: The goal of this retrospective review is to analyze intravenous moderate sedation records from multiple private practicing periodontists to evaluate a variety of data and how they relate to periodontal procedures. Evaluated data included patient demographics, procedure type, procedure duration, medication dosages, fluid administration, hemodynamic changes, respiratory changes, and complications. Intravenous sedation cases performed during the past 5 years at five private periodontal practices were evaluated.

Conclusions: Intravenous moderate sedation using fentanyl and versed is a safe and effective adjunct for periodontal surgical procedures with minimal complications. Predictable changes in hemodynamic and respiratory levels will ensue when using these agents. Finally, practitioners using intravenous moderate sedation should schedule an additional 30 minutes of procedure time to account for preoperative and postoperative patient management. *Clin Adv Periodontics* 2014;4:88-93.

Key Words: Anesthesia, dental; conscious sedation; dental implants; retrospective studies; safety.

Background

Multiple published articles have documented the use of intravenous moderate sedation in the practice of dentistry, especially for periodontal and oral surgery procedures.¹⁻³ These articles consistently demonstrate that, when administered by properly trained professionals, intravenous moderate sedation is a safe adjunct for dental procedures. Additionally, these articles readily demonstrate that there is a difference, specifically in time duration, between oral surgery and periodontal procedures. For procedures using intravenous moderate sedation, these time differences can be critical because longer procedures require additional medication use and place patients in prolonged periods of altered consciousness. Studies evaluating intravenous conscious sedation for oral surgery procedures typically report average durations ranging from 50 to 98 minutes,^{4,5} whereas those evaluating periodontal procedures, including placement of dental implants, report average times of

80 to 210 minutes.^{6,7} The time differences between these procedures are significant, as are the types and amounts of medications. The goal of this article is to report on the safety of intravenous moderate sedation when used as an adjunct for periodontal procedures and to evaluate average changes in hemodynamic and respiratory parameters during these procedures. Additionally, patient characteristics, average medication use, and fluid administration are examined.

Clinical Presentation and Case Management

This retrospective observational analysis reports on a total of 964 patients on whom intravenous moderate sedation was used to facilitate various periodontal surgeries during the past 5 years in the offices of five private practitioners (DH, FH, JB, NT, NS). Each provider is a Diplomate of the American Board of Periodontology and received anesthesia training during service in the US Military (US Navy for DH, JB, NT, and NS; US Army for FH). Because each provider received similar anesthesia training, the methods used for administration were very analogous. All sedation records from January 2007 to June 2012 were retrieved and reviewed for parameters listed in Table 1.

For all sedation procedures, patients received a preprocedural history and physical evaluation that reviewed past medical history, past surgical history, and preprocedural vital signs, including blood pressure, heart rate, respiratory rate, and oxygen saturation. The Mallampati et al. classification⁸

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TABLE 1 Data Analyzed From Record Review

Patient sex
Patient age
Patient weight
Patient ASA status ⁹
Patient Mallampati et al. ⁸ classification
Surgical procedure
Surgery duration
Total fluid administration
Total medication administration
Baseline oxygen saturation reading
Intrasurgical minimal oxygen saturation reading
Systolic blood pressure at procedure start, midpoint, and end
Diastolic blood pressure at procedure start, midpoint, and end
Heart rate at procedure start, midpoint, and end
Adverse events

TABLE 2 Mallampati et al.⁸ Classification System

Class 1: full visibility of tonsils, uvula, and soft palate
Class 2: visibility of hard and soft palate, upper portion of tonsils and uvula
Class 3: soft and hard palate and base of the uvula are visible
Class 4: only hard palate visible

TABLE 3 ASA Classification⁹

ASA I: healthy patient
ASA II: mild-to-moderate systemic disease that can be controlled with medications
ASA III: severe systemic disease that limits daily activity but is not incapacitating
ASA IV: moribund patient with little chance of long-term survival
ASA V: patient being kept alive for organ harvest

(Table 2) was evaluated, and American Society of Anesthesiology (ASA) status⁹ (Table 3) was established. Medical consultations were ordered when necessary for ASA Class II patients and were mandatory for all ASA Class III patients. ASA Class IV and V patients were not treated. Before the initiation of sedation, all patients were required to ingest

TABLE 4 Ramsay et al.¹⁰ Sedation Scale

Level	Patient Characteristics
1	Patient anxious, agitated, and/or restless
2	Patient cooperative, oriented, and tranquil
3	Patient responds to commands only
4	Brisk patient response to light glabellar tap or auditory stimulus
5	Sluggish patient response to light glabellar tap or auditory stimulus
6	No patient response to light glabellar tap or auditory stimulus

no food or drink for at least 6 hours prior to the procedure. Additionally, all female patients were required to have a negative human chorionic gonadotropin pregnancy test immediately before procedure initiation.

After signing informed consents for both the surgical and conscious-sedation procedures, all patients were seated in a semisupine position and monitors, including automatic sphygmomanometer and three- or five-lead electrocardiography, were administered. A nasal cannula was applied with 100% oxygen, and intravenous access was obtained. In most instances, an 18-gauge needle was used in the antecubital vein for intravenous access, and 0.9% normal saline solution was administered. In some instances, intravenous access was established in the veins of the dorsal hand or the cephalic vein, typically with smaller 20- or 22-gauge catheters. After establishment of a patent intravenous line, medication was administered via titration. Sedative/pain-control medications used for all procedures included both fentanyl and midazolam. During administration of intravenous medications, sedation levels were assessed according to the scale described by Ramsay et al.¹⁰ (Table 4). Once +3 sedation levels were attained, local anesthesia was administered intraorally, and surgeries were performed. During the surgical procedures, additional doses of fentanyl and versed were provided as needed to maintain +3 sedation levels.

Patients were monitored before, during, and after the surgical procedures. Automated monitors were used to evaluate blood pressure, heart rate, oxygen saturation, and respiratory rate at 5-minute intervals. Patient sedation levels were continuously assessed throughout, and additional medications were administered intravenously as necessary. Intravenous flow rate was adjusted according to patient needs during the procedure, with flows being temporarily increased after medication administration.

After the completion of each surgery, patients were recovered for a period of 15 minutes. Aldrete and Kroulik scores¹¹ (Table 5) of 8 or higher were required before patient dismissal. All patients were released to their escort with written post-surgical instructions.

TABLE 5 Aldrete and Kroulik¹¹ Score: Patient Should Have Combined Score of 8 or More Before Dismissal

Points	Activity	Respiration	Circulation	Color	Consciousness
0	Cannot move	Hypoxia or apnea	± >50 mm Hg from baseline systolic	Cyanotic	Not arousable
1	Can move two extremities	Dyspnea	±20 to 50 mm Hg from baseline systolic	Pale	Arousable
2	Can move all extremities	Can take deep breath and cough	± <20 mm Hg from baseline systolic	Pink	Fully awake

TABLE 6 Types of Periodontal Procedures Performed

Procedure Total	Procedure Type
238	Dental implant placement
197	Combination osseous surgery with guided tissue regeneration
128	Mucogingival grafting
107	Sinus lift
68	Block graft (ramus, symphysis, or allograft)
63	Guided bone regeneration (particulate, growth factor, or combination)
48	Crown lengthening
42	Dental extraction plus site preservation
33	Ridge split augmentation
19	Periodontally accelerated osteogenic orthodontics
12	Biopsy
9	Canine exposure for orthodontics

For the purposes of this retrospective observational report, procedure duration was considered to be from the time that the patients sat in the operating chair until they were discharged. This includes presurgical vital sign recordings after the placement of monitoring devices and postsedation recovery.

Clinical Outcomes

After exhaustive retrospective chart review from the five different private practices involved with this report, a total of 964 patients had intravenous moderate sedation used to facilitate various periodontal surgeries during the past 5 years. A total of 518 female and 446 male patients with an average age of 56.49 years (range: 16 to 82 years) were treated. Average patient weight was 79.82 kg (range: 46 to 136 kg). The types of periodontal procedures performed are reported in Table 6.

The average procedure duration was 138.3 minutes (range: 34 to 390 minutes). Presurgically, it took an average

of 16.4 minutes to place patient monitors, obtain baseline vital signs, and establish intravenous access. Postsurgically, all patients were recovered for an average time of 15.8 minutes. Average surgical procedure time was 106.1 minutes.

The intravenous moderate sedation procedures in this retrospective chart review use a combination of fentanyl and midazolam for sedation and pain-control purposes. Additional medications were often used, such as dexamethasone before surgery to reduce inflammation, and ketorolac at the end of surgical procedures for post-surgical pain control. Average fentanyl use was 125.23 µg (range: 25 to 300 µg), whereas average midazolam use was 9.69 mg (range: 3 to 28 mg). Average ketorolac use was 30.0 mg (range: 0 to 30 mg), and average dexamethasone use was 8.24 mg (range: 6 to 10 mg). An average of 761.26 mL (range: 400 to 2,000 mL) of fluids was administered during the procedures.

Evaluated hemodynamic parameters included heart rate, systolic pressure, and diastolic pressure at the start, midpoint, and end of each procedure (Table 7). Reviewed respiratory parameters included baseline pulse oxygenation values, intraprocedure low pulse oxygenation values, and respiratory rates at the start, midpoint, and end of each procedure (Table 8).

For the 964 intravenous conscious-sedation procedures reported here, a total of 18 complications were found: 10 episodes of restlessness, four episodes of nausea/vomiting, three episodes of syncope, and one episode of intravenous infiltration. Reversal medications, such as flumazenil and/or naloxone, were not required in any procedures. There were no major complications, such as cardiac arrest, severe hypertension/hypotension, laryngospasm, or apnea. Use of adjunctive airway devices, such as positive pressure oxygenation or endotracheal intubation, was not required in any of the cases.

Discussion

Over the past three decades, multiple articles involving thousands of patients have documented the safety of intravenous conscious sedation when used as an adjunct for dental procedures.^{1-3,12-14} These articles consistently report minimal adverse events. In consecutive reviews of 5,200 and 10,000 cases, Ceravolo et al.^{12,13} reported no major complications when intravenous sedation was used for periodontal surgery. Concerning oral surgery procedures, Rodgers¹⁴ reported a complication rate of 2.66% during

TABLE 7 Measured Hemodynamic Data (mm Hg)

Systolic Start	Systolic Midsurgery	Systolic End	Diastolic Start	Diastolic Midsurgery	Diastolic End	Heart Rate Start	Heart Rate Midsurgery	Heart Rate End
129.24 ± 14.90	114.36 ± 13.15	122.41 ± 11.73	77.68 ± 10.47	63.86 ± 9.03	70.84 ± 10.30	75.28 ± 11.08	67.91 ± 10.23	71.97 ± 9.38

TABLE 8 Measured Respiratory Data (respirations per minute)

Respiratory Rate Start	Respiratory Rate Midsurgery	Respiratory Rate End	Baseline Pulse Oxygen	Low Pulse Oxygen
16.48 ± 1.06	14.02 ± 1.69	15.76 ± 1.26	99.82 ± 0.52%	97.80 ± 2.49%

the first 7 years of practice, with most being minor complications, such as presyncope/syncope, restlessness/combattiveness, and nausea/vomiting. During the second 7 years of practice, Rodgers¹⁴ noted that complications associated with conscious sedation for dental procedures fell to 1.57%. Although most complications associated with sedation procedures are minor, some deaths have occurred.^{15,16} In the 964 periodontal procedures reviewed in this article, 18 complications, all minor, were noted, for a rate of 1.87%, similar to that reported by Rodgers.¹⁴ Although this article and others have documented the safety of intravenous dental sedation,^{1-3,12-14} clinicians must remain diligent in the safe application of this procedure because the risk of death is always present when medications are introduced to patients intravenously. According to the American Dental Association (ADA) *Guidelines for the Use of Sedation and General Anesthesia by Dentists*¹⁷ as adopted by the 2007 ADA House of Delegates, “Patients considered for minimal, moderate, or deep sedation must be suitably evaluated prior to the start of any sedative procedure. In healthy or medically stable individuals (ASA I, II) this may consist of a review of their current medical history and medication use. However, patients with significant medical considerations (ASA III, IV) may require consultation with their primary care physician or consulting medical specialist.” The careful presurgical evaluation and selection of patients for intravenous sedation may be one of the reasons for the minimal complication rate noted in this and other articles evaluating the use of intravenous sedation in the dental office.^{1-2,12-14}

All patients in this case series were taken to a level of sedation referred to as “moderate,” which the ADA¹⁷ defines as “a pharmacological-induced minimally depressed level of consciousness during which patients respond purposefully to verbal commands either alone or accompanied by light tactile stimulation. No interventions are required to maintain a patent airway and spontaneous ventilation is adequate. Cardiovascular function is usually maintained.” To achieve this level of sedation for the cases reviewed here, a combination of fentanyl and midazolam was used. The average amount of midazolam used (9.69 mg) was similar to that reported by Runes and Ström⁴ (10.45 mg) and significantly higher than that

reported by Win et al.⁶ (5.4 mg). The average amount of fentanyl used was 125.23 µg, which is significantly higher than the 82.9 µg fentanyl reported by Rodgers.¹⁴ The differing amounts of medication used for the procedures in the current review may be related to longer procedure duration times.

The average duration of the procedures reviewed in this article was 138.3 minutes, with 32.2 minutes of that time used for presurgical preparations and post-surgical recoveries. This is similar to the findings of Staretz et al.,⁷ who reported an average of 142 minutes for periodontal procedures with an intravenous conscious-sedation adjunct. These periodontal procedures are significantly longer than the reported 50 to 98 minutes for oral surgery intravenous conscious-sedation procedures.^{4,5}

Concerning hemodynamic parameters, during the course of the procedures analyzed for the present case series, systolic blood pressure reduced an average of 11.51% from baseline, whereas diastolic pressures dropped an average of 17.80%. Likewise, intraoperative pulse rate dropped an average of 9.69%. These findings are similar to those reported by Win et al.,⁶ who reported systolic blood pressure reduction of 11.11% and diastolic pressure reduction of 10.67%. Interestingly, whereas a heart rate reduction of 9.69% was found in the present procedures, Win et al.⁶ reported a 10.81% increase in heart rate. A 2011 study by González-Lemonnier et al.¹⁸ evaluating hemodynamic and respiratory changes during dental implant surgery with conscious sedation found that systolic and diastolic blood pressures dropped 7.1% and 11.4%, respectively, while heart rate increased 7.9%.

Concerning respiratory parameters, the current case series found an average intraoperative pulse oxygenation drop of 2.02%. Similarly, intraoperative pulse oxygenation dropped an average of 2.05% in the study by González-Lemonnier et al.¹⁸ These findings are in agreement with a much larger study by Viljoen et al.,¹⁹ who evaluated oxygen saturation levels in 3,500 dental conscious-sedation cases. The results of their study found that some patients had pulse oxygenation values drop below 94% and concluded that “a single operator/sedationist, supported by a well-trained team of nurses, can consistently maintain safe oxygen saturation levels.”¹⁹ ■

Summary

Why are these cases new information?

- This case series shows that higher total medication doses are used in periodontal procedures compared to oral surgery procedures, likely as a result of longer procedure durations.
- This case series shows that at least 30 minutes of additional procedure time should be scheduled for intravenous moderate sedation cases to account for pre- and post-surgical patient management.
- Predictable changes in hemodynamic and respiratory levels will ensue with the use of fentanyl and midazolam for intravenous moderate sedation.

What are the keys to successful management of these cases?

- There must be adherence to the *ADA Guidelines for the Use of Sedation and General Anesthesia by Dentists*.¹⁷
- Preprocedural medical consultation for ASA Class II patients with significant medical conditions and all ASA Class III patients and referral to higher echelon of care for all ASA Class IV patients are required.
- Use of properly maintained patient monitoring equipment is necessary.
- Proper use of sedation medications in terms of dosage and administration is required.
- All providers and staff should be properly trained in emergency management of respiratory and hemodynamic complications.

What are the primary limitations to success in these cases?

- Improper use of sedation medications in terms of dosage and administration may result in severe consequences up to and including patient death.^{15,16}

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○ indicates key references.