Dexmedetomidine vs. Midazolam in Sedation Dentistry

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ABSTRACT

Background – Dexmedetomidine is a commonly used sedative in the medical setting in the United States, but in sedation dentistry, most State Boards limit its use to dentist anesthesiologists and oral surgeons, who hold a permit in general anesthesia. As a result, benzodiazepines like midazolam are a popular choice for sedation in dentistry, but they also come with certain risks, such as respiratory depression, paradoxical reactions resulting in failed sedations, and tolerance and dependence issues.

Aim – This review sets out to examine the safety and efficacy of dexmedetomidine compared to midazolam and evaluate its potential for use in the dental clinical setting.

Methods – A narrative literature review was carried out identifying studies comparing dexmedetomidine and midazolam use in the pediatric, adult, and geriatric patient populations in the dental outpatient setting.

Results – The search identified 13 studies, of which 5 were conducted among pediatric patients, 5 among adult patients, and 3 among geriatric patients. These studies identified sedations with dexmedetomidine, those with midazolam, and those with a combination of the two. When compared to midazolam, none of the 13 studies showed an association between dexmedetomidine and respiratory depression or potential risk of addiction. With regards to efficacy in all studies, dexmedetomidine had a longer working time and recovery time compared to midazolam. Additionally, in 4 studies, dexmedetomidine had a lower failure rate and decreased rate of paradoxical agitation.

Conclusion – Dexmedetomidine has a higher safety profile and increased efficacy when compared to midazolam and is a safe and effective sedative for sedation dentists to keep in their armamentarium in the outpatient clinical setting.

BACKGROUND

Prior to looking into these studies, it is important to understand the properties of each drug [1,2]

	Midazolam	Dexmedetomidine
Mechanism of action	• Bonds to GABA, enhancing hypopolarization • Results in dose-dependent CNS depression	• Alpha-2 adrenergic agonist • Triggers G-protein cascade • Acts on the locus ceruleus in the brainstem, resembling natural sleep
Route of administration	• PO, IN, IV	• IN, IV
Dosing	• PO or IN: 0.2-0.5mg/kg; 20mg max • Loading IV: 1-2mg • Infusion IV: 0.06-0.12 mg/kg/hr	• IN or loading IV: 0.5-1µg/kg given slowly over 10 min • Infusion IV: 0.2-1 µg/kg/hr
Duration of onset	• PO: 15-30 minutes • IN: 6-15 minutes • IV: 1.5-2 minutes	• IN: 20-40 minutes • IV: 5 minutes • *Note: onset is dose dependent*
Duration of action	• PO: 30-45 minutes • IN: 30-60 minutes • IV: peak in 3-5 minutes, lasts 30-90 minutes	• IN/IV: peak in 15 minutes, lasts 55-100 minutes
Strengths	• Anxiolytic/sedative • Skeletal muscle relaxation • Anterograde amnesia • Short half-life of active metabolite makes it clinically insignificant • Reversal agent available (flumazenil)	• Reduces anesthetic requirements • Anxiolytic/sedative • Minimize emergence delirium • Maintain respiratory drive & airway reflex • Lacks burning sensation during IN administration
Risks and Limitations	• Paradoxical excitatory reactions (especially in the extremes of age) • Respiratory depression, airway collapse • Burning sensation IN • N/V	• No reversal agent • Slow induction time for a parenteral • Elimination half-life of ~2hr • Nausea • Bradycardia • Hypotension

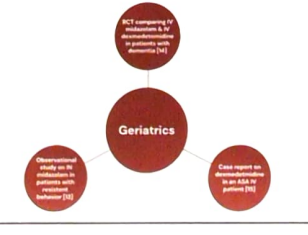
MATERIALS & METHODS

A narrative literature review was conducted identifying studies between pediatric, adult, and geriatric patients across a variety of dental procedures. These studies looked at safety, rate of failed sedations, and adverse effects. PubMed search terms included "Dexmedetomidine", "Midazolam", "Sedation", & "Dentistry".

Pediatric Studies: 5 total articles were reviewed: 3 were RCTs, 1 was a retrospective study, and 1 was a systematic review.

Adult Studies: Articles 5 total articles were reviewed: 3 were RCTs, 1 was a cohort study, and 1 was a systematic review.

Geriatric Studies: 3 total articles were reviewed: 1 was an observational study, 1 was an RCT, and 1 was a case report.



RESULTS

The literature review confirms the safety of dexmedetomidine compared to benzodiazepines given no observed incidences of respiratory depression dependence, or tolerance. Additionally, in some cases, sedations have been shown to be more effective and have a lower failure rate, as well as a decreased rate in paradoxical excitation.

Pediatric Studies:

	Midazolam	Dexmedetomidine
Safety	• Statistically significant drop in SpO2	• No respiratory depression observed
Successful vs failed sedations	—	• Better for completing longer procedures • Most studies show rate of successful sedation significantly higher
Positive effects	• Faster onset • Faster recovery • Retrograde amnesia	• Better overall consistent calmness & cooperation • Lower incidence of emergence delirium
Adverse effects	• Post-op agitation • Burning during IN admin • Hypotension • Delerium • Post-op N/V	• Post-op drowsiness • Bradycardia • Hypotension (more so than what is seen seen with midazolam)

Adult Studies:

	Midazolam	Dexmedetomidine
Safety	• Increased incidence in respiratory depression • Observed apnea >20 seconds, able to stimulate	• No respiratory depression observed; does not affect ventilatory response to CO2 • Easily arousable
Successful vs failed sedations	• Most studies showed equal rates of success	• One study showed dexmedetomidine was more successful because patients did not have disinhibition
Positive effects	• Anterograde amnesia	• When in combination with other medications, able to significantly reduce the doses of other sedatives given by 30-40% • Smoother sedation • Significantly less anxiety • Analgesic properties • More stable diastolic BP
Adverse effects	• Disinhibition makes it more difficult for the patient to comply • Category D	• Bradycardia • Hypotension • Category C

Geriatric Studies:

	Midazolam	Dexmedetomidine
Safety	• Observed hypoxemia (SpO2 <90%) requiring chin-lift maneuver	• No respiratory depression observed • Able to maintain cerebral blood flow, making it a safer option for patients with dementia
Successful vs failed sedations	—	• Rates of successful sedation equal
Positive effects	• Amnestic properties	• Can protect against significant deviations in HR and/or BP • Sympatholytic; prevents cardiac stimulation and hypertension
Adverse effects	• HR increase >20% • Burning during IN admin • Reduced cerebral blood flow by 10% in patients with dementia	• Hypotension • Rapid administration can cause hypertension, which is then followed by hypotension and bradycardia

CONCLUSION & FUTURE STUDY

For the safety of dental patients, dentists licensed in sedation dentistry should consider implementing dexmedetomidine into their armamentarium. Given the longer working time of dexmedetomidine, it is not well suited for operative procedures that can be completed in a short timeframe (e.g., single simple extraction or a single restoration). For short operative cases, midazolam is a suitable option due to its quick onset and short duration of action. When considering more comprehensive cases such as full mouth rehabilitation, dexmedetomidine could be an excellent option due to its increased working time.

Limitations to this literature review include a lack of studies comparing dexmedetomidine to other benzodiazepines, such as diazepam, triazolam, or lorazepam. More studies comparing dexmedetomidine to a variety of benzodiazepines can help create a more robust schema to understand indications for dexmedetomidine in sedation dentistry.

Moving forward, future research should expand this study by following oral surgeons and dentist anesthesiologists that use dexmedetomidine for in-office dental procedures in order to evaluate its efficacy as well as the prevalence of any adverse effects using the SAS (Sedation Agitation Scale).

These potential future findings could provide a foundation for motions to approve the use of dexmedetomidine for dentists who hold a parenteral sedation permit, as opposed to restricting its use to oral surgeons and dentist anesthesiologists alongside a general anesthetic agent.

REFERENCES

1. Kramer, Brady. Anesthetic agents commonly used by oral and maxillofacial surgeons. *Oral Maxillofac Surg*. 2018; 30(2):155-64.
2. Devaya A, Sanjanagiaj M. Dexmedetomidine: A Review of a Newer Sedative in Dentistry. *J Clin Pediatr Dent*. 2015; 39(5):401-9.
3. Jamiani P, Gurunathan D, Manohar R. Comparative evaluation of intranasal dexmedetomidine, intranasal midazolam, and nitrous oxide for conscious sedation of anxious children undergoing dental treatment: A randomized cross over trial. *J Indian Soc Pedod Prev Dent*. 2024 42(2):141-8.
4. Unkel JH, Berry EJ, Ko BL, et al. Effectiveness of intranasal dexmedetomidine with nitrous oxide compared to other pediatric dental sedation drug regimens. *Pediatr Dent*. 2021 43(6):457-62.
5. Unkel JH, Crume C, Rice A, et al. A retrospective evaluation of the safety profile of dexmedetomidine and nitrous oxide for pediatric dental sedation. *Pediatr Dent*. 2021 43(2):129-32.
6. Nie, Chen, Xie, Ding. Oral midazolam vs. intranasal dexmedetomidine plus oral midazolam for sedation of pediatric outpatients: A double-blinded randomized controlled trial. *BMC Anesthesiol*. 2023 23:341.
7. Goswami M, Sangal A, Rahman B, Chawla S. Comparison of the safety and efficacy of dexmedetomidine with midazolam for the management of pediatric dental patients: A systematic review. *J Indian Soc Pedod Prev Dent*. 2021 39(4):233-9.
8. Mincer, Lee, Chung, Huang, Sung. Dexmedetomidine reduces the amount of benzodiazepines and opioids administered during moderate conscious sedation for dental treatment. *Spec Care Dentist*. 2020; 40:437-42.
9. Wenig VF, Ti L, Islam S. Comparison of dexmedetomidine and midazolam for conscious sedation in dental surgery monitored by bispectral index. *Br J Oral Maxillofac Surg*. 2014 51(5):428-33.
10. Cheung, Ng, Chiu, Wong, Ng, Irwin. A comparison of dexmedetomidine and midazolam for sedation in third molar surgery. *Anesthesia*. 2007 62(11):1132-8.
11. Zhang Y, Li C, Shi J, Gong Y, Zeng T, Lin M, Zhang X. Comparison of dexmedetomidine with midazolam for dental surgery: a systematic review and meta-analysis. *Medicine*. (2021) 99:43: e22268.
12. Ustun, Gunduz, Erdogan, Berkbay. Dexmedetomidine Versus Midazolam in Outpatient Third Molar Surgery. *Am Assoc Oral Maxillofac Surg*. 2006.
13. Barends, Absalom, Visser. Intranasal midazolam for the sedation of geriatric patients with care-resistant behavior during essential dental treatment: An observational study. *Gerodontology*. 2022 39:161-9.
14. Murimoto, Hayashi, Yao, Nishizaki, Ishii, Mizuzuki, Hara. Comparison of intravenous sedation using midazolam versus dexmedetomidine in elderly patients with dementia: a randomized cross over trial. *Sci Rep*. 2022 12:6293.
15. Young, Russell, Giovannitti. Dexmedetomidine infusion for routine dental management of an ASA IV patient: A case report. *Anesth Prog*. 2017 64(3):88-96.

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