The effect of Temperament on Outcomes of Opioid and Non-Opioid Pediatric Dental Sedation

Raymond Lee

A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Science in Dentistry

University of Washington

2023

Committee:

Travis Nelson

Anna Forsyth

Mariella Garcia

JoAnna Scott

Program Authorized to Offer Degree:

University of Washington Department of Pediatric Dentistry

University of Washington

Abstract

The effect of Temperament on Outcomes of Opioid and Non-Opioid Pediatric Dental Sedation

Raymond Lee

Chair of the Supervisory Committee:

Travis Nelson

Department of Pediatric Dentistry

Background: Procedural sedation is frequently used to safely and effectively complete pediatric dental treatment. However, there is no standard regimen or patient assessment used among pediatric dentists and sedation outcomes vary widely.

Purpose: The primary objective of this randomized trial was to assess the effects of oral sedation using midazolam and hydroxyzine with and without meperidine on sedation outcomes in pediatric dental patients. The secondary objective was to assess the relationship between child temperament and sedation outcomes.

Methods: This pilot study recruited 37 children between the ages of 3-7 years who met study eligibility criteria and were planned to undergo dental treatment with oral sedation at the University of Washington Center for Pediatric Dentistry. The children were randomly assigned

to receive a regimen of midazolam and hydroxyzine with or without meperidine. Parents completed the Child Behavior Questionnaire Short Form (CBQ-SF) to assess temperament.

Results: There were no significant differences in sedation outcome with age, sex, insurance status, sedation regimen, isolation method, or duration of procedure. In general, children with high pre-operative Frankl behavioral ratings were more likely to have successful sedation outcomes. Children who displayed high soothability experienced higher rates of success, and this effect was more pronounced in the non-opioid regimen group.

Conclusions: Overall, there was a low rate of success in this study and a relatively small sample size. However, the results suggest that pre-procedure behavior and the temperament characteristic of soothability may warrant more exploration as predictors of sedation success.

Table of Contents

I. INTRODUCTION

Procedural Sedation and Temperament in Pediatric Dentistry

Young children can pose significant behavioral challenges in the dental setting. These patients may have dental anxiety or lack the effortful control (self-regulation) needed to successfully navigate the dental experience. Procedural sedation is an advanced pharmacological behavior guidance technique that can be employed when basic behavior guidance techniques alone are likely to be ineffective. Sedation can be a valuable tool, not only to facilitate dental treatment, but also to protect a young child's psyche, reduce dental fear, and ensure the safety of both the patient and the dental team.[1,2]

Case selection is crucial to optimizing sedation outcomes. In addition to biological factors like age, gender, and weight, temperament of the pediatric sedation candidate must also be carefully evaluated. Developmental psychologist, Mary Rothbart defined temperament as, "the constitutional differences in reactivity and self-regulation."[3] Her work focuses on the underlying traits that shape an individual's emotional function and externalizing behaviors. Rothbart categorized temperament characteristics into three domains: Extraversion/Surgency, Negative Affectivity, and Effortful Control. Extraversion and Surgency reflects the degree in which a child is happy, active and enjoys stimulation. Negative affectivity refers to the ability to calm a child or their degree of shyness. Effortful control is the propensity for a child to focus without getting distracted. These three are further broken down into 15 subgroups that define each of the larger domains.[4]

Studies across different fields of medicine suggest that pediatric temperament may help predict treatment success.[5] For example, compared with children who have high levels of effortful control, children who exhibit high levels of impulsivity may be more likely to respond

poorly to uncomfortable or unfamiliar procedures. This may result in uncooperative behavior during sedation, and ultimately more sedation failures.[6,7]

Drug Regimens and Sedation Risk

There is no standard drug regimen or protocol for oral sedation.[8] Varying drug regimens are used depending on operator preference, experience, and the extent of the procedure. Benzodiazepines, opioids, and antihistamines are commonly used alone or in combination to achieve desired sedative effects and minimize potential side effects of co-administered drugs. For example, midazolam is a rapid-onset, short-acting benzodiazepine that offers a sedative effect with some degree of amnesia.[9] These qualities make midazolam an ideal sedative for relatively minor or quick operative procedures in young children. An opioid such as meperidine can be added to potentiate the sedative effect and offer analgesia for lengthier, more complex procedures.[10] Additionally, an antihistamine like hydroxyzine can be added to increase sedation and as an antiemetic to counter nausea from the use of an opioid.[11] For these reasons, a benzodiazepine, opioid, and antihistamine combination such as the midazolam/meperidine/hydroxyzine sedation regimen has become popular in pediatric dentistry.[12]

Though there are many routes of sedation, oral sedation is the most popular in dentistry perhaps due to its low technical demands.[1] In some cases, permitting for a single agent regimen may not require the need for advanced training. However, compared with intravenous or intranasal methods of drug delivery, oral delivery of sedation medications can be challenging due to their long latent period, unpredictable hepatic first-pass metabolism, and inability to titrate the medications.[13,14] In some children, oral sedation effects may linger long after the procedure is

completed and affect post-discharge outcomes.[15,16] The addition of an opioid to the sedation regimen can increase depth and further prolong the effects of sedation. This may aid in the management of an anxious child, but it can increase the risk of adverse outcomes compared with single or non-opioid drug regimens.[17-19] Adverse events can be avoided with careful case selection, appropriate medication dosing, and proper intra-operative monitoring.[20,21] However, in the rare cases when serious adverse events occur, they typically result from respiratory depression, a condition that is more likely to occur with opioid administration.[22] Given that opioid and multi-drug regimens can increase the likelihood of adverse events, identifying effective non-opioid options has the potential to reduce sedation risk.

Objectives

The primary objective of this single-blind randomized pilot study was to assess the effects of oral sedation using midazolam and hydroxyzine with and without meperidine on sedation outcomes in pediatric dental patients undergoing dental treatment at the University of Washington Center for Pediatric Dentistry. The secondary objective was to evaluate the relationship between child temperament and sedation outcome in each treatment group.

II. METHODS

Study Population

Children scheduled for dental treatment with oral moderate sedation at the University of Washington Center for Pediatric Dentistry were recruited for the study if they fulfilled the assigned inclusion criteria:

1. Between 36-95 months of age,
2. ASA I or II without behavioral diagnoses such as autism spectrum disorder or ADHD,[23]
3. No previous history of dental treatment with procedural sedation,
4. Under the 95th weight for age BMI percentile,
5. Able to take diagnostic bitewing radiographs,
6. Able to take medication by mouth,
7. Brodsky tonsillar scores of II or less,
8. Planned to receive at least 2 restorations in a single sedation appointment, and
9. Had an accompanying caregiver who could speak and read English.

Enrollment of Subjects

The study protocol was approved by the University of Washington Institutional Review Board. The parents or legal guardians of eligible patients were contacted via telephone at least one day prior to their scheduled sedation appointment to provide preliminary study information. Caregivers who were interested in participating were e-mailed a copy of the study information and consent forms. When presenting to their sedation appointment, those who agreed to participate were enrolled in the study. Informed consent was signed for the dental procedure, administration of sedation medications, and study participation. Once enrolled, participants were not eligible to participate in the study at subsequent sedation visits.

Randomization

Participants were randomly assigned to one of two oral sedation regimens: midazolam 0.5mg/kg, hydroxyzine 1.0mg/kg, and meperidine 1.5mg/kg, or midazolam 0.5mg/kg and hydroxyzine 1.0mg/kg. Randomization software was used to create assignment blocks of 10 from which patients were allocated to each arm of the study.

Intervention

All medications were dosed based on a lean body weight scalar derived from each patient's total body weight and height. Drug regimens were mixed with a flavoring syrup and delivered orally. After thirty-five minutes of supervision, the children were moved to the treatment room and placed on a protective stabilization wrap on the dental chair. For safety, the children had their wrists and legs passively placed into the straps. The torso strap was only utilized if behavior deteriorated during the procedure.

Participants were administered N_2O/O_2 at a flow rate of 5 L/min, beginning at 50%/50% N_2O/O_2, and titrated according to behavior and sedation level. A calibrated sedation monitor who was not directly involved in patient care recorded blood pressure, heart rate, oxygen saturation, respiratory rate, end-tidal CO_2, and Houpt Behavior Rating Scale (HBRS) score at five-minute intervals.

The sedation monitor and operating dentist evaluated each participant's behavior during sedation and came to a consensus on the intraoperative and overall HBRS scores. During treatment, patient caregivers completed the 94 question Children's Behavior Questionnaire Short Form (CBQ-SF).

Upon completion of the sedation procedure, patients were discharged based on a 14-point fast-track discharge criteria assessing alertness, return to baseline stability, and postoperative side effects. Families received a telephone call from the operating dentist between 5-8 hours after the procedure to assess patient disposition and occurrence of adverse events after discharge.

Data Collection

Treatment variables including age, sex, ASA status, insurance type, and pre-operative Frankl behavior scale ratings were recorded from the electronic charts and sedation records of participating children.[24] Isolation method was recorded as no isolation, Isovac (Zyris, Santa Barbara, CA), or rubber dam. Treatment complexity was categorized as simple or complex. Simple procedures consisted of intracoronal composite restorations, sealants, and Hall crowns. Complex procedures consisted of pulp therapy, stainless steel crowns, and extractions. Procedure duration was also recorded. Temperament scores were calculated from the completed CBQ-SF surveys. Procedures with an overall Houpt rating of excellent, very good, or good were categorized as successful. A rating of fair, poor, or aborted was categorized as a procedure failure.

Data Analysis

Study data were collected and stored in REDCap at the University of Washington and analyzed in Stata (StataCorp, College Station, TX). Descriptive statistics were calculated for each variable. Fisher's Exact tests were used to analyze relationships between sedation outcome and sex, insurance status, pre-operative behavioral rating, sedation regimen, isolation method, treatment complexity, and duration of procedure. Wilcoxon Rank-Sum tests were conducted to

evaluate the associations among sedation regimens, temperament scales, and sedation outcomes. Significance levels were set to $\alpha = 0.05$.

III. RESULTS

The study included 37 participants. The average age in months was 69.1±14.0. Fifty-one percent of the patients were female and the majority had Medicaid insurance (76%). All participants were healthy with an ASA I classification. There were no intra- or postoperative adverse events, and 33 of the participants (89%) returned to a baseline level of activity and energy by the time of the post-operative follow-up phone call. Four families did not return phone calls to obtain post-operative recovery information.

Twenty sedations were categorized as successful and 17 were categorized as failures, a success rate of 54%. Approximately three-quarters of patients (73%) had a pre-operative behavioral rating of Frankl positive (+) or definitely positive (+/+). There was a statistically significant association between pre-operative behavioral ratings and success *($P<0.01$)*. There were no statistically significant associations between sedation outcome and age, sex, or insurance status. (Table 1).

Twenty participants received the opioid regimen, and 17 participants received the non-opioid regimen. There was no significant difference in sedation outcome between the two regimens. Eighteen (49%) subjects had treatment completed with an Isovac, and 15 (41%) subjects had treatment completed with a rubber dam. The remaining subjects (11%) were unable to tolerate either isolation method. Complex treatment was performed for 20 (54%) of the participants. Seventeen (46%) patients received simple treatment, though 6 of the 17 subjects initially planned for complex treatments ultimately received Hall crowns (categorized as a simple

procedure) due to deteriorating behavior. Patients with successful sedation were more likely to have received complex treatment (*P=0.03*). The majority of procedures were between 30-60 minutes in duration. (Table 2).

CBQ-SF scores were tabulated for the three overarching temperament domains of effortful control, negative affectivity, and extraversion/surgency as well as all fifteen temperament subgroups. Temperament data for one of the 37 participants was not available because the family did not fill out the CBQ-SF. At baseline, the non-opioid group had significantly higher average effortful control (*P=0.03*) and soothability (*P=0.04*) scores compared with the opioid group (Table 3). Patients with successful sedation had greater average soothability (*P=0.04*) (Table 4).

The association between temperament and sedation success was evaluated separately for each treatment regimen. There were no statistically significant differences in temperament scores between successful and failed sedations in the opioid group. In the non-opioid group, subjects with sedation failures had significantly higher frustration and sadness scores compared with subjects with sedation success (*P = 0.05*). Participants with successful sedations in the non-opioid regimen group also showed higher soothability (*P<0.01*) (Table 5).

IV. DISCUSSION

Sedation Outcomes

In this study we found no difference in success rates for patients who received an opioid or non-opioid medication regimen. However, in the non-opioid group the temperament characteristics of effortful control and soothability were associated with success while frustration and sadness were associated with failure. In both treatment groups soothability and pre-

procedure behavior scores were associated with success. These findings suggest that dental sedation outcome success may be associated with specific behavioral characteristics and assessing temperament may be particularly important for patients who receive a non-opioid sedation regimen.

We focused on success rates in this study, noting that participants who had a Frankl (+) or (+/+) score had a higher likelihood of sedation success. However, perhaps a more clinically relevant finding is that 9 out of 10 participants with a Frankl (-) or (-/-) score failed treatment. This seems to indicate that good pre-procedure behavior may help predict sedation success, and poor pre-procedure behavior is a very strong indicator of sedation failure. In addition, while previous studies have suggested that an opioid sedation regimen may be more successful, the present study did not show a difference in success with either regimen.[10] Given that opioid regimens pose higher risks of respiratory depression and adverse events compared with a non-opioid regimen, there should be a clear justification of added benefit from an opioid before using it in the pediatric procedural sedation setting.

The results of this study suggest that patient temperament may be part of the justification for adding an opioid to the sedation regimen. With a large sample size and appropriate randomization, no significant differences in temperament scores would be expected between the two sedation regimens. However, that was not the case in the present study, in which the non-opioid group demonstrated higher levels of effortful control and soothability. This difference may have blunted the effect of the opioid. However, the difference helps elucidate effortful control and soothability as potentially valuable clinical predictors. While effortful control has been found previously to impact sedation outcome, to our knowledge this is the first time soothability has been identified as a predictive factor in pediatric dental sedation success.[6]

Soothability, which refers to the rate of recovery from peak distress, excitement, or general arousal, is particularly important in a child's ability to rebound from a challenging situation like dental treatment.[3] Previous research has associated this characteristic with "easy temperament," which aligns with the findings in the present study.[25] Specific CBQ-SF questions from these temperament domains are included in the appendix.

In this study high levels of the temperament frustration and sadness were associated with "difficult temperament" and higher rates of failure.[25] Frustration looks at the amount of negative affect related to interruption of ongoing tasks or goal blocking. Sadness shows the amount of negative affect, lowered mood and energy related to exposure to suffering, disappointment, and object loss.[3] A child who experiences difficult points in a dental procedure tests both these aspects. Those with high scores in these qualities will likely not be able to tolerate treatment, as seen in our sedation failures in the non-opioid group.[25]

In addition to temperament, our study showed other findings were associated with successful sedations. Complex procedures and longer treatment were linked with better outcomes. The reasons for this finding are not entirely clear, but it may simply be that more complex treatment was attempted on patients who were doing well under sedation. This is supported by the fact that all sedations with treatment longer than 60 minutes were categorized as successful. It should also be noted that several patients received simple treatment such as a Hall crown when an SSC was originally planned in cases where behavior deteriorated.

While more data is needed to assess whether there are differences in sedation outcomes between the two regimens, the findings of this study suggest that pediatric dentists should carefully consider when adding an opioid to the sedation regimen is indicated.

Limitations

A limitation of this study was the small sample size. We had significantly more difficulty recruiting participants than anticipated. In over twenty months of recruitment with up to four sedation cases planned per week, we were only able to recruit 37 participants. After applying the exclusion criteria, only about 30% of the patient families were willing to take part. The most common reason caregivers declined was concern regarding the study medication protocols. These concerns clustered into two main categories: those who did not want their child to receive an opioid, and those that preferred that their child receive one. Caregivers who declined to participate cited anxiety about opioid use, despite receiving pre-procedure counseling indicating that the opioid regimen was routinely used at the clinic for non-study procedures. In contrast, some caregivers expressed a strong desire for the opioid combination because they perceived it would result in reduced pain and better patient compliance. The strong preferences of parents have implications for patient education and treatment planning.

Another major limitation was the low overall rate of success in this study. The overall success rate of sedation treatment was 54% for the opioid regimen and 46% for the non-opioid regimen. Both these numbers are significantly lower than the clinic average of 70-80%, as well as figures reported in other research studies.[11,26,27] The most likely cause for this discrepancy is the small sample size.

The UW Center for Pediatric Dentistry is an academic institution and site for a pediatric dentistry residency training program. Accordingly, there were 10 resident providers who performed treatment in the study. Each provider had varying levels of experience and clinical skills, which may have affected patient behavioral responses.

This study was not double-blinded. Ideally, the judgment of overall behavior outcome would be assessed without knowledge of which sedation regimen was given. For safety purposes, it was decided not to have providers blinded to the sedation regimen. That way in the event of a drug-induced medical emergency appropriate emergency care could be administered. To compensate for this effect consensus on the HBRS score between the sedation operator and monitor was reached for each child. It is still possible that preconceived notions about the efficacy of a particular regimen could have shaped the treatment outcome.

Finally, results from this study may apply to predominantly English-speaking populations in a university-based dental clinic. The findings may not be generalizable to families who speak primary languages other than English or to families seeking dental care in a community setting, as those families were not recruited to participate in the study.

V. CONCLUSIONS

In this study, we found no difference in success rates for patients who received an opioid or non-opioid oral sedation combination. Patients in the non-opioid group with high effortful control and soothability had a greater likelihood of success. Frustration and sadness in this group were associated with failure. In both treatment groups soothability and pre-procedure behavior scores were associated with success. These findings suggest that sedation success may be associated with specific temperament characteristics. Careful assessment of these characteristics may aid in selection of an opioid or non-opioid sedation regimen and improve sedation success.

VI. TABLES

Table 1. Demographics of study participants by sedation success.

		Sedation Success		
	Total	**Yes**	**No**	
	N = 37	**N = 20**	**N = 17**	
	N (%)	**N (%)**	**N (%)**	**p-value**
Age in Months (Mean±SD)	69.19±14.05	68.35±13.24	70.18±15.31	0.80†
Sex				0.63‡
Female	19 (51.4%)	11 (55.0%)	8 (47.1%)	
Male	18 (48.7%)	9 (45.0%)	9 (52.9%)	
ASA status				N/A
I	37 (100.0%)	20 (100.0%)	17 (100.0%)	
II	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Insurance status				0.99§
Medicaid	28 (75.7%)	15 (75.0%)	13 (76.5%)	
Private	9 (24.3%)	5 (25.0%)	4 (23.5%)	
Pre-operative behavioral rating				**<0.01§**
Frankl (+/+)	12 (32.4%)	9 (45.0%)	3 (17.7%)	
Frankl (+)	15 (40.5%)	10 (50.0%)	5 (29.4%)	
Frankl (-)	4 (10.8%)	0 (0.0%)	4 (23.5%)	
Frankl (-/-)	6 (16.2%)	1 (5.0%)	5 (29.4%)	

SD = Standard Deviation; †Calculated using Wilcoxon Rank-Sum tests; ‡Calculated using Fisher's Exact tests

Table 2. Procedure variables by sedation success

		Sedation success		
	Total	**Yes**	**No**	
	N = 37	**N = 20**	**N = 17**	
	N (%)	**N (%)**	**N (%)**	**p-value†**
Sedation Regimen				0.90†
Midazolam + Hydroxyzine + Meperidine	20 (54.1%)	11 (55.0%)	9 (52.9%)	
Midazolam + Hydroxyzine	17 (46.0%)	9 (45.0%)	8 (47.1%)	
Isolation method				0.09‡
None	4 (10.8%)	0 (0.0%)	4 (23.5%)	
Isolite	18 (48.7%)	11 (55.0%)	7 (41.2%)	
Rubber dam	15 (40.5%)	9 (45.0%)	6 (35.3%)	
Treatment Complexity				**0.03†**
Simple	17 (46.0%)	6 (30.0%)	11 (64.7%)	
Complex	20 (54.1%)	14 (70.0%)	6 (35.3%)	
Duration of Procedure				0.15‡
< 30 min	4 (10.8%)	1 (5.0%)	3 (17.7%)	
30 - 60 min	28 (75.7%)	15 (75.0%)	13 (76.5%)	
> 60 min	4 (10.8%)	4 (20.0%)	0 (0.0%)	

†Calculated using Fisher's Exact tests

Table 3. Temperament scales in relation to treatment type

	Overall	Midazolam + Hydroxyzine + Meperidine	Midazolam + Hydroxyzine	
	N = 36	N = 19	N = 17	
	Mean ± SD	Mean ± SD	Mean ± SD	P-value†
Effortful Control	5.59 ± 0.68	5.38 ± 0.47	5.84 ± 0.81	0.03
Attention Control	4.83 ± 0.91	4.68 ± 0.80	4.99 ± 1.02	0.14
Inhibitory Control	5.07 ± 0.88	4.79 ± 0.80	5.40 ± 0.89	0.07
Perceptual Sensitivity	5.69 ± 0.68	5.53 ± 0.63	5.85 ± 0.71	0.17
Low-Intensity Pleasure	6.05 ± 0.69	5.93 ± 0.75	6.21 ± 0.58	0.30
Negative Affectivity	4.30 ± 0.64	4.44 ± 0.75	4.12 ± 0.43	0.15
Frustration	4.01 ± 1.15	4.25 ± 1.26	3.73 ± 0.95	0.20
Fear	3.74 ± 1.23	3.99 ± 1.33	3.46 ± 1.09	0.27
Discomfort	4.22 ± 1.22	4.50 ± 1.33	3.91 ± 1.05	0.26
Sadness	4.06 ± 0.82	4.28 ± 0.88	3.80 ± 0.67	0.17
Soothability	4.78 ± 1.14	4.42 ± 1.04	5.20 ± 1.14	0.04
Extraversion/Surgency	4.26 ± 0.47	4.30 ± 0.46	4.21 ± 0.50	0.49
Activity	4.87 ± 1.25	5.00 ± 1.27	4.71 ± 1.25	0.53
Shyness	3.57 ± 1.26	3.60 ± 1.42	3.54 ± 1.07	0.97
High-Intensity Pleasure	4.96 ± 0.89	5.00 ± 0.97	4.91 ± 0.80	0.83
Smiling & Laughter	5.79 ± 1.03	5.98 ± 0.93	5.56 ± 1.13	0.27
Impulsivity	4.34 ± 1.01	4.52 ± 1.06	4.15 ± 0.94	0.21
Positive Anticipation	5.30 ± 0.70	5.51 ± 0.72	5.05 ± 0.62	0.11

†Calculated using Wilcoxon Rank-Sum tests

Table 4. Temperament scales by sedation success.

	Overall	Sedation success	Sedation failure	
	N = 36	N = 20	N = 16	
	Mean ± SD	Mean ± SD	Mean ± SD	P-value†
Effortful Control	5.59 ± 0.68	5.50 ± 0.56	5.72 ± 0.81	0.48
Attention Control	4.83 ± 0.91	4.83 ± 0.86	4.83 ± 1.00	0.89
Inhibitory Control	5.07 ± 0.88	5.01 ± 0.93	5.16 ± 0.85	0.73
Perceptual Sensitivity	5.69 ± 0.68	5.81 ± 0.64	5.54 ± 0.73	0.20
Low-Intensity Pleasure	6.05 ± 0.69	5.98 ± 0.63	6.15 ± 0.77	0.32
Negative Affectivity	4.30 ± 0.64	4.29 ± 0.63	4.31 ± 0.67	0.95
Frustration	4.01 ± 1.15	3.94 ± 1.22	4.10 ± 1.08	0.73
Fear	3.74 ± 1.23	3.62 ± 1.40	3.89 ± 1.01	0.31
Discomfort	4.22 ± 1.22	3.97 ± 1.20	4.53 ± 1.23	0.24
Sadness	4.06 ± 0.82	4.05 ± 1.02	4.07 ± 0.47	0.71
Soothability	4.78 ± 1.14	5.08 ± 1.27	4.38 ± 0.81	0.04
Extraversion/Surgency	4.26 ± 0.47	4.20 ± 0.49	4.33 ± 0.45	0.44
Activity	4.87 ± 1.25	5.14 ± 0.92	4.54 ± 1.51	0.43
Shyness	3.57 ± 1.26	3.23 ± 1.28	4.01 ± 1.13	0.10
High-Intensity Pleasure	4.96 ± 0.89	4.76 ± 0.96	5.22 ± 0.74	0.07
Smiling & Laughter	5.79 ± 1.03	5.74 ± 1.07	5.85 ± 1.01	0.93
Impulsivity	4.34 ± 1.01	4.46 ± 0.90	4.20 ± 1.14	0.66
Positive Anticipation	5.30 ± 0.70	5.30 ± 0.74	5.31 ± 0.68	0.88

†Calculated using Wilcoxon Rank-Sum tests

Table 5. Temperament scores in relation to sedation outcomes for each sedation regimen.

	Midazolam + Hydroxyzine + Meperidine				Midazolam + Hydroxyzine			
	Overall	**Sedation success**	**Sedation failure**		**Overall**	**Sedation success**	**Sedation failure**	
	N = 19	**N = 11**	**N = 8**		**N = 17**	**N = 9**	**N = 8**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**P-value†**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**P-value†**
Effortful Control	5.38 ± 0.47	5.39 ± 0.41	5.35 ± 0.56	0.80	5.84 ± 0.81	5.62 ± 0.71	6.08 ± 0.89	0.18
Attention Control	4.68 ± 0.80	4.52 ± 0.83	4.92 ± 0.75	0.26	4.99 ± 1.02	5.20 ± 0.78	4.74 ± 1.25	0.39
Inhibitory Control	4.79 ± 0.80	4.77 ± 0.96	4.83 ± 0.57	0.84	5.40 ± 0.89	5.30 ± 0.84	5.53 ± 1.00	0.67
Perceptual Sensitivity	5.53 ± 0.63	5.68 ± 0.61	5.33 ± 0.64	0.18	5.85 ± 0.71	5.95 ± 0.67	5.74 ± 0.79	0.66
Low-Intensity Pleasure	5.93 ± 0.75	5.84 ± 0.69	6.04 ± 0.85	0.49	6.21 ± 0.58	6.14 ± 0.52	6.30 ± 0.67	0.56
Negative Affectivity	4.44 ± 0.75	4.58 ± 0.70	4.25 ± 0.81	0.34	4.12 ± 0.43	3.93 ± 0.23	4.37 ± 0.52	0.06
Frustration	4.25 ± 1.26	4.45 ± 1.22	3.96 ± 1.35	0.30	3.73 ± 0.95	3.31 ± 0.93	4.25 ± 0.73	0.05
Fear	3.99 ± 1.33	3.94 ± 1.65	4.06 ± 0.87	0.48	3.46 ± 1.09	3.28 ± 1.05	3.69 ± 1.19	0.60
Discomfort	4.50 ± 1.33	4.42 ± 1.37	4.60 ± 1.35	0.59	3.91 ± 1.05	3.48 ± 0.76	4.45 ± 1.17	0.11
Sadness	4.28 ± 0.88	4.49 ± 1.02	4.00 ± 0.59	0.28	3.80 ± 0.67	3.52 ± 0.77	4.16 ± 0.28	0.05
Soothability	4.42 ± 1.04	4.43 ± 1.27	4.42 ± 0.70	0.77	5.20 ± 1.14	5.87 ± 0.75	4.33 ± 0.97	<0.01
Extraversion / Surgency	4.30 ± 0.46	4.34 ± 0.49	4.24 ± 0.43	0.65	4.21 ± 0.50	4.04 ± 0.46	4.43 ± 0.49	0.11
Activity	5.00 ± 1.27	5.40 ± 1.06	4.51 ± 1.38	0.18	4.71 ± 1.25	4.83 ± 0.64	4.58 ± 1.75	0.70
Shyness	3.60 ± 1.42	3.11 ± 1.31	4.20 ± 1.38	0.13	3.54 ± 1.07	3.37 ± 1.30	3.76 ± 0.72	0.46
High-Intensity Pleasure	5.00 ± 0.97	4.76 ± 1.11	5.33 ± 0.66	0.14	4.91 ± 0.80	4.77 ± 0.79	5.10 ± 0.85	0.34
Smiling & Laughter	5.98 ± 0.93	5.85 ± 1.16	6.16 ± 0.49	0.99	5.56 ± 1.13	5.61 ± 1.01	5.50 ± 1.35	0.96
Impulsivity	4.52 ± 1.06	4.90 ± 0.99	4.04 ± 1.00	0.17	4.15 ± 0.94	3.96 ± 0.47	4.38 ± 1.35	0.42
Positive Anticipation	5.51 ± 0.72	5.62 ± 0.66	5.37 ± 0.81	0.41	5.05 ± 0.62	4.91 ± 0.67	5.24 ± 0.54	0.29

†Calculated using Wilcoxon Rank-Sum tests

VII. REFERENCES

1. Nelson, Travis, and Gary Nelson. “The Role of Sedation in Contemporary Pediatric Dentistry.” *Dental Clinics of North America.*, vol. 57, no. 1, 2013, pp. 145–161.,
2. Wilson, Stephen. “Pharmacological Management of the Pediatric Dental Patient.” *P ediatric Dentistry.*, vol. 26, no. 2, 2004, pp. 131–136.
3. Rothbart, M. K., & Derryberry, D. (1981). Development of Individual Difference in Temperament. In M. E. Lamb, & A. L. Brown (Eds.), Advances in Developmental Psychology (pp. 37-86). Hillsdale, NJ: Lawrence Erlbaum Associates.
4. Rothbart MK, Putnam SP. Temperament and socialization. In: Pulkkinen L, Caspi A, editors. *Paths to successful development: Personality in the life course.* Cambridge, England: Cambridge University Press; 2002. pp. 19–45.
5. Voepel-Lewis, Terri, et al. “Sedation Failures in Children Undergoing MRI and CT: Is Temperament a Factor?” Pediatric Anesthesia, vol. 10, no. 3, 2000, pp. 319–323.
6. Lane KJ, Nelson TM, Thikkurissy S, Scott JM. Assessing Temperament as a Predictor of Oral Sedation Success Using the Children's Behavior Questionnaire Short Form. *Pediatr Dent.* 2015;37(5):429-435.
7. Finley GA, Stewart SH, Buffett-Jerrott S, Wright KD, Millington D. High levels of impulsivity may contraindicate midazolam premedication in children. *Can J Anaesth.* 2006;53(1):73-78.
8. McCormack L, Chen JW, Trapp L, Job A. A comparison of sedation-related events for two multiagent oral sedation regimens in pediatric dental patients. *Pediatr Dent.* 2014;36(4):302-308.
9. Conway A, Rolley J, Sutherland JR. Midazolam for sedation before procedures. *Cochrane Database Syst Rev.* 2016(5):CD009491.
10. Nathan JE, Vargas KG. Oral midazolam with and without meperidine for management of the difficult young pediatric dental patient: a retrospective study. *Pediatr Dent.* 2002;24(2):129-138.
11. Shapira J, Kupietzky A, Kadari A, Fuks AB, Holan G. Comparison of oral midazolam with and without hydroxyzine in the sedation of pediatric dental patients. *Pediatr Dent.* 2004;26(6):492-496.
12. Sheroan, Marianne M., et al. “A Prospective Study of 2 Sedation Regimens in Children: Chloral Hydrate, Meperidine, and Hydroxyzine versus Midazolam, Meperidine, and Hydroxyzine.” *Anesthesia Progress*, vol. 53, no. 3, 2006, pp. 83–90., https://doi.org/10.2344/0003-3006(2006)53[83:apsosr]2.0.co;2.
13. Nelson TM, Xu Z. Pediatric dental sedation: challenges and opportunities. *Clin Cosmet Investig Dent.* 2015;7:97-106.
14. Dionne RA, Yagiela JA, Coté CJ, et al. Balancing efficacy and safety in the use of oral sedation in dental outpatients. *J Am Dent Assoc.* 2006;137(4):502-513.
15. Huang A, Tanbonliong T. Oral Sedation Postdischarge Adverse Events in Pediatric Dental Patients. *Anesth Prog.* 2015;62(3):91-99.
16. Dosani FZ, Flaitz CM, Whitmire HC, Vance BJ, Hill JR. Postdischarge events occurring after pediatric sedation for dentistry. *Pediatr Dent.* 2014;36(5):411-416.
17. Coté CJ, Notterman DA, Karl HW, Weinberg JA, McCloskey C. Adverse sedation events in pediatrics: a critical incident analysis of contributing factors. *Pediatrics.* 2000;105(4 Pt 1):805-814.

18. Coté CJ, Karl HW, Notterman DA, Weinberg JA, McCloskey C. Adverse sedation events in pediatrics: analysis of medications used for sedation. *Pediatrics.* 2000;106(4):633-644.
19. Mitchell AA, Louik C, Lacouture P, Slone D, Goldman P, Shapiro S. Risks to children from computed tomographic scan premedication. *JAMA.* 1982;247(17):2385-2388.
20. Chicka MC, Dembo JB, Mathu-Muju KR, Nash DA, Bush HM. Adverse events during pediatric dental anesthesia and sedation: a review of closed malpractice insurance claims. *Pediatr Dent.* 2012;34(3):231-238.
21. Coté CJ, Wilson S. Guidelines for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures. *Pediatr Dent.* 2019;41(4):26E-52E.
22. Dahan A, van der Schrier R, Smith T, Aarts L, van Velzen M, Niesters M. Averting Opioid-induced Respiratory Depression without Affecting Analgesia. *Anesthesiology.* 2018;128(5):1027-1037.
23. Saklad, Meyer. "Grading of Patients for Surgical Procedures." *Anesthesiology*, vol. 2, no. 3, 1941, pp. 281–284.
24. Frankl SN., et al. "Should the parent remain in the operatory?" Journal of Dentistry for Children 29 (1962): 150-163.
25. Nelson TM, Griffith TM, Lane KJ, Thikkurissy S, Scott JM. Temperament as a Predictor of Nitrous Oxide Inhalation Sedation Success. *Anesth Prog.* 2017;64(1):17-21.
26. Chen, Norman, and Thomas Tanbonliong. "Comparison of Two Morphine-Benzodiazepine-Hydroxyzine Combinations for the Oral Sedation of Pediatric Dental Patients: A Retrospective Study." *Pediatric Dentistry*, vol. 10, no. 1, 2018, pp. 43–48.
27. Gentz, Rachel, et al. "Safety and Efficacy of 3 Pediatric Midazolam Moderate Sedation Regimens." *Anesthesia Progress*, vol. 64, no. 2, 2017, pp. 66–72.,

VIII. APPENDIX

Examples of CBQ-SF Statements for each Temperament

The temperament statements were rated on a scale of how "true" or "untrue" the description was of the patient within the past six months.

Number	Description
1	Extremely untrue of your child
2	Quite untrue of your child
3	Slightly untrue of your child
4	Neither true or false of your child
5	Slightly true of your child
6	Quite true of your child
7	Extremely true of your child
NA	Not Applicable

Soothability

- "Is easy to sooth when s/he is upset."
- "If upset, cheers up quickly when s/he thinks about something else."
- "When angry about something, s/he tends to stay upset for ten minutes or longer."
- "If upset, cheers up quickly when s/he thinks about something else."

Effortful Control

- "Can easily stop an activity when she or he is told 'no.'"
- "Sometimes becomes absorbed in a picture book and looks at it for a long time."
- "Can wait before entering into new activities if s/he is asked to."
- "Hardly ever complains when ill with a cold."

Frustration

- Gets quite frustrated when preventing from doing something s/he wants to do."
- "Gets angry when told s/he has to go to bed."
- "Has temper tantrums when s/he doesn't get what s/he wants."
- "Gets angry when called in from play before s/he is ready to quit."

Sadness

- “Cries sadly when a favorite toy gets lost or broken.”
- “Tends to become sad if the family’s plans don’t work out.”
- “Becomes upset when loved relatives or friends are getting ready to leave following a visit.”
- “Seems to feel depressed when unable to accomplish some task.”