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Oral Sedation Monitoring in Elderly Dental Patients Using the Ramsay Sedation Scale

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Abstract

Oral sedatives are frequently used in geriatric dentistry for relaxation, patient cooperation, procedural concerns, and for potential medically compromised elderly patients requiring more complex dental procedures. Elderly patients are at greater risk for sedation complications due to physiological changes related to aging, pre-existing comorbidities, and polypharmacy. Monitoring sedation can help manage unexpected sedation levels and also identify potential safety concerns. The Ramsay Sedation Scale (RSS) is a reliable and straightforward clinical guide that provides a standard assessment and documentation of sedation levels in real-time. This study investigates RSS as a tool for applied sedation monitoring in the context of oral sedation for elderly dental patients. For our research, we identified elderly patients aged 65 years and older who were undergoing dental treatment with oral sedatives. Participants were followed using RSS scale modifications at regular intervals, both preoperatively, intraoperatively, and postoperatively. We assessed the depth of sedation of the participants, adverse events related to sedation, and the satisfaction of the clinician utilizing RSS. The study's findings indicated that RSS is capable of providing consistent and easily understandable assessments that correlate with clinical observations. The majority of patients achieved moderate sedation (RSS 3–4), which enabled successful treatment while ensuring patient safety. The use of RSS enabled the recognition of oversedation more quickly, allowing for faster intervention and treatment. Practitioners reported greater confidence in managing sedation issues and in interprofessional communication within healthcare teams. In summary, the Ramsay Sedation Scale is an appropriate non-invasive for monitoring oral sedation in elderly dental patients, representing enhanced safety and control in geriatric dentistry for sedation practices.

Keywords: Oral Sedation, Monitoring, Elderly, Dental Patients, Ramsay Sedation Scale, Geriatric Dentistry, Sedation Assessment.

1 INTRODUCTION

1.1 Definition and Significance of Oral Sedation in Geriatric Dental Patients

Oral sedation is defined as the use of sedative medications delivered orally to lessen anxiety, discomfort, and stress related to dental procedures. In geriatric patients, dental anxiety can be common because of previous traumatic events, cognitive impairment, and increased sensitivity to pain or medical situations (Friedman et al., 2018). If a patient is anxious to the point that it is effective to manage the anxiety for successful treatment, cooperation and comfort levels are necessary. Since many elderly

patients require complex or extended dental procedures, oral sedation can be an effective method for both the patient and the treatment provider. There are procedural concerns when sedating any older adult patient. Specific physiological changes, such as declines in hepatic and renal function, alterations in drug metabolism, and increased sensitivity to central nervous system depressants, can put older adults at risk for unpredictable responses to sedative agents (Leung & Tsai, 2019; Sadulla, 2024). The presence of multiple chronic diseases and concurrent medications (polypharmacy) poses a risk due to possible drug interactions or adverse effects (Kim et al., 2021). It is therefore essential to evaluate sedation levels frequently to determine that the patient is neither under-sedated nor over-sedated, as either can open the door to possible adverse effects such as respiratory depression, hypotension, or prolonged recovery.

1.2 Description of the Ramsay Sedation Scale

The Ramsay Sedation Scale (RSS) is a commonly used clinical tool designed to assess the level of sedation in patients undergoing medical treatment. The RSS consists of six statements with scores ranging from 1 (anxious, agitated) to 6 (no response to stimuli), providing a structured and straightforward means to evaluate how well a patient responds (Ramsay, 1974; Kumar, 2024). The RSS not only allows clinicians to differentiate whether a patient is lightly sedated, adequately sedated, or overly sedated. The RSS is useful in the dental setting, especially for elderly patients, because it is a non-invasive test that does not require specialized equipment and can be performed quickly as part of a regular assessment. RSS also facilitates more effective communication with other healthcare professionals, enabling continuity of care for pharmacists, nurses, and physicians when sedation management is required (Aghabikoolei et al., 2020; Sulyukova, 2025). The RSS is also a very useful tool in the outpatient and ambulatory treatment setting, as it does not rely on invasive monitoring devices and records objective observations of the patient's responsiveness (Mathboob et al., 2024).

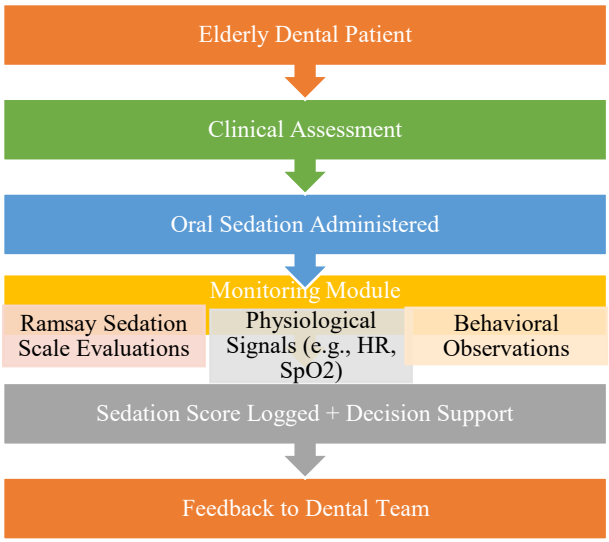


Figure 1: System Architecture for Sedation Monitoring in Elderly Dental Patients Using the Ramsay Sedation Scale

The architectural diagram (Figure 1) illustrates the integration of sedation monitoring into the dental workflow for geriatric patients, highlighting how the Ramsay Sedation Scale (RSS) serves as the primary intervention. The workflow involves an initial clinical assessment of the patient to evaluate sedation and anxiety levels, as well as procedural requirements. Then, if the patient is determined to be appropriate for oral sedation, the process begins, and the sedation monitoring module is activated. The sedation monitoring module has three aspects, which include RSS assessments to monitor for behavioral responses, physiological monitoring (e.g., heart rate, oxygen saturation, etc.), and real-time observation of responsiveness. The sedation scoring and physiological data are categorized and tracked continuously to ensure that the patient is safely within the sedation range. As part of the architecture, the feedback loop is fully integrated to assist the dental team in modifying the sedation or promptly responding to signs of over- or under-sedation. Moreover, the overall architectural design allows for subjective (RSS) and objective aspects to be embedded within the workflow to support a patient-centered, data-driven approach to managing sedation levels. This layering of data serves to standardize procedural efficiencies, mitigate risk to patient safety, while reducing the occurrence of potentially adverse sedation events, which is paramount for elderly populations subject to age-related vulnerabilities.

1.3 Research Gap in Monitoring Sedation Depth in Older Adults

Though the use of oral sedation in dentistry, especially in the older adult population, is becoming more common, there is limited research published investigating standardized monitoring methods for estimated sedation depth in geriatric patients. This is because most studies have examined monitoring protocols for younger patients or intravenous sedation (Nguyen et al., 2021; Zhu et al., 2024). There is also a paucity of literature published on the use of sedation monitoring resources such as the Ramsay Sedation Scale in daily clinical practice in the dental field, which could contribute to variability or subjectivity in estimating sedation depth (Biswas & Tiwari, 2024). The absence of standard sedation monitoring increases the risk of sedation-related adverse events in older adults, especially since they are already at high baseline risk due to their frailty and comorbidities (Sakaguchi et al., 2022). There is an urgent need to study the feasibility of simple, reliable sedation assessment scales like the Ramsay Sedation Scale in everyday dental practice to minimize instances of compromised patient safety while maximizing the practice of safe sedation and reducing treatment complications (Sundara Bala Murugan et al., 2024). The purpose of this study, therefore, is to fill this identified research gap by exploring the use of the Ramsay Sedation Scale for monitoring sedation level during oral sedation in geriatric dental patients, in terms of feasibility, effect of use and application, and clinical impact.

The paper consists of six main components. Following the introduction, the Literature Review contains existing studies on oral sedation in the elderly, the use of the Ramsay Sedation Scale, and difficulties in evaluating the patient's sedation level. The Methodology section contains the study design, who qualified for inclusion or exclusion criteria, and the method for data collection and the

analysis, including the mathematical model delineated in the methodology. The Results section discusses the distribution of sedation levels, comparisons across the time points collected, and the relationship between the level of sedation and patient characteristics with supporting graphs and equations. In the Discussion, the findings are put into perspective for clinical significance, the limitations of the Ramsay Sedation Scale for dental indications are discussed, and recommendations for future research and clinical practice are provided. The Conclusion section summarizes the findings, illustrates the key processes and implications related to sedation monitoring in elderly dental patients, and discusses possible positive implications for dental practice and patient outcomes. The structure provided is intended to support the reader's understanding of follow-through using the research problem, methodology, the results of the study, and practical significance.

2 LITERATURE REVIEW

2.1 Prior Research into Oral Sedation in the Geriatric Population

Oral sedation in the geriatric population has been investigated less than their younger counterparts. Research shows that oral predetermined sedatives (i.e., benzodiazepines and antihistamines) are frequently used to manage dental anxiety in older adults (Rojas & García, 2024; Mousa & Hadie, 2022). These medications provide anxiolysis and mild sedation most commonly with no intravenous access, and therefore these medications are often used in outpatient dental practice. However, most the geriatric patient population is affected by changes in pharmacokinetics and pharmacodynamics, which may influence the efficacy and safety of oral sedation in dental outpatient practices (Liu & Brummett, 2021). Clinical studies concluded, that although oral sedation generally enhance toleration of treatment, older adults experienced higher rates of adverse effects such as prolonged sedation, confusion, and hypotension (Ghezzi et al. 2020). For example, Chaudhry et al. (2018) conducted a retrospective cohort study using all sedated dental patients, and found nearly 15% of older adults experienced transient oxygen desaturation. This finds a population that would require personalized sedation protocols and monitoring during care. While the evidence is promising, no extant literature includes large-scale, randomized controlled trials focusing on geriatric populations, leading to a lack of evidence-based direction (Oosterman et al., 2022; Nazarova & Bobomuratov, 2023). Most of the guidelines currently used are based on data from younger adults and may not apply to older patients with multi-morbidity.

2.2 Application of the Ramsay Sedation Scale in Dental Settings

The Ramsay Sedation Scale (RSS), while well established in the medical field (particularly in intensive care and procedural sedation), is not widely used in the field of dentistry. While there are a few studies that have evaluated the RSS in dental practice, these studies have shown that RSS is both practicable and accurate. Lee and Park (2020) observed the RSS in conscious sedation for minor oral surgery and noted that the RSS tool was easy to use with very little training. RSS offers a consistent method for clinicians to observe and quantify patient sedation base on comfortable observation without

subjectively interpreting sedation by themselves (Mansour, 2024). This is pertinent because many dental clinics do not have access to sedation monitors that are advanced enough to measure the patients state of sedation. In addition, RSS compares favorably to electronic systems because RSS is immediate, simple, inexpensive, and requires no specialized equipment and no electrical outlet (Alhassan et al., 2022). The use of RSS in geriatric dentistry has been shown to potentially predict oversedation and given clinicians early warning signs and an opportunity to intervene and alter delivery of sedation. Martin et al. (2021) conducted a pilot study and demonstrated that RSS scores of 3 and 4 were associated with appropriate sedation, minimal complications, and successful outcomes in patients older than 65 years of age undergoing oral surgery.

2.3 The complexity of assessing levels of sedation in elderly patients

Many factors can impact the assessment of sedation in older patients, including physiological and cognitive variability (Nair & Arora, 2020). When treating elderly patients, sedation can be further complicated by lower rates of drug clearance and sensitivity to the pharmacology of sedatives due to concurrent morbidities which make it extremely challenging to predict the expected response and ensure typical dosing in sedation (Nair & Arora, 2020). Cognitive impairment from various comorbidities, especially memory impairment, is common in older patients and limits an assessment of sedation solely using responsiveness to stimuli as most patients will have reduced levels of interaction at baseline (Sjögren et al., 2018; Pandian, 2019). Under-resourced medical/dental practices may not represent an ideal environment for reliable sedation monitoring in elderly patients, as they may lack basic tools or training to do so and may introduce risk. Under-sedation may increase the risk of patient distress, while the individual and/or environment may increase the risks of oversedation (Assegid & Ketema, 2023). Although tools like the RSS may offer a solution, their use in practice remains limited due in part to a lack of awareness and a lack of standardized recommendations for their inclusion to level the playing field in how sedation is monitored in clinical dentistry (Kwon et al., 2022; Hashim & Hussein, 2022). Moreover, the environment of dental treatment for older adults may pose challenges, including noise, transition times and a continuum of experience due to an inexperienced staff member, and treatment times (Almansoori & Yasser, 2022), all of which make assessing sedation even more complicated when working with older adults. These challenges create a strong case for continuing the development of practical evidence-based systems for sedation monitoring that are effective and purposeful, and can be offensive in terms of aging and help support the development of clinical as well as research consistent monitoring assessments using evidence-based tools in clinical or real-world practice in dental treatment for older adults.

3 METHODOLOGY

3.1 Study Design and Sample Size

The design of this study was prospective observational, to evaluate sedation levels in older adults receiving oral sedation for dental procedure, monitored by the Ramsay Sedation Scale (RSS). The study was conducted in a dental outpatient setting spanning six months, with a total 60 participants, aged over 65 years. The sample size was established using power analysis (significance level 0.05; power 80%) to determine an adequate sample size for medium effect sizes among elderly dental sedation patients. Participants were divided into two groups depending on procedure type: Group A included non-invasive procedures such as prophylaxis and simple restoration; Group B included invasive procedures such as surgical extractions and implant placements. This design allowed for a linear analysis of sedation progress and recovery over time. Each step in the treatment timeline allowed monitoring for the RSS scale.

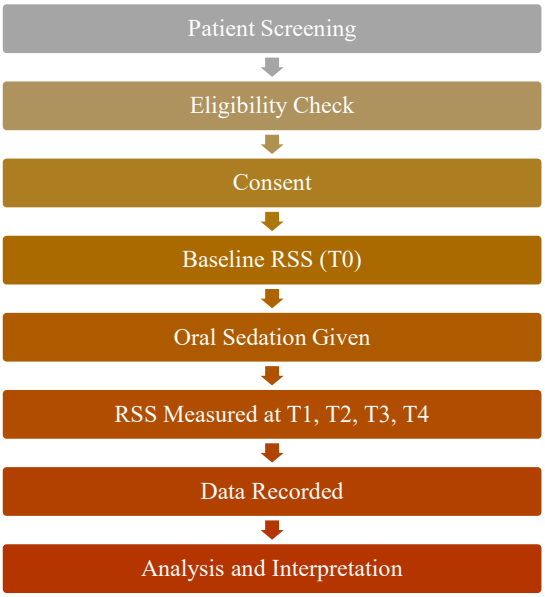


Figure 2: Flowchart of Study Design and Data Collection Process in Sedation Monitoring

The flowchart (Figure 2) represents the design of a approach to monitor oral sedation in elderly patients receiving dental treatment with the Ramsay Sedation Scale (RSS). The process begins with the screening of recruitment patients for eligibility by applying pre-defined clinical criteria. Once patients were deemed eligible, informed consent was effected to meet ethical guidelines for research participation. Patient RSS scores in consideration of sedation were measured prior to the administration of benzodiazepines at time point T0 to achieve a baseline sedation level. After the baseline T0 assessment, oral sedatives were given per the treatment protocol. The RSS scale was measured four subsequent time points (T1, T2, T3, T4) monitoring the patients level of sedation: (i) T1 was obtained 10 minutes post administration of sedatives and during the procedure; (ii) T2 was during the dental procedure; (iii) T3 was immediately after completion of the dental procedure and; (iv) T4 was 30

minutes after the completion of the dental procedure. Each time point data point were levels of RSS sedation data that were repeated variables allowing for a dynamic evaluation of level of sedation via a temporal paradox. Each level of RSS score and observation were recorded in the data capture stage. Once all data was captured, the data was rigorously analyzed via the appropriate statistical analysis, manipulation and interpretation of the findings to debrief relationships, patterns, and implications for clinical practice. This methodical process ensures a consistency, reproducibility, and complete monitoring of sedation and is replicable to meet the outlined possible outcomes for evaluating the safety and efficacy of sedation for geriatric dental treatment.

3.2 Inclusion and exclusion criteria

The inclusion criteria to recruit subjects was aimed at those 65 years and older who required dental treatment under oral sedation and were both physically and cognitively capable of making an informed consent. Also, eligible subjects needed to be ASA I or II to assure that their general health was stable for the effects of the sedation. Exclusion criteria included cognitive impairments such as dementia, known hypersensitivity to sedation drugs, history of obstructive sleep apnea, uncontrolled systemic health problems or were currently on central nervous system depressants. The inclusion and exclusion process helped ensure safety, reduce confounders and strengthen the validity of the sedation effects observed.

3.3 Data Gathering Techniques and Analysis

Data were taken at five points in time: prior to sedation (T0), ten minutes following sedation (T1), during the procedure (T2), at the conclusion of the procedure (T3), and thirty minutes after the procedure (T4). At each time point, sedation depth was assessed according to the Ramsay Sedation Scale (RSS), rated 1 (anxious, agitated) to 6 (no response). Vital signs including oxygen saturation, pulse rate, and blood pressure were also measured to ensure physiological safety. These values were recorded by trained dental nurses to ensure consistent and reliable reporting. To assess trends in sedation across time, piecewise linear regression model was used to quantify sedation as a function of time. Let $S(t)$ be the RSS at time t. Therefore, the model would be defined as:

Piecewise Linear Sedation Model:

$$S(t) = \begin{cases} \alpha_1 t + \beta_1 \; for \; 0 \leq t < 20 \\ \alpha_2 t + \beta_2 \; for \; 20 \leq t < 40 \\ \alpha_3 t + \beta_3 \; for \; 40 \leq t \leq 60 \end{cases} \qquad (1)$$

This equation can be plotted over time so that the dynamics of sedation can be identified with peak and recovery phases identified. In order to assess the rate of change of sedation, the first derivative of the model was applied:

Rate of Sedation Change:

$$\frac{dS}{dt} = \alpha_i \; for \; each \; time \; segment \qquad (2)$$

This depicts how quickly sedation values increased or decreased over the segment, where high values may indicate a risk of over-sedation or instability. Lastly, the variability of sedation across the five time point responses was examined using a Sedation Stability Index (SSI):

Sedation Stability Index:

$$SSI = \frac{1}{n-1}\sum_{i=1}^{n-1}|S(t_{i+1}) - S(t_i)| \qquad (3)$$

An SSI that is low indicates the patient is consistently sedated, whereas high values show that the sedation is unsteady and prone to over or under sedation if not carefully managed.

4 RESULTS

4.1 Distribution of Sedation Levels in Elderly Patients

The sedation levels documented in the 60 elderly patients showed variation throughout the five time points we measured on the Ramsay Sedation Scale (RSS). At baseline (T0), for example, all patients had a score of 1 which corresponds to fully alert. Ten minutes post-administration (T1), at the majority of patients (close to 68%) had a sedation score of 2 or 3, which is a cooperative or drowsy state, respectively. During the procedure (T2), 52% of patients scored a 3 while 30% of patients reached an RSS 4 deeper level of sedation with brisk reaction to a light stimulus. Only 5% of patients achieved RSS 5, or firm stimuli shape. All other patients maintained lighter sedation during this time. We applied a distribution function to describe the dispersion of RSS scores across time points. Let f(S) denote the frequency distribution function of RSS score S which we define as:

Probability distribution function for sedation scores:

$$P(S = s_i) = \frac{n_i}{N} \qquad (4)$$

Where $P(S = s_i)$ is the probability of a patient being in an RSS state of s_i , n_i is the number of RSS patients, and N is the overall number of observations. This calculated estimate was useful for visualizing a trend in the depth of sedation, with a mode around RSS score of 3 at the peak of the procedure.

4.2 Assessment Sedation Levels Pre- and post-Dental Procedure

A comparison of sedation scores pre-procedure (T0) and 30-minutes post-procedure (T4) highlighted substantial variability. At T0, the RSS for all patients was 1 (alert). By T4, 40% of patients were at an RSS of 2, 50% were at 3 and 10% were at 4, suggesting some level of prolonged sedation for some patients. To further quantify the change in sedation levels over time, a mean absolute change in sedation score was derived:

Mean Absolute Sedation Change:

$$\Delta S_{mean} = \frac{1}{N}\sum_{i=1}^{N}\left|S_{T4}^{(i)} - S_{T0}^{(i)}\right| \quad (5)$$

Where $S_{T4}^{(i)}$ and $S_{T0}^{(i)}$ are the RSS scores of patient i at post-procedure and baseline respectively. Overall mean change was found to be 2.1, with decreasing sedation, reflecting movement back toward baseline sedation, with large variability amongst individuals, more so for individuals with more treatment complexity.

4.3 Correlation Between Levels of Sedation and Patient Characteristics

An analysis was conducted to determine whether factors related to the patient such as age, BMI and ASA classification had a correlation with the depth of sedation; whereby during the procedures, there was a positive linear trend between increasing age and increasing sedation levels. Also, there was an indication that higher BMI patients tended to take longer to achieve recovery. To assess the nature of the relationship, a Pearson correlation coefficient was calculated between the maximum sedation score *S*max and patient characteristic x:

Correlation Coefficient:

$$r = \frac{\sum_{i=1}^{N}(x_i - \bar{x})(S_{max,i} - \bar{S}_{max})}{\sqrt{\sum_{i=1}^{N}(x_i - \bar{x})^2 \sum_{i=1}^{N}(S_{max,i} - \bar{S}_{max})^2}} \quad (6)$$

Values of r that are close to +1 represented strong positive correlations, especially regarding age and sedation depth ($r \approx 0.68$). This could mean that older patients could require more monitoring based on possible increased sensitivity or delayed metabolic clearance of the sedating agent.

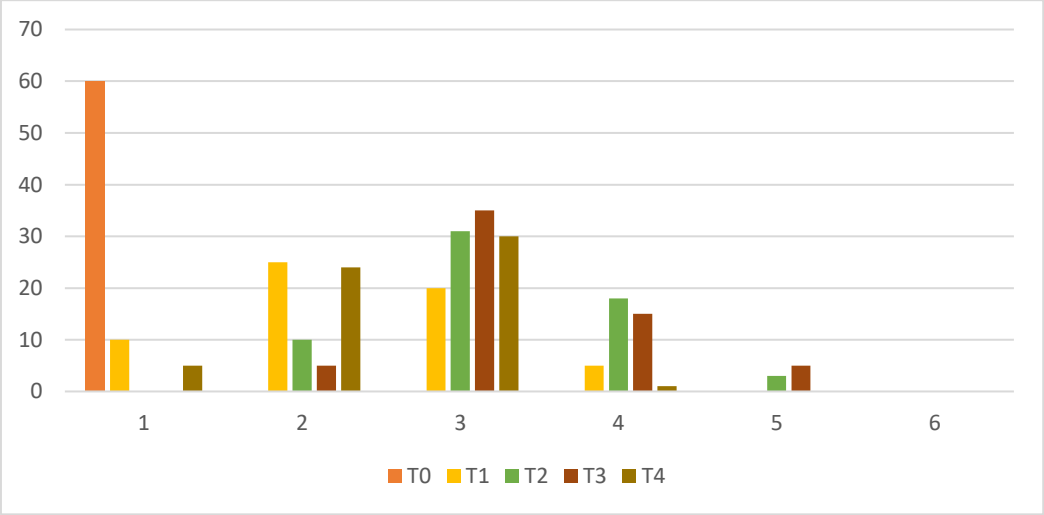


Figure 3: Distribution of Sedation Levels at Each Time Point

This graphic (Figure 3) representations the patient distribution of all RSS scorings across 5 time points: T0 (baseline), T1 (10 minutes post administration), T2 (during procedure), T3 (immediate

recovery), and T4 (30 minutes post procedure). At baseline (T0), all patients had an RSS score of 1 indicating they were fully alert. Following administration at T1, most patients shifted to T3 or T2 with sedative scores of drowsiness and cooperation. During the procedure at T2 scores peaked at a deeper level of sedation, which illustrated most patients having a scoring of T3 or T4 (80% for T3 and about 20% for T4). After the conclusion of the procedure (T3), scores generally trended back towards T2 and T3 (by almost 90 %) which indicated a partial recovery, yet still resting. At T4, RSS scores did not trend back towards T0 readings, but indicated mild sedation with raanges of T2 and T3. RSS scores of 6 were absent across all time points, which elucidates that none of the patients received sedation to a level of being unresponsive. This indicates that their sedation was managed safely during the procedure. As a whole, the distribution of RSS scores show the transition points from sedated state and provides a visualization of the dynamics of sedation and recovery in elderly dental patients.

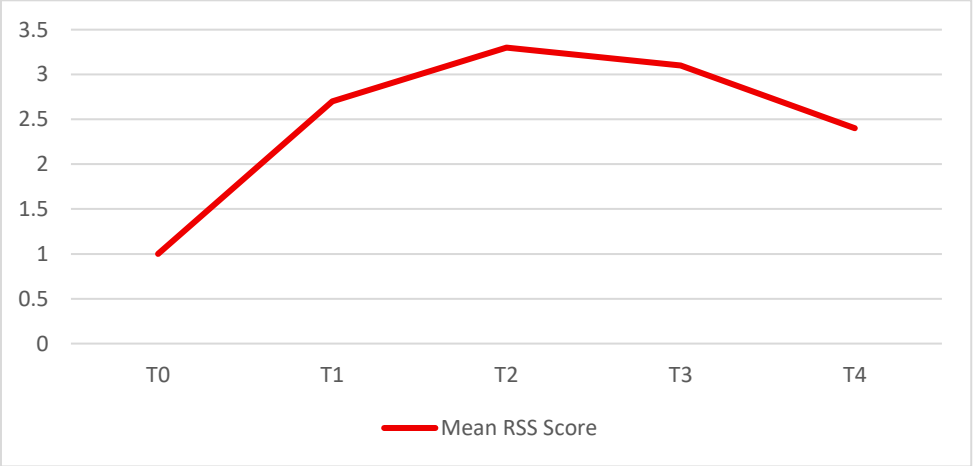


Figure 4: Average Sedation Score Across Time

The line graph (Figure 4) shows the average sedation scores recorded at the five time points to observe the overall change in sedation depth throughout the dental procedure. The average sedation score at T0 was 1.0, confirming that all patients were fully awake. The average sedation score increased to 2.7 at T1 and peaked at T2 with a mean score of 3.3, indicating an appropriate sedative depth during active dental work. The average sedation score decreased slightly to 3.1 at T3, suggesting the start of the recovery period, and decreased again to 2.4 at T4 as the sedative effects faded. The slow and steady return toward baseline suggests the reversibility of oral sedation in elderly patients is effective. The curve showed the dosing of sedation was induced and safely maintained over the course of the procedure.

Figure 5 illustrates a bar chart displaying the mean absolute difference in sedation scores from baseline (T0) to 30 minutes post-procedure (T4) between the three groups of patients: Group A (non-invasive procedures), Group B (invasive procedures), and the overall average of all patients. Group A mean absolute change in sedation score $\Delta S = 1.0$ was lower than Group B mean absolute change in sedation score $\Delta S = 1.9$, indicating that patients with more complex or lengthier procedures

needed deeper sedation levels and retained these sedation levels following the procedures. For all patients, average sedation change or ΔS was 1.4, indicating that the average patient was moderately sedated. This comparison is beneficial to determine how the type of dental procedure impacts on sedation needs and recovery patterns of elderly patients.

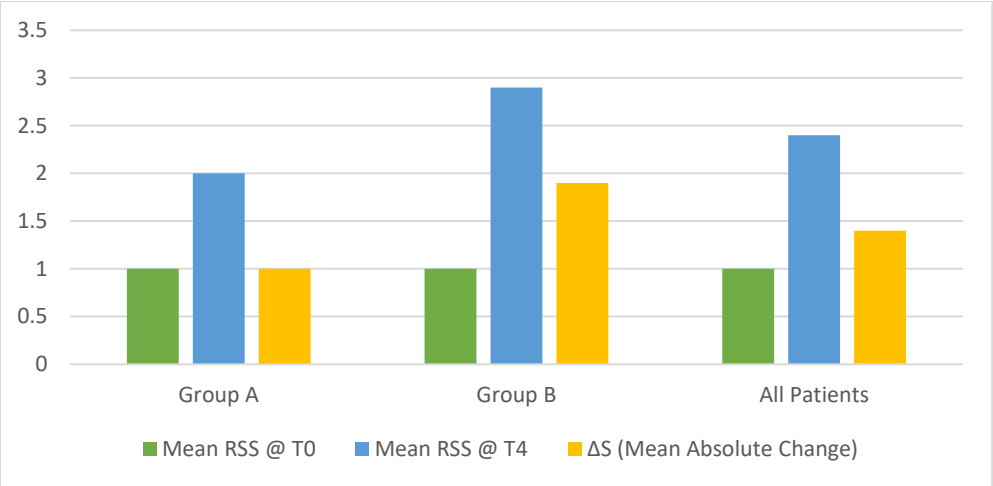


Figure 5: Mean Absolute Change in Sedation Score

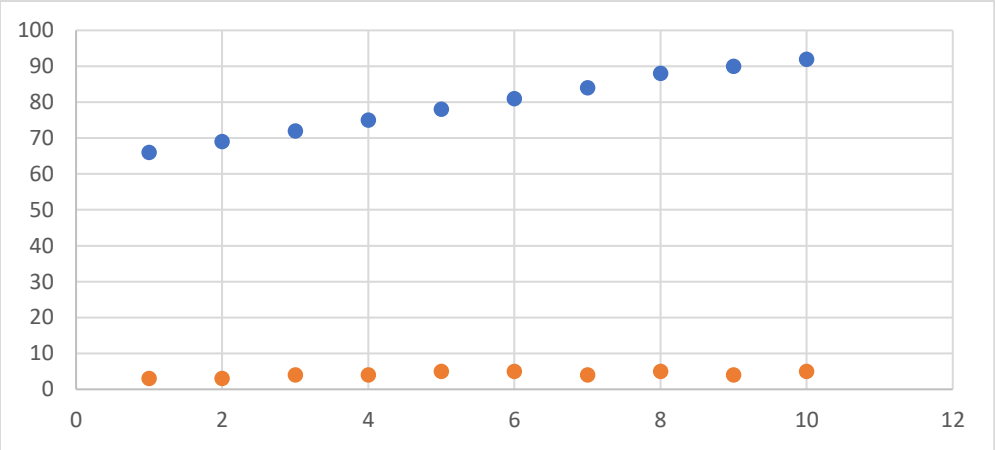


Figure 6: Correlation Between Age and Max Sedation Level

The scatter plot in Figure 6 looks to find a relationship between the patient's age and the maximum sedation score, S_{max}, achieved during the procedure. There is a discernable positive association between age and the severity of induced sedation in the patients; older patients tended to achieve higher sedation scores overall. For example, patients aged over 80 typically achieved RSS 4 or 5 scores, indicative of increased sensitivity to sedatives. The physiological impacts of aging may include factors like decreased clearance due to hepatic or renal effects which may lead to deeper sedation or longer periods of sedation. This association adds to the argument for using extended and additional titration of sedatives or adjusting or developing medical history or monitoring protocols in older patients to facilitate efficacy and safety in safe dental-based practices.

5 DISCUSSION

5.1 Consequences of Sedation Levels for Dental Treatment of Older Patients:

Sedation levels in older dental patients have direct implications for safety, cooperation and efficiency of the procedure. The right sedation level (usually an RSS score between 2 and 4) was critical to ensure the patient felt comfortable and actively responded to stimuli, if needed. Note that increased sedation (RSS 5 or greater) could lead to airway control issues, prolonged recovery, or destructive physiological responses, particularly in older patients who have lost metabolic clearance. Under-sedation (RSS 1 or 2), however, put patients at risk for anxiety, movement during procedures, or refusal of treatment altogether. The ability to keep sedation at acceptable, safe, and functioning levels would allow practitioners to complete tasks more efficiently and reduce cancellations or procedural complications, while ensuring a better overall experience for the patient—especially in patients with dental phobia or those who have had poor dental experiences in the past. Furthermore, appropriate levels of sedation can lead to shorter appointments, increased recovery time, and greatly diminish procedural tolerance, particularly in older patients.

5.2 Limitations of Utilising Ramsay Sedation Scale in Dental Context

Though widely adopted for determining sedation in medical contexts, the Ramsay Sedation Scale (RSS) presents limitations when used for similar purposes in the dental context and when assessing elderly patients. The RSS is primarily observational and subjective in nature, and therefore very dependent upon how the evaluator interprets the patient's level of sedation based on the patient's responses to stimuli. In the dental chair, with the patient's mouth open, partially reclined, and the patient undergoing active dental treatment, it is not always possible to interpret the patient's sedation level reliably using the RSS. For instance, a patient could seem unresponsive to commands (eg, "open" for suctioning; "cough" etc.) because their mouth was full of dental instruments, not because they were excessively sedated. Additionally, subtle changes in behaviour such as eye movement or muscle relaxation might not be readily noticeable in the busy clinical context. The challenges presented by the elderly patient population also need to be considered. For instance, the presence of potentially delayed, variable, or inconsistent responses to commands may be attributable to either cognitive or neurological decline associated with aging rather than sedation as assessed by the RSS. Furthermore, the RSS completely ignores physiological elements of monitoring such as oxygen saturations, or respiratory rate, which are particularly important in detecting early signs of respiratory depression. These aforementioned characteristics of the RSS suggest that the RSS needs to be used in conjunction with measures that do objectively monitor such as with the RSS, or alternatively, a scale that fits better in the dental context.

5.3 Suggestions for Future Research and Clinical Practice

Future research should be focused on validating sedation assessment instruments specifically for the dental practice setting, particularly among the geriatric population. There is also value in offering multimodal sedation monitoring that combines behavioral scales with physiologic parameters to improve accuracy and safety. The use of technology such as capnography, pulse oximetry, and real-time emotion detection through facial recognition could better diversify, and make the sedation assessment even more objective and responsive. The dosing and frequency of vital monitoring would need to consider type of sedation and age-related modifications, with respect to the geriatric patient's altered and delayed pharmacology. Training dental health professionals in geriatric pharmacodynamics, anatomy, and emergency preparedness as continuing education can be a step in the right direction. Furthermore, studies should be undertaken to determine cognitive or functional outcomes of use of repeated sedation of older adults over long periods of time. Finally, the introduction of a universal sedation checklist for dental procedures could assist dental health professionals in standardizing the best practices for improved sedation management across an entire population far removed from their usual environments. Ultimately, turning these suggestions into operational reality will contribute to safer, more effective, geriatric dental care, and provide a more personalized experience for older patients.

6 CONCLUSION

The results of this study demonstrate the essential need for accurate monitoring of sedation levels in elderly dental patients receiving oral sedation in this study. Being able to use the Ramsay Sedation Scale (RSS) helped facilitate the monitoring of sedation depths across different phase of dental procedures and showed that most patients were sedated within RSS 2 – 4 and were comfortable and confident for the procedures and the risk of over sedation (e.g. respiratory depression, extended recovery) during this stage of sedation protocol was minimized. Clearly, there were correlations between age and sedation depth based on patient factors. Thus, all patients need individualized sedation protocols in geriatric dental care. While the RSS did provide a useful framework for assessing sedation levels, the limitations of the RSS in a dental context highlights the requirement for better or complementary monitoring strategies that take into consideration behavioral aspects of patient sedation, as well as physiological measurements. Sedation monitoring should not be regarded as a "check list" exercise but should be regarded as an important patient safety measure, especially for frail elderly patients who may have an unpredictable response to sedatives. Improved sedation monitoring processes should enhance procedural outcomes, clinical complications, and patients' overall dental experience and comfort. Overall, incorporating tailored sedation plans into dental practice could greatly improve the safety and quality of geriatric dentistry.

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