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ORIGINAL ARTICLE

Child Stress and Behaviour During Restorative Treatment under Non-Pharmacological Techniques and Sedation: A Case Series

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ABSTRACT

Objective: To evaluate the behaviour and stress of children undergoing restorative treatment with and without sedation. **Material and Methods:** Participants were 14 healthy children aged between 2.5 and 6 years and with a history of dental behavioural management problems. In the dental treatment visit, the child was treated with non-pharmacological techniques, and in the second, moderate sedation was added. The child received the same procedure performed by a paediatric dentist in both visits: composite resin restoration using local anaesthesia and rubber dam isolation. In both visits, saliva was collected at the children's arrival at the dental clinic, during local anaesthesia and at the end of treatment. The visits were filmed for later analysis of behaviour according to the Ohio State University Behavioural Rating Scale. **Results:** About 78.5% of children improved their behaviour from the first to the second visit. The salivary cortisol curve of the first visit was maintained in the second visit for 21.4% of children but varied in the remaining participants. **Conclusion:** Most children presented better behaviour and less stress when sedation was added to non-pharmacological techniques during dental care.

Keywords: Dental Anxiety; Stress, Physiological; Dental Care for Children; Conscious Sedation; Midazolam.

Introduction

About 23% of children have dental anxiety [1] that might result in behaviour management problems (DBMP) during dental treatment [2]. Factors other than anxiety can cause DBMP, including young age, temperament, dental pain, shyness with strangers, and negative parental expectations about the child's behaviour [3-7]. Dental anxiety can be directly assessed through salivary cortisol assessment [8-13], which is an easy, non-invasive, safe, and painless method [14].

Several pharmacological and non-pharmacological techniques have been used for behaviour management in dental care [15-17]. Of the pharmacological techniques, dental sedation allows the dentist to perform treatment in a minimally traumatic manner and promotes the child's trust in the dentist [17]. Dental sedation is indicated for uncooperative or fearful/anxious children due to a lack of psychological, emotional or mental maturity, or a physical or medical disability. However, it is contraindicated in patients with medical/physical conditions or in cooperative patients [18]. The success rate of sedation can range from 53.9 to 75.0%, depending on the child's characteristics, the sedative regimen used, and the type of procedure performed [19,20]. The best behaviour management of potentially cooperative children is the combination of sedation and non-pharmacological methods, such as distractions, tell-show-do technique, and positive reinforcement [16].

It is known that dental procedures associate with an increase in the level of physiological stress in children, measured by salivary cortisol [21]. In potentially cooperative children, the level of stress seems to be greater than in cooperative children [22], and even simple procedures can increase cortisol levels [10]. A crossover clinical trial would be the most appropriate study design to investigate the effectiveness of different behaviour management methods in paediatric dentistry, applying the different methods in the same child and controlling for the subject factors that interfere with the outcomes. However, crossover studies can show a carryover effect from one visit to another [23-25]. Therefore, a case series could shed light on the effects of different behavioural management techniques on children's stress and behaviour and provide important information to clinical practice. This study aimed to describe the behaviour and measure stress levels of children undergoing restorative treatment without and with dental sedation.

Case Series

Fourteen children with a history of behaviour management problems were included in this case series (Table 1). This study is a secondary analysis of a randomised clinical trial (RCT) approved by the Research Ethics Board of the Federal University of Goiás (UFG) (protocol 36411214.1.0000.5083) and registered at ClinicalTrials.gov (NCT02447289). The RCT protocol [24] and primary outcome results [26] have been previously published. Interventions took place between May 2015 and October 2016 at the UFG dental sedation centre, the *Núcleo de Estudos em Sedação Odontológica* (NESO), which has adequate physical structure and trained staff for being in charge of the procedures and also for any complications that might occur. This case series was reported according to the PROCESS guidelines [27].

For this secondary analysis of that RCT [24,26], we selected only the children who had two sequential dental treatment visits, the first without sedation and the second with a sedative regimen following the trial protocol. One paediatric dentist performed similar procedures in both dental treatment visits: professional prophylaxis, topical and infiltrative anaesthesia, rubber dam isolation, and composite resin restoration of a cavity without pulp involvement. The sedatives children received in the second visit were per their original randomisation group [24,26]: oral midazolam, oral midazolam associated with ketamine, or intranasal midazolam associated with intranasal ketamine. The entire trial comprised 84 children (28 per group), but only

14 needed two dental treatment visits. The other 70 children had negative behaviour during the dental examination. They were booked straight to the dental sedation appointment, as they would not stand more invasive dental procedures without being sedated. Dental sedation procedures were video-recorded for a later detailed behaviour assessment.

Salivary cortisol takes 25 minutes after the stimulus to be secreted in saliva [28,29]. So, saliva samples were collected using Salivette® tubes at children's arrival, 25 minutes after local anaesthesia, and 25 minutes after the end of the procedure to reflect the exact time of the stimulus. The tubes were then centrifuged at 3000 rpm for 15 min (Sislab/Basic, São Paulo, SP, Brazil), the samples were stored in Eppendorf tubes, and frozen at -80° (Sanyo/Vip® Plus™, Wood Dale, Illinois, USA) until analysis. Cortisol was measured using an enzyme immunoassay kit (Salimetrics, State College, PA, USA). Samples were evaluated in duplicate using a microplate reader (Molecular Devices, Spectra Max 190, Sunnyvale, CA, USA) for absorbance at 450 nm. Cortisol levels were determined according to standard curves following the manufacturer's instructions. Detection limits ranged from 0.012 to 3000 µg/dL.

The behaviour analysis was performed by four research assistants after training and calibration, using the Ohio State University Behavioural Rating Scale (OSUBRS) [30] and the Observer XT software (Noldus Information Technology, Netherlands). The scale classifies behaviour according to the observation of movement, crying, and physical resistance: 1- no crying and no movements (quiet); 2- crying, no movement; 3- struggling movements without crying; 4- crying and struggling movement [30]. The intra- and inter-examiner agreement were acceptable (intra-class coefficients ≥ 0.8).

Exclusive non-pharmacological behavioural management techniques were used in the first visit, which lasted between 10 and 44 minutes. All children exhibited quiet behaviour for some time, then intense crying and movements led to their referral for sedation (Figure 1). Protective stabilisation was necessary in 85.7% of cases (n=12), and the dental procedure was aborted in 57.4% of cases (n=8) (Table 1). Fifty per cent of the children (n=7) had the highest cortisol levels at the administration of local anaesthesia (Figure 2).

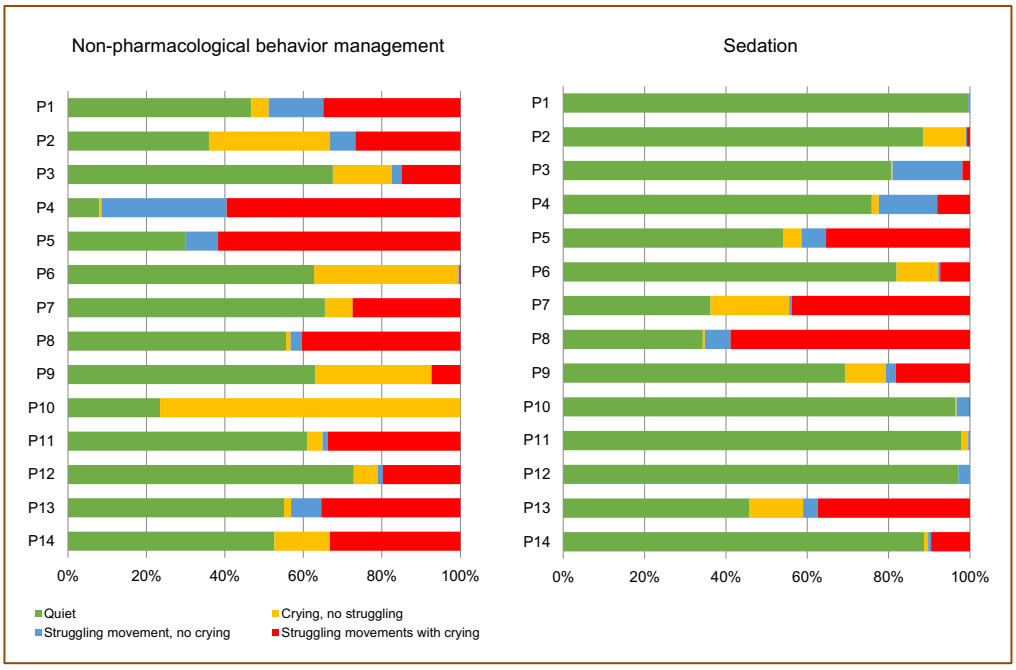

Figure 1. Frequencies of child behaviours during dental care with non-pharmacological behavioural management techniques (left) and with sedation added (right).

Moderate sedation was added to the non-pharmacological techniques in the second visit, following the American Academy of Pediatric Dentistry (AAPD) guidelines [18], due to the child's lack of cooperation in the previous visit. The adopted sedative regimens were planned in the RCT protocol [24]: midazolam (intranasal – 0.2mg/kg or oral –0.5 mg/kg, maximum 20 mg) and ketamine (4.0 mg/kg either by oral or intranasal group, maximum 100 mg) or midazolam alone (1.0 mg/kg, maximum 20 mg). The visits ranged between 8 and 40 minutes. The duration of quiet behaviour during the visit increased in 11 children, and a reduction in struggling behaviour was observed compared to the previous visit (Figure 1). Protective stabilisation was necessary in 64.2% of cases (n=9), and the visit was aborted in 14.2% of cases (n=2) (Table 1). Based on the salivary cortisol level, the most stressful moments corresponded to the arrival at the dental clinic and the local anaesthesia administration; 35.7% of the children had peak levels in each of those moments (n=5) (Figure 2).

Table 1. Characteristics of patients in the case series.

Case	Age (months)	Sex	Visit without Sedation		Visit with Sedation		
			Treatment Aborted	Protective Stabilisation	Sedative	Treatment Aborted	Protective Stabilisation
P1	44	Girl	No	Yes	KMIN	No	Yes
P2	30	Boy	No	Yes	MO	No	Yes
P3	37	Girl	No	Yes	MO	No	Yes
P4	43	Girl	Yes	Yes	KMIN	No	No
P5	43	Girl	Yes	Yes	MO	No	Yes
P6	45	Girl	Yes	Yes	KMIN	No	No
P7	49	Boy	Yes	Yes	MO	No	Yes
P8	42	Boy	Yes	Yes	MO	Yes	Yes
P9	52	Girl	No	Yes	MO	No	No
P10	36	Boy	No	No	KMO	No	No
P11	41	Girl	Yes	Yes	MO	No	Yes
P12	72	Boy	No	No	KMIN	No	No
P13	34	Girl	Yes	Yes	KMO	Yes	Yes
P14	52	Girl	Yes	Yes	KMO	No	Yes

KMIN: Intranasal Ketamine and Midazolam; KMO: Oral Ketamine and Midazolam; MO: Oral Midazolam.

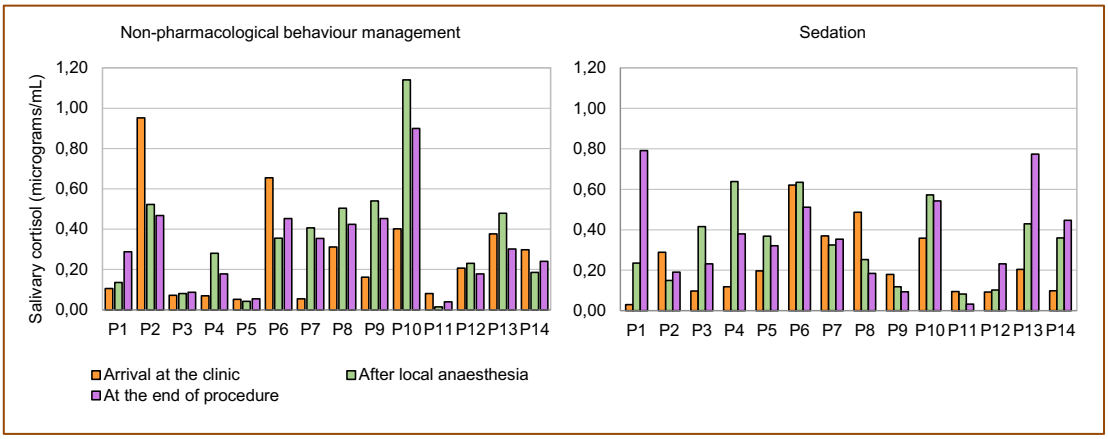

Figure 2. Salivary cortisol levels at arrival, local anaesthesia, and the end of the procedure, with non-pharmacological behavioural management (left) and sedation added (right).

There was an improvement in the frequency of quiet behaviour in the second visit compared with the first visit for 78.5% of the children (n=11) (Figure 3). In 21.4% of the patients (n=3), the salivary cortisol variation pattern was maintained in both visits (cases P1, P4 and P10), while in the other children, the pattern varied (Figure 2).

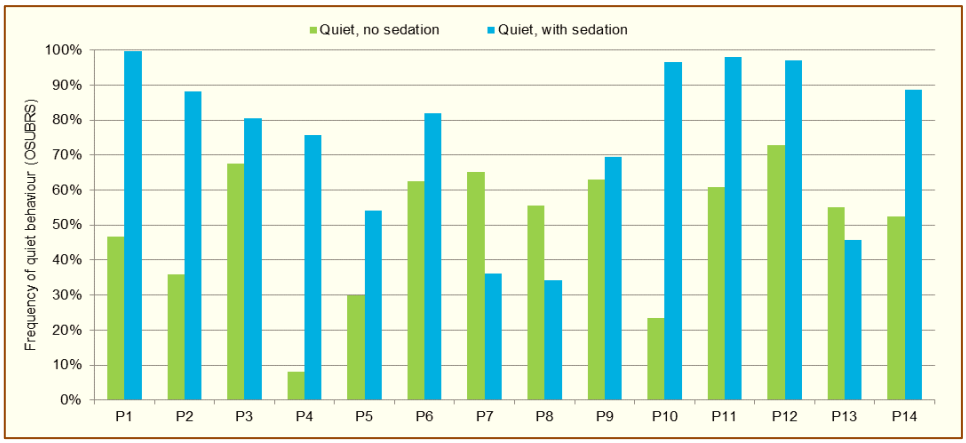

Figure 3. Frequency of time when the child was 'quiet' during the dental visit, according to the Ohio State University Behavioral Rating Scale (OSUBRS).

Intraoperative and postoperative adverse events were recorded during and after the dental sedation in a specific form, as recommended by the World SIVA International Sedation Task Force [31]. The day after the visit, a team member contacted the child's guardian to ask about the child's status and any adverse event after discharge. Of the 14 patients seen, 6 had no intra-or postoperative adverse events, 3 had postoperative vomiting, 2 had a prolonged recovery, 1 had a restless recovery, 1 had postoperative irritability, and 1 patient was not evaluated. Children's parents were aware of the adverse events that could occur, and, in case of any issue, they were advised to contact us by phone or go to the primary health centre in their neighborhood.

Discussion

This case series demonstrates that moderate sedation helps young children's behavioural management when adequately implemented and with the continuous use of non-pharmacological techniques. The benefit of sedation was clearly shown in case P10, a boy that showed an increase in quiet behaviour from 23 to 96% with sedation. Such behaviour improvement was observed in 78.5% of patients. However, it cannot be attributed exclusively to sedatives; factors like a stronger bond between children and the dental team, positive memories from the first visit, and non-pharmacological techniques might have favoured the positive result. In any case, this finding reinforces the carryover effect in children's behaviour from one visit to the next and undermines crossover RCTs in this topic [23,24].

Sedatives have increased the frequency of quiet behaviour during dental treatment [19]. However, sedation used in the present study was moderate, and other characteristics of the child, such as age [19,32,33] and temperament [5,34-36] may have influenced their behaviour during the visits. For example, some of the younger patients showed improvement (P2 and P3), while others had worsening (P13) of their behaviour in the visit with sedation. This finding highlights the limitation of moderate sedation for young children, who could be benefit from general anaesthesia instead of sedation, as deep sedation's risks are not desirable in an outpatient setting.

The use of protective stabilisation and the number of aborted procedures decreased when using sedation. However, most children (n=9) still needed protective stabilisation when under moderate sedation, especially for local anaesthesia application, as their consciousness was maintained [37]. According to the literature [4,5,9,17-20,23,26,30,34-36], the sedation of young children might need the addition of protective stabilisation to finish the procedure, as one cannot dismiss the patient with an unfinished restoration, for example. Two children (P8 and P13) had their treatment aborted in both visits, with more struggling behaviour with sedation; they would

probably benefit from sedation for minimally invasive procedures and general anaesthesia for more invasive ones [38].

A reduction in salivary cortisol level was observed during sedation in one time-point for 11 cases, two time-points for 5 cases, and three time-points for 2 cases. Lower levels of salivary cortisol in the second visit could partly be due to the lower dental anxiety from non-pharmacological behavioural management techniques used in the previous treatment and the sedative effect [9]. In this case series, 6 of the 7 children who received ketamine and midazolam had higher cortisol levels at least one time-point, possibly due to the increased release of cortisol by ketamine [39].

The indication of dental sedation is a complex task. We can see in Figure 3 that 9 of the 14 children showed quiet behavior in more than 50% of the session with basic behavioral management techniques. However, this behavior occurred at the beginning of the session, and as soon as the dental stimulus increased, the excessive cry and movement behavior increased, making the treatment unfeasible. In addition, the children already had a history of non-cooperation in previous consultations, allowing them to benefit from sedation for treatment. Therefore, we understand we attempted to properly manage these children's behaviour before recommending them for sedation. Still, we suspect children's cognitive, social and emotional development might not be enough to allow successful non-pharmacological techniques to be applied by certified pediatric dentists. Nevertheless, based on the literature [17-19] and our research and clinical experience, protective stabilisation and moderate sedation have precise indications for children's behaviour management and should not be banalised.

The British Society of Paediatric Dentistry (BSPD) [16] recommends that the term "non-cooperative" children be avoided, as it is inaccurate and does not consider that children might collaborate in the future. Our results from this case series support the BSPD guidance, showing the change in behaviour of young children over two visits of conventional restorative care with local anaesthesia and rubber dam isolation.

Conclusion

Most children with potentially cooperative behaviour in a first dental treatment visit benefit from the second visit under moderate sedation, showing improved behaviour and lower cortisol levels than in the first visit without sedation.

Authors' Contributions

MMM	https://orcid.org/0000-0001-7904-3713	Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data Curation, Writing - Original Draft, Writing - Review and Editing and Visualization.
AAA	https://orcid.org/0000-0003-1391-8235	Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing - Original Draft and Writing - Review and Editing.
LRC	https://orcid.org/0000-0001-7637-0049	Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review and Editing, Visualization, Supervision, Project Administration and Funding Acquisition.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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