THE COMPARISON OF TWO DOSES OF INTRANASAL MIDAZOLAM SEDATION IN A PAEDIATRIC DENTAL EMERGENCY CLINIC

DR. AHMED ELSHEIKH OMER MAHGOUB

A mini-thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Dental Science, MSc (Paed Dent) at the Faculty of Dentistry - University of the Western Cape

Supervisor: Dr. Fathima Peerbhay
Co-Supervisor: Prof. James Roelofse

Nov 2013
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KEYWORDS
Intranasal
Midazolam
Sedation
Comparison
Anxious
Paediatric
Children
Dental
Emergency
Clinic
ABSTRACT

The comparison of two doses of intranasal midazolam in a paediatric
dental emergency clinic

A.E.O.M MAHGOUB

Aim:

The aim of the study was to compare two doses of intranasal midazolam (INM) 0.3 mg/kg and 0.5 mg/kg in terms of effectiveness and recovery time.

Design:- This study was a Randomized Controlled Trial (RCT) and Triple blinded study.

Sample and methods A sample of one hundred and eighteen children aged from 4-6 years old were randomly assigned for Intranasal sedation (INS) to either the 0.3 mg/kg group or the 0.5 mg/kg group. Children were taken in fasting and non-fasting conditions. The children were monitored using a pulse-oximeter, the sedation was assessed using Wilson sedation scale and the anxiety and behaviour scales were rated by Venham’s scale throughout the treatment. The facial image Scale (FIS) was also used to assess anxiety and mood of children before and after treatment.

Results

The mean BMI of children was found to be from 14-16. Intranasal sedation with both 0.3 mg/kg and 0.5 mg/kg midazolam was completed in 100% of the children. The pulse rates were within normal limit but statistically lower in the 0.5 mg/kg group. Oxygen saturation was above 98% in all except for one child who desaturated to 90%. Thirty five percent found this route acceptable in this study; Nine percent had burning sensation from midazolam. The state anxiety between the two groups of 0.3 mg/kg and 0.5 mg/kg were insignificant using Venham’s scale. However, behaviour scores showed statistical significant results of p value (0.03) and (0.04) in the behaviour during LA and behaviour during extractions respectively. The facial
images scale (FIS) ratings chosen by the children before and after sedation was insignificant to the anxiety and behaviour ratings.

The FIS revealed that 66% chose a happy face at the end of treatment. Fifty percent of the children in the study chose the same image before and after sedation. There were no adverse events encountered during the procedure.

**Conclusion**

INS with midazolam using the 0.3 mg/kg or 0.5 mg/kg doses resulted in safe and effective sedation. The 0.5 mg/kg proved to be more effective than the 0.3 mg/kg in providing better behaviour and decreasing anxiety when compared with the 0.3 mg/kg dose. The 0.5 mg/kg dose was found to be safe and the recovery time was slightly more than the 0.3 mg/kg but the difference was not clinically significant.
Declaration

I declare that the comparison of two doses of intranasal midazolam sedation in a paediatric dental emergency clinic is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Ahmed Mahgoub

Signature................... November 2013
**Acknowledgements**

I am deeply indebted to my Paediatric Dentistry Department for I have learned so much, and so well, during my MSc Program and without the support, help and assistance that I have received, this research would not have been possible. Deep gratitude is also extended to my supervisors Dr Nadia Mohamed and Dr Soraya Harnekar for their endless effort and guidance.

Special thanks to my supervisor Dr Fathima Peerbhay, for being a great teacher and mentor, for continuously encouraging and motivating me to perform better, her devotion and passion is a blessing to all her students. I am grateful for her continuous support and for providing me with all the practical equipment necessary to complete this research.

Thank you to my co-supervisor Prof James Roelofse for his expertise and guidance.

I extend my sincere appreciation to all the staff at the Paediatric Emergency clinic for their invaluable support, cooperation and patience during the duration of this study.

I would also like to thank all my colleagues for their encouragement and support and especially Dr. Asim Satti.

Last but not least, thanks to the Faculty of Dentistry for their approval to carry out this research and for providing me with the required facilities and support.

I could not have done this without you all. Thank you.
Dedication

To the soul of my mother who has taught to me the most important lesson in life ... that of having faith and that by God’s Grace we shall not stray.

Also, I dedicate this humble effort to my father and my sisters Lena, Linda and Aala for their continuous support and encouragement.
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<td>Dental General Anaesthesia</td>
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<td>AAPD</td>
<td>American Academy of Pediatric Dentistry</td>
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<td>ECC</td>
<td>Early Childhood Caries</td>
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<td>CMAS</td>
<td>Children Manifest Anxiety Scale</td>
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<td>STAI</td>
<td>State-trait anxiety inventory</td>
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<td>SAJAA</td>
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<td>Facial Image Scale</td>
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<td>LA</td>
<td>Local Anaesthetic</td>
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Chapter (1)

Introduction
Background to the problem

The paediatric emergency dental clinic at Tygerberg Oral Health Centre, in the Western Cape provides dental treatment for children who present with acute pain and sepsis and they are primarily managed with dental extractions. These children tend to be anxious and apprehensive and would therefore benefit from any form of sedation, as extractions tend to be an unpleasant procedure. The ideal sedation route provided to children for emergency extractions at Tygerberg Oral Health Centre is intravenous sedation (IVS). There is a scarcity of anaesthetists and medical practitioners trained in sedation, and therefore IVS is a limited treatment option in the South African public service. The large number of children that require this resource exacerbates the apparent lack of IVS resources. The implication is that the majority of children who receive extractions as emergency treatment do not have access to any form of sedation. Hence, the possibility that these children will become traumatised and not co-operate with any future dental treatment, is relatively high. This poor co-operation contributes to the possibility that they will subsequently require general anaesthesia for any future dental treatment, and this increases the burden on the general anaesthesia resources which is also limited and much more expensive than sedation. There is therefore a need for a solution that allows the operator to perform a sedation technique that is safe and effective without the mandatory presence of an anaesthetist/or trained sedationist.
Chapter (2)

Literature Review
One of the greatest challenges facing dentists in paediatric emergency dental clinics is the management of anxious children who require emergency dental extractions.

The delivery of safe and effective sedation along with anxiolysis (decrease of anxiety) is an important component under the umbrella of behaviour management in children. Anxious children in the pre-cooperative level are usually traumatised by conventional methods of dental extractions, leading to future anxiety and complicating subsequent dental visits that eventually lead to the need for treatment under dental general anaesthesia (DGA).

Dental general anaesthesia (DGA) is preferred in cases where very anxious children need numerous extractions and extensive treatment. Despite the effective results morbidity is still a risk. It may also be associated with a few challenges; such as increased health care costs, time consumption, specialised equipment and specialist health professionals needed especially in an emergency facility setting.

On the other hand, the safety margin of sedation may be a more practical and efficient option for the treatment of pre-cooperative children with mild to moderate anxiety in an emergency facility. Interestingly, a survey from an emergency dental clinic in the United Kingdom, found that 68% of the patients claimed nervousness and 43% cited fear and nervousness, as the reason for not seeking dental treatment. The authors concluded that offering dental sedation would be a viable option to improve care and alleviate fear (Ryding and Murphy, 2007).

Intranasal sedation (INS) with midazolam has been recommended as a valuable adjunct to behaviour management to treat anxious children in an emergency setting (Johnson et al, 2010). INS has shown favourable outcomes in terms of the level of sedation and safety due to its faster and more acceptable route of administration (Johnson et al, 2010).
The American Academy of Pediatric Dentistry’s (AAPD) policy on early childhood caries (ECC) treatment also recommends sedation. To achieve safe and effective treatment, the policy by the AAPD states that a dentist must assess a child’s developmental level in addition to the extent of disease process to determine the need for pharmacological behaviour. As such, the dentist needs to choose between sedation and general anaesthesia (AAPD, 2011).

2.1 Early Childhood Caries

Early childhood caries (ECC) is defined as “at least one carious lesion affecting the maxillary anterior teeth in preschool-aged children”. It is also considered to be a virulent form of dental caries leading to widespread destruction of primary teeth (Gussy, 2006).

In spite of the recent advances our current knowledge and understanding of dental caries, ECC still has an extremely high prevalence with one in three children in South Africa currently being affected (Postama, 2008). More than 80% of children in South Africa in the 4-5 years old group with dental caries in are not treated (Van Wyk, 2004).

A course of action needs to be instituted by providing prevention programs and effective treatment plans (Van Wyk, 2004). The majority of children affected by ECC are at the pre-school stages and are also considered to be at the pre-cooperative level (Alwin et al, 1991). Unfortunately, children in this age group are most likely to exhibit dental fear and anxiety. This is considered as the main reason that leads to poor co-operation thus interfering in the development of rapport between child and dentist (Alwin et al, 1991).
The dilemma of limited and delayed treatment of ECC due to dental fear and anxiety motivated researchers to assess dental anxiety in children (Alwin et al, 1991). Dental fear was defined as “a dread of something specific” and anxiety is “the fear of the unknown”.

The results of the study by Alwin et al (1991) to assess dental anxiety in children using Venham’s scale and the Children Manifest Anxiety Scale (CMAS) have shown no difference in general anxiety between anxious children and the control group. This study did however find significant differences between anxiety and cooperation ratings made by dentist and parents (Alwin et al, 1991).

2.2 Anxiety

Dental anxiety can persist into adulthood leading to the avoidance of dental care and subsequent deterioration of oral health. Therefore the assessment and management of child anxiety and implementation of new and different techniques is crucial (Gussy, 2006).

The measurement of anxiety does not use given equations to formulate the level of anxiety nor does it reveal what is masked behind it. They have been derived from theories such as the cognitive theory, which postulates that the central feature of anxiety disorder is the preoccupation with danger and responses to endangering situations. Asking how the children feel in a certain situation assesses the cognitive measure. This can be in form of a questionnaire or by using rating scales (Alwin et al, 1991).
In the assessment of dental anxiety in children, it has been stated that researchers favoured the assessment of state and trait anxiety (Alwin et al, 1991). “Trait anxiety” is a relatively stable level of anxiety proneness that varies between individuals and state anxiety is a transitory feeling of anxiety experienced in specific situations” (Alwin et al, 1991). Both these terms are measured by the State-trait anxiety inventory (STAI)” (Alwin et al, 1991).

Facial image scale (FIS) is another instrument that was proven in its validity when compared to the Venham picture test. The FIS has been favoured in satisfying most of the criteria’s needed to determine anxiety in young children.

FIS was chosen for the reasons of its validity, easy to understand for young children and practical in the dental setting (Buchanin and Niven, 2002).

**2.3 Temperament**

Temperament is another factor that is found to be associated with dental fear and is defined as “an emotional quality, which varies individually but is relatively stable over time” (Anrup, 2002). Temperament does contribute to the behaviour of children, but unpleasant dental experiences probably contribute more to the development of dental fear (Anrup, 2002).

In a study sample in Sweden of 124 children; shyness and abnormal feelings scored higher among children with dental fear in contrast to those without such fear (Anrup, 2002). The low socio-economic status also does weigh on the orientation to dentistry and leads to dental fear increasing exponentially (Anrup, 2002).
2.4 Intervention Options

The Non-Pharmacological Approach

Non-pharmacological behaviour management is a comprehensive methodology, meant to build a relationship between the patient and the dental professional, which is considered essential to achieve a positive dental attitude and experience (Anrup, 2002). Some of the techniques of behaviour management are the “tell, show, do,” method, modelling and desensitisation (Anrup, 2002). The application of these non-pharmacological behaviour management techniques to manage an anxious child can be very time consuming and frequently extensive dental caries in young children necessitates treatment under dental general anaesthesia (Anrup, 2002).

The pharmacological approach is by means of:

1. Dental general anaesthesia (DGA) is a drug-induced loss of consciousness. The ability to maintain independent respiratory function is impaired (SAJA, 2010). Patients require assistance in maintaining a patent airway, and positive pressure ventilation may be required because of depressed spontaneous ventilation or drug-induced depression of neuromuscular function. The cardiovascular function may also be impaired (SAJA, 2010).

Dental general anaesthesia can be used for patients who fit the physical status classification but are associated with a risk of mortality thus considered an invasive option, when compared to the non-pharmacological approach or sedation. Recent clinical guidelines from the British Society of Paediatric Dentistry state that the use of DGA is indicated when non-pharmacological techniques is not adequate to manage the child in the dental chair.
2. **Conscious sedation** is a medically controlled state of depressed consciousness that allows protective reflexes to be maintained in cardiovascular stability, patent airway and permits appropriate response by the patient to physical stimulation or verbal command (Krauss and Green, 2000; Nikhil, 2009).

Conscious sedation is indicated in a child that has mild to moderate anxiety and willing to cooperate with treatment. Other indications are children who suffer from movement disability and lack psychological and emotional maturity to enable an unpleasant and complicated procedure to be carried out without distress to the patient (Nikhil, 2009).

The goals of conscious sedation are as follows: - (SAJAA, 2010)

1. To provide the most comfortable, efficient and high quality dental service.
2. To control inappropriate behaviour.
3. To produce a positive dental attitude.
4. To allow for safe and quick recovery of patients.

Conscious sedation is the technique that “utilizes drugs to induce a cooperative state in an anxious child” (SAJAA, 2010). Paediatric dentists should be aware that sedation represents a continuum and should consider guidelines of the use of sedative agents and carrying out the treatment (SAJAA, 2010).

Charles J Cole stated in the guidelines for the safe use of procedural sedation and analgesia for diagnostic and therapeutic procedures in children that safe sedation of children requires a protective net composed of skilled personal and reliable monitoring equipment (SAJAA, 2010). The appropriate selection of patients, drugs usage, age and size plus appropriate airway management equipment and drugs to sustain life is also important. Seizures, respiratory arrests and death in a variety of practice settings have occurred when any of these are deficient” (SAJAA, 2010).
The classification of patient selection guidelines set by the South African Journal of Anaesthesia and Anaesthesiology and the AAPD regarding patient’s physical health status for Sedation:

<table>
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<th>Description</th>
<th>Examples Unremarkable medical history</th>
<th>Suitability</th>
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<tr>
<td>1</td>
<td>Normal healthy child</td>
<td>Unremarkable medical history</td>
<td>Excellent</td>
</tr>
<tr>
<td>2</td>
<td>Child with mild systemic disease - no functional disability</td>
<td>Mild asthma, controlled seizures, anaemia, controlled diabetes</td>
<td>Generally good</td>
</tr>
<tr>
<td>3</td>
<td>Child with severe systemic disease - definite functional limitation</td>
<td>Moderate-to-severe asthma, poorly controlled diabetes/seizures, moderate obesity, pneumonia, moderate obesity, pneumonia</td>
<td>Intermediate to poor; consider benefits v risks</td>
</tr>
<tr>
<td>4</td>
<td>Child with severe systemic disease - constant threat to life</td>
<td>Severe broncho-pulmonary dysplasia, advanced degrees of pulmonary, cardiac, renal, hepatic or endocrine insufficiency, sepsis</td>
<td>Poor: benefits rarely outweigh risks</td>
</tr>
<tr>
<td>5</td>
<td>Child moribund - not expected to survive without op</td>
<td>Septic shock, severe trauma, severe trauma without hope</td>
<td>Extremely poor</td>
</tr>
</tbody>
</table>

Table 1 adapted from SAJAA (2010)

The types of conscious sedation used in dentistry are classified according to the route of administration i.e. oral, inhalation, intravenous and intranasal sedation.

**Oral Sedation**

When taken orally a sedative drug such as midazolam is rapidly absorbed in the gastrointestinal tract and reaches its peak effects in about 30 minutes; with a half-life of about 1.75 hours. It has been proven to be very effective in doses between 0.5 to 0.75 mg/kg (Al-zahrani et al, 2009).

Oral sedation is usually the most popular route of sedation due to the following advantages, firstly it is a non-invasive procedure as children fear injections, secondly, there is no mask involved as in the inhalation route where children become very uncooperative and thirdly, it has good patient acceptability (Lee-kim et al, 2004).

The disadvantages would be the long onset duration and dose determination. The risk is over sedation and need for intravenous cannulation for administration of reversal antagonist drug (flumazenil) (Adamji et al, 2011).
Inhalation Sedation

Inhalation sedation with nitrous oxide and oxygen is also a popular technique for paediatric dental sedation. It involves the titration of nitrous oxide and oxygen using a machine, which delivers the gas mixture to the patient via a nasal hood. The titration of nitrous oxide is critical, and therefore the nitrous oxide concentration should range from 20-40% (Adamji et al, 2011).

Inhalation sedation is contraindicated in patients with moderate/severe learning disability due to the inability to tolerate the nasal mask and cooperate with nasal breathing, and patients’ with chronic obstructive pulmonary disease (Adamji et al, 2011).

Intravenous Sedation

Intravenous sedation (IV) using combination of drugs is less predictable in young children and may lead to longer recovery periods because of over sedation (Mikhael et al, 2007).

Collado (2013) conducted a clinical trial comparing the efficacy and tolerance of midazolam administration between patients with intellectual disabilities and patients with dental anxiety. It was concluded that intravenous administration of midazolam is an effective and well-tolerated procedure.
Intranasal Sedation (INS)

Nowadays as mentioned in the study, INS with midazolam is also being developed and provided in emergency boxes for the treatment of status epileptics in a form of a spray nozzle and nasal adapter (Gilchrist et al, 2007).

Intranasal sedation (INS) is considered to be an easy and painless route of administration probably due to better compliance in children (Mazaheri et al, 2007).

This is highlighted when compared to challenges faced with placement of cannulas for IV sedation and appropriate mask positioning for inhalation sedation (Mazaheri et al, 2007).

The use of intranasal sedation (INS) according to SAJAA (2010) guidelines is not recommended due to the burning sensation and bitter taste experienced by the children during INS administration. However, the use of INS enables rapid onset sedation and provides the shortest recovery period than any other route. This is essential in an emergency setting for dental extractions. This could be a viable route of sedation for emergency dental extractions if the burning sensation and bitter taste can be resolved or managed. Furthermore, the need for sedation is on the increase and there is a scarcity of anaesthetists to work in the public health service. Sedation can be administered through the different routes other than the IV route which is considered “advanced” sedation and is restricted to skilled sedationists (Roelofse, 2011). Therefore, it was suggested that operator-sedationists such as dentists and healthcare professionals can administer single drugs for sedation via all other routes except IV (Roelofse, 2011) providing they have the appropriate training in basic life support (BLS) and paediatric advanced life support (PALS) (Chiang, 2011). This ensures minimal sedation which renders a wide margin of safety (SAJAA, 2010), and hence to deliver optimal treatment to the large number of anxious children in a paediatric emergency dental setting.
Also, intranasal midazolam is gaining popularity as a conscious sedation technique in the management of patients who cannot cooperate with cannulation (Adamji et al, 2011). It is delivered via a Mucosal Atomising Device (MAD) and is rapidly absorbed through the nasal mucosa into the systemic circulation (Adamji et al, 2011).

The intranasal route has the potential advantage of rapid absorption, bypassing the first portal pass metabolism therefore a much faster onset than the other routes administered (Lee-Kim et al, 2004). It is also three times faster than the oral route and risk of child spitting the medication is highly unlikely in this route (Lee-Kim et al, 2004). The intranasal (IN) sedation route is also used by 75% of anaesthetists in the United States as a premedication prior to general anaesthesia (Mazaheri et al, 2007). It therefore deserves to be considered as a possible option provided the burning sensation and bitter taste can be eliminated.

Oral sedation and inhalation sedation are the most commonly used in dentistry due to fear of injection in children. However, the oral route has the disadvantage of a long onset time and the compliance needed by parents to starve the child prior to the procedure.

Midazolam is the drug of preference in dentistry due to its remarkable advantages when compared to diazepam and other drugs. It is a benzodiazepine that has high water solubility resulting in less pain experienced during administration (Wildschut et al, 2011). The amnesic effect of midazolam is better than diazepam and its efficacy and safety have been extensively studied in both adults and children (Wildschut et al, 2011).

Midazolam is also effective for sedation as a single drug or in combination with an opioid. Adequate sedation for procedures in the emergency room is achieved in over 90% of all procedures when midazolam is used as a single drug. Moreover, it is both cost effective and has high safety profile when administered appropriately with adequate monitoring and experienced personnel (Wildschut et al, 2011).
The behavioural outcome was the focus of a systematic review conducted to evaluate the efficacy of midazolam as a premedication. A total of 30 out of 171 randomized controlled trials (midazolam vs. placebo) were identified. The authors concluded that “premedication with midazolam 0.5 mg/kg administered 20–30 min preoperatively, is effective in reducing both separation and induction anxiety in children (grade A recommendation), with minimal effect on recovery times” (Wildschut et al, 2011).

A study by Lee-Kim and colleagues compared between intranasal and oral sedation in both groups to assess time of onset and maximum working time, efficacy and safety for patient requiring treatment. (Lee-Kim et al, 2004).

The study concluded that intranasal sedation using midazolam as the active drug was three times faster than the oral administration of midazolam. Although, the overall behaviour of patients was similar in both groups, more movement and less sleep were seen with the IN group at the end of the treatment (Lee-Kim et al, 2004).

Another study to assess the use of intranasal midazolam by Gilchrist et al (2007) was conducted for the purpose of doing dental extractions or simple surgical procedures for a sample of twenty children aged between 2-9 years of age. They were given a dose of 0.25 mg/kg with successful results including high oxygen saturations pre and post operatively. All patients were alert and awake and responsive throughout the treatment (Gilchrist et al, 2007). The mean time for the onset of the treatment was calculated to be 13 min. (treatment duration ranged from 5 to 20 min with the average of 17 min). Patients were discharged after a mean average of 46 min (Gilchrist et al, 2007).
Chiaretti \textit{et al} (2011) evaluated the effectiveness of IN midazolam and noted high levels of satisfaction by doctors and parents in this study. Positive remarks were made due to its ease of administration in addition to its desired level of sedation and quick recovery. Lidocaine spray was added in a concentration of 0.5 mg/kg via mucosal atomiser device to avoid any nasal discomfort or burning sensation caused by the intranasal midazolam.

It concluded that the presence of inhalation sedation and intravenous sedation is a useful adjunct to treatment but needs to have the required skills, competency and proper setting for safe and useful application (Woolley \textit{et al}, 2009).

The combination of inhalation sedation (nitrous oxide) with 0.6 mg/kg oral midazolam in comparison to oral midazolam only, has shown similar results. It was concluded that the combination of inhalation sedation and oral midazolam produced less movement and more comfort was to both the children and operators (Al-Zahrani \textit{et al}, 2009).

In a double blind random control trial Rakaf \textit{et al} (2001) assessed the effectiveness of intranasal midazolam in three different concentrations; group A (0.3 mg/kg), B (0.4 mg/kg) and C (0.5 mg/kg). The results showed a longer duration of action (60 min) in group C whereas group A and B ranged between (25-40 min).

The results achieved were 79\%, 96\%, 100\% effectiveness of sedation to groups A, B and C respectively. The dosage of 0.5 mg/kg was shown to be the most effective and safe in prolonging duration of sedation to complete the desired treatment (Rakaf \textit{et al}, 2001).
All doses administered showed statistically significant results regarding the general behaviour of child to accept treatment (P<0.05) (Rakaf et al, 2001). The study has also shown an important finding that further favours this route since there was no difference in terms of fasting or non-fasting child where child is obliged to starve before dental session for 4-6hrs (Rakaf et al, 2001).

The acceptability of the oral route in children is higher when compared with the other routes due to fear of injection (Lee-Kim et al, 2004). However, the intranasal route could still be of greater use in an emergency setting due to its faster onset and shorter duration of action (Lee-Kim et al, 2004).

2.5 Conclusion

The effective delivery of sedation and analgesia reduces children’s fear in a threatening environment and reduces their anxiety from an unpleasant procedure such as dental extraction. According to the literature, the administration of intranasal midazolam with doses of 0.3 mg/kg, 0.4 mg/kg and 0.5 mg/kg produced favorable results in terms of effectiveness, safety margin and recovery and would be beneficial in an emergency clinic, were time is of essence (Rakaf et al, 2001; Chiaretti et al, 2011; Gilchrist et al, 2007; Lee-Kim et al, 2004; Wildchut et al, 2011).
Chapter (3)

Research design & Methodology
3.1 Aim of the Study

The aim of the study was to compare two doses of intranasal midazolam (INM) 0.3 mg/kg and 0.5 mg/kg in terms of safety, effectiveness and recovery time.

3.2 Objectives

The objectives of the study was to:-

(A) Assess the effectiveness of 0.3 mg/kg INM and 0.5 mg/kg INM in a paediatric emergency dental clinic.

(B) Compare the recovery time of 0.3 mg/kg INM and 0.5 mg/kg INM.

(C) To show that INM can be safely used to treat anxiety in children.

3.3 Study Design

This study was a Randomized Controlled Trial (RCT), Triple blinded study:

1. Operator one, 2. Operator two, 3. Two Raters

- Operator 1 was the nurse who administered the intranasal sedation.
- Operator 2 was the dentist who performed the dental procedure.
- Two dentists were the raters who assessed the anxiety of the children by using the Venham’s anxiety scale, Facial image scale and Wilson scale for sedation.

3.4 Methodology

Pilot Study

A pilot study was conducted with 10 patients in order to evaluate:-

- The feasibility of the study
- Any adverse events
- The statistical variability in order to predict an appropriate sample size
- The study design
- The inter-rater reliability
3.5 Sample Size

A sample of one hundred and eighteen physical status classification (ASA) class I children aged from 3-6 years old were included from the patients that attended the paediatric dentistry emergency clinic at the Tygerberg Oral Health Centre, University of Western Cape, South Africa.

All the patients attending who met the inclusion criteria were included in the study. The patients were randomly assigned into two equal groups:-

1. Group A was administered 0.5 mg/kg intranasal midazolam (INM)
2. Group B was administered 0.3 mg/kg INM.

The randomisation process was conducted by placing an equal number of papers with A or B written on them. These pieces of paper were folded and then placed in a box where patients chose one folded piece of paper that they handed to the nurse who recorded the doses to be given.

The Inclusion Criteria

1. Children aged from 3-6 years old.
2. Patients who were medically fit (ASA I) with no sign and symptoms of any systemic disease or with a well-controlled systemic disease.
3. Children who attended the dental clinic only for emergency extractions of primary teeth.
4. Children who were mild to moderately anxious.
5. Children with not more than four extractions.
6. Children with no airway abnormalities or known syndromes.
7. Children who were not allergic to midazolam.
The Exclusion Criteria

1. Age less than four years or more than six years of age.
2. Children that need more than four teeth for extraction.
3. Pulmonary, cardiovascular, gastrointestinal or neurological problems, or significant anaemia.
4. Children with congenital syndromes or major congenital anomalies.
5. Obesity (> 95th percentile body mass index (BMI) for age).
6. Children who had nasal polyps or nasal congestion.
7. Children with any adverse drug allergies.

3.6 Data Analysis

The data was collected from the record sheets and then entered into Microsoft EXCEL.

The data was then analysed with the R program to compare the efficacy and average recovery time between the two groups.

3.7 Drug and Dosage

• First, 5 mg/ml lignocaine of 0.2 mg/kg concentration was squirited into each nostril with an insulin syringe using the MAD device.
• The lignocaine was allowed to penetrate the mucosa for 3-4 min to allow for the nasal mucosa to become anaesthetised.
• The MAD device was also used to spray equal amounts of the chosen dose of midazolam into each nostril.
3.8 Ethical Consideration

The literature has stated that midazolam is an effective drug for sedation as a single drug or in combination with an opioid. As a single drug, adequate sedation for procedures in the emergency room is achieved in over 90% of all procedures. Midazolam has been shown to be safe with no serious side effects reported and is cost effective (Wildschut et al, 2011; Gilchrist et al, 2007; Rakaf et al, 2001; SASA, 2010).

Permission was requested from the:-

- Clinical Dean at the Faculty of Dentistry at the Tygerberg Oral Health Centre to conduct the study in the paediatric emergency dental clinic. (Appendix J).
- Faculty Research Committee of the University of the Western Cape.
- Research Senate Committee of the University of the Western Cape.

Parents were given written information sheets (Appendix D) so that they understood the nature of this study. Prior to the appointment a written consent was obtained after the child was assessed for the procedure requirements. Patients were encouraged to ask questions, if anything was not clear. Parents were also informed that data to be collected would be treated as strictly confidential, and no individually identifiable information would be published. Parents were also given the free will and right to decline the procedure at any time and admit their child for emergency extraction without sedation.

3.9 Conflict of Interest

The researcher declared no interest with manufacturers and suppliers, and had no intentions of advertising and had no conflict of interest, with a specific party or organisation.
### Statistical Analysis

The T-test, Chi Square and the Fisher exact test were used to compare mean values between variables of groups 0.3 mg/kg (group A) and 0.5 mg/kg (group B) using the R software and illustrated by tables, graphs and charts.

### Results

The inter-rater reliability between the two raters revealed the proportion of agreement to be 70%. The gender in relation to anxiety and behaviour proved not to be statistically significant.

The correlation of age with the facial image chosen before treatment was not statistically significant (p=0.777).

### Body mass index (BMI) of children in both dose groups

The majority of the children presented with a BMI value of 14-16 (figure 1). There was no statistical significance in the BMI value between the 0.3 mg/kg (A group) and 0.5 mg/kg (B group) (p=0.131) (figure 1).

**Figure 1  The BMI of children**

![BMI of both groups](image)
The number of extractions in relation to the 0.3 and 0.5 group

The number of extractions in relation to groups A and B groups was not statistically significant as most of the p-values were greater than 0.05. The few cases where the Chi-squared p-value was less than or equal to 0.05, the Fisher exact test was used.

Pulse Rate (PR)

The baseline pulse rate (PR) revealed mean values of 103.5 in group A (0.3 mg/kg) and 100.3 in group B (0.5 mg/kg). The baseline PR in the 0.3 mg/kg and 0.5 mg/kg group was not statistically significant (p=0.2).

The final PR revealed mean values of 115 in group A and 108 in group B with p = 0.029 making the final PR statistically significant (figure 2).

Figure 2: - The pulse rate of both dose groups

![Pulse Rate Graph](image)
**Oxygen saturations**

The mean oxygen saturations at baseline were statistically significant (p=0.004) with a value of 99.33 in group A (0.3 mg/kg) and 98.627 in group B (Figure 3).

The final oxygen saturation yielded mean values of 98.53 in group A and 98.69 in group B with a p value of 0.5 making the final oxygen saturation rate statistically insignificant. Only one child had a lower oxygen saturation of 90% in the recovery stage, which was clinically significant (Figure 3).

**Figure 3:** Oxygen Saturations of both dose groups

![Graph showing oxygen saturations](image)

**Sedation Effectiveness**

The Wilson sedation scale which measures the effectiveness of sedation, revealed 100% effectiveness in both groups A and B. The majority of children (97%) displayed a sedation scale rating of two (patient drowsy) and only four children (3%) displayed a sedation scale rating of three (patients eyes closed but rousable to command).
Table 2 Venham Anxiety scale

<table>
<thead>
<tr>
<th>Scales</th>
<th>Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale 0</td>
<td>Relaxed and smiling</td>
</tr>
<tr>
<td>Scale 1</td>
<td>Uneasy and concerned</td>
</tr>
<tr>
<td>Scale 2</td>
<td>Scared</td>
</tr>
<tr>
<td>Scale 3</td>
<td>Crying</td>
</tr>
<tr>
<td>Scale 4</td>
<td>General crying not related to treatment</td>
</tr>
<tr>
<td>Scale 5</td>
<td>Out of proportion to threat</td>
</tr>
</tbody>
</table>

INS Acceptability

Figure 4: The anxiety of the children during Intranasal (IN) administration
Table 3: Venham behaviour Scale

<table>
<thead>
<tr>
<th>Scales</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale 0</td>
<td>Total cooperation</td>
</tr>
<tr>
<td>Scale 1</td>
<td>Mild, soft verbal protest or (quiet) crying</td>
</tr>
<tr>
<td>Scale 2</td>
<td>Protest more prominent. Both crying and hand signals.</td>
</tr>
<tr>
<td>Scale 3</td>
<td>Protest presents real problem to dentist</td>
</tr>
<tr>
<td>Scale 4</td>
<td>Protest disrupts procedure</td>
</tr>
<tr>
<td>Scale 5</td>
<td>General protest, no compliance or cooperation</td>
</tr>
</tbody>
</table>
Table 4:- The Anxiety scores at all stages of treatment of groups A and B

Table 4 provides a detailed indication of the anxiety displayed by the children at the different stages of treatment.

<table>
<thead>
<tr>
<th>Scales</th>
<th>(0 scales)</th>
<th>(1 scales)</th>
<th>(2 scales)</th>
<th>(3 scales)</th>
<th>(4 scales)</th>
<th>(5 scales)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before INS</td>
<td>86 %</td>
<td>9 %</td>
<td>5 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
</tr>
<tr>
<td>During INS</td>
<td>35 %</td>
<td>24 %</td>
<td>31 %</td>
<td>8 %</td>
<td>2 %</td>
<td>0 %</td>
</tr>
<tr>
<td>Before LA</td>
<td>85 %</td>
<td>8 %</td>
<td>7 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
</tr>
<tr>
<td>During LA</td>
<td>23 %</td>
<td>15 %</td>
<td>55 %</td>
<td>4 %</td>
<td>3 %</td>
<td>0 %</td>
</tr>
<tr>
<td>Before Extraction</td>
<td>81 %</td>
<td>9 %</td>
<td>8 %</td>
<td>2 %</td>
<td>0 %</td>
<td>0 %</td>
</tr>
<tr>
<td>During Extraction</td>
<td>35 %</td>
<td>20 %</td>
<td>31 %</td>
<td>12 %</td>
<td>2 %</td>
<td>0 %</td>
</tr>
</tbody>
</table>

The anxiety scales in relation to dose

The anxiety scales did not show any statistical significance during all the stages of treatment between groups A and B (p>0.05) (Figures 5-10).
The different anxiety scales during stages of treatment

Figure 5: Anxiety before IN sedation (INS)

Before INS

Figure 6: Anxiety scale scores during INS

During INS
Figure 7: Anxiety scale scores before local anaesthesia (LA)

Figure 8: Anxiety scale scores before extractions/s
The behaviour scales during LA and extraction

The behaviour between the two doses showed statistical significance only in the behaviour of Local Anaesthesia (LA) t-test, p-value (0.04), and the extraction using the t-test, the p-value was 0.03. Therefore, the higher dose of 0.5 mg/kg had lower behaviour scales than the 0.3 mg/kg dose on both the LA and extraction stages. (See figure 9 and 10)

Figure 9:- Behaviour scale scores during local Anaesthesia

![Behaviour during LA](image)
Figure 10:- Behaviour scale scores during extraction/s

Nine % (n=5) of the sample in group A displayed anxiety and behaviour scores of zero during all the stages of treatment in comparison to 22% (n=13) zero scores in group B.

**Facial image Scale (FIS):**

The association between the facial image test scores (FIS) in groups A and B chosen before INS administration was not statistically significant (p-value = 0.4659) (Figure 11).
However, the association between the facial image test scores in groups A and B chosen after INS administration was statistically significant (marginal p value =0.059) (Figure 12).

**Figure 11:** FIS before INS

![FIS before INS administration](chart)

**Figure 12:** FIS after treatment

![Satisfaction of children after treatment](chart)
Figure 13: Mood of children (FIT) before and after treatment

Mood of children before and after INS

<table>
<thead>
<tr>
<th>DOSE</th>
<th>BEFORE</th>
<th>DOSE</th>
<th>AFTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td></td>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>

Happy  Neutral  Sad

Figure 14: Overall mood (FIT)

Overall Mood

Happy  Neutral  Sad
Facial image Scale (FIS) rating before and after sedation (Appendix G)

Table 8: FIS before sedation in the 0.3 mg/kg group

<table>
<thead>
<tr>
<th></th>
<th>Scale 1</th>
<th>Scale 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td>41.32%😊</td>
<td>22.41%😊</td>
</tr>
<tr>
<td>Neutral</td>
<td>22.41%</td>
<td></td>
</tr>
<tr>
<td>Sad</td>
<td>3.44% 😞</td>
<td>10.34% 😞</td>
</tr>
</tbody>
</table>

Table 9: FIS after sedation in the 0.3 mg/kg group.

<table>
<thead>
<tr>
<th></th>
<th>Scale 1</th>
<th>Scale 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy😊</td>
<td>36.2%😊</td>
<td>18.9%😊</td>
</tr>
<tr>
<td>Neutral</td>
<td>22.4%</td>
<td></td>
</tr>
<tr>
<td>Sad 😞</td>
<td>3.44% 😞</td>
<td>18.9% 😞</td>
</tr>
</tbody>
</table>
Table: -10 FIS before sedation in the 0.5 mg/kg group.

<table>
<thead>
<tr>
<th></th>
<th>Scale 1 = 41.6% 😊</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td>Scale 2= 26.6% 😊</td>
</tr>
<tr>
<td>Neutral</td>
<td>Scale 3= 13.3%</td>
</tr>
<tr>
<td>Sad</td>
<td>Scale 4= 10% 😊</td>
</tr>
<tr>
<td></td>
<td>Scale 5= 8.3% 😊</td>
</tr>
</tbody>
</table>

Table: -11 FIS after sedation in the 0.5 mg/kg group.

<table>
<thead>
<tr>
<th></th>
<th>Scale 1 = 38.3% 😊</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td>Scale 2= 28.3% 😊</td>
</tr>
<tr>
<td>Neutral</td>
<td>Scale 3= 16.6%</td>
</tr>
<tr>
<td>Sad</td>
<td>Scale 4= 11.6% 😊</td>
</tr>
<tr>
<td></td>
<td>Scale 5= 5% 😊</td>
</tr>
</tbody>
</table>
Time of procedure

The time of the procedure from time of INS administration to extraction were mean values of 35.21 min in 0.3 mg/kg and 36.45 min in the 0.5 mg/kg group, p-value (0.34) hence statistically not significant.

Figure 15: Time of procedure

In group A the discharge time recorded from extraction to discharge time was 16.5 minutes and in group B the discharge time was 18.8 minutes. This shows a statistical significance (Figure 16). The analysis using the Welch t-test gave P=0.044, but the Wilcoxon rank sum test gives P=0.098 suggesting small statistical significance between the two means.
The discharge score of 12 at 15 min between the two groups was analysed by the Chi-square and Fisher exact test. This showed p-value= 0.04318 and Fisher exact value of 0.034. The proportion of discharge score=12 is greater in the 0.3 mg/kg group, hence statistically significant.

The percentages of the score of 11 or less indicating more than 15 minutes for recovery is 6.2% in the 0.3 mg/kg group and 21% in the 0.5 mg/kg group.
Side Effects

Figure 17: Side effects due to INS

The side effects experienced by patients due to the INS are illustrated by figure 17.

The three percent illustrated by “other” represents the one child who experienced a dull aching pain in the head for a few minutes and the child who presented with hiccups for a few seconds (See figure 17).
Chapter (5)

Discussion
Discussion

The intranasal route for sedation was selected for this study due to its rapid onset, greater bioavailability and quick recovery, thus making it more appropriate for use in an emergency setting for children in the pre-cooperative stage (Lee Kim et al, 2004).

The only drawback of the administration of intranasal sedation is that a burning sensation of the nasal mucosa has been reported in children (Lee Kim et al, 2004). Chiareitti et al (2011) conducted a study using INS with midazolam but administered a local anaesthetic (LA) spray (Lignocaine) in order to anaesthetize the nasal mucosa prior to intranasal sedation (INS) and they reported that there was no burning sensation experienced in 100% of their sample. This motivated the researchers in this study to include a local anaesthetic (LA) (Lignocaine) in order to anaesthetize the nasal mucosa prior to intranasal sedation (INS) and thus avoid the unpleasant burning sensation experienced. The effectiveness can be acknowledged from the results in this study as discussed later.

The drug (midazolam) utilized in the INS route was selected because it provides an appropriate degree of memory loss (Gilchrist et al, 2007). The unpleasant experience of the dental extractions is therefore forgotten by the child and future dental treatment can be positive thus allowing the child to achieve an improved oral health status (Alzahrani et al, 2009). Amnesia is strongly recommended in young children undergoing unpleasant procedures such as dental extractions (Gilchrist et al, 2007) as it was shown that most of the extremely anxious children in their first dental appointment experience psychological trauma and the parents rated the dentist as unfriendly (Salem et al, 2011).
A literature search by the researcher using several search engines such as PubMed did not identify any randomized clinical trials conducted comparing different doses of IN midazolam in an emergency setting thus far. Hence, two doses were assessed in terms of safety, effectiveness and recovery times of each dose in order to determine the dose that would be most appropriate for an emergency setting where time and recovery area space is of the essence.

Previous literature proved that doses of the 0.3 mg/kg and 0.5 mg/kg midazolam resulted in successful sedation (Rakaf et al, 2001). However these studies did not compare the doses in a paediatric dental emergency clinic. This study therefore aimed, to compare doses of intranasal midazolam that would be of significant benefit in a paediatric dental emergency clinic.

The results of this study revealed a 100% success rate of INS with both doses of 0.3 mg/kg and 0.5 mg/kg midazolam in children by attaining a safe and effective procedure. The safety was assured by continuously monitoring the oxygen saturations of the children. On the other hand, the specialists rated effectiveness of sedation in its capability to decrease anxiety and motion of children to allow dental extractions to be performed successfully.

Gender, age and BMI were included in this study to observe if any of these parameters revealed a statistical difference to the anxiety and behaviour ratings of each of the dose groups. Seeing that children at the pre-cooperative level lack the cognitive ability to understand the necessity of the procedure, the unknown frightens them (Buchanin and Niven, 2002). These parameters were not included in previous studies (Rakaf et al, 2001; Wood, 2011; Lee-Kim et al, 2004) in relation to the 0.3 mg/kg and 0.5 mg/kg doses, and therefore were analysed to assess if any of the variables are significant for future considerations to dose administration.
There was no difference in the anxiety levels between males and females. These results are in line with similar studies conducted by Buchanin and Niven (2002). The different ages of children were not related to their anxiety and behaviour ratings. The correlation of the facial image scale and age before treatment showed that age was not linked to the mood of the child or state of anxiety. There was also no significant difference between the two dose groups in correlation to BMI.

The mean BMI of both groups was from 14-16 and did not influence on the effectiveness of both 0.3 and 0.5 mg/kg doses (P=0.131). The anxiety and behaviour scores of the children in this study were not influenced by either gender, age or BMI.

Hence, gender, age and BMI were not statistically significant (P >0.05) to the anxiety and behaviour scores of pre-cooperative stage children in this study.

**Facial Image Scale to assess anxiety of children before and after sedation (FIS)**

The two most commonly used scales to assess anxiety in previous studies examined are the Venham Picture Scale (VPS) and the Facial Image Scale (FIS) (Wood, 2011; Buchanin and Niven, 2002; Alwin *et al*, 1991; Newton and Buck, 2000). The FIS was favoured due to its greater validity in a clinical context in comparison to the VPS and was thus chosen as the scale for this study (Buchanin and Niven 2002). The FIS is easier and quicker to use in a clinical setting (Buchanin and Niven 2002) and was found to be useful in young children because they lack the cognitive ability to understand straightforward questions about their feelings (Buchanin and Niven, 2002). The limitations of the scale may still be challenged by the child’s intellectual abilities as this varies among children and their age (Buchanin and Niven, 2002).
The FIS was applied to this study to ascertain if the state of anxiety of the children before sedation had a direct impact on their anxiety and behaviour during dental extractions, and whether the children’s mood was affected by the treatment.

The relation of the state of anxiety that is represented by a picture from the FIS is also important to ascertain which dose is more effective in decreasing the anxiety. This would help clinicians to draw up the optimal treatment plan or decide on the correct dosages to manage the different levels of anxiety displayed by children in an emergency clinic (Buchanin and Niven, 2002).

Before sedation, 65% of the children selected a happy face (scale of 1 and 2), indicating that they were mildly anxious patients and this is consistent with the inclusion criteria of the study. The rest of the children (18%) chose a scale of 3 (neutral face) whereas the children who selected the 4 or 5 scale (sad faces) represented 16% of the sample. The sad faces may be due to temperament, socioeconomic status or a reflection of parent’s anxiety (Alwin et al, 1991).

After sedation 61% of children of both doses groups chose a happy face at the end of the treatment. This result clearly indicates successful sedation for both the 0.3 and 0.5 mg/kg doses and further demonstrates the amnesic property of midazolam. Interestingly, two parents provided voluntary feedback when they attended the emergency clinic for subsequent treatment. The parents reported that their children did not remember the dental extractions after treatment on the following day. The reports were also supported by the findings that suggested amnesia effect by showing that 50% of the children chose the same picture before and after the sedation. Moreover the 61% of happy faces after treatment is close to the 65% happy faces chosen before commencement of treatment suggesting effective amnesia and recovery of children to their usual mood.
Furthermore, there was a slight statistical difference in images chosen between the 0.3 mg/kg and 0.5 mg/kg after sedation with a marginal p-value of 0.059. The 0.5 mg/kg group showed a higher percentage (66%) of happy faces in comparison to the 55% happy faces chosen in the 0.3 mg/kg group. The 0.5 mg/kg group presented with 16% of sad faces chosen in comparison to 22% sad faces in the 0.3 mg/kg group. As a result, the 0.5 mg/kg suggests higher anxiolysis and a happier mood in children than the 0.3 mg/kg dose.

In contrast, 20% of the children in the 0.3 mg/kg group selected a neutral face and 19% a sad face at the end of the treatment. This could be due to the temperament of the child, and/or the high anxiety experienced during the treatment. The high anxiety could be attributed to factors such as the children’s previous unpleasant experiences and their diverse personalities. This is supported by Anrup (2002) who found that shy children had higher anxiety levels to the dental treatment in contrast to the children that are not shy.

Moreover, the researcher observed that FIS before and after sedation in children had its’ limitations, where the children’s mood or state of anxiety was influenced by the parents’ expressions.

**Temperament**

Temperament is defined as “the emotional quality of the child that varies individually but is relatively stable over time” (Anrup, 2002). Some children adapt quickly to new environments and stimuli while others react with great fear and agitation (Alwin et al, 1991). Factors such as the temperament and mood of the child also influence how the child will react at the time of assessment, determination of the picture scale, and their anxiety and behaviour during treatment. Aminabadi et al (2011) concluded that temperament is a significant and predictive factor in determining the child’s behaviour during treatment. It was shown from the study that some children in the 0.3 mg/kg and 0.5 mg/kg dose groups had a rating of zero (relaxed and smiling) in the anxiety and behaviour scales throughout the treatment.
Temperament is believed to possibly have had a positive impact on the anxiety and behaviour of these children during the treatment.

**Rater’s assessment of anxiety during the different stages of treatment**

The assessment of the effectiveness of the 0.3 mg/kg and 0.5 mg/kg on the anxiety and behaviour of children was done using Venham’s scale (Appendix H) throughout the procedure of dental extraction (before INS until dental extraction/s).

The before INS results (table 3) showed that children were mildly anxious. However, the administration of INS increased the anxiety levels and decreased the cooperation of the children (table 7). This increase in anxiety levels was represented by crying (table 7) and the cooperation decreased evident by the children protesting with hand signals. This could be due to the discomfort of the INS route, which was not well tolerated by children. The large volume of the drug due to the low concentration (5mg/ml) might have resulted in part of the solution being disseminated in the spray and some of the solution leaking into the nasal mucosa causing the nasal burning (Wermeling *et al*, 2006). Also, the low pH of the solution could have stimulated the peripheral pain receptors of the trigeminal nerve supply in the nasal mucosa causing discomfort (Wood, 2011).

Local anaesthetic (LA) (lignocaine) was given prior to INS to reduce and or eliminate the burning sensation of midazolam. However, 10% of children reported a burning sensation, which could be due to the fact that inadequate time was allowed between LA administration and the INS administration (Wood, 2011). This implies that perhaps a slightly longer time period should be allowed for after the LA in order for it to have the maximum anaesthetising effect on the nasal mucosa.
According to the findings by Wood (2011), 43% of children had burning sensation in his study in comparison to 10% in this study. The lignocaine used in the study by Wood (2010) was given with the midazolam as opposed to this study where lignocaine was given three to four minutes prior to INS. The effective local anaesthesia resulted in an absence of the burning sensation.

A bitter taste is experienced when the drug is swallowed and this is due to the fact that the drug is diluted and a large volume is allowed to pass through the oropharynx and makes contact with the tongue (Wood, 2011). The large volume of solution is due to the concentration of midazolam being 5mg/ml. The concentrated formulation of 40 mg/ml used by Wood (2011) had decreased the likelihood of swallowed midazolam through the nasopharynx (Wood, 2011). This concentrated dose of 40mg/ml was believed to result in 57% acceptability during INS in Woods’ study, in comparison to 35% acceptability in this study.

The intranasal sedation studies documented thus far have not included any reports on the correct technique of INS using the MAD (Appendix K). The technique could play a major role in instances where the child is swallowing the drug leading to bitter taste, and also reducing the rapid onset of IN route. It is recommended that the intranasal medication be administered with the chin tilted towards the chest to avoid the solution from going down the throat and causing a bitter taste.

The effectiveness of sedation among children varied after INS administration. This could be due to the midazolam solution either being swallowed or being expelled during sneezing after INS administration. It is thus possible that the bioavailability of the drug decreased and therefore different onset times were experienced. It is also believed that the quick onset of INS could be due to the passing of the drug through the cribriform plate to the brain and cerebrospinal fluid (Lee-Kim et al, 2004). Children were continuously assessed until raters reached a consensus that the child was drowsy. Drowsiness was confirmed by asking the child to stand up with support.
One hundred per cent of the children were drowsy at the interval of 5-10 minutes that was also similar to findings made by Rakaf et al (2001) and Wood (2011). This quick onset and rapid effectiveness was due to its rapid absorption, bypassing the hepatic portal (Lee-kim et al, 2004). The intranasal route of sedation allows for the highest bioavailability of the drug compared to the other routes of sedation other than the IV route. INS results in quick onset of sedation thus making it the preferred option for its use in an emergency setting (Wood, 2011).

The duration of the treatment between the two groups (figure 15) are in line with duration times of Rakaf et al (2001) and Wood (2011), indicating effective sedation of the 0.3 mg/kg and 0.5 mg/kg doses which provided sufficient time for emergency dental extractions to be carried out.

Before local anaesthesia was injected, topical anaesthetic was applied whilst the child was on the dental chair and the result shows that 85% of children displayed good behaviour. This indicates that both the 0.3 mg/kg and 0.5 mg/kg doses provided effective sedation. In contrast, when the LA was administered anxiety and behaviour levels increased. The children exhibited the highest level of anxiety at this stage by being scared (table 7) and their behaviour changed due to the painful sensation of the LA. This provoked the children to react by crying (figure 9) and protest by hand signals and movement of the head. Pain experienced led to an increase in the ratings of anxiety and change in behaviour by more than the scale of 1 in 60% of the children.

After the LA injection was completed, 81% of the children became calm in both dose groups. The majority of the children had stopped crying and protesting almost immediately after the LA was completed. This rapid calming down response indicates effective sedation of both dose groups.
The period when the extractions were being performed also produced increase in anxiety levels and change in behaviour as demonstrated by the crying and protesting (table 7). Nevertheless, patients displayed a lower anxiety level cooperated better than during the period when the LA was being administered. This was due to the effective analgesia, and more profound level of sedation achieved.

The Stimulation of LA and extraction on Anxiety and behaviour scales

An emergency clinic usually presents with a large number of patients seeking relief from pain and sepsis and there is a need to provide the emergency service quickly and effectively. Therefore, to increase the number of patients for treatment in an emergency clinic, LA is injected quickly that might aggravate the pain. This increase in pain is due to the buffering of the drug. The LA injection should preferably be given slowly to provide the desired buffering effect. The anxiety and behaviour of children was unstable during the different stages of treatment because midazolam lacks analgesic effect.

The administration of LA resulted in an increased anxiety in children, and showed signs of verbal protesting or crying (Mazheri et al, 2007). There are different types of LA injections such as the mandibular block, buccal infiltrations and palatal injections that presented with different anxiety and behaviour patterns according to the ratings used. It was noted that palatal injections caused the highest anxiety and behaviour change and had a rating scale of 2. A painful experience such as a local anaesthetic injection creates a negative memory associated with fear and psychological trauma and this experience exacerbates pain (Salem et al, 2012).
(E) Safety

Safety is the primary goal in sedation and the use of a pulse oximeter is compulsory to regularly check pulse rate and oxygen saturations as done in this study (Wilson, 2012). The pulse rates of the children were monitored throughout the procedure and charted before and after sedation and both dose groups were in the normal range. The mean pulse rate was lower in the 0.5 mg/kg group (108) PR in comparison to 115PR in the 0.3 mg/kg. Both mean values of pulse rates of the two groups were within a normal range for children aged 3-6 years old (NIH, 2013). However, the 0.5 mg/kg suggested more effective anxiolysis.

The pulse-oximeter also showed oxygen levels above 95% at baseline and after treatment indicating adequate breathing and airway patency except one child who desaturated briefly. The child who desaturated briefly had an oxygen saturation value of 90% for a period of 3 minutes. The child presented with snoring during this brief period of desaturation. The initial management in this event of desaturation was by stimulating and rousing the child, to increase muscle tone affected by the drug and prompt breathing (Wilson, 2012). This manoeuvre normalised the oxygen saturations immediately to above 95%. There were no cases that needed respiratory support or emergency interventions. Both doses of midazolam had proven to be used safely in the emergency clinical setting for the pre-cooperative age group of 3-6 years old children.
Monitoring and Discharge

Once the dental extractions were completed the child was placed in the recovery room for further monitoring and assessment for discharge using the universal discharge scale (Appendix J).

According to the universal discharge scale, it is safe to discharge the child when there is an accumulative score of 9/12 and the child cannot be discharged if any of the parameters being monitored is zero (Appendix J). Hence, in this study the score was further increased to 12/12, which is the optimal discharge score for the reasons of safety, consistency and ease of rating.

The majority (90%) of children were discharged after 15 minutes and only 10% of children needed to stay in recovery for an additional 15 minutes. The reason for this was that they were unable to move all four extremities on command or when the level of consciousness was not a score of 2.

The increased recovery time was seen mostly in the 0.5 mg/kg dose group (Figure 16), which was statistically significant when compared to the 0.3 mg/kg dose group (p value=0.03). The greater recovery time seen with the 0.5 mg/kg dose was due to the deeper level of sedation achieved with these children. The dosage required for INS should take into consideration the child’s behaviour and time required for treatment (Rakaf et al 2001). Rakaf et al (2001) suggested the use of 0.5 mg/kg for procedures such as dental extractions.

The only disadvantage of the 0.5 mg/kg is the slight increase in recovery time, but this dose still outweighed the 0.3 mg/kg by producing improved behaviour and cooperation during the course of treatment. The FIS scales also illustrated that the children presented with an improved state of mind and better mood after treatment with the 0.5 mg/kg.
The discharge time recorded for the children who had the 0.5 mg/kg dose was seen as being statistically significant by a difference of a few minutes in comparison to the discharge time recorded for the 0.3 mg/kg dose (figure 16). However, this was not viewed as being clinically significant in slowing down the flow of the emergency clinic and is thus considered as being the more suitable INS dose in an emergency clinic.

**Signs and side effects**

Benzodiazepines used for sedation without the combination of opiates or any sedative drugs are regarded as minimal sedation, which is less likely to result in adverse events due to the wide margin of safety (SAJAA, 2010).

The 0.3 mg/kg and 0.5 mg/kg doses of midazolam in this research have shown no significant or serious adverse events such as respiratory depression, apnoea or cardiovascular instability. The minor side effects of sneezing might have decreased the effectiveness of the dose administered (figure 17). However, this had no significant clinical effect on the level of sedation according to the Wilson sedation scale or discharge times. Hiccups are a known side effect of midazolam and was recorded in two patients and disappeared within seconds after INS.
Pre-operative Fasting

Pre-operative fasting cannot be planned for emergency settings; hence sedation that does not require for the child to be starved is appropriate for emergency dental extractions (Wilson, 2012).

Due to risk of aspiration, fasting times are mandatory in GA cases rather than procedural sedation. The fasting time for procedural sedation is controversial, and the gastric emptying is believed to be delayed due to the distracting pain (Wilson, 2012).

The aim of the study was to achieve minimal but optimal sedation. Therefore, risk of aspiration in non-fasting conditions was uneventful in this study, due to the maintained protective reflexes of swallowing and normal breathing throughout the treatment. Similarly, Rakaf et al (2001) showed that the safety of both 0.3 mg/kg and 0.5 mg/kg doses in fasting and non-fasting conditions, making INS a suitable sedation technique in an emergency setting.

The oral route of sedation is unpredictable in terms of sedation level and recovery and therefore fasting is advised. In conclusion, fasting for minimal sedation using the 0.3 mg/kg or 0.5 mg/kg doses intranasally is seen not practical because of immediate care needed for emergency dental extractions and considered unnecessary for sedation requirements.
Limitations

An adult nasal cavity can only receive and retain 0.15ml of liquid and therefore children receiving INS should preferably be administered a concentrated solution in order to maximize the effect of the drug and decrease side effects (Wermeling et al, 2006).

The use of the diluted dose of 5 mg/ml in the study increased the volume of the drug required for sedation therefore increasing the probability of the child experiencing a burning sensation in the nasal mucosa and bitter taste in the throat when drug is swallowed. The inadequate time given for the Lidocaine to anaesthetize nasal mucosa had led to 10% of the children experiencing a burning sensation. The volume of the drug and the inadequate time for Lidocaine to anaesthetise the nasal mucosa are the reasons that acceptability of INS in this study was decreased. Chiaretti et al (2011) used 10 mg/puff lidocaine and results showed that their were no burning sensation experienced with the children in their study.

The technique of administering the IN midazolam where the childs’ head was occasionally tilted backwards increased the chance of drug being swallowed, and resulted in the bitter taste being experienced and perhaps also decreasing the effectiveness of the drug (Appendix K).

The inclusion of follow up questionnaires could have been included in the study and given to the parents so as to assess any side effects after recovery as well as the amnesia expected from the use of midazolam.

The limited space provided for recovery in a busy emergency clinic affected the possibility of having a larger sample size.
Chapter (6)

Conclusion & Recommendations
Conclusion

The majority of the anxious children who presented with Early Childhood Caries required emergency dental extractions and further comprehensive treatment. Children in the pre-cooperative stage are most likely to react to the pain evoked by the LA injections due to lack of analgesia in the INM. It is therefore suggested from the anxiety and behaviour ratings to add an analgesic agent like ketamine to minimise distress, and to reach optimal goals of sedation (Mikhael et al, 2007). It is important to consider the risk of over sedation and use the least amount of drugs with the highest therapeutic index.

The administration of LA into the nasal mucosa prior to INS prevented the burning sensation from being experienced in 91 percent of the children. Despite the distress in the provocative stages of LA and extraction, both doses still succeeded in decreasing the anxiety and movement of children.

The 0.5 mg/kg dose resulted in the cooperation and behaviour levels (relaxed and smiling throughout the procedure) of this group of children being approximately three times better than the group that received the 0.3 mg/kg dose.

The recovery time with the 0.5 mg/kg dose was slightly more than the 0.3 mg/kg, yet it did not impede the flow of patients in the emergency clinic.

INS with 0.3 mg/kg or 0.5 mg/kg midazolam resulted in safe and effective anxiolysis for emergency dental treatment in children under the age of six years who did not fast. No adverse events related to sedation were encountered throughout the course of treatment.

The 0.5 mg/kg was more effective than the 0.3 mg/kg as it reduced anxiety and improved behaviour and thus allowed for these children to be managed more easily.
**Recommendations**

- To avoid distress being experienced during unpleasant procedures such as dental extractions, and to adhere to minimal sedation in an emergency clinic, additional sedation with nitrous oxide can be utilised together with intranasal midazolam. This combination has achieved superior outcomes ($P<0.05$) in terms of movement and crying during LA administration, in comparison to midazolam alone as proved by Zahrani et al, (2009). Hence, the intranasal midazolam can be used in conjunction with nitrous oxide to improve the child’s cooperation and further reduce anxiety.

- The use of a concentrated LA (Lidocaine) (10mg/puff) prior to INS administration can be used to reduce or avoid the burning sensation from being experienced (Chiaretti et al, 2011).

- A concentrated dose of midazolam such as 25 mg/ml or 40 mg/ml with LA is recommended to decrease or avoid burning sensation and bitter taste experienced with midazolam. The concentrated dose will also ensure greater retention in the nasal cavity thus increases the bioavailability of drug and decreases side effects.

- It is also suggested that mint or lemon drops or lemon lozenges could be given prior to or after INS This will reduce or eliminate any possibility of bitter taste experienced and is advised only to be given to older and mildly anxious children to avoid events such as aspiration.

- Operator sedationists in emergency dental clinics can safely and effectively use INS in a dose of 0.5 mg/kg for children under the age of six years old provided that their vital signs are monitored with a pulse-oximeter, and resources that are adequate are available for patient recovery.
• Effective INS with the 0.5 mg/kg is recommended in a hospital setting. The availability of experienced staff with PBLS (Paediatric Basic Life Support) and PALS (Paediatric Advanced Life Support) qualifications is mandatory as stated by the guidelines for the safe use of procedural sedation and analgesia for diagnostic and therapeutic procedures in children in order to manage the airway and provide medical intervention if required (SAJAA, 2010).

• Intra-nasal flumazenil antagonist is a relieving discovery in an emergency setting (Zanette et al, 2009). The intranasal flumazenil have shown similar plasma concentrations to the intravenous flumazenil (Scheepers et al, 2000), and therefore could be given without intravenous access that is painful for children and requires an anaesthetist. The reversal of midazolam by intranasal flumazenil can therefore be successfully achieved by the intranasal route and can be done by any of the staff members, and not necessarily an anaesthetist.

• Ideally the painful sensation of injections and extraction require an analgesic effect in addition to the sedation. Midazolam has an anxiolytic and amnesic effect but does not have any analgesic effect. Research on the use of intranasal ketamine in the emergency setting is recommended (Wood, 2011) due to its analgesic and anxiolytic effect (Mikhael et al, 2007).
References


APPENDIX A: INFORMATION SHEET

Please take your time in reading the information sheet; we will do our best to explain any part that needs clarity if you have any queries.

Warm Greetings,

I would like to kindly request parents/guardians to read this information sheet carefully before considering taking part in the study, as this is of great importance to us and you, in delivering standard care and the optimal treatment possible to your child. To understand the nature of the study to be conducted, this information sheet will include details explaining terms such as anxiety that relates to your child and sedation being the procedure needed to do the dental extractions required.

1) Anxiety

Anxiety is defined as a state in which your child is afraid or stressed to attend the dental clinic and especially if an unpleasant procedure is needed, such as dental extractions. The condition of your child is normal and is usually expected at this age group, as it is difficult for them to understand and adapt to a new and maybe threatening environment. It is very much believed that the feeling of pain is more, when the child is anxious and afraid.

2) Definition of Sedation

“A technique in which the use of one drug or more produces a state of decreased response of the central nervous system, making your child drowsy and enabling treatment to be carried out, but during which verbal contact with the patient is maintained throughout the period of sedation. The level of sedation must be such that the patient remains awake, and is able to react to any stimulation, and to understand and to respond to verbal commands”.
3)Goals of sedation

According to South African Journal of Anaesthesia and Analgesia (Sajaa):

The goals of sedation in the paediatric patient for diagnosis and treatment procedures are:

1) To protect the patient's safety and welfare.
2) To minimize physical discomfort and pain.
3) To control stress, minimize psychological trauma, and maximize the potential for amnesia that means, ability of the drug to make the child forget unpleasant procedure.
4) To control behaviour and/or movement so as to allow the safe completion of the procedure.
5) To return the patient to a state, in which safe discharge from medical supervision, as determined by recognized criteria, is possible.

4) Name and purpose of the study to be conducted

The comparison of two doses, of intranasal midazolam sedation, in a Paediatric Dental emergency clinic.

The purpose of the study is to evaluate the doses of midazolam drug to be used in the study, meaning to find out which one is the most appropriate in:

1) Decreasing the stress to your child during dental extraction.
2) Completion of the procedure without psychological trauma to your child.
3) To have a reasonable time of recovery that fits the emergency dental clinic, and to further accommodate the large number of children that attends the emergency dental clinic in Tygerberg Oral Health Centre.
This procedure also helps your child to have a pleasant dental experience, because the drug is capable of allowing your child, to forget the event of dental extraction. The drug used for sedation (midazolam), helps in achieving a good rapport between the child and dentist, and not to fear dentistry in the future.

This study will help us in collecting more information on how your child will react to one of these doses. There is a high dose and a lower dose used for the study, your child will have an equal chance of either getting a high dose or lower dose for treatment. The reason why a high and low doses are suggested in the study, is to know which dose would be the best in making your child calm and cooperative, in addition to completing dental extraction in a reasonable time to fit the emergency dental clinic. These doses have already been proven as effective in previous studies taken, and the procedure is already offered in many hospitals.

The study will help us, to know which dose is better in an emergency setting, and aims in treating all children in the event of an emergency effectively (without psychological trauma) and quickly.

5) Why your child is chosen for the study

Your child and all the children attending the emergency dental clinic are invited to take part in the study, if they meet the criteria and for the following reasons:

1) Within the age group needed for the study (4-6 years of age): as this age group is the most anxious, because of difficulty for them to understand why we need to do the treatment and difficulty for them to adapt to a new environment.

2) A healthy child for the study as this will definitely decrease the likelihood of any adverse events or complications.

3) Does not have any airway or nasal abnormalities as this is important to ensure safety and effectiveness of the drug.
6) Freedom of choice

The procedure will only be done on your permission and you have the complete right to withdraw at any time. In this event your child will still qualify for other options of treatment.

7) Taking part in the study

The decision to take part in the study will require your child to be medically assessed, to ensure safety of your child before procedure. Your child is then going to be monitored during and after the procedure, to assess that all the vital signs are normal and to intervene if readings are not within the normal limits.

Your child is given midazolam drug that causes sedation as explained. The drug will be given by a mucosal atomized device (MAD). This will give the drug in the form of mist through each nostril to achieve sedation, according to the previous studies in an average of 15-20 min.

After your child is calm because of sedation, the child is then given an injection to avoid pain and then proceed with the extraction/s required. The child is then taken to the recovery room to further assess vital signs and to ensure safety and well-being before discharge. The time of the procedure is variable depending on your child’s response to the drug and the recovery from the drug. Our primary goal and intention is the safety of the child and secondly, the effectiveness of the drug in terms of reduction of stress and fast dental extraction and recovery.
8) The cost of the study

I would like to notify you that the procedure of sedation used in the study, and required for your child to undergo dental extraction, is free of cost and is funded by the University of the Western Cape. However, if your choice is not to take part in the study, other options will be offered and if there are issues regarding cost of treatment, you are more than welcome to raise your issue and we will try our best to help in any way possible.

9) Risks of the procedure

The sedation response is variable and depends from one child to another. The possible risks that might occur to your child is to sleep during the procedure, or experience breathing difficulty. In the event of any emergency, qualified personnel and emergency equipment needed, will always be on site, and the effect of the drug can be reversed immediately to return the patient to a fully recovered state.

10) Benefits of taking part

This sedation procedure is stated as safe and effective by numerous studies and reports. Compliance in children with intranasal sedation is also much easier and acceptable by an anxious child than other routes used. I very much believe that the procedure will help in treating your child, by reducing his/her stress and fear from dental extraction and allow for good cooperation from your child to complete treatment.
11) Confidentiality

The data to be collected is treated as strictly confidential, and no individually identifiable information will be published. The data collected and needed for the study, are scores of the level of sedation and recovery time of your child, which is going to be added with other results to reach to a conclusion on the effectiveness of the two doses used in the study.

As stated by the American academy of Pediatrics (AAPD):

“You, as parent/legal guardian, play a key role in your child's dental care. Children often perceive a parent's anxiety which makes them more fearful. They tolerate procedures best when their parents understand what to expect and prepare them for the experience. If you have any questions about the sedation process, please ask. As you become more confident, so will your child” (AAPD, 2011). A telephone/cell number will be supplied to you, if you need to contact the dentist.
APPENDIX B: CONSENT FORM

Department of Paediatric Dentistry at Tygerberg Oral Health Centre

To: Dear Parents/guardians of ………………………………………………….

My name is Dr. Ahmed Mahgoub, I am conducting a research under the supervision of the Paediatric Dentistry department and the approval of the University of the Western Cape. The research is on the comparison of two doses of intranasal midazolam sedation, in the Paediatric Dentistry emergency clinic at Tygerberg Oral Health Centre.

You are being invited to consider taking part in the study, which involves sedation through the nostrils that helps to calm your child for dental extraction. The study is comparing two doses of midazolam drug and aims to assess which dose is most effective in making your child calm, so that he/she is able to cooperate and complete dental extraction without stress and psychological trauma, in a reasonable time. The purpose of the study is to have an understanding of how your child is going to react to the medication, and to investigate which dose is most applicable in an emergency setting.

I would like to inform you that your child after being assessed by our paediatric dentists as anxious requires sedation, to perform the extractions required. The drug we administer is safe and has been used for a long time. However, it is possible that your child might sleep which is a deeper level of sedation. In this event, the drug will be immediately be reversed by qualified practitioners to return the patient to a fully recovered state.

In case you still feel uncertain after reading the information sheet provided about the nature of the study and the sedation, you can always raise questions, and will try our best to clarify any area of concern. It is sometimes challenging to make a decision in
situations of an emergency that requires prompt treatment and management, so we would kindly request you to take your time reading during your waiting for service, to ensure your satisfaction. The procedure will only be done on your permission and you have the complete right to withdraw at any time. In this event your child will still qualify for other options of treatment.

I (………………………………………….) have been informed about the study entitled (Comparison of two doses of intranasal midazolam sedation in paediatric dentistry emergency clinic) by Dr Ahmed Mahgoub.

I understand the purpose and procedures of the study to assess the level of child being calm and determine the recovery time between the two doses of midazolam.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any treatment or care that I would usually be entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at Tygerberg Paediatric department.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

DENTISTRY RESEARCH ETHICS COMMITTEE
Research Office, Tygerberg Campus
Fransie van Zyl Drive
Private Bag X1
Tygerberg
7505
Cape Town, SOUTH AFRICA
Tel: 27 21 937 3095 - Fax: 27 21 931 2287
Email: suenaidoo@uwc.ac.za
(Only class I patients are eligible for the study)

### TABLE 1. ASA PHYSICAL STATUS CLASSIFICATION

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Normal healthy patients</td>
</tr>
<tr>
<td>Class II</td>
<td>Patients with mild systemic disease</td>
</tr>
<tr>
<td>Class III</td>
<td>Patients with severe systemic disease that is limiting but not incapacitating</td>
</tr>
<tr>
<td>Class IV</td>
<td>Patients with incapacitating disease that is a constant threat to life</td>
</tr>
<tr>
<td>Class V</td>
<td>Patients not expected to live more than 24 hours</td>
</tr>
</tbody>
</table>

ASA = American Society of Anesthesiologists
From: Department of Health, 2007
APPENDIX D: Preparation and Setting up for Sedation Procedures

Part of the safety net of sedation is to use a systematic approach so as to not overlook having an important drug, piece of equipment, or monitor immediately available at the time of a developing emergency. To avoid this problem, it is helpful to use an acronym that allows the same setup and checklist for every procedure. A commonly used acronym useful in planning and preparation for a procedure is SOAPME (American Academy of Pediatrics and American Academy of Pediatric Dentistry, 2006).

S = Size-appropriate suction catheters and a functioning suction apparatus.
O = an adequate oxygen supply and functioning flow meters/other devices to allow its delivery
A = Airway: size-appropriate airway equipment (nasopharyngeal and oro-pharyngeal airways, laryngoscope blades [checked and functioning], endotracheal tubes, stylets, face mask, bag-valve-mask or equivalent device [functioning]).
P = Pharmacy: all the basic drugs needed to support life during an emergency, including antagonists as indicated. E.g. (Flumazenil needed for reversal effect of midazolam).
M = Monitors: functioning pulse oximeter with size-appropriate oximeter probes and other monitors as appropriate for the procedure (e.g., non-invasive blood pressure, end tidal, carbon dioxide, ECG, stethoscope).
E = Special equipment or drugs for a particular ease (e.g., defibrillator
APPENDIX E: CLINICAL PROCEDURE

The study included two operators, the nurse who administers the INS, and one dentist performing the dental extractions, and two raters that are needed for intra-rater reliability. The nurse who administers the INS will also record the data for APPENDIX F.

The sister who administers the INS will be the only person to know and record the dose given to the child. In the event of any adverse reaction the blinding factor will be breached if required to ensure safety of the child.

* Raters are given separate forms to record.

(A) Before Procedure:

1. Children to choose anxiety level from the Venham anxiety picture test.
2. Two raters assessed children for anxiety measurement using Venham’s scale, during screening for physical status and medical condition. (Appendix H)
3. Physical status/airway and general medical condition was assessed using the patient selection criteria ASA 1 (Appendix C).
5. The dental assistant recorded age and weight of the child and vital signs including, pulse rate and oxygen saturation are also recorded at baseline. (Appendix F)

(B) Beginning and during the Procedure:

6. After explaining the procedure, the first operator administered lignocaine using MAD (mucosal atomiser device) to anaesthetize nasal mucosa for 4 min, to prevent burning sensation and nasal discomfort caused by intranasal midazolam.
7. Child would be received treatment via intranasal route using midazolam and delivered by a mucosal atomiser devise therefore chances of sneezing and significant amount being swallowed is reduced. Any signs of sneezing, coughing or swallowing would be recorded by dental assistant.
8. A pulse-oximeter was used to monitor and record pulse and oxygen saturation prior to treatment, and every 15 min during treatment and at the end of treatment in recovery by the dental assistant.

9. The second operator performed the dental extractions required.

   The nurse recorded: (APPENDIX F)
   a) Time and dose of the drug to be given.
   b) Beginning of procedure
   c) End of procedure.

10. Level of sedation will be recorded by raters using original Wilson scale. (APPENDIX I)

11. A Qualified medical practitioner was on site in the event of any signs of possible deep sedation, and the need for cannulation to reverse effect of midazolam using antagonist flumazenil IV.

(C) After Procedure

10. The patient was taken to the recovery room and further assessed by the raters for discharge using the discharge-scoring sheet. (Appendix J) A score of nine is at least needed to discharge the patient. The raters will record the discharge score and discharge the patient.

    11. Post-operative instructions were given to the parents and any signs of discomfort should be reported with 24 hours of the procedure.

    12. A telephone/cell number was given to the parent if they need to contact the dentist.
APPENDIX F: RECORDING OF PATIENT DETAILS AND TIME
BY DENTAL ASSISTANT

File number…………………………
Name………………………………..
Gender………………………………
Age…………………………………
Weight……………………………..
Height………………………………

Teeth to be extracted……………………… Total number……………………

Dose given is………………………

**Pulse Rate (PR), Oxygen Saturation (OS).**

<table>
<thead>
<tr>
<th>Time/min</th>
<th>Baseline</th>
<th>15min</th>
<th>30min</th>
<th>45min</th>
<th>60min</th>
<th>End.of Procedure</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Time/min at:**

<table>
<thead>
<tr>
<th>Drug admin./INS</th>
<th>Before LA</th>
<th>In To Recovery</th>
<th>Discharge time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Any signs of coughing, sneezing or swallowing etc…………………………
APPENDIX G: Facial Image Scale

Facial Image Scale

<table>
<thead>
<tr>
<th>Before procedure at waiting room</th>
<th>FIS SCALE NO.........................</th>
</tr>
</thead>
<tbody>
<tr>
<td>After Recovery</td>
<td>FIS SCALE NO.........................</td>
</tr>
</tbody>
</table>
APPENDIX H: VENHAM SCALE OF ANXIETY & BEHAVIOUR MEASUREMENT

Rater Name……………………………

Anxiety (A) and behaviour (B) score using Facial image scale.

0. Child is relaxed, smiling, willing and able to converse.

1. Uneasy, concerned. During stressful procedure may protest briefly and quietly to indicate discomfort. Hands remain down or partially raised to signal discomfort. Child willing and able to interpret experience as requested. Tense facial expression, may have tears in eyes.

2. Child appears scared. Tone of voice, questions and answers reflect anxiety. During stressful procedure, verbal protest, (quiet) crying, hands tense and raised, (not interfering much -- may touch dentist’s hand or instrument, but not pull at it). Child interprets situation with reasonable accuracy and continues to work to cope with his/her anxiety.


4. Anxiety interferes with ability to assess situation. General crying not related to treatment. More prominent body movement, child can be reached through verbal communication, and eventually with reluctance and great effort he or she begins the work of coping with the threat.

5. Child out of contact with the reality of the threat. General loud crying, unable to listen to verbal communication, makes no effort to cope with threat. Actively involved, in escape. Physical restraint required.
**Behaviour rating scale**

0. Total cooperation, best possible working conditions, no crying or physical protest.

1. Mild, soft verbal protest or (quiet) crying as a signal of discomfort, but does not obstruct progress. Appropriate behaviour for procedure, i.e., slight start at injection, “own” during drilling if hurting, etc.

2. Protest more prominent. Both crying and hand signals. May move head around making it hard to administer treatment. Protest more distracting and troublesome. However, child still complies with request to cooperate.

3. Protest presents real problem to dentist. Complies with demands reluctantly, requiring extra effort by dentist, body movement.

4. Protest disrupts procedure, requires that all of the dentist’s attention be directed toward the child’s behaviour. Compliance eventually achieved after considerable effort by dentist, but without much actual physical restraint. (May require holding child’s hands or the like to start). More prominent body movement.

5. General protest, no compliance or cooperation. Physical restraint is required
## RATERS RECORDING SHEET

<table>
<thead>
<tr>
<th>Anxiety</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEFORE (INS)</td>
<td>A:</td>
</tr>
<tr>
<td>DURING (INS)</td>
<td>A:</td>
</tr>
<tr>
<td>BEFORE (LA)</td>
<td>A:</td>
</tr>
<tr>
<td>DURING (LA)</td>
<td>A:</td>
</tr>
<tr>
<td>BEFORE (XLA)</td>
<td>A:</td>
</tr>
<tr>
<td>DURING (XLA)</td>
<td>A:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behaviour:</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEFORE INS</td>
<td>B:</td>
</tr>
<tr>
<td>DURING INS</td>
<td>B:</td>
</tr>
<tr>
<td>BEFORE LA</td>
<td>B:</td>
</tr>
<tr>
<td>DURING LA</td>
<td>B:</td>
</tr>
<tr>
<td>BEFORE XLA</td>
<td>B:</td>
</tr>
<tr>
<td>DURING XLA</td>
<td>B:</td>
</tr>
</tbody>
</table>
APPENDIX I: ORIGINAL WILSON SEDATION SCALE

Rater Name……………………………

Patient File number………………………

Patient Name………………………………..

<table>
<thead>
<tr>
<th>1</th>
<th>Fully awake and oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Drowsy</td>
</tr>
<tr>
<td>3</td>
<td>Eyes closed but rousable to command stimulation (earlobe tug)</td>
</tr>
<tr>
<td>4</td>
<td>Eyes closed but rousable to mild physical</td>
</tr>
<tr>
<td>5</td>
<td>Eyes closed but not rousable to mild physical</td>
</tr>
</tbody>
</table>

Sedation level Assessment using above Original Wilson scale.

<table>
<thead>
<tr>
<th>From beginning of INS to XLA, Time/min</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX J: DISCHARGE SCORING SHEET

As stated and advised by the South African Society of Anaesthesiology, (SAJAA, 2010)

Patient file number…………………………………………..

Discharge scoring system

<table>
<thead>
<tr>
<th>Physical sign</th>
<th>Clinical level</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of consciousness</td>
<td>Fully awake/alert/answer questions</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Responsive to verbal command</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No response</td>
<td>0</td>
</tr>
<tr>
<td>Respiration</td>
<td>Able to take deep breaths and cough adequately</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Shallow breathing with poor cough</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Apnoeic periods</td>
<td>0</td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td>&gt; 96% on room air</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Requires oxygen to maintain saturation &gt; 90%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Saturation &lt; 90% with oxygen</td>
<td>0</td>
</tr>
<tr>
<td>Movement</td>
<td>Able to move all four extremities on command</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Able to move two extremities on command</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Not able to move extremities on command</td>
<td>0</td>
</tr>
<tr>
<td>Temperature</td>
<td>30-36 °C</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>35.5-35.9 °C or 36.1-38.5 °C</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&lt; 35.5 °C or &gt; 38.5 °C</td>
<td>0</td>
</tr>
<tr>
<td>Pain</td>
<td>Minimal discomfort or pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Significant pain</td>
<td>0</td>
</tr>
</tbody>
</table>

A score of 12 indicates that the patient has recovered fully and can be discharged from the recovery area. Discharge cannot be permitted if the score for any individual category is 0.

<table>
<thead>
<tr>
<th>In to Recovery. After 15 min Time/min</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Discharge Score: …………………
APPENDIX K: INTRANASAL ADMINISTRATION TECHNIQUE

INTRANASAL MEDICATION DELIVERY PROCEDURE
using the MAD® Nasal (Mucosal Atomization Device)

MATERIALS

1. MAD® Nasal device with vial adapter and 3ml syringe (Cat. # MAD140)
2. Medication of appropriate concentration for intranasal medication delivery
   » High concentration – Low volume

PROCEDURE

1. Remove and discard the green vial adapter cap.
2. Pierce the medication vial with the syringe vial adapter.
3. Aspirate the proper volume of medication required to treat the patient (an extra 0.1ml of medication should be drawn up to account for the dead space in the device).
4. Remove (twist off) the syringe from the vial adapter.
5. Attach the MAD® device to the syringe via the luer-lock connector.
6. Using the free hand to hold the crown of the head stable, place the tip of the MAD® snugly against the nostril aiming slightly up and outward (toward the top of the ear).
7. Briskly compress the syringe plunger to deliver half of the medication into the nostril.
8. Move the device over to the opposite nostril and administer the remaining medication into that nostril.

KEY CONCEPTS

To improve Intranasal Medication Delivery success:

1. Minimize volume, maximize concentration
   » 1/3 ml per nostril is ideal, 1 ml is maximum
   » Use the appropriately concentrated drug
2. Maximize total mucosal absorptive surface area
   » Atomize the drug (rather than drip it in) to cover broad surface area
   » Use BOTH nostrils to double the absorptive surface area
   » Aim slightly up and outwards to cover the turbinates and olfactory mucosa
3. Beware of abnormal mucosal characteristics
   » Mucous, blood and vasoconstrictors reduce absorption
   » Suction nostrils or consider alternate drug delivery method in these situations