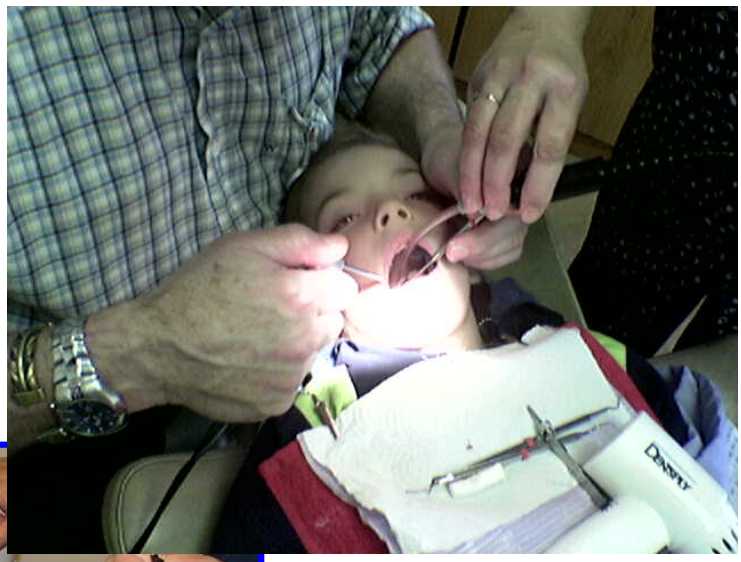
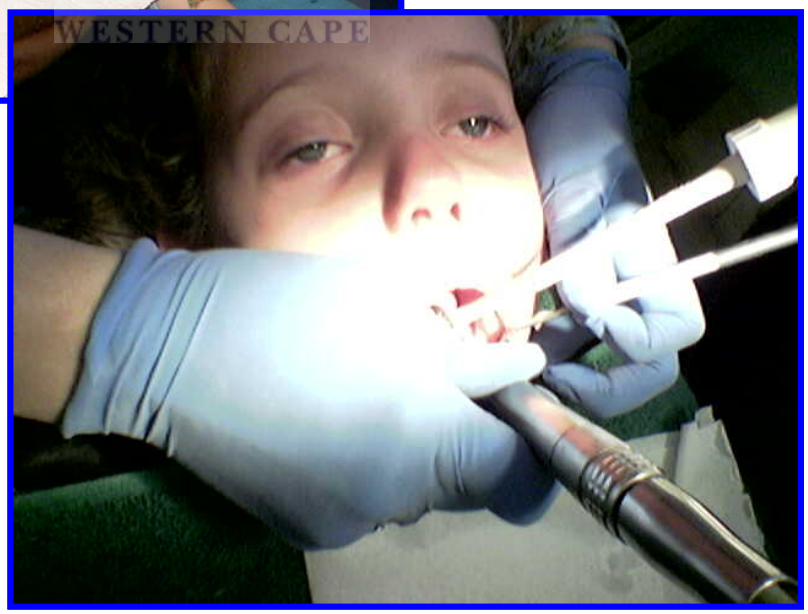
Paediatric



Intravenous Sedation

In Dental Practise



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TITLE PAGE:

MSc (Anaesthesiology and Sedation)

In the Discipline Anaesthesiology and Sedation
University of the Western Cape

MULTIDRUG SEDATION FOR DENTAL PROCEDURES IN CHILDREN YOUNGER THAN EIGHT

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A Thesis submitted in partial fulfilment of the requirements for the degree of Magister Scientiae (Anaesthesiology and Sedation) in the Discipline of Anaesthesiology and Sedation of the University of the Western Cape.

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Wilson sedation scale
Aldrete recovery scale.

ABSTRACT:

Degree: MSc (Anaesthesiology and Sedation). Department of Anaesthesiology and Sedation, University of the Western Cape

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MULTIDRUG SEDATION FOR DENTAL PROCEDURES IN CHILDREN YOUNGER THAN EIGHT

OCTOBER 2005

In this case study research project I have determined that multidrug sedation in children younger than eight years are possible.
Conscious sedation [or sedation where verbal contact with the patient is possible] can be used successfully to decrease anxiety and fear for unpleasant experiences, like dental procedures.
Behaviour therapy in conjunction with one or more drugs can be used to depress the central nervous system in order to decrease the patient's awareness of unpleasant stimuli. This enables treatment to be carried out without patient interference.
Extensive literature surveys were done to determine the ideal drugs as well as the ideal route for conscious sedation in dental treatment for children.
In this study project drugs like midazolam, propofol, alfentanyl and ketamine were titrated intravenously to achieve conscious sedation.

Glycopyrrolate was used to counteract side effects of ketamine and local anaesthesia was used for pain relief.
Patients were selected by eight different dentists.
The goals set for the procedures to be carried out was to obtain anxiolysis, sedation, amnesia, and analgesia.
Adequate trained personnel and resuscitation equipment were available with every sedation procedure.
An electrical infusion pump was used to titrate the desired amount of drugs intravenously to achieve conscious sedation. The infusion pump could be programmed with the patient's weight, drug concentration and time duration.
Children treated were evaluated by the sedationist, the surgeon as well as the parent.
Parameters monitored by the sedationist was:
Clinically: Age, weight, gender, treatment received.
Psychologically: behaviour, level of sedation according to the Wilson sedation scale.
Physiologically: pulse, blood pressure, respiratory rate and oxygen saturation.
Pharmacologically: Amount of drugs used, average dose in ml/kg/h and recovery according to the modified Aldrete recovery scale.
The surgeon has completed a scoring system and evaluated the patient on an anxiety, restlessness and movement score and the ability to work efficiently and cost effectively.
The parents evaluated the sedation procedure by acceptability, side effects and costs.
Final conclusions were done and recommendations made for safe sedation techniques outside the hospital environment.

DECLARATION:

I declare that this MSc (Anaesthesiology and Sedation) is my own work, that it has not been submitted for any other degree or examination in any other University, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full name: Elizabeth Johanna Bester Date: October 2005

Signed……

ACKNOWLEDGEMENTS:

I would specially like to thank the following dentists in Uitenhage who trusted me with the sedation of their patients:
Dr J Scherman
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Dr A Fourie
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Dr M Bester
Dr F Badenhorst
Dr C Van Heerden
Dr K Chetty

I would also like to thank my supervisor Prof JA Roelofse for his assistance and availabilty.

MAIN TEXT

MAIN TEXT:

CHAPTER 1:

INTRODUCTION

In recent worldwide literature surveys, I could find less than ten articles on successful and safe multidrug intravenous sedation techniques for children undergoing dental treatment.[1] Negative literature on paediatric sedation are available.[2] In this research project I wanted to determine if a child could be safely intravenously sedated for dental procedures, or is it really an oxymoron as described by Charles Cote: "When caring for children, particularly when they have to remain quiet for a length of time, one must induce pharmacologic coma – be honest and call it exactly what it is."

It is important to start with a few definitions:

The South African Dental Association has defined conscious sedation as: 'A state of altered consciousness induced by the use of oral, parenteral or inhaled drug(s). While the patient is in this state, treatment can be carried out with optimal comfort, and communication can be maintained, the patient can respond to commands, and should maintain stable vital signs, protective reflexes and an independent airway. The drugs and techniques for conscious sedation must have a margin of safety to make loss of consciousness very unlikely.'

Sedation:

- Sedation reduces the state of awareness; it does not relieve pain.
- Sedation may cause hypnosis [sleep].

Analgesia:
Analgesia reduces or eliminates the perception of pain.

Amnesia:
Amnesia is the inability to remember an event or experience.

It is important to understand that sedation is a continuum.

---

[1] Using Medline search engine

[2] Cote CJ, Notterman DA, Karl HW, Adverse sedation events in pediatrics: a critical incident analysis of contributing factors. Pediatrics. 2000; 105:805-814

The American Academy of Paediatrics has defined 3 levels of sedation, but the American Society of Anesthesiologists has defined 4 levels:

1. Minimal sedation [anxiolysis]
2. Moderate sedation/analgesia [formerly called conscious sedation]
3. Deep sedation/analgesia
4. General anaesthesia [GA]

1. Minimal sedation/anxiolysis:

A drug induced state characterised by a normal response to verbal stimuli, but with a reduction in anxiety. This level of sedation may impair cognitive function and coordination, but ventilatory and cardiovascular functions remain intact.

2. Moderate sedation / conscious sedation:

A drug induced state that results in somnolence with a preserved response to verbal stimulation, although the patient may need a little tactile stimulation. The patient requires no interventions to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is maintained.

3. Deep sedation/analgesia:

A drug induced depression of consciousness during which patients cannot be easily aroused, but respond purposely to repeated painful stimuli. This level of sedation may impair the patient's ability to maintain ventilatory function. A patient may require assistance to maintain a patent airway. Cardiovascular function is usually maintained.

4. General anaesthesia:

This is a drug induced loss of consciousness during which a patient cannot be aroused, even by painful stimulation. Patients lose airway protective reflexes and the cardiovascular system may be impaired.

Most sedative agents can induce very deep levels of sedation, sometimes approaching general anaesthesia.
The level of sedation produced will vary from patient to patient. A certain dose of sedative agent may be inadequate for one patient, but render

another deeply unconscious. It is therefore important to note that the most important monitor during a sedation is the sedationist.

Sedation must be justified:

It is wise to remember that not all patients qualify for sedation. Not all operations can be done under sedation. There are risks and contra-indications to sedation.
A sedation may be justified by:

- Patient – anxious, phobic, children
- Procedure – multiple injections, time duration of procedure
- Surgeon - alternative to GA

Dental treatment is one of the most common sources of stress and anxiety for both adult and child in today's society.
Conscious sedation has been used successfully to alleviate stress and anxiety, which can be part of a visit to the dentist.

In this case study project the academic aim was:[1]

"To determine whether it was possible to do conscious sedation:

- safely
- effectively
- outside the hospital environment
- for children younger than eight years
- undergoing dental procedures,
- using a combination of drugs."

The strategic aim was:

With the rise in costs of medical care in South Africa, and dentistry often being excluded from basic benefits of medical aid schemes, to save costs by working outside the hospital environment.

'Conscious sedation' as used in this project is defined as:

A situation where the patient can still have verbal contact with the surgeon and sedationist, but is relaxed, not anxious and co-operative.

[1] Yagiela J.A. Making patients safe and comfortable for a lifetime of dentistry: frontiers in office-based sedation. J Dent Educ.2001 Dec; 65(12):1348-56

Different routes by achieving the ideal sedation has been advocated:

- inhalational,
- oral / transmucosal
- nasal,
- rectal
- intramuscular
- intravenous/parenteral

Unfortunately none of them has been proven ideal, as most of the techniques use a single drug/agent.

Drugs used for sedation:

In children there is no ideal single agent.

- Most analgesics have some sedative properties, but many sedatives lack analgesic effects.
- Benzodiazepines provide sedation only without any analgesic effect.
- Narcotics are primarily analgesics; they only have sedative effects in large doses.
- Dissociative agents [ketamine] provide both sedation and analgesia.

Unfortunately with these single drug techniques children end up either over- or under sedated.
This has implications for both the patient and surgeon i.e. safety, finances, time management and efficiency.
A well balanced intravenous multidrug sedation technique can be an acceptable alternative.
This is only possible if the sedationist has a proper knowledge of the drugs used, has a knowledge of possible drug interactions and knowledge of the level of sedation.

Safety:

Every sedationist must understand that there are guidelines to safe sedation:

- sedation policy document – covering assessment, personnel requirements, monitoring and recovery facilities, discharge criteria
- proper training

This project:

In this case study project 239 children under the age of eight years were successfully sedated for dental treatment.

In the following chapters I will discuss the rationale for using multiple drugs intravenously for conscious sedation.

Sedative drugs for sedation include:

- benzodiazepines
- opioids
- sedative-hypnotics

Drugs for analgesia

- local anaesthetic agents
- opioids
- sedative hypnotics with a dose related analgesic effect

Drugs to counteract side effects:

- anticholinergic agents

Drugs used for reversal of sedative agents
Emergency drugs

In chapter two the reasons why the drugs are acceptable, as well as their pharmacology, and literature review on the drugs will be discussed. Non-pharmacological behaviour management used during sedation will also be discussed.

Chapter three will cover the research design and methodology:
The reason why children undergoing dental treatment form an ideal research project for conscious sedation i.e. where local anaesthesia can be used to alleviate pain and sedative drugs can be used for sedation, so that a deep sedation is not necessary.

Chapter four will cover the findings and analysis on the 239 patients that have been treated.

Chapter five will discuss the conclusion and further recommendations.

CHAPTER 2:

LITERATURE REVIEW AND PHARMACOLOGY OF DRUGS USED

A. PHARMACOLOGY:
1. Midazolam
2. Ketamine
3. Propofol
4. Alfentanyl
5. Glycopyrrolate
6. Local Anaesthetic agents:
   - 6.1 lignocaine
   - 6.2 Emla®patch

B. RATIONALE FOR COMBINING DRUGS

C. LITERATURE REVIEW

D. NON-PHARMACOLOGICAL BEHAVIOUR MANAGEMENT

A. PHARMACOLOGY OF DRUGS USED:

INTRODUCTION:

To achieve the goals of sedation namely:

- anxiolysis
- sedation
- amnesia [preferred in children]
- analgesia,

a multidrug mixture seems to be the most appropriate.

Conscious sedation is usually carried out by using one or more drugs administered by various routes.
In children however there is no ideal single agent.
Although this is a study project on multidrug sedation, I must state that drug therapy without behaviour management is impossible.
The success of the drug therapy depends on the patient's psychological preparation before drug therapy is initiated.
Conscious sedation is usually carried out by administering drugs inhalational, oral, intra-nasal, rectal, intramuscular, subcutaneous or intravenous.
Unfortunately, with these methods [except intravenously or inhalational] drugs cannot be titrated and many patients end up either over- or under sedated.
Over-sedated patients take a long time to recover, but more seriously are the risks of loss in airway protection and hypoxia.
This particularly proves a problem in dental procedures where the surgeon shares the airway with the patient.
An under-sedated patient is difficult to treat and has implications on the efficacy of the procedure.

The question may be asked: "What is the ideal route, as well as the ideal drugs for conscious sedation in children?"

1. ***The ideal route to achieve conscious sedation must be:***

- Painless,
- safe administration,
- easy to titrate.

The sedative drug must be titratable to achieve the ideal sedation level for specific procedures.
In this specific project you will see that the drug dose is more procedure dependant than dependant on the age or weight of the patient.
To explain better: a patient treated for dental extractions will need a higher dose of sedation agent than a patient having his teeth scaled and polished.
This is why it is important that a drug must be titratable.
Many times different procedures will be done on the same patient eg. dental fillings, extractions and prophylaxis.
Sedation levels will vary with each of the procedures indicated.
The most popular route for a titratable sedation agent is inhalational or intravenous.
The intravenous route is preferred, because a sedation beyond anxiolysis can easier be achieved.
With intravenous sedation it is also easier to use more than one drug.

2. ***The ideal sedation agent must have the following properties:***

1. Safe, anxiolytic, amnesic and analgesic properties
2. Painless administration
3. Predictable duration
4. Reversible
5. Absence of side effects
6. Quick recovery: fast onset/offset at various doses
7. Undergo rapid biotransformation to inactive metabolites
8. Clearance should be independent of duration of administration
9. Water soluble with long stability at room temperature
10. No interactions with other drugs
11. Minimal cardiovascular effects
12. Minimal respiratory depression
13. Low potential for anaphylactoid/allergic reactions

No single agent has all these characteristics, therefore I decided on a combination of drugs to achieve these goals.
Multidrug combinations can be safer with less side effects.
Especially when one uses a small dose of each of the drugs rather than a large dose of a single drug.
The synergistic effect [1+1=3] plus the addition effect [1+1=2] can be used to its advantage.
The sedation practitioner administers intravenous sedation agents either by increments of drugs calculated according to the child's weight and

response or as a continuous infusion calculated by milligram per kilogram of body weight per time period up to a clinical end period.

Both these methods were used in this study project as each patient's response differed to various drugs.
With conscious sedation, the intravenous sedation drug should not only be titrated to a fixed scale of example weight or age.
Each patient must be treated individually according to his response on the drugs used.

The following drugs were used during the process of conscious sedation in this project:

1. Midazolam
2. Ketamine
3. Propofol
4. Alfentanyl
5. Glycopyrrolate
6. Local anaestesia: lignocaine with adrenalin
   EMLA® Patch (transdermal therapeutic system)

1. MIDAZOLAM [DORMICUM ®]

CHEMICAL STRUCTURE:

Midazolam is a short acting benzodiazepine.
Benzodiazepines are most commonly used as sedatives and should be the first group of drugs to be considered.
Benzodiazepines have a large therapeutic index and the availability of a specific receptor antagonist, flumazenil, makes it reasonably safe.
Flumazenil blocks the central effects of agents acting through the benzodiazepine-receptor complex by competitive inhibition.
Benzodiazepines relieve anxiety, produce sedation, have anterograde amnesic properties, acts as a hypnotic, anticonvulsant and cause skeletal muscle relaxation.

Pharmacodynamics:

Midazolam is a derivative of the imidazobenzodiazepine group.
The free base is a lipophilic substance with low solubility in water.
The basic nitrogen in position 2 of the imidazobenzodiazepine ring system enables the active substance of midazolam to form water soluble salts with acids.
Midazolam possesses pronounced sedative and sleep-inducing properties.
It also exerts an anxiolytic, anticonvulsant and muscle relaxing effect.
After administration anterograde amnesia of short duration may occur. [1]
Unfortunately it has no analgesic properties.

Pharmacokinetics and distribution:

Absorption after IM injections:
Absorption from the muscle is rapid and complete.
The maximum plasma concentration is reached within 30 minutes.
Bioavailability is over 90%.

When midazolam is injected intravenously the course of the plasma concentration shows a short distribution of 5-15 minutes, followed by an elimination phase.
The volume of distribution calculated under steady state conditions is 0,7 - 1,2 litre/kg body weight.
Studies show a protein binding of 96 - 98%.

Metabolism:

Midazolam is completely metabolized and the primary metabolite is a alpha hydroxy midazolam.
The fraction extracted by the liver is 40-50%.
The active metabolite conjugates with glucoronic acid and is then eliminated by the kidneys.

Elimination:

The half life is between 1,5 - 2,5 hours in adults. In children it is shorter.
The elimination half life in children is 1-1.5 hours, but prolonged in neonates, due to an immature liver.

[1] Properties of an ideal sedation agent

When midazolam is given by IV infusion its elimination kinetics does not differ from those following a bolus injection.

DOSAGE AND DIRECTIONS FOR USE:

Midazolam is a potent sedative agent which requires slow administration and individualisation of the dosage.
A rate of administration of 1 mg over 30 seconds is recommended.
The dose should be individualised and titrated to the desired state of sedation according to the clinical need, physical status, age and usage of concomitant medication.[(1)]
Remember that the drug effect clinically presents only after 2 minutes post IV injection.

Premedication:

In children the dosage range between 0,375-0,5 mg/kg orally with a maximum dose of 7,5mg.

Conscious sedation:

Ideally the drug should be titrated with a loading dose of 0,025 – 0,05mg/kg and a maintenance dosage of 1-2 micrograms/kg/min intravenously.
Midazolam may also be administered by other routes:

- Per mouth: 0.5-0.75mg/kg with an onset of action between 10-30 minutes.
- Per rectum: 0.3-1mg/kg with an onset of action from 10 minutes.
- Nasal: 0.2-0.3mg/kg with an onset of action from 5-10 minutes.
- Intra muscular: 0.1-0.2mg/kg with an onset of action between 5-10 minutes.

I use both the oral and intravenous route in conscious sedation.

SIDE EFFECTS AND SPECIAL PRECAUTIONS:

Side effects most commonly encountered are drowsiness and over sedation.
Effects like nausea, vomiting, headache, hiccoughs, laryngospasm, dyspnoea and hallucinations have also been reported.

---

(1) Decrease the dosage in a multidrug sedation .

Double vision, or the inability to focus clearly can be a problem in smaller children.[1]
Midazolam can be considered a safe agent in the correct dose, but toxicity can cause paradoxal reactions,[2] confusion or life threatening respiratory depression and coma.
Fortunately the effect can be reversed with flumazenil.
Flumazenil can be given at 0,1mg/kg IV and can be repeated after 2 minutes up to a maximum of 1mg. Flumazenil has a rapid onset and the effect peaks within 6-10 minutes. The half life of flumazenil is 0.7-1.3 hours, therefore a repeated dose may be indicated.
Patients who have taken midazolam must always be discharged in the care of a responsible person.

Drug interactions:

Drugs like erythromycin may prolong the action of midazolam.
Enhancement of the central depressant effect may occur when midazolam is used with other hypnotics, narcotic analgesics, anti-epileptic drugs, anaesthetics and sedative antihistamines.
Midazolam potentiates the effect of opiates. When you use opiates, you have to reduce the dosage of midazolam to 0.25% of the original.
Midazolam works in synergism with local anaesthetic agents.
Be careful, it may mask the effects of local anaesthetic toxicity.

Midazolam is compatible with intravenous infusions like 0,9% sodium chloride, dextrose 5%, and Ringer's lactate.
Midazolam precipitates in sodium bicarbonate

PERSONAL EXPERIENCE:

In children younger than eight years [<30kg] I prefer to use half of a midazolam 7,5mg tablet [3,75mg] as premedication 30 minutes before the procedure.
I crush it with two teaspoons and mix with a little sugar, as the tablet is quite bitter to swallow.
This dose is not enough to sedate an average child, but causes enough anxiolysis, so that the moment I start with behaviour therapy the child is able to listen without fear.
It also helps with the anterograde amnesic effect if IV access is difficult to achieve.

[1] Double vision is very common in children
[2] This effect especially in children

As the clinical effect of oral midazolam is longer acting than that of IV midazolam, I find a low dose oral midazolam giving a level of anxiolysis that enhances the effect of the other IV sedation agents.
With initiation of the IV sedation I use another 1mg midazolam intravenously.
The basic idea here is to counteract the possibility of a hallucinogenic effect caused by the ketamine used later in the IV sedation mix.
I very seldom use another bolus of midazolam during the sedation procedure, except in very extreme cases where I know the problem is not pain or any other physiological problem, but anxiety.
I find sharing the airway with the dentist and using a drug that may cause respiratory depression an extra reason for caution. Therefore I do not use a continuous midazolam infusion.
There are other less respiratory depressing sedative drugs which can be used, especially in children undergoing dental procedures.
In patients who have not received the oral midazolam premedication [for whatever reason: too late, allergies etc.], I find the sedation procedure to be very sensitive – I have to titrate the IV sedation medication very carefully and the patients end up either too awake or too deep to make it a pleasant procedure.

2. KETAMINE

CHEMICAL STRUCTURE

Ketamine hydrochloride is a phencyclidene derivative and was introduced in 1965. Ketamine is classified as a dissociative anaesthetic agent producing a state of sedation, immobility, amnesia, marked analgesia, as well as a strong feeling of dissociation.

Dissociative sedation is defined as:

A trancelike cataleptic state characterised by profound analgesia and amnesia, with retention of protective airway reflexes, spontaneous respiration and cardiopulmonary stability.

Ketamine differs from other anaesthetic agents by not producing generalized depression of the CNS.
It is presented as a hydrochloric salt made isotonic with Sodium chloride.

Ketamine is known as a very old and safe agent in children.

Pharmacodynamics:

The chemical structure is 2-[o-chlorophenyl]-2-[methylamino]-cyclohexanone hydrochloride.
Ketamine is soluble in water and is presented as solutions of 10mg/ml containing sodium chloride to produce isotonicity, and in 50 or 100mg/ml multi dose vials which contain 0.1mg/ml benzethonium chloride as preservative. The pH of the solutions are 3.5-5.5. The pKa of ketamine is 7.5.

Pharmacokinetics:

Ketamine produces dissociative anaesthesia which is characterized by a state of sedation, immobility and marked analgesia as well as a strong feeling of dissociation.[1]
Ketamine has powerful analgesic properties and act as an NMDA [N-methyl-D-aspartate] receptor agonist, increasing glutamate at synapses. [2]
Ketamine is a potent somatic analgesic at sub-anaesthetic blood concentrations.
Ketamine is extremely lipid soluble.
After IV injection it can induce anaesthesia within 30-60 seconds.[3]
A single IV dose can produce unconsciousness for 10-15 minutes.[4]
Ketamine is also effective within 3-4 minutes after IM injection, and has a duration of action between 15-25 minutes.
Amnesia often persists for up to one hour after regaining consciousness.
Protein binding of ketamine is 20-25% and the elimination half life +/- 80 minutes [some articles say up to 150 minutes].
90% Of ketamine is excreted renally after extensive metabolism in the liver.
Hepatic dysfunction may elevate plasma levels and delay in elimination.
Norketamine is a major metabolite and has about one sixth of the activity of ketamine.
Distribution and elimination is slower if a benzodiazepine is administered concurrently.
Although induction of anaesthesia is smooth, ketamine may cause restlessness, disorientation and agitation.

[1] Please note : many of these effects are dose dependant
[2] See article of McCartney in literature discussion
[3] Dose dependant
[4] Dose dependant

Vivid and unpleasant dreams may also occur.[1]
Fortunately this can also be avoided by the concomitant use of benzodiazepines.
Nightmares are reported less commonly by children and older people.

SYSTEMIC EFFECTS:

Side effects increase with age. The incidence is 12.1% in children older than 5 years and 3.5% in children younger than 5 years.
Cerebral blood flow as well as intracranial pressure is increased.
Cardiovascular: Arterial pressure increases up to 25% and heart rate 20%. Myocardial oxygen demand increases as well as myocardial sensitivity to adrenaline. This is of clinical significance especially in dental sedation cases where local anaesthetic agents containing adrenaline are used.[2]
Respiratory effects: Transient apnoea may occur with high doses IV ketamine injection, but ventilation is well maintained thereafter.
Laryngeal and pharyngeal reflexes and a patent airway are well maintained in comparison to other sedative agents.
Ketamine is a potent bronchial muscle relaxer.
GIT: Salivation is increased. This effect can easily be reversed by using an anticholinergic drug like glycopyrrolate.
Eye movements may persist.
All these effects can qualify for adverse effects, when ketamine is used in the incorrect dosage for the wrong reasons on poorly selected patients.

INDICATIONS FOR USE:

Ketamine qualifies as an analgesic agent, sedation agent as well as an anaesthetic agent. All of these actions are dose related.

Analgesia and sedation**:**
Intra muscular 0.5-2mg/kg, repeated as required, or orally 8mg/kg or intravenously 0.25mg/kg.
Paediatric doses may vary a little.
IV onset of action is usually within 30 seconds with a duration of action for 10-15 minutes.
IM administration takes 3-4 minutes for the onset of action and the duration may last between 12-25 minutes.

[1] This is very seldom seen at sedative doses.
[2] See pulse speed increases in chapter 3.

Due to the excessive salivation caused by administration of ketamine it should be preceded by a suitable anti-muscarine agent like glycopyrrolate or atropine.[1]
The emergence reactions or hallucinations can be avoided by giving a suitable benzodiazepine.

QUALITIES THAT MAKE KETAMINE A GOOD SEDATIVE AGENT:

- The route it can be administered: orally, intra nasally, IM, IV or even rectal.
- Smooth induction of sedation
- Relative quick onset of action
- Relative short duration of action [dose dependant]
- It can either be used as bolus injection or continuous infusion
- Good analgesic and amnesic effect
- Compatible with other drugs
- Maintained respiration

MY EXPERIENCE:

The unique qualities of ketamine as previously discussed, make ketamine an ideal sedation agent if all the guidelines are followed.
The correct sedative dosage and the concomitant use of a benzodiazepine and anti-cholinergic agent should always apply.
I premedicate all patients with midazolam orally and use a small dose of midazolam [1mg] and 0.1mg glycopyrrolate IV before I use any ketamine.
I have not yet experienced hallucinations in children, though I have seen excessive salivation in children where I had to use ketamine IM.

3. PROPOFOL:

CHEMICAL STRUCTURE:

Propofol is classified as a short acting sedative-hypnotic with a quick onset of action.

[1] If no IV access is available it means another painful injection.

This phenol derivative was identified as a potential useful intravenous anaesthetic agent in 1980 and became commercially available in 1986.
Propofol is a white aqueous emulsion containing soyabean oil and purified egg phosphatide.
Ampules contain 200mg propofol in 20ml [1%]

PHARMACOLOGICAL ACTION:

Pharmacodynamics:

Propofol [2.6-di-isopropylphenol] is a short acting sedative hypnotic with a rapid onset of action of approximately 30 seconds.

The mechanism of action is poorly understood. The entire CNS is deactivated, but all the effects are dose dependant.
Cardiovascular there may be an initial drop in mean arterial blood pressure at induction, but the hemodynamic parameters remain stable during maintenance.
Respiratory effects are a drop in tidal volume, but increase in respiratory rate, but any clinical effects are easily manageable.
Propofol reduces cerebral blood flow, intracranial pressure and cerebral metabolism.
Recovery from anaesthesia is rapid and clear headed within 5-8 minutes.
Propofol is a strong anti-emetic agent and act also as an antipruritic.
Propofol has no analgesic properties.
Propofol has amnesic properties only if the dose exceeds 4mg/kg/h.

Pharmacokinetics:

Propofol metabolism can be described by the three compartment model.
The first phase is characterised by a rapid distribution [half-life 2-4 minutes], followed by rapid elimination [half-life 30-60 minutes] and a slower final phase of redistribution from poorly perfused tissue.
Propofol is extensively distributed and rapidly cleared from the body [total body clearance 2 litres/minute].
Clearance occurs by metabolic processes, mainly in the liver, to form inactive conjugates of propofol and its corresponding quinol, which are excreted in the urine.
The pharmacokinetics are linear over the recommended range of infusion rates.

With the usual maintenance regimens no significant accumulation of propofol occurs.

INDICATIONS FOR USE:

The FDA approved product information on propofol says " Diprivan® injection should be administered only by persons trained in the administration of GA and not involve themselves in the conduct of the surgical/diagnostic procedure."
Propofol is only used by intravenous route due to its short half life.
In the hands of trained and experienced sedationists, propofol can successfully be used as part of a balanced continuous infusion for sedation, combined with opioids, benzodiazepines and ketamine.

SPECIAL PRECAUTIONS:

Respiration must be monitored to ensure adequate gas exchange.
Special care should be taken if propofol is used together with other respiratory depressants.[1]
Anaphylaxis to propofol has been reported.
In epileptic patients the risk of convulsion may increase.
As propofol is a lipid emulsion, it is an ideal bacterial growth medium.
After 6 hours all unused propofol must be discarded.
General side effects like excitation, involuntary movement, hiccups, flushing and hypertension have been reported.
Local pain during induction can be a severe problem.[2]
The manufacturers recommend the co-administration of lignocaine.
I find this to be a problem in dental sedations as the dentist will also use lignocaine for local anaesthesia and one can easily run into a toxic dose.
I prefer to use an analgesic dose of ketamine to prevent this, or try to use a larger vein.

The propofol infusion syndrome made headlines lately:
This potentially fatal side effect of long term propofol sedation was described in children younger than 3 years. [3]
These children received high doses of propofol in doses ranging from 4-10 mg/kg/h for more than 48 hours.

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[1] Benzodiazepines; opiates
[2] See the use of ketamine to reduce propofol pain in the article by McCartney
[3] Withington DE, Decell MK, A case of propofol toxicity: further evidence for causal mechanism. Ped Anesth. 2004;14:505

Prolonged high doses of propofol in children younger than three years had an association with metabolic acidosis and multisystem organ failure. It was marked by sudden onset of bradycardia, lipemic plasma, metabolic acidosis, clinically an enlarged liver and occasionally rhabdomyolysis or myoglobinuria.
It can be treated with charcoal hemoperfusion and inotropic support, but can be fatal if not recognised early.

DOSAGE:

Propofol is not recommended for the use in children under the age of 3 years. The dosage required decreases with the increase in age.
An infusion of 0.1-2mg/kg/h has been advocated, but it is better to titrate by clinical response.
Due to its short half life, an electrical variable infusion pump method is best for obtaining and maintaining controllable levels of sedation.

MY EXPERIENCE:

I have used a continuous infusion of propofol combined with ketamine and alfentanyl for sedation successfully in children undergoing dental procedures.

4. ALFENTANYL

CHEMICAL STRUCTURE:

Alfentanyl is classified as a very potent, short acting, opioid narcotic analgesic.
Opioids may be used as the sole supplement to local or regional anaesthesia, but do not produce reliable sedation in the absence of significant respiratory depression.
Opioids can be classified by either their chemical structure or action on receptors.
Alfentanyl falls in the group of phenylpiperidines.
Alfentanyl is distributed under the proprietary name of Rapifen® and contains 0.544mg of alfentanyl/ml and sodium chloride 9mg in water.
Pharmacodynamics:

Alfentanyl is a synthetic derivative of fentanyl.
It has a high lipid solubility and acts within one arm-brain circulation time after IV administration.
Fentanyl is a synthetic opioid related structurally to pethidine [phenylpiperidines].
Alfentanyl differs from fentanyl, that in its analgesic potency it is four times less potent than fentanyl.
Its depressant effects on the respiratory rate and alveolar ventilation are also shorter than that of fentanyl.
In most cases the clinical analgesic effect lasts longer than the respiratory depressant effect.
The onset of action is four times quicker than that of an equi-analgesic dose of fentanyl, with the respiratory depressant effects peaking within one minute.
The duration of action is three times shorter than fentanyl, but is clearly dose related. Consequently, alfentanyl is more suitable for continuous IV infusion than fentanyl.
At high doses [>120 microgram /kg] alfentanyl can induce sleep. The induction is smooth, pain free and devoid of cardiovascular stress responses.
Recovery after alfentanyl is smooth and rapid.
All actions of alfentanyl are immediately and completely reversed by the specific antagonist naloxone hydrochloride.[1]
Alfentanyl is cardiovascular stable and don't cause any histamine release.

<u>Pharmacokinetics:</u>

Alfentanyl is rapidly eliminated after intravenous administration.
Sequential distribution half lives of 0.4-2.2 minutes and terminal half lives of 83-233 minutes have been reported.
The low degree of ionisation [11% at pH 7.4] contributes to a rapid, but limited tissue distribution. Reported volumes of distribution are 1.27-4.8 litre [volume of distribution of the central compartment] and 12.1-98.2 litre [volume of distribution at steady state].
Plasma protein binding is 92%.
Alfentanyl is mainly metabolised in the liver.
Only 1% of unchanged alfentanyl is found in the urine.
Metabolites are inactive and 70-80% of them are eliminated via the urine.
The plasma clearance in young children average 356ml/minute and decreases with age.

[1] An ideal sedation agent must be reversible

Accumulation may occur with prolonged continuous infusion or with repeated administration of single doses.

INDICATIONS FOR USE:

Alfentanyl may be used as a narcotic analgesic, or an anaesthetic induction agent. Used as bolus doses or a continuous infusion.

SPECIAL PRECAUTIONS:

Be careful to use alfentanyl in patients who are respiratory compromised. The most common adverse reaction that may occur is respiratory depression.
The respiratory depressing effect is more likely when the intravenous dose is given too rapidly.
Also be careful in patients with myopathies. Alfentanyl may cause myoclonic movements and muscle rigidity of the chest wall. This can be avoided by slow intravenous injection and benzodiazepine pre-medication.
In children, alfentanyl may decrease the heart rate by means of increasing vagal activity. This effect can be antagonised by the use of atropine. The heart rate should be monitored carefully. It is advisable to pre-administer an anticholinergic in children.
Opiates may cause nausea. Droperidol can be used to prevent nausea and vomiting [although when I used alfentanyl in combination with propofol, I have never found it necessary to use droperidol].[1]
Medicines such as neuroleptics, barbiturates and benzodiazepines potentiate the effect of alfentanyl.
As alfentanyl is metabolized via the cytochrome P450 3A4 enzyme system, the metabolism may be inhibited by erythromycin and fluconazole. This may prolong the repiratory depressant effect and patients must be carefully observed when using these medicines.

DOSAGE AND DIRECTIONS FOR USE:

The dosage of alfentanyl should be individualized.
Some factors to be considered in determining the dosage are:

- age,
- body mass,

[1] Droperidol is not the ideal agent in an outpatient situation due to its long half life.

- physical status,
- use of other medicines,
- type and duration of surgical procedure.

In children, the initial dose should be higher, but the initial effect should be taken into account in determining the supplemental doses.
Alfentanyl in small doses is useful for minor, painful surgical procedures and for outpatients, provided good monitoring equipment and resuscitation equipment are available.
Alfentanyl at an infusion rate of 1 microgram/kg/min has been advocated as sole agent, but I find that in conscious sedation the dose is much lower.

MY EXPERIENCE

Alfentanyl may be used as a sole supplement to local anaesthesia, but do not produce reliable sedation in the absence of significant respiratory depression.
Therefore I use it in combination with a benzodiazepine [midazolam] and other hypnotic agents like propofol and ketamine.

5. GLYCOPYRROLATE:

CHEMICAL STRUCTURE:

Glycopyrrolate is classified as an anticholinergic agent.

Pharmacological action:

Glycopyrrolate, like other anticholinergic agents, inhibits the action of acetylcholine on structures innervated by postganglionic, cholinergic nerves and on smooth muscle that respond to acetylcholine, but lacks cholinergic innervation.
The peripheral cholinergic receptors are present in the autonomic effector cells of smooth muscle, cardiac muscle, the sinoatrial node, the atrioventricular node, exocrine glands and to a limited degree in the autonomic ganglia.
Therefore, glycopyrrolate diminishes the volume and free acidity of gastric secretions and controls excessive pharyngeal, tracheal and bronchial secretions.

Glycopyrrolate antagonizes muscarinic symptoms such as bronchospasm, bradycardia and intestinal hypermotility induced by cholinergic drugs.
Glycopyrrolate has a highly polar quaternary ammonium group in its structure, which limits its passage over lipid membranes, such as the blood brain barrier.
This is in contrast with atropine, with a tertiary ammonium structure, which penetrates lipid membranes easily.
Peak effects of glycopyrrolate occur within one minute after IV injection.
The vagal blocking effect persists for 2-3 hours, while the antisialagogue effect may last up to 7 hours.
Glycopyrrolate may also be administered subcutaneously or intra muscular.

INDICATIONS FOR USE:

Glycopyrrolate is indicated for use pre-operatively as an anti-muscarinic agent to reduce salivary, tracheobronchial, and pharyngeal secretions.
Anticholinergic: to block vagal responses due to cholinergic drugs.
It is very useful in blocking the vagal activity of alfentanyl and to reduce the secretions caused by ketamine.

SPECIAL PRECAUTIONS:

Be very careful when you use glycopyrrolate in patients with asthma and glaucoma.
Adverse effects in general may include a dry mouth, urinary hesitancy, blurred vision, tachycardia and palpitations.

DOSAGE AND DIRECTIONS FOR USE:

The recommended dose IM for pre-anaesthetic medication is 0.004mg/kg-0.008mg/kg. To block vagal responses a single IV dose of 0.1mg is recommended.
Glycopyrrolate is compatible to use in Ringers Lactate and Saline infusions.

MY EXPERIENCE:

I like to use a single bolus dose of 0.1mg glycopyrrolate IV before any sedation medication is given, to block the vagal effect of alfentanyl and reduce the secretions caused by ketamine.

6. LOCAL ANAESTHETIC AGENTS:

6.1 LIGNOCAINE

Reliable and safe pain control is a prerequisite for any sedation/surgical procedure.
In general dental practise, local anaesthetics are administered as a matter of routine and it is estimated that +/- 2 million dental injections are administered world wide each day.
The most commonly used local anaesthetic is lignocaine, but for special conditions prilocaine is also used.

CHEMICAL STRUCTURE:

The three constituents of a local anaesthetic solution are:

- The anaesthetic agent: lidocaine, mepivacaine or prilocaine
- The vasoconstrictor: adrenaline, noradrenaline
- The preservative: sulphites, parabens

Lignocaine can be presented in different commercially available combinations:

- Xylotox E 80A® 2%: Containing lignocaine HCL 20mg/ml with adrenaline 1:80 000 and preservative Na Metabisulphite
- Xylotox L® 2%: Containing lignocaine HCL 20mg/ml with noradrenaline 1:80 000 and preservative Na Metabisulphite
- Xylotox SE®: Containing Lignocaine HCL 20mg/ml without adrenaline or a preservative.

Pharmacodynamics:

The local anaesthetic agents start a reversible process whereby pain impulses travelling along a sensory nerve is blocked and so prevented from reaching the somatic sensory cortex in the brain.
Here the patient is awake, and analgesia is confined to the area of innervation of the nerve involved, which is in contrast with general anesthesia.
Except for prilocaine, most local anaesthetics are tertiary amines.

The free form of the local anaesthetic agent is unstable in air and insoluble in water, but combined with a hydrochloride salt to render it stable and water soluble.

Pharmacokinetics:

Lignocaine is classified as a medium acting amide.
Lignocaine is about 2 times as potent and toxic as procaine [ester linked].
It is used in concentrations of 2%-3% for dental treatment.
It offers good penetrative power, rapid onset, and intermediate duration of nerve anaesthesia.
In the plain form it has slight vasodilative activity and duration of action can be from 30 minutes to 120 minutes.
With the addition of a vasoconstrictor the duration of action can be 180 minutes or more.
Without the vasoconstrictor, the rate of systemic absorption from the injection site is rapid, with a greater risk of toxic blood levels.
The way in which local anaesthetic agents reach vital organs, start at the area of injection. Here venous absorption into the circulation commences as soon as the local anaesthetic is released into the tissue. The speed of absorption will depend on the degree of vascularity, vasoconstriction or -dilatation in the area of absorption.

From the oral cavity, the route to travel is via the vena cava to the right heart, pulmonary artery into the circulation.
Peak circulating blood levels of local anaesthetic agents are reached within 10-15 minutes after intra-oral injections.
Elimination time of lignocaine plain is 63% in 2 hours and 41% in 2 hours for lignocaine with adrenaline.
Elimination and absorption may be quicker in children, but maximum doses should always be based on body weight.[1]

ADVERSE EFFECTS AND SPECIAL PRECAUTIONS:

The standard maximum dosage for lignocaine is 4,3mg/kg lean body mass. [Be careful of the application of highly concentrated topical preparations]
The perception that doses of local anaesthetic agents used in dentistry are too small to give adverse effects must be rejected.
The high vascularity of the oral cavity lends itself to rapid absorption of both injected and topically applied local anaesthetics.

[1] Quick reference: 1 cartridge of Lignocaine 2% with adrenalin per 7kg body weight

Toxic effects are reported with blood plasma levels of lignocaine ranging from 2 - 6 micrograms/ml.
Toxic effects are often insidious and unexpected.
Any change in mental or hemodynamic status of a patient receiving lignocaine should be considered due to toxicity.
Early signs of toxicity:

- Dizziness, drunken feeling
- Warm, flushed feeling
- Tinnitus
- Paraesthesia around the lips, fingers and toes

Later signs of toxicity:

- Hyperventilation, muscle twitching
- Nystagmus
- Shivering
- Respiratory failure
- Loss of consciousness
- Cardiovascular collapse

All these symptoms may be very difficult to detect when a patient is under conscious sedation.
Therefore the sedationist must monitor the amount of local anaesthetic extremely careful.

Drug interactions:

Drug interactions can potentiate the depressant effect of local anaesthetic agents synergistically or additively.
Any drug that has depressant effects on the cardiovascular or central nervous system, when used in combination with local anaesthetic agents can potentiate the effects and lead to toxicity:

- Narcotic analgesics: pethidene, alfentanyl
- Anti-emetic sedatives: chlorpromazine
- Antihistamines
- Benzodiazepines

Sedative drugs used in conscious sedation in combination with local anaesthetics should be administered with extreme care, especially in children, who are more prone to adverse effects.
Clinicians should stay within the prescribed therapeutic ranges and should consider the combined effects.

Adequate patient monitoring should be undertaken, and a trained sedation practitioner in appropriate facilities would be a much safer idea.

Vasoconstrictors in local anaesthetic agents:

Vasoconstrictors serve a good purpose in local anaesthetic agents:

- It prevents rapid development of toxic blood levels
- Ensure sufficient quality and duration of nerve anaesthesia
- Controls bleeding in order to obtain a clear operative field as well as post operative bleeding.

Adrenaline:

Adrenaline elicits the same effects as the physiologically released hormone.
The alpha 1 and beta receptor effect lead to the following:

- Increased heart rate and force of contraction resulting in increased cardiac output and myocardial oxygen demand.
- At low doses the alpha effect predominates with constriction of the vessels in mucous membranes, skin and kidneys, with dilatation of vessels in the skeletal muscle.
- Bronchial smooth muscle relaxes, which can bring relief in asthma patients.
- Metabolically it can elevate blood sugar.
- In children all these effects must be taken in consideration when other drugs for conscious sedation are used.

MY EXPERIENCE:

Always count the ampoules of local anaesthetic that the surgeon uses and make a quick calculation: Maximum: 1 cartridge/7kg of bodyweight.

6.2 EMLA PATCH ® [TRANSDERMAL THERAPEUTIC SYSTEM]

One Emla® patch contains lidocain 25mg plus prilocain 25mg.
An Emla® patch is a unit dose formulation of EMLA® in the form of an occlusive dressing.

An absorbent cellulose disc saturated with 1g of Emla® emulsion 5% is affixed to a laminate backing equipped with an adhesive tape frame.

PHARMACOLOGICAL CLASSIFICATION:

Local anaesthetic agents

PHARMACOLOGICAL ACTION

Lidocain and prilocain are amide-type local anaesthetic agents.
They stabilize neuronal membranes by inhibiting the ionic fluxes required for the initiation and conduction of impulses, thereby producing local anaesthesia.
The quality of the local anaesthesia depends on the application time, thickness of the skin and application area.
The Emla® patch provides dermal anaesthesia through the release of lidocain and prilocain when applied to intact skin.
The depth of anaesthesia increases with application time – 3mm after 120 minutes of application time.
The Emla® emulsion produces a biphasic vascular response involving initial vasoconstriction followed by vasodilatation on the application site.

CONTRA INDICATIONS:

Be careful in patients allergic to the amide type local anaesthetics and patients with congenital methemoglobinemia.
Be careful in children with atopic dermatitis – a shorter application time is sufficient.
In some cases an initial burning or itching may be reported, but it is transient.

MY EXPERIENCE:

I use Emla® patches on all the children before IV cannulation.
All children receive an EMLA® patch to take home and be applied at least 2 hours before the procedure on a suitable vein.
Usually the site of application of the EMLA® patch is identified when the child is booked for the sedation and procedure.
I find the best place is on top of the hand, but on very small children on top of the foot will also do.

When you put up an IV cannula on a small child and want to continue with a sedation, you need to do it as painless as possible.

It is extremely important to put the Emla® patch on the best site.
In a very small child it is difficult to reach the site if it is on the inside of the elbow, because it is usually the area where the dental tray is.
It makes it even more difficult to reach when you use the venflon IV cannula which has an injection site and you want to give a quick bolus dose of medication.

I usually put a sticker on the Emla® patch and ask the mother to strap it securely with some cello tape.
Then the child is less tempted to pull the patch off.

It is very important to make sure that the mother/caregiver knows exactly how to put the Emla® patch on.
Explain to them that they have to pull off the protective foil layer and apply the skin coloured patch and not to press on the center of the patch where the Emla® saturated pad is.

An Emla® patch on the correct area, applied for at least two hours, can make the difference between a successful and failed intravenous sedation.

B. RATIONALE FOR COMBINING DRUGS:

The aim in this case study project was to do a safe conscious sedation for a child younger than eight years in the dentist's rooms.

The properties of an ideal sedation agent were previously discussed.[1]
In the pharmacology review, not one single agent met all the criteria.

By using a single agent intravenously the child would end up over- or under sedated. In a small child weighing less than 30 kg this is even more critical.

With the information on all the previous drugs, I can apply the multimodel scientific basis for combining drugs, described by Kehlet, to do this case study project.
By combining drugs we get a synergistic [1+1=3] or addition [1+1=2] effect, producing sedation and analgesia with fewer side effects.

The rationale for a multidrug mixture is to use a benzodiazepine for its sedative, hypnotic and amnesic effects.
Add the sedative and analgesic effects of an opioid [narcotic analgesic].
Use the safety, sedative and analgesic effects of a dissociative agent like ketamine and combine it with the ideal combination drug [propofol] which has sedative and amnesic properties and an excellent pharmacological profile.

Propofol seems to be the ideal drug to combine with other drugs:

- Rapid onset and recovery
- Lack of active metabolites
- Provide sedation and amnesia

Ketamine seems to be the ideal drug to combine it for:

- Analgesia
- Sedation
- Amnesia

When studying the literature, is seems that propofol can block ketamine induced hallucinations, if not already blocked by the benzodiazepine.
Propofol is a good anti-emetic, which can counteract the nausea caused by opiates.
There is better post-operative analgesia when ketamine was used for sedation.[2]
Local anaesthesia was tolerated better after the use of ketamine.
Midazolam works synergistically with opiates as well as with local anaesthetic agents.

[1] See page 8
[2] Preventative analgesic effect of ketamine

Side effects like vagal activity and cholinergic effects could easily be blocked by using an anti-cholinergic like glycopyrrolate.

By combining these drugs, a safe, low-dose mixture can be used to achieve conscious sedation in children.

C. LITERATURE REVIEW:

Arya and Damle published a comparative evaluation of midazolam and propofol as intravenous sedative agents in the management of unco-operative children [2-5 years] receiving dental treatment.
The results showed both agents to be effective for short pedodontic procedures and had minimal side effects. [3][1]

Funk and Jacob reported on a study using midazolam and ketamine in combination orally as pre-medication.
They found good anxiolysis, sedation and response on venopuncture. [9]

Pruitt did a study in 1995 on the intramuscular route of ketamine 3mg/kg plus midazolam 0.05mg/kg plus glycopyrrolate for the use in an emergency setup for children with facial injuries.
Onset of sedation was within 6 minutes and time to discharge averaged 76 minutes.
This approach was rendered safe, effective and practical, although advanced airway management proficiency was recommended and all the procedures were done in the emergency department. [25]

Ruiz did a study on propofol sedation in general dental practise, but found that requirements exceeded the upper limit of recommended dose ranges[2] and was not appropriate for single operator/sedationist.
The patients nevertheless were very satisfied. [29]

Parker published a study on the efficacy and safety of intravenous midazolam [0.05mg/kg] and ketamine [1-2mg/kg] used for sedation in therapeutic and diagnostic procedures in children.
He found it to be safe and effective and it has greatly reduced patient and parent anxiety. [23]

[1] See bibliography for details
[2] Rationale for combining drugs

Wathen did a study on the frequency of adverse effects in children receiving IV ketamine and midazolam for sedation.
Midazolam did not alter emergence reactions, but children receiving ketamine alone experienced more nausea and vomiting.
The combination of ketamine [1mg/kg] and midazolam [0.1mg/kg] IV lead to more oxygen desaturation.
Parental and physician satisfaction were rated high in both groups. [36]

Sullivan and Wilson used oral ketamine 8mg/kg-10mg/kg in combination with diazepam in paediatric dental patients.
Success rates were between 28-44%. [31]
Personally I don't think the use of diazepam [with a very long half life] is such a good idea in an outpatient situation. Midazolam has a shorter half life and is easy to use orally as well as intravenously.

Litman did a study on the use of remifentanil for sedation in painful surgical procedures.
He found that every time ketamine had to be used for pain relief, as the adequate dose of remifentanil caused severe respiratory depression. [16]

In 1998 Prof JA Roelofse published a study comparing oral trimeprazine-methadone [3mg/kg-0.2mg/kg] with ketamine-midazolam [5mg/kg-0.35mg/kg] for sedation in paediatric patients undergoing dental procedures. Analgesia was achieved by the use of local anaesthesia.
The surgeon rated the ketamine-midazolam group better then the trimeprazine-methadone group.
This study rendered ketamine-midazolam orally as a safe, effective and practical approach to managing children for minor dental procedures. [27]

Unfortunately there was also a study published in 1997 where a child developed severe hypoxia with the use of ketamine 5mg/kg and midazolam 3.5mg/kg orally.
This was a single case study and I wonder if other factors were not overlooked.

A study on midazolam or midazolam combined with ketamine administered rectally for children having dental procedures was published by Roelofse and Joubert in 1996.
They found it to be safe, effective and practical, although excessive salivation and hallucinations were quite common.[1] [28]

[1]By rather using IV sedation there is already IV access to treat side effects.

Tobias did a study in 1999 evaluating respiratory effects of sedation regimens and focused on end tidal carbon dioxide monitoring and pulse oximetry to evaluate the respiratory effects of midazolam and ketamine. The conclusion was that the adverse effects of the midazolam-ketamine combination were lower than that reported with other commonly used regimes. [33]

Back in 1994 Lu wrote in the ASDC-J-Dent that hypnosis in combination with chemical sedation using ketamine to be extremely effective in overcoming stressful and frightening aspects of dental care in paediatric patients.[1][18]

McCartney wrote in Anaesthesia and Analgesia 2004 that in 58% of studies, the pre-operative administration of ketamine reduced pain, analgesic consumption, or both, immediately and beyond clinical duration of action of the drug when used preventatively – 'preventative analgesia'.[2][19]

Younge compared the efficacy of oral ketamine [10mg/kg] with oral midazolam [0.7mg/kg] in providing sedation for suturing lacerations in children.
In these doses tolerance to LA injection was better in children receiving ketamine, with fewer behaviour changes following in the next 2 weeks. [41]

Morse reported on the use of BIS monitoring during IV sedation using a combination of midazolam-ketamine for oral surgery.
He found BIS [bispectral index] levels to be close to baseline levels and no additional benefit to currently established methods of monitoring patients. [22]

Hosey published a study in 2004 on the use of subanaesthetic doses of propofol IV in anxious children undergoing dental treatment.
The mean range was 2.5 mg/kg propofol used. He concluded that this dosage facilitated operative dental treatment in anxious children. [11]

Barbi reported in 2004 on the pre-treatment with ketamine to reduce propofol infusion pain in children.
Group 1 received ketamine 0.5mg/kg and atropine before propofol injection and the second group received atropine and a mixture of lignocaine and propofol.

[1] I find it impossible to do conscious IV sedation without behaviour management.
[2] Ketamine is an excellent analgesic at sub anaesthetic doses.

The ketamine group reported 8% pain on injection with propofol, while the lignocaine/ propofol group reported 37% pain with injection. [1][4]

D: NON-PHARMACOLOGICAL BEHAVIOUR MANAGEMENT

AIM**:**

The aim of behaviour management in this study project is to instil a positive dental attitude.
It does not imply just the behaviour necessary to complete a given task, but includes creating a long term interest on the patient's part, for ongoing prevention and improved dental health in the future.

Behaviour management aims to give children coping strategies.
That does not mean to trick the child into an experience.
To achieve a coping strategy, the sedationist and the dentist must establish a relationship based on trust with the child and parent.
This will ensure compliance with preventive regimens and allow treatment to occur.

Behaviour management is based on two parts:

- communication and
- education

It is the relationship between the patient, the family, the sedationist and the dental team.
Usually it starts when the patient is booked for a procedure.
Building the relationship starts with oral and written information to the patient and the parent [if the patient is a child].
When the patient arrives at the surgery for the procedure and sedation, the relationship will continue with dialogue, voice tone, facial expression, body language and touch.
You have to be very sensitive to each child's needs, as not all these techniques will be applicable.

REASONS FOR A CHILD'S BEHAVIOUR**:**

[1] This is significant, as the manufacturors of propofol still advise the use of lignocaine to prevent propofol infusion pain

Children are frequently labelled as unco-operative when they have experienced difficulty at the dentist's rooms.
Remember, children seldom choose to go to the dentist.
It is usually the parent's decision or an acute dental problem.
Many parents have the same anxiety for the dentist and transfer it directly to their children.
Children have relatively limited communication skills and are less able to express their fears and anxieties.
Their only means to show their inability to cope is by their behaviour.

Children must rather be described as potentially co-operative and pre co-operative.
Examples of pre co-operative children are:

- very young children or
- children mentally disabled to co-operate.

FACTORS INFLUENCING A CHILD'S BEHAVIOUR**:**

Children are not small adults and the appropriate language and behaviour techniques according to their age must be applied.

- History: children with a previous bad medical experience are more likely to express poor behaviour at following visits.

- Parental anxiety: parents project their fears directly and indirectly to their children. Children reflect their parent's own perceptions, experiences and anxieties.

- Existing dental problem: a child who knows that he has a dental problem is more likely to exhibit negative behaviour at his first visit. Usually it is the fear of experiencing more pain.

- Communication: With children, one on one communication is necessary. Many times parents or dental assistants want to help, but by interfering they cause more problems. Communication with the parent must be a separate issue. I prefer talking to the parent first and then give my full attention to the child. The parent is allowed to sit in the room, but without any interference. Remember to use age appropriate language. Non verbal communication takes place all the time.

- Role of the parent: I prefer the parent to be a silent helper. The parent is allowed in the room, until the child falls asleep. They provide a comforting presence, without unhelpful interference. As soon as the procedure is completed, the parent is allowed back in the room.

Research suggests that children up to 4 years still have separation anxiety, although I think all children going through a stressful experience do better if a familiar person is present.
It is important to explain practise policies concerning the presence of the parent during the procedure beforehand.
I also find it difficult to concentrate on the patient when I do a sedation if a parent is present.
Many times the parent wants to ask questions like: 'Why is the child's eyes open and not closed ?, 'Is he really asleep?', 'Does he feel any pain?' etc.
I find myself all the time trying to explain to the parent, rather than giving my full attention to the child under sedation.[1]

BEHAVIOUR MANAGEMENT TECHNIQUES:

1. ***Before the procedure:***

- Information letters:

A nice informative letter to the parent and patient explaining exactly what is going to happen will help a lot.
Contact telephone numbers to sort out any uncertainties must be part of the letter.
Information on the exact time of arrival at the surgery, time of the procedure, time of discharge and aftercare must be included in the letter.
[2]Advice on preparing the child for the procedure and the role of the parent will make them feel an active part of the team.

2. On the day of the procedure:

- Non verbal communication:

Physical contact, like a gentle pat or hug, has been found to be more effective than verbal reassurance to minimise anxiety.

[1] The sedationist is still the most important monitor during a sedation.
[2] You do get parents who don't read the letter at home, I have now started to print critical information on the outside of the envelope.

- Voice control:

It is important to know that young children respond better to the tone of your voice, than the actual words spoken. You can use voice control techniques like altering the tone, volume and pace to gain your patient's attention.
This will not only gain attention, but also establish authority. Voice control has been shown to decrease disruptive behaviour without long term negative effects.
Just make sure you have explained everything to the parent.

- Tell-show-do technique:[1]

I find this the most satisfying of all behaviour management techniques.
I make sure the children know why they are in the dental chair.
Then I show them what each instrument is used for and use age appropriate language to explain it with.
For example: Tell them a sedation is like sleeping in front of the TV – although there is a noise going on you will still be able to sleep.
The probe of the pulse oximeter is the remote control of the TV [all children like to be in charge of the remote control].
The drill is the star machine, putting some beautiful stars on your teeth.
Show them and let them feel on their hands [obviously without the drill tip] the ticklish feeling.

I can't stress too much what a big difference this has made in my sedation techniques.
It has changed my technique from a deep unco-operative patient to a nearly awake co-operative patient.
The only important message here is that you need time!
I find the parents also more willing to leave the room when they realise that their child is happy with a drill in his mouth, and actually quite excited to find out what will happen next.
Many times this will also decrease the anxiety of the parent.
One of my practical examples is a child who needed a second sedation for a lot of dental fillings and extractions. He could not wait and was very excited to get to the dentist's rooms.
The words of the mother were: 'I don't know what is wrong, because he is so excited to come to the dentist.' [unfortunately she has never overcome her fear for the dentist - hopefully soon!]

[1] McKnight-Hanes C., Myers D.R., Dushku J.C.,et al (1993) The use of behaviour management techniques by dentists across practitioner type, age, and geographic region. Pediatr Dent 15:267-271

- Enhancing control:

This is a technique where children are made aware that they are still in control.
Not control of avoiding the situation, but rather the possibility of influencing how it is experienced.
They will be able to show when it hurts, and we usually agree on a specific sign like lifting one hand.
Research by Wardle has found that 15% of children given a stop signal could handle pain, while more than 50% reacted severely to pain when they did not receive a specific stop signal.[1]

- Positive reinforcement:[2]

Behaviour that is reinforced is likely to occur again, while inappropriate responses must better be tried to be ignored.
You have to be specific in your praise. It is better to say: 'you have held your head very still', than to say: 'you are a good boy'.

- Distraction:

This is a technique I use quite often, when I think there is unnecessary stress that is not going to improve the patient's behaviour – like seeing the needle I put the IV catheter in with.
When I want to do the IV cannulation I will show the child the plastic tubing of the infusion line and explain that I am going to strap it to his hand where the EMLA® patch has been. Then the assistant will distract him with a sticker or a temporary tattoo which he can select from a box. Usually we have a race to see who has finished first, my 'plaster' or he and the assistant putting up the temporary tattoo on the opposite arm.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

[1] Wardle, J.(1982) Management of dental pain. Paper presented at the British Psychological Society Annual Conference, New York, 1982.
[2] Weinstein P and Nathan J. (1998) The challenge of fearful and phobic children. Den Clin N Amer.

A. Patient selection
B. Instructions to patients
C. Pre medication
D. Intravenous sedation process
E. Monitoring
F. Evaluation criteria
G. Facilities for resuscitation

A. PATIENT SELECTION

Benefits of sedation for the patients include:

- Overcoming the 'fear factor'- patient satisfaction
- Early discharge
- Less side effects
- Cost factor
- Communication
- Well informed patient
- In children –comforting presence of the parent

Patients were selected by the following categories:

1. procedure
2. patient: positioning / fitness
3. surgeon
4. aftercare
5. location

1. Procedure:

Procedure selection: a. Type of procedure
b. Duration of procedure

a. Type of procedure:
In this case study project 239 children undergoing dental surgery were selected.
Dental surgery is most suitable for conscious sedation, as adequate local anaesthesia can be used for pain relief and deep sedation is not needed.

The dental procedures being performed in this project were limited to dental fillings, extractions and minimal invasive procedures like frenectomies.
More invasive procedures in children did not qualify for sedation outside the hospital environment, as fluid balance monitoring and systemic analgesia were involved.

b. Duration of procedure:
The time duration of the procedure was also a limiting factor.
Usually after 90 minutes some children start to get restless.
They have to lie in the same position and physiological factors like a full bladder can make a child very restless.

2. Patient:

2.1 Patient positioning: Anatomy of a child

Patients can be well positioned in the dental chair, as it is able to move in different directions.
The headrest is able to move or be removed completely.
The dentist and the patient share the oral cavity and thus the airway, which make positioning critical.
Children may have a relative large occiput, short neck, and large tongue.
Sometimes the mandible may be underdeveloped.
The larynx is higher in the neck [C3-4] compared to the adult [C5-6].
The child can be ideally positioned with a small towel rolled under the neck and the headrest a little lowered.
Extension of the atlanto-occipital joints result in alignment of the oral, pharyngeal and tracheal axes.
Proper positioning places the external ear canal anterior to the shoulder.

2.2 Patient Fitness for sedation:

For this specific project, all patients needed to be under the age of eight years.
Patients had to be fit and healthy and classified ASA 1 or 2.

ASA SCORE SELECTION CRITERIA:

- I: A healthy patient
- II: A patient with mild systemic disease, no functional limitation

- III: A patient with severe systemic disease that limits activity but is not incapacitating
- IV: A patient with an incapacitating systemic disease that is a constant threat to life
- V: A moribund patient not expected to survive 24 hours with or without an operation

Children with an acute illness, flu or extreme tachycardia were also excluded in this project.
As the patients didn't receive additional oxygen during the sedation procedure, these situations would cause an increased oxygen demand leading to hypoxemia.
Children classified ASA 2 who qualified for sedation outside the hospital, were usually children with well controlled asthma and no acute illness. They usually had an oxygen saturation above 98% before the procedure.
A blocked or runny nose, acute sinusitis, excessive snoring with enlarged tonsils and adenoids or any other abnormality in the upper respiratory tract disqualified a child for sedation outside the hospital environment.
If treatment was urgent the child would rather be booked for a general anaesthetic.
The above selection criteria are very important as the patient and dentist share the airway.

3. Surgeon:

The surgeons selected all the patients who qualified for treatment.
All surgeons were familiar with the sedation technique and procedure and knew the limitations of sedation.
Any surgeon who had not worked under sedation previously was required to first assist during a sedation procedure and then work under supervision.
Surgeons differed concerning the type of procedures they felt comfortable doing under sedation.
Unexperienced surgeons preferred short procedures, like extracting a few teeth, while other surgeons were comfortable with procedures exceeding an hour.
All surgeons were required a BLS [basic life support certificate] to assist in emergency situations.
Surgeons preferred working in their rooms.
Patients that needed X-rays taken were easier treated in the rooms.

4. Aftercare:

Patients received verbal as well as written orders on aftercare when they were booked for sedation.

This included information on:

- time of arrival at the surgery
- the time to be spend at the surgery
- time of recovery at home
- side effects of medication used – including the numb feeling caused by local anaesthetic agents
- special instructions on eating/drinking
- instructions on pain relief post operatively
- transport to and from the surgery
- availability of a responsible person when the child went home after a sedation
- information on when to resume normal activities eg. going to school again

5. Location:

All surgeries had sufficient space to do sedations in.
Some of the surgeons even plan special surgical rooms for sedation patients in future.
A separate recovery room was also available in all the surgeries.
The personnel were well trained and most of them had done a BLS for healthcare assistants.
Most of the surgeries have emergency equipment.
I preferred to bring my own, as well as my own monitoring equipment as I then knew that it was in good working order.
All surgeries were in Uitenhage.
A private hospital, as well as a government hospital are within 5 minutes drive from the surgeries.
Both facilities have good emergency rooms as well as ICU [intensive care unit] facilities.
Patient selection was from town, as well as the different townships within a few minutes drive.
Patients from rural areas stayed in town with family or friends for the night following the procedure.

B. INSTRUCTIONS TO PATIENTS:

1. INFORMATION THAT WAS GIVEN BY THE SURGEON:

- Basic explanation of a sedation procedure as well as the surgical procedure.
- Advantages and disadvantages of sedation versus general anaesthesia.
- Consent to the procedure as well as financial implications.
- Date and time of the sedation and procedure.
- Time of arrival at the surgery.
- Time to be spent at the surgery: duration of the procedure, as well as the recovery period.
- Time needed for recovery.
- Pre operative instructions: identify a suitable vein, explain where, why and how the EMLA® patch must be applied.
- Explain the role of the Dormicum® tablet.
- Explain that sedation is the treatment of choice, but always a chance of not being successful, an alternative is general anaesthesia.
- Post operative care: a responsible person need to be available for at least four hours
- Transport home must be arranged in advance and a crowded taxi is not the ideal transport!

2. WRITTEN INFORMATION SUPPLIED BY THE SEDATIONIST:

All patients were supplied with a standard written information brochure which contained the following information:

- The brochure explains what a sedation is.
- That the child will receive oral as well as intravenous medication for the sedation.
- The child may or may not receive local anaesthesia.
- Side effects of the drugs are explained, like amnesia, double vision, nausea, numbness due to local anaesthesia and the child's likely reaction.
- Instructions for the Emla® Patch, how it needed to be applied, as well as for how long and where [this is quite critical- if it is not applied correctly it is ineffective]
- Time to be nil per mouth: clear fluids – 2 hours, time of the last meal: 4-6 hours.

- A consent form to complete by the legally competent person.
- Information required: personal, medical aid, authorizations etc.
- A medical questionnaire to complete before the procedure.
- Contact numbers for both the dentist and the sedationist were included.
- This written letter is included in an envelope containing the EMLA® patch as well as an alcohol swab and a 7.5mg Dormicum® tablet.
- Instructions on the use of the Dormicum® tablet, not to be given at home, but to bring it to the surgery.
- All patients had to be at the surgery at least 30 minutes prior to the procedure.

3. THE FOLLOWING ARE EXAMPLES OF WRITTEN INFORMATION THE PATIENTS RECEIVED:

a.

Patient Details & Consent for Dr EJ Bester

Patient's name and surname and date of birth :
Mr Ms Mrs Master .....
.....
Member's name and surname:
.....

Medical Aid:.....
Number:..... dependant code: …….
Authorization nr.....

Patient's address:.....
.....
Patient's telephone: home: .....
work: .....
ID number: .....

Date of service: .....

b.

Before your Procedure

You will be offered a tablet [Dormicum ®7,5 mg] to decrease your anxiety and discomfort during the procedure.
Please be at the surgery 45 minutes before the procedure.
Please do not take the tablet at home, but bring it to the surgery where you can take it with a little water.

In all cases the tablet must be taken at least 30 minutes before the procedure.
This preparation may cause drowsiness and memory loss, but not always.

Dose: Dormicum® 7,5 mg

1. Children between the ages 3-8yrs require half a tablet with a little water or cool drink.
2. Children 8 yrs and older, including adults: one tablet with a little water or cool drink.

Please note the following:

1. Arrange transport for yourself while using this medication.
2. Be fully convinced of the nature of the procedure prior to taking the tablet.
3. Do not eat or drink at least 2 hours prior to the procedure.
4. Do not drive or take alcohol within 6 hours of taking the tablet.
5. Sign the consent form before taking the tablet.

C.

EMLA®local anaesthetic patch [only for children]

Dr Bester, the anaesthetist, will be injecting your sedation and painkilling medication.
To make this a painless injection to kids, a unique patch must be put over a vein.
It is included in this package, but IT MUST BE APPLIED FOR AT LEAST 2 HOURS over an appropriate vein to be effective:
Enclosed please find the foil protected patch called EMLA®.

***This patch contains medication designed to numb the pain of an injection into a vein.**
***Clean the area with the enclosed alcohol swab and allow to dry completely. The foil part is discarded and the cream part placed over the vein. If it doesn't stick well, please cover with some tape or a bandage.**
***Veins of children: top of the hand or inside the elbow, as a last resort inside the wrist or on top of the foot. Please clear up any uncertainty with the attending doctor. In small children there is only one chance. Make sure you have looked on both arms and hands.**

d.

Post Operative Care

Children:
1. Recovery can take between 1-6 hours.
2. Nausea and vomiting are uncommon but may occur.
3. Your child may be disorientated during recovery, and may hurt themselves if they try to walk or get up on their own. Do not leave them unsupervised.
4. They may see 2 of something [double vision].
5. A numb chin, lip or tongue may upset them if local anaesthetic was used.
6. They may be sleepy after recovery and may sleep the night through.
7. They may not remember going to the doctor/dentist.
8. Sometimes when they are upset, they need a toilet.

What You can do:
1. Do not leave your child unsupervised while in a disoriented state, lying in his own bed is ideal.
2. Nausea and vomiting may last for 1-4 hours, but will go away by itself. If it continues a Valoid ® suppository may be necessary.
3. Be careful not to let them bite their numb lip or cheek/tongue.
4. They may eat or drink as directed by the doctor.
5. It is the best to let them sleep the sedation off.

e.

Consent

I, the undersigned, am legally competent to give consent, am aware of the nature and scope, risks and possible consequences of the surgical procedure and sedation involved. The doctors involved may increase the reasonable scope thereof if considered necessary; or end the sedation/procedure and convert to a general anaesthetic if necessary. I further consent to a sample of my blood being taken in the event of contamination of blood or body fluids to a health worker occurring. I accept full responsibility for the account, even if medical aid should refuse to settle.

Person legally competent to give consent:

Name.....

Signature:.....

Witnessed:.....

f.

Medical questionnaire

Age:..... Male..... Female....
Weight.....

Do you have any of the following? [Y/N]

***Allergies to any medication .....**

***Asthma.....**

***Porphyria.....**

***High Blood Pressure.....**

***Diabetes mellitus.....**

***Muscular diseases.....**

***Heart problems: angina.....**

rheumatic fever.....

heart attack.....

bypass surgery.....

***Cold or flu now: ..... recently[2w] .....**

***Fluids or liquids within the last 2 hrs.....**

***Medication for any other condition including homeopathic.....**

***Previous adverse reaction to any anaesthetic.....**

***Do you get nauseous easily?.....**

***Told to avoid any medication?.....**

***Others/ Details**

……

……

……

……

.....

C. PRE MEDICATION:

- EMLA® LOCAL ANAESTHETIC PATCH
- DORMICUM® 7.5 MG TABLET
- BEHAVIOUR MANAGEMENT

1. EMLA® LOCAL ANAESTHETIC PATCH:

The EMLA® patch was included in the envelope which the parent received on the day when the child was booked for the sedation.
Instructions were given how to place the EMLA® correctly.
This patch was to be put up at least 2 hours prior to the procedure on a suitable vein.
I prefer on top of the hand. It is easily reachable, especially in a dental setup where the child's thoracic area is usually covered with a towel and other dental instruments.

2. DORMICUM® 7.5 MG TABLET

I preferred the commercially available midazolam tablet:
Dormicum® 7.5 mg.
It can easily be broken in half and is separately packed.
I preferred to include the tablet in the envelope, as the tablet is sealed, and rather let the parent bring it to the surgery where the assistant would give it to the patient to drink with a little water.
If the child had difficulty in swallowing a tablet it was a good idea to crush it with two teaspoons and mix it with a little sugar as it is quite bitter to taste. Then I found that even the most difficult child would swallow the tablet.
All children younger than 8 years received half of a 7.5 mg Dormicum® tablet 30 minutes prior to the procedure.
As Dormicum® is regarded as a sedative agent all children were monitored after he or she had taken the tablet.

3. BEHAVIOUR MANAGEMENT:

I found behaviour management to be the cornerstone of a successful paediatric sedation.
Parents typically experienced high levels of stress in relation to their children's medical procedures.
A Parent's anxiety could cause or exacerbate a child's fear, therefore the very important role of a well informed parent.
In this research project, behaviour management started the moment the patient visited the dentist for the first time.

When the child was identified as a possible sedation patient, the dentist explained and informed the parent on what a sedation is.
The parent received written information on the sedation and procedure.

On the day of the sedation the patient arrived 30 minutes before the procedure was scheduled.
The receptionist would receive the completed consent- and medical questionnaire from the patient and hand it over to me.
If there were no contra indications, the child would be given half of the Dormicum® 7.5 mg tablet, either crushed with a little sugar or whole with a little water.
The patient was then taken to the toilet.

After about 15 minutes I would personally take the child and parent from the waiting room to the procedure room.
On the way we would have a light conversation.
I never lied or tricked a child into a procedure.
Usually at this stage the child felt a little unsteady and would take my hand. [Non-verbal communication]
The dental chair would be introduced as the throne for the 'prince' or the 'princess' to sit on.
He or she was then covered with a nice comfortable blanket.
It gave a sense of security and privacy and also prevented heat loss during the procedure.

At this stage the dentist could still continue with other patients in a separate room as this behaviour management stage could take up to 20 minutes and the surgeon was not directly involved.
Usually an assistant was available to help, but the room was never overcrowded with people.
The parent would be the passive, silent helper. The child would be able to see the parent, but the parent was not allowed to interfere.
I prepared the sedation trolley with all the medication, as well as the resuscitation equipment in advance in a separate room.
In front of the child no drugs were mixed and no needles or syringes shown.

The next stage was to introduce the child to all the dental equipment.
I found the 'Tell-show-do' technique to be very successful.
It was important to introduce the child to all the equipment on an age appropriate basis.
The pulse oximeter was introduced as the TV. I explained to the child that children often fall asleep in front of the TV.

Although the TV makes a loud noise he would still be able to sleep.
Exactly the same today - we were going to make some noise, but he/she would be able to sleep.
Then I started introducing him/her to the noises.
The suction was called the vacuum cleaner.
The child was allowed to feel and touch all the instruments.
Eventually all instruments were used in the correct way, like suction in the mouth, the drill on the teeth etc.
The drill was introduced as the star machine that could tickle a bit.
The mouth prop was also practised in the mouth and explained that I did not want to wake him up every time to tell him to open his mouth so I would rather help him with the mouth prop.
The child was congratulated with everything he did correctly.[1]
By taking a nice deep breath the child was shown how to increase his oxygen saturation.
A good relationship had been build up to this stage and I would ask the child to if he would do some things for me, like: keeping his head still when we work, open his mouth wide, keep his arms still etc.
Amazingly most of them agreed to help me.
The Dormicum® tablet was now well absorbed and had relieved the initial anxiety.

The next step was to put up the drip.
The EMLA® patch was removed and the child allowed to feel the numb area. I then showed him/her the infusion line [without the needle] and told them that I was going to stick it to the numb area.
I would give the child a pinch on the numb area and explain that maybe he would feel me pinching him, but it won't hurt. [This was also a test to see if the Emla® patch had been on the hand for an appropriate time.]
Then I told them that I did not want them to look at something 'boring', but rather something better. The assistant would open a box with stick on tattoos. The child would select a nice tattoo and the assistant would help him to stick it on the opposite arm while I put up the drip.[2]
It was important to use good strapping for the drip. The child did not realise there was a drip put up on the hand and might move it suddenly and pull out the drip.
I strapped it well with elastoplast.
The EMLA® patch also caused greasiness on the skin which made ordinary strapping no good.
At this stage the dentist would arrive and I would start with the intravenous sedation process.

[1] positive reinforcement
[2] distraction technique

D. INTRAVENOUS SEDATION PROCESS

1. EQUIPMENT AND MEDICINES USED:

The intravenous sedation process started as soon as the IV line was placed.
For this specific case study project I used 24G Optiva IV cannula's with an injection port.
I preferred to use an IV cannula with an injection port – when medication needed to act immediately, it did not need to travel all the way through the IV line.
I used a 2ml IV line. This line was filled with 1ml glycopyrrolate [0.1mg/1ml] and 1 ml midazolam [1mg/1 ml].

I prepared a 20 ml syringe with the following:

- 40mg ketamine [2mg/ml]
- 120 mg propofol [6mg/ml]
- 0.5mg alfentanyl [0.025mg/ml]
- water to make up to 20ml

Bolus dose preparations:

- Ketamine 5mg/ml
- Midazolam 1mg/ml

2. PATIENT:

The patient was positioned in a comfortable position for the dentist to work, usually horizontal and covered with a blanket.
A towel roll was placed to support the neck and the head positioned to secure adequate oxygenation.
Possible pressure points were checked.
Monitors for SpO2, ECG, Pulse and Blood pressure were attached.

3. SEDATION PROCESS:

When I started the intravenous sedation process I gave the 2ml [1ml glycopyrrolate and 1ml midazolam] in the IV line as a bolus.
I did not use the propofol mix as a bolus, but rather started it as a continuous infusion with a Graesby infusion pump programmed at 1-4mg/kg/h depending on the patient's response.
The infusion pump was also programmed with the child's weight and the concentration of the sedation mixture at 6mg/ml.
At this stage the dentist would place the mouth prop in the child's mouth and do a re-examination.
If there were going to be painful procedures like extractions or root canal treatment he would apply some topical anaesthetic to the appropriate areas where local anaesthesia was going to be injected.
Most of the dentists used lignocaine 2% with adrenaline.
Usually a total dose of 2 to 3 1.8 ml cartridges were used on an average child.
The dose was calculated according to the child's weight up to a maximum of 4mg/kg lignocaine.
About 2 minutes prior to the injection of the local anaesthetic I would give the child a bolus dose of ketamine [0.25mg/kg]. I found this to be an excellent analgesic.

At the different surgeries I found different preferences for the rest of the sedation process:

- Some dentists preferred to do all the precision work, like drilling, first. Some children started to get restless after 45 minutes due to physiological factors and then all the precision work was finish. The dentist could then take his time to fill all the cavities.

- Some dentists preferred to do one side of the mouth at a time. Especially in long cases the local anaesthesia could start to wear off if the initial dose was very small.

- Other dentists preferred to do the less stimulating work like fissure sealings first and when the child had settled in a comfortable sleep and the local anaesthetic worked well, continued with the more uncomfortable work.

The advantage of a continuous IV sedation technique is that one can accommodate every surgeon's preference.
When the dentist needed the child to be more asleep one could increase the dose gradually with the infusion pump, not necessarily having to give

a bolus dose. In a very restless child one could give a bolus dose to calm the child immediately.
The only important factor was that the sedationist had to monitor the patient constantly. That implied not only checking the monitors, but to look, listen and feel.
All children were monitored continuously: pulse, breathing rate, oxygen saturation, blood pressure and level of sedation.
Recordings on paper were made every 15 minutes, except if there was a rapid change within 5 minutes.
The multidrug infusion was continued up to the end of the surgical procedure.
After the infusion was stopped, the child was made comfortable and allowed to sleep undisturbed for a few minutes.
If all parameters were stable the child was transported to the recovery room.
The parent was allowed in the recovery room.
Post operatively all children were kept at least 20 minutes in the recovery room or until discharge criteria were met. [see evaluation criteria].

E. MONITORING:

All children were physically examined and the medical history checked before the sedation process was started.
The age, weight and baseline observations: pulse, blood pressure, oxygen saturation and breathing rate were recorded.

When the sedation process was started, all children were monitored continuously by the sedationist.
This included look, feel and listen:

- Observing the colour of the patient,
- the breathing rate, depth, listen to abnormal sounds, auscultation of the chest,
- monitor the level of sedation – that the child was still able to swallow, cough
- check for pressure points,
- checking the IV infusion line
- make sure the child is warm and no air conditioner is blowing a cold wind on him.

Oxygen saturation, pulse and breathing rate were monitored with the appropriate equipment. Initially I tried monitoring blood pressure on all patients. This was not successful, as the cuff of the electronic BP monitor inflate too tight and hurt the child. I also found that the readings on the same patient differed from moment to moment and was influenced by the movement of the patient.

All observations were recorded on a specific chart at 15 minute intervals. If there were any rapid changes in 5 minutes, specific notifications were made

All medicines, mixtures and materials used were also documented, as well as the dose amount, time given and total amount of medication used.

Time when the sedation was started, as well as when the surgeon started, was recorded.

Duration of the surgery as well as the duration of the sedation was recorded.

Discharge time was also recorded.

Duration of the sedation was difficult to determine, as not all medication had been completely metabolised at discharge.

Patients qualified for discharge when they reached a modified Aldrete score of 10.

THIS IS AN EXAMPLE OF THE DOCTOR'S RECORD:

Doctor's Record

Procedure :	**Used:**
Dental.....Other.....	*** Venflon 1 2 3 4**
Premed:	*** Infusion line 1 2**
Dormicun 7,5	*** Dormicum: …….. mg**
Emla Patches 1 2	*** Ketamine: ……. .mg**
	*** Diprivan……. mg**
Time.....	*** Rapifen ……..mg**
.....	*** Anexate 0,5 1,0 ……**
Child ..... Anxiety	*** clopamon 10mg……**
Extensive work.....	*** Robinul 0,2……..**
Other.....	*** alcohol swab X.....**
Compliant. yes / no	*** other…….....**
Access: hand.... elbow...	***syringes.....**
other	***10 ml water.**
Induction: good ok difficult	***TTO.....**
Laryngospasm ..... ……..	

INTRA OPERATIVE RECORD:

. ..h..... h.....h.....h.....h.....h.....h……
pulse
O2
Bp

F. EVALUATION CRITERIA:

All patients were evaluated using the following criteria:

1. Age, date of birth
2. Medical history: ASA classification
3. Gender
4. Weight
5. Reasons for surgery
6. Pre operative observations: pre medication received, dosage, pulse, blood pressure, breathing rate, oxygen saturation
7. Behaviour scale
8. Ease of IV cannulation
9. Time of sedation
10. Time of surgery
11. Sedation level according to the Wilson sedation scale
12. Sedation level requested by the surgeon
13. Deeper sedation level decided by the sedationist
14. Intra operative signs: 20 minutes post starting, 40 minutes post starting, end of sedation
15. Total amount of IV sedation mixture used, as well as added ketamine and midazolam
16. Average dose of mixture used in mg/kg/h
17. Aldrete recovery score 20 minutes post operative
18. Surgeon scoring system
19. Patient evaluation

The following is a standard evaluation form completed

for all the patients in this research project:

CASE REPORT FORM

KETAMINE/ALFENTANYL/PROPOFOL IN CHILDREN

Mixture used: **Ketamine 40 mg**
Alfentanyl 500mcg
Propofol 120 mg

Sterile water to 20ml

INFUSION LINE 2ML:

1ML MIDAZOLAM [1MG/ML] +
1ML GLYCOPYRROLATE [0,1 MG/ML]

DATE

PATIENT NO

PATIENT HISTORY……
……

DATE OF BIRTH

SEX

MALE FEMALE

WEIGHT

REASONS FOR SURGERY……
……

PRE-OP OBSERVATIONS

DATE OF PROCEDURE:

PRE-MED	**120 MIN PREOP**	**EMLA PATCH**
	30 MIN PREOP	**DORMICUM TAB 7.5**
		½ …….1

BP:
PULSE:
RESP RATE:
SPO2:

BP → IS DIFFICULT IN ANXIOUS CHILD BUT GOOD TO HAVE

AIM IS LEVEL 3 – 4 WILSON SEDATION SCALE WHEN TITRATING

BEHAVIOUR SCALE

1	**Very anxious, weepy/ not weeping**
2	**Alert, anxious, not weeping**
3	**Calm, indifferent, not anxious**
4	**Asleep**

EASE OF CANULATION

Movement score	**1**	**Continuous movement, making cannulation difficult**
	2	**Movement, no interference with cannulation**
	3	**Quiet, no movement**
	1	**Weeping hysterically**
	2	**Weeping, making cannulation difficult**
	3	**Mild weeping, no interference with cannulation**
	4	**Quiet, no weeping**
	1	**Impossible**
	2	**Poor – done with difficulty**
	3	**Good – limited difficulty**
	4	**Very good – no problem with IV cannulation**

SEDATION

Time commenced

Surgery started

Surgery stopped

Total time of sedation

WILSON SEDATION SCALE

1	**Fully awake, orientated**
2	**Drowsy**
3	**Eyes closed, arousable by verbal command**
4	**Eyes closed, arousable to mild physical stimulation**
5	**Eyes closed, unarousable to mild stimulation**

DID SURGEON REQUEST DEEPER SEDATION LEVEL?

YES

NO

WHY?

DID ANAESTHETIST DECIDE ON DEEPER LEVEL

YES

NO

WHY?

GO TO LEVEL 3-4?

INTRA OPERATIVE SIGNS 20 MIN POST IV DRUGS

BP	PULSE	RESP RATE	SPO2	ANXIETY	SED. LEVEL

INTRA OPERATIVE SIGNS 40 MIN POST IV DRUGS –

BP	PULSE	SPO2	ANXIETY	SED.LEVEL

END OF SURGERY – AFTER STOPPING SEDATION

BP	PULSE	RESP. RATE	SPO2	ANXIETY	SED.LEVEL

TOTAL AMOUNT OF MIX USED

ML

DOSE OF MIX IN MG/KG/HR

MODIFIED ALDRETE RECOVERY SCORE 20 MIN POST-OP

Activity	**2**	**Able to move 4 extremities voluntary or on command**
	1	**Able to move 2 extremities**
	0	**Unable to move extremities**
Respiration	**2**	**Able to deep breath and cough freely**
	1	**Limited breathing – good airway**
	0	Apnoeic -OBSTRUCTED
Circulation: BP SP	**2**	**SBP < + 20 % preop**
DP	**1**	**SBP + 20 – 50% preop**
	0	**SBP>50% pre op**
Consciousness	**2**	**Awake (answers questions)**
	1	**Arousable (by name)**
	0	**Non responsive**
Oxygen saturation	**2**	**SpO2>92% on room air**

	1	**Supplemental O2 required to maintain SpO2>92%**
	0	**SpO2<92% on supplemental Oxygen**

SURGEON – SCORING SYSTEM

1	**No limb movement – total co-operation**
2	**Small amount of movement – not restless**
3	**Small degree of restlessness and anxiety. Surgeon still able to do procedure**
4	**Considerable movement, poor co-operation, restless, anxious, not able to work**
5	**Restless, anxiety severe, impossible to do procedure**

DISCHARGE CRITERIA:

In this specific project the modified Aldrete recovery scale was used for recovery and discharge criteria.
All the patients received written information on post sedation treatment and recovery.

- All patients were awake and back to baseline level of consciousness.
- All protective reflexes were intact.
- Oxygen saturation was back to pre-sedation level.
- Pain was controlled and a prescription for supplementary pain medication was given if indicated.
- The IV cannula was only removed when there were no signs of nausea.
- All vital signs were stable.
- Patients were asked if they wanted a little water or cool drink, to see if they could swallow and keep it in. (optional)
- The child was able to sit unattended, speak and answer an age appropriate question before discharge.

Thereafter the child was handed over to a responsible person.
This was usually about 30 minutes after surgery was stopped and the last dose of sedative agent.
The parent was actively involved in the recovery process.
On discharge all parents received a card with the contact telephone number of the sedationist and dentist.
Patients were contacted after 6 hours or the following day if there were any complications or adverse effects like nausea, and also to determine patient satisfaction.

THE MODIFIED ALDRETE RECOVERY SCALE:

The Modified Aldrete recovery scale [2] can be used for safe discharge criteria. It examines the movement of limbs, breathing, blood pressure, consciousness and oxygen saturation of a patient on a scale 0-10. A score of 0 needs assistance and a score of 10 means fully recovered.
The only shortcomings of the scale is that it does not attend to adverse effects like nausea and vomiting or surgical discharge criteria like pain and bleeding.

G. FACILITIES FOR RESUSCITATION:

Safe sedation and analgesia for procedures required careful assessment of the patients before the administration of any agent.
It is said that 90% of all medical emergencies can be prevented.
Well trained personnel forms the basis of any emergency protocol.
All staff assisting during sedation were required to have basic life support skills and the surgeon a BLS for healthcare providers.

WHEN TO EXPECT MEDICAL EMERGENCIES:

- Just before treatment: 1.5%
- During/following injection of local anaesthesia: 54.9%
- During treatment: 22.9%
- In the surgery after treatment: 15.2%
- At home 5.5%

PROTOCOL FOR MEDICAL EMERGENCIES:

1. PREVENTION:

Pre operatively:

- Proper assessment of the patient
- well trained staff
- no patients who had received any sedation medication [orally or IV] were ever left unattended.

Intra operatively:

- Patients who received IV sedation agents were monitored from the start of the infusion to complete recovery.

Post operatively:

- Patients were only discharged when rousable, at their baseline verbal ability, able to sit unassisted and follow age appropriate commands.
- Patients were only discharged in the care of a responsible person.

2. EQUIPMENT AVAILABLE FOR RESUSCITATION:

An emergency trolley with the following:

1. Pocket face mask
2. Oxygen cylinder with pressure and flow gauge attached to a face mask
3. Ambu bag with reservoir to give 100% oxygen
4. Oral airways sizes 00-2
5. Laryngoscope with 3 different blade sizes
6. Endotracheal tubes in sizes 3-7
7. Emergency tracheostomy set
8. Emergency drugs: adrenaline, atropine, naloxone, flumazenil, hydrocortisone, theophylline, dextrose, muscle relaxants: Scoline®[succinylcholine] Esmeron® [roccuronium bromide]
9. Intravenous fluids: Normal saline, Ringers lactate, 5% glucose
10. IV cannulas 20-24G, Syringes, needles, cotton swabs
11. ECG and defibrillator with paediatric paddles
12. Suction and suction catheters
13. Glucose monitor
14. Magill's forceps

3. PROTOCOL FOR EMERGENCY:

1. Stop surgery
2. Check breathing/patency of airway
3. Feel pulse, check SpO2 curve
4. Arouse patient: verbal/touch
5. Call for help

4. CLASSIFICATION OF MEDICAL EMERGENCIES:

A: AIRWAY
B: BREATHING/RESPIRATORY SYSTEM
C: CIRCULATION/CARDIOVASCULAR SYSTEM
D: DRUGS/DRUG INTERACTIONS

A. AIRWAY:

Check warning signs:

- Stridor, excessive snoring, paradoxal chest moving
- Falling SpO2
- Cyanosis is a late sign [SpO2<75%]

Check ethiology:

- Obstruction
- Laryngospasm/bronchospasm
- Foreign body
- Oversedation

B. BREATHING:

- Check warning signs for airway obstruction
- Hypoventilation
- Check ethiology:
    i. hypoventilation: DRUGS - benzodiazepines, opiates
    ii. apnoea - opioids
    iii. muscle rigidity - opioids
    iv. bronchospasm
    v. allergic asthma
- Treatment: LOOK, LISTEN, FEEL:
    1. Open airway [lift chin, jaw thrust], remove obstruction [big tongue]
    2. Listen for breathing
    3. Feel breathing
    4. Stimulate breathing
    5. Oxygen
    6. Naloxone, Flumazenil, hydrocortisone if indicated
    7. Positive pressure ventilation with face mask
    8. Intubate and ventilate

C. CIRCULATION:

- Bradycardia = Hypoxia till proven otherwise
- A slow pulse needs treatment:
    * If the SpO2 drops or
    * SpO2 is <95% or
    * the blood pressure drops.

D. DRUGS/ DRUG INTERACTIONS:

- **Over sedation/deep sedation:**

1. Restlessness
2. Confusion
3. Wilson sedation scale >4
4. Hypoventilation
5. Hypoxia.

Treatment:

1. Prevent over/deep sedation
2. ABC: open airway, give oxygen if breathing, intubate if necessary, check circulation and reverse midazolam with flumazenil, opiates with nalaxone.

- **Toxic reactions to local anaesthetics:**

Cause:

i. Intravascular injection,
ii. Too rapid injection,
iii. Overdose: lignocaine [plain] >5mg/kg. Cartridge 1.8ml 2% =36 mg, > 1 cartridge/7kg.
iv. Synergistic effect with benzodiazepines

Signs and Symptoms:

i. Numbness of the tongue
ii. Light headedness
iii. Visual and hearing disturbances
iv. Agitation and confusion
v. Breathing difficulties
vi. CNS: muscle twitching, convulsions, coma respiratory arrest
vii. CVS: dysrhythmias, cardiovascular collapse

Treatment:

1. Stop injection
2. Position for adequate breathing
3. Recovery position for unconscious patient
4. Maintain airway and give oxygen
5. Give diazepam slowly IV for convulsions

6. Monitor for cardiac arrest
7. Perform Basic Life Support if necessary

- **Mild allergic reaction:**

Signs and Symptoms:

1. Flushing and itching
2. Urticarial weals
3. Angioneurotic oedema
4. Bronchoconstriction
5. Light headedness
6. Sweating, palpitations

Treatment:

Check observations: Pulse/BP/Saturation.
If normal, treat with antihistamines: promethazine 0.5-1mg/kg IV stat or hydrocortisone sodium succinate IV 4-5mg/kg over 2 minutes [maximum dose 200mg].
Maintain airway and oxygenation.

- **Anaphylactic shock:**

Cause:

Release of histamine following exposure to an antigen in a previously sensitized individual.

Signs and Symptoms:

i. Flushing
ii. Acute breathing difficulties
iii. Paraesthesia around the mouth and fingers
iv. Severe anxiety
v. Loss of consciousness
vi. Impalpable pulse
vii. Severe hypotension
viii. Cyanosis
ix. Oedema

Treatment:

1. Lay patient flat and raise legs
2. Adrenaline 1:1000 : 0.01-0.02ml/kg subcutaneously or IM.
3. If IV access is available dilute to 10ml: give 0.01-0.02ml/kg
4. Maintain airway, give oxygen.
5. Call emergency services

CHAPTER 4

RESEARCH FINDINGS AND ANALYSIS:

1. **Age, medical history, gender**
2. **Reasons for surgery**
3. **Behaviour scale**
4. **Ease of cannulation**
5. **Influence of procedure on sedation time**
6. **Vital signs: pulse, respiratory rate, SpO2**
7. **Sedation level and sedation mixture requirements**
8. **Recovery score**
9. **Surgeon's score**
10. **Patient's evaluation**

RESULTS:

1. AGE, MEDICAL HISTORY, GENDER, WEIGHT:

As the big controversy in paediatric sedation is about age, I have decided to evaluate all parameters in specified age groups.
The first group of patients were very well selected and had very specific indications for sedation, as I personally prefer to do a general anaesthetic on a child younger than 3 years.

The first group of patients ranged between 1.6 and 3 years and totalled 18 out of the 239 patients evaluated [7.5% of the total patients.]

General Information on children 0-3 years old: 18 Patients [7.5%]

ID No	Date	History	DOB	Age	Gender	Weight [kg]
652	09-Feb-05	ASA 1	02-Jul-03	1.61	male	11
729	03-Jun-03	ASA 1	04-Sep-01	1.74	male	13
697	09-Jun-04	ASA 1	20-Mar-02	2.22	female	13
720	21-Jul-04	ASA 1	18-Apr-02	2.26	female	14
677	17-Jun-04	ASA 1	04-Mar-02	2.29	female	14
868	16-Apr-03	ASA 1	17-Dec-00	2.33	female	11
716	24-Nov-04	ASA 1	10-Jul-02	2.38	male	12
676	15-Oct-04	ASA 1	27-Apr-02	2.47	female	13
656	10-Sep-04	ASA 1	20-Mar-02	2.48	female	15
849	02-Feb-05	ASA 1	18-Jul-02	2.55	male	13
867	02-Jun-03	ASA 1	22-Oct-00	2.61	female	13
688	25-Feb-05	ASA 1	04-Jul-02	2.65	female	10
869	06-Mar-03	ASA 1	07-Jun-00	2.74	female	13
870	27-Aug-03	ASA 2	11-Nov-00	2.79	male	15
685	25-Feb-05	ASA 1	04-May-02	2.81	male	12
689	25-Feb-05	ASA 2	19-Apr-02	2.86	female	15
857	26-Mar-03	ASA 2	17-May-00	2.86	male	16
672	04-Feb-05	ASA 1	08-Feb-02	2.99	male	18

General information on children 3-4 years: 26 Patients [10.8%]

ID No	Date	History	DOB	Age	Gender	Weight [kg]
723	15-Sep-04	ASA 1	15-Sep-01	3.00	male	15
756	27-Oct-04	ASA 2	25-Sep-01	3.09	female	12
957	13-Jun-05	ASA 1	01-May-02	3.12	female	15
840	16-Apr-04	ASA 1	16-Feb-01	3.16	male	12
852	03-Mar-05	ASA 1	19-Dec-01	3.20	male	16
874	04-Sep-03	ASA 1	13-Jun-00	3.23	male	15
448	26-Mar-03	ASA 1	04-Dec-99	3.31	male	12
837	18-May-04	ASA 2	22-Jan-01	3.32	male	15
438	10-Mar-03	ASA 1	19-Oct-99	3.39	male	17
750	07-Feb-05	ASA 1	18-Sep-01	3.39	male	16
821	11-Jan-05	ASA 1	08-Aug-01	3.43	male	17
456	25-Apr-03	ASA 1	19-Nov-99	3.43	female	15
919	26-Apr-04	ASA 1	28-Oct-00	3.49	female	15
844	04-Feb-05	ASA 1	07-Aug-01	3.50	female	12
958	13-Jun-05	ASA 1	14-Dec-01	3.50	male	18
749	20-Aug-04	ASA 2	01-Feb-01	3.55	male	15
950	08-Jun-05	ASA 2	15-Oct-01	3.65	female	15
450	27-Mar-03	ASA 2	25-Jul-99	3.67	female	14
955	10-Jun-05	ASA 1	08-Oct-01	3.67	female	16
929	25-Aug-04	ASA 1	16-Dec-00	3.69	male	12
519	28-Aug-03	ASA 1	15-Dec-99	3.70	female	20

843	27-Jan-05	ASA 1	26-Apr-01	3.76	male	20
853	08-Nov-04	ASA 1	05-Jan-01	3.84	female	12
717	21-Jul-04	ASA 1	07-Sep-00	3.87	female	18
834	19-Jan-05	ASA 1	02-Feb-01	3.96	female	16
754	26-Jan-05	ASA 1	04-Feb-01	3.98	female	15

General information on children 4-5 years: 48 Patients [20%]

ID No	Date	History	DOB	Age	Gender	Weight [kg]
959	15-Jun-05	ASA 1	04-Jun-01	4.03	female	16
502	30-Jul-03	ASA 1	29-Jun-99	4.08	female	17
846	03-Mar-05	ASA 1	25-Jan-01	4.10	male	15
488	03-Jul-03	ASA 1	24-May-99	4.11	male	20
490	03-Jul-03	ASA 1	24-May-99	4.11	female	15
925	25-Jan-05	ASA 1	16-Dec-00	4.11	male	15
927	10-Jun-04	ASA 2	01-May-00	4.11	female	12
765	07-Jan-05	ASA 1	23-Nov-00	4.12	female	17
520	28-Apr-05	ASA 1	11-Mar-01	4.13	female	16
921	26-May-04	ASA 1	04-Apr-00	4.14	male	15
841	21-Apr-05	ASA 1	27-Feb-01	4.15	female	12
935	29-Jul-04	ASA 1	21-May-00	4.19	female	12
928	23-Aug-04	ASA 1	26-May-00	4.24	female	16
459	08-May-03	ASA 2	04-Feb-99	4.25	male	15
920	25-May-04	ASA 1	18-Feb-00	4.27	male	15
441	12-Mar-03	ASA 2	03-Dec-98	4.27	female	16
918	24-Nov-04	ASA 1	19-Jul-00	4.35	female	15
916	25-Apr-05	ASA 1	09-Dec-00	4.38	female	15
939	25-Nov-04	ASA 1	22-Jun-00	4.43	female	16
780	19-May-05	ASA 1	03-Dec-00	4.46	female	14
497	18-Jul-03	ASA 1	28-Jan-99	4.47	male	15
464	14-May-03	ASA 1	22-Nov-98	4.47	male	18
917	28-Oct-04	ASA 1	06-May-00	4.48	female	20
940	22-Jul-04	ASA 1	26-Jan-00	4.49	female	18
770	19-May-05	ASA 1	16-Nov-00	4.50	male	18
854	01-Oct-04	ASA 2	23-Mar-00	4.53	male	18
701	22-Jun-04	ASA 1	09-Dec-99	4.54	female	22
963	22-Jun-05	ASA 1	06-Dec-00	4.54	male	24
933	27-Jul-04	ASA 1	05-Jan-00	4.56	female	14

938	25-Nov-04	ASA 1	26-Apr-00	4.58	female	22
816	13-May-05	ASA 1	02-Oct-00	4.61	female	15
483	06-Jun-03	ASA 1	25-Oct-98	4.61	female	17
817	12-May-05	ASA 2	12-Sep-00	4.66	female	15
913	22-Apr-05	ASA 2	22-Aug-00	4.67	male	18
702	23-Jun-04	ASA 1	14-Oct-99	4.69	male	16
434	06-Mar-03	ASA 1	21-Jun-98	4.71	female	18
433	06-Mar-03	ASA 1	17-Jun-98	4.72	male	18
962	21-Jun-05	ASA 1	25-Sep-00	4.74	female	19
521	01-Sep-03	ASA 1	27-Nov-98	4.76	female	17
964	22-Jun-05	ASA 1	31-Aug-00	4.81	male	18
439	11-Mar-03	ASA 1	29-Apr-98	4.87	female	15
499	25-Jul-03	ASA 2	29-Aug-98	4.90	male	12
481	17-Jun-03	ASA 1	16-Jul-98	4.92	male	15
875	26-Jan-05	ASA 1	25-Feb-00	4.92	female	18
764	08-Sep-04	ASA 1	21-Sep-99	4.97	male	17
900	13-Apr-05	ASA 1	19-Apr-00	4.98	male	16
679	27-May-04	ASA 1	01-Jun-99	4.99	female	18
952	08-Jun-05	ASA 1	10-Jun-00	4.99	male	25

General information on children 5-6 years old: 59 Patients [24.6%]

ID No	Date	history	DOB	Age	Gender	Weight [kg]
493	09-Jul-03	ASA 1	06-Jul-98	5.01	male	20
819	12-May-05	ASA 2	01-May-00	5.03	male	20
924	25-Feb-05	ASA 1	10-Feb-00	5.04	female	13
773	17-Sep-04	ASA 1	30-Aug-99	5.05	female	17
694	15-Jun-04	ASA 1	18-May-99	5.08	male	18
785	18-May-05	ASA 1	02-Apr-00	5.13	female	20
792	19-May-05	ASA 1	14-Mar-00	5.18	female	15
782	08-Oct-04	ASA 1	30-Jul-99	5.19	female	19
755	30-Aug-04	ASA 1	19-Jun-99	5.20	female	25
709	30-Jun-04	ASA 1	14-Apr-99	5.21	female	21
517	26-Aug-03	ASA 1	05-Jun-98	5.22	male	24
886	22-Mar-05	ASA 2	09-Dec-99	5.28	female	19
861	15-Feb-05	ASA 1	02-Nov-99	5.29	male	26
908	20-Apr-05	ASA 1	01-Jan-00	5.30	female	18
831	23-Dec-04	ASA 1	27-Jul-99	5.41	female	20
760	31-Aug-04	ASA 1	03-Apr-99	5.41	male	22

774	17-Sep-04	ASA 1	20-Apr-99	5.41	female	15
926	02-Jun-05	ASA 1	01-Jan-00	5.42	male	12
898	13-Apr-05	ASA 1	11-Nov-99	5.42	male	24
462	09-May-03	ASA 1	05-Dec-97	5.42	female	18
659	28-Apr-04	ASA 2	22-Nov-98	5.43	male	22
500	29-Jul-03	ASA 1	12-Feb-98	5.46	female	20
435	09-May-05	ASA 1	10-Nov-99	5.49	female	19
695	15-Jun-04	ASA 1	13-Dec-98	5.51	male	22
791	27-Oct-04	ASA 1	20-Apr-99	5.52	female	21
635	24-Mar-04	ASA 1	11-Sep-98	5.53	male	24
772	16-Jun-04	ASA 1	29-Nov-98	5.55	male	20
501	29-Jul-03	ASA 1	05-Jan-98	5.56	female	20
437	10-Mar-03	ASA 1	14-Aug-97	5.57	female	19
487	30-Jun-03	ASA 2	28-Nov-97	5.59	male	20
818	25-Nov-04	ASA 1	16-Apr-99	5.61	female	22
533	10-Sep-03	ASA 2	15-Jan-98	5.65	male	15
641	05-Apr-04	ASA 2	11-Aug-98	5.65	female	30
793	28-Oct-04	ASA1	28-Feb-99	5.66	male	19
892	06-Apr-05	ASA 1	31-Jul-99	5.68	male	15
795	28-Oct-04	ASA 1	09-Feb-99	5.72	male	22
481	28-Apr-05	ASA 1	02-Aug-99	5.74	female	16
691	10-Jun-04	ASA 1	10-Sep-98	5.75	male	16
480	28-Apr-05	ASA 1	27-Jul-99	5.75	female	21
475	28-May-03	ASA 1	21-Aug-97	5.77	female	20
668	12-May-04	ASA 1	04-Aug-98	5.77	male	20
788	26-Oct-04	ASA 1	04-Jan-99	5.81	female	29
805	18-May-05	ASA 1	27-Jul-99	5.81	female	20
471	21-May-03	ASA 1	24-Jul-97	5.82	male	20
449	06-May-05	ASA 1	07-Jul-99	5.83	male	23
798	01-Nov-04	ASA 1	01-Jan-99	5.83	female	22
485	30-Jun-03	ASA 1	20-Aug-97	5.86	female	20
909	21-Apr-05	ASA 1	31-May-99	5.89	female	19
909	21-Apr-05	ASA 1	31-May-99	5.89	female	19
509	11-Aug-03	ASA 1	11-Sep-97	5.91	female	19
440	11-Mar-03	ASA 1	07-Apr-97	5.92	female	20
528	08-Sep-03	ASA 1	29-Sep-97	5.94	male	20
482	19-Jun-03	ASA 2	07-Jul-97	5.95	female	15
903	14-Apr-05	ASA 1	02-May-99	5.95	male	20
903	14-Apr-05	ASA 1	02-May-99	5.95	male	20
526	28-Apr-05	ASA 1	12-May-99	5.96	female	22
483	25-Jun-03	ASA 1	07-Jul-97	5.97	female	15
678	27-May-04	ASA 1	05-Jun-98	5.98	male	21
530	09-Sep-03	ASA 1	14-Sep-97	5.98	female	22

General information on children 6 -7 years: 46 Patients [19.2%]

ID No	Date	history	DOB	Age	Gender	Weight [kg]
456	25-Apr-03	ASA 1	19-Apr-97	6.02	female	20
859	09-Feb-05	ASA 2	01-Feb-99	6.02	male	20
454	06-May-05	ASA 1	21-Apr-99	6.04	female	26
736	13-Aug	ASA 1	24-Jul-98	6.06	female	26
835	10-Jan-05	ASA 1	15-Dec-98	6.07	male	16
893	08-Apr-05	ASA 1	11-Mar-99	6.08	female	25
466	19-May-03	ASA 1	13-Apr-97	6.10	female	18
856	08-Feb-05	ASA 1	30-Nov-98	6.19	male	26
465	19-May-03	ASA 1	20-Feb-97	6.24	male	20
960	20-Jun-05	ASA 1	18-Mar-99	6.26	female	18
910	21-Apr-05	ASA 1	16-Jan-99	6.26	male	26
529	09-Sep-03	ASA 1	04-Jun-97	6.26	female	20
865	23-Feb-05	ASA 1	13-Nov-98	6.28	male	20
873	03-Mar-05	ASA 2	17-Nov-98	6.29	female	16
522	02-Sep-03	ASA 1	01-May-97	6.34	female	20
654	22-Apr-04	ASA 1	02-Dec-97	6.39	male	25
972	29-Jun-05	ASA 2	04-Feb-99	6.40	male	20
703	23-Jun-04	ASA 1	27-Jan-98	6.40	male	30
700	22-Jun-04	ASA 1	22-Jan-98	6.41	female	21
511	14-Aug-03	ASA 1	03-Mar-97	6.45	female	18
746	18-Aug-04	ASA 1	07-Mar-98	6.45	male	15
842	26-Jan-05	ASA 1	12-Aug-98	6.46	female	18
739	16-Aug-04	ASA 1	24-Feb-98	6.48	female	14
784	10-Oct-04	ASA1	20-Apr-98	6.48	male	20
708	29-Jun-04	ASA 1	29-Dec-97	6.50	female	25
742	18-Aug-04	ASA 1	10-Feb-98	6.52	female	13
743	18-Aug-04	ASA 1	10-Feb-98	6.52	female	14
735	11-Aug-04	ASA 1	02-Feb-98	6.52	male	20
901	14-Apr-05	ASA 1	28-Sep-98	6.54	female	29
829	23-Dec-04	ASA 1	31-May-98	6.57	female	22
505	06-Aug-03	ASA 1	06-Jan-97	6.58	male	25
514	18-Aug-03	ASA 1	17-Jan-97	6.58	female	20
484	10-Jun-03	ASA 1	10-Oct-96	6.66	female	17
771	15-Sep-04	ASA 1	06-Jan-98	6.69	male	18
636	24-Mar-04	ASA 1	14-Jul-97	6.69	female	29
647	14-Apr-04	ASA 1	04-Aug-97	6.69	female	20
730	03-Aug-04	ASA 1	12-Nov-97	6.72	female	33
934	30-Aug-04	ASA 1	29-Oct-97	6.84	female	26
532	10-Sep-03	ASA 2	06-Nov-96	6.84	male	36
719	22-Jul-04	ASA 1	30-Aug-97	6.89	female	19
828	14-Dec-04	ASA 2	22-Jan-98	6.89	female	28
740	16-Aug-04	ASA 1	11-Sep-97	6.93	female	18
648	26-Apr-05	ASA 1	11-May	6.96	male	25
815	22-Nov-04	ASA 2	28-Nov-97	6.98	male	38
881	11-Mar-05	ASA 1	16-Mar-98	6.99	male	20
890	05-Apr-05	ASA 1	09-Apr-98	6.99	male	20

General information on children 7-8 years old: 42 patients [17.5%]

ID No	Date	History	DOB	Age	Gender	Weight [kg]
777	29-Sep-04	ASA 1	29-Sep-97	7.00	female	21
655	22-Apr-04	ASA 1	21-Apr-97	7.00	male	25
833	06-Jan-05	ASA 1	01-Jan-98	7.01	female	22
665	04-May-04	ASA 1	07-Apr-97	7.07	female	25
980	04-Jul-05	ASA 1	14-May-98	7.14	female	14
776	29-Sep-04	ASA 1	08-Aug-97	7.14	female	23
676	13-Sep-04	ASA 1	18-Jul-97	7.16	male	25
690	10-Jun-04	ASA 1	12-Apr-97	7.16	female	22
971	27-Jun-05	ASA 1	13-Apr-98	7.21	male	20
832	06-Jun-05	ASA 1	06-Mar-98	7.25	male	27
527	08-Sep-03	ASA 1	27-May-96	7.28	male	30
732	04-Aug-04	ASA 1	21-Apr-97	7.29	female	28
871	28-Feb-05	ASA 1	06-Nov-97	7.31	female	18
508	11-Aug-03	ASA 1	02-Apr-96	7.36	female	25
510	14-Aug-03	ASA 1	05-Apr-96	7.36	male	25
714	06-Jul-04	ASA 1	18-Feb-97	7.38	male	25
718	22-Jul-04	ASA 1	03-Mar-97	7.39	female	18
858	09-Feb-05	ASA 1	18-Aug-97	7.48	male	28
789	26-Oct-04	ASA 1	30-Apr-97	7.49	female	21
860	09-Feb-05	ASA 1	08-Aug-97	7.51	female	17
757	30-Aug-04	ASA 1	20-Feb-97	7.52	male	20
712	05-Jul-04	ASA 1	22-Dec-96	7.53	female	25
794	18-May-05	ASA 1	29-Oct-97	7.55	male	25
865	22-Mar-05	ASA 1	01-Sep-97	7.55	female	25
830	23-Dec-04	ASA 1	01-Jun-97	7.56	male	26
778	30-Sep-04	ASA 1	08-Mar-97	7.56	female	25
644	06-Apr-04	ASA 1	11-Sep-96	7.57	male	21
769	13-Sep-04	ASA 1	17-Feb-97	7.57	female	20
783	14-Oct-04	ASA 1	10-Mar-97	7.60	male	31
894	08-Apr-05	ASA 1	13-Aug-97	7.65	male	28
666	05-May-04	ASA 2	23-Aug-96	7.70	female	22
731	04-Aug-04	ASA 1	22-Nov-96	7.70	male	18
800	02-Nov-04	ASA 1	16-Jan-97	7.79	male	34
710	30-Jun-04	ASA 1	10-Sep-96	7.80	female	25
820	25-Nov-04	ASA 1	05-Feb-97	7.80	female	16
699	21-Jun-04	ASA 1	13-Aug-96	7.85	male	30
733	05-Aug-04	ASA 1	15-Sep-96	7.89	female	30
734	05-Aug-04	ASA 1	15-Sep-96	7.89	female	30
897	12-Apr-05	ASA 1	13-May-97	7.92	male	28
895	11-Apr-05	ASA 1	06-May-97	7.93	female	40
763	08-Sep-04	ASA 1	26-Sep-96	7.95	female	35
669	13-May-04	ASA 1	23-May-96	7.97	male	25

2. REASONS FOR SURGERY

Reasons for surgery : 0-3 year old children [18]

ID No	Reasons for surgery
652	dental extractions
720	dental extractions
868	dental extractions
716	dental extractions
849	dental extractions
870	dental extractions
729	dental fillings
697	dental fillings
677	dental fillings
676	dental fillings
656	dental fillings
688	dental fillings
869	dental fillings
685	dental fillings
672	dental fillings
867	dental fillings+extractions
689	dental fillings+extractions
857	dental fillings+extractions

1. Patients for extractions: 6 [33%]
2. Patients for fillings: 9 [50%]
3. Patients for fillings + extractions: 3 [16.6%]

Reasons for surgery 3-4 year old children: 26

Patients for extractions: 9 [34%]
Patients for dental fillings: 12 [46%]
Patients for fillings + extractions: 5 [19%]

ID No	Reasons for surgery
723	dental extractions
756	dental extractions
852	dental extractions
749	dental extractions
450	dental extractions
717	dental extractions
834	dental extractions
754	dental extractions
950	dental extractions
957	dental fillings
837	dental fillings
438	dental fillings
821	dental fillings
456	dental fillings
919	dental fillings
844	dental fillings
958	dental fillings
955	dental fillings
929	dental fillings
519	dental fillings

853	dental fillings
840	dental fillings+extractions
874	dental fillings+extractions
448	dental fillings+extractions
750	dental fillings+extractions
843	dental fillings+extractions

Reasons for surgery 4-5 year old children: 48

Patients for extractions: 16 [33.3%]
Patients for dental fillings: 20 [41.6%]
Patients for dental fillings + extractions: 12 [25%]

ID No	Reasons for surgery:
962	dental extractions
959	dental extractions
502	dental extractions
520	dental extractions
935	dental extractions
918	dental extractions
939	dental extractions
780	dental extractions
464	dental extractions
917	dental extractions
940	dental extractions
770	dental extractions
434	dental extractions
964	dental extractions
875	dental extractions
952	dental extractions
483	dental filings
927	dental fillings
765	dental fillings
928	dental fillings
459	dental fillings
920	dental fillings
441	dental fillings
497	dental fillings
854	dental fillings
963	dental fillings
933	dental fillings
816	dental fillings
817	dental fillings
702	dental fillings
433	dental fillings
521	dental fillings
439	dental fillings
499	dental fillings
764	dental fillings
900	dental fillings+extractions
846	

488	dental fillings+extractions
490	dental fillings+extractions
925	dental fillings+extractions
921	dental fillings+extractions
841	dental fillings+extractions
916	dental fillings+extractions
701	dental fillings+extractions
938	dental fillings+extractions
913	dental fillings+extractions
481	dental fillings+extractions
679	dental fillings+extractions

Reasons for surgery: children 5-6 years old[59]

Patients for dental extractions: 18 [30.5%]
Patients for dental fillings: 24 [40.6%]
Patients for dental fillings+ extractions: 17 [28.8%]

ID No	Reasons for surgery
792	dental extractions
886	dental extractions
908	dental extractions
926	dental extractions
791	dental extractions
501	dental extractions
818	dental extractions
533	dental extractions
641	dental extractions
892	dental extractions
481	dental extractions
691	dental extractions
805	dental extractions
471	dental extractions
449	dental extractions
903	dental extractions
903	dental extractions
483	dental extractions
493	dental fillings
819	dental fillings
924	dental fillings
773	dental fillings
694	dental fillings
785	dental fillings
782	dental fillings
709	dental fillings
774	dental fillings
462	dental fillings
659	dental fillings
435	dental fillings
772	dental fillings
437	dental fillings

793	dental fillings
795	dental fillings
480	dental fillings
485	dental fillings
909	dental fillings
909	dental fillings
509	dental fillings
440	dental fillings
482	dental fillings
526	dental fillings
861	dental fillings+extractions
755	dental fillings+extractions
517	dental fillings+extractions
831	dental fillings+extractions
760	dental fillings+extractions
898	dental fillings+extractions
500	dental fillings+extractions
695	dental fillings+extractions
635	dental fillings+extractions
487	dental fillings+extractions
475	dental fillings+extractions
668	dental fillings+extractions
788	dental fillings+extractions
528	dental fillings+extractions
678	dental fillings+extractions
530	dental fillings+extractions
798	dental fillings+frenectomy

Reasons for surgery : children 6-7 years old [47]

Patients for extractions: 10 [21%]
Patients for dental fillings: 21 [44.6%]
Patients for dental fillings+ extractions: 16 [34%]

ID NO	Reasons for surgery
865	dental extractions
873	dental extractions
522	dental extractions
703	dental extractions
511	dental extractions
746	dental extractions
784	dental extractions
647	dental extractions
740	dental extractions
648	dental extractions
456	dental fillings
454	dental fillings
736	dental fillings

835	dental fillings
893	dental fillings
466	dental fillings
856	dental fillings
465	dental fillings
960	dental fillings
910	dental fillings
739	dental fillings
708	dental fillings
742	dental fillings
743	dental fillings
735	dental fillings
829	dental fillings
514	dental fillings
484	dental fillings
532	dental fillings
881	dental fillings
890	dental fillings
859	dental fillings+extractions
529	dental fillings+extractions
654	dental fillings+extractions
972	dental fillings+extractions
700	dental fillings+extractions
842	dental fillings+extractions
901	dental fillings+extractions
505	dental fillings+extractions
771	dental fillings+extractions
636	dental fillings+extractions
730	dental fillings+extractions
934	dental fillings+extractions
719	dental fillings+extractions
828	dental fillings+extractions
815	dental fillings+extractions

Reasons for surgery: children 7-8 years old [43]

Patients for dental extractions: 10 [23.2%]
Patients for dental fillings: 11 [25.5%]
Patients for dental extractions + fillings: 22 [51.1%]

ID No	Reasons for surgery
655	dental extractions
833	dental extractions
732	dental extractions
508	dental extractions
860	dental extractions
712	dental extractions
794	dental extractions
666	dental extractions

710	dental extractions
820	dental extractions
777	dental fillings
527	dental fillings
718	dental fillings
757	dental fillings
830	dental fillings
778	dental fillings
783	dental fillings
731	dental fillings
733	dental fillings
734	dental fillings
763	dental fillings
665	dental fillings+extractions
980	dental fillings+extractions
776	dental fillings+extractions
676	dental fillings+extractions
690	dental fillings+extractions
971	dental fillings+extractions
832	dental fillings+extractions
871	dental fillings+extractions
510	dental fillings+extractions
714	dental fillings+extractions
858	dental fillings+extractions
789	dental fillings+extractions
865	dental fillings+extractions
644	dental fillings+extractions
769	dental fillings+extractions
894	dental fillings+extractions
800	dental fillings+extractions
699	dental fillings+extractions
897	dental fillings+extractions
895	dental fillings+extractions
669	dental fillings+extractions

COMMENTS ON RESULTS:

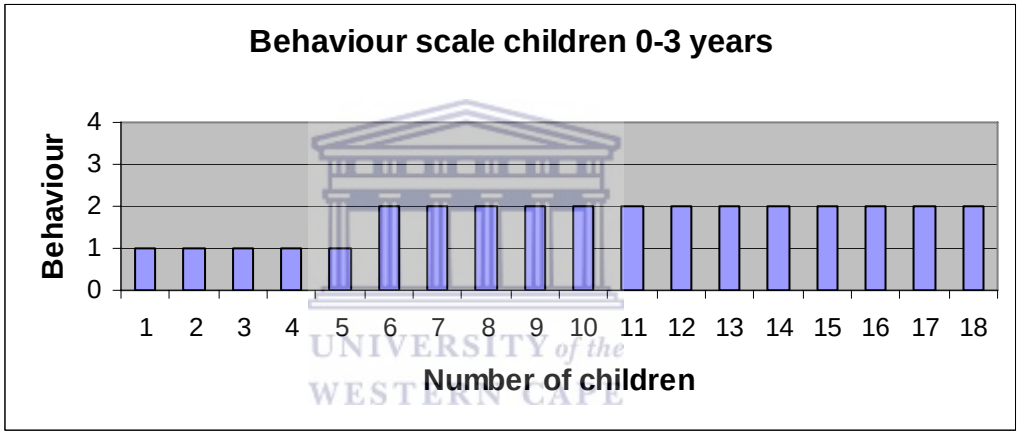
There was no specific pattern on the type of procedures being performed for the patients in different age groups. The whole spectrum was covered. Patients were treated for dental extractions or combinations of procedures.
Specific procedures did not disqualify a patient for being treated under sedation.
As this case study project was done at different surgeries there was a random selection of patients.

4. BEHAVIOUR SCALE:

[after 3.75mg Dormicum® per os]

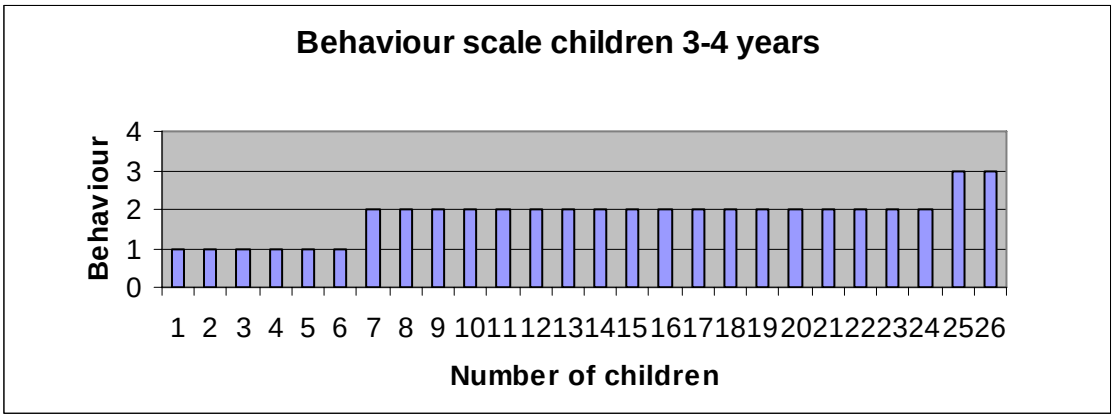
The following behaviour scale was used:

1: A very anxious, weeping patient
2: An alert, anxious, not weeping patient
3. A calm, indifferent, not anxious patient
4. An asleep patient

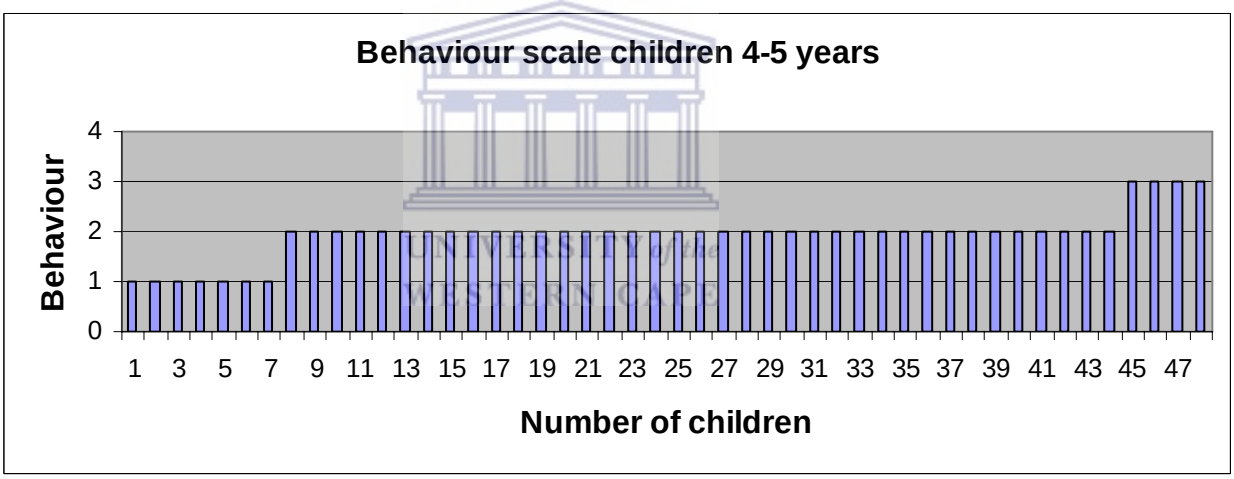


Comments on results:

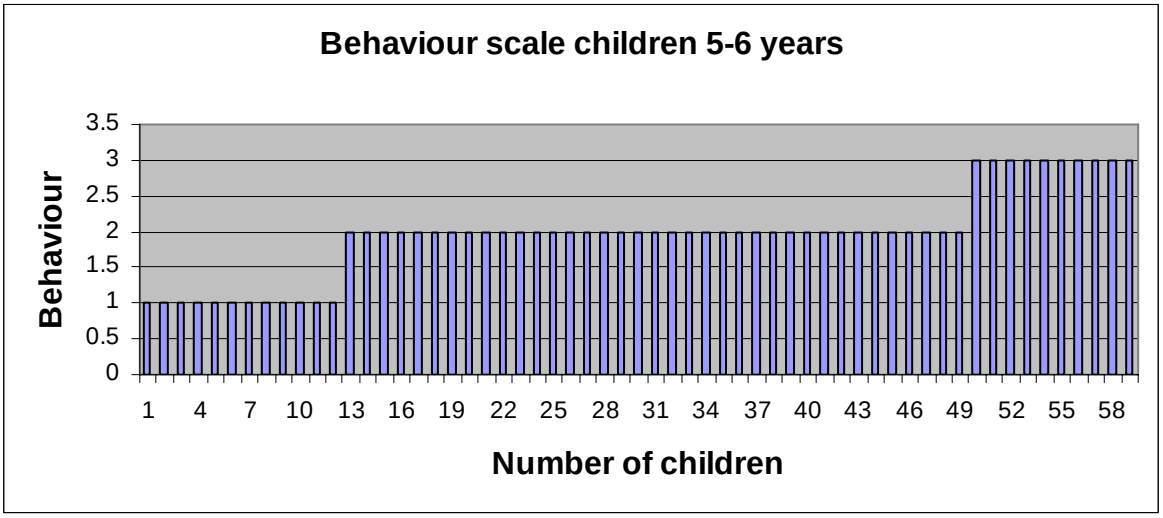
Usually children in this age group will go to theatre for dental procedures. As this group was very small, [only 7.5% of the total], they were very well selected and only qualified for a sedation under very special circumstances.
These children were still very young to understand the concept of sedation. 5 Of them were very anxious [27%].
13 Children were anxious and alert, but not weeping [72.2%].
None of them were calm and not anxious, or asleep.



Comments on results:
Children in this age group generally visited the dentist for the first time for work to be done. Therefore the majority fell in the category of alert and anxious children, but not weeping [69%]. 23% Of the children were very anxious [? separation anxiety] and only 7.5% were calm and indifferent.

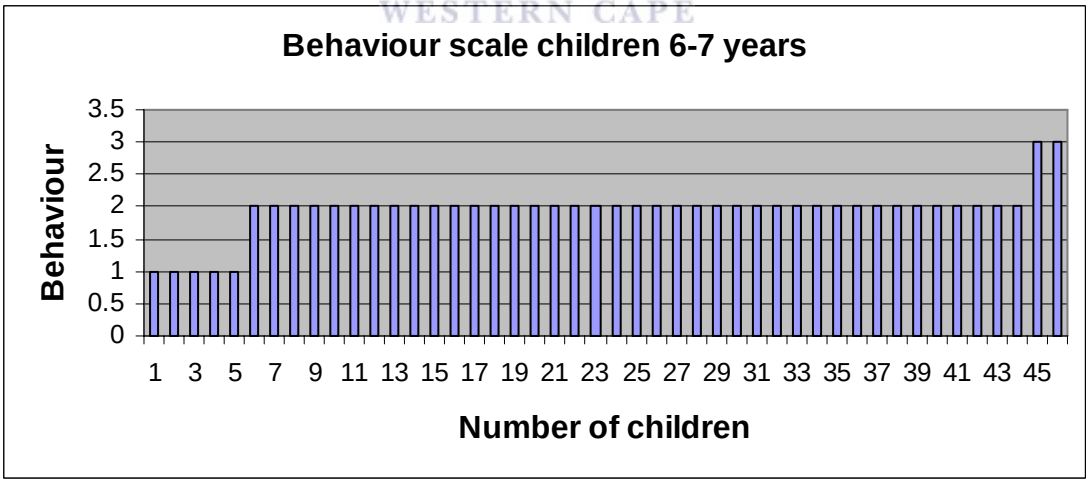


Comments on results:
I found the groups were getting bigger between 4 and 6 years. The children began to understand better and would qualify for a sedation rather than going to theatre for dental procedures. Some of them had started nursery school and were quite keen for a new experience. The majority of children were in the category of alert and anxious, but not weeping.[77%]. 14.5% Of the children were still very anxious, but 5.3% were calm and indifferent. Personally I found this group very satisfying to work with, as they wanted to be actively involved in the sedation process. Usually these children did not have a fear for a dentist yet, and the most common reason they qualified for a sedation was a combination between the procedure and their behaviour.



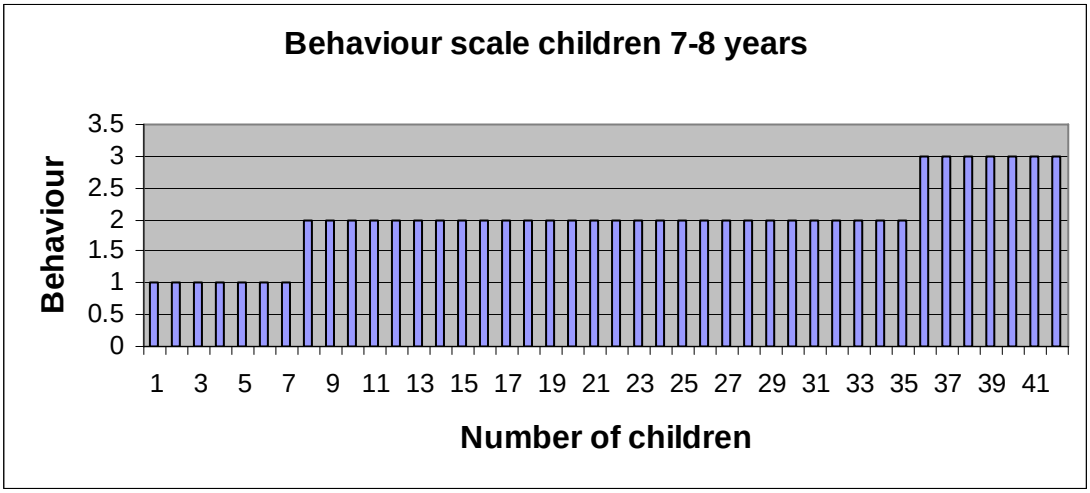
Comments on results:

This group was the biggest of all the age groups [24.6% of the total]. A combination of procedure and patient had an influence on the reason for the sedation. 20.3% Of the children were very anxious, maybe they already had a previous bad experience. 16.9% Of the children were calm and indifferent – the reason for the sedation could be the procedure, either too long for an awake child to sit still in the dental chair, or just too uncomfortable to be awake. 62.7% Of the children in this age group were alert and anxious, but not weeping, thus the combination of procedure and patient were the reason for the sedation.



Comments on results:

This was also quite a large group - 19.2% of the total patients of 239. 10.8% Of the children were very anxious. 4.3% Of the children were calm and indifferent and 84,7% of the children were anxious, but not weeping. This shows that the majority of children qualifying for a sedation were in category 2.



Comments on results:
I found this age group more difficult to work with. 16.6% Of the patients were in the very anxious category.
Most commonly they had a previous bad experience or were influenced by the parental fear factor.
It was usually not their first visit to the dentist.
The calm and indifferent group increased to 16.6%. Children in this category were usually sedated due to the length and difficulty of the procedure.
66.6% Of the children were alert and anxious and qualified due to a combination of procedure and behaviour for the sedation.

4. EASE OF CANNULATION:

Measured by a :

- **Movement score of the patient**
- **Behaviour score of the patient**
- **Doctor's impression of difficulty doing the IV cannulation**

MOVEMENT SCORE:

1. Continuous movement, making cannulation difficult
2. Movement, no interference with cannulation
3. Quiet, no movement

PATIENT'S RESPONSE SCORE TO IV CANNULATION:

1. Weeping hysterically
2. Weeping, making cannulation difficult
3. Mild weeping, no interference with cannulation
4. Quiet, no weeping

DOCTOR'S IMPRESSION OF DIFFICULTY DOING THE IV CANNULATION:

1. Impossible
2. Poor – done with difficulty
3. Good – limited difficulty
4. Very good – no problem with IV cannulation

In all patients an EMLA® local anaesthetic patch was given to numb the area of IV cannulation. Still, the correct application of the EMLA®patch was a problem. The patients also received half of a Dormicum® 7.5 mg tablet 30 minutes prior to IV cannulation.

GROUP 0-3 YEARS

Age	Behaviour	Movement	response	Doctor's impression
2.26	1	1	2	2
2.47	1	1	2	2
2.48	1	1	2	2
2.81	1	2	4	3
2.86	1	2	4	3
1.61	2	1	3	2
1.74	2	2	3	2
2.22	2	1	4	3
2.29	2	2	3	3
2.33	2	1	3	2
2.38	2	2	4	3
2.55	2	1	4	3
2.61	2	3	4	3
2.65	2	2	4	3
2.74	2	2	4	3
2.79	2	2	4	3
2.86	2	2	4	3
2.99	2	2	4	3

Movement: 38.8% of children aged 0-3 years moved continuously and made IV cannulation difficult. Only one child in this group was quiet without any movement. In 58% the movement did not interfere with the IV cannulation.
Patient's response: 16.6% Of the children were weeping, which made IV cannulation difficult. 22.2% Of the children wept a little without interference doing the IV cannulation. 61% Of the children in this age group were quiet without any weeping.
Doctor's impression: In 33% of the cases I found the IV cannulation done with difficulty, but experienced limited difficulty in 67% of cases.

GROUP 3-4 YEARS

Age	Behaviour	Movement	Response	Doctor's impression
3.00	1	1	2	2
3.09	1	1	2	2
3.12	1	1	4	3
3.32	1	1	3	2
3.55	1	2	3	2
3.76	1	1	4	3
3.16	2	3	4	3
3.20	2	2	4	3
3.23	2	2	4	2
3.31	2	2	3	3
3.39	2	3	4	4
3.39	2	2	4	3
3.43	2	2	4	3
3.43	2	2	3	3
3.49	2	3	4	3
3.50	2	2	4	3
3.65	2	2	4	3
3.67	2	2	4	3
3.69	2	2	4	3
3.70	2	2	4	3
3.84	2	3	4	3
3.87	2	2	4	3
3.96	2	3	4	3
3.98	2	2	4	3
3.50	3	3	4	3
3.67	3	2	4	3

Movement:

57% of the children in this age group responded with a little movement without any interference to the IV cannulation.
23% Of the children were sitting quietly when doing the cannulation.
19.2% Of the children made continuous movements interfering with the IV cannulation process.
It can also be noted that the children with a behaviour response of 1 [very anxious] were also the children who moved the most [1- continuous movement].

Patient's response:

Only 2 children in this age group responded with mild weeping, they also were the children with a behaviour response of 1 [very anxious].
77% Of the children were sitting quietly, during IV cannulation.

15% Of the children aged 3-4 years wept a little, but it didn't interfere with the IV cannulation process.

Doctor's impression:
In 77% of 3-4 year old children I have done the IV cannulation with limited difficulty.
In 20% of the cases IV cannulation was done with difficulty.
They were the children with a behaviour response of 1 [very anxious] and also the movement score of 1 [continuous movement].
Only 1 patient qualified as a very good IV cannulation.

GROUP 4-5 YEARS:

Age	Behaviour	Movement	Response	Doctor's impression
4.08	1	1	2	2
4.11	1	2	4	3
4.15	1	2	4	3
4.54	1	1	4	2
4.54	1	1	2	2
4.58	1	2	3	3
4.74	1	2	4	3
4.10	2	2	4	3
4.11	2	3	4	3
4.11	2	2	4	3
4.11	2	3	4	3
4.12	2	3	4	3
4.13	2	2	4	3
4.19	2	2	4	3
4.24	2	3	4	3
4.25	2	2	4	3
4.27	2	2	3	3
4.35	2	2	4	3
4.38	2	2	4	3
4.43	2	2	4	3
4.46	2	3	4	3
4.47	2	2	4	3
4.47	2	3	4	3
4.48	2	3	4	3
4.49	2	2	3	2
4.50	2	3	4	3
4.53	2	2	4	3
4.56	2	2	4	3
4.61	2	3	4	3
4.61	2	2	4	3
4.66	2	2	4	3
4.67	2	2	3	3

4.69	2	2	4	3
4.71	2	1	3	2
4.72	2	2	4	3
4.76	2	2	4	3
4.87	2	2	4	3
4.90	2	3	4	3
4.92	2	3	4	3
4.92	2	3	4	3
4.97	2	3	4	3
4.98	2	3	4	3
4.99	2	2	4	3
4.99	2	2	4	3
4.03	3	2	4	3
4.14	3	3	4	3
4.27	3	3	4	3
4.81	3	2	4	3

Children 4-5 years:

Movement:
In this age group only 8.3% of children responded with continuous movement during IV cannulation.
They were also the children with a behaviour scale of 1 [very anxious].
54% Of the children moved a little [which is typical for a child of this age] without any interfering with the IV cannulation.
37% Of the children were sitting quietly, without any movement.

Patient's response:
Only 2 children [4%] in this age group responded with some weeping during IV cannulation.
They were also the children with a behaviour response of 1 and were crying even before the procedure started.
More than 85% of the children were sitting quietly, without any movement during the IV cannulation process.

Doctor's impression:
In 92% of patients in this age group I found the cannulation was done, with limited difficulty. This is also why I prefer this age group to work with.
The other 8%, which was done with difficulty, was due to a combination of factors, the physical status of the patient, as well as the behaviour of the child.

GROUP 5-6 YEARS:

Age	Behavior	Movement	Response	Doctor's impression
5.03	1	2	4	3
5.21	1	1	3	2
5.22	1	2	4	3
5.43	1	2	3	3
5.46	1	2	4	3
5.59	1	1	2	2
5.61	1	1	2	2
5.66	1	1	2	2
5.75	1	2	3	3
5.89	1	2	4	3
5.89	1	2	4	3
5.92	1	2	4	3
5.01	2	2	4	3
5.04	2	3	4	4
5.05	2	3	4	3
5.13	2	3	4	3
5.18	2	3	4	3
5.19	2	2	4	2
5.20	2	2	4	3
5.28	2	3	4	3
5.29	2	3	4	3
5.30	2	3	4	3
5.41	2	2	4	3
5.41	2	3	4	3
5.41	2	2	4	3
5.42	2	2	4	3
5.42	2	1	2	2
5.49	2	3	4	3
5.56	2	3	4	3
5.57	2	3	4	3
5.65	2	1	3	2
5.68	2	2	4	3
5.74	2	2	4	3
5.75	2	3	4	3
5.77	2	3	4	3
5.81	2	2	4	3
5.81	2	3	4	3
5.82	2	3	4	3
5.83	2	2	4	3
5.83	2	3	4	3
5.86	2	2	4	3
5.91	2	3	4	3
5.94	2	2	4	3
5.95	2	3	4	3
5.95	2	2	4	3
5.95	2	2	4	3
5.96	2	2	4	3
5.97	2	3	4	3

5.98	2	3	4	3
5.08	3	3	4	3
5.42	3	3	4	3
5.51	3	3	4	3
5.52	3	2	4	3
5.53	3	3	4	3
5.55	3	3	4	3
5.65	3	3	4	3
5.72	3	3	4	3
5.77	3	3	4	3
5.98	3	3	4	3

Children 5-6 years

Movement:
10% Of the children in this age group responded with movement that made IV cannulation difficult. This is more than in the younger group [4-5 years].
Most of them also had a behaviour scale of 1 and were very anxious.
In some cases the EMLA patch was also applied incorrectly and didn't numb the cannulation area.
40% Of the children were moving a little, but without any interference of the IV cannulation.
50% Of the children were sitting quietly during IV cannulation.

Patient's response:
6% Of the children were weeping during IV cannulation.
They were also the children with a behaviour response of 1 and were most probably crying before the IV cannulation started.
86% Of the children were not crying during the IV cannulation procedure.

Doctor's impression:
In 11% of this age group I found the cannulation done with difficulty due to different circumstances.
Either the patient's behaviour, which was the biggest influence, but also physical factors like the EMLA® patch placed on the wrong area [somewhere on a muscle with no vein in sight] or obesity.
Fortunately 89% of the patients were IV cannulated with limited difficulty.

GROUP 6-7 YEARS:

Age	Behaviour	Movement	Response	Doctor's impression
6.19	1	2	4	3
6.26	1	2	4	3
6.52	1	2	4	3
6.54	1	2	4	3
6.96	1	2	4	3
6.02	2	3	4	3
6.02	2	3	4	3
6.04	2	3	4	3
6.06	2	2	4	3
6.07	2	3	4	3
6.08	2	3	4	3
6.10	2	2	4	3
6.24	2	3	4	3
6.26	2	2	3	3
6.26	2	2	4	3
6.28	2	3	4	3
6.29	2	2	4	3
6.34	2	3	4	3
6.39	2	2	4	3
6.40	2	2	4	3
6.40	2	2	4	3
6.41	2	3	4	3
6.45	2	3	4	3
6.45	2	2	4	3
6.46	2	2	4	3
6.48	2	2	4	3
6.48	2	3	4	3
6.50	3	3	4	3
6.52	2	3	4	3
6.52	2	2	4	3
6.57	2	2	4	3
6.58	2	3	4	3
6.58	2	3	4	3
6.66	2	3	4	3
6.69	2	3	4	3
6.69	2	2	4	3
6.69	2	3	4	4
6.72	2	3	4	3
6.84	2	2	4	3
6.84	2	3	4	3
6.89	2	3	4	3
6.93	2	2	4	3
6.98	2	3	4	4
6.99	2	3	4	3
6.89	3	3	4	3
6.99	2	2	4	3

GROUP 6-7 YEARS:

Movement:
Not one of the patients in this age group was moving continuously.
47% Of the children were moving, but without any interference doing the IV cannulation.
53% Of the children were sitting quietly without any movement during IV cannulation.
Patient's response:
In this whole group only one child was a little upset [3], but the rest were sitting quietly.
Doctor's response:
Doing an IV cannulation on all of the children in this age group ranged from limited difficulty to no problem at all.

GROUP 7-8 YEARS:

Age	Behaviour	Movement	Response	Doctor's impression
7.14	1	2	4	3
7.38	1	1	4	3
7.55	1	3	4	3
7.57	1	1	2	2
7.60	1	3	4	3
7.70	1	1	2	2
7.95	1	3	3	3
7.00	2	3	4	3
7.01	2	3	4	3
7.14	2	3	4	3
7.16	2	2	4	3
7.21	2	2	4	3
7.25	2	3	4	3
7.28	2	2	4	3
7.29	2	2	4	3
7.36	2	3	4	3
7.36	2	2	4	3
7.39	2	3	4	3
7.49	2	3	4	3
7.51	2	3	4	3
7.52	2	3	4	3
7.55	2	3	4	3
7.56	2	2	4	3
7.56	2	3	4	3
7.57	2	3	4	3
7.65	2	3	4	3
7.70	2	3	4	3
7.79	2	3	4	4
7.80	2	3	4	3

7.85	2	3	4	3
7.89	2	3	4	3
7.89	2	3	4	3
7.92	2	3	4	3
7.93	2	3	4	3
7.97	2	3	4	3
7.00	3	3	4	3
7.07	3	3	4	3
7.16	3	3	4	3
7.31	3	3	4	3
7.48	3	3	4	3
7.53	3	3	4	3
7.80	3	3	4	3

CHILDREN 7-8 YEARS

Movement:
3 Children [7%] in this age group were responding with continuous movement which made cannulation extremely difficult.
They also had a behaviour scale of 1 and didn't even want to come into the dentist's rooms.
They were weeping and the IV cannulation was done with difficulty. The only reason why I continued with the IV cannulation was on the request of the parents.
Children in this age group can understand well and behaviour therapy works very well.
76% of the children were sitting quietly without any movement.

Patient's response:
1 Of the 3 children moving continuously could be convinced to do the IV cannulation and responded without any weeping and ended up as a good IV cannulation.
92% of the children were sitting quietly during IV cannulation.

Doctor's impression:
2 Of the 3 very anxious patients ended with a poor score for IV cannulation and it was only on the parent's request that I continued with the procedure.
The rest of the patients were treated with limited difficulty or no problem with IV cannulation.

INFLUENCE OF PROCEDURE ON SEDATION TIME:

Please note that the sedation time in the following tables started at the time of IV cannulation up to recovery time, when the patient was fit to be discharged into the care of a responsible person.

Group 0-3 years:

Age	Reason for surgery	Duration of Surgery in Minutes	Duration of Sedation in Minutes
1.61	dental extractions	20.0	60.0
2.26	dental extractions	15.0	60.0
2.33	dental extractions	10.0	40.0
2.38	dental extractions	15.0	60.0
2.55	dental extractions	15.0	55.0
2.79	dental extractions	20.0	50.0
1.74	dental fillings	50.0	90.0
2.22	dental fillings	75.0	105.0
2.29	dental fillings	65.0	100.0
2.47	dental fillings	45.0	120.0
2.48	dental fillings	20.0	95.0
2.65	dental fillings	30.0	60.0
2.74	dental fillings	45.0	60.0
2.81	dental fillings	30.0	70.0
2.99	dental fillings	70.0	100.0
2.61	dental fillings+extractions	20.0	40.0
2.86	dental fillings+extractions	45.0	75.0
2.86	dental fillings+extractions	70.0	90.0

Group 3-4 years:

Age	Reasons for surgery	Duration of surgery in Minutes	Duration of sedation in Minutes
3.00	dental extractions	30.0	65.0
3.09	dental extractions	20.0	60.0
3.20	dental extractions	10.0	50.0
3.55	dental extractions	30.0	60.0
3.67	dental extractions	25.0	60.0
3.87	dental extractions	30.0	60.0
3.96	dental extractions	15.0	50.0
3.98	dental extractions	10.0	45.0
3.65	dental extractions	15.0	55.0
3.12	dental fillings	45.0	70.0
3.32	dental fillings	30.0	75.0

3.39	dental fillings	25.0	55.0
3.43	dental fillings	60.0	85.0
3.43	dental fillings	35.0	55.0
3.49	dental fillings	30.0	60.0
3.50	dental fillings	45.0	75.0
3.50	dental fillings	50.0	75.0
3.67	dental fillings	45.0	75.0
3.69	dental fillings	40.0	70.0
3.70	dental fillings	60.0	90.0
3.84	dental fillings	40.0	60.0
3.16	dental fillings+extractions	65.0	105.0
3.23	dental fillings+extractions	65.0	100.0
3.31	dental fillings+extractions	60.0	100.0
3.39	dental fillings+extractions	55.0	85.0
3.76	dental fillings+extractions	40.0	55.0

Group 4-5 years:

Age	Reason for surgery	Duration of Surgery in Minutes	Duration of Sedation in Minutes
4.74	dental extraction	20.0	50.0
4.03	dental extractions	15.0	40.0
4.08	dental extractions	30.0	60.0
4.13	dental extractions	20.0	45.0
4.19	dental extractions	15.0	35.0
4.35	dental extractions	15.0	45.0
4.43	dental extractions	15.0	45.0
4.46	dental extractions	15.0	45.0
4.47	dental extractions	20.0	55.0
4.48	dental extractions	15.0	55.0
4.49	dental extractions	20.0	45.0
4.50	dental extractions	15.0	40.0
4.71	dental extractions	30.0	110.0
4.81	dental extractions	15.0	50.0
4.92	dental extractions	15.0	60.0
4.99	dental extractions	15.0	55.0
4.61	dental filings	35.0	75.0
4.11	dental fillings	145.0	180.0
4.12	dental fillings	90.0	175.0
4.24	dental fillings	70.0	100.0
4.25	dental fillings	60.0	85.0
4.27	dental fillings	50.0	75.0
4.27	dental fillings	80.0	120.0
4.47	dental fillings	45.0	80.0
4.53	dental fillings	60.0	90.0
4.54	dental fillings	60.0	90.0
4.56	dental fillings	45.0	75.0
4.61	dental fillings	50.0	70.0
4.66	dental fillings	50.0	80.0
4.69	dental fillings	50.0	70.0
4.72	dental fillings	45.0	70.0

4.76	dental fillings	40.0	90.0
4.87	dental fillings	65.0	90.0
4.90	dental fillings	60.0	90.0
4.97	dental fillings	50.0	70.0
4.98	dental fillings	50.0	80.0
4.10	dental fillings+extractions	40.0	70.0
4.11	dental fillings+extractions	105.0	140.0
4.11	dental fillings+extractions	55.0	85.0
4.11	dental fillings+extractions	40.0	65.0
4.14	dental fillings+extractions	35.0	60.0
4.15	dental fillings+extractions	20.0	45.0
4.38	dental fillings+extractions	30.0	60.0
4.54	dental fillings+extractions	70.0	95.0
4.58	dental fillings+extractions	45.0	85.0
4.67	dental fillings+extractions	45.0	70.0
4.92	dental fillings+extractions	45.0	80.0
4.99	dental fillings+extractions	40.0	75.0

Group 5-6 years:

Age	Reasons for surgery	Duration of Surgery in Minutes	Duration of Sedation in Minutes
5.18	dental extractions	15.0	35.0
5.28	dental extractions	10.0	35.0
5.30	dental extractions	15.0	45.0
5.42	dental extractions	20.0	55.0
5.52	dental extractions	30.0	60.0
5.56	dental extractions	30.0	60.0
5.61	dental extractions	15.0	90.0
5.65	dental extractions	15.0	45.0
5.65	dental extractions	20.0	60.0
5.68	dental extractions	30.0	60.0
5.74	dental extractions	20.0	55.0
5.75	dental extractions	30.0	55.0
5.81	dental extractions	15.0	45.0
5.82	dental extractions	15.0	50.0
5.83	dental extractions	60.0	90.0
5.95	dental extractions	15.0	50.0
5.95	dental extractions	15.0	50.0
5.97	dental extractions	30.0	55.0
5.01	dental fillings	30.0	75.0
5.03	dental fillings	65.0	95.0
5.04	dental fillings	105.0	120.0
5.05	dental fillings	75.0	110.0
5.08	dental fillings	65.0	90.0
5.13	dental fillings	70.0	85.0
5.19	dental fillings	25.0	75.0
5.21	dental fillings	25.0	75.0
5.41	dental fillings	45.0	70.0
5.42	dental fillings	35.0	60.0

5.43	dental fillings	55.0	105.0
5.49	dental fillings	65.0	105.0
5.55	dental fillings	30.0	60.0
5.57	dental fillings	50.0	75.0
5.66	dental fillings	45.0	80.0
5.72	dental fillings	50.0	70.0
5.75	dental fillings	40.0	70.0
5.86	dental fillings	30.0	60.0
5.89	dental fillings	70.0	105.0
5.89	dental fillings	70.0	105.0
5.91	dental fillings	20.0	50.0
5.92	dental fillings	30.0	55.0
5.95	dental fillings	85.0	120.0
5.96	dental fillings	35.0	60.0
5.29	dental fillings+extractions	25.0	55.0
5.20	dental fillings+extractions	55.0	85.0
5.22	dental fillings+extractions	50.0	70.0
5.41	dental fillings+extractions	65.0	100.0
5.41	dental fillings+extractions	70.0	100.0
5.42	dental fillings+extractions	30.0	60.0
5.46	dental fillings+extractions	35.0	70.0
5.51	dental fillings+extractions	40.0	60.0
5.53	dental fillings+extractions	45.0	65.0
5.59	dental fillings+extractions	55.0	95.0
5.77	dental fillings+extractions	30.0	55.0
5.77	dental fillings+extractions	35.0	70.0
5.81	dental fillings+extractions	85.0	120.0
5.94	dental fillings+extractions	45.0	70.0
5.98	dental fillings+extractions	30.0	75.0
5.98	dental fillings+extractions	45.0	75.0
5.83	dental fillings+frenectomy	55.0	80.0

Group 6-7 years:

Age	Reasons for surgery	Duration of Surgery in Minutes	Duration of Sedation in Minutes
6.28	dental extractions	20.0	60.0
6.29	dental extractions	10.0	35.0
6.34	dental extractions	25.0	45.0
6.40	dental extractions	20.0	60.0
6.45	dental extractions	20.0	60.0
6.45	dental extractions	15.0	50.0
6.48	dental extractions	10.0	40.0
6.69	dental extractions	20.0	45.0
6.93	dental extractions	20.0	40.0
6.96	dental extractions	25.0	60.0
6.02	dental fillings	35.0	60.0
6.04	dental fillings	25.0	55.0
6.06	dental fillings	85.0	120.0
6.07	dental fillings	35.0	80.0

6.08	dental fillings	60.0	90.0
6.10	dental fillings	35.0	55.0
6.19	dental fillings	75.0	100.0
6.24	dental fillings	25.0	50.0
6.26	dental fillings	45.0	60.0
6.26	dental fillings	45.0	70.0
6.48	dental fillings	45.0	70.0
6.50	dental fillings	60.0	85.0
6.52	dental fillings	90.0	120.0
6.52	dental fillings	75.0	105.0
6.52	dental fillings	60.0	85.0
6.57	dental fillings	75.0	115.0
6.58	dental fillings	45.0	70.0
6.66	dental fillings	90.0	110.0
6.84	dental fillings	60.0	85.0
6.99	dental fillings	45.0	80.0
6.99	dental fillings	145.0	175.0
6.02	dental fillings+extractions	65.0	90.0
6.26	dental fillings+extractions	45.0	75.0
6.39	dental fillings+extractions	125.0	160.0
6.40	dental fillings+extractions	55.0	80.0
6.41	dental fillings+extractions	40.0	70.0
6.46	dental fillings+extractions	70.0	100.0
6.54	dental fillings+extractions	35.0	60.0
6.58	dental fillings+extractions	55.0	90.0
6.69	dental fillings+extractions	35.0	60.0
6.69	dental fillings+extractions	65.0	85.0
6.72	dental fillings+extractions	40.0	70.0
6.84	dental fillings+extractions	35.0	55.0
6.89	dental fillings+extractions	105.0	130.0
6.89	dental fillings+extractions	40.0	70.0
6.98	dental fillings+extractions	30.0	60.0

Group 7-8 years:

Age	Reasons for surgery	Duration of Surgery in Minutes	Duration of Sedation in Minutes
7.00	dental extractions	10.0	60.0
7.01	dental extractions	25.0	60.0
7.29	dental extractions	25.0	60.0
7.36	dental extractions	30.0	50.0
7.51	dental extractions	20.0	60.0
7.53	dental extractions	15.0	60.0
7.55	dental extractions	15.0	55.0
7.70	dental extractions	25.0	60.0
7.80	dental extractions	15.0	45.0
7.80	dental extractions	15.0	45.0
7.00	dental fillings	65.0	90.0
7.28	dental fillings	35.0	70.0
7.39	dental fillings	75.0	105.0

7.52	dental fillings	35.0	55.0
7.56	dental fillings	90.0	115.0
7.56	dental fillings	70.0	95.0
7.60	dental fillings	100.0	145.0
7.70	dental fillings	70.0	100.0
7.89	dental fillings	90.0	130.0
7.89	dental fillings	75.0	105.0
7.95	dental fillings	90.0	120.0
7.07	dental fillings+extractions	20.0	45.0
7.14	dental fillings+extractions	65.0	85.0
7.14	dental fillings+extractions	40.0	60.0
7.16	dental fillings+extractions	50.0	80.0
7.16	dental fillings+extractions	60.0	90.0
7.21	dental fillings+extractions	50.0	70.0
7.25	dental fillings+extractions	40.0	70.0
7.31	dental fillings+extractions	25.0	45.0
7.36	dental fillings+extractions	50.0	85.0
7.38	dental fillings+extractions	55.0	90.0
7.48	dental fillings+extractions	50.0	70.0
7.49	dental fillings+extractions	50.0	70.0
7.55	dental fillings+extractions	45.0	85.0
7.57	dental fillings+extractions	60.0	85.0
7.57	dental fillings+extractions	65.0	90.0
7.65	dental fillings+extractions	30.0	60.0
7.79	dental fillings+extractions	55.0	80.0
7.85	dental fillings+extractions	50.0	70.0
7.92	dental fillings+extractions	60.0	90.0
7.93	dental fillings+extractions	30.0	60.0
7.97	dental fillings+extractions	60.0	85.0

Comments on surgical procedure and sedation time:

As can be seen in the above tables, the surgical and sedation time depended on the type of surgery.

Dental extractions were quite quick procedures. The moment the local anaesthetic has taken effect the procedure could begin.

Total sedation time for dental extractions was seldom longer than 60 minutes.

In this case study project of 239 children only 3 children had a total sedation time longer than 60 minutes for dental extractions.

One child in the 4-5 year old group and 2 children in the 5-6 year old group had a sedation time longer than 60 minutes for dental extractions.

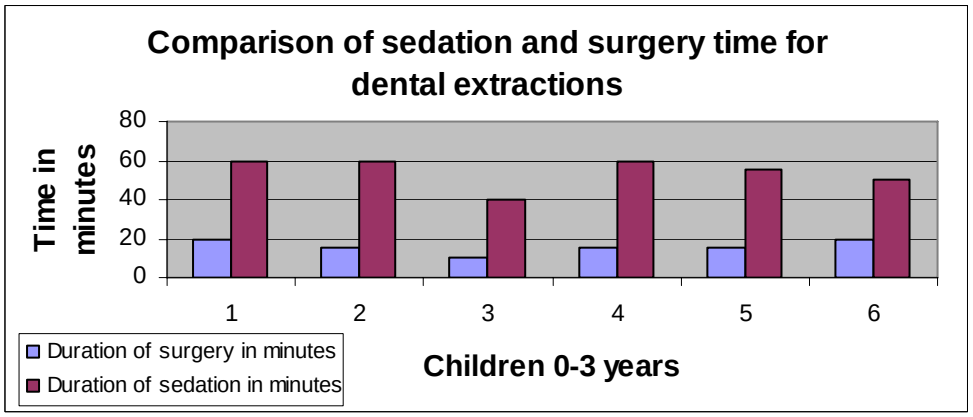
These children had a behaviour response of 1: very anxious and weeping

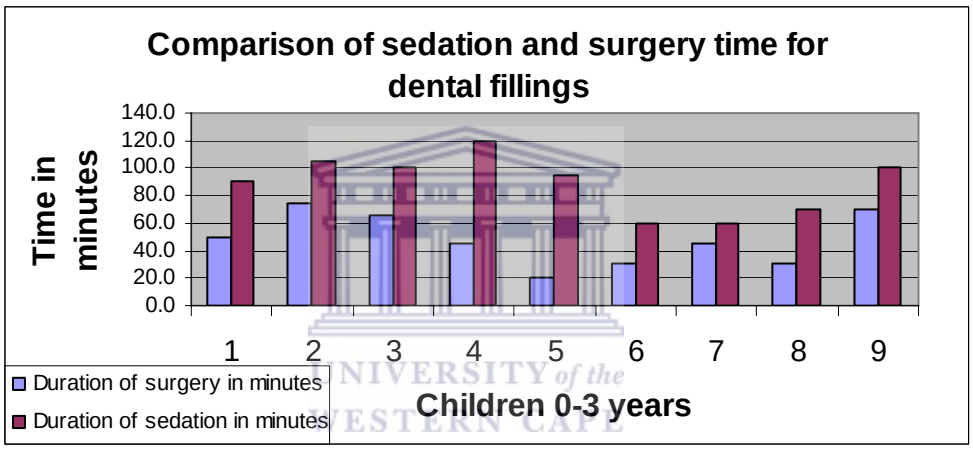
A movement score of 1: continuous movement making cannulation difficult, a response of 2: weeping, making cannulation difficult and the doctor's score of 2: IV cannulation poor, done with difficulty.

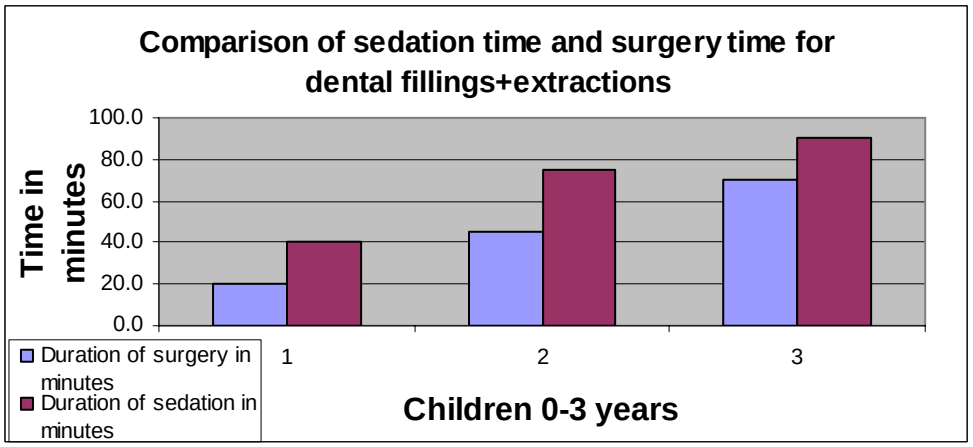
If the IV cannulation time is brought into consideration, the true pharmacological sedation time is much shorter.

RELATION BETWEEN SURGICAL AND SEDATION TIME:

GROUP 0-3 YEARS



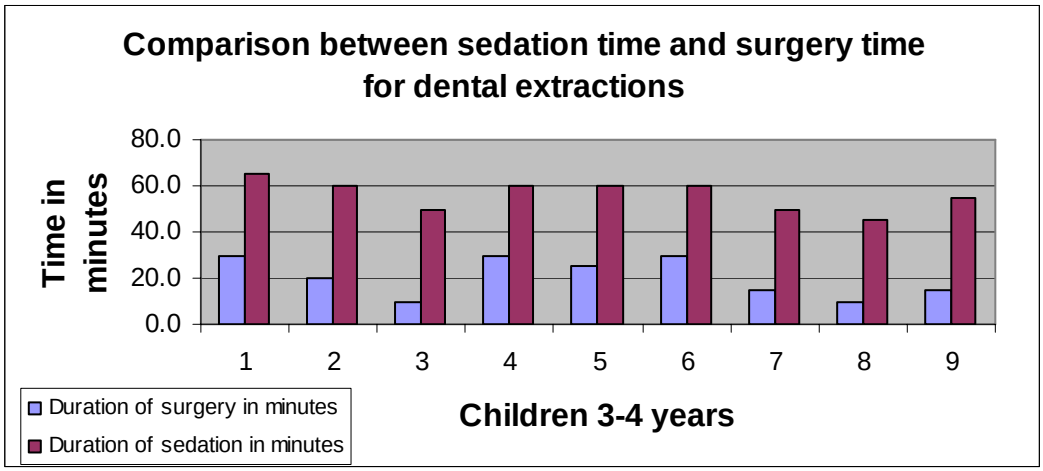


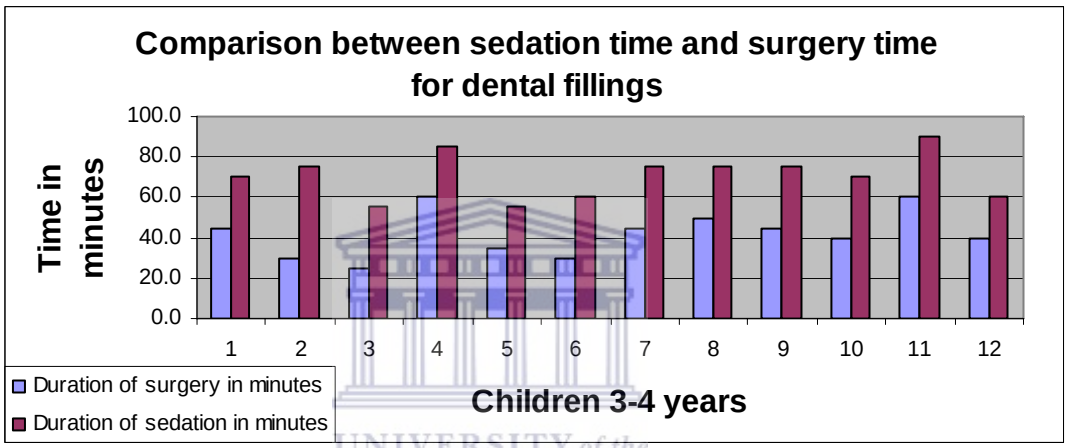


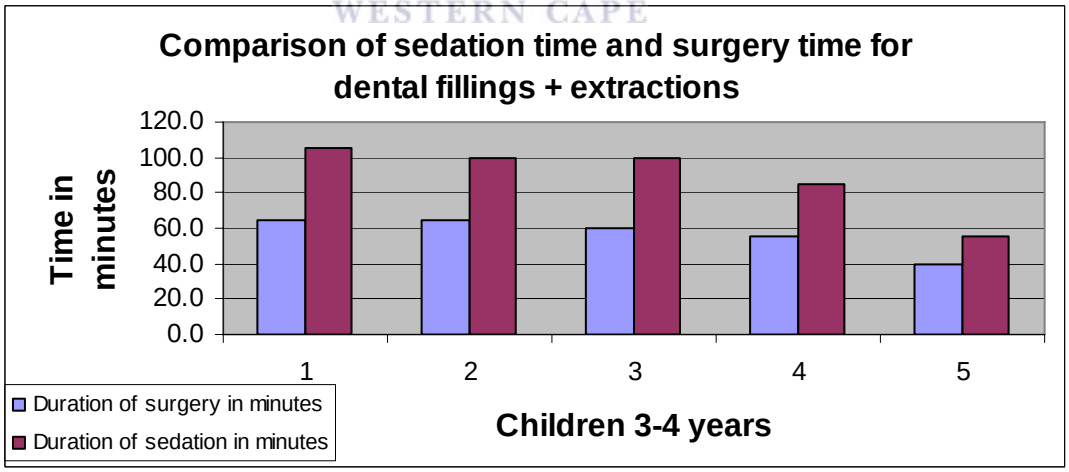
Comments:

In patients treated for dental extractions there were big differences between sedation time and surgery time. In this group the patients who were treated for both dental fillings and extractions the difference between sedation time and surgery time was the least.

Group: 3-4 Years:



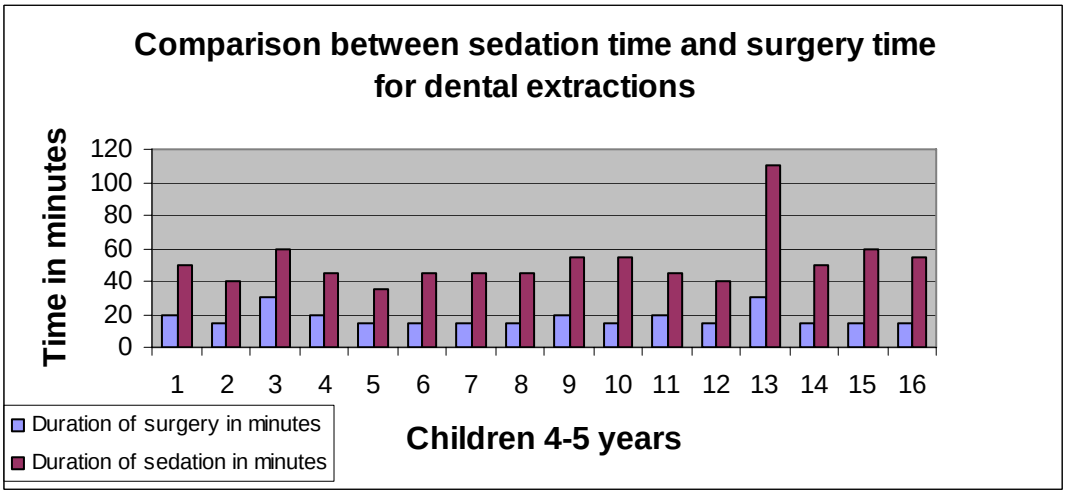


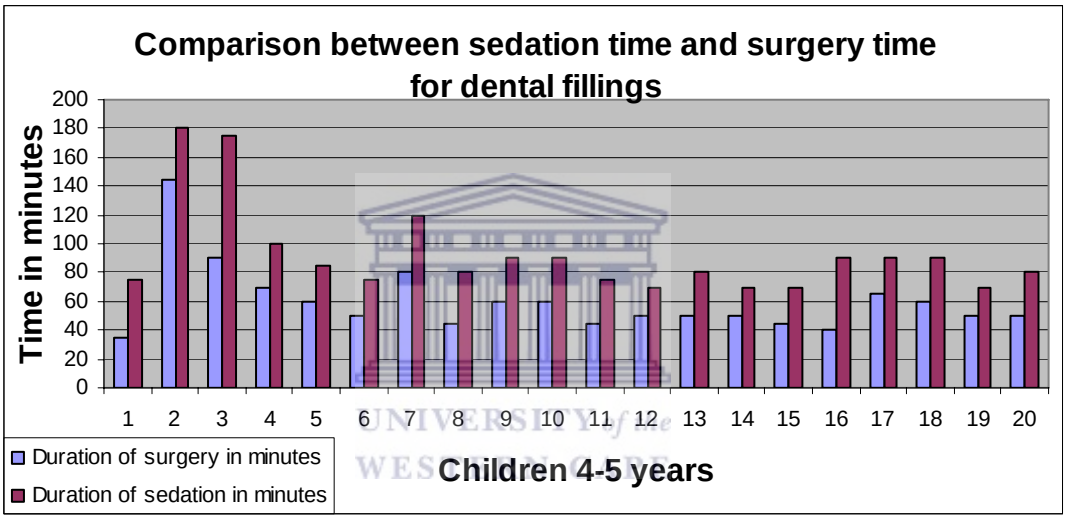


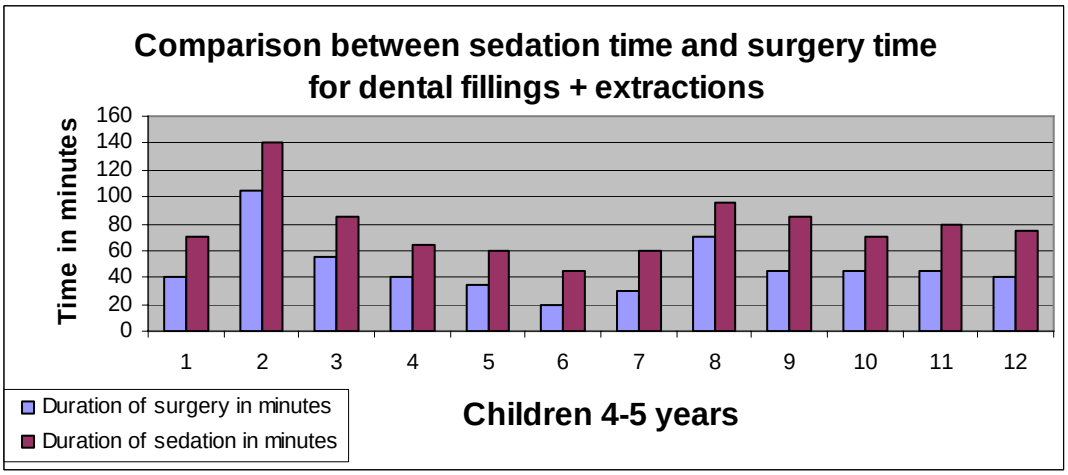
Comments:

Again in this age group the patients undergoing dental extractions had the biggest difference between surgery time and sedation time. IV sedation mixture could be reduced for patients receiving dental fillings as soon as the drilling was over, therefore the less difference between sedation and surgery time.

GROUP 4-5 YEARS:



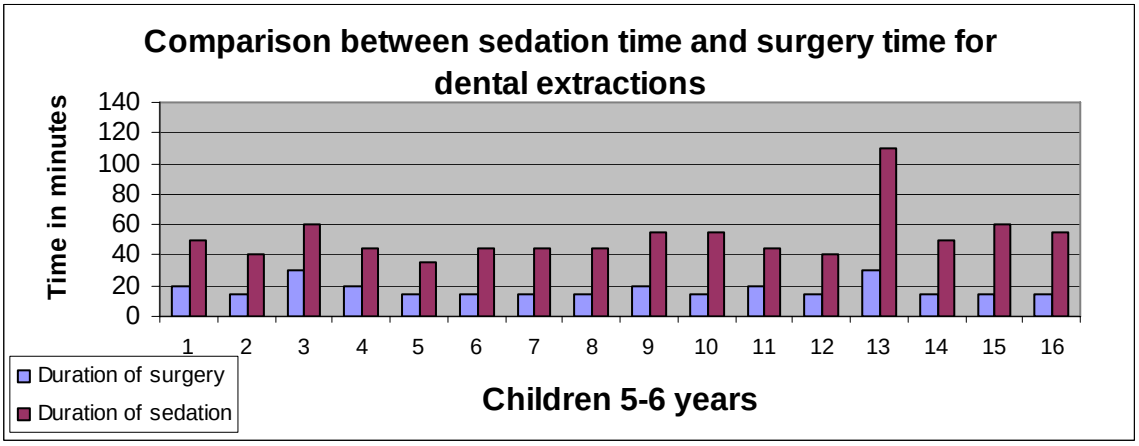


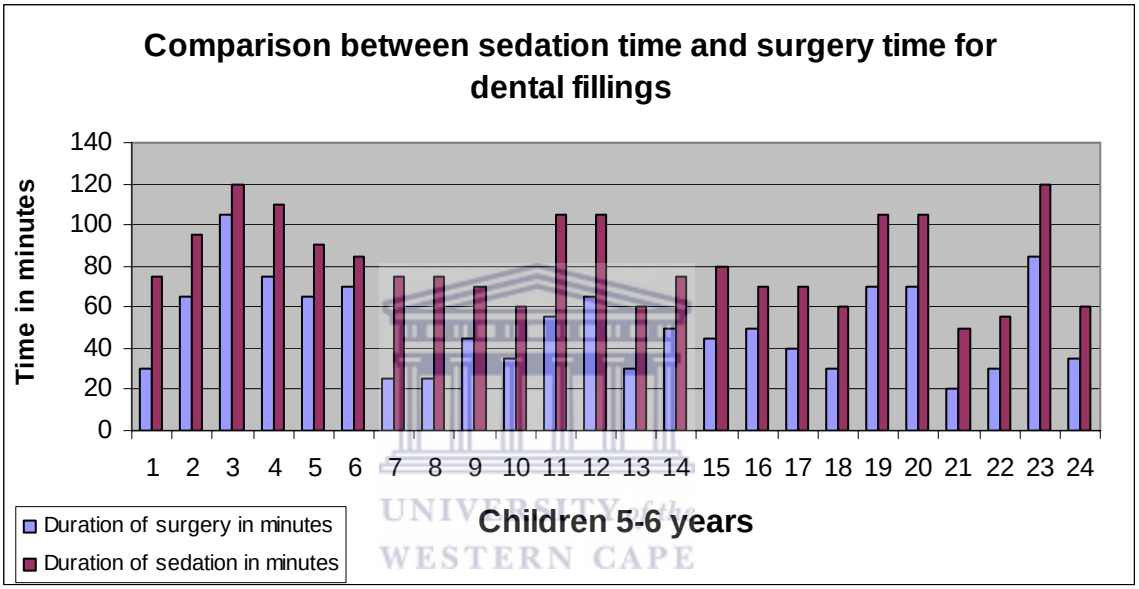


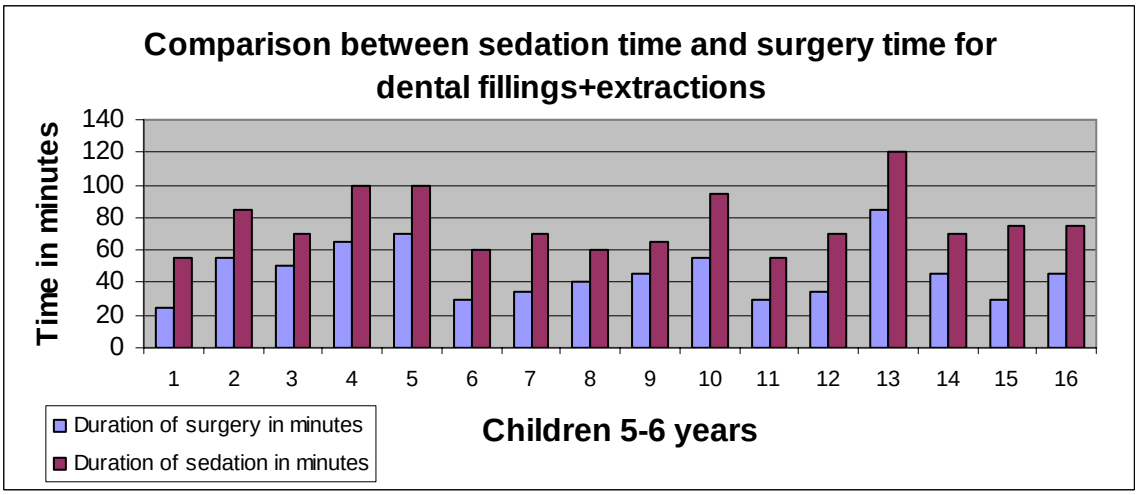
Comments:

Again in this age group the biggest difference between sedation time and surgery time was in the dental extraction group.

GROUP 5-6 YEARS:



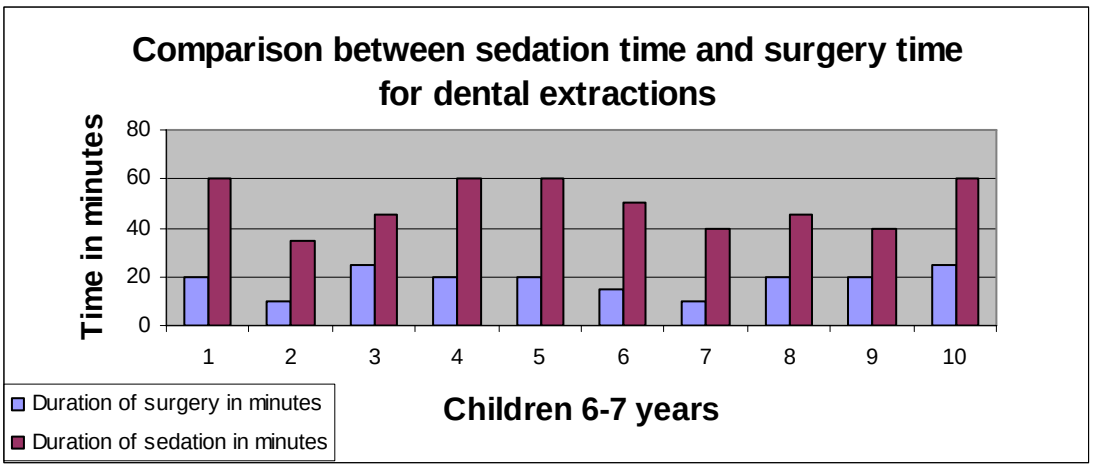


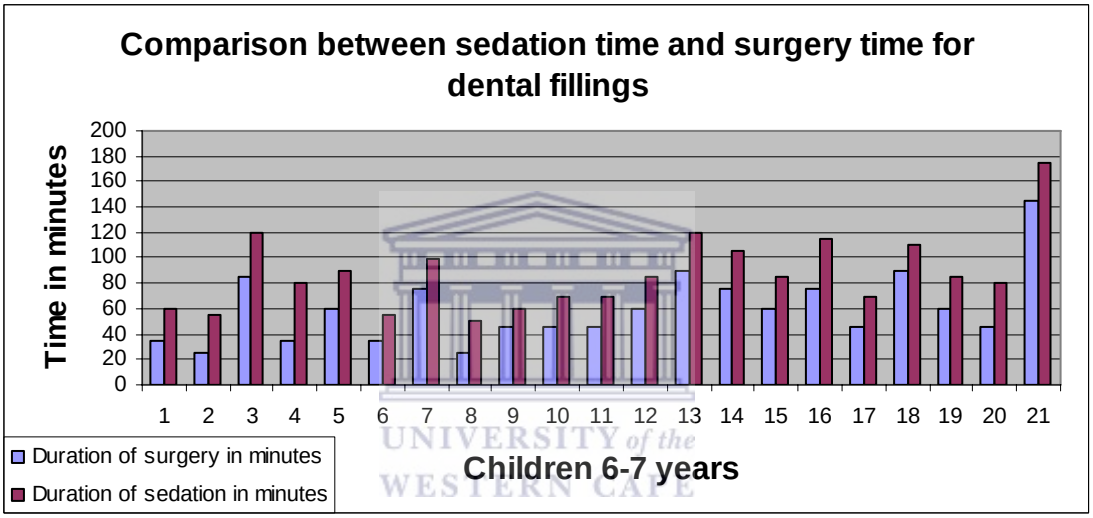


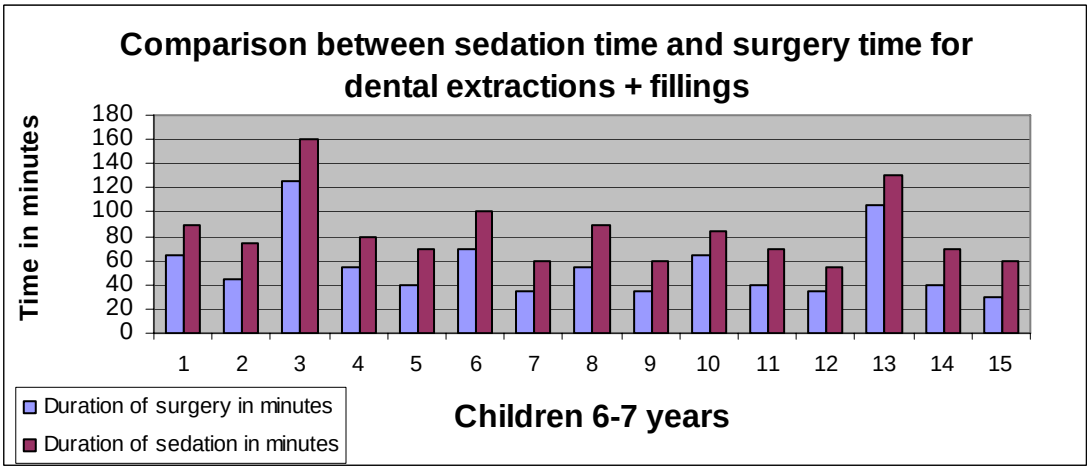
Comments:

As in the previous age groups, again the biggest difference between sedation time and surgery time is in the dental extraction group.

GROUP 6-7 YEARS:



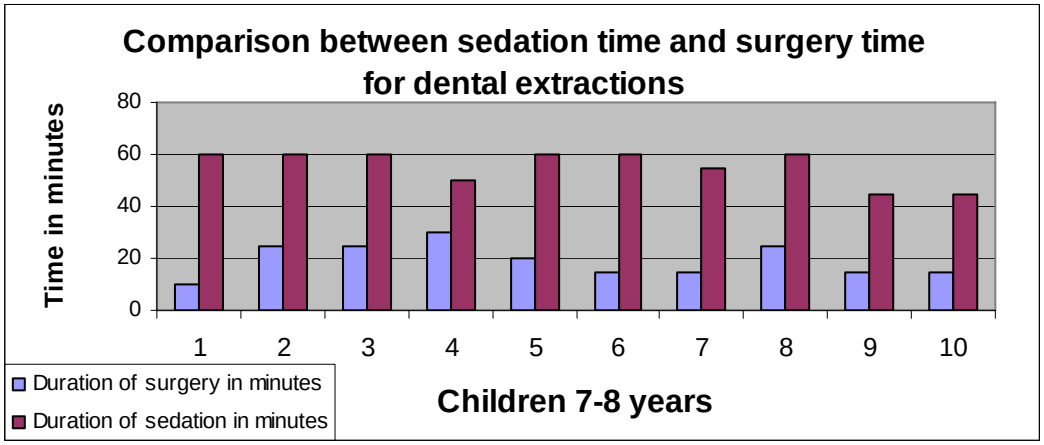


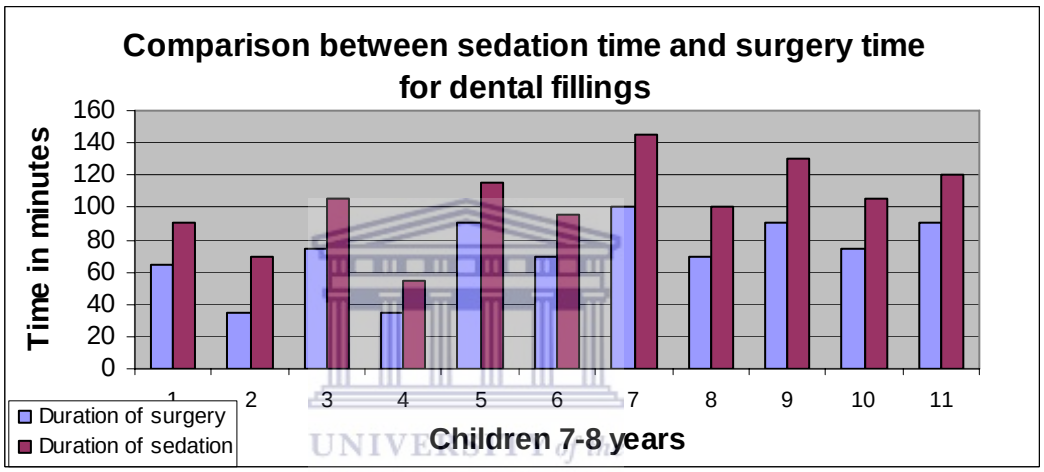


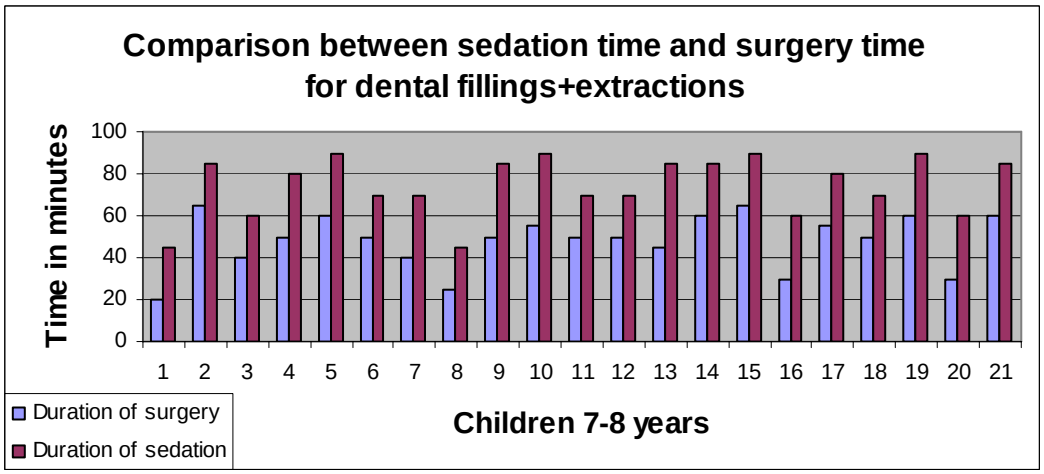
Comments:

In this age group again the biggest difference between sedation time and procedure time was in the dental extractions group.

GROUP 7-8 YEARS:





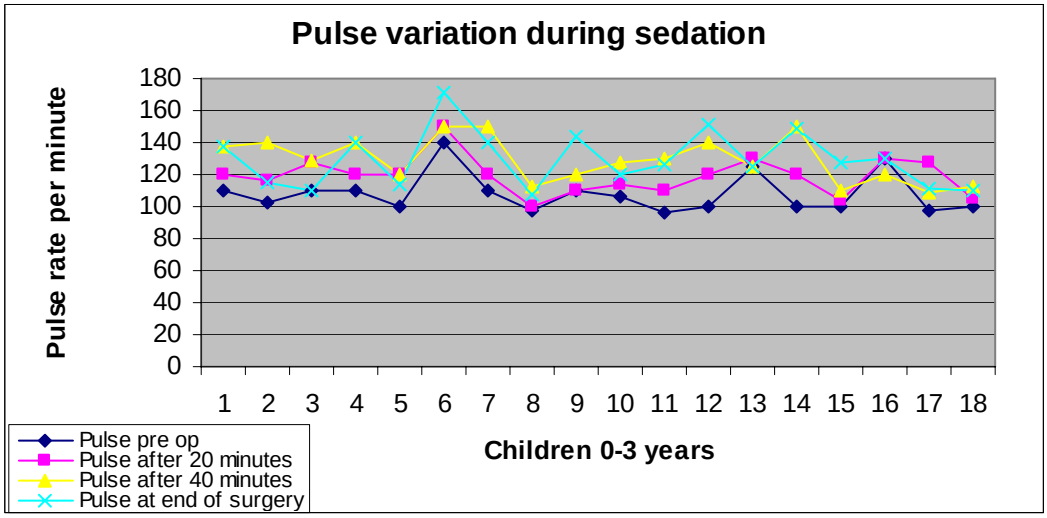


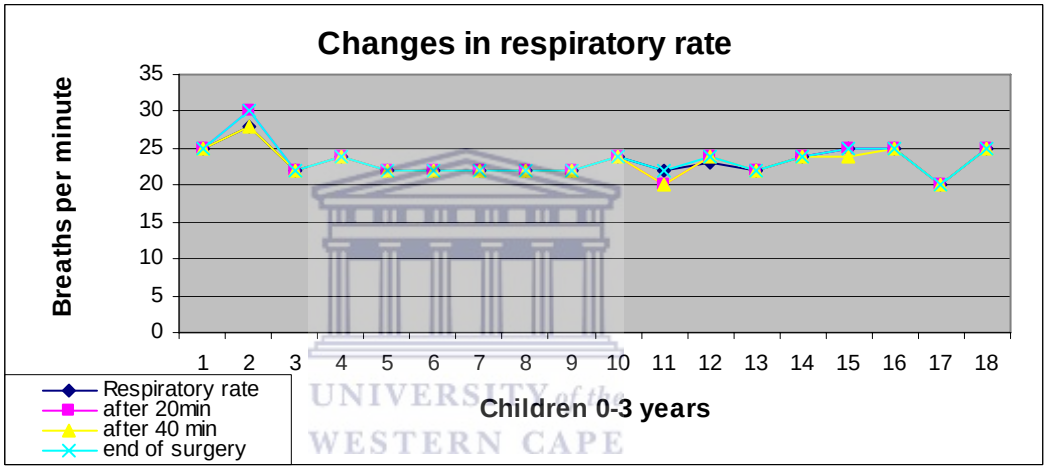
COMMENTS:

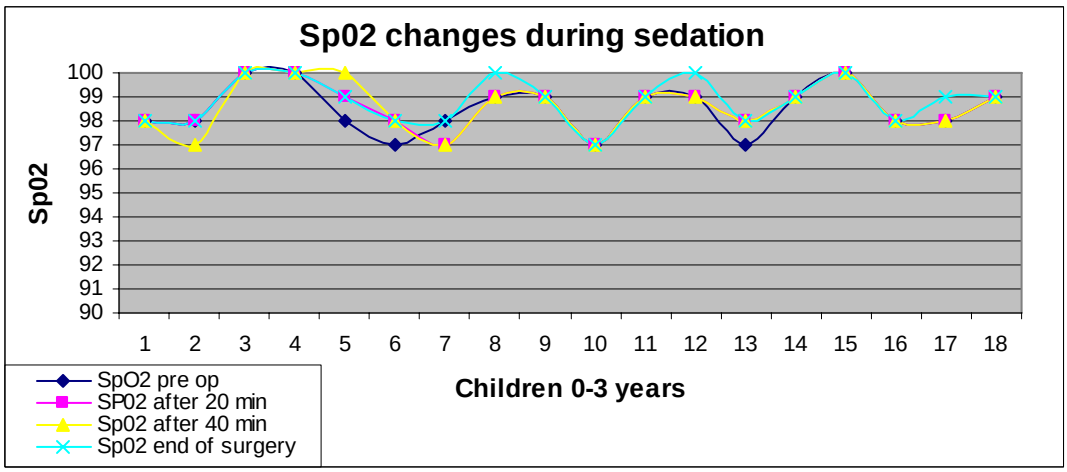
More children in this group had dental fillings and extractions done at the same time. Still the sedation time and surgery time for the extraction group alone had the biggest difference in time.

6. VITAL SIGNS: OBSERVATIONS

AGE 0-3 YEARS:



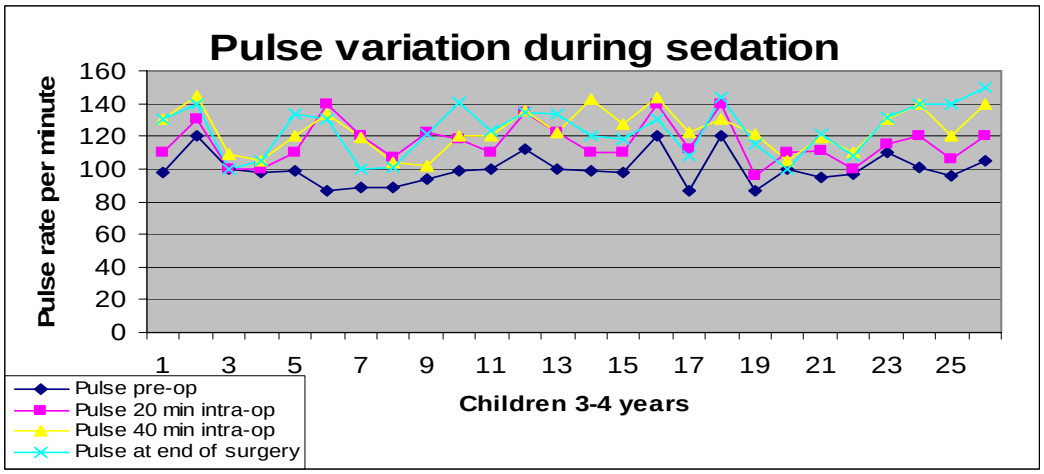


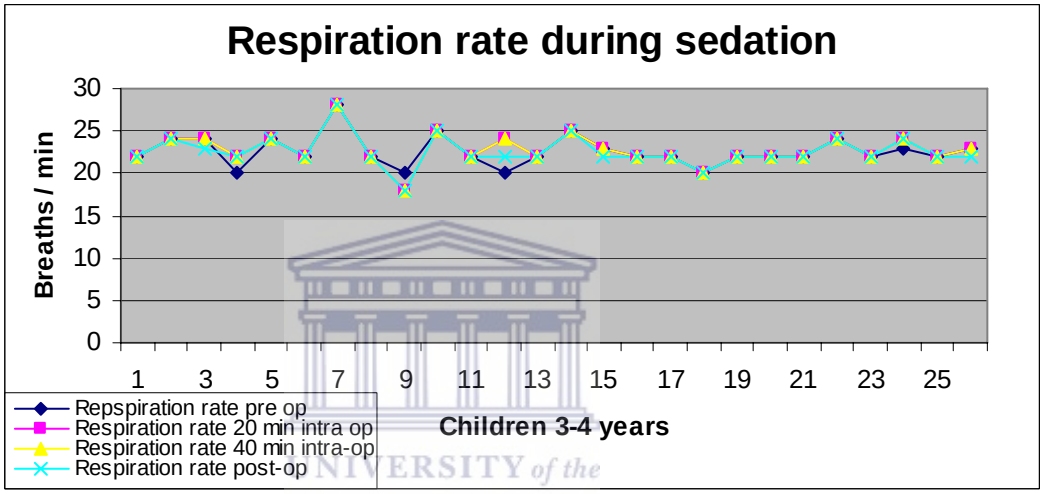


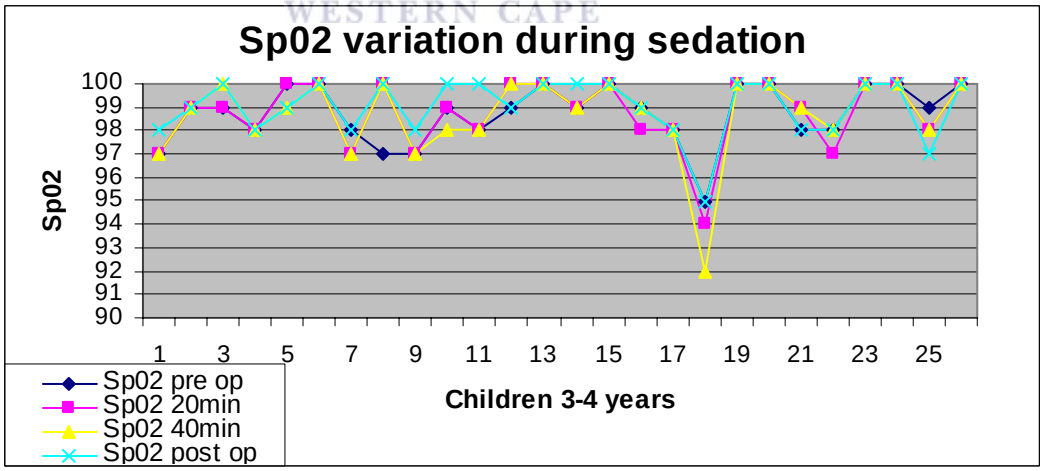
COMMENTS:

There was an increase in pulse rate between 10-15%. Reasons may be the use of ketamine, adrenalin and glycopyrrolate. The respiratory rate did not change. SpO2 was never lower than 96% and in some cases even increased to the end of the sedation. This may be due to a removal of a mucus plug in the upper airways.

CHILDREN 3-4 YEARS



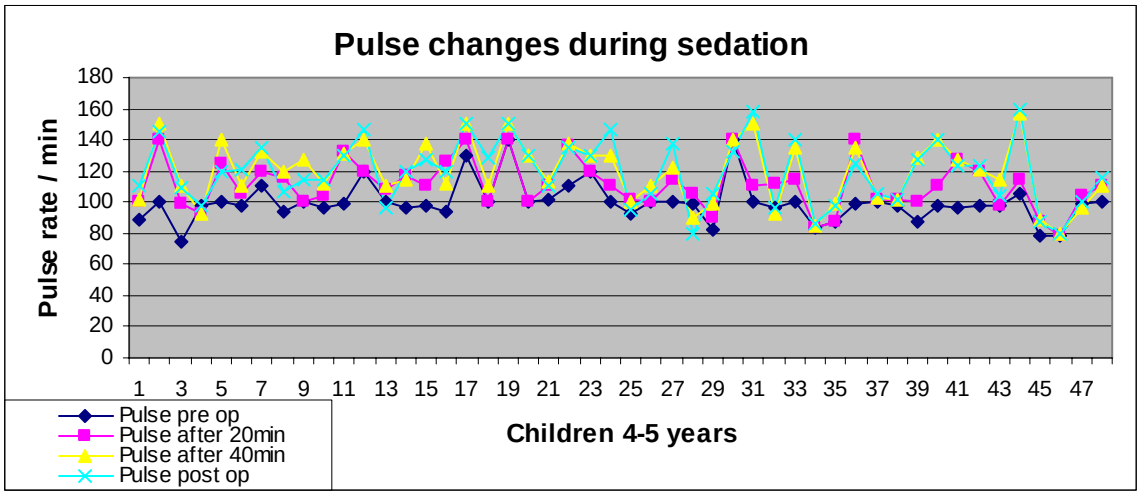


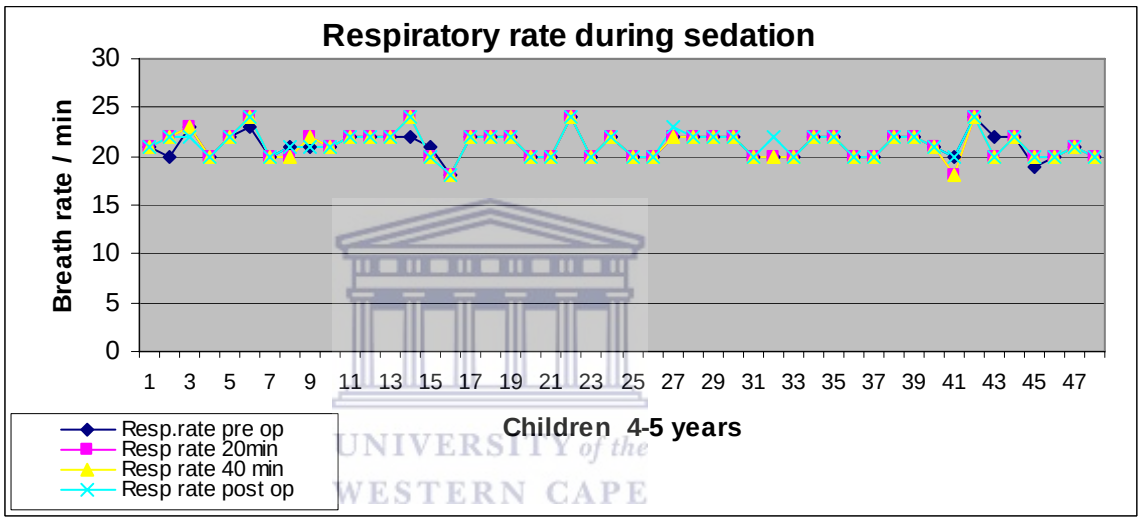


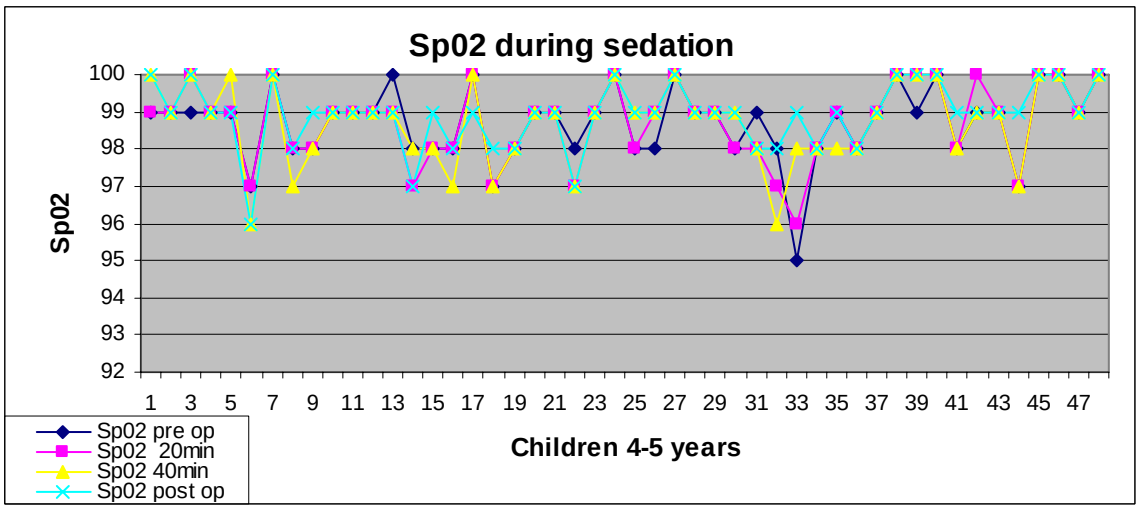
COMMENTS:

Again there was an increase in pulse rate. There were minimal changes in respiratory rate. One patient had a drop in SpO2, [asthma patient] but after hydrocortisone treatment returned to baseline. [95%]

CHILDREN 4-5 YEARS:



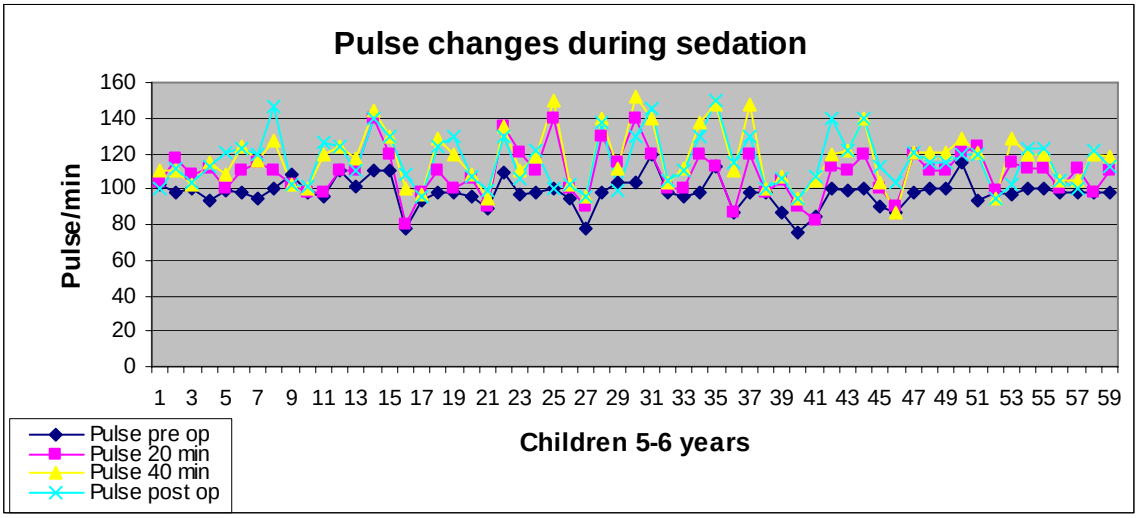


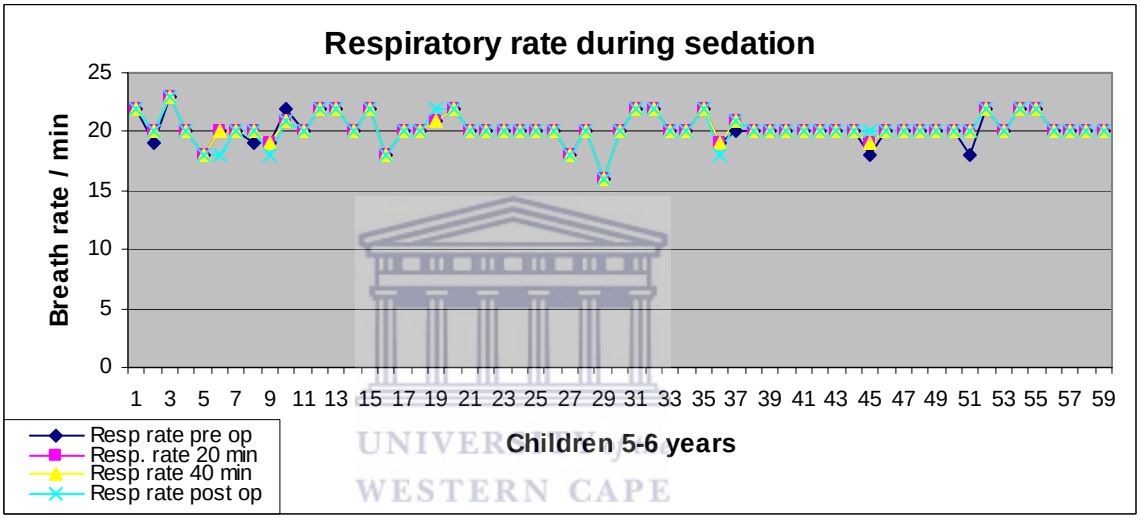


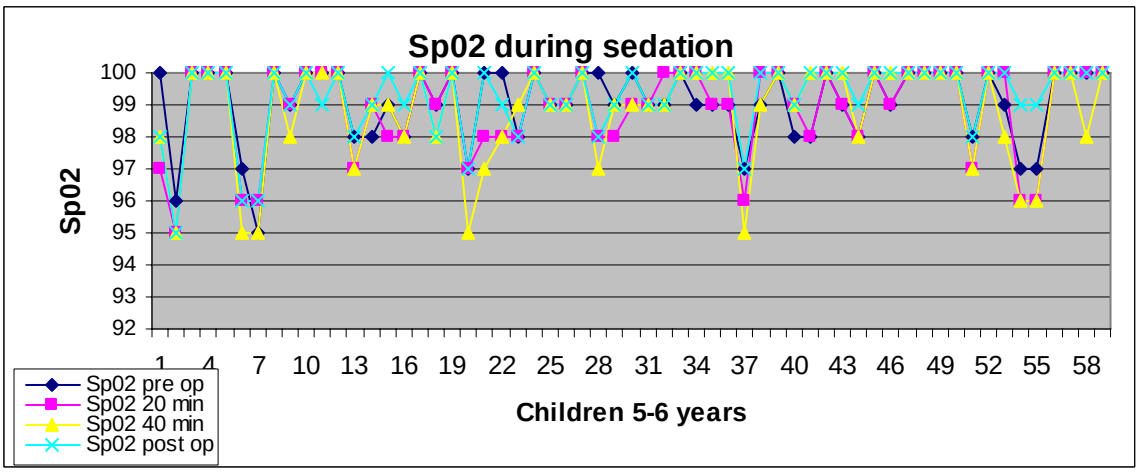
COMMENTS:

Pulse rate again increased in this age group. Breathing rate was unchanged. SpO2 varied but was never below 95%. The child with a SpO2 of 95% pre op had a mucus plug removed from the posterior nasopharynx and SpO2 increased to 99%.

CHILDREN 5-6 YEARS:



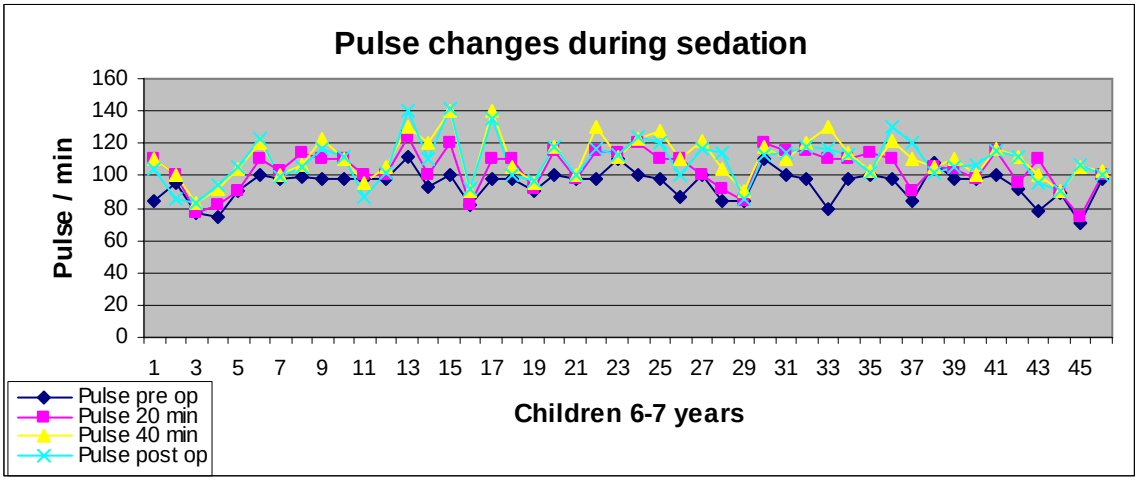


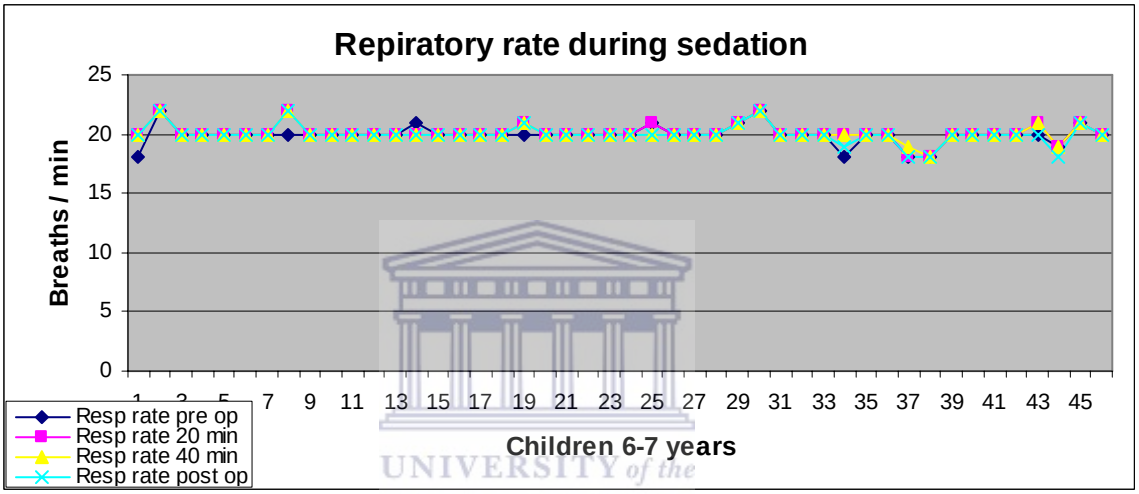


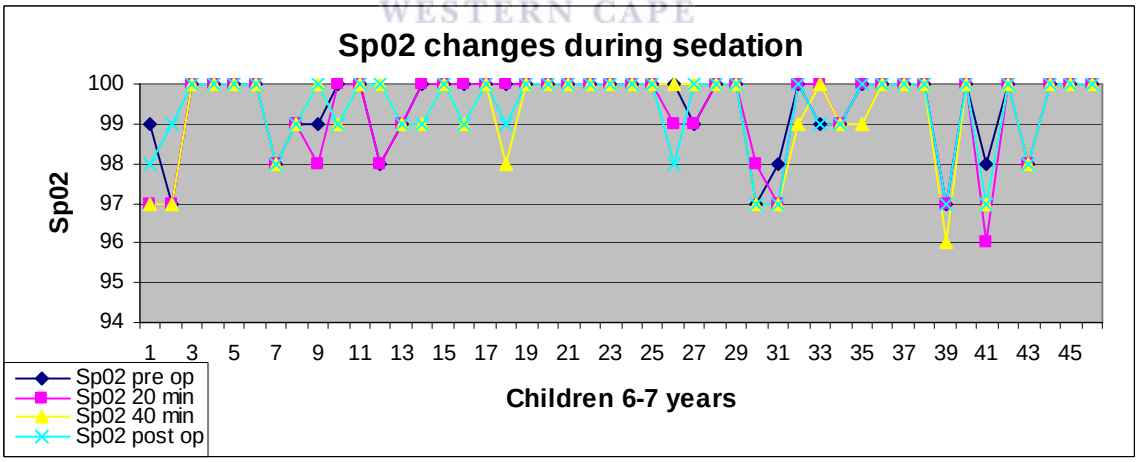
COMMENTS ON RESULTS:

Again there was a slight increase in pulse rate. Breathing rate was unchanged. 5 Patients had a desaturation to SpO2 of 95%, but the pre op SpO2 in these patients were not higher than 97%.

CHILDREN 6-7 YEARS:



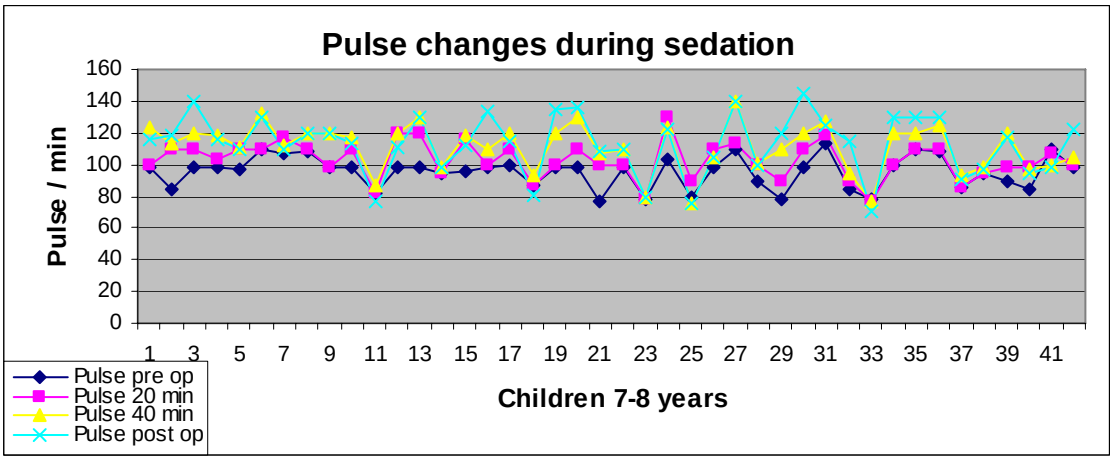


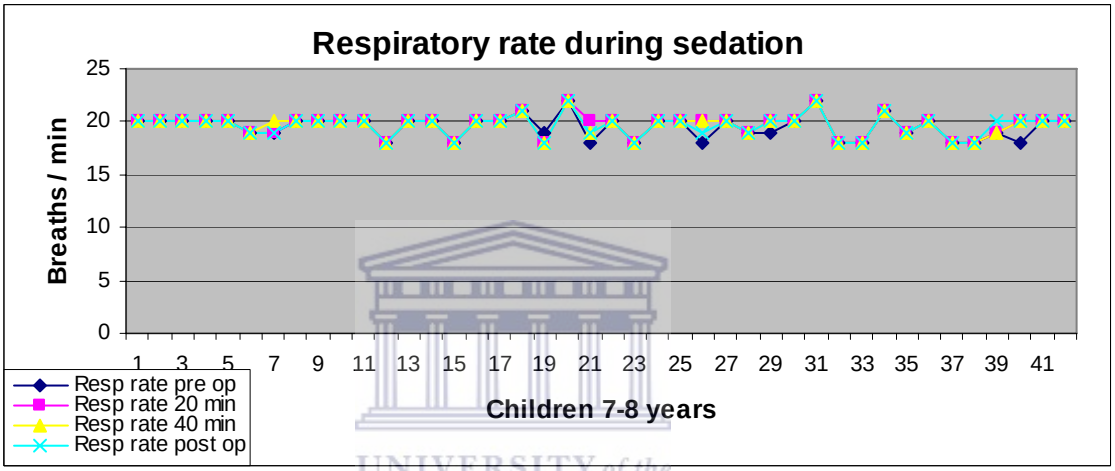


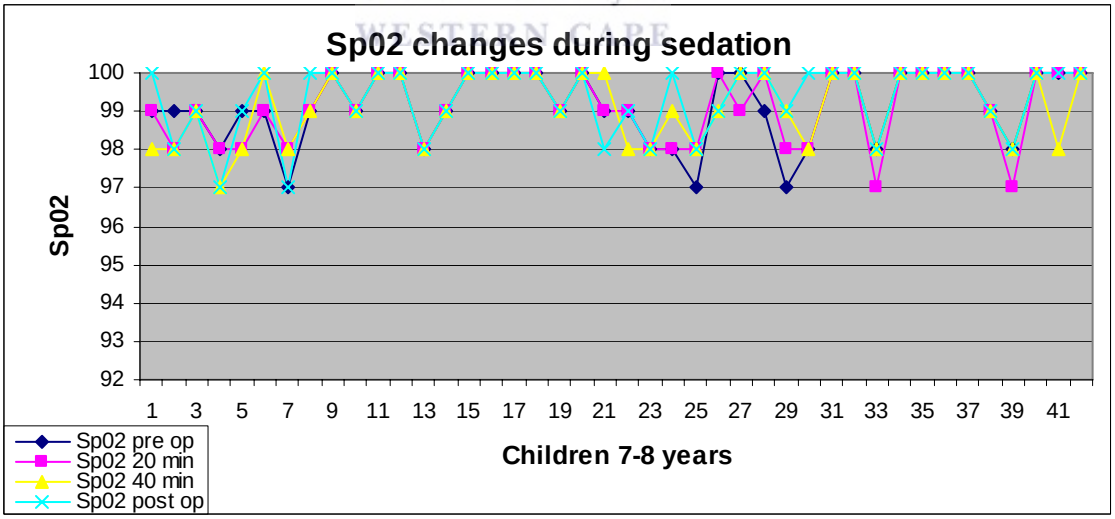
COMMENTS ON RESULTS

Again a slight increase in pulse rate is noted. Respiratory rate was unchanged. SpO2 varied, but was never less than 96%.

CHILDREN 7-8 YEARS







COMMENTS ON RESULTS:

Again a slight increase in pulse speed. Breathing rate was unchanged. SpO2 varied, but was never below 97%.

COMMENTS ON OBSERVATIONS:

PULSE:

All patients received Robinul ® [glycopyrrolate] for its anticholinergic effect and most patients received lignocaine 2% with adrenaline as a local anaesthetic. Both these drugs could cause an increase in pulse rate.
The sympathomimetic effect of ketamine could also cause an increase in pulse rate.
As seen in the above tables most of the patients had a mild increase in pulse rate ranging from 0-20%. The cholinergic effect of alfentanyl in the mixture, might counteract the effect a little.

RESPIRATORY RATE:

Normal variation in respiratory rate was noted. No patients experienced respiratory depression.
The respiratory depressing effect of midazolam and alfentanyl was not noted, maybe due to the extreme low doses.

OXYGENATION:

Sp02 varied between 95 – 100% for most of the patients.
In one case the Sp02 dropped to 92%. This particular patient was an asthmatic which responded with a decrease in Sp02 with mild sedation. After some hydrocortisone the Sp02 increased to pre operative values of 95%.
Another patient with a pre operative Sp02 of 95% had a mucus plug in the posterior nasopharynx, and when it was removed the Sp02 increased to 99%.
As can be seen on many of the graphs, the Sp02 after the procedure was better than the value pre operatively.
The reason for this is that a patient for a dental sedation must be able to breath through his nose during the sedation procedure.
Before the dentist started working I cleaned the nasopharynx very well with a suction catheter.
Many patients had mucus plugs in the posterior nasopharynx, which could easily be removed with gentle suction. [Any parent will know that no small child likes to blow his/her nose].

7. SEDATION LEVEL AND SEDATION MIXTURE REQUIREMENTS:

SEDATION LEVEL:

The Wilson sedation scale was used to monitor the sedation level of every patient.
As a titratable intravenous multidrug mixture was used for sedation and the patient was continuously monitored, the sedation level was never allowed to go beyond a conscious sedation [level 3].

WILSON SEDATION SCALE:

1. Patient fully awake, orientated
2. Drowsy
3. Eyes closed, rousable to verbal command
4. Eyes closed, rousable to mild physical stimulation
5. Eyes closed, unrousable to mild stimulation

As the sedation process is a continuum, many patients drifted from a stage 2 into a stage 3, or back to a stage 2.
In the following tables you will see a recording 2.5. This was used for patients who were at times a stage 2 and at other times drifted into a deeper sleep to a stage 3.
The Wilson sedation scale recordings were made at 15 minute intervals, although the patients were monitored continuously.
Recordings were only made during the time the patient received the intravenous sedation mixture.
For post operative evaluation, the modified Aldrete recovery score was used.

SEDATION MIXTURE REQUIREMENTS:

All patients received the multidrug intravenous sedation mixture:

1ml = 6 mg propofol + 2mg ketamine + 0.025mg alfentanyl

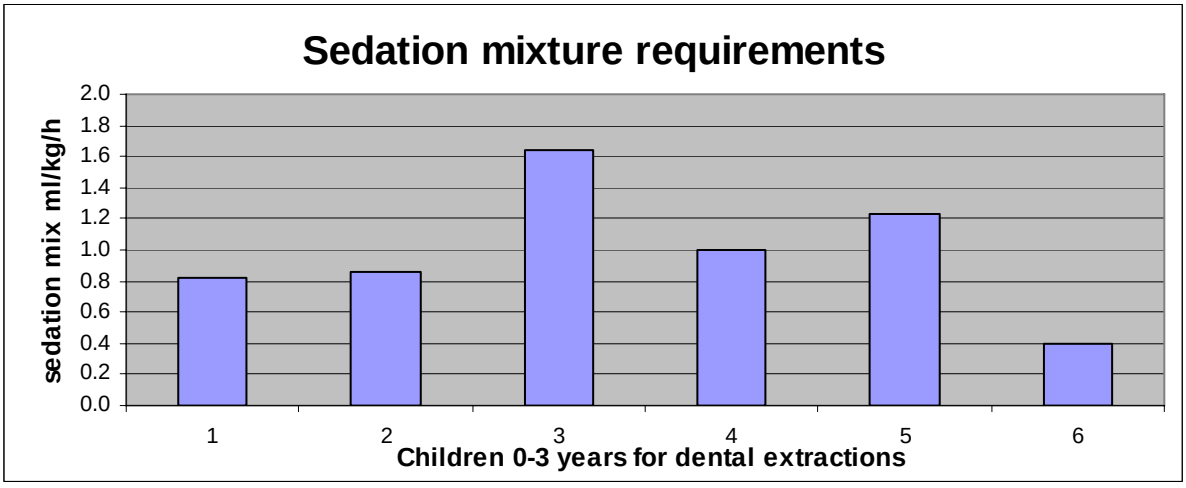
The infusion rate varied between 1-4 mg/kg/h at a concentration of 6mg/ml

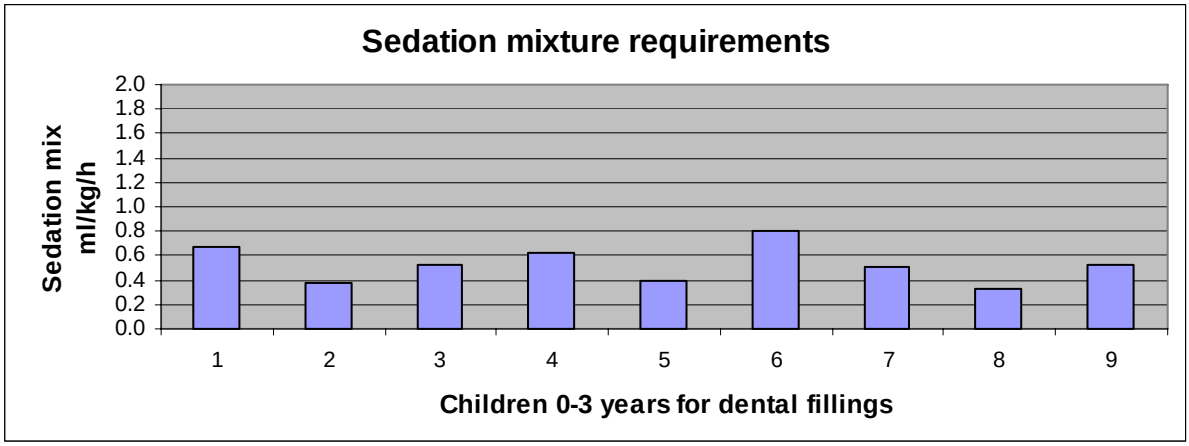
When required, additional bolus doses of ketamine 5mg/ml or midazolam 1mg/ml were given.

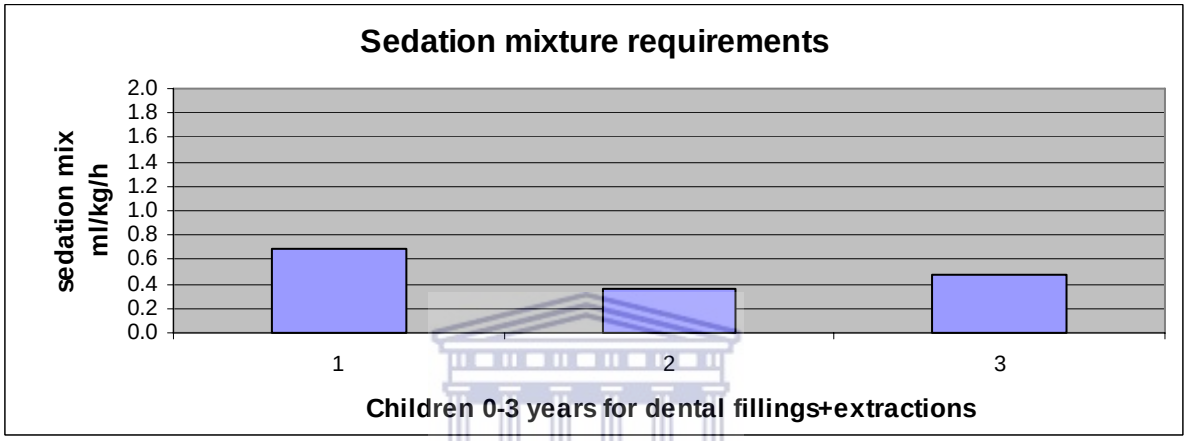
RESULTS:

Children 0-3 years:

Age	Reasons for surgery	Wilson sedation scale	ml/kg/h	Additional bolus ketamine mg	Additional bolus Midazolam mg
1.61	dental extractions	3.0	0.818	10	
2.26	dental extractions	3.0	0.857	20	
2.33	dental extractions	3.0	1.636		
2.38	dental extractions	3.0	1.000	20	
2.55	dental extractions	3.0	1.231	10	
2.79	dental extractions	2.5	0.400	5	
1.74	dental fillings	3.0	0.672	10	5
2.22	dental fillings	3.0	0.369	20	
2.29	dental fillings	3.0	0.527	40	0.5
2.47	dental fillings	2.5	0.615	20	
2.48	dental fillings	3.0	0.400	20	
2.65	dental fillings	2.5	0.800	10	
2.74	dental fillings	3.0	0.513		
2.81	dental fillings	2.5	0.333	10	
2.99	dental fillings	3.0	0.524		
2.61	dental fillings+extractions	2.0	0.692		
2.86	dental fillings+extractions	2.5	0.356	10	
2.86	dental fillings+extractions	2.5	0.482		







COMMENTS ON SEDATION MIXTURE REQUIRED FOR CHILDREN 0-3 YEARS:

1 ml mixture = 6mg propofol + 2mg ketamine + 0.025mg alfentanyl:

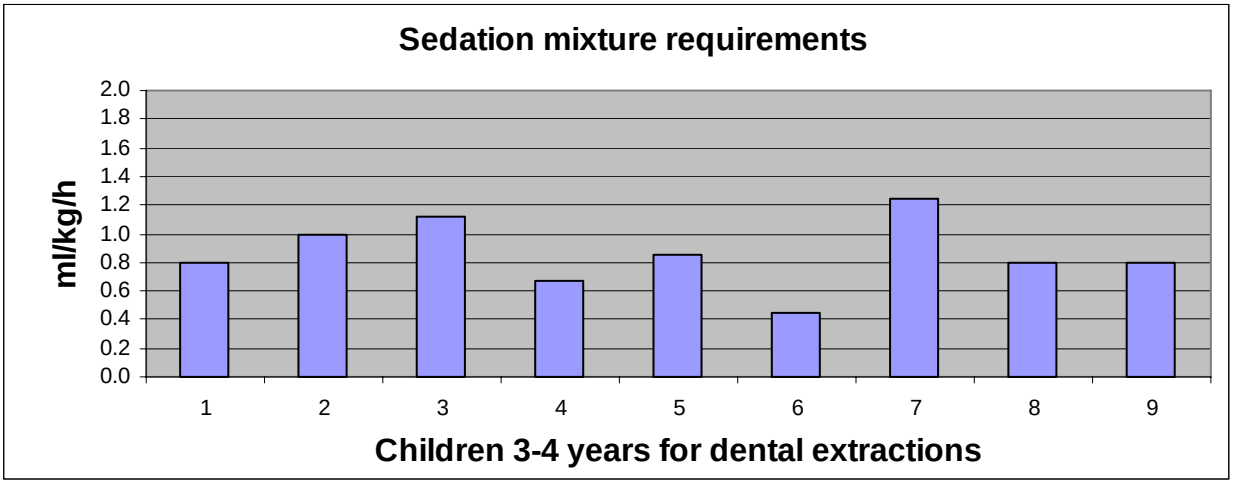
I prefer to group the patients undergoing the same procedures together.
6 Patients needed dental extractions. Sedation mixture requirements for this type of procedure varied between 0.4 – 1.6 ml/kg/h.
Patients for dental fillings required between 0.3 - 0.8 ml/kg/h of the sedation mixture.
Patients for dental fillings + extractions needed between 0.35-0.69 ml/kg/h of the sedation mixture.
Most of the patients who had received between 0.3 - 0.8 ml/kg/h mixture also received bolus doses of ketamine.
The patient that received 1.6ml/kg/h mixture didn't need additional ketamine.
The 2 patients that received additional Dormicum ® bolus doses were both for dental fillings and were very young. The first one only 1.7 years. I doubt if she really swallowed the Dormicum ® tablet which was part of the pre-medication.

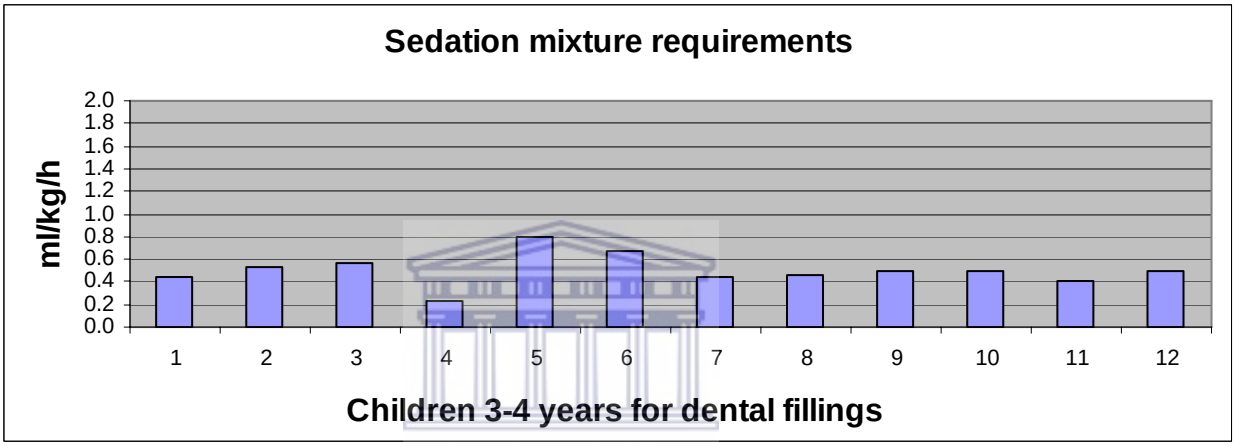
SEDATION LEVEL:

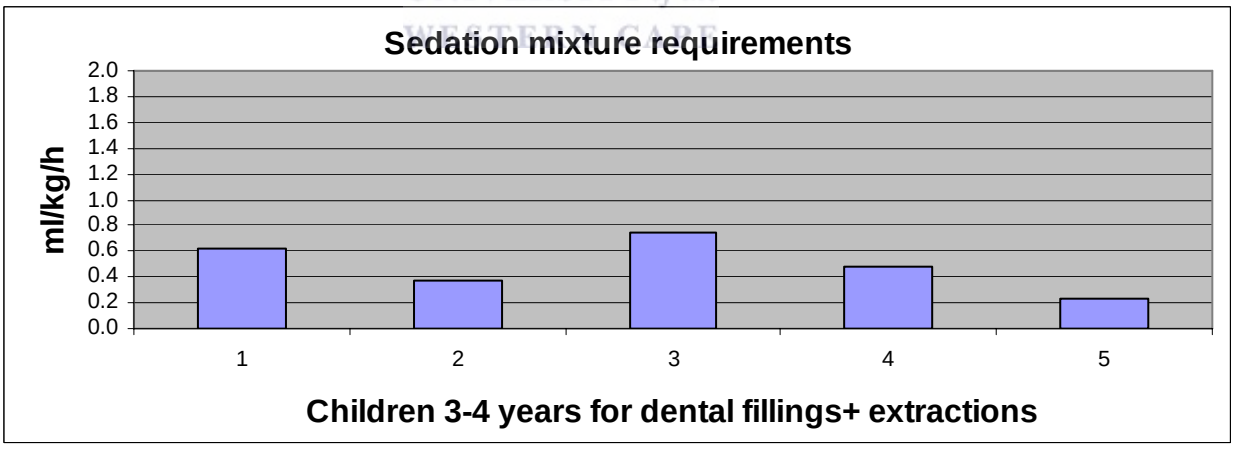
All patients for dental extractions were at a sedation level 3. As dental extractions were a more invasive procedure I preferred to put the patients at a deeper sedation level. [Doctor's choice, not patient's preference]
Patients for dental fillings varied between 2.5 and 3.
Patients for dental fillings and extractions were at sedation levels of 2 – 2.5. Please note that the average dosage [ml/kg/h] not necessarily determined the level of sedation. One of the patients for dental fillings was at a level 3 on 0.513 ml/kg/h, while another patient for dental fillings and extractions was at a level 2 on a dosage of 0.692 ml/kg/h.

Children 3-4 years:

Age	Procedure	Wilson sedation scale	ml/kg/h	Additional bolus Ketamine mg	Additional bolus Midazolam mg
3.00	dental extractions	3.0	0.800	30	
3.09	dental extractions	3.0	1.000	10	
3.20	dental extractions	3.0	1.125	10	
3.55	dental extractions	2.0	0.667	20	
3.67	dental extractions	2.5	0.857		
3.87	dental extractions	3.0	0.444	20	
3.96	dental extractions	3.0	1.250	20	
3.98	dental extractions	3.0	0.800	10	
3.65	dental extractions	3.0	0.800	5	
3.12	dental fillings	2.5	0.444	5	
3.32	dental fillings	3.0	0.533	20	
3.39	dental fillings	2.0	0.565		
3.43	dental fillings	3.0	0.235	20	
3.43	dental fillings	2.0	0.800		
3.49	dental fillings	2.0	0.667		
3.50	dental fillings	2.0	0.444		
3.50	dental fillings	2.5	0.467	5	1
3.67	dental fillings	2.5	0.500	10	
3.69	dental fillings	2.0	0.500	10	
3.70	dental fillings	2.5	0.400		
3.84	dental fillings	2.0	0.500	10	
3.16	dental fillings+extractions	3.0	0.615		
3.23	dental fillings+extractions	3.0	0.369	10	
3.31	dental fillings+extractions	2.5	0.750		
3.39	dental fillings+extractions	2.5	0.477	10	
3.76	dental fillings+extractions	3.0	0.225	10	







COMMENTS ON SEDATION MIXTURE REQUIRED FOR 3-4 YEAR OLD CHILDREN:

1ml= 6mg Propofol +2mg ketamine + 0.025mg alfentanyl

In this age group 9 children required dental extractions. Sedation mixture required for dental extractions varied between 0.44ml/kg/h – 1.25ml/kg/h.

The total amount of ketamine given as bolus doses was also very high in this group. All patients for dental extractions required ketamine bolus doses, except one patient. No additional Dormicum ® was given in this group.
Patients for dental fillings required between 0.23-0.8ml/kg/h of the sedation mixture.
7 Of the 12 Patients needed bolus doses of ketamine and one patient needed an additional Dormicum ® [1mg] bolus IV.
Five patients in this age group required both dental fillings and extractions. Sedation mixture required varied between 0.22-0.75ml/kg/h.
3 Of the 5 patients needed ketamine bolus doses, but none needed additional Dormicum ®.

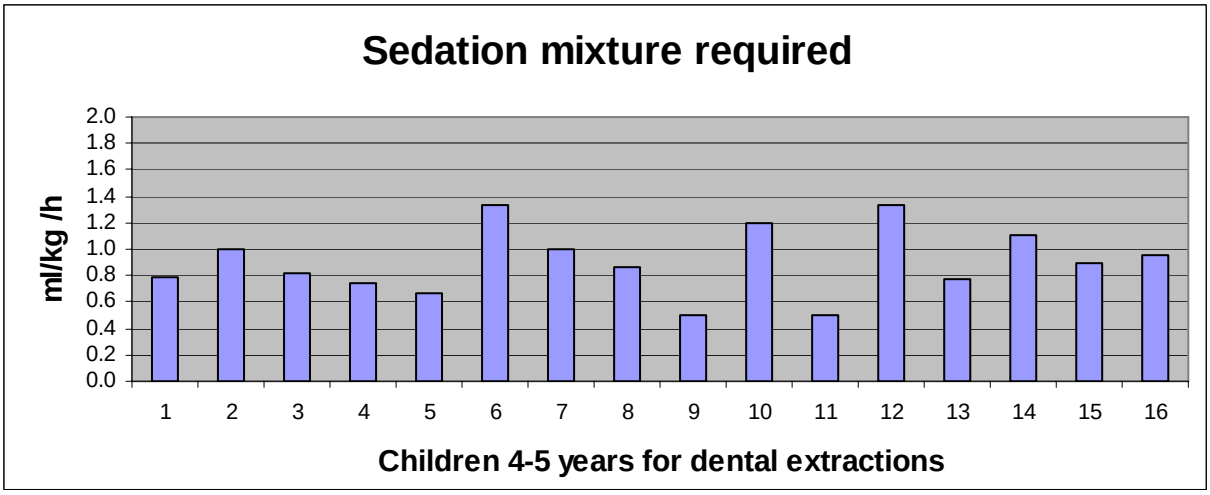
SEDATION LEVEL:

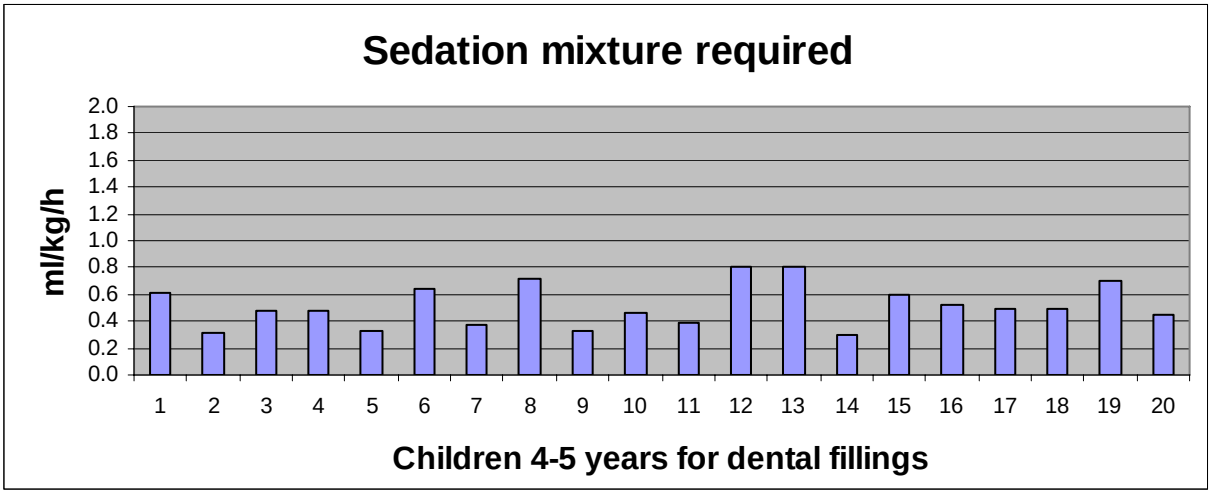
7 Of the 9 patients for dental extractions were at a level 3 during the sedation process.
Patients for dental fillings were more awake. 6 Of the 12 patients had a score of 2 and only 2 patients had a score of 3.
Patients for dental fillings + extractions were a little more asleep than patients for dental fillings only: 3 patients scored a 3 and 2 patients a 2.5.

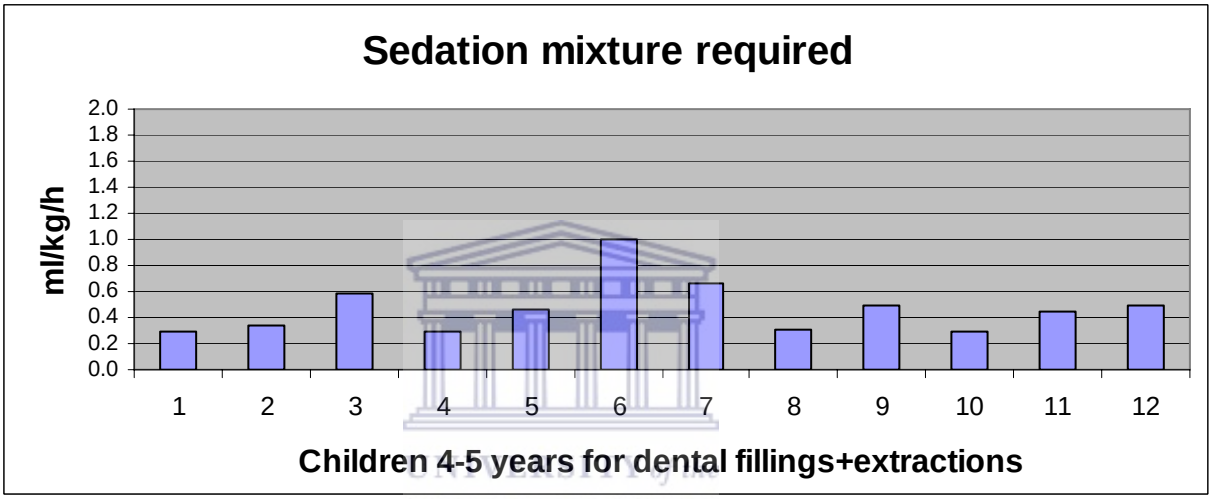
Children 4-5 years:

Age	Procedure	Wilson sedation scale	ml/kg/h	Additional Bolus Ketamine mg	Additional Bolus Midazolam mg
4.74	dental extraction	2.5	0.789	5	
4.03	dental extractions	2.0	1.000	10	
4.08	dental extractions	3.0	0.824	10	
4.13	dental extractions	3.0	0.750	10	
4.19	dental extractions	2.5	0.667	20	
4.35	dental extractions	2.0	1.333	20	
4.43	dental extractions	3.0	1.000	20	
4.46	dental extractions	3.0	0.857	10	
4.47	dental extractions	2.5	0.500		
4.48	dental extractions	3.0	1.200	20	
4.49	dental extractions	3.0	0.500	10	
4.50	dental extractions	3.0	1.333	10	
4.71	dental extractions	3.0	0.778		
4.81	dental extractions	3.0	1.111	10	
4.92	dental extractions	3.0	0.889	10	
4.99	dental extractions	2.5	0.960	20	
4.61	dental filings	2.5	0.605		
4.11	dental fillings	3.0	0.310	40	
4.12	dental fillings	2.5	0.471	20	
4.24	dental fillings	2.5	0.482	10	

4.25	dental fillings	3.0	0.333		
4.27	dental fillings	2.5	0.640	40	1
4.27	dental fillings	3.0	0.375		
4.47	dental fillings	3.0	0.711		
4.53	dental fillings	2.5	0.333	20	
4.54	dental fillings	3.0	0.458	10	
4.56	dental fillings	2.5	0.381	10	
4.61	dental fillings	2.0	0.800	5	
4.66	dental fillings	2.5	0.800	10	
4.69	dental fillings	2.5	0.300	10	
4.72	dental fillings	2.0	0.593		
4.76	dental fillings	2.0	0.529		
4.87	dental fillings	3.0	0.492		
4.90	dental fillings	2.0	0.500		
4.97	dental fillings	2.0	0.706		
4.98	dental fillings	2.0	0.450		
4.10	dental fillings+extractions	3.0	0.300	20	
4.11	dental fillings+extractions	2.5	0.343	30	4
4.11	dental fillings+extractions	2.0	0.582		
4.11	dental fillings+extractions	2.5	0.300	10	
4.14	dental fillings+extractions	2.0	0.457	10	
4.15	dental fillings+extractions	3.0	1.000	5	
4.38	dental fillings+extractions	3.0	0.667	10	2
4.54	dental fillings+extractions	3.0	0.312	40	
4.58	dental fillings+extractions	3.0	0.485	40	1
4.67	dental fillings+extractions	2.5	0.296	10	
4.92	dental fillings+extractions	2.5	0.444		
4.99	dental fillings+extractions	3.0	0.500	20	1







COMMENTS ON SEDATION MIXTURE REQUIRED FOR 4-5 YEAR OLD CHILDREN:

1ML = Propofol 6mg +ketamine 2mg +alfentanyl 0.025mg

16 Children in this age group were treated for dental extractions.
Sedation mixture required varied between 0.5ml/kg/h-1.3ml/kg/h.
All the patients except 2 required bolus doses of ketamine.

20 Children were treated for dental fillings.
Sedation mixture required varied between 0.3ml/kg/h-0.8ml/kg/h.
50% Of the children needed bolus doses of ketamine and one child needed an extra 1mg Dormicum ® IV.

12 Children in this age group were treated for dental fillings+extractions.
Sedation mixture required varied between 0.29-1.0ml/kg/h.

10 of the 12 patients needed bolus doses of ketamine and 4 patients needed bolus doses of Dormicum ® IV.

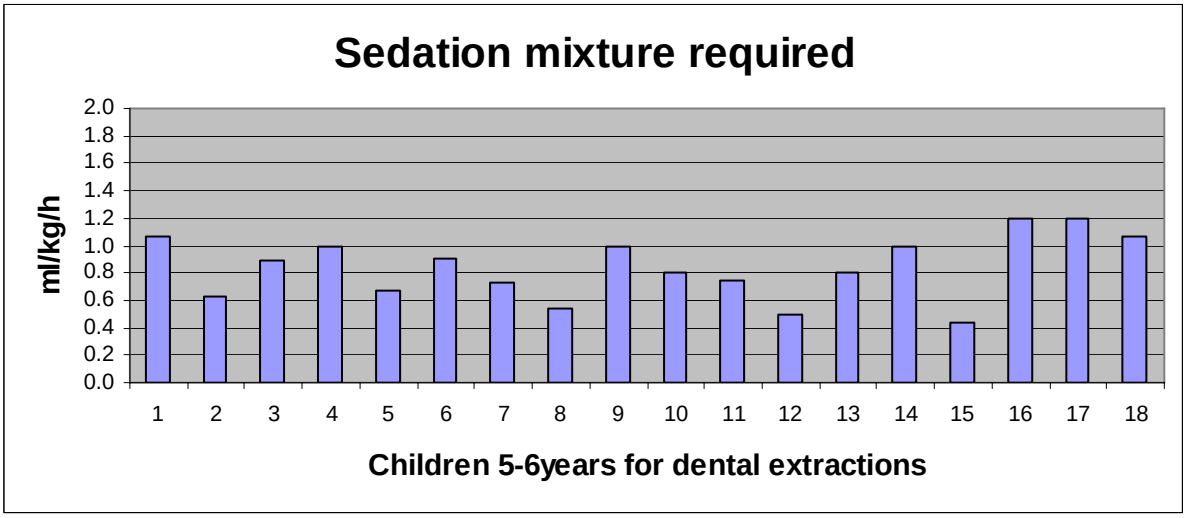
SEDATION LEVEL:

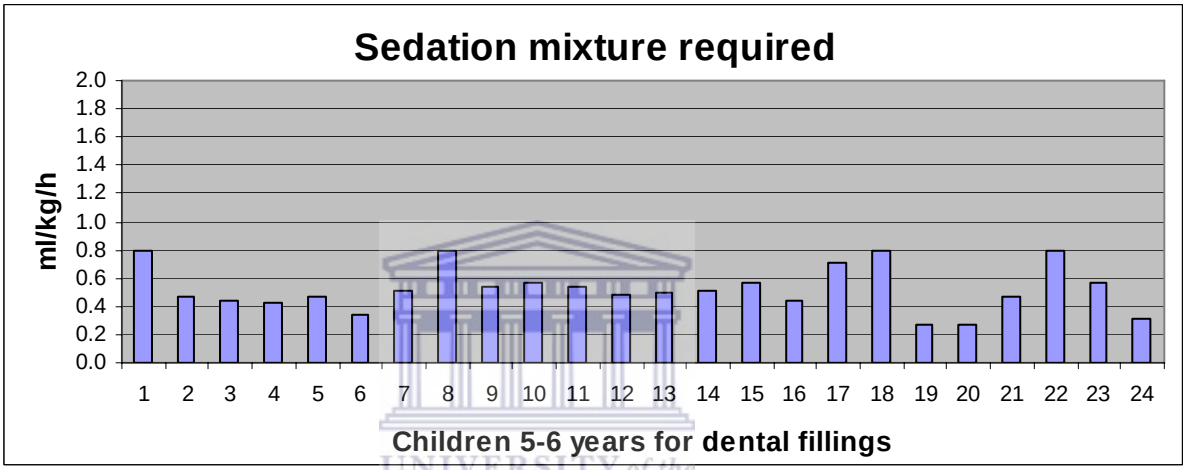
Of the 16 Patients in this age group treated for dental extractions, 10 Of them were at a level 3 and only 2 at a level 2.
The patients treated for dental fillings varied between levels 2 – 3, with 6 patients scoring 3, 6 patients scoring 2 and 8 patients scoring 2.5.
13 Patients were treated for both dental fillings + extractions. 7 Patients received a score of 3, 4 patients a score of 2.5 and 2 patients a score of 2.

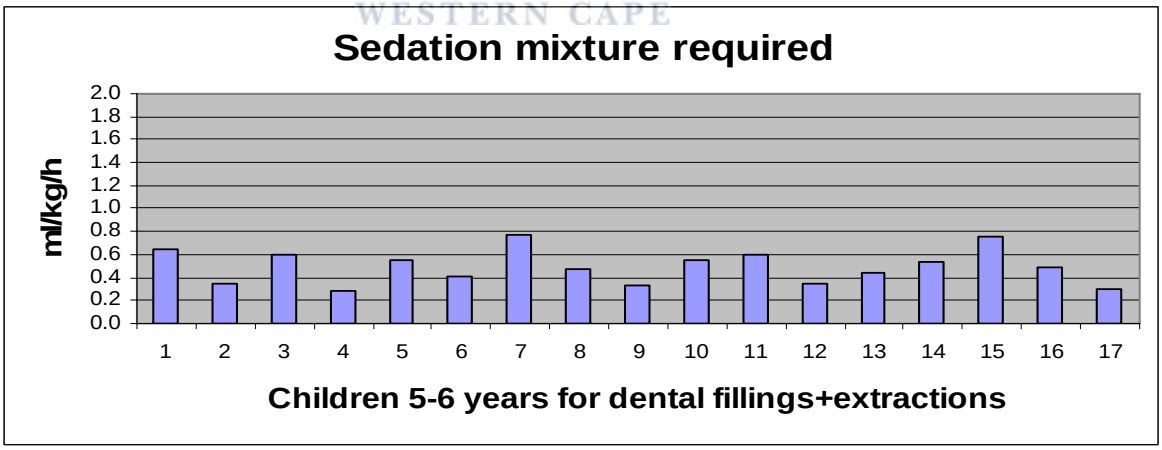
Children 5-6 years:

Age	Procedure	Wilson sedation scale	ml/kg/h	Additional bolus Ketamine mg	Additional bolus midazolam mg
5.18	dental extractions	3.0	1.067	10	
5.28	dental extractions	3.0	0.632	10	
5.30	dental extractions	3.0	0.889	20	
5.42	dental extractions	3.0	1.000	20	
5.52	dental extractions	3.0	0.667	20	
5.56	dental extractions	2.0	0.900		
5.61	dental extractions	3.0	0.727	20	
5.65	dental extractions	2.0	0.533	10	
5.65	dental extractions	2.5	1.000	10	
5.68	dental extractions	3.0	0.800	10	
5.74	dental extractions	3.0	0.750	20	
5.75	dental extractions	3.0	0.500	10	
5.81	dental extractions	3.0	0.800	10	
5.82	dental extractions	3.0	1.000		
5.83	dental extractions	3.0	0.435	10	
5.95	dental extractions	3.0	1.200	10	
5.95	dental extractions	3.0	1.200	10	
5.97	dental extractions	2.0	1.067		
5.01	dental fillings	2.0	0.800		
5.03	dental fillings	3.0	0.462	5	1
5.04	dental fillings	2.5	0.440	10	
5.05	dental fillings	2.0	0.424	10	
5.08	dental fillings	2.0	0.462		
5.13	dental fillings	2.5	0.343		
5.19	dental fillings	2.5	0.505	20	
5.21	dental fillings	3.0	0.800	10	
5.41	dental fillings	2.5	0.533	10	
5.42	dental fillings	2.5	0.571		
5.43	dental fillings	3.0	0.545	20	1
5.49	dental fillings	3.0	0.486	10	
5.55	dental fillings	2.0	0.500	10	

5.57	dental fillings	2.0	0.505		
5.66	dental fillings	3.0	0.561	40	
5.72	dental fillings	2.0	0.436		
5.75	dental fillings	3.0	0.714		1
5.86	dental fillings	2.0	0.800		
5.89	dental fillings	3.0	0.271	10	
5.89	dental fillings	3.0	0.271	10	
5.91	dental fillings	2.5	0.474	5	
5.92	dental fillings	2.5	0.800		
5.95	dental fillings	2.0	0.565		2
5.96	dental fillings	2.0	0.312		1
5.29	dental fillings+extractions	2.0	0.646	10	
5.20	dental fillings+extractions	2.5	0.349	20	
5.22	dental fillings+extractions	2.0	0.600	5	2
5.41	dental fillings+extractions	3.0	0.277	20	
5.41	dental fillings+extractions	2.0	0.545	20	
5.42	dental fillings+extractions	3.0	0.417	20	
5.46	dental fillings+extractions	2.0	0.771		
5.51	dental fillings+extractions	3.0	0.477	10	
5.53	dental fillings+extractions	3.0	0.333	20	1
5.59	dental fillings+extractions	2.5	0.545	5	2
5.77	dental fillings+extractions	2.0	0.600		
5.77	dental fillings+extractions	3.0	0.343	40	
5.81	dental fillings+extractions	2.5	0.438	40	
5.94	dental fillings+extractions	2.5	0.533		
5.98	dental fillings+extractions	3.0	0.762	20	
5.98	dental fillings+extractions	2.0	0.485		
5.83	dental fillings+frenectomy	2.0	0.306		







COMMENTS ON SEDATION MIXTURE REQUIRED FOR 5-6 YEAR OLD CHILDREN:

1ML= propofol 6mg+ketamine 2mg +alfentanyl 0.025mg

In this age group 18 patients were treated for dental extractions. Mixture required varied between 0.43-1.2 ml/kg/h. 15 Of the 18 patients were

given bolus doses of ketamine. No patients needed additional Dormicum®.

24 Children were treated for dental fillings. Sedation mixture required varied between 0.27-0.8 ml/kg/h. 5 Of the 24 children needed an additional dose of 1-2mg Dormicum® IV as a bolus. 13 Of the 24 children [54%] needed bolus doses of ketamine.

17 Children were treated for both dental fillings and extractions. Sedation mixture required varied between 0.27-0.76 ml/kg/h. 12 of the 17 children [70%] received additional ketamine in bolus doses. 3 of the children needed an additional dose [1-2mg] of Dormicum® IV.

It can also be noted that in this age group 12 patients had a behaviour scale of 1 [very anxious], which can explain the additional Dormicum® used in this group.

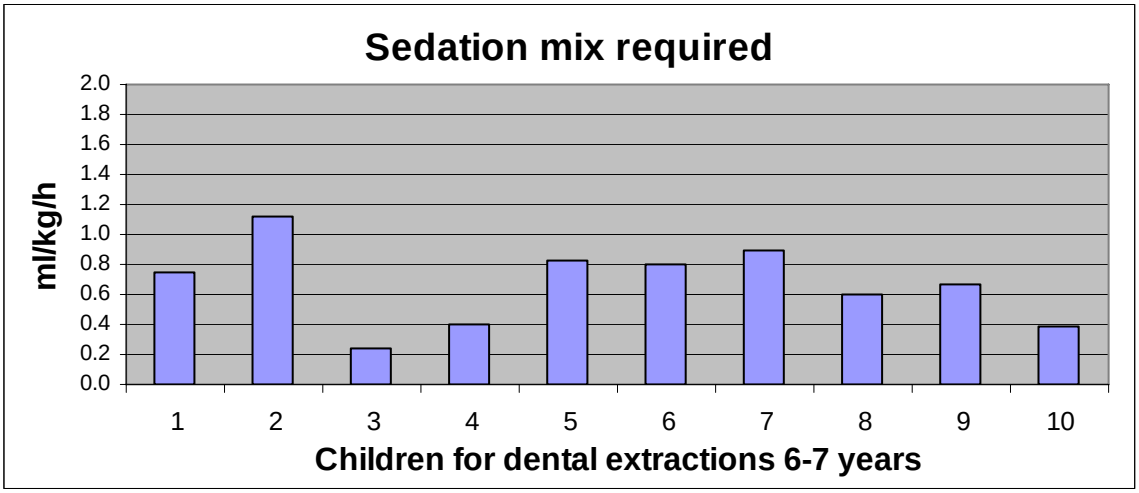
SEDATION LEVEL:

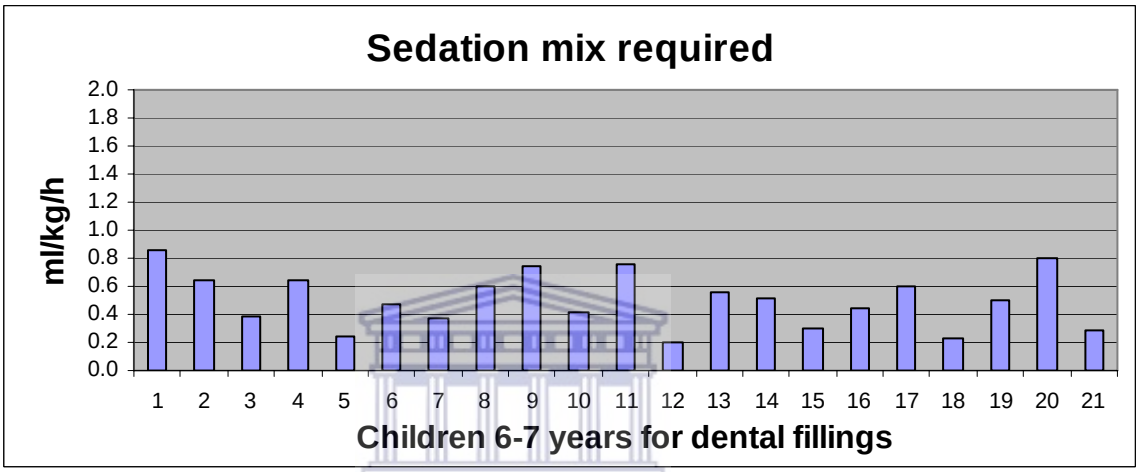
In this age group18 children were treated for dental extractions.
14 Patients were at a level 3, 3 at a level 2 and 1 patient at 2.5.
24 Patients were treated for dental fillings. 9 Patients were at a level 2 during sedation, 7 at 2.5 and 8 at 3.
17 Patients were treated for both dental fillings + extractions. 7 Patients were drowsy with a level 2 sedation, 4 patients varied between 2 and 3 and 6 patients were sedated to a level 3.

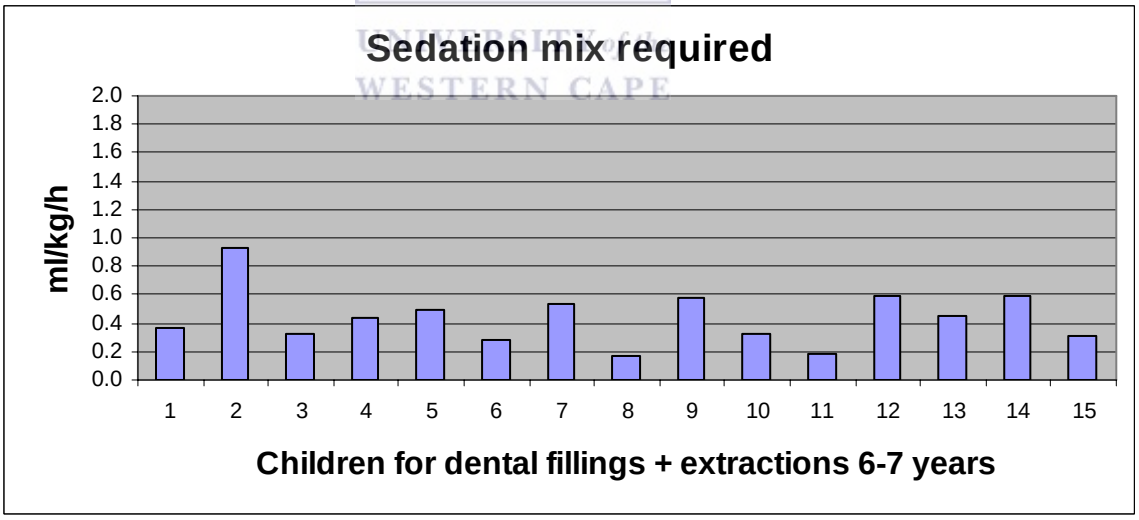
Children 6-7 years:

Age	Procedure	Wilson sedation scale	ml/kg/h	Additional bolus Ketamine mg	Additional bolus Midazolam mg
6.28	dental extractions	2.5	0.750	20	
6.29	dental extractions	3.0	1.125	10	
6.34	dental extractions	2.0	0.240	5	
6.40	dental extractions	3.0	0.400	10	
6.45	dental extractions	2.5	0.833	5	
6.45	dental extractions	3.0	0.800	20	
6.48	dental extractions	3.0	0.900	20	
6.69	dental extractions	3.0	0.600	10	
6.93	dental extractions	2.0	0.667	10	
6.96	dental extractions	3.0	0.384	10	
6.02	dental fillings	2.0	0.857		

6.04	dental fillings	2.5	0.646		
6.06	dental fillings	2.0	0.380	10	
6.07	dental fillings	2.5	0.643		
6.08	dental fillings	2.0	0.240	20	
6.10	dental fillings	2.5	0.476		
6.19	dental fillings	2.5	0.369	10	2
6.24	dental fillings	2.5	0.600		
6.26	dental fillings	2.5	0.740		
6.26	dental fillings	2.0	0.410		
6.48	dental fillings	2.0	0.762	10	
6.50	dental fillings	2.0	0.200	10	
6.52	dental fillings	2.0	0.564	10	0.5
6.52	dental fillings	2.0	0.514	10	
6.52	dental fillings	3.0	0.300	20	
6.57	dental fillings	3.0	0.436	10	
6.58	dental fillings	2.5	0.600	10	1
6.66	dental fillings	2.0	0.235		
6.84	dental fillings	2.0	0.500		
6.99	dental fillings	2.0	0.800		
6.99	dental fillings	2.5	0.290	40	2
6.02	dental fillings+extractions	2.5	0.369	10	
6.26	dental fillings+extractions	2.0	0.933		
6.39	dental fillings+extractions	3.0	0.326	20	7
6.40	dental fillings+extractions	2.5	0.436	20	
6.41	dental fillings+extractions	2.5	0.500	20	1
6.46	dental fillings+extractions	3.0	0.286	20	
6.54	dental fillings+extractions	2.5	0.532	20	3
6.58	dental fillings+extractions	3.0	0.175	10	2
6.69	dental fillings+extractions	2.0	0.571	10	
6.69	dental fillings+extractions	3.0	0.318	20	6
6.72	dental fillings+extractions	2.0	0.182	20	
6.84	dental fillings+extractions	2.0	0.593	20	
6.89	dental fillings+extractions	2.5	0.451	20	
6.89	dental fillings+extractions	3.0	0.589	20	2
6.98	dental fillings+extractions	2.0	0.316	20	







COMMENTS ON SEDATION MIXTURE REQUIRED:

1ML= propofol 6mg +ketamine 2mg + alfentanyl 0.025mg

10 Children in this age group required dental extractions.
Sedation mixture required varied between 0.24 ml/kg/h - 1.125 ml/kg/h.
All of the patients received bolus doses of ketamine.

21 Children were treated for dental fillings.
Sedation mixture required varied between 0.2 ml/kg/h - 0.85 ml/kg/h.
11 Of the 21 [52%] children needed bolus doses of ketamine.
4 Of the children needed additional Dormicum® [0.5-2mg] IV.

15 Children were treated for dental fillings + extractions.
Sedation mixture required varied between 0.175 ml/kg/h - 0.93 ml/kg/h.
All of the patients except one required additional ketamine bolus doses.
6 Of the 15 children for dental fillings + extractions required additional Dormicum ® IV, ranging from 1-6 mg.
It can also be noted that the surgical time in these patients exceeded 65 minutes. May be physiological factors was contributing to restlessness and not anxiety.

SEDATION LEVEL:

In this age group 10 patients received dental extractions. 6 Of them were sedated to a level 3. 2 Of them were comfortable at a level 2 and 2 patients drifted between level 2 and 3.

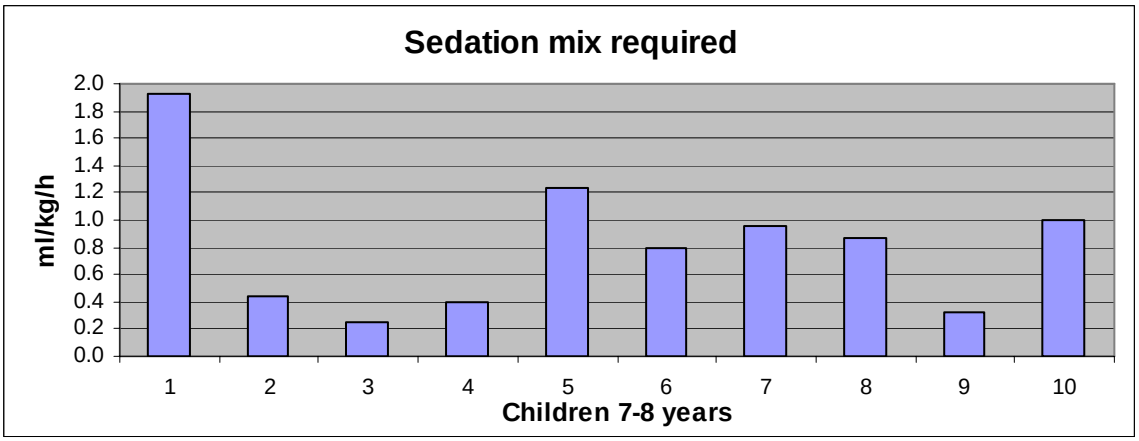
21 Patients were treated for dental fillings. 11 Of this patients were comfortable at level 2.
8 Patients were drowsy [2] and drifted into a sleep [3].
Only 2 patients for dental fillings were at level 3.

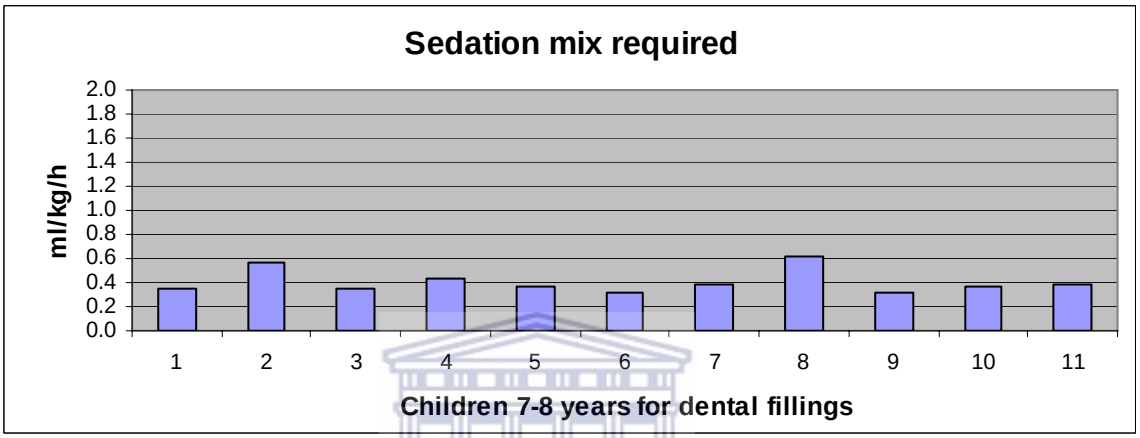
The patients for dental fillings + extractions were equally divided between sedation levels 2 and 3.

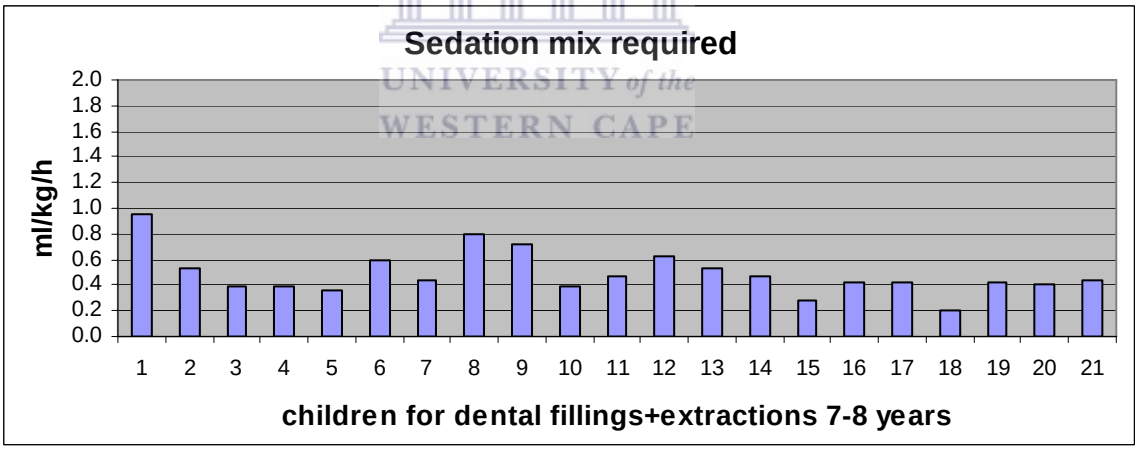
CHILDREN 7-8 YEARS:

Age	Procedure	Wilson sedation scale	ml/kg/h	Additional bolus Ketamine mg	Additional bolus Dormicum mg
7.00	dental extractions	3.0	1.920	20	1
7.01	dental extractions	2.5	0.436	20	
7.29	dental extractions	2.0	0.257	20	
7.36	dental extractions	2.0	0.400	10	
7.51	dental extractions	3.0	1.235	20	
7.53	dental extractions	2.5	0.800	5	
7.55	dental extractions	3.0	0.960	10	
7.70	dental extractions	3.0	0.873	10	
7.80	dental extractions	2.5	0.320	10	
7.80	dental extractions	2.0	1.000	10	

7.00	dental fillings	2.5	0.352	20	
7.28	dental fillings	2.0	0.571		
7.39	dental fillings	3.0	0.356	20	
7.52	dental fillings	2.0	0.429	10	
7.56	dental fillings	2.5	0.359		1
7.56	dental fillings	2.5	0.309	20	
7.60	dental fillings	2.0	0.387	20	2
7.70	dental fillings	2.0	0.619		
7.89	dental fillings	2.0	0.311	20	1
7.89	dental fillings	2.0	0.373	20	1
7.95	dental fillings	3.0	0.381	20	2
7.07	dental fillings+extractions	2.0	0.960	10	1
7.14	dental fillings+extractions	2.5	0.527	10	
7.14	dental fillings+extractions	2.0	0.391	10	
7.16	dental fillings+extractions	2.0	0.384	20	
7.16	dental fillings+extractions	3.0	0.364		1
7.21	dental fillings+extractions	2.5	0.600	10	
7.25	dental fillings+extractions	3.0	0.444		
7.31	dental fillings+extractions	2.0	0.800	20	
7.36	dental fillings+extractions	2.5	0.720	5	2
7.38	dental fillings+extractions	3.0	0.393	20	
7.48	dental fillings+extractions	2.0	0.471	10	
7.49	dental fillings+extractions	2.5	0.629	20	
7.55	dental fillings+extractions	2.0	0.533	20	
7.57	dental fillings+extractions	3.0	0.476	10	
7.57	dental fillings+extractions	2.5	0.277	20	
7.65	dental fillings+extractions	2.0	0.429	20	
7.79	dental fillings+extractions	2.0	0.417	20	
7.85	dental fillings+extractions	2.5	0.200	30	
7.92	dental fillings+extractions	2.5	0.429	10	
7.93	dental fillings+extractions	2.0	0.400	20	
7.97	dental fillings+extractions	2.5	0.440	40	







COMMENTS ON SEDATION MIXTURE REQUIRED:

In this age group 10 children were treated for dental extractions. The sedation mixture required varied between 0.27- 1.92ml/kg/h. All patients for dental extractions needed additional bolus doses ketamine. Only one patient needed additional Dormicum ® IV.

Patients for dental fillings needed between 0.31-0.61ml/kg/h of the sedation mixture.

8 Of the 11 patients for dental fillings needed bolus doses of ketamine.
5 Of the patients for fillings needed additional Dormicum ®.

Patients treated for dental fillings and extractions needed between 0.2-0.8ml/kg/h of the sedation mixture.
19 Of the 21 patients for dental fillings + extractions needed bolus doses of ketamine.
In total 9 patients for dental fillings + extractions needed additional bolus doses of Dormicum®.
It can also be noted that 12 patients in this group had a surgical time of more than 60 minutes.

SEDATION LEVEL:

In this age group 10 patients were treated for dental extractions. Sedation level for extractions were equally divided between scores 2, 2.5 and 3.

11 Patients were treated for dental fillings only. 6 Of them were drowsy [2], 3 at level 2 and 2 patients slept at level 3.

Of the 21 patients treated for dental fillings + extractions, 9 were on level 2.
8 Patients varied between level 2 and 3. 4 Patients slept at level 3.

COMMENTS ON SEDATION LEVEL AND SEDATION MIXTURE REQUIREMENTS IN ALL AGE GROUPS:

The aim in this study project was to do safe, conscious sedation on children receiving dental treatment.
For this to be done, the sedation level had to be between 2 and 3 on the Wilson sedation scale. With a titratable intravenous mixture this was possible.
I must state again that conscious sedation without behaviour management is impossible. During a sedation for dental treatment, there is continuous physical stimulation, apart from the noise of the drill and suction catheter. Therefore it is extremely important for the child to know how to respond to every stimulus. It is very difficult to calm down a disorientated child who is not familiar with noises ‘attacking’ him.
Behaviour management will also explain why children in the younger age group [0-3 years] for dental extractions [stronger stimulus] were sedated to a deeper level. [3]. Although the children were made familiar with the

noises, their reactions to it were still unpredictable. This is the reason why I preferred them asleep.

Children in the age group 7-8 years for dental extractions were equally divided between levels 2, 2-3 and 3. Behaviour therapy made the difference.
Personally I don't have a problem with a deeper sedation [level 3] for procedures like dental extractions. Here the patient don't need to swallow excess water from the drill or don't have to follow instructions during the procedure. As long as the indication for the deeper sedation is not pain. Local anaesthesia must be adequate for complete surgical pain relief. Many times the dentist is in a hurry and don't give adequate time for the local anaesthetic to take effect.[1] It is unacceptable to do a deeper sedation for pain relief.

Patients for dental extractions needed higher dosages of the intravenous sedation mixture, averaging 0,8ml/kg/h. [stronger stimulus]

Many patients received bolus doses of ketamine, rather than a bolus dose of IV sedation mixture.
I give bolus doses of ketamine routinely before all local anaesthetic injections. I find it to be an excellent agent for acute pain relief. Although the local anaesthetic is explained to the child, the prick of the needle in the mouth may still give him a fright, with the consequent moving of the head and an unwanted needle prick injury to the dentist or assistant. Ketamine as a bolus dose definitely stops this reaction. With blood borne infections in our country a reality, it is also a good idea to ask the assistant to hold the head for the moment the local anaesthetic is injected. This not only prevents a sudden unwanted movement, but many times it makes the child feel more comfortable. I usually explain to the child that we are going to press a little against the head and usually he is quite content with that. Thus, the bolus doses of ketamine were not used for sedation, but for acute pain relief.

Patients for dental fillings and extractions or fillings alone usually had a much longer surgical time. As previously explained, different dentists have different approaches. I prefer them to start with gentle work, like fissure sealings, to give enough time for the patient to drift into a comfortable sleep. This is also the reason why I don't use an initial bolus dose of IV sedation mixture when I start with the sedation.

[1] Peak blood levels of lignocaine infiltration in the mouth is only reached after 10-15 minutes.

With dental fillings, the procedure is usually more uncomfortable than painful. There is also adequate time for the local anaesthetic to take effect. [If it is needed.]
In this project the sedation levels for dental fillings or the combination of dental fillings + extractions depended on the patient. Many times the patient drifted from a level 2 to 3 to be at a level 2 at the end of the surgical procedure.
Sedation mixture requirements varied from patient to patient, some needed 0.4ml/kg/h to be at a level 3 and others needed 0.8ml/kg/h to be at a sedation level of 2.
With a titratable intravenous sedation technique and the use of an adjustable infusion pump it is easy to titrate the patient to the desired level of a safe sedation to do a surgical procedure.
Except the age group 0-3 years, I did not have a different approach in the younger and older age groups.
Children between 3 and 4 years of age may not understand everything, but they will listen better and try to please you more than the older children. Many times older children had previous bad experiences and were much more difficult to treat than younger children.

If I may make exceptions of patients in this project: The most difficult patient to treat was a 7 year old boy with severe behaviour problems, and the easiest was a 4 year old girl who grew up in a home with an older brother and sister 12 and 15 years her senior. Therefore, age is not necessarily an exclusion for conscious sedation.

The correct dosage of the IV multidrug sedation mixture, is the dosage that causes the patient to be at a sedation level where he is able to relax, be comfortable and co-operate with the surgeon to have the procedure done efficiently.

8. MODIFIED ALDRETE RECOVERY SCORE :

USED TO ASSESS RECOVERY AND SAFE DISCHARGE OF PATIENTS

High quality care and satisfactory outcomes mandate the adoption of criteria for safe discharge of all patients.
Specific for the outpatient, the incorporation of an appropriate scoring tool to evaluate ‘home-readiness’ was necessary.

A successful ambulatory surgery- and sedation program depends upon timely and safe discharge of all treated patients.
A discrete time interval is no longer considered crucial for discharge; however the patient must achieve clinical criteria that reflect passage through the phases of recovery.
The modified Aldrete recovery scale was used to evaluate all patients +/- 20 minutes after stopping the intravenous sedation medication.
Responses were measured according to the following:

- Activity
- Respiration
- Consciousness
- Oxygen saturation
- Circulation

MODIFIED ALDRETE RECOVERY SCALE:

10 total score; > 9 needed for discharge

- Activity: 2 able to move all extremities voluntary or on command
  1 able to move 2 extremities
  0 unable to move extremities

- Respiration: 2 able to breath deeply and cough freely
  1 limited breathing – good airway
  0 apnoeic – obstructed

- Consciousness: 2 fully awake
  1 arousable by name
  0 non-responsive

- Oxygen saturation 2 SpO2 > 92% on room air
  1 Supplemental oxygen required to maintain SpO2 > 90%
  0 SpO2 < 92% with supplemental oxygen

- Circulation: 2 blood pressure within 20 % of pre op value
  1 blood pressure within 20-50% of pre op value
  0 blood pressure within 50% of pre op value

THE RESULTS WERE AS FOLLOWING:

CHILDREN 0-3 YEARS:

AGE	ACTIVITY	RESPIRATION	CONSCIOUSNESS	SpO2	CIRCULATION
1.61	2	2	2	2	2
1.74	2	2	2	2	2
2.22	2	2	2	2	2
2.26	2	2	2	2	2
2.29	2	2	2	2	2
2.33	2	2	2	2	2
2.38	2	2	2	2	2
2.47	2	2	2	2	2
2.48	2	2	2	2	2
2.55	2	2	2	2	2
2.61	2	2	2	2	2
2.65	2	2	2	2	2
2.74	2	2	2	2	2
2.79	2	2	2	2	2
2.81	2	2	2	2	2
2.86	2	2	2	2	2
2.86	2	2	2	2	2
2.99	2	2	2	2	2

CHILDREN 3-4 YEARS :

AGE	ACTIVITY	RESPIRATION	CONSCIOUSNESS	SpO2	CIRCULATION
3.00	2	2	2	2	2
3.09	2	2	2	2	2
3.12	2	2	2	2	2
3.16	2	2	2	2	2
3.20	2	2	2	2	2
3.23	2	2	2	2	2
3.31	2	2	2	2	2
3.32	2	2	2	2	2
3.39	2	2	2	2	2
3.39	2	2	2	2	2
3.43	2	2	2	2	2
3.43	2	2	2	2	2
3.49	2	2	2	2	2
3.50	2	2	2	2	2
3.50	2	2	2	2	2
3.55	2	2	2	2	2
3.65	2	2	2	2	2
3.67	2	2	2	2	2
3.67	2	2	2	2	2
3.69	2	2	2	2	2
3.70	2	2	2	2	2
3.76	2	2	2	2	2
3.84	2	2	2	2	2
3.87	2	2	2	2	2

3.96	2	2	2	2	2
3.98	2	2	2	2	2

CHILDREN 4-5 YEARS:

AGE	ACTIVITY				RESPIRATION
4.03		2			
4.08		2			
4.10		2			
4.11		2			
4.11		2			
4.11		2			
4.11		2			
4.12		2			
4.13		2			
4.14		2			
4.15		2			
4.19		2			
4.24		2			
4.25		2			
4.27		2			
4.27		2			
4.35		2			
4.38		2			
4.43		2			
4.46		2			
4.47		2			
4.47		2			
4.48		2			
4.49		2			
4.50		2			
4.53		2			
4.54		2			
4.54	2	2	2	2	2
4.58		2			
4.61		2			
4.61		2			
4.66		2			
4.67		2			
4.69		2			
4.71		2			
4.72		2			
4.74		2			
4.76		2			
4.81		2			
4.87		2			
4.90		2			
4.92		2			
4.92		2			
4.97		2			
4.98		2			
4.99		2			
4.99		2			

CHILDREN 5-6 YEARS:

AGE	ACTIVITY	RESPIRATION	CONSCIOUSNESS	SpO2	CIRCULATION
5.01	2	2	2	2	2
5.03	2	2	2	2	2
5.04	2	2	2	2	2
5.05	2	2	2	2	2
5.08	2	2	2	2	2
5.13	2	2	2	2	2
5.18	2	2	2	2	2
5.19	2	2	2	2	2
5.20	2	2	2	2	2
5.21	2	2	2	2	2
5.22	2	2	2	2	2
5.28	2	2	2	2	2
5.29	2	2	2	2	2
5.30	2	2	2	2	2
5.41	2	2	2	2	2
5.41	2	2	2	2	2
5.41	2	2	2	2	2
5.42	2	2	2	2	2
5.42	2	2	2	2	2
5.42	2	2	2	2	2
5.43	2	2	2	2	2
5.46	2	2	2	2	2
5.49	2	2	2	2	2
5.51	2	2	2	2	2
5.52	2	2	2	2	2
5.53	2	2	2	2	2
5.55	2	2	2	2	2
5.56	2	2	2	2	2
5.57	2	2	2	2	2
5.59	2	2	2	2	2
5.61	2	2	2	2	2
5.65	2	2	2	2	2
5.65	2	2	2	2	2
5.66	2	2	2	2	2
5.68	2	2	2	2	2
5.72	2	2	2	2	2
5.74	2	2	2	2	2
5.75	2	2	2	2	2
5.75	2	2	2	2	2
5.77	2	2	2	2	2
5.77	2	2	2	2	2
5.81	2	2	2	2	2
5.81	2	2	2	2	2
5.82	2	2	2	2	2
5.83	2	2	2	2	2
5.83	2	2	2	2	2
5.86	2	2	2	2	2
5.89	2	2	2	2	2
5.89	2	2	2	2	2

5.91	2	2	2	2	2
5.92	2	2	2	2	2
5.94	2	2	2	2	2
5.95	2	2	2	2	2
5.95	2	2	2	2	2
5.95	2	2	2	2	2
5.96	2	2	2	2	2
5.97	2	2	2	2	2
5.98	2	2	2	2	2
5.98	2	2	2	2	2

CHILDREN 6-7 YEARS:

AGE	ACTIVITY	RESPIRATION	CONSCIOUSNESS	SpO2	CIRCULATION
6.02	2	2	2	2	2
6.02	2	2	2	2	2
6.04	2	2	2	2	2
6.06	2	2	2	2	2
6.07	2	2	2	2	2
6.08	2	2	2	2	2
6.10	2	2	2	2	2
6.19	2	2	2	2	2
6.24	2	2	2	2	2
6.26	2	2	2	2	2
6.26	2	2	2	2	2
6.26	2	2	2	2	2
6.28	2	2	2	2	2
6.29	2	2	2	2	2
6.34	2	2	2	2	2
6.39	2	2	2	2	2
6.40	2	2	2	2	2
6.40	2	2	2	2	2
6.41	2	2	2	2	2
6.45	2	2	2	2	2
6.45	2	2	2	2	2
6.46	2	2	2	2	2
6.48	2	2	2	2	2
6.48	2	2	2	2	2
6.50	2	2	2	2	2
6.52	2	2	2	2	2
6.52	2	2	2	2	2
6.52	2	2	2	2	2
6.54	2	2	2	2	2
6.57	2	2	2	2	2
6.58	2	2	2	2	2
6.58	2	2	2	2	2
6.66	2	2	2	2	2
6.69	2	2	2	2	2
6.69	2	2	2	2	2
6.69	2	2	2	2	2
6.72	2	2	2	2	2
6.84	2	2	2	2	2

6.84	2	2	2	2	2
6.89	2	2	2	2	2
6.89	2	2	2	2	2
6.93	2	2	2	2	2
6.96	2	2	2	2	2
6.98	2	2	2	2	2
6.99	2	2	2	2	2
6.99	2	2	2	2	2
7.00	2	2	2	2	2
7.00	2	2	2	2	2
7.01	2	2	2	2	2
7.07	2	2	2	2	2
7.14	2	2	2	2	2
7.14	2	2	2	2	2
7.16	2	2	2	2	2
7.16	2	2	2	2	2
7.21	2	2	2	2	2
7.25	2	2	2	2	2
7.28	2	2	2	2	2
7.29	2	2	2	2	2
7.31	2	2	2	2	2
7.36	2	2	2	2	2
7.36	2	2	2	2	2
7.38	2	2	2	2	2
7.39	2	2	2	2	2
7.48	2	2	2	2	2
7.49	2	2	2	2	2
7.51	2	2	2	2	2
7.52	2	2	2	2	2
7.53	2	2	2	2	2
7.55	2	2	2	2	2
7.55	2	2	2	2	2
7.56	2	2	2	2	2
7.56	2	2	2	2	2
7.57	2	2	2	2	2
7.57	2	2	2	2	2
7.60	2	2	2	2	2
7.65	2	2	2	2	2
7.70	2	2	2	2	2
7.70	2	2	2	2	2
7.79	2	2	2	2	2
7.80	2	2	2	2	2
7.80	2	2	2	2	2
7.85	2	2	2	2	2
7.89	2	2	2	2	2
7.89	2	2	2	2	2
7.92	2	2	2	2	2
7.93	2	2	2	2	2
7.95	2	2	2	2	2
7.97	2	2	2	2	2

COMMENTS ON THE MODIFIED ALDRETE RECOVERY SCALE:

In all the age groups a modified Aldrete recovery score of 10 was achieved after 20 minutes.
This means that the level of consciousness, physical activity, respiratory stability, hemodynamic stability and oxygen saturation status were adequate for safe discharge of the patient.
I must state that the modified Aldrete recovery scale has definitely some shortcomings for discharge criteria. [1]

I would like to use the 'Postanesthesia Discharge Scoring System' in conjuction with the modified Aldrete recovery score to assess post operative pain, nausea and vomiting as well as surgical bleeding before discharge of the patient.

POSTANESTHESIA DISCHARGE SCORING SYSTEM:

Circulation is measured as Vital signs [Bp and pulse]:

2 = within 20% of pre operative baseline
1 = 20-40% of pre operative baseline
0 = >40% of pre operative baseline

Activity:

2 = steady gait, no dizziness, or pre operative level
1 = requires assistance
0 = unable to ambulate

Nausea and vomiting:

2 = minimal; treated with oral medication
1 = moderate; treated with IM medication
0 = Continues after repeated treatment

Pain:

Acceptable to patient; controlled with oral medications
2 = yes
1 = no

[1] Twersky, R.S., Recovery and Discharge of the Ambulatory Anesthesia Patient. Brooklyn, New York

Surgical bleeding:

2 = minimal, no extra swabs required
1 = moderate, up to two changes
0 = severe, more than 3 changes

A score of >9 is required for safe discharge of the patient.

Resumption of oral intake and spontaneous voiding are no longer viewed as pre requisites for discharge criteria.
Patients should therefore be given the option of whether or not to drink before discharge.
It was found that mandatory drinking may provoke nausea and vomiting in paediatric patients. [1]

Post operative nausea and vomiting were uncommon side effects in this sedation project.
Children prone to nausea and vomiting eg. patients with nausea after previous sedations or general anaesthetics were given the option of IV metoclopramide.
Droperidol, metoclopramide and prochlorperazine are effective against post operative nausea and vomiting, but in an outpatient setting extrapyramidal side effects and prolonged sedation and drowsiness may be a problem.
Antiemetic therapy should incorporate pharmacological as well as non-pharmacological components.
Recent studies have shown that alleviating dehydration with adequate perioperative fluid therapy will reduce the incidence of postoperative adverse outcomes such as nausea and vomiting.[2]

PAIN:

Pain in sedation patients is very seldom a problem.
During the sedation, local anaesthesia is used to control pain.
The effect of the local anaesthetic usually exceeds the time of the sedation and the patients wake up without any pain, although the numbness caused by the local anaesthetic may upset some children a little.
An oral analgesic is all that is needed for pain control at home.

[1] Schreiner MS: Anaesthesiology 76:528-33
[2] Yogendran S; Anaest Analg 80: 682-6

9. SURGEON SCORE:

The following scoring system was used by the surgeon to evaluate the sedation according to the effectiveness of working under sedation.
One must always remember that the surgeon was the person who initially assessed the patient and decided that doing the procedure under sedation may be the treatment of choice for this specific patient.

Surgeon score:

1 - No limb movement – total co-operation
2 - Small amount of movement – not restless
3 - Small degree of restlessness and anxiety. Surgeon still able to do the procedure.
4 - Considerable movement, poor co-operation, restless, anxious, not able to work.
5 - Restless, anxiety severe, impossible to do the procedure

The results were as following:

CHILDREN 0-3 YEARS:

AGE	SURGEON SCORE
1.61	2
1.74	3
2.22	2
2.26	3
2.29	3
2.33	2
2.38	2
2.47	2
2.48	2
2.55	2
2.61	2
2.65	2
2.74	2
2.79	2
2.81	2
2.86	2
2.86	2
2.99	2

COMMENTS:
In this age group the surgeon rated 15 of the 18 children [83.3%] with a score of 2 – a small amount of movement, but not restless. 3 Of the 18

children [16.6%] had a degree of restlessness and anxiety, but the surgeon was still able to do the work.

CHILDREN 3-4 YEARS:

AGE	SURGEON SCORE
3.00	3
3.09	2
3.12	2
3.16	2
3.20	2
3.23	2
3.31	2
3.32	1
3.39	1
3.39	2
3.43	3
3.43	2
3.49	2
3.50	2
3.50	2
3.55	3
3.65	2
3.67	2
3.67	2
3.69	2
3.70	2
3.76	2
3.84	1
3.87	2
3.96	2
3.98	1

COMMENTS:
In this age group 4 of the 27 [14.8%] children were rated by the surgeon a score of 1 – no limb movement, total co-operation. 3 Children [11.1%] were rated a score of 3 – a small degree of restlessness and anxiety, but the surgeon was still able to do the work. 20 Of the 27 children [74%] in this age group scored a 2 – they were moving a bit, but were not restless.

CHILDREN 4-5 YEARS:

AGE	SURGEON SCORE
4.03	3
4.08	3
4.10	2
4.11	3
4.11	2

4.11	2
4.11	2
4.12	2
4.13	2
4.14	2
4.15	2
4.19	2
4.24	2
4.25	2
4.27	2
4.27	2
4.35	2
4.38	3
4.43	2
4.46	2
4.47	3
4.47	2
4.48	1
4.49	2
4.50	2
4.53	2
4.54	3
4.54	2
4.56	2
4.58	3
4.61	1
4.61	2
4.66	1
4.67	2
4.69	1
4.71	1
4.72	2
4.74	2
4.76	1
4.81	2
4.87	2
4.90	1
4.92	2
4.92	2
4.97	2
4.98	2
4.99	2
4.99	2

COMMENTS:

In this age group 7 of the 48 children [14.5%] treated were rated by the surgeon a score of 1 –no limb movement, total co–operation. 34 Children [70.8%] were rated as 2 – a small amount of movement, but not restless. 7 children [14.5%] received a score of 3- a small degree of restlessness and anxiety, but the surgeon was still able to do the work.

CHILDREN 5-6 YEARS:

AGE	SURGEON SCORE
5.01	2
5.03	2
5.04	2
5.05	2
5.08	2
5.13	1
5.18	2
5.19	1
5.20	3
5.21	2
5.22	3
5.28	1
5.29	2
5.30	2
5.41	1
5.41	3
5.41	2
5.42	2
5.42	2
5.42	2
5.43	3
5.46	3
5.49	2
5.51	2
5.52	3
5.53	1
5.55	1
5.56	1
5.57	1
5.59	3
5.61	2
5.65	2
5.65	1
5.66	3
5.68	2
5.72	1
5.74	2
5.75	2
5.75	2
5.77	3
5.77	2
5.81	2
5.81	2
5.82	1
5.83	2
5.83	1
5.86	1
5.89	2
5.89	2
5.91	2
5.92	3

5.94	1
5.95	2
5.95	2
5.95	2
5.96	2
5.97	1
5.98	2
5.98	2

COMMENTS:

In this age group 59 children were treated. 15 Children [25.4%] received a score of 1 – total co-operation and no limb movement. 34 children [57.6%] were rated 2 – a small amount of movement, but not restless. 10 children [16.9%] were restless with anxiety [3], but the surgeon was still able to work.

CHILDREN 6-7 YEARS:

AGE	SURGEON SCORE
6.02	2
6.02	2
6.04	1
6.06	2
6.07	1
6.08	2
6.10	1
6.19	3
6.24	1
6.26	2
6.26	2
6.26	2
6.28	2
6.29	2
6.34	1
6.39	3
6.40	2
6.40	1
6.41	2
6.45	1
6.45	2
6.46	1
6.48	2
6.48	2
6.50	1
6.52	1
6.52	2
6.52	2
6.54	3
6.57	2
6.58	3

6.58	2
6.66	2
6.69	1
6.69	2
6.69	1
6.72	2
6.84	3
6.84	1
6.89	1
6.89	2
6.93	2
6.96	3
6.98	1
6.99	1
6.99	2

COMMENTS:

In this age group 46 children were treated. 16 Children [34%] were rated with a score of 1 – total co-operation and no limb movement. 6 children [13%] were restless with anxiety [3], but the surgeon was still able to work. 24 Of the children [52%] had a small amount of movement, but were not restless [2].

CHILDREN 7-8 YEARS:

AGE	SURGEON SCORE
7.00	2
7.00	2
7.01	2
7.07	2
7.14	2
7.14	1
7.16	2
7.16	2
7.21	2
7.25	2
7.28	1
7.29	1
7.31	1
7.36	2
7.36	2
7.38	3
7.39	1
7.48	1
7.49	1
7.51	3
7.52	1
7.53	1
7.55	2
7.55	2
7.56	3

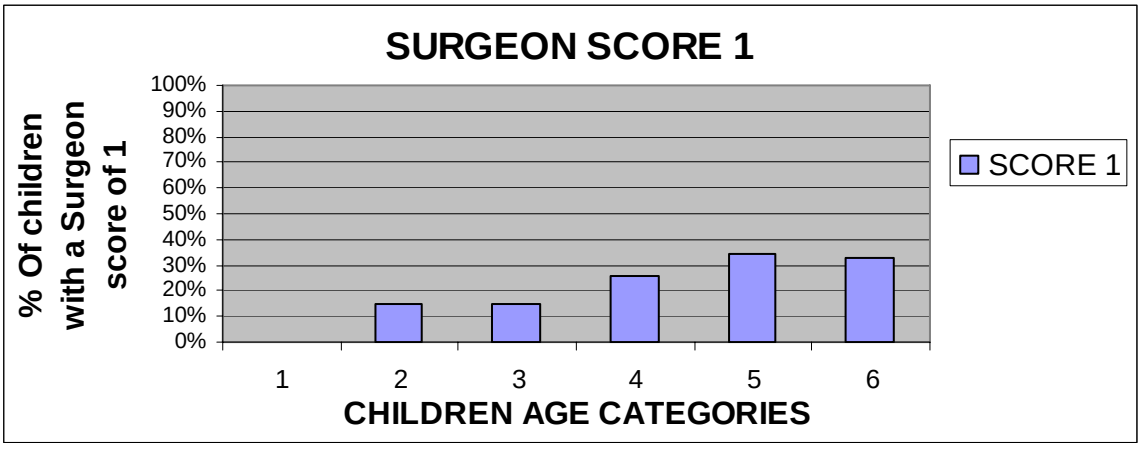
7.56	2
7.57	2
7.57	2
7.60	2
7.65	1
7.70	2
7.70	1
7.79	2
7.80	1
7.80	1
7.85	2
7.89	2
7.89	2
7.92	2
7.93	1
7.95	3
7.97	2

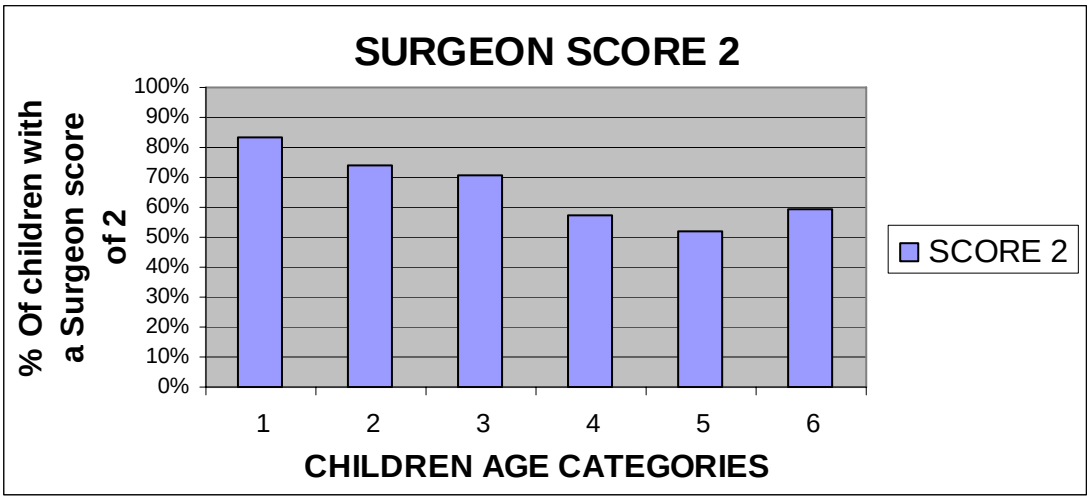
COMMENTS:

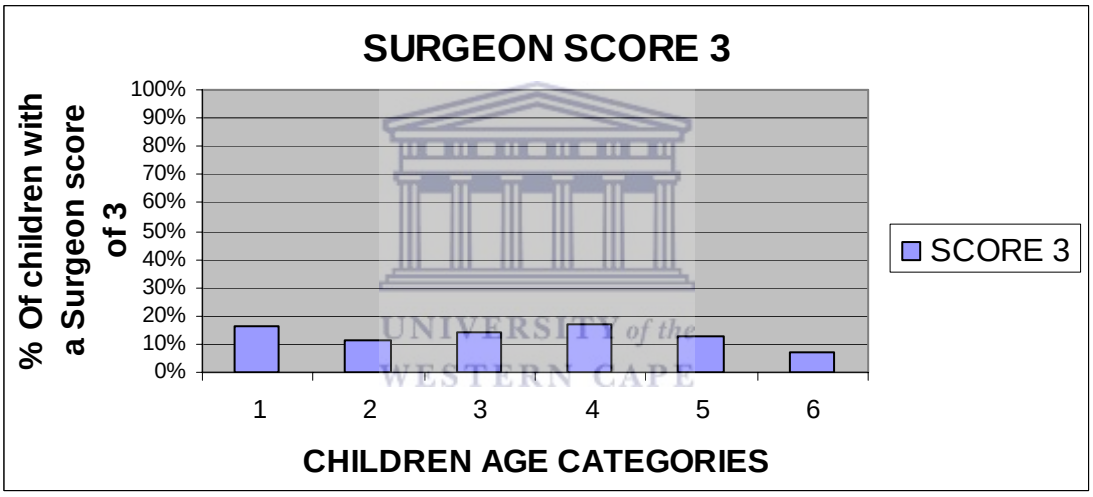
In this age group 42 children were treated. 14 of the 42 [33.3%] children treated were rated by the surgeon with a score of 1 – total co-operation with no limb movement. 24 children [57%] had a score of 2 –a small degree of movement, but not restless. 4 Children [9.5%] were very restless with anxiety, but the surgeon was still able to work.

SURGEON'S SCORE FOR DIFFERENT AGE CATEGORIES:

Children age categories: 1: Children 0-3 years
2: Children 3-4 years
3: Children 4-5 years
4: Children 5-6 years
5: Children 6-7 years
6: Children 7-8 years







COMMENTS ON THE GRAPHS:

A surgeon score rating of 1 or 2 is acceptable to work comfortably, efficient and cost effective.
For the different age groups category 3 varied between 9.5-16.9%.
More than 80% of all the patients were in category 1 or 2.
This means that the amount of movement of the patient was acceptable to the surgeon to still render the patient a good service.

10. PATIENT EVALUATION:

Patients were not required to complete a patient evaluation form as they were still too small to complete it by themselves.
Parents were satisfied with the sedation process and the procedure, although to many it was a new concept.
Parents were well aware of the fact that they had to care for the patient at home and many working parents took a day's leave to care for the child at home.

Sedation definitely is cost effective to the parents. As the local provincial hospital has no facilities for dental fillings, the only alternative is the private hospital or treating the patient in the dentist's rooms under sedation. The sedation option is definitely more cost effective.

An important positive factor of doing a sedation in the rooms is the presence of the parent till the child 'falls asleep'. Many private hospitals don't allow parents in theatre. Separation anxiety is then a big problem and many children have a permanent fear for the hospital after the procedure.
My personal experience is also that small children don't want to take off their own clothes to put on hospital gowns. This is not necessary in the dentist's rooms.

Some dentists have an attitude: If it is an 'easy patient' [co operative] with a lot of work – take him to theatre, if it is a difficult patient –do a sedation.
The rationale for this is that the dentist has to build a relationship with the patient, many times a lifelong one, to ensure proper ongoing dental health.
A general anaesthetic will put the patient asleep to do the work, but if anxiety for the dental treatment is not resolved in a positive way, the fear will stay.

To conclude: a final case study:
An eight year old boy was booked for urgent dental treatment. He was referred by the psychiatrist as a case of severe anxiety, had a previous very bad experience in hospital and not to be taken to theatre again for treatment.
The phobia was so bad that he did not even get out of the car when taken to the dentist.

This specific patient received his Dormicum® tablet in the car, was convinced to walk with me into the surgeon's rooms and was treated successfully with the help of an intravenous sedation process.

To confirm patient satisfaction I have to complete the rest of the story.
The father was an alcoholic who abused his wife and children.
On the day of the sedation he was present in the rooms.
It has changed his whole life.
Today, [+/- 2 years after the incident] he is completely rehabilitated and the whole family is re united.
Needless to say, the dentist confirms that it is just a pleasure to have them as patients. No sedations were needed again.

CHAPTER 5

1. SUMMARY AND CONCLUSIONS:

The academic aim for this research project was to determine whether:

- it is possible to do conscious sedation safely and effectively
- outside the hospital environment
- for children younger than eight years
- undergoing dental procedures
- using a multidrug intravenous technique.

The strategic aim was to save the patient costs, but providing a safe alternative to a general anaesthetic.

The conclusion was that to be safe, we wanted to do a conscious sedation. That means that all protective airway reflexes of the patient were still intact, vital signs were stable, the patient could respond to commands, but was comfortable and not anxious.

I wanted a compliant patient so that the surgeon could do his procedure efficiently and cost effectively.
To achieve this, intravenous drugs plus behaviour management were necessary to alter the central nervous system of the patient in response to unpleasant stimuli.

Extensive literature surveys were done to determine which drugs could be used safely for sedation in an outpatient situation.

The goals set for sedation were anxiolysis, sedation, amnesia and analgesia.

Patients were selected by 8 different dentists.
Only ASA 1 and 2 patients qualified for sedation outside the hospital environment.
All patients were fit and healthy without an acute illness.
The dentists were well aware of the limitations of working under sedation and were adequately trained in resuscitation techniques.
All of them had excellent staff assisting in the sedation process.

Assisting in the sedation process started from the booking of the patient, by giving proper instructions, explanations, being helpful and answers questions, up to the discharge of the patient after the procedure.

As behaviour therapy is the crux of a successful sedation, adequate time was spend with the patient before the intravenous sedation procedure was started.
Parents were allowed in the procedure room as ‘silent helpers’.
The ‘tell-show-do’ technique proved to be very successful, especially in the dental setup where a lot of noise is made during the surgical/sedation process.
Behaviour therapy also influenced the ease of IV cannulation to start the IV sedation.
The problem with a very small child [0-3 years] may be that they don’t understand what is going to happen, but after a proper tell-show-do they usually were quite content.
The problem with the older child in behaviour management is usually a previous bad experience.
This is much more difficult to overcome, as confidence in the dentist and environment must be re-established.
Parents as the silent helpers were found to be very effective.

I found the easiest children to treat ranged between 4-5 years.
The dental treatment needed were usually a combination of work, the behaviour of the child was acceptable, as well as the physical and mental development of the child at that age.

For the intravenous sedation process we decided on a combination of drugs, as there is no ideal single agent.
As the intravenous method is the best way to titrate a combination of drugs it was the route of choice.

Drugs used were evaluated according to their painless, safe and titratable administration, absence of side effects, reversibility, side effects, drug interactions, biotransformation and clearance, quick onset/offset at various doses and minimal systemic effects.
Drugs evaluated for the intravenous sedation process were benzodiazepines, opioids, and sedative hypnotics.

For pre-medication midazolam proved to be the best drug, but in combination with behaviour therapy, to minimize anxiety.
An Emla® local anaesthetic patch was used to make IV cannulation painless.

A combination of propofol, ketamine and alfentanyl were used for the intravenous sedation process. This mixture was titrated with an electric infusion pump according to the child's weight, concentration of the drugs, but most importantly to the child's response to the sedative drugs.

Local anaesthesia [lignocaine 2% with adrenalin] was used as analgesic for painful procedures. A bolus dose of ketamine 2 minutes before the injection of the local anaesthetic proved to be an excellent analgesic to minimize the initial injection pain.

Glycopyrrolate, as anticholinergic drug, was used to counteract the side effects of ketamine and alfentanyl.

Adequate sedation was achieved with very low doses [starting from 0.2 ml/kg/h] of a mixture containing 6mg propofol + 2mg ketamine + 0.025mg alfentanyl per ml.

It was found that the dosage regimen was not age dependant, but rather procedure dependant.
Children undergoing dental extractions needed and average of 0.5-1.3ml/kg/h.
While children treated for dental fillings ranged between 0.3-0.8ml/kg/h.
Children treated for dental extractions as well as fillings ranged between 0.29-1.0 ml/kg/h.
Ketamine in bolus doses of 0.25mg/kg was used effectively for acute pain relief; for example before injection of the local anaesthetic.

Surgery time and sedation time were influenced by the type of procedure.
A child undergoing painful procedures like dental extractions received a higher dose intravenous sedation mixture per surgical time period.
The biggest difference in sedation and surgical time were in this group.
Many children who received less painful procedures were usually completely awake at the end of the surgical procedure.

The ketamine-propofol-alfentanyl sedation mixture proved to have very little effect on the vital signs of the patients.
Breathing rate, oxygen saturation and blood pressure stayed within the normal range.
The only parameter that was influenced was the pulse speed.
The change in pulse speed could be linked to the use of glycopyrrolate and adrenalin in the local anaesthetic agents.
The sedation levels of the patients varied between 2 - 3 on the Wilson sedation scale, but never more than 3.

Recovery after this intravenous sedation technique was quick.
All patients scored a 10/10 on the modified Aldrete recovery scale after 20 minutes. As the modified Aldrete recovery scale don't measure post operative pain, nausea or surgical bleeding, it was decided that the Postanesthesia Discharge Scoring System will be used together with the modified Aldrete recovery scale for safe discharge of the patients.

Nausea and vomiting were very seldom seen.
The only patients prone to nausea and vomiting were children with a family history of nausea after surgical procedures or nausea after previous general anaesthetics. They were given the option of IV metoclopramide.

The surgeon score rating in this research project was very satisfying.
In all age groups more than 80% of children were regarded as co-operative; or were moving a bit, but without interference with the surgeon in doing his work. [May be this is the reason why the surgeons continue to book patients for sedation.]

Parents found sedation to be an acceptable alternative to general anaesthesia for their children.
They enjoy being actively involved in the sedation process, as well as in the recovery process.
Personally I think they feel proud to be part of the team involving the treatment of their child.
A call after the procedure made them feel that you value them as a person and not only as a patient.

2. RECOMMENDATIONS:

Intravenous sedation in children younger than eight years can be done successfully, safely and effectively outside the hospital environment if certain criteria are met:

- Correct patient selection
- Correct and sufficient information to the parent/caregiver: risks, benefits, limitations, alternatives
- Written informed consent for the procedure and sedation from them
- Proper pre procedure patient evaluation / physical examination
- A well trained, experienced sedationist solely dedicated to the patient's safety and monitoring during the sedation process

- A skilled surgeon trained in resuscitation with a knowledge on the limitations of sedation
- Adequate and trained staff
- Correct use of behaviour therapy in anxious children
- A proper knowledge of the pharmacology of sedative- and emergency drugs used by the sedationist
- Correct choice of Agents: sedatives to decrease anxiety, analgesics to relieve pain
- Dose titration or medications given incrementally with sufficient time between doses to assess effects
- Adequate monitoring equipment for circulation, ventilation, oxygenation and sedation
- Adequate emergency equipment and personnel trained in advanced life-support skills.
- Proper record keeping and documentation
- Adequate recovery and aftercare facilities: post procedural recovery observation, monitoring and predetermined discharge criteria.
- Safe discharge to a responsible person

The American Society of Anaesthesiologists has recommended most of these guidelines to improve clinical efficacy [1] and reduce adverse outcomes during sedation.

Unfortunately they forgot a very important criterium:

- Compassion for children and a heart for sedation!

****

[1] Satisfactory sedation and analgesia

CHAPTER 6

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APPENDIX: