IMPACTED MANDIBULAR THIRD MOLARS: THE EFFICACY OF PROPHYLACTIC ANTIBIOTICS AND CHLORHEXIDINE MOUTHWASH IN PREVENTING POSTOPERATIVE INFECTIONS.

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Degree of Master of Science in Dentistry by coursework and research report

A Research Report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Dentistry.

Johannesburg, 2016

Declaration

I, Pooshan Gopee, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Dentistry in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

8th day of August 2016.

Dedication

"Aum Shri Ganeshaya Namaha"

To my parents for their valuable guidance, support and encouragement throughout my studies and to the almighty for his continuous blessing and strength granted to keep believing and persevering in every task I undertake.

ABSTRACT

Objective: The aim of this study was to investigate:

1) The efficacy of a prophylactic antibiotic regimen compared to a chlorhexidine mouthwash in reducing postoperative infections in mandibular third molar surgery.

2) The pattern of presentation and the indication for extraction of mandibular third molars.

Study Design and Method: A total of 100 patients were randomly assigned to two groups (group 1, 15 ml of chlorhexidine mouthwash for 1 minute before surgery; group 2, 2g amoxicillin orally 1 hour before surgery). The outcome which included surgical site infection and other complications was assessed 7 days postoperatively.

Data collected included patients' age, gender, type of impaction, indication for extraction and surgical morbidity (postoperative complications). The data were then analysed using the statistical package STATA 13.1 for Windows.

Results: Of the 100 patients, 4 patients in group 1 and 3 patients in group 2 presented with surgical wound infection. The infection rate was 8% for group 1 and 6% for group 2 while the overall infection rate was 7%. No statistically significant difference in surgical wound infection was found between the 2 groups.

The ages ranged from 18 to 46 years with a mean of 27.75(+/- 5.79). There were 48 males and 52 females, the male to female ratio being 1:1.08. Mesioangular impaction was the most common type of impaction recorded (46; 46%), while the most prevalent indication for extraction was pericoronitis (39; 39%).

Conclusion: In terms of efficacy, this study failed to show that amoxicillin prophylaxis is more effective than a preoperative chlorhexidine mouthrinse for reducing postoperative infections in third molar surgery. Hence, antibiotic prophylaxis must not be routinely administered in non-immunocompromised patients for such procedures.

Patients that presented for mandibular third molar extraction were generally young with an almost equal distribution in gender. The pattern of presentation as well as the indication for extraction of mandibular third molars seem to correlate with those found in literature.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the following persons:

- Dr E Rikhotso for his valuable guidance and assistance in completing the research report.
- Dr M Kasilembo for his assistance and permission to perform the study at Rob Ferreira hospital.
- Dr K L Ntambwe for his continuous encouragement and for allowing me to carry out the study at Ermelo hospital.
- My fellow colleagues at Rob Ferreira and Ermelo hospitals for assisting me in the collection of data.
- Dr M Mabongo and Dr P Struthers for their valuable time in reading the research report and making insightful recommendations.
- Mr E Ngamasana, the biostatistician, for his assistance and contribution in analysing the data collected.
- Ms S Lukhoo for her unwavering support and encouragement.
- To everyone who has contributed, either directly or indirectly, into making this research report a possibility.

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NOMENCLATURE

- American Dental Association =ADA
- American Heart Association =AHA
- American Academy of Orthopaedic Surgeons =AAOS
- British Society for Antimicrobial Chemotherapy =BSAC
- World Health Organisation =WHO
- Chlorhexidine =CHX
- Amoxicillin =AMOX
- Human Immunodeficiency Virus =HIV
- Standard Deviation =STD
- Inter quartile Range =IQR

CHAPTER 1

INTRODUCTION/ BACKGROUND

Removal of impacted teeth is a very common surgical procedure performed by Oral and Maxillofacial Surgeons as well as general dentists in the South African Public Health sector.[1] Owing to the complexity of this surgical procedure, extensive skills and training are required in order to reduce the risk of complications that may arise during and after surgery.[1] In addition, adequate knowledge regarding the diagnostic and treatment modalities is essential in order to achieve optimum results for the patients.

Rob Ferreira Hospital and Ermelo Provincial Hospital are two public hospitals in the province of Mpumalanga in South Africa where removal of impacted wisdom teeth are routinely performed by general dentists. Although a generally low complication rate is associated with such procedures, postoperative surgical site infection has been observed to remain common in mandibular third molar removal at these institutions. In this setting, prophylactic antimicrobials are often used haphazardly in an attempt to curb the incidence of infection.

The unsystematic prescription of antibiotics among dentists has become a serious cause for concern due to the rapid development of antibiotic resistance. Presently, there is no consensus with regards to the efficacy of antibiotics in third molar surgery despite a plethora of studies being available in the literature.[2,3] In addition, there is a limited number of studies that have assessed the effectiveness of prophylactic mouthrinses in third molar surgery.[3]

Very few studies on impacted third molar teeth have been conducted in South Africa.[4,5] The only identified study on antibiotic prophylaxis in third molar surgery was carried out by Siddiqui et al[6] at the University of the Western Cape.

Hence, the rationale behind this study is to generate a pool of data not only in the demographics and distribution patterns in patients presenting with impacted third molar teeth but also in treatment outcomes after removal. Such data will be essential in establishing evidence based clinical guidelines that will further assist in the development of sound treatment protocols.

CHAPTER 2

LITERATURE REVIEW

Impacted Mandibular Third Molars

2.1 Definition

Peterson and Ness[1] have defined an impacted tooth as one that cannot erupt into a normal functioning position during the usual range of expected time. In 2004, Farman characterized impacted teeth as those that cannot erupt due to some physical obstruction along the path of eruption.[7]

Impaction of third molar teeth remains a very common pathological condition with a frequency of occurrence reported to range from 16.7%-68.6%.[8] Generally, the eruption ages are between 17 and 21 years.[7] The wide variation in ages may be due to differences in race, nature of the diet, the force with which the masticatory apparatus is used or genetic characteristics.[7]

2.2 Development

Radiographic evidence of third molar tooth starts as early as seven years of age, with cusp mineralization being complete at around 11 years.[1] At this age, the tooth bud is located in the anterior border of the mandibular ramus with its occlusal surface facing anterior and upward at an angle of 40-45 degrees.[9] The tooth then migrates forward and

upward, rotating from a horizontal to mesioangular and ultimately into a vertical position distal to the second molar.[9] The crown formation is completed at around 14 years while the root is fully formed by the age of 20.[1,10] Assuming that the tooth has sufficient space to erupt, then it will be brought into its normal position by about 20 years of age.[1] Any failure for the tooth to rotate into its normal position will lead to impaction.[1]

2.3 Aetiology

Several theories have been proposed following the high incidence of impacted mandibular teeth.

One of the most popular theories is a lack of growth of the retromolar space between the second molar and the ascending ramus.[7] The Mendelian theory advocates that the coarse nature of the diet of primitive men led to increased teeth attrition with a subsequent decrease in the collective length of teeth, thereby increasing the space needed to accommodate wisdom teeth.[5] Moreover, the unrefined nature of the food as opposed to what is presently available, resulted in increased masticatory movements and force which probably stimulated jaw growth.[5]

Other theories put forward include malposition of the tooth germs, insufficient eruption force of mandibular third molars and a decrease in the mandibular angulation.[7]

The causes of impaction have been classified into local and systemic factors.[11]

Among the local factors are: abnormal position of an adjacent tooth, dense overlying bone, nature of the overlying soft tissues, arch length and tooth size discrepancy, malposition of the tooth bud, over retained deciduous teeth and unfavourable path of eruption.[11]

Systemic causes are subdivided into prenatal and postnatal causes. The prenatal cause is mainly hereditary and postnatal causes include rickets, anaemia, congenital syphilis, malnutrition, cleidocranial dysostosis and tuberculosis among others.[11]

2.4 Classification

Two systems of classification are widely advocated for impacted mandibular third molars and these are the Pell & Gregory classification (1933) and Winter's classification (1926).[7,12]

The Pell and Gregory classification evaluates the depth of the tooth within the alveolar bone as well as the distance that exists between the anterior ramus of the mandible and the distal aspect of the second molar.

Winter's classification, as described below, assesses the long axis of the impacted 3rd molar in relation to the long axis of the second molar.[11,13]

Mesioangular: The long axis of the 3rd molar bisects the long axis of the second molar at or above the occlusal plane.

Distoangular: The long axes of the 2nd and 3rd molars are divergent at the occlusal plane.

Horizontal: The long axis of the 3rd molar bisects that of the second molar at a right angle.

Vertical: The long axes of the 2nd and 3rd molars run parallel to one another.

Transverse: The tooth is impacted in a bucco-lingual direction.

Inverted: The crown of the tooth is directed vertically down towards the inferior alveolar canal.

A study carried out by Almendros Marqes et al[12] comparing the two third molar classification systems concluded that intra-examiner and inter-examiner reproducibility levels are very high when attempting to classify third molar teeth based on the Winter's classification system, as compared to the Pell and Gregory classification system. Hence, Winter's classification was used in this study.

2.5 Pattern of Presentation

Several studies have been carried out to determine the pattern of distribution of impacted mandibular third molars.[5,8,14,15] With regards to gender, most studies have shown no sexual predilection for impacted third molars, while some studies revealed a higher frequency in Caucasian, South East Iranian and Singapore Chinese females.[14,16] As far as the type of impaction is concerned, Kramer and Williams[17] found that mesioangular and horizontal impactions account for 75% of all mandibular impactions. Hashemipour et al[8] revealed that mesioangular impaction was more common in the mandible (48.3 %). Gtobolorun et al[18] and Tabetze[5] similarly noted higher prevalences of mesioangular mandibular impaction in their studies carried out at the Lagos university hospital and the university of Limpopo respectively. However, their results were in contrast with those found by Hugoson and Kugelberg (1988) who noted that vertical impaction was most common.[16]

2.6 Indications for Removal

Removal of impacted third molar teeth has remained a subject of controversy over many years. Some clinicians advocate for the prophylactic removal of third molars, while others suggest little justification for the removal of pathology free impacted third molars.[19,20] However, as a general principle, once an impacted third molar tooth has been diagnosed, it has to be evaluated for extraction, periodic monitoring or retention.[19]

Nordenram et al[20] in an investigation of 2630 cases of mandibular third molar extractions, reported that 60% of the teeth involved had some pathological changes with pericoronitis being the most common diagnosis.

A prospective study on the indications for third molar surgery done at the Queen Alexandra hospital in Portsmouth, United Kingdom demonstrated that the commonest recorded reason for third molar extraction was recurrent pericoronitis (35.7%) followed by intermittent pain (20.7%), single episode of pericoronitis (17.2%), caries (8.7%) and periodontal disease (7.1%).[21]

In contrast, caries and its sequelae (63.2%) was the most common reason for extraction in a separate review of 1763 cases carried out by Adeyemo et al[22].

Taking into account the indications mentioned above, it is generally agreed that if the potential benefits outweigh the risks involved for third molar surgery, then it is recommended that the tooth be extracted.

2.7 Prophylaxis in third Molar Surgery

The oral cavity harbours a diverse and complex microbial community. Due to the high number of host bacteria present at the operative site, postoperative complications remain common during third molar surgery.[23] The non-infection related complications usually include pain, swelling and erythema due to the normal inflammatory process following trauma while complications that may occur with infection include alveolar osteitis, necrotic bone, lymphadenopathy (localized/ generalized) and fascial space involvement.[24] The infection rate associated with mandibular third molar extraction has been reported to range from 1-12.6%.[24] In order to reduce the incidence of infection, the use of antibiotic therapy or antimicrobial agents such as chlorhexidine mouthwash has often been advanced to reduce bacterial contamination at the surgical site.[24,25]

Antibiotic prophylaxis is described as the prescription of antibiotics in order to prevent infection at the operative site.[3] Various antibiotic regimens have been used with different timing in administration. In South Africa, the general trend for antibiotic prescription is a five day postoperative course. Similarly, in Australia between 78% to 90% of dentists prescribe a five day postoperative course of antibiotic prophylaxis following the removal of third molars.[3]

However, there is considerable evidence that antibiotics taken preoperatively may have significant effects on the rate of postoperative infections, while other studies have also demonstrated that prophylactic antibiotics may not be of any value in reducing the incidence of infection.[6,25-28]

In a randomized controlled clinical trial evaluating the efficacy of amoxicillin and metronidazole in third molar surgery, Pasupathy et al[26] failed to demonstrate any significant advantage over the placebo in reducing postsurgical wound infections.

The results of the study on antibiotic prophylaxis in third molar surgery carried by Siddiqui et al[6] showed that preoperative or postoperative prophylactic antibiotics did not have any significant effect in reducing postoperative infections and should not be routinely administered in non-immunocompromised patients.

Arteagoitia at al[29] investigated the effect of amoxicillin/ clavulanic acid to prevent infection following lower impacted mandibular third molar removal. They reported no significant difference in infection rate in the antibiotic group and the placebo.

Ataoqlu et al[30] devised a study involving three groups of patients requiring removal of lower third molar teeth. The first group received no antibiotic treatment while the second and third groups were administered a five day preoperative and postoperative course of amoxicillin respectively. There were no significant differences in postoperative complications including infection in the groups assessed.

In a prospective, randomized controlled trial, Olusanya et al[31] compared the efficacy of a single pre-emptive bolus of antibiotics to that of a five day postoperative course of antibiotic regimen. They found no significant difference in the reduction of surgical morbidity in the two groups.

Acute phase protein levels were used as indicators of infection by Bulut et al[32]. The levels of C-reactive protein and alpha-1 antitrypsin were measured preoperatively and postoperatively in patients that received prophylactic antibiotics or placebos. They concluded that there is no statistically significant difference in the incidence of infection between the two groups.

Lopez Cedrun et al[28] investigated the efficacy of amoxicillin treatment in preventing postoperative complications in 123 patients. It was concluded that patients who received preoperative or postoperative amoxicillin prophylaxis showed greater efficacy in preventing postoperative complications than the placebo group.

Similarly, Monaco et al[27] in their evaluation of the removal of third molars in 59 young patients, demonstrated a statistically significant difference in postoperative complications between patients that received preoperative amoxicillin prophylaxis and the control group.

In a recent systematic review of randomized controlled trials to assess the effectiveness of a single dose of preoperative antibiotics during lower third molar extraction, Marcussen et al[33] deduced that a single preoperative bolus of 2g amoxicillin significantly reduced the incidence of surgical site infection.

While the need for antibiotic therapy in third molar surgery remains controversial, it is unclear whether the use of antibacterial mouthrinses have an effect in the reduction of surgical morbidity in third molar surgery. Several studies have claimed their usefulness in reducing the incidence of alveolar osteitis.[34] However, there is a paucity of studies that have assessed their efficacy in reducing postoperative infections in third molar surgery.

The relatively few studies that compared the efficacy of antibacterial mouthrinses to an antibiotic regimen have all used bacteraemia as a marker for infection.[35-37]

A pilot study carried out by Tuna et al[35] to evaluate the effects of antibacterial mouthrinses on bacteraemia concluded that bacteraemia was reduced with 0.2% chlorhexidine and 7.5 % Povidone Iodine mouthrinses in third molar surgery.

Duvall[36] and colleagues compared the efficacy of a 0.12% chlorhexidine and amoxicillin in reducing the incidence and magnitude of bacteraemia in third molar extraction. It was deduced that an oral rinse or systemic antibiotic intervention does not significantly reduce the incidence and magnitude of bacteraemia.

A study to compare the effectiveness of amoxicillin, clindamycin and a chlorhexidine mouthrinse in the prevention of post extraction bacteraemia was carried out by Maharaj et al[37]. The study revealed a statistically significant difference in bacteraemia between the amoxicillin and chlorhexidine groups. However, none of the regimens were effective in preventing post extraction bacteraemia.

Table 2.1: Summary of the investigations carried out and the clinical findings thereof.

INVESTIGATOR	TYPE OF STUDY	GROUP	SIZE	FINDINGS
Siddiqui et al [6], 2010	-Prospective -Randomized -Double blind -Controlled	o Placebo o Preoperative antibiotics o Postoperative antibiotics	100	No significant difference in infection rate between groups
Pasupathy et al [26], 2011	-Prospective -Randomized -Controlled	o Placebo o Preoperative Amoxicillin o Preoperative Metronidazole	89	No significant difference in infection rate between groups
Monaco et al [27], 2009	-Prospective -Randomized -Controlled	o Placebo o Preoperative Amoxicillin	59	Significant difference between Control and Amoxicillin groups
Arteogotia et al [29], 2015	-Prospective -Randomized -Double blind -Controlled	o Placebo o Preoperative and continuing postoperatively	118	No significant difference in infection rate between groups
Ataoqlu et al [30], 2008	-Prospective -Randomized -Controlled	o Placebo o Preoperative Amoxicillin/ Clavulanic acid o Postoperative Amoxicillin/ Clavulanic acid	150	No significant difference in complications and infection rate between groups
Olusanya et al [31], 2011	-Prospective -Randomized -Controlled	o Preoperative Amoxicillin/ Metronidazole o Postoperative Amoxicillin/ Metranidazole	84	No significant difference in surgical morbidity between groups

Maharaj et al [32], 2012	-Prospective -Controlled	○ Control ○ Chlorhexidine ○ Amoxicillin ○ Clindamycin	160	Significant difference in bacteraemia between the Control and Chlorhexidine groups when compared to the Amoxicillin group
Tuna et al [35], 2012	-Prospective -Controlled	○ Sterile Saline ○ Povidone Iodine ○ Chlorhexidine	34	Incidence of bacteraemia reduced in the Povidone Iodine and Chlorhexidine groups
Duvall et al [36], 2013	-Prospective -Randomized -Blind -Controlled	○ Placebo ○ Chlorhexidine ○ Preoperative Amoxicillin	160	No Statistical difference in reducing bacteraemia between the groups

CHAPTER 3

AIMS AND OBJECTIVES

3.1 Aims

This study aims to investigate the efficacy of a prophylactic antibiotic therapy as compared to a chlorhexidine regimen in preventing postoperative infections in third molar surgery, and to establish the association between the pattern of presentation of impacted mandibular third molars with age, gender and indications for extraction.

3.2 Objectives

1. To evaluate the complication that arises due to infection after third molar surgery in two groups of patients.
2. To provide current local data on the age and gender of patients presenting with impacted mandibular third molars.
3. To evaluate the type of impacted mandibular third molars based on Winter's classification.
4. To determine the indications for the removal of impacted lower third molars.

3.3 Hypothesis

1. There is no difference in efficacy between the preoperative antibiotic therapy and a regimen of chlorhexidine mouthrinse.
2. There is no gender predilection for patients presenting with impacted mandibular third molars.
3. The type of impaction is independent of the age or gender of the patients.
4. Indications for extraction are independent of the type of impaction.

CHAPTER 4

MATERIALS AND METHODS

4.1 Ethical Clearance (Ethical Considerations/ Issues)

Permission to carry out the study was obtained from the heads of each institution where the study was undertaken. All information gathered in this study was treated with confidentiality. Patient file numbers were used instead of names. Since the study involved clinical assessment and treatment on human subjects, a submission for Ethics approval was submitted to the Human Research Ethics Committee (HREC) of the University of the Witwatersrand and granted; Certificate NO: M140435 (Appendix A). Patients who fulfilled the inclusion criteria were given written and verbal explanation of the study and were made to sign a consent form (Appendix B) for agreeing to participate in the study.

4.2 Inclusion Criteria

1. Patients with impacted third molars presenting to Ermelo and Rob Ferreira hospitals and who gave consent to participate in the study.

2. Patients between the ages of 18–50 years and who are medically competent.

3. Patients undergoing removal of impacted maxillary molars were also included in the study.

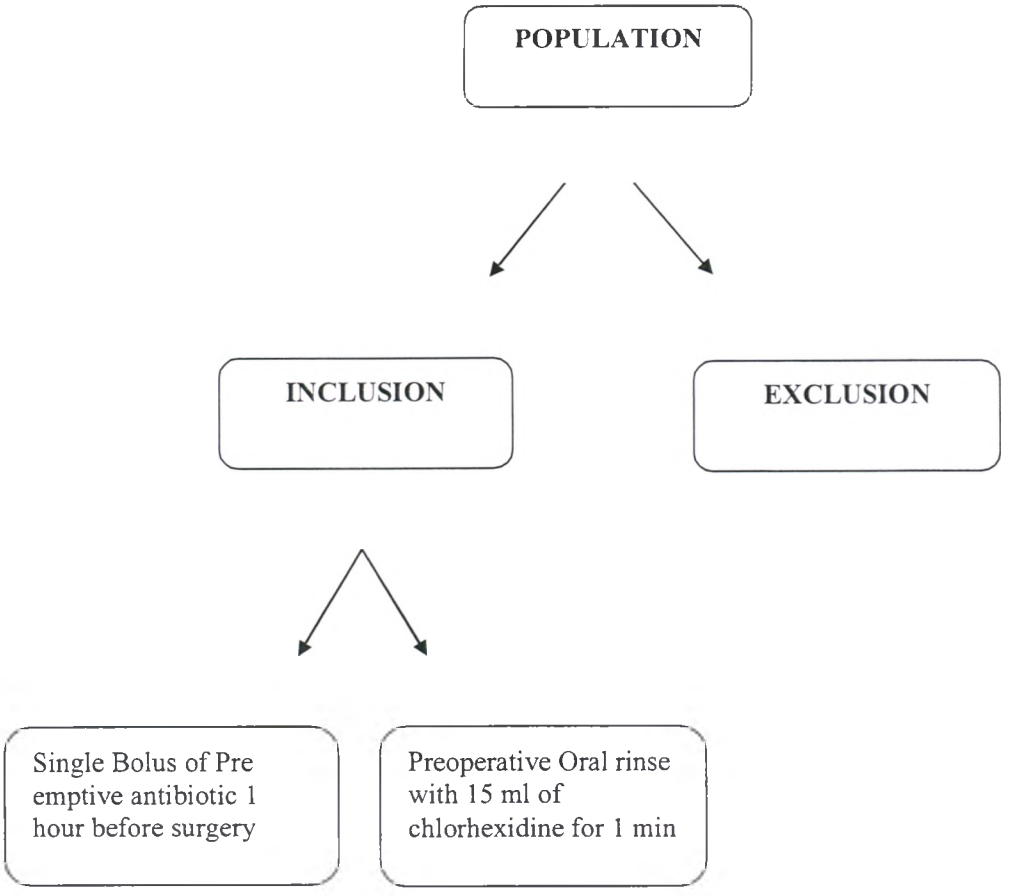
4.3 Exclusion Criteria

1. Patients with co morbidities.

2. Patients presenting with third molars that have incomplete root formation.

3. Patients that failed to give consent or withdrew from the study.

INCLUSION AND EXCLUSION CRITERIA



4.4 Study Design

This is a prospective randomized controlled trial which involved patients who presented to the Oral and and Dental Department of Ermelo Provincial and Rob Ferreira hospitals for third molar extractions under local anaesthesia during the period October 2014 to October 2015.

4.5 Data Collection

All eligible patients presenting at the dental department underwent a general clinical evaluation that included complete dental and medical history taking, followed by an orofacial assessment that involved intraoral and extraoral examination. All the relevant information for the study such as age, gender, impacted tooth number, indication for extraction were recorded in a data assessment sheet (Appendix D). Preoperative panoramic radiographs were taken for all participating patients. Orthopanthomograms were assessed to determine the type of impaction based on the Winter's classification system.

4.6 Surgical Data

All extractions were performed by a single medical officer using a standardized procedure. Indications for extraction were recorded according to those listed in the Scottish intercollegiate guidelines [38] on the management of unerupted and impacted teeth.

To test the effectiveness of the prophylactic regimen in the study, patients were randomly assigned to two groups (using two sealed envelopes). In the first group (control group), patients were instructed to rinse with 15ml of 0.2% chlorhexidine (with alcohol) mouthrinse for one minute prior to the surgery. In the second group (test group), 2g amoxicillin was administered orally one hour before the surgery.

The **Control group** consisted of 50 patients; 22 males and 28 females.
The **Test group** consisted of 50 patients; 26 males and 24 females.

All the operations were of a surgical nature and performed under Local Anaesthesia (2% lignocaine with 1:80000 adrenaline)

The surgical procedure was carried out based on the university's protocol on third molar extraction. Envelope or triangular mucoperiosteal flap elevation with ostectomy and/or odontectomy was achieved using a surgical scalpel blade no. 15 for best access.

Ostectomy was performed using a crosscut tapered fissure bur mounted on a straight handpiece. The tooth was sectioned appropriately where necessary depending on the surgeon's judgement whilst trying to achieve minimal exposure.

Following the removal of the tooth, the surgical site was debrided and irrigated with sterile water. Primary closure of the flap was achieved using resorbable chromic catgut sutures, 3/0.

The time of surgery was recorded as the time span between the first incision and the last suture placed.

Patients were prescribed 1g of Paracetamol with codeine and 400mg of Ibuprofen as analgesics and postoperative instructions of care were given, which included rinsing with warm saline three times daily starting from the day after surgery.

A recall visit was scheduled seven days later and any postoperative complications were noted in a questionnaire. Pain, swelling, trismus, alveolitis and surgical site infection were recorded.

Trismus is defined as an inability to clear an inter incisal distance of at least 2 cm.

Alveolar osteitis is defined as pain that arises 2-5 days after surgery, presence of necrotic tissue, exposed bone, and absence of clot.[23, 39]

Infection is defined as a purulent discharge at the extraction site with/ without painful induration.[23]

If any complication arose before the recall visit was scheduled, the patient was asked to report back to the hospital to receive the appropriate treatment and postoperative antibiotics were then prescribed, if required. The complication was recorded on the data collection sheet.

4.7 Data Analysis

A questionnaire was used to capture all relevant data needed for the study. Based on previous studies, a sample size of 100 patients was used.

Data were captured on an excel spreadsheet which was later imported into Stata13.1 for further analysis.

Participants were described using frequencies and percentage for categorical predictors and means and standard deviations for continuous variables.

Associations were investigated using appropriate statistical tests such as the Student's t-test and Fisher's exact test for categorical predictors and ANOVA test for equal Variance to analyze any significant differences inter-groups. Statistical tests used were two sided and p values ≤ 0.01 were considered significant.

CHAPTER 5

RESULTS

A total number of 110 patients that visited Rob Ferreira and Ermelo provincial hospitals for third molar surgical extractions were recorded for the study. Out of the 110, 100 patients met the inclusion criteria with 52 Female patients (52%) and 48 (48%) Male patients. The Female to Male ratio was 1.08:1.

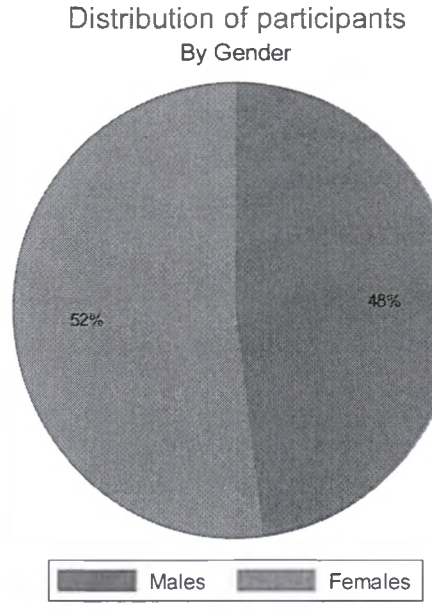


Figure 5.1 shows a representation of the participants by gender.

Table 5.1: Description of the Study Population

VARIABLE	FREQUENCY		%
Sex			
Female	52		52.00
Male	48		48.00
Age (mean, std)	27.75 (5.79)		
Type of Impaction			
Vertical	37		37.00
Horizontal	14		14.00
MesioAngular	46		46.00
DistoAngular	3		3.00
Indication for Extraction			
Pericoronitis	39		39.00
Abscess	3		3.00
Caries	34		34.00
Periodontal Disease	10		10.00
Root Resorption	2		2.00
Atypical facial pain	6		6.00
Oral Pathology	1		1.00
Prophylactic removal	4		4.00
Tooth in line of fracture	1		1.00
Time taken in minutes (mean, std)	22.14 (9.69)		
Medication			
Antibiotics	50		50
Chlorhexidine Mouthwash	50		50
Complication	**CHX**	**AMOX**	
No complication	38	42	
Pain	9	6	
Swelling	8	4	
Trismus	3	1	
Alveolitis	4	3	
Infection	4	3	

Table 5.1 shows a description of the study population by frequency count. Of the 100 patients who participated into the study, the two types of medication were evenly distributed with 50% receiving each type of medication.

The frequencies of the various complications occurred, were recorded. Two or more complications may have presented simultaneously. Alveolitis was recorded in the presence or absence of infection. For the purpose of this study, the focus was on infection as a complication.

Mesioangular impactions followed by vertical impactions were the highest angulations recorded. There were no patients that presented with an inverted type of impaction.

Pericoronitis and caries accounted for most of the indications for extraction. In addition, no tooth was extracted due to the following indications: Prosthetic Rehabilitation, Orthodontic treatment or Radiotherapy.

The average time taken to complete the procedure was 22.14 minutes with a standard deviation of 9.69 minutes. The minimum and maximum times to complete the procedure were recorded as 5 and 54 minutes respectively.

Table 5.2: Association between baseline characteristics of the patients and presence of infection.

Variable	Presence of Infection		Total	p-value
	Yes	No		
Sex				
Female	4 (7.69 %)	48 (92.31%)	52	1.00
Male	3 (6.25%)	45 (93.75%)	48	
Age (mean, std)	26.85 (5.21)	27.82 (5.85)		0.67
Type of Impaction				
Vertical	1	36	37	0.187
Horizontal	1	13	14	
MesioAngular	4	42	46	
DistoAngular	1	2	3	
Indication				
Pericoronitis	4	35	39	0.651
Abscess	0	3	3	
Caries	1	33	34	
Periodontal Disease	1	9	10	
Root Resorption	0	2	2	
Atypical facial pain	1	5	6	
Oral Pathology	0	1	1	
Prophylactic Removal	0	4	4	
Tooth in line of Fracture	0	1	1	
Time taken in minute (median, IQR)	28 (20-35)	20 (15-26)		0.07
Medication				
Antibiotic	3	47	50	1.00
Chlorhexidine mouthwash	4	46	50	

Table 5.2 depicts the association between the presence of infection and the different variables recorded. The p values calculated show that there is no association between the presence of infection and the following variables: Gender, Type of impaction, Indications for extraction, Time taken, Medications used.

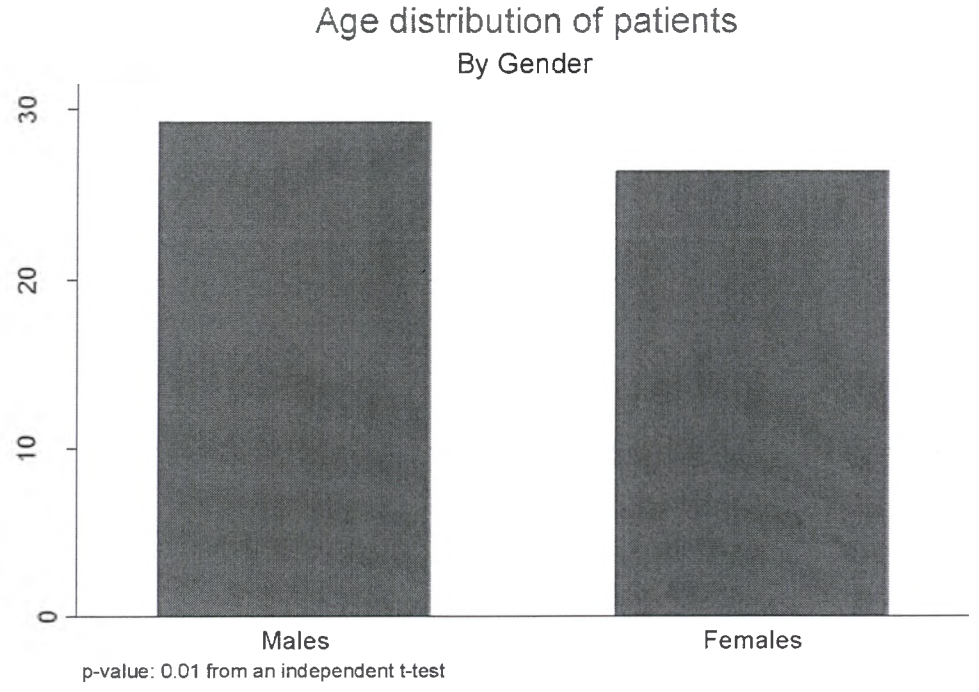


Figure 5.2 illustrates the mean age of the patients in males and females. The p value indicates a marginal association between the mean age of the patients and gender.

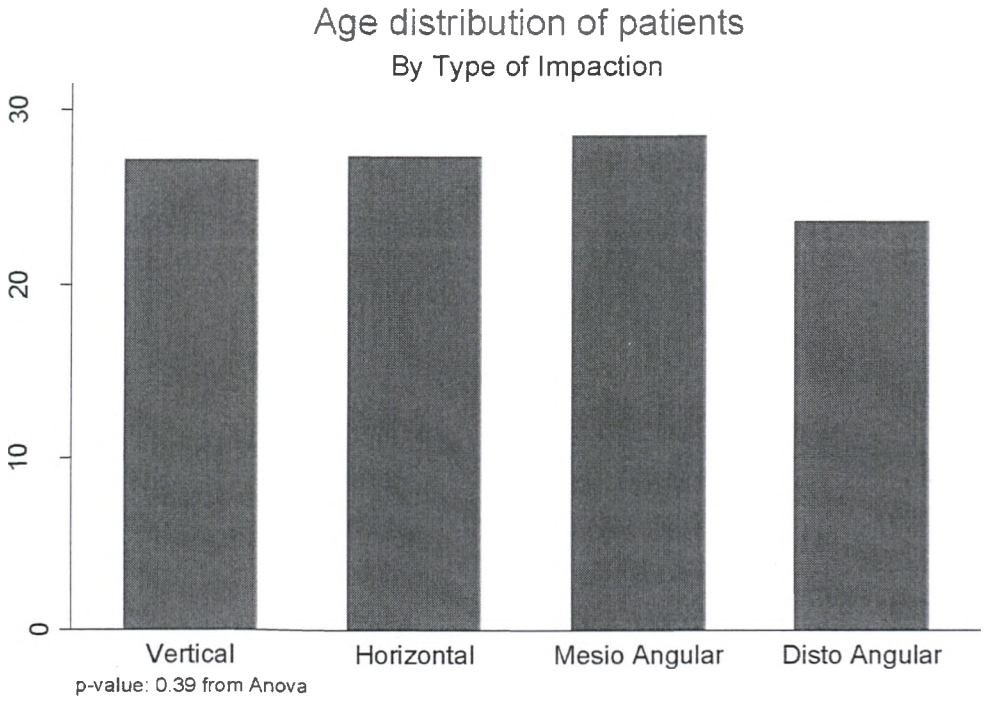


Figure 5.3 shows a representation of the mean age of the patients by type of impaction. The p value demonstrates no association between mean age and the type of impaction.

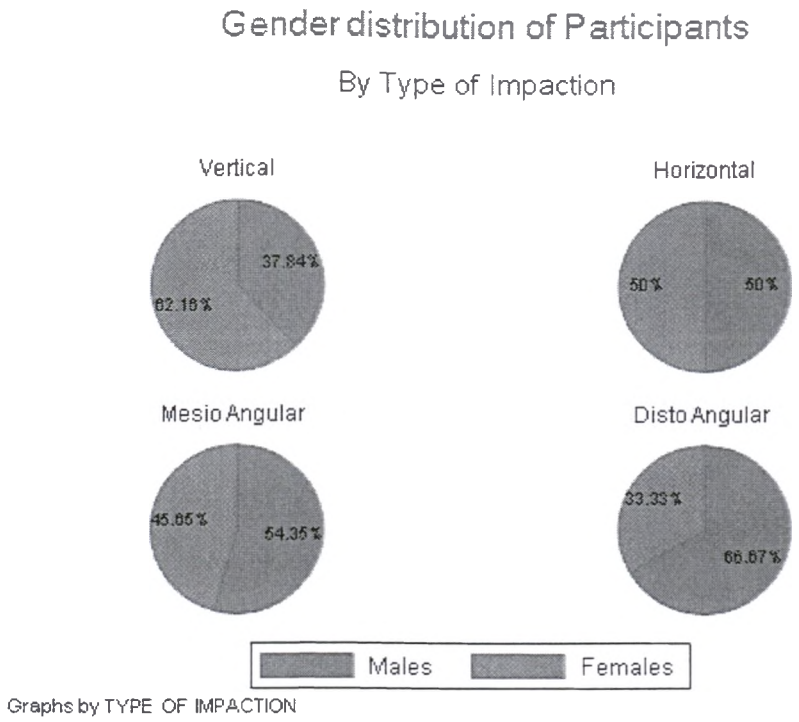


Figure 5.4 shows the frequency distribution of males and females that presented with the different types of impaction. The Fisher's Exact test indicates a p value of 0.467 and there is no association between gender and the type of impaction.

Table 5.3: Analysis of Indications for Extraction by the Type of Impaction

Indications	Type of Impaction				
	Vertical	Horizontal	Mesioangular	Distoangular	Total
Pericoronitis	17	6	13	3	39
Abscess	2	-	1	-	3
Caries	14	1	19	-	34
Periodontal Disease	2	2	6	-	10
Root Resorption	-	1	1	-	2
Atypical Facial Pain	1	1	4	-	6
Oral Pathology	1	-	-	-	1
Prophylactic Removal	-	2	2	-	4
Tooth in Line of Fracture	-	1	-	-	1
Total	37	14	46	3	100

The Fisher's Exact test shows a p value of 0.070 and there is no association between the type of impaction and the indications for extraction of third molar teeth.

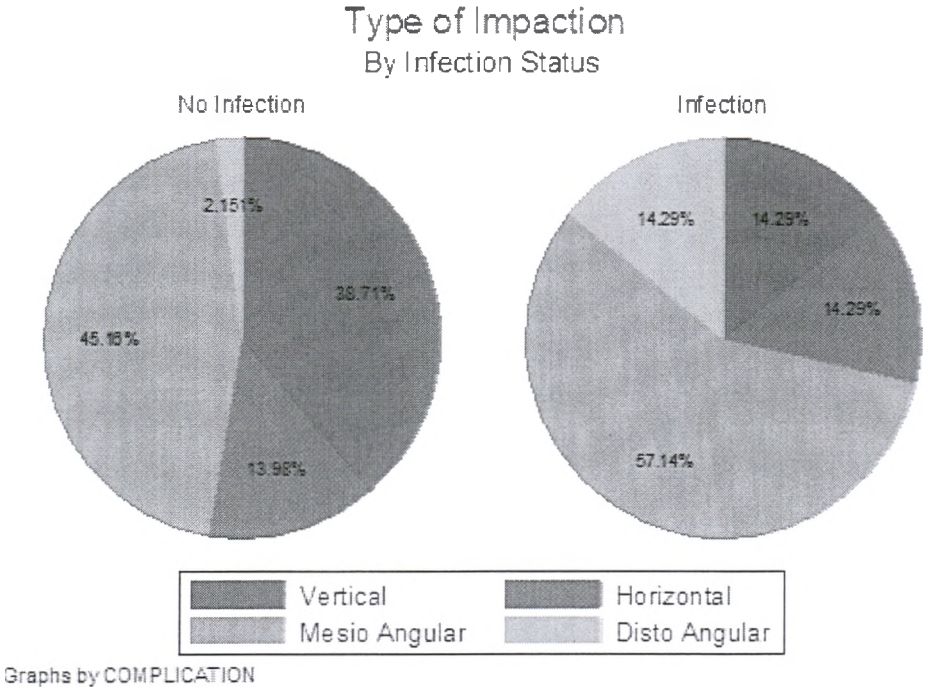


Figure 5.5 shows the different types of impacted teeth associated with their infection status. The p value from the Fisher's exact test is 0.651 and demonstrates no association between the type of impaction and the infection status.

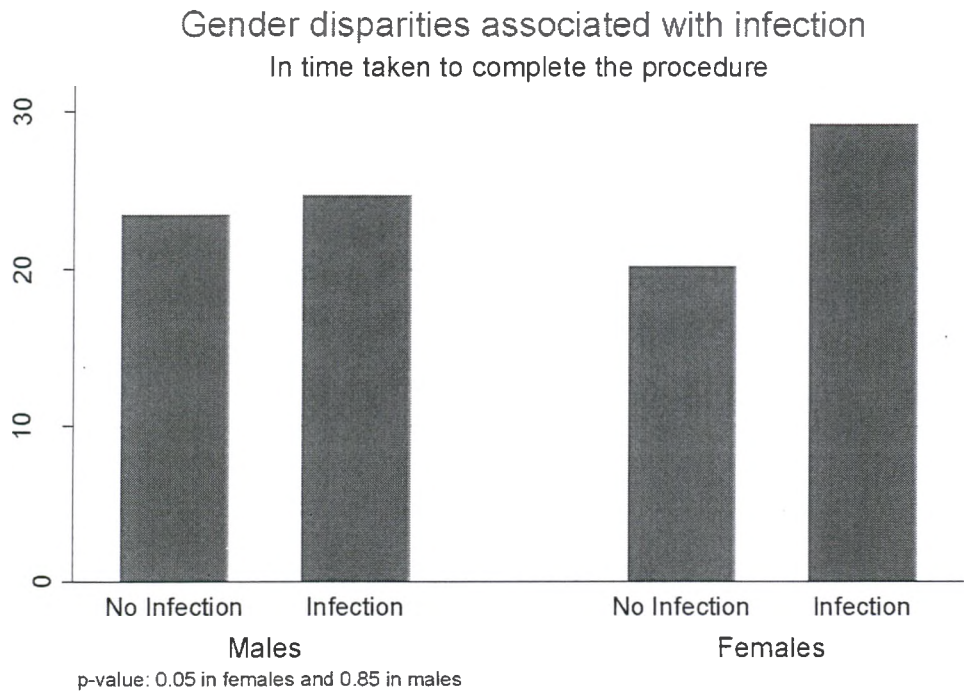


Figure 5.6 illustrates the average time taken to complete the procedures by infection status in males and females. The p values show no association between the average time taken and the infection status in both genders.

Flowchart diagram

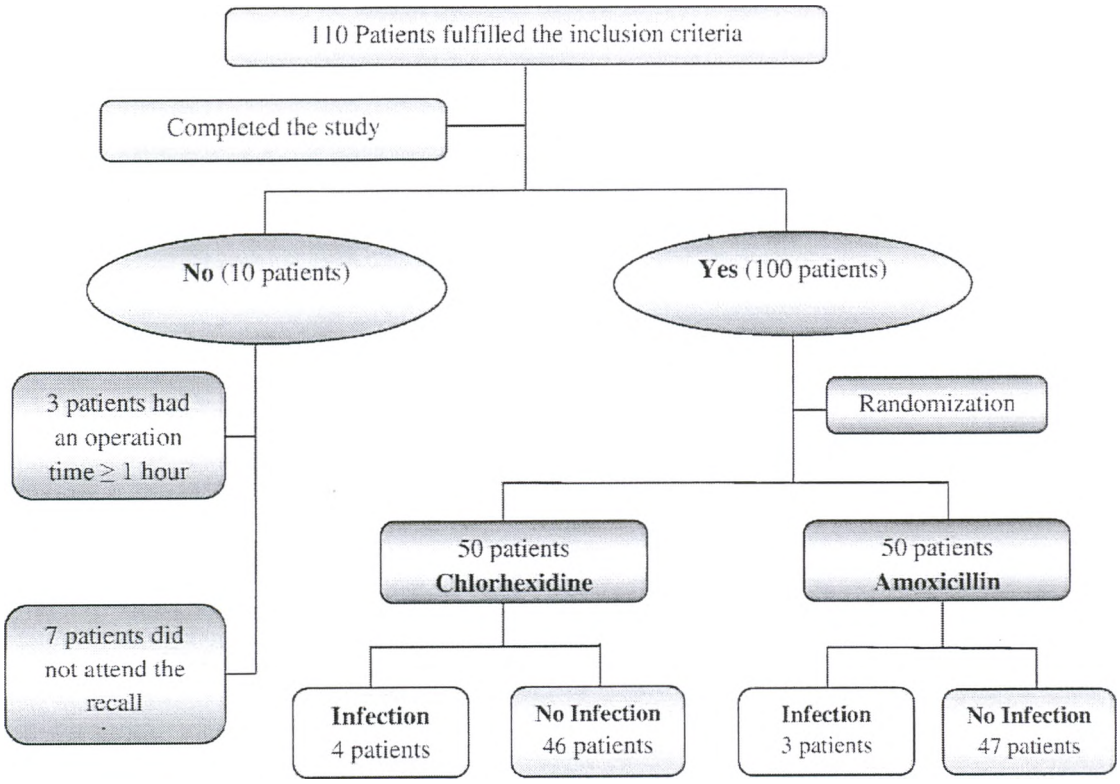


Figure 5.7 The above flowchart shows a summary of the study and results obtained.

CHAPTER 6

DISCUSSION

This study attempted to compare the efficacy in prophylaxis of two different therapeutic strategies:

1) A one minute oral rinse with 15 ml of chlorhexidine mouthwash,

2) A single bolus of 2g Amoxicillin, prior to mandibular third molar extraction in healthy patients.

110 patients were followed. Seven patients did not attend their recall visit and were excluded from the study. Three patients had an operating time for extraction of above one hour. Patients with an operating time of one hour and above were not included due to increased exposure to bacteria within the oral cavity which could compromise the results. In addition, the procedures were performed in the absence of pericoronitis or active infection. Therefore, a total of 100 patients completed this study with 50% each receiving either type of treatment. Each subject had an equal chance of being selected, thus eliminating any possibility of bias. Furthermore, the assessment of the recall visit was recorded by independent practitioners who were blinded to the type of treatment dispensed.

Among the 50 patients, to whom a preoperative rinse of chlorhexidine mouthrinse (control group) was administered, four patients presented with postoperative infections and in the group that consumed a bolus of preoperative antibiotics (test group), three patients

presented with postoperative infections. The infection rate recorded in this study was 8% for the chlorhexidine group and 6% for the antibiotic group. The Fisher's exact test between the two groups of patients demonstrates a p value > 0.01 indicating no significant difference in infection rate between the chlorhexidine group and the antibiotics group.

Based on this finding, it can be deduced that the results in terms of efficacy obtained with either antimicrobial therapy is comparable and therefore an assessment of their mechanism of action, risk and cost benefits is important before making a recommendation.

Chlorhexidine gluconate is a well-known antimicrobial agent with a broad spectrum of activity against both Gram positive and Gram negative bacteria, facultative anaerobes and aerobes, yeasts as well as certain viruses including HIV.[40] It exists in the form of cations and readily binds to the negatively charged particles of the oral mucosa and bacteria exhibiting an immediate as well as a prolonged antimicrobial effect on a broad spectrum of bacteria and fungi.[40] Its use in the routine disinfection of patients and medical devices in ICU or in surgical scrubs has been well established.[41] In dentistry, chlorhexidine in the form of an oral rinse, is often used for prophylaxis or in the treatment of oral infections.

In this study, a 0.2% oral rinse of chlorhexidine gluconate was used as a prophylaxis. At this concentration, chlorhexidine displays bactericidal properties by disrupting the function of cell membranes and altering the osmotic equilibrium of bacteria.[40] The rationale behind its use in this study was to reduce the oral bacterial load at the surgical site, thereby decreasing bacteraemia which harbours significant risks for post extraction infections.[42] Organisms that have shown high susceptibility to chlorhexidine include several species of *staphylococci*, *streptococci* and various anaerobes which are important constituents of the complex oral flora.[43]

Several studies have demonstrated that a preoperative rinse with 0.2% chlorhexidine has significant antimicrobial effects on the oral flora and post extraction bacteraemia.[35,42] In 1997, the AHA recommended the use of an antiseptic mouthwash to reduce bacteraemia prior to any dental manipulation before modifying it in 2007. In 2006, the British Society for Antimicrobial Chemotherapy (BSAC) recognized the importance of a preoperative rinse with a 0.2% chlorhexidine mouthwash before any dental procedures in patients at high risk of infective endocarditis.[44] It has also been suggested that forceful rinsing with a chlorhexidine mouthwash may actually produce bacteraemia but there is no substantial evidence to confirm this hypothesis.[42]

In addition to its broad antibacterial spectrum and substantivity, one of the major advantages of chlorhexidine is the absence of resistance to the microorganisms it affects.[45] The few and rare documented adverse reactions to chlorhexidine include hypersensitivity, unpleasant taste or tooth discolouration.[40] Also, there is no evidence that contradicts the use of chlorhexidine mouthwash in pregnant or lactating women.[40]

As opposed to the few studies published on the efficacy of chlorhexidine prophylaxis in third molar surgery,[35,39] there is a plethora of studies on antibiotic prophylaxis.[3,26-28] However, its usefulness in preventing postoperative infections continues to remain a matter of debate. Different treatment protocols and different antibiotics have been used and conflicting information exists regarding its benefit. Although there are definite recommendations by the AHA and ADA/AAOS for antibiotic prophylaxis in the prevention of infective endocarditis and prosthetic joint infection, the guidelines for prophylactic antibiotics to prevent surgical site infection in oral and maxillofacial surgery are less clear.[46] It is widely accepted that surgical site infections are caused by the patients' own endogenous flora and the purpose of prophylaxis is to considerably reduce the systemic level of the infective pathogens in the tissues at the operative site.[47,48]

The choice of the antibiotics is greatly influenced by the bacteria present at the operative site. Peterson[1] has set forth certain criteria when choosing an antibiotic for prophylaxis. He advocates that the correct antibiotic with the narrowest antibacterial spectrum must be selected. In addition, a high enough dosage must be administered at the most appropriate time and with the shortest exposure. Amoxicillin has been the gold standard for treatment of infections or prophylaxis in dentistry due to its high efficacy against Gram positive *streptococcus* and *staphylococcus* species as well as several Gram negative bacteria which are common isolates in oral infection.[49] In addition, its good absorption in the gastro intestinal tract coupled with its capacity in reaching fast and effective concentrations at the site it targets has made it an antibiotic of choice.[50]

A 2g amoxicillin regimen one hour before surgery was used in this study based on the AHA/ADA/AAOS guidelines.[36] Similar protocols were used in several studies with varying results on the efficacy of the prophylactic treatment.[30,51] Ren et al[52] performed a meta-analysis of 23 studies on the effectiveness of antibiotic prophylaxis in third molar surgery and concluded that when systemic antibiotics are administered before surgery, they are effective in reducing the frequency of wound infections. In contrast, in a review of published clinical trials on the efficacy of antibiotic prophylaxis, Oomens et al[53] reported that there is a lack of evidence to support the use of prophylactic antibiotics in lower third molar surgery.

The use of amoxicillin in the prevention of infection in dentistry is a major talking point due to the development of antibacterial resistance and other adverse reactions such as anaphylaxis or toxicity.[24] The WHO's 2014 global report on antibiotic resistance highlighted resistance as a major global threat to worldwide public health with new resistance mechanisms continuously emerging and spreading globally at an alarming rate.[54] The development of resistance over the years is most probably due to overuse or

misuse of antibiotics.[24] There is no doubt that the poor antibiotic prescribing practices by dentists, often motivated by factors ranging from inadequate knowledge to social factors, contribute significantly towards the formation of multiresistant bacterial strains.[55]

The judicious use of antibiotic prophylaxis based on evidence rather than perception is imperative. The published infection rate associated with third molar surgery ranges between 1%-12.6%.[24] The infection rate for amoxicillin and chlorhexidine prophylaxis in this study is 6% and 8% respectively and falls within the expected rate of infection for third molar removals. Hence the efficacy of both regimens is comparable.

In view of the potential harmful complications associated with the use of antibiotics for prophylaxis and the relatively low rate of infection posed by third molar surgery, the use of amoxicillin is not warranted for such procedures. However, chlorhexidine gluconate which is a cheap, safe and broad spectrum antiseptic must be recommended to reduce the oral bacterial count at the surgical site prior to making an incision.[56]

The demography and socio economic status of the patients seen in Mpumalanga is such that many of them have never visited the dentist, and the presence of plaque and calculus in these subjects will be higher than expected. Therefore the administration of a chlorhexidine mouthrinse prior to extraction is highly recommended.

Moreover, a session of professional scaling would have been desirable before third molar surgery to decrease the oral bacterial load but due to the limited resources in the public service and the long waiting list to get an appointment, this treatment plan is not always feasible.

Finally, the use of chlorhexidine must be an adjunct to proper surgical technique in an aseptic environment to achieve optimum treatment outcomes.

As far as demographics are concerned, the ratio of male to female in this study was 1:1.08, which shows an almost equal distribution between the two gender groups. This is in agreement with most studies that have reported no sexual predilection for impacted third molars.[8] Other studies have shown a higher predilection for females and it is believed that mandibular growth for females stops by the time the third molar starts erupting resulting in a lack of space for the tooth to erupt.[4,8,14]

The most common type of impaction recorded was the mesioangular type (46%) followed by the vertical type (37%). Mesioangular impactions are most probably caused by the late development and maturation of the tooth germ with a resulting lack of space for the tooth to erupt in a normal position.[8] The results were similar to those found by Hashemipour et al[8] and Gbotolorun et al[18] in Iran and Nigeria respectively. This is in contrast to other studies that demonstrated the vertical type of impaction to be more common.[4,12] Differences in methods of classification for angulation used, variation in genetics between the populations studied or the type of food consumed in the different geographical areas may account for the discrepancies.[8] This study also demonstrated that no correlation exists between the type of impaction and the different variables of age and gender.

The mean age of the subjects was 27.75 with a standard deviation of 5.79. The age group 25-30 had the highest proportion of patients with impacted teeth. The delayed manifestation of patients for impacted teeth removal may be due to a lack of Oral Health Education. In certain cases there is also the wrong perception that the tooth is still growing and will erupt eventually until the symptoms become significant. Moreover, due to apprehension for dental treatment, most patients in Mpumalanga visit the dentist only when they are inflicted with pain.

Pericoronitis followed by caries accounted for the largest distribution of indication for extractions. These results are comparable to those found by Krishnan et al[57] where pericoronitis was the most frequent reason for extraction followed by caries. The high prevalence of these pathologies is not uncommon since they usually present with symptoms of pain which force patients to seek dental assistance. Pericoronitis in the patients seen is probably exacerbated by the accumulation of bacteria and food under the operculum. Similarly caries may have been formed due to poor oral hygiene resulting in a build-up of food and debris that become impacted around the partially erupted tooth.

Hence, the implementation of oral health education in community based programs remains key to informing patients on the importance of oral hygiene. Also, several steps must be taken to bring down the different barriers that render access to oral health care difficult for rural residents. In addition, a paradigm shift from interventional dentistry towards preventive oral health within the hospital setting will undoubtedly assist in curtailing the burden of oral diseases in the community.

CHAPTER 7

CONCLUSION

This study demonstrated that the prophylactic use of a chlorhexidine mouthrinse and amoxicillin in third molar surgery is equally effective in keeping postoperative infections to a minimum in medically competent patients. Furthermore, a single dose of antibiotic prophylaxis failed to show any additional clinical advantage compared to the use of a chlorhexidine mouthrinse in reducing infections.

Routine administration of amoxicillin in medically competent patients is therefore not recommended as the risks associated outweigh the benefits. Amoxicillin prophylaxis must be restricted to cases where the rate of infection is high and the consequences are severe. The routine prescription of antibiotics motivated by a fear for surgical site infections is not justifiable and must be strongly discouraged. The focus must rather be on the application of sound surgical techniques in an aseptic field.

Owing to the lack of oral health awareness among patients seen in the public health service in Mpumalanga, the value of chlorhexidine mouthwash as a prophylaxis in third molar surgery remains paramount.

Despite the recognized benefits of chlorhexidine as an antiseptic in dentistry, no studies that assess its effectiveness in reducing postoperative infection have been conducted. Although a few studies have demonstrated its efficacy in reducing post extraction bacteraemia.[35,37] There are no investigations so far that establish the relation between bacteraemia and disease. Moreover, although the results gave clear indications on the

potency of chlorhexidine, the sample size used may not reflect statistical differences in the true population.

Further studies that encompass larger sample size and that take into account the relationship between bacteraemia and infection are needed to reach a final consensus on the efficacy of either type of prophylactic regimen.

If anything, it appears like a session of preoperative professional cleaning and a routine rinse with 0.2% chlorhexidine mouthrinse is more beneficial than antibiotic administration.

APPENDIX

Appendix A

R14/49 Dr Pooshan Gopee

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M140435

NAME: (Principal Investigator)	Dr Pooshan Gopee
DEPARTMENT:	Oral and Maxillofacial Surgery Ermelo Provincial Hospital Rob Ferreira Hospital
PROJECT TITLE:	Impacted Mandibular Third Molars: The Efficacy of Prophylactic Antibiotics and Chlorhexidine Mouthwash in Preventing Postoperative Infections
DATE CONSIDERED:	25/04/2014
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr E Rikhotso
APPROVED BY:	Professor P Cleaton-Jones, Co-Chairperson, HREC (Medical)
DATE OF APPROVAL:	12/08/2014

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix B

INFORMATION SHEET

RESEARCH TITLE: Impacted mandibular third molars: The efficacy of prophylactic antibiotics and chlorhexidine mouthwash in preventing postoperative infections.

Dear Patient,

My name is Dr. Pooshan Gopee. I am a postgraduate part-time student in the Department of Oral and Maxillofacial Surgery at the University of the Witwatersrand. As part of my training, I am carrying out a study on impacted mandibular third molars (blocked wisdom teeth) and the effectiveness of preoperative (before surgery) antibiotic use in the prevention of postoperative (after surgery) complications.

Since you present with the condition stated above, I am kindly requesting you to participate in the study and I would be grateful if I could use your clinical records (physical and medical examination and X rays analysis) for the purposes of this study. It is hoped that this study will help provide a better understanding of the above mentioned dental condition and improve the treatment and service delivery to our patients.

This study involves the testing of the efficacy of preoperative antibiotics versus a chlorhexidine mouthwash in the elimination of postoperative infections. The risk for the complete elimination of infections after surgery cannot be guaranteed but appropriate treatment shall be dispensed should any complications arise.

All your personal information will remain confidential as far as possible and will be used for research purposes only. Absolute confidentiality cannot be guaranteed and may be disclosed by law if required. Please note that your participation in this study will be on a purely voluntary basis and you may refuse to participate in the study or you may withdraw from the study at any time without affecting the outcome of your treatment.

If you require any additional information regarding this study, please feel free to contact me on 076 470 3139. Any complaints regarding the study may be addressed to the Human Research Ethics Committee of the University of the Witwatersrand on 011 717 1252.

Thank you.

Appendix C

CONSENT FORM

RESEARCH TITLE: Impacted mandibular third molars: The efficacy of prophylactic antibiotics and chlorhexidine mouthwash in preventing postoperative infections.

Details of the study including possible side effects of the drugs to be used as well as implications on my participation in the study have been clearly and fully explained to me. I freely agree to take part in the study and I understand that I have the authority to refuse to participate. I am also allowed to withdraw from the study at any given time without compromising the outcome of treatment.

NAME: .....

SIGNATURE: ..... **DATE: .....**

Appendix D

DATA COLLECTION SHEET

Patients code number: **Age:**

Gender: M / F **Date:**

Relevant Medical History:

Relevant Surgical History:

Impacted Tooth Number and Type: *(tick appropriate)*

TN[1]	TYPE OF IMPACTION				
	VERTICAL	HORIZONTAL	MESIO ANGULAR	DISTO ANGULAR	INVERTED
38					
48					

1- Tooth Number

Indications for Extraction: *(tick appropriate)*

TN[1]	PERICO RONITIS	ABSCESS	CARIES	PERIO DONTAL DISEASE	ROOT RESORPTION	ATYPIC FACIAL PAIN	ORAL PATHOLOGY	PROSTHETIC REHAB	PROPHYLACTIC REMOVAL	ORTHODONTIC RX	TOOTH IN FRACTLINE	RADIOTHERAPY
38												
48												

1-Tooth Number

Type of Procedure: Surgical/ Non-surgical. *(Please tick)*

Prophylactic Regimen: Chlorhexidine oral rinse/ Antibiotic. *(Please tick)*

Time Taken for surgery: minutes.

Postoperative Complication: *(tick appropriate)*

TN[1]	NO COMPLICATION	PAIN	SWELLING	TRISMUS	ALVEOLITIS	INFECTION
38						
48						

1- Tooth Number

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