

**Demographic profile, clinical data and
radiographic analysis of patients for third
molar surgery under general anaesthesia at the
Faculty of Dentistry at the University of the
Western Cape**



**UNIVERSITY of the
WESTERN CAPE**

**Mahomed Ridhwaan Goolam Nabee
2614776**

A thesis submitted in partial fulfilment of the requirements for the
degree of MSc in Minor Oral Surgery

**Supervisor: Prof. J. A. Morkel
Co-Supervisor: Dr. D. A. Smit**

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DEDICATION

This thesis is dedicated to my loving parents Mahomed Rauf and Safoora for their sacrifice, guidance, encouragement, motivation and continuous love and support throughout the years.

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DECLARATION

I declare that this dissertation has been completed by me and has not been copied elsewhere. Furthermore, it has not been submitted for any examination or degree at any other University. All sources quoted and used have been marked and acknowledged by complete references.



Mahomed Ridhwaan Goolam Nabee

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LIST OF ABBREVIATIONS

Term	Abbreviation
Cone-beam computed tomography	CBCT
Computer Tomography	CT
Fracture	#
General Anaesthesia	GA
Impaction Type (Classification of Impaction)	ImpType
Inferior alveolar nerve canal	IANC
Local Anaesthesia	LA
Medical History	Md Hx
No sinus approximations	NSA
Not Applicable	N/A
Odds ratio	OR
Oral antral communication	OAC
Orthodontic Treatment	Ortho Rx
Orthopantomogram	OPG
Pantomogram	PAN
Sinus approximation	SA
Standard deviation	SD
Temporomandibular joint	TMJ

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KEY WORDS

- Achondroplasia – Primary retention of teeth is due to a lack of osteoclastic activity which does not provide resorption of the bone overlying the developing teeth
- Benign paroxysmal positional vertigo – Sudden sensation that you are spinning or feeling of spinning inside the head
- Hurler syndrome – Genetic disorder that results in a build-up of glycosaminoglycans due to a deficiency of alpha-Liduronidase
- Iatrogenic damage – Error made by the operating surgeon
- Intra-operative complication – Complications that affect the patient during surgery
- Miscegenation – The interbreeding of people considered to be of different racial types
- Neuropraxia – Peripheral nerve injury classified as a transient conduction block of motor or sensory function without nerve degeneration
- No Sinus Approximation (NSA) – When 2mm or more bone is present between the sinus floor and impacted third molar
- Operating time – Duration from start to finish of the said operation
- Orthopantomogram/Pantomogram – Two-dimensional scanning dental radiograph of the upper and lower jaw
- Oxycephaly – Type of cephalic disorder where the top of the skull is conical due to premature closure of the coronal suture plus any other suture
- Paraesthesia – Pressure or damage on peripheral nerves which results in a “pins and needles” sensation
- Pericoronitis – Inflammation surrounding the soft tissues around the crown of a partially erupted tooth
- Periostitis – Inflammation of the membrane enveloping the bone
- Post-operative complication – Complications that affect the patient after the procedure
- Progeria – Rare genetic disorder where aging symptoms manifest at an early age
- Proximity of root to inferior alveolar nerve canal- Impacted third molars that appeared to be within 2mm or less from the inferior alveolar nerve canal.
- Registrar – Post graduate specialist trainee and registered master’s student in a specialist programme
- Sinus Approximation (SA) – When a thin bone or no bone is present between the impacted third molar and floor of the sinus

- Surgical complication – Any unexpected event in a particular surgical situation that requires additional management beyond that originally planned
- Surgical difficulty – Variables that generally cause the duration of the operation to increase due to a decreased ease in removing third molars

ABSTRACT

Aim

To analyze the demographic profile, clinical data and radiographs of patients who had third molar surgery under general anaesthesia at the Faculty of Dentistry at the University of the Western Cape over a 10 year period.

Introduction

Minor oral surgical procedures are carried out by Maxillofacial and Oral Surgeons daily. The surgical removal of third molars is a large part of Minor Oral Surgery which is common throughout the world. The general impression of third molar surgery performed by experienced professionals is the ease of the operation, however no-matter how experienced one may be, a simple procedure should never be underestimated (Carvalho and Do Egito Vasconcelos, 2011). New surgical techniques, as well as extensive training, skill and experience have led to the evolution of oral surgery and allowed this procedure to be carried out in a less traumatic manner. Certain factors precipitate third molar surgery to be performed in theatre as opposed to the dental clinic setting. These factors will be discussed in this research report.

Materials and Methods

The study was a retrospective record-based study which focussed on patients who presented for third molar surgery at the Department of Maxillofacial and Oral Surgery at Tygerberg Oral Health Centre and who met the inclusion criteria. Theatre records, patient files and radiographs from January 2010 to December 2016 of the respective patients were assessed. A confidential patient database was created, raw data saved on an Excel Spreadsheet and analyses was done using Epi Info 7[®].

Results

There were 1386 third molar surgery cases performed from January 2010 to December 2016. Only 690 cases complied with the inclusion criteria. An average of 198 third molars were

removed under GA annually with majority of the patients being White, female, in their 20's, unemployed with no medical aid and residing in Cape Town. The most common main complaint was pain. The average waiting time for surgery was 24 weeks. More than 67% of patients had all four third molars removed which were done by 19 surgeons with an average of 11 years' experience. 94% of cases were performed by registrars. The most common angulation in the maxilla was disto-angular and the most common position was Position C. In the mandible the most common angulation was mesio-angular and Position B. More than 99% of patients' had third molars roots in close proximity to the inferior alveolar nerve canal. The mean operating time for four third molars was found to be 65.47 minutes. Age and sex of the patient as well as experience of the surgeon affected the duration of surgery. There was a 5% intra-operative complication rate with OAC being the most common. Furthermore, a longer duration of operation was noted when maxillary third molars were bucco-angulated, mesio-angulated or transverse, Class C with SA and mandibular third molars being linguo-angulated, inverted or horizontal, Position C, Class III and roots in close proximity to the inferior alveolar nerve canal. A 20% incidence rate of post-operative complications was found with paraesthesia being the most common.

Discussion

Similar studies on the demographic profile was conducted in different parts of the world. Similarities were found for the mean age (23.87 years) by Carvalho *et al.* (2013) and Jerjes *et al.* (2010). There were similarities (54% Byahatti (2015), 72.5% Carvalho *et al.* (2013)) and differences (66.36% male majority in Pillai *et al.*'s study in 2014) with regards to sex with a predominance of female to male 1:3. The main complaint in this study was recorded as pain (80.43%) which differed from studies wherein pericoronitis was the main complaint (Macluskey *et al.* (2005) and Krishnan *et al.* (2009)). The main indication for GA was related to the classification of the impaction (99.57%) which was similar to Obiechina *et al.* (2001). Susarla and Dodson (2004) reported similar results. Winter (1926) stated that 43% of mandibular impactions were mesio-angular which was similar to the current study with 41.76% of mandibular impactions being mesio-angular. According to Osunde *et al.* (2014) similar results to the current study were found where registrars (56.97%) performed more of the surgeries compared to the specialists (10.6%). The mean operating time in this study was 62.73 minutes which differed significantly with other studies. Benediktsdóttir *et al.* (2004) revealed that 90%

of their operations lasted for 25 minutes or less while only 5% lasted for longer than 31 minutes. In a similar study Phillips *et al.* (2010) determined a mean surgery time of 30 minutes. There was a 20.43% incidence of post-operative complications found in this sample. The most common complication was paraesthesia (28.41%). This was different to the study by Khan *et al.* (2014) where there was a significant difference in the post-operative complication rate (4.5%) and where OAC and dry sockets (5.9%) were the most common.

Conclusion

There is a strong association between the demographic profile of patients and clinical and radiological status that influences third molar surgery under GA at the Faculty of Dentistry at the University of the Western Cape. These factors should therefore definitely play a significant role during the assessment of patients for third molar surgery by all oral surgeons. This study will enable the surgeons, lecturers, supervisors and students of the University of the Western Cape and the other Universities in South Africa to have better understanding of the field of third molar surgery. This should better equip the clinicians in their understanding and management of their patients.

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1. INTRODUCTION

Minor oral surgical procedures are carried out by Maxillofacial and Oral Surgeons daily. Surgical third molar removal is a large part of Minor Oral Surgery which is common throughout the world. The general impression of third molar surgery by experienced professionals is the ease of the operation, however no-matter how experienced one may be, a simple procedure should never be underestimated (Carvalho and Do Egito Vasconcelos, 2011). New surgical techniques, as well as extensive training, skill and experience have led to the evolution of oral surgery and allowed this procedure to be carried out in a less traumatic manner. Certain factors precipitate third molar surgery to be performed in theatre as opposed to the dental clinic setting. These factors will be discussed in this research report.



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2. LITERATURE REVIEW

2.1 HISTORY

Impaction (Latin origin—*Impactus*) is the cessation of eruption of a tooth caused by a physical barrier or ectopic positioning of a tooth. An impacted tooth is a term that is used to describe a tooth that is erupted, partially erupted or un-erupted and does not show signs of eventually assuming a normal arch relationship with other teeth and tissues in the oral cavity (Sanghai and Chatterjee 2009).

Many members of different races exhibit a disproportion between jaw size and tooth size in that they possess jaws which are too small to accommodate their teeth. The third molar is the last tooth to erupt and so it becomes either impacted or displaced if there is insufficient space for it in the arch. The frequency of this occurrence is illustrated by a study that reveals that 65.6% of males with an average age of 19.5 years had one to four embedded third molars equally divided between the four quadrants of the dental arches (Howe 1985).

2.2 AETIOLOGY AND PATHOGENESIS OF THIRD MOLARS

Teeth that present as being impacted have a certain tendency. Usually a specific tooth is more likely to be impacted as opposed to others. The frequency of impacted teeth from most common to least common are: Mandibular 3rd molars, Maxillary 3rd molars, Maxillary canines, Mandibular premolars, Maxillary premolars, Mandibular canines, Maxillary central incisors and lastly Maxillary lateral incisors (Malik 2010).

There are different opinions, theories and ideologies as to why impaction occurs. These theories will be discussed in their respective categories.

2.2.1 Inadequate space in the dental arch for eruption

The first one is the Phylogenic theory which states that due to evolution the human jaw size is becoming smaller and since the third molar teeth are the last to erupt there may not be enough space for it to erupt (Malik 2010).

The Mendelian theory is based on genetic variations. Impacted teeth are a result of the individual receiving a small jaw from one parent and large teeth from the other parent (Malik 2010). According to Nodine and others, the modern diet does not require a decided effort in mastication and so the growth stimulus of the jaws is lost and modern man has impacted teeth (Archer 1985).

2.2.2 Local causes

According to Archer (1985), Malik (2010) and Sanghai and Chatterjee (2009) some of the local causes of impaction include overlying and surrounding bone being too dense, pressure and an irregular position from an adjacent tooth, overlying mucous membrane becoming dense as a result of long standing chronic inflammation, retention or premature loss of primary teeth, shortage of space due to underdeveloped jaws, necrosis of bone due to infection or abscess formation, ankylosis of permanent teeth, ectopic position of a tooth bud, dilaceration of roots and habits involving the tongue or finger.

2.2.3 Systemic causes

According to Archer (1985), Malik (2010), and Sanghai and Chatterjee (2009) the systemic causes of impaction are broken down into prenatal causes such as heredity and miscegenation; postnatal causes like rickets, anaemia, congenital syphilis, tuberculosis, endocrine dysfunctions and malnutrition; rare endocrine disorders including hypothyroidism and achondroplasia and rare hereditary linked disorders such as cleidocranial dysostosis, oxycephaly, progeria, cleft deformities, Down syndrome, Hurler syndrome and osteopetrosis.

2.3 COMPLICATIONS

Infection related to an impaction is as a result of pericoronitis, alveolar abscess, periostitis, osteomyelitis and necrosis of bone (Sanghai and Chatterjee 2009).

Pain can be referred to the distribution centre of the nerve and even the related nerve plexus. Pain can be slight and localized to the tooth or it can be severe and excruciating involving all the lower and upper teeth on the affected side including all the areas supplied by Trigeminal

nerve. This can also include temporal pain. Pain may present as intermittent facial neuralgia (Archer 1985).

Paraesthesia is another condition that can occur. Patients experience a “pins and needles” sensation due to nerve involvement. For example in a case where a dentigerous cyst associated with an impacted third molar can cause impingement on the IANC. However, this is usually rare (Sumer *et al.* 2007).

Pathological fracture of the jaw may occur due to weakening of the jaw secondary to tooth follicles/impactions (Sanghai and Chatterjee 2009).

Trismus is a common occurrence resulting in difficulty in opening the mouth due to infection of the masticator muscles (Sanghai and Chatterjee 2009).

The tooth that is impacted may result in ulcer formation and white patches on the buccal mucosa adjacent to it due to Chronic Cheek Biting (Sanghai and Chatterjee 2009).

Malalignment of other teeth can occur such as mesial migration of the other tooth e.g. 2nd molar is caused by the pressure from mesially impacted 3rd molar (Sanghai and Chatterjee 2009).

Very rare complications associated have been reported such as dimness of vision, blindness, iritis, pain simulating that of glaucoma and TMJ arthralgia (Archer 1985).

2.4 CONTRAINDICATIONS

It is generally accepted that if the potential benefit of a procedure outweighs the potential complications and risks then the operation should be performed. However, if the potential risks and complications are greater than the potential benefits then the procedure should be deferred.

2.4.1 Extremes of Age

Some surgeons are of the opinion that the tooth follicle can be removed between the ages of seven to nine with minimum surgical morbidity. However, most surgeons are not in favour of

this view. The consensus is that very early removal of third molars should be left until an accurate diagnosis of an impaction can be made (Peterson *et al.*, 1998).

On the other end, advanced age poses an even bigger challenge. As the patient ages the bone calcifies significantly and becomes less flexible and is less likely to bend under the influences of tooth extraction. Hence more bone will have to be removed. In addition, post-operative healing takes longer in the elderly patient (Peterson *et al.*, 1998).

According to Peterson *et al.* (1998), in a patient over the age of 40 with a root remnant in place and no signs of pathology such as infection or cystic formation, it will be unlikely that there will be future complications and the procedure to remove it be deferred. Dentists however should monitor it every one to two years. In the elderly coronectomies can be considered.

2.4.2 Compromised medical status

It is suggested that if the patient is immunocompromised and the impacted tooth is asymptomatic, then the procedure should be deferred and the surgeon needs to consult the patient's physician prior to removing the tooth (Peterson *et al.*, 1998).

2.4.3 Probable excessive damage to adjacent structures

Peterson also suggests that if the impacted tooth is asymptomatic and positioned in an area in which removal of it may jeopardize adjacent nerves, teeth, bridges, etc. it may be best to leave it in place. If it becomes symptomatic then the surgeon needs to provide the best care and take special measures to prevent damage to adjacent structures (Peterson *et al.*, 1998).

2.5 DEMOGRAPHICS

Susarla and Dodson (2005) conducted a study where 250 third molars, 53% (being mandibular third molars) were removed from 82 patients via 15 surgeons. 8.8 - 11.1 years was the mean level of surgical experience. Seventy two percent of the patients were white, 27.3% were female and the mean age was 26.2 years. There was an error in estimating surgical difficulty in the

study but several anatomic and demographic variables such as sex, ethnicity and cheek flexibility were statistically significant ($p < 0.05$).

Carvalho and Vasconcelos (2011) conducted a prospective cohort study involving patients that required at least one surgical removal of an impacted lower third molar. 473 surgeries were performed on a total of 285 patients. Variables that could result in surgical difficulty were recorded preoperatively. Two surgeons performed all the surgical procedures under the same conditions. They were not informed about the data collected in the pre-selection phase. Data analysis was done using Fisher's exact test or Pearson's chi-square test. 21.8 years was the mean patient age. Female to male ratio was at 3:1. Females accounted for 75.1% and males at 24.9% respectively. Overweight patients were found to be approximately one in every 5. 49.3% of the surgeries accounted for a relation between the mandibular third molar to the IANC. According to the Pell & Gregory and Winter's classifications, the most frequent tooth positioning was A at 48.4%, Class I at 59.4% and vertical at 49.5%. 73.8% presented with non-bulbous crown morphology. 42.9% of cases presented with a lack of contact between the second and third molars. 57.9% of cases required osteotomy for removal of lower third molars. Significant predictors of surgical difficulty included second molar relation, root number and morphology, periodontal space and tooth position. Non-significant predictors of surgical difficulty included width of third molar crown, gender, patient age, associated pathologies, body mass index and relation with the IANC.

Susarla and Dodson (2013) conducted a prospective cohort study by removing 450 third molars in 150 patients. The index sample which consisted of removing 313 third molars from 100 patients had a mean age of 25.4 years. Of these 67.0% were white and 60.0% were female. The operative, anatomic and demographic variables were recorded. 6.4 – 7.0 minutes was the mean extraction time per tooth. The following were assessed: surgical experience, procedure type, number of teeth extracted, tooth morphology, Winter's classification and third molar location. Between the validation sample and the index sample for any of the study variables, no statistically significant differences were observed. The coefficients of the validation model were similar in magnitude and direction for most variables once compared to the index model. The predicted extraction time compared to the observed extraction time was not significantly different. The teeth were approximately evenly distributed by location and within each dental arch. The following factors resulted in an increase in the extraction time: mandibular teeth at

1.9 minutes, Winter's classification at 1.4 minutes for disto-angular; 0 minutes for vertical; 4.2 minutes for horizontal and 2.8 minutes for mesio-angular and procedure type at 5.6 minutes for full bony impaction; 0 minutes for nonsurgical erupted; 2.8 minutes for soft tissue impacted; 1.4 minutes for surgical erupted; and 4.2 minutes for partial bony impacted. Factors associated with a shorter operating time included: favourable tooth morphology at 5.4 minutes relative to unfavourable morphology, number of teeth extracted at 1.6 minutes per tooth and surgical experience.

2.6 CLINICAL PRESENTATION

According to various studies the prevalence of erupted third molars has changed over time. Rajasuo *et al.* (1993) have reported that during 1949 – 1990, the number of male patients with erupted third molars have decreased. Also, the average age of third molar eruptions may differ among ethnic and racial populations.

Hugoson and Kugelberg (1988) carried out a study on a Scandinavian population to assess the prevalence of third molars. They discovered that 77% of 20 year olds had third molars in sites, while only 32% of 30 year olds had all four third molars. According to Phillips and White (2012) in their study, they found that the reason for removal of third molars were mostly unknown.

In an eight year follow up study by Kruger *et al.* (2001), they found that at a mean age of 26 years fewer mandibular third molars remained unerupted. Disto-angular maxillary third molars were less likely to erupt than third molars with a vertical or mesio-angular angulation while horizontal and mesio-angular mandibular third molars were less likely to erupt. However, the interpretation of the effect of baseline position or angulation of third molars on position eight years later, was complicated by the extraction of approximately one third of third molars during the interval of the study (Phillips and White, 2012).

Cross-sectional studies have suggested that the prevalence of erupted third molars has changed over time. For example, Rajasuo *et al.* (1993) reported that the proportion of male patients with erupted third molars decreased from 1949 to 1990, suggesting that non-contemporaneous studies may not be informative. Other cross-sectional studies have suggested that the average age of eruption of third molars may differ among ethnic/racial populations. Hugoson and

Kugelberg (1988) reported that 20 year olds with four third molars accounted for 77%, whereas only 32% of 30 year olds still had all four third molars. Usually the reason for removal is unknown.

Lack of space due to growth patterns of the jaw results in the failure of third molars erupting to the occlusal plane. The age distribution in the sample study by Phillips *et al.* (2010) revealed that at least 47% of the sample size was 21 years old while 7% of the sample size was more than 30 years old.

A prospective study by Jerjes *et al.* (2010) involved surgical removal of impacted third molars in 3236 patients. Information that was recorded included grade of the treating surgeon and the patients' radiological and demographic parameters. Patients' ages ranged from 17 – 36 years with a mean age of 24.2 years. 49.2 % of the study sample belonged to the 21 to 25-year old age group. 55.3% of the sample size was female. As for the impacted third molars, 79.5% were partially impacted with 34.9% being vertical and 46.9% being mesial. According to the radiograph 78.2% of the teeth were close to the IANC.

2.7 RADIOLOGY

Maxillary and mandibular third molars are classified radiographically by angulation, depth and arch length or relationship to the anterior portion of the ascending mandibular ramus. The classification is helpful because it describes the general position of the impacted third molar and it aids in estimating the difficulty in removing the tooth.

2.7.1 Classification of Impacted Mandibular 3rd Molars

a) Winter's Classification-

This classification is based on the long axis of the impacted 3rd molar in relation to the long axis of the 2nd molar (Winter, 1926).

The classification includes Mesio-angular where the long axis of the impacted tooth is mesially tilted; Vertical such that the long axis of the impacted tooth is vertical; Horizontal

as in the long axis of the impacted tooth is horizontal; Disto-angular where the long axis of the impacted tooth is distally tilted; Bucco-angular displayed by the impacted tooth is erupting buccally; Linguo-angular such that the impacted tooth is erupting lingually and Inverted where the impacted tooth is erupted inverted. Winter noted that 43% of mandibular impactions are mesio-angular.

b) Pell and Gregory Classification

There are 3 parts to this classification:

The first part is based on the space between the 2nd molar and ramus. There are three sub classifications including CLASS I where there is sufficient space between the distal side of the 2nd molar and the anterior border of the ascending ramus for the 3rd molar to erupt; CLASS II where the space between the distal side of the 2nd molar and the anterior border of the ramus is less than the mesio-distal width of the crown of the 3rd molar. This means that bone is covering the distal part of the third molar and CLASS III where due to a total lack of space the third molar is completely embedded in bone (Pell and Gregory, 1933).

The second part is based on the 3rd molar's relative depth including POSITION A where the highest position of the tooth is above or on the same occlusal line; POSITION B where the highest position is above the cervical line of the 2nd molar but below the occlusal line and POSITION C where the highest position of the tooth is below the cervical line of the 2nd molar. The deeper the tooth the more difficult it becomes to remove the impacted molar (Pell and Gregory, 1933).

The third and final part is based on the long axis of the 3rd molar in relation to the long axis of the 2nd molar which is the same as Winter's Classification.

2.7.2 Classification of Impacted Maxillary 3rd Molars

There are three classification types for Maxillary third molars.

The first classification is based on the position. This includes Vertical where the long axis of the tooth is vertical; Disto-angular where the Long axis of the tooth is distally tilted; Mesio-angular where the long axis of the tooth is mesially tilted and transverse where Inverted and horizontal impactions occur; which is rare (Winter, 1926).

The second classification is the Pell and Gregory Classification which is based on the depth). Here we have CLASS A which is when the highest point of the 2nd molar and highest point of the impacted 3rd molar is in line; CLASS B when the highest point of the 3rd molar is between the plane of occlusion and the cervical line and CLASS C when the highest point of the 3rd molar is below the cervical line (Pell and Gregory, 1933).

The third classification is based on relation to the maxillary sinus floor. We either have Sinus Approximation (SA) which is when a thin bone or no bone is present between the impacted 3rd molar and floor of the sinus or we have No SA (NSA) when 2mm or more bone is present between the sinus floor and impacted 3rd molar (Pell and Gregory, 1933).

2.7.3 Orthopantomogram imaging used for the assessment of impacted third molars

A retrospective study was carried out at Sultan Qaboos University Hospital in Muscat, Oman. They investigated the prevalence and pattern of third molar impaction in patients between the ages of 19 and 26 years. Between October 2010 and April 2011 they looked at 1000 Orthopantomograms (OPG). They assessed the level of eruption, angulation, associated pathological conditions and prevalence of third molar impaction. 543 OPG's presented at least one impacted third molar while the total number of impacted third molars amounted to 1128. Mesio-angular impactions at 35% was the most common angulation of impaction while Position (level) A was the most common level in the mandible. There were 388 bilateral impactions with 377 being in the mandible. 18% of impactions had associated pathology (Al – Anqudi *et al.*, 2014).

Pillai *et al.* (2014) conducted a study in India where they evaluated the position of impacted third molars based on Winter's and Pell and Gregory's Classifications. The study took place in Chowdhary hospital during January 2011 to December 2012. 1100 OPG's were selected as part of this retrospective study. 730 male patients while only 370 female patients formed part of the

1100 total sample size. 3910 third molars were either impacted or erupted while 490 were missing. At 41.4% the most common angulation of impaction in the mandible was the vertical position. Mesio-angular fell in second place at 33.3%. In the maxilla the vertical position also presented as the most common at 67.4% while disto-angular was present in 15.2% of the cases. Level A was the most common level of eruption at 43.9%, level B at 34.8 and level C only at 21.3%.

2.7.4 CBCT imaging used for the assessment of impacted third molars

CBCT was first introduced to the United States of America in 2001 (Hatcher, 2010). It was initially developed for angiography and over time its applications have spread to other fields such as radiotherapy guidance, mammography and dentistry (Scarfe and Farman, 2008).

A CBCT is different from a traditional CT scan. A CT scan uses a fan-shaped x-ray beam in a helical progression to acquire individual image slices of the field of view and then stacks the slices to obtain a 3D image. A CBCT acquires 150 to 600 sequential planar projection images of the field of view which is done in a partial or complete arc (Scarfe and Farman, 2008).

According to Hatcher (2010) CBCT is a useful tool for diagnosis and treatment planning in all specialities in dentistry. CBCT is most commonly being used in the assessment for maxillofacial and oral surgery, orthodontics, endodontics, implant dentistry, TMJ imaging, periodontics and forensic dentistry (Scarfe and Farman, 2008). In Oral and Maxillofacial Surgery CBCT's are being used to investigate inflammatory bone lesions, exact three-dimensional location of jaw pathologies (tumours and cysts), impacted teeth, exact location of supernumerary teeth and their relation to vital structures, to demarcate changes in the cortical and trabecular bone in patients with bisphosphonate-associated necrosis of the jaws, evaluate bone grafts, pathologies of paranasal sinuses and to assess obstructive sleep apnoea. In addition, small calcifications are easily identified on a CBCT as opposed to conventional dental imaging which can be important for certain clues in some types of tumours and cysts (Pindborg tumour, Gorlin cyst). It is also instrumental in the evaluation of arch segment positioning, dental age and morphology of the defect in cleft lip and palate patients (Kumar *et al.*, 2015).

Advantages of CBCT include shorter examination time, reduced image unsharpness and distortion and increased tube efficiency. In general CBCT may be cheaper than a hospital CT scan. It is perfect for imaging of the craniofacial structures due to the quality of the contrasting structures and can also provide a three-dimensional volumetric data in axial, sagittal and coronal planes (Kumar *et al.*, 2015). High image accuracy is achieved due to having submillimetre isotropic voxel resolution ranging from 0.076mm to 0.4mm. CBCT's produce a lower radiation dose ranging from 29 to 477 microsieverts. This is 10 times less than a conventional CT scan (Kumar *et al.*, 2015). It also provides unique demonstrating features in 3D that intra-oral, panoramic and cephalometric images cannot achieve (Scarfe and Farman, 2008).

The main disadvantage which is more common with a larger field of view, is limitation in image quality. In addition the following disadvantages occur: X-ray beam artefacts, patient artefacts, scanner artefacts, cone-beam related artefacts and poor soft tissue contrast (Scarfe and Farman, 2008).

According to American Dental Association Council on Scientific Affairs (2012) CBCT should only be used after a thorough medical and clinical examination is completed provided that the diagnostic yield will benefit patient care, improve the clinical outcome significantly and enhance patient safety. In addition, in accordance with the National Council on Radiation Protection & Measurements (NCRP's) Report No. 145 and standard selection criteria for dental radiographs: "Clinicians should perform radiographic imaging, including CBCT, only after professional justification that the potential clinical benefits will outweigh the risks associated with exposure to ionizing radiation." They also advise that CBCT should be considered as an adjunct to standard oral imaging (American Dental Association and U.S. Department of Health and Human Services, 2004). The reason for this is that CBCT produces a radiation dose higher than any other imaging procedures in dentistry (Table 1) and practitioners should abide by the ALARA (As Low As Reasonably Achievable) principle. The basis for this is that the benefit of this diagnostic measure must outweigh the individual detriment radiation exposure. It is also advised that CBCT should not replace standard digital radiography but must be used as a complementary modality for specific applications (Scarfe and Farman, 2008). According to Jaju and Jaju (2015) we need to move from the principle of ALARA to ALADA. This means setting a new goal of "As Low As Diagnostically Acceptable". Bhatia and Kohli (2016) reiterate that clinicians need

to respect their ethical obligation to protect their patients and CBCT should not be used for screening purposes.

IMAGING TECHNIQUE	Dosage (µSv)
Conventional Radiography	
Four-image posterior bitewings	5.0
PAN	3.0 – 24.3
Cephalograph	5.1 – 5.6
Full Mouth Radiographs	34.9 – 170.7
CBCT	
Dentoalveolar (small to medium field of view)	11 – 674
Maxillo-Facial (large field of view)	30 – 1073

Table 1: Effective dose estimates for conventional dental radiographs vs. CBCT (American Dental Association Council on Scientific Affairs, 2012)

Neves *et al.* (2012) assessed PAN's and CBCT images of 72 patients (142 mandibular third molars) before extraction of the mandibular third molars. An attempt was made to assess the presence or absence of corticalisation between the mandibular third molar and the mandibular canal on PAN's and CBCT images. It was observed that absence of corticalisation between the mandibular third molar and the mandibular canal on CBCT images were statistically significant, both as isolated findings ($p = 0.0001$ and $p = 0.0006$, respectively) and in association ($p = 0.002$). However, there was no statistically significant association with regards to the PAN's either individually or in association ($p > 0.05$). It was concluded that PAN imaging is in fact an effective method for pre-operative assessment of mandibular third molars. The signs observed on PAN's are effective in determining the risk relationship between the roots and the mandibular canal.

Szalma *et al.* (2011) and Nakamori *et al.* (2008) conducted studies which investigated the presence of two or more signs on a PAN and association with an increased risk of IANC exposure or injury. Jhamb *et al.* (2009) and Szalma *et al.* (2011) have discovered that the absence of corticalisation between the tooth roots and the mandibular canal on spiral CT images and IANC exposure are only significantly associated with some PAN signs (darkening of roots and interruption of the white line). According to Monaco *et al.* (2004) three dimensional imaging should only be carried out when darkening of the roots, narrowing of the mandibular canal and interruption of the white line are observed on a PAN. Matzen and Wenzel (2015) conclude from their research that PANs are sufficient in most cases before removal of mandibular third molars. However, CBCT can be used when one or more signs appear on the conventional radiograph which suggest a close contact between the tooth and the IANC.

2.7.5 Radiological assessment of proximity of mandibular third molar roots to the Inferior alveolar nerve canal

A study was conducted by Deshpande *et al.* (2013) to assess the radiographic proximity of impacted mandibular third molars to the inferior alveolar canal on panoramic radiographs. They radiographic distance between the impacted mandibular third molars and IANC was measured. Reliable radiographic risk predictor signs that indicate close proximity between the two structures were taken into account. 68 symptomatic impacted mandibular third molars arising from 64 subjects were evaluated. The following were interpreted from the radiographs: one or more of the seven radiographic risk predictor signs, radiographic distance between the impacted mandibular third molars to the IANC and the type of impaction. In addition, the proximity was assessed also based on the exposure of the IANC after all these teeth were surgically removed. 0.50mm was calculated as the overall mean distance from the IANC to the impacted mandibular third molars. 1.40mm was calculated as the mean distance for 61.8 % of the samples which extended beyond the superior border of the IANC. 1.14mm was calculated as the distance for mesio-angular impactions to the IANC. The only statistically significant radiographic risk predictor sign was the interruption of the white line. This indicated close proximity of the IANC to the impacted mandibular third molars.

Another study was conducted to evaluate the topographic relationship between the roots of impacted mandibular third molars to the IANC. The study conducted by Byahatti (2015) at the

Department of Oral Medicine and Radiology, Maratha Mandals NG Halgekar College of Dental Sciences and Research Centre, Belgaum, Karnataka, India. It involved 100 patients consisting of 54 female and 46 male patients visiting the outpatient department between the age group of 18 and 50 years. The study included only those patients who had a full set of dentition clinically. No cases with history of extraction or agenesis cases were included in the study. Pre-operative PAN's were taken and examined and the proximity of the IANC to the roots of impacted mandibular third molars was divided into the following groups: notching, perforation, adjacent, grooving and superimposition or none. The true relationship between the IANC and the root apices were founded on the three groups namely grooving, notching and perforation. Additional aspects noted included sex and age of the patient and the type of impaction. Mesio-angular impactions were the most frequent impaction at 49% of the total sample. 3% were classified as aberrant. Impactions were most common in the 18 – 30 year old groups. From the radiographs the position of the IANC showed that 25% of teeth were of superimposition and 15% of teeth were of perforating categories in relation to the canal. The relationship between the angular positions of the mandibular third molars to the IANC was found to be more common at 49% in mesio-angular impactions. Byahatti (2015) found that the relationship between the roots of the impacted third molars to the position of the IANC varied according to the patient's age.

2.7.6 Radiological assessment of proximity of maxillary third molar roots to the maxillary sinus

Demirtas and Harorli (2015) investigated the relationship and position of the maxillary third molars to the maxillary sinus. They made use of panoramic images and cone-beam computed tomography (CBCT) for 162 impacted third molars in 100 patients. Angulation and depth of the third molars, proximity of the roots to the sinus and the horizontal and vertical positions of the maxillary sinus relative to the maxillary third molars were assessed using CBCT images. Based on Winter's classification for impacted maxillary third molars, vertically impacted third molars accounted for 59.9 %, followed by mesio-angular at 14.2 % and disto-angular at 9.9 %. Most of the impacted teeth were Class B according to the Pell and Gregory's Classification. According to CBCT the depicted relationship of the maxillary sinus with the maxillary third molars, horizontal type 2 (maxillary sinus located between roots) accounted for 64.8 % whereas vertical type III (buccal root related with maxillary sinus) amounted to 34% of impactions.

Another study was conducted which made use of panoramic radiography and CBCT to investigate maxillary third molars and their relation to the maxillary sinus. Jung and Cho (2015) investigated 234 patients and a total of 395 maxillary third molars. The following was examined: the relationship between the sinus and the roots, the number of roots, the relationship to the second molars, the angulation, available retromolar space and the eruption level of the maxillary third molars. They found that females had a higher incidence of maxillary third molars with occlusal planes above the cervical line of the second molar compared to males. Class C accounted for all third molars with insufficient retromolar space. With regards to the angulation, vertical was found to be the most common with bucco-angular coming in second. Almost all the third molars that were grouped as part of Class C made contact with the roots of the second molar. Three roots were found to be the most common in erupted teeth while one single root was most common in impacted teeth. If the sinus floor was located on the buccal side of the root, it resulted in the superimposition of one third of the root over it. This was confirmed by CBCT images which displayed expansion of the sinus to the buccal side of the root. With each gender, eruption levels varied. The relationship between the available retromolar space and eruption level was statistically significant.

2.8 THIRD MOLAR SURGERY

The following formation supplied by Fonseca, Barber and Matheson (2009) can be used as a basic guide for the surgical removal of third molars.

The mucoperiosteal flap is raised to obtain good visual access. The labial bone is then removed using a high-speed surgical drill with a round or crosscut bur. The crown is exposed up to the cemento-enamel junction and room is made to allow an elevator in. The surgeon then attempts to gently elevate for mobility.

If the impacted tooth still cannot be removed by elevation then the crown is sectioned either horizontally or vertically depending on the type of impaction using a high-speed surgical drill. A straight elevator is used to separate the crown from the tooth. The roots are delivered with root tip elevators. If no mobility is present then additional superior and labial bone needs to be removed. The roots can also be sectioned if necessary.

The bony socket is inspected for loose debris and any bleeding problems. Bony margins can be smoothed off with a bone file. Follicular soft tissue must be then removed. Copious irrigation of the socket is then needed. Tissue edges should be re-approximated and closed with a suture thread.

Optionally it is suggested that the surgeon can inject the masseter with 4mg of dexamethasone to prevent excessive post-operative swelling, especially if extensive bone surgery was done. Before the patient is discharged post-surgical bleeding needs to be assessed.

2.8.1 Indications for removal of third molars

A Consensus Development Conference on removal of third molars was held at the National Institute of Dental Research, (National Institute of Health) in 1979. More than 200 practicing dentists and scientists reached an agreement on three issues: “There are well defined criteria for mandibular third molar removal: infection, non-restorable carious lesion, cyst, tumour and destruction of adjacent bone and tooth; it was agreed that reduced morbidity resulted from extraction in younger patients than those did in advanced adulthood; and current predictive growth studies were not sufficiently accurate to form a basis on which clinical action could be justified” (NIH Consensus Development Conference for removal of third molars, 1980).

In addition, the following indications for third molar removal has also been indicated: lack of space in the posterior part of the alveolus, pain of an unknown aetiology, pre-irradiation removals and when posterior retraction is considered during orthodontic treatment (Van der Linden *et al.* 1993).

Song *et al.* (1997) documents: “In the absence of good evidence to support prophylactic removal there appears to be little justification for the removal of pathology free third molars. However, Goodsell (1977) claimed that more second molars are lost due to third molar being left in place, than for any other reason. In addition the view of SASMFOS (1999) is that asymptomatic does not necessarily mean pathology free. A highly carious tooth can be asymptomatic but not pathology free. Shafer *et al.* (1974) classify impacted teeth as “A developmental disturbance of the oral and para-oral structures and is therefore a developmental pathologic condition”.

The National Institute for Health and Clinical Excellence (NICE) in March 2000 issued a statement to the National Health Service (NHS) what they deemed appropriate for removal of third molars. NICE suggested that prophylactic removal of pathology-free impacted third molars should no longer take place in the NHS. One of the motivation were to reduce the rate of unnecessary postoperative complications as a result of third molars being prophylactically removed. With this being said, to date, there is no evidence based study that shows a correlation between prophylactic removal of third molars and a higher complication rate.

The Royal College of Surgeons of England stated: “It is unreasonable to remove pathology-free impacted third molars in the absence of good evidence to support prophylactic surgery”. However the American Guidelines, American Association of Oral and Maxillofacial Surgeons and Scottish Royal College of Physicians of Edinburgh say that third molars can be prophylactically removed but each case should be assessed individually and the surgeon needs to decide if the benefit outweighs the risks. This must be thoroughly done to ensure that if post-operative complications arise he/she must be able to get away litigation free (Jerjes *et al.* 2010).

The South African Society of Maxillo-Facial and Oral Surgeons (SASMFOS) supports the American Association of Oral and Maxillofacial Surgeons (AAOMS) in a policy statement that “firmly supports the surgical management of erupted and impacted third molar teeth (wisdom teeth), even if the teeth are asymptomatic, if there is a presence or reasonable potential that pathology may occur, caused by or related to the third molar teeth (wisdom teeth)” (SASMFOS, 2012).

The final recommendation as per SASMFOS (2012) is that it is good practice and in the best interest of the patient to remove an impacted third molar when the roots are no more than two thirds formed; when a high probability of disease or pathology exists and when risks associated with early removal are less than the anticipated risks of removal later on. It is also advisable to remove other remaining impacted third molars even if they are “pathology free” if the procedure is being done under GA. In older patients completely embedded impacted third molars could be left in situ and monitored and reassessed regularly. The choice of pain, anxiety control and mode of anaesthesia can be made jointly by the patient and the clinician with the clinician providing the patient with guidance on the best option.

2.8.2 Indications for performing third molar surgery under GA

In the year 2002 between June and August at the Massachusetts General Hospital Oral and Maxillofacial Surgery Unit, 82 patients were selected for a study. The aim of the study was to measure the difficulty of third molar extractions and to identify demographic, anatomic and operative variables associated with extraction difficulty. The sample consisted of patients between the ages of 15 – 65 years old with a mean age of 26.2. 72.0% of the patients were white and females totalled 57.3%. 6.9 - 7.6 minutes was the average extraction time and each subject had an average of 3.1 third molars removed. The surgeons' years of experience ranged from 7 – 36 years with a mean surgical experience of 8.8 - 11.1 years. The teeth were approximately evenly distributed by dental arch and position. Due to the expected difficulty of the operation GA was selected. Indications for using non-office-based ambulatory anaesthesia are plenty. Co-morbid conditions, patient preference and obesity or airway compromise are common indications for using the operating room (Susarla and Dodson, 2004).

Macluskey, *et al.* (2005) performed a prospective study at a specialist surgical dentistry practice and dental teaching hospital in 2003. Pre and post-operatively a pro-forma was completed. The aim of the study was to investigate the indications for and anticipated difficulty of third molar surgery between two different referral settings. Patients that were referred for third molar surgery were signed up. Radiographical and clinical assessment was recorded pre-operatively for each patient. Also the extent of surgery required was noted post-operatively. It was discovered that pericoronitis was the main indication in the referral of third molar removal in both centres.

2.8.3 Duration of third molar surgery

The duration of the operation is dependent on several variables. Some of the variables that affected operation time noted by Susarla and Dodson (2013), were demographic factors such as ethnicity, age, gender and race. Anatomic factors such as Winter's and Pell & Gregory Classifications, mouth opening, body mass index, position of the crown, cheek flexibility, morphology of the crown and roots and position of the roots also contributed to the duration of the operation. Furthermore, operative factors whether the procedure was actually surgical or

not, the number of teeth extracted and the experience of the surgeon would also determine the duration of the operation.

Factors associated with a shorter operating time were found to be a favourable tooth morphology (5.4 minutes relative to unfavourable morphology), number of teeth extracted (1.6 minutes/tooth), and surgical experience (Susarla and Dodson, 2013).

Benediktsdóttir *et al.* (2004) claimed that the operating time was related to factors such as the experience of the surgeon, tooth position and severity of the impaction.

2.8.4 Factors associated with surgical difficulty

Akadiri and Obiechina (2009) recorded that demographic, radiographic, and surgical variables were strongly associated with surgical difficulty. Previously no other studies were conducted which assessed associations among preoperative factors, surgical difficulties and complications. In a study by Nakagawa *et al.* (2007) it was found that patients' gender propagation was 3:1 female to male. In studies by Gbotolorun *et al.* (2007) and Carvalho and Do Egito Vasconcelos (2011) sex was not a significant factor in determining surgical difficulty. However, Renton *et al.* (2001) reported sex as a significant factor in determining the operative duration. In a univariate analysis males were associated with a longer duration of surgery while in a multivariate analysis sex was not a significant factor. Males were reported to be associated with an increased difficulty of extraction due to increased bone density. They found females were more likely to experience post-operative complications.

Age has been associated as the most consistent factor in the determination of surgical difficulty by many authors. This is due to the differences in bone density associated with age. Although bone density is a factor, a higher rate of complications among patients over 25 years old (29%) vs. younger patients at 18.3% were found. The latter was related to complete root formation in the third molars in the older patients (Carvalho and Do Egito Vasconcelos, 2011).

In a study by Benediktsdóttir *et al.* (2004) older patients had a two times higher risk for a longer operating time when compared to younger patients. Postoperative pain and paraesthesia has also been linked to older patients. Benediktsdóttir *et al.* (2004) assessed radiographic images alone

and found three variables that would increase operating time. These included: with an odds ratio of 2.33; $p = 0.014$ a horizontally positioned third molar would result in the operation time being longer than if it was vertical; with an odds ratio of 2.01; $p = 0.014$ if two roots were present in the third molar there was a risk of a longer operating time compared to it having one root; and with an odds ratio of 2.09; $p = 0.003$ if the third molar was in close relation to the IANC it was at a higher risk of a longer operating time.

One of the most difficult teeth to remove is those with complete and divergent roots. These teeth are usually sectioned before any mobility occurs. If the teeth were sectioned it reduces the retention areas of the tooth and also preserves bone in the area. Carvalho and Do Egito Vasconcelos (2011) discovered that surgical difficulty was also associated with a greater space between the second molar and wisdom tooth. Contact with just the root or with the crown & root and ankylosis required greater surgery time due to extra sectioning procedures. According to Kruger *et al.* (2001) impacted third molars that were vertical, fully erupted and visible in the mouth were surgically easier to remove than those that were horizontally impacted (Table 2).

Position	Angulation
Fully erupted, fully visible in mouth	Vertical
Not impacted	Mesio-angular
Impacted (Winter's Class.)	Horizontal

Table 2: Tooth position vs. Angulation according to Kruger *et al.* (2001)

The Carvalho and Do Egito Vasconcelos's (2011) study corroborated the findings of a previous study which indicated that crown morphology did not have a significant association with surgical difficulty. They also noted that due to the limited root development, a tooth rotated around its axis, which then required sectioning involved a surgical time greater than 30 minutes.

Akadiri *et al.* (2009) reported that demographic, radiographic, and surgical variables were strongly associated with surgical difficulty. 3:1 was the gender proportion of female to male.

In addition, age and related differences in bone density when ageing, was associated to surgical difficulty. Age can then also contribute to a higher rate of complications. In addition, complete root formation is a factor in older patients. In this study there were 29.0% of complications in older patients vs. 18.3% of complications in younger patients. More complications were found in patients over 25 years of age.

At the Oral and Maxillofacial Surgery Unit, University of Pernambuco in Brazil Carvalho *et al.* (2013) conducted a prospective cohort study. Patients who needed the removal of at least one maxillary third molar surgically were recruited. 204 surgeries were performed on 106 patients. Proportion of women to men was 3:1 with women totalling 72.5% and men 27.5%. The patients' mean age was 22.8 years. Overweight patients accounted for about 20%. Surgical difficulty predictor variables included: radiographic aspects, clinical and demographic. Based on the surgical technique the degree of surgical difficulty was categorized from low, moderate to high. Low surgical difficulty was encountered at 55.9% when just the use of an elevator was used to remove the maxillary third molar. 40.2% required use of an elevator and osteotomy which resulted in a moderate degree of difficulty. 3.9% of cases were a high degree of difficulty that required the use of an elevator, osteotomy, and tooth sectioning. The high degree of surgical difficulty was found in five variables. Almost all patients (98 patients) had bilateral extractions done but each procedure was done at different times. 52.0% of patients presented with maxillary third molars with one fused root, 97.1% had a radiolucent periodontal space, 92% had a non-dilacerated root and 92% had no associated pathologies. More than three quarters (78.4%) of procedures had a relation between the maxillary sinus and the maxillary third molars. Almost three quarters (76.5%) of tooth positions were vertical according to Winter's Classification. The majority (79.4%) of crowns were non-bulbous. In the majority (71.6%) of cases, contact was found between the second and third molars. 6.58 minutes was the mean surgery time. Low degree of surgical difficulty was also found in lower third molars. The findings of this study showed that sex was not a determinant of surgical difficulty. Age was a determinant for surgical difficulty for surgical removal of lower third molars due to the increase in bone density but the results of this study showed that in maxillary third molars, age did not play a part in surgical difficulty.

2.8.5 Root Morphology

According to Peterson *et al.* (1998) the degree of surgical difficulty definitely has a correlation to root morphology. They stated that the perfect time to remove an impacted tooth was when the roots were between one to two thirds formed. This was because the roots were blunt and then almost never fractured. If the entire length of the root was developed, there was a higher possibility of root fracture. If the root was less than one third complete it made it difficult to remove because it tended to roll in its crypt.

Divergent roots are much more difficult to remove than fused conical roots. Severely dilacerated roots were more difficult to remove than slightly curved roots. The direction in which a root is curved also plays a significant role. For example, if a tooth is mesially impacted and the roots curve distally it can be removed easily without fracture. However if the tooth is mesially impacted and the roots curve mesially, there was a very high chance of fracture.

In further stated that the wider the periodontal ligament space, the easier it was to remove a tooth; the narrower the more difficult (Peterson *et al.*, 1998).

2.8.6 Experience versus complication rate in third molar surgery

Three qualified maxillofacial and oral surgeons and four maxillofacial and oral surgery registrars carried out surgical procedures on 1087 patients. They recorded the following variables: post-operative complications, operating time, treating surgeon, radiographic position of third molars, patients' gender and age. The study concluded that the complications encountered by the registrars were: infection, trismus, alveolar osteitis and nerve paraesthesia, while post-operative bleeding was the main complication amongst the specialists. The mean age of patients' was 23.3 years. Impacted third molars that appeared to be within 2mm or less from the IANC amounted to 77.6% of cases. 18 minutes was the mean surgery time. Half of the sample (52.3%) were treated by the specialists. 16.2% of the fully impacted teeth were removed by the specialists while 80.1% of the teeth close to the IANC were removed by the registrars. Specialists exhibited a higher degree of surgical experience as they encountered fewer complications compared to the registrars (Jerjes *et al.* 2006).

2.9 GENERAL ANAESTHESIA

2.9.1 Theatre planning for overweight patients

Every hospital needs to have a special team in place to manage overweight patients. This team must consist of a theatre staff member and a named consultant anaesthetist that has experience in managing overweight patients.

In the first world countries, an increasing number of obese patients present for surgery. This requires special handling and equipment and most importantly, consideration. It is also highly imperative to distinguish the difference in patients regarding large vs. being overweight.

The choice of anaesthetic technique, pre-operative assessment and preparation, the availability of the equipment, patient positioning and handling and post-operative care need to be completed prior to the patient arriving to theatre. An exit strategy needs to be in place as well which may entail not performing the operation or changing the anaesthetic technique (The association of Anaesthetists of Great Britain and Ireland, 2007).

2.9.2 Complications from third molar surgery under GA

Complications such as iatrogenic damage to adjacent teeth, nerve damage, pain, haemorrhage, jaw fracture and trismus can arise during surgical removal of wisdom teeth. Removal of mandibular third molars account for more severe complications than removal of maxillary third molars (Benediktsdóttir *et al.*, 2004). A definition that is proposed is that a surgical complication is any unexpected event in a particular surgical situation that requires additional management beyond that was originally planned (Carvalho and Do Egito Vasconcelos, 2011). These complications are usually explained to the patient when informed consent is taken. During this informed consent procedure, the information given to the patient regarding complications, operation time, post-operative pain, swelling, paraesthesia, trismus, damage to adjacent teeth, soft tissue trauma, infection, ulcer formation and jaw fracture should be explained properly (Benediktsdóttir *et al.*, 2004).

According to Benediktsdóttir *et al.* (2004) tooth-related factors were linked to postoperative complications such as mesio-horizontal position of the tooth, deep impaction, and pericoronitis which all may lead to extended operating time. Hence if any of the above complications were likely to arise, it was found that this would extend the operating time as the surgeon would be more cautious in his approach (Pitak-Arnnop and Pusch, 2011).

A greater chance for the above mentioned complications to occur usually took place when the preoperative assessment was done incorrectly. This led to difficulties and complications during surgery that then led to longer theatre time. Surgical complication furthermore led to loss of workdays, loss of productivity, several postoperative sessions, as well as a possible lawsuit. On the other hand, according to Carvalho and Do Egito Vasconcelos (2011) the evidence-based approach is a challenging task because many of the studies that addressed this topic were merely based on opinions and were retrospective studies. It was suggested that surgeons should try their best to plan and perform surgical procedures based on scientific evidence.

According to Brauer *et al.* (2013) there are numerous studies, which identify risk factors for intra-operative and postoperative complications. Studies that reviewed permanent inferior alveolar, lingual nerve damage and mandibular fractures during and after third molar removal are numerous. All of these complications were considered major. Furthermore, there were single case reports that describe extreme events, such as asphyxial death caused by post-extraction haematoma, life threatening haemorrhage, herpes zoster syndrome, subcutaneous and tissue space emphysema, benign paroxysmal positional vertigo, and subdural emphysema.

A retrospective study was done by Sigron *et al.* (2014) which analysed the influence of different parameters, such as the radiological projection using PAN's of wisdom teeth on the mandibular canal, patients' gender, age, postoperative complications and retention type. 1199 third molars were removed. Complications that occurred totalled 101. This included one fistula, one haematoma, four sequestra, five post-operative bleeding cases, seven dehiscence, 12 temporary & six persistent sensation disorders, 15 abscesses and 50 alveolar osteitis cases. No correlation was found for the patients' age and gender. Alveolar osteitis was higher in females than males and was higher in those who had a previous pericoronal infection. Alveolar osteitis was not influenced by smoking. There was a significant correlation between the radiological projection of the roots of the impacted third molars and sensation disorders.

2.10 CONCLUSION

Surgeons should base their protocols on scientific evidence and consider all evidence based aspects when estimating the degree of surgical difficulty of each case and hence the operation time.



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3. AIM OF STUDY

To analyse the demographic profile, clinical data and radiographs of patients who had third molar surgery under GA at the Faculty of Dentistry at the University of the Western Cape over a 10 year period.

4. OBJECTIVES

The objectives were:

1. To determine the demographic profile of the patients i.e. age, gender, race, employment status, travelling distance, socio-economic status
2. To determine the indications for third molar surgery for GA
3. To determine the waiting period of the surgical waiting list
4. To describe the radiographs regarding third molar position and difficulty
5. To determine the experience level of the operating surgeon
6. To ascertain the incidence of post-operative complications

5. MATERIALS AND METHODS

5.1 STUDY DESIGN

This was a retrospective record-based study which focussed on patients who presented for third molar surgery at the Department of Maxillofacial and Oral Surgery at Tygerberg Oral Health Centre.

5.2 STUDY POPULATION AND LOCATION

This study comprised of patients who attended the Tygerberg Oral Health Centre for removal of third molars that met the inclusion criteria. The theatre records for these cases were available and present at the study site, Department of Maxillo-Facial and Oral Surgery, Tygerberg Oral Health Centre. However, attempting to acquire the patient files proved challenging. While some of the files from the year 2010 could be accessed, most of the files had already been moved to archives. It proved fruitless acquiring files of patients whose theatre dates occurred prior to 2010. Thus, the study focused on patients who had third molars removed in theatre from January 2010 to December 2016. In this period, 2416 third molars were surgically removed in 690 patients.

5.3 SELECTION CRITERIA

The following criteria were set in determining whether a person may or may not be included in the study:

5.3.1 Inclusion Criteria:

- Patients who had third molars removed under GA
- Patients with clinical records that include relevant clinical data, radiological and surgical records
- Primary operation was third molar surgery

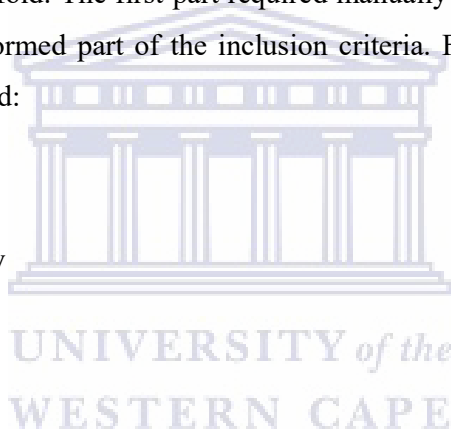
5.3.2 Exclusion Criteria

- Removal of third molars that were done secondary to the main operation (e.g. orthognathic surgery, traumatology, reconstructive or oncological surgery).
- Removal of multiple teeth including third molars.
- Incomplete records
- Any other surgical procedure that was done in addition to the third molar surgery e.g. enucleation, cosmetic surgery and other.

5.4 DATA COLLECTION

The raw data collected from this study was recorded on Microsoft Excel (Appendix 1). Collection of data was two-fold. The first part required manually assessing the theatre records to locate those cases that formed part of the inclusion criteria. From the theatre records, the following data were recorded:

- Date of operation
- File number
- “Clinicom” Category
- Name of patient
- Sex
- Age
- Surgeon
- Tooth number surgically removed
- Duration of operation



Date of the operation was recorded to determine how many cases per year were performed. The file number was necessary in order to extract the files from the records for further analysis. Clinicom category is a classification system for patients as a determination of fees used by the State hospitals in South Africa. This classification is divided in five categories namely: H0, H1, H2, H3 and P (medical aid). Patients are either full paying, subsidised or free. Patients categorized as H0 are fully subsidized. This includes social pensioners (old age, child support, veteran’s pension, care dependency, pension for the blind, family allowance, maintenance grant, disability grant and single care grant), formerly unemployed or persons classified as H0. The

default classification for a person without an income is H1. Unless proof of status is produced a patient is classified as H1 to H3 depending on their income (Gilbert, 2002). Sex and age formed part of the demographic analysis. Name of the patient remained confidential but was recorded to correlate with the file numbers. The surgeon's name also remained confidential but was recorded to determine between the registrar and specialist. Tooth number and duration of operation (in minutes) were also recorded.

The second part of the data collection involved manually extracting the files from the records department. Thereafter each file was individually examined in order to assess if all the necessary records were present. Files with incomplete records were not included in the study. The following data from the files were recorded:

- Patient's weight
- Race
- Referred or not
- Referring practitioner
- Employment status
- Employment type
- Income
- Marital status
- Geographic location
- Sub district
- Medical aid status
- Medical aid type
- Main complaint
- Tooth number
- Radiograph present in the file
- Medical/health status of the patient
- Allergies
- Medical history
- Waiting time for operation from the first date of consult
- Indications for GA

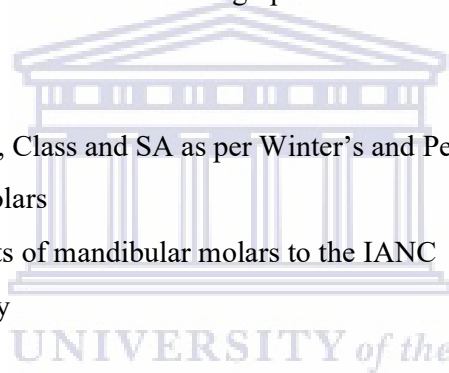


- Intra-operative complications
- Post-operative complications

The following categories formed part of the demographic analysis: Race, referred or not, employment status and income (South African Rand), marital status, geographic location and medical aid status. Clinical data included main complaint, tooth number, medical status and history of the patient, waiting time for the operation (weeks), indications for GA, intra-op complications and post-op complications.

Radiographic analysis was done using PAN's which were in the patients' files. No other radiograph views were used. If the PAN was not present in the file, the file would be disregarded. In addition, both analogue and digital PAN's were used. The analogue radiographs examined were observed on a bright and illuminated radiograph view box. The following factors from the radiographs were assessed:

- Angulation, Position, Class and SA as per Winter's and Pell & Gregory's Classification of Impacted third molars
- Proximity of the roots of mandibular molars to the IANC
- Associated Pathology



With specific reference to the above criteria on classifying the impaction from the radiographs the principal investigator was calibrated against Prof J. A. Morkel (Supervisor and Head of the Maxillofacial and Oral Surgery Department).

In addition, the following columns were added to the Microsoft Excel Spreadsheet:

- Age category one – Age category seven
- Weight category one – Weight category five
- In/out of Cape Town
- Registrar study year
- Junior/senior registrar
- Years of experience of the surgeon
- Registrar/specialist
- Jaw

- Upper right, upper left, lower left, lower right
- Distance travelled from home
- One Class III, Two Class III
- One Class II, Two Class II
- One Class I, Two Class I
- Post-op complications OAC vs. Nerve Injury

The categories labelled one to seven were used to identify in which age category patients would present. As an example age category two includes patients from ages 20 to 29. The weight categories are similar to the age categories. The weight of the patients was grouped into five categories namely: 30 – 49kg, 50 – 69kg, 70 – 89kg, 90 – 109kg, 110 – 134kg. In/out of Cape Town was used to determine if the patients reside in Cape Town or out of Cape Town. The registrar study year was obtained from the Head of Department. This was used as a guide in determining how far the registrar was with their traineeship. Registrars were further subcategorised as Junior or Senior. A junior registrar would be anywhere between his first to third year of study. A registrar would be considered senior in his fourth and fifth year of study. The HPCSA register which is obtainable online (HPCSA, 2017) was used in order to obtain how many years of experienced the surgeon had. Number of years of experience was calculated from the date of qualification of the surgeon with his Dental Degree to the year that the operation was performed. Surgeons were also categorized as either a registrar or specialist. The column indicated as “Jaw” was used to mark each patient wherein the operation was performed on one jaw or both jaws. The columns of upper right, upper left, lower left and lower right indicating tooth numbers 18, 28, 38 and 48 (FDI tooth numbering system) was used to mark which teeth was surgically removed for every respective patient. Google maps online (Google, 2017) was used to calculate the distance that the patient travelled from home to Tygerberg Oral Health Centre. The categories of One Class III, Two Class III, One Class II, Two Class II, One Class I, and Two Class I was added to indicate if the patient presented with either one or two of the respective classification regarding Class of the lower molars. This would be vital when compared to duration of operation and post-operative complications. Post-operative complications OAC vs. Nerve Injury was added in to compare which post-operative complications between OAC’s and Nerve Injuries were higher.

In addition to manually typing in all the raw data into the spreadsheet, a database of each individual patient's records was created. This involved the principal investigator digitally capturing the records and storing it electronically. Each patient's records were collected and stored in individual folders.

5.5 DATA MANAGEMENT AND ANALYSIS

Data was collected and saved on Microsoft Excel. The data was analysed using Epi Info 7[®]. Radiographs were assessed on a light illuminated view box and readings were recorded on the same Microsoft Excel Spreadsheet. To simplify and easily understand the recordings certain analyses were plotted on graphs and tables.

5.6 ETHICAL CONSIDERATIONS

The research proposal was submitted to the Biomedical Research Ethics Committee for approval on 07 October 2016 (Reference – DENRC 2016/04 Page 159 – 213).

Ethics approval was granted on 24 November 2016 at the Senate Research Ethics Committee Meeting (Project Registration Number: BM/16/5/5).

Prior to commencement of the study permission was obtained from the Maxillofacial and Oral Surgery theatre and the Supervisor at the Records Department on B-Floor.

Patient and surgeon identifiable data were used in the original datasheet to ensure and confirm patient records were true. However, this information was safely collected and secured on a password-protected computer with only exclusive access to the principal investigator. All personal identifiers were changed when the data were published. Anonymity was secured by not publishing or releasing any of the personal and private information.

5.7 COST OF STUDY

All costs involved with the study were the sole responsibility of the principal investigator.

5.8 OUTCOMES AND SIGNIFICANCE

The outcomes of this study was aimed to give a better understanding of the demographic information of patients that presented for third molar surgery. By assessing the demographics of the patients and indications for third molar surgery under GA, these were compared with previous studies conducted. This study would enable the lecturers, supervisors and students to create a better understanding in the field of third molar surgery. This would better equip the clinicians in perfecting their skills and better managing their patients.

5.9 DECLARATION OF INTEREST

The researcher had no associative or commercial interest that represented a conflict of interest in connection with this study.



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6. RESULTS

This study involved assessing and investigating patient files and theatre records of those patients that presented for third molar surgery at the Department of Maxillo-Facial and Oral Surgery, Tygerberg Oral Health Centre. There were 1386 third molar surgery cases performed from January 2010 to December 2016. The total number of cases/year are depicted in Table 3.

Year	No. of cases
2010	203
2011	239
2012	197
2013	234
2014	143
2015	178
2016	192



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Table 3: Third molar surgery cases under GA performed from 2010 - 2016

Taking the exclusion criteria into consideration 415 files were excluded from this study. From the balance of the 971 cases a total of 281 cases were also excluded for varying reasons (archived files, invalid file numbers, files on loan to other departments and files located at Mitchells Plain Oral Health Centre). A total of 690 cases formed the backbone of this study. All the 690 cases were accurately documented and captured for analysis.

6.1 DEMOGRAPHIC PROFILE

6.1.1 Age

The ages of patients included in this study ranged from 14 – 72 years old. The mean age of the sample was 23.87 years (SD = 6.99). Almost two thirds (60.43%) of the patients were between

the ages of 20 to 29 years old while a quarter (24.20%) were between the ages of 14 to 19 years old. A breakdown of the age categories in the entire sample is depicted in Figure 1.

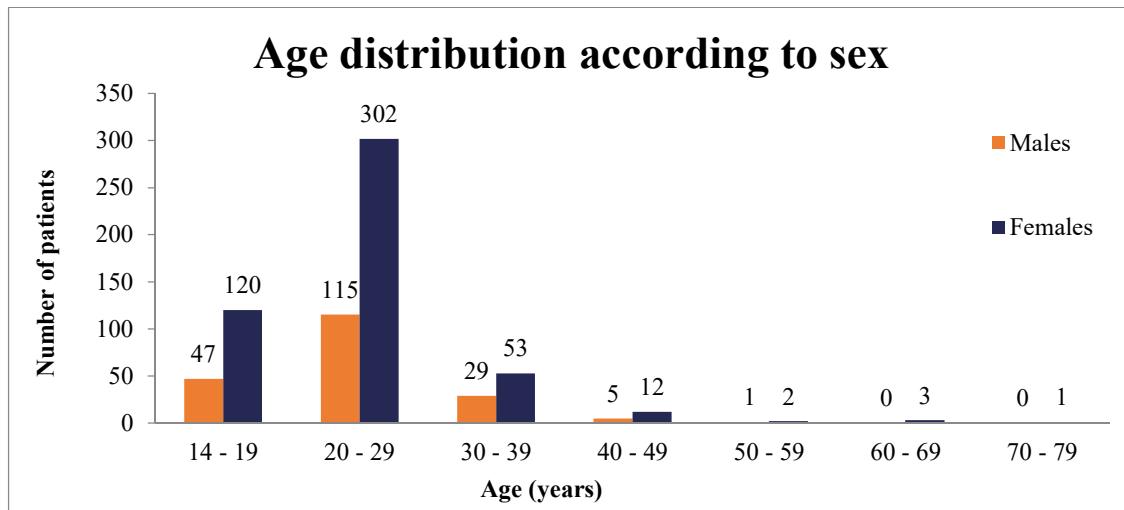


Figure 1: Age and sex distribution of patients

6.1.2 Sex

Females made up the majority of the sample size totalling 71.45%. There were only 197 males with a male to female ratio of 1: 2.5. The highest number of females was from the 3rd decade of life (43.77%). In addition the mean age for males was found to be 24.45 (SD = 6.42) while the mean age for females was 23.67 (SD = 7.20). This was statistically significant with $p = 0.04$.

6.1.3 Race

Just over half of the patients were White (50.72%) while the second largest group were Coloured (41.01%). Black African and Indian or other Asians were the two smallest groups at 5.65% and 2.46% respectively. The number of males and females per racial group are depicted in Table 4.

Racial Group	Males	Females	Total number
White	82	268	350
Coloured	88	195	283
Black African	19	20	39
Indian	08	09	17
Asian	0	01	01

Table 4: Number of males and females per ethnic group

From Table 4, it can be noted again that majority of the patients per ethnic group were females. The Asian group cannot be included in the rest of the study as there was only one patient. Thus, the White racial group had the largest number of females at 76.57%.

The mean age per racial group proved quite similar between Indian (23.65 years) (SD = 5.76), White (23.62 years) (SD = 6.94) and Coloured patients (23.32 years) (SD = 6.19). However, Black African patients expressed a mean age of 30.26 years (SD = 10.06). This was significantly different ($p < 0.005$).

6.1.4 Weight

Part of the demographic profiling was to analyse the patients' weight. Their weights ranged from 30kg to 134kg. The mean weight in the study sample was 67.92kg (SD = 16.83). Patients were further categorized into five groups based on their weights. It was discovered that 50.29% of patients were between 50 – 69kg. The breakdown of the other categories are depicted in Table 5.

Weight category (kg)	30 – 49	50 – 69	70 – 89	90 – 109	110 – 134
Number of patients	63	347	200	65	15

Table 5: Weight distribution of patients

It was further observed that Black Africans exhibited a mean weight of 71.78kg (SD = 11.62), White 70.27kg (SD = 16.39), Coloured race group 64.98kg (SD = 17.43) and Indians 60.94kg (SD = 16.65) respectively.

6.1.5 Location and distance travelled for treatment

In order to get an understanding of where patients originated from, the patients' location of residence and how far they travelled for treatment were investigated. It was found that the mean distance travelled was 34.80km (SD = 85.51). There was no significant difference in the mean distance travelled by males (34.71km) (SD = 80.88) vs. females (34.83km) (SD = 87.38) with $p = 0.62$. The study found that White patients travelled the furthest with a mean distance of 43.36km, Black African patients, 29.17km and Coloured patients, 26.17km. Indian patients had the smallest mean distance travelled at 15.23km. This was significantly different from other race groups ($p = 0.0001$). Patients travelled from 272 different locations. The majority of patients (90.87%) who presented for treatment were from the Cape Town area. The mean age of the patients who travelled from within Cape Town was 23.76 (SD = 6.82) while the mean age of patients from outside of Cape Town was 24.95 (SD = 8.51). Majority of the patients included in this study (3.62%) travelled from Bellville, which is 5km away from the Tygerberg Oral Health Centre. The closest distance that a patient had to travel for treatment was 1km. The most common distance travelled was 6km. Only 6.23% of the patients travelled more than 100kms for treatment. The furthest distance travelled by one patient was 1665km from Salt Rock in Kwa-Zulu Natal. The majority of patients who travelled from Cape Town were either White (50%) or Coloured (43%).

	Within Cape Town	Out of Cape Town	Total
Age (mean)	23.76	24.95	
Sex			
Males	179	18	197
Females	448	45	493
Race			
White	308	42	350
Coloured	267	16	283
Black Africans	34	05	39
Indians	17	0	17

Table 6: Demographic profile of patients according to their geographic location

6.1.6 Socio economic status

The socio economic status of a patient was regarded as a relevant part of the demographic profile. This was also investigated in the study. More than two thirds (69.57%) declared that they were unemployed. The mean age of those employed was 26.9 years, which was significantly differently from the mean age of those unemployed (22.5 years) ($p < 0.0005$).

The mean income of those who were employed was R5404.36 per month. In addition, males generally had a higher mean income of R5771.81. When the income of the different ethnic groups was compared, it was discovered that Coloured patients had the highest mean income of R5790 per month. Only 6.67% of the sample had a medical aid. The most common medical aid used was Discovery Health.

	Employed	Income (ZAR) per month	Has a medical aid
Total sample (n = 690)	210	5404.36	46
Sex			
Male (n = 197)	64	5771.81	20
Female (n = 493)	146	5242.18	26
Age			
Males	26.99	-	
Females	22.53	-	
Race			
White (n = 17)	127	5513.13	23
Coloured (n = 283)	66	5790.22	16
Black African (n = 39)	16	3217.50	5
Indian (n = 17)	01	1500	1

Table 7: Demographic profile of employed patients and other socio-economic factors

As per Table 8 (below), 60.72% of the sample was categorized as H1 with almost a third (30.29%) being White. 60.77% of the patients that travelled from within Cape Town were H1 patients. H3 patients travelled a longer mean distance (41.81km; SD = 80.92) than the patients from the other categories. This however was not significant with $p = 0.59$.

Clinicom® Category	H0	H1	H2	H3	Total
N	24	419	121	126	690
Mean age (years)	21.54	23.62	24.39	24.63	23.87
Sex					
Males	6	117	35	39	197
Females	18	302	86	87	493
Race					
White	15	209	66	60	350
Coloured	09	180	43	51	283
Black African	00	24	06	09	39
Indian	00	05	06	06	17
Mean distance travelled (km)	26.10	35.20	27.81	41.81	34.8
Residing within Cape Town	23	381	111	112	627

Table 8: Clinicom® classification of patients and distance travelled for treatment

6.1.7 Referral status

Patients' files were assessed to see if they were referred or not. It was discovered that more than half (56.09%) of the patients that presented for third molar removal were referred. In addition there was a total of 252 sources of referral. The sister hospitals namely Groote Schuur Hospital and Mitchells Plain Oral Health Centre referred a total of 10 and six patients respectively.

Almost three (70.28%) quarters of these patients were female and common racial classifications that presented with a referral letter were Coloured (43.41%) and White (46.9%). There was no significant difference in the mean age of a patient being referred or not. The mean age of a

patient being sent with a referral letter was 23 years (SD = 7.10) compared to those who were not referred (23 years; SD = 6.7).

Majority of the referrals included patients who were unemployed (66.15%) and only 9.3% of all referrals belonged to a medical aid. Most (87.34%) of the referred patients were from Cape Town and 62.27% of all referrals were categorized as H1.

6.2 MAIN COMPLAINT AND INDICATIONS FOR THIRD MOLAR SURGERY

6.2.1 Pain

The majority of patients (80%) had a main complaint of pain when the surgeon performed the initial consult. The mean age of patients who complained of pain at the consultation visit was 24 years compared to the mean age of 22 years of patients who did not complain of pain. This was significantly different ($p < 0.05$). There was also an association between not having a medical aid and presenting with pain at the consultation visit. Those who did not have a medical aid were 2.6 times more likely to have pain at the consultation visit compared to those who had a medical aid (OR = 2.60; $p = 0.006$).

6.2.2 Pericoronitis

Slightly more than four percent (4.78%) of patients presented with pericoronitis at the consultation visit. These patients had a mean age of 26.21 (SD = 4.93) compared to patients without pericoronitis who were 23.75 years old. This was significantly different ($p = 0.0008$). There was no association between sex and the main complaints of pain and pericoronitis.

6.2.3 Prophylactic removal

Slightly more than four percent (4.20%) of patients presented for prophylactic removal of their third molars with a mean age of 26.21 (SD = 10.62). From these patients, more than three quarters (79.31%) were female and almost two thirds (65.52%) were White.

6.2.4 Sepsis

Eight patients (1.16%) presented with sepsis with a mean age of 30.87 (SD = 17.12). Of these patients, 87.50% were female and 62.50% were White. Only 3.19% of patients presented with swelling with a mean age of 20.04 (SD = 4.29). Of these patients, 72.73% were female. Swelling was the most common in coloured patients at 54.55% with no African or Indian patients presenting with this complaint.

Main Complaint	Pain	Orthodontic Influences	Pericoronitis	Prophylactic Treatment	Swelling	TMJ Dysfunction	Sepsis	Skeletal Profile	Crown Fracture
Patients (n)	555	54	33	29	22	17	08	07	02
Age (Mean)	24.20	19.11	26.21	26.21	22.04	22.30	30.87	19	29.50
Sex									
Male (n = 197)	157	20	08	06	06	04	01	02	01
Female (n = 493)	398	34	25	23	16	13	07	05	01
Referred (n = 387)	291	53	24	11	14	09	06	03	02
Medical aid (n = 46)	29	04	04	03	02	02	01	03	00
Race									
White (n = 350)	289	20	10	19	10	09	05	02	00
Coloured (n = 283)	218	32	19	07	12	07	01	05	02
Black African (n = 39)	36	01	02	01	00	00	01	00	00
Indian (n = 17)	11	01	02	02	00	01	01	00	00
Residence									
In Cape Town (n = 627)	502	49	31	28	20	17	07	05	02
Out Cape Town (n = 63)	53	05	02	01	02	00	01	02	00

Table 9: Demographic profile of patients according to their Main Complaint

6.2.5 TMJ Dysfunction

The study found 18 patients (2.46%) who presented with TMJ dysfunction at the consultation visit with a mean age of 22.30 (SD = 11.00). From these patients three quarters (76.47%) were female and more than half were White (52.94%).

6.2.6 Orthodontic treatment Influences

Slightly less than 10% (8.12%) of patients were seen for associated orthodontic reasons. These patients had a mean age of 19.11 (SD = 3.54) and almost two thirds were female (62.96%).

6.2.7 Skeletal Profile/Appearance

Seven patients (1.01%) were scheduled for orthognathic surgery and needed their third molars removed. They had a mean age of 19.0 (SD = 2.24) and almost three quarters (71.43%) were female, Coloured and resided in Cape Town.

6.3 INDICATIONS FOR GA

In this study there were 18 different combinations of indications for GA. The most common combination that was indicated for GA was Impaction Type, Close to the IANC and SA. There were a total of nine main indications for GA which were noted in this study.

6.3.1 Main indications

Almost all the patients (99.57%) were indicated for GA based on Impaction type (Classification of Impaction). Similarly, 99.12% of patients were indicated for GA because the lower third molar roots were in close proximity to the inferior alveolar canal. A lesser percentage (90.29%) of patients was indicated for GA because their upper third molars had SA. Only 4.35% of patients were indicated for GA because of their medical conditions. It was found that the most common medical problem was asthma (13.99%), followed by a penicillin allergy (11.92%) and hypertension (3.63%). There was only one patient who disclosed an HIV positive status. Almost a tenth (8.41%) of patients presented with allergies ranging from medication allergies to food

allergies. Only 1.16% of the patients were indicated for GA due to sepsis with a mean age of 32.12 (SD = 16.71). Only 0.58% of patients were indicated for GA due to radiographic pathology. There was only one patient that was indicated for GA due to failure of local anaesthetic in the clinical setting. This patient was female, White and 23 years of age. In addition there were only three patients that were indicated for GA due to a local anaesthetic allergy. It was found that 67.54% of patients needed to surgically remove all four third molars. The mean age of these patients was 22.51 (SD = 5.29).

6.3.2 Intra-operative complications

In order to get an understanding of the indications for GA and the complexity of the procedure, intra-operative complications was also assessed. There was a 5.07% intra-operative complication rate. The most common intra operative complication was OAC with a combined total of 28.57% between the upper right and upper left third molars. This was followed by excessive intra-operative bleeding (22.86%). The mean age at which intra-operative complications occurred in this sample was 30.00 years (SD = 9.03) which was significantly different to those who did not have an intra operative complication (23.54 years) ($p < 0.05$). Only 35 patients (22 females and 13 males) experienced an intra-operative complication with 57.14% of them being White. However both sex ($p = 0.25$) and race ($p = 0.56$) were not associated with having an intra-operative complication.

Only 10 patients (1.45%) with a mean age of 31.10 (SD = 9.24) experienced an OAC during the surgical procedure. Nine patients (1.30%) with a mean age of 31.55 (SD = 8.12) experienced a root fracture. 11 patients (1.16%) with a mean age of 31.00 (SD = 12.20) suffered from excessive bleeding.

Four patients (0.58%) with a mean age of 26.50 (SD = 5.67) experienced an iatrogenic complication. Only three patients (0.43%) with a mean age of 26.33 (SD = 4.04) experienced a dento-alveolar fracture. There was one White female patient (17 years old) who experienced a bur fracture during the surgical procedure. There was also only one Indian male (33 years old) who experienced a lingual nerve injury during the surgical procedure.

Intra-operative Complications	OAC	Root Fracture	Excessive Bleeding	Iatrogenic Complications	Dento-alveolar Fracture	Bur Fracture	Lingual Nerve Injury
N	10	09	08	04	03	01	01
Age (Mean)	31.10	31.55	31.00	26.50	26.33	17.00	33.00
Sex							
Male	04	02	02	02	02	00	01
Female	06	07	06	02	01	01	00
Race							
White	08	05	04	01	01	01	00
Coloured	01	02	02	02	01	00	00
Black African	01	01	01	01	01	00	00
Indian	00	01	01	00	00	00	01

Table 10: Demographic profile of patients according to Intra-operative Complications

Almost two thirds (65.71%) of patients who experienced intra-operative complications were referred while 12 out of 35 patients that had intra-operative complications were not. In addition only two out of 35 patients that had intra-operative complications were not healthy.

6.4 WAITING PERIOD OF THE SURGICAL WAITING LIST

When a patient attends the Maxillo-Facial and Oral Surgery Clinic at Tygerberg Oral Health Centre, the surgeon performing the consultation would make notes and note the date of the visit. The waiting period from the initial consult until the date of operation was recorded in weeks.

The mean waiting time of the entire sample was 24.17 weeks (SD = 17.84). There was a total of four cases whose operation was performed on the same day as the consult. The longest waiting time was 160 weeks. The common waiting period was 24 weeks.

6.4.1 Waiting time influenced by Demographic Profile

A multiple regression analysis was done which found that age was associated with the waiting time ($r^2 = 0.01$ and $p = 0.04$). It was found that there was no statistical difference in the waiting period between males (23.52 weeks) (SD = 18.14) and females (24.43 weeks) (SD = 17.73) with $p = 0.55$. There were significant different waiting times for the different racial groups. It was found that Black African patients had the shortest waiting time (20.92 weeks) (SD = 14.33) while Indian patients had the longest waiting time (26.88 weeks) (SD = 26.97). There was a large difference in the mean waiting times between Coloured (22.92 weeks) (SD = 19.02) and White patients (25.38) (SD = 16.61).

6.4.2 Waiting time influenced by Main Complaint

Patients who were busy with orthognathic workup also waited a relatively short period with a mean of 11.86 weeks (SD = 8.73). This was significantly different ($p = 0.03$). Patients that had the longest mean waiting time were patients with TMJ Dysfunction (32.82 weeks) (SD = 25.11). This was not significant with $p = 0.11$. Patients that also had a long mean waiting time (32.39 weeks) (SD = 20.70) were the patients who required prophylactic removal of their third molars. This was highly significant with $p = 0.001$. The balance of the results can be found in Table 11.

Main Complaint	Waiting time (wks)	SD	p-value
Skeletal profile (Orthognathic surgery workup)	11.86	8.73	0.03
Orthodontic treatment	21.78	16.34	0.18
Swelling	22.18	10.46	0.92
Pericoronitis	22.91	12.39	0.82
Pain	23.99	17.58	0.64
Sepsis	25.25	20.62	0.80
Prophylactic Removal	32.39	20.70	0.0015
TMJ Dysfunction	32.82	25.11	0.11

Table 11: Mean waiting time for surgery according to the main complaint

6.4.3 Waiting time influenced by Operating Surgeon

There was significant difference ($p = 0.0002$) in the mean waiting time of cases performed by junior registrars (22.51 weeks) (SD = 17.07) vs. senior registrars (27.20 weeks) (SD = 18.82). However there was no significant difference between the waiting time of cases performed by registrars (24.10 weeks) (SD = 17.81) vs. specialists (25.29 weeks) (SD = 18.60) with $p = 0.92$.

6.4.4 Waiting time influenced by Jaw and Tooth Factors

When assessing the difference in the waiting time based on removing third molars in both jaws or only one jaw there was a significant difference with $p = 0.002$. The shortest mean waiting time was 19.02 weeks (SD = 18.59) if only the lower jaw was indicated. There was a small difference in the waiting time if both jaws (24.65 weeks) (SD = 17.9) were operated on. If only the upper jaw was operated, the waiting time was 25.44 weeks (SD = 7.27). The mean waiting time if all four third molars were removed was 24.83 weeks (SD = 17.78) compared to 22.79 weeks (SD = 17.92) if less than four teeth were removed.

Patients who were indicated for GA because their upper third molars displayed SA had a mean waiting time of 24.72 weeks (SD = 17.71). This was significantly different to those without SA ($p = 0.01$).

6.4.5 Waiting time influenced by patients' Medical History

There was a statistically significant difference between the mean waiting times of healthy patients (24.85 weeks) (SD = 18.45) compared to patients with medical complications (20.17 weeks) (SD = 13.08). Healthy patients waited approximately more than one month extra ($p = 0.03$). However when the three most common medical disorders found in this sample were assessed, there was no real significant difference. Patients with respiratory disorders had a mean waiting time of 23.19 weeks vs. patients with medication allergies (23.45 weeks). Although the mean waiting time for patients with cardiovascular disorders was 20.34 weeks (SD = 15.00), this was not significantly different to those who did not have a cardiovascular disorder ($p = 0.19$).

6.5 THIRD MOLAR POSITION AND ANTICIPATED DIFFICULTY OF OPERATION USING RADIOGRAPHIC ANALYSIS

Analogue and digital PANs were used to assess and classify third molars. Angulation, Position and Class as per Pell and Gregory's and Winter's classifications were used.



Figure 2: Analogue PAN



Figure 3: Digital PAN

A total of 2416 third molars were surgically removed in 690 patients with an average of 3.50 teeth per patient. 51.74% of the teeth removed were located in the mandible.

6.5.1 Tooth number combinations surgically removed

There were 15 different combinations in which the third molars were removed. The most common being 18, 28, 38, 48 which made up two thirds (67.54%) of all cases. Details are depicted in Figure 4.

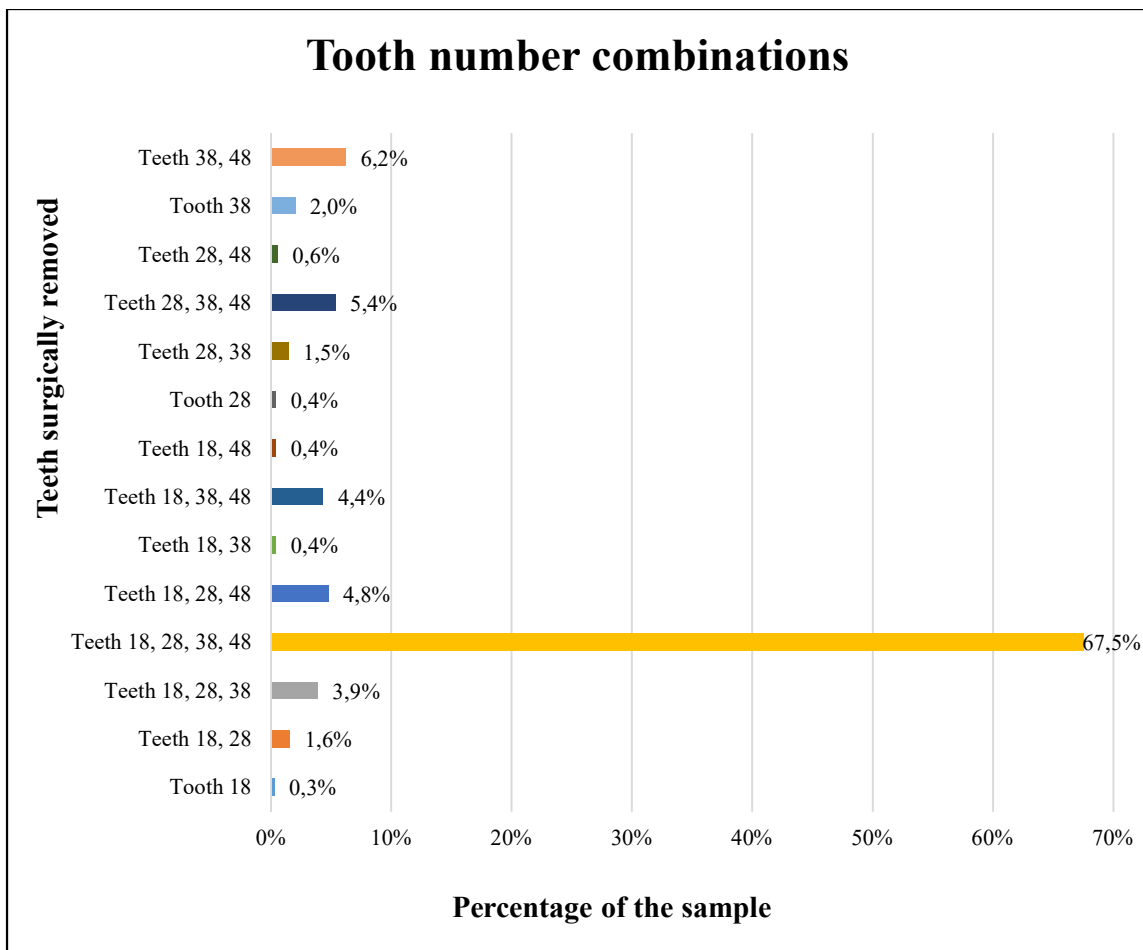


Figure 4: Distribution of tooth number(s) combinations that were removed surgically

6.5.2 Jaw location of surgery

The majority (88.84%) of surgical removals occurred in both jaws. The mean age was 23.17 years (SD = 5.84) and the majority (71.29%) were female with more than half (52.29%) being White. Black African and Indians only accounted for 5.55% and 2.45% respectively.

8.84% of cases were isolated to the mandible only with a higher mean age of 30.47 years (SD = 12.30). 68.85% were female. Coloured patients were the majority (57.38%). Black Africans (6.56%) and Indians (3.28%) proved to be the minority. Just more than 2% of cases involved the maxilla only. More than two thirds (87.50%) were female. The mean age of this sample was 25.50 years (SD = 7.16). 62.50% were White. There was only one Black African patient and no Indian patients in this group.

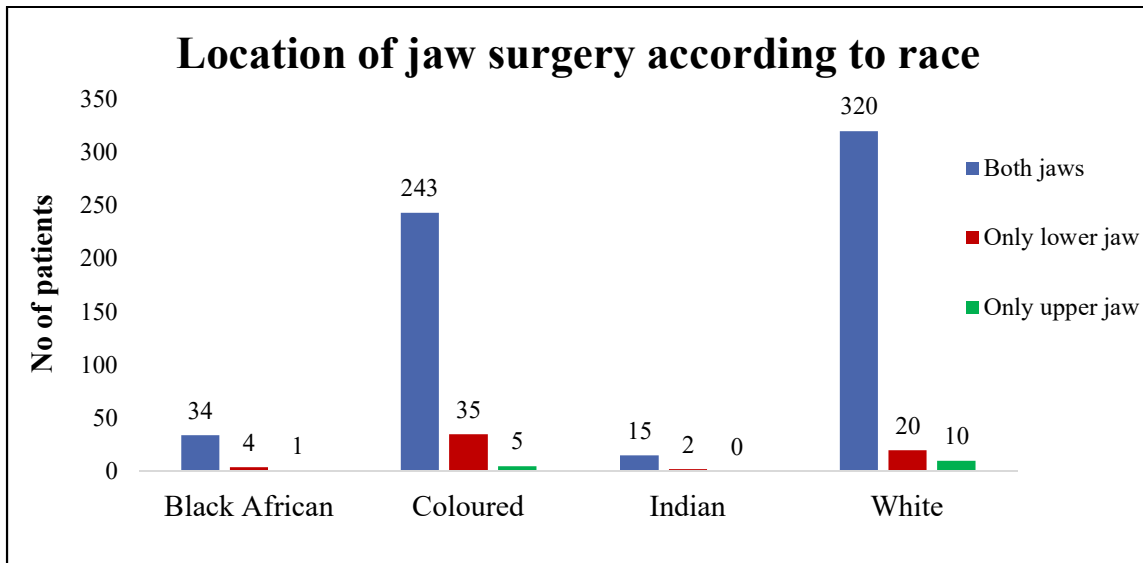


Figure 5: Jaw location of surgery according to race

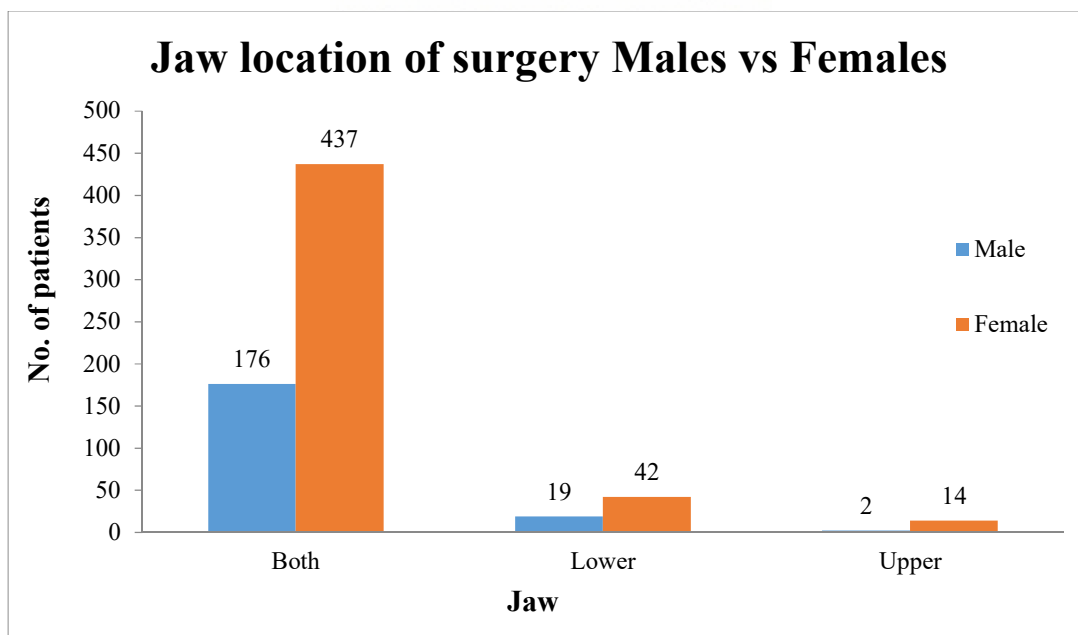


Figure 6: Jaw location of surgery according to Sex

6.5.3 Radiographic analysis of Tooth 18

The main elements assessed on the radiographs were the Angulation, Position, Class and SA of the third molars. There were a total of 575 upper right third molars (tooth number 18) surgically removed with 70.78% of the sample being female and White (52.17%). Angulations included buccal, distal, horizontal mesial and vertical. The most common angulation was disto-angular (55.30%) while the least common angulation was horizontal (0.35%). The mean age of patients with disto-angular 18's was 22.49 years (SD = 5.58) with the majority being female (40.87%) and White (29.04%). The most common Class was C (52.87%) with a mean age of 21.94 years (SD = 5.53). 38.09% were female and White (28.35%). 95.30% related to tooth 18 presented with SA. Patients who had SA had a mean age of 22.91 years (SD = 5.50) and were majority female (71.17%) and White (51.82%).

	n	Age	Sex		Race			
			Males	Females	White	Coloured	Black African	Indian
Total	575	23.81	168	407	300	228	31	15
Angulation								
Bucco-angular	4	24.25	0	4	3	1	0	0
Disto-angular	318	22.49	83	235	167	126	15	9
Horizontal	2	24.5	0	2	1	1	0	0
Mesio-angular	35	24.37	9	26	23	11	1	0
Vertical	216	23.44	76	140	106	89	15	6
Class								
Class A	75	26.52	31	44	28	36	8	3
Class B	195	23.17	51	144	109	71	9	5
Class C	304	21.94	85	219	163	121	13	7
SA	548	22.91	158	390	284	220	29	14

Table 12: Radiographic profile of Tooth 18 according the age, sex and race

6.5.4 Radiographic analysis of Tooth 28

There were a total of 591 upper left third molars (tooth number 28) surgically removed with 72.25% being female and White 53.81%. Angulations included buccal, distal, horizontal, mesial, transverse and vertical. The most common angulation was disto-angular (57.02%) while the least common angulation was shared between horizontal and transverse (0.17%) respectively. The mean age of patients with disto-angular 28's was 22.64 years (SD = 5.74) with 42.81% being female and 29.27% being White. The most common class was Class C (53.30%) with a mean age of 22.01 years (SD = 5.53). 39.25% were female and White (28.93%). 96.28% of tooth 28 presented with SA. Patients who exhibited SA had a mean age of 22.88 years (SD = 5.42), were majority female (72.93%) and White (53.60%).

	n	Age	Sex		Race			
			Males	Females	White	Coloured	Black African	Indian
Total	591	27.33	164	427	318	227	33	12
Angulation								
Bucco-angular	03	25.67	0	03	02	1	0	0
Disto-angular	337	22.64	84	253	173	139	18	06
Horizontal	1	24.00	0	1	1	0	0	0
Mesio-angular	35	25.60	12	23	24	11	0	0
Vertical	214	23.09	68	146	118	75	15	06
Transverse	1	43.00	0	1	0	1	0	0
Class								
Class A	90	26.52	37	53	40	35	11	03
Class B	186	23.07	44	142	107	68	07	04
Class C	315	22.01	83	232	171	124	15	05
SA	569	22.88	154	415	305	220	32	11

Table 13: Radiographic profile of Tooth 28 according the age, sex and race

6.5.5 Radiographic analysis of Tooth 38

There were a total of 630 lower left third molars (tooth number 38) surgically removed. Angulations included buccal, distal, horizontal, inverted, lingual, mesial and vertical. The most common angulation was mesio-angular (42.38%) with the least common being linguo-angular (0.16%). The mean age of patients with mesio-angular 38's was 21.77 years (SD = 5.77). The most common position was Position B (47.46%) with four patients being uncategorized due to the absence of adjacent teeth in the mandible. The mean age of the patients that presented with Position B was 23.68 years (SD = 5.75).

51.53% of the lower left third molars (tooth number 38) were classified as Class III. 66.36% of the patients who had a Class III of the lower left third molar were female of which 45.37% were White.

6.5.6 Radiographic analysis of Tooth 48

There were a total of 623 lower right third molars (tooth number 48) surgically removed. Angulations included buccal, distal, horizontal, inverted, lingual, mesial and vertical. The most common angulation was mesio-angular (41.13%) with the least common being linguo-angular (0.16%). The mean age of patients with mesio-angular 48's was 21.42 years (SD = 4.96) with 30.64% being female and White (20.97%). The most common position was B (53.23%). Two patients were uncategorized as there were no adjacent teeth in the mandible. The mean age was 23.11 years (SD = 5.99) with 39.35% being female and White (30.48%). 54.09% related to tooth 48 was classified as Class III with a mean age of 23.94 (SD = 6.49). More than two thirds (69.44%) of the patients who had a Class III were female of which 49.85% were White.

	n	Age (Mean)	Sex		Race			
			Males	Females	White	Coloured	Black African	Indian
Total	630	26.84	189	441	318	258	36	17
Angulation								
Buccal	10	22.50	03	07	05	05	0	0
Distal	74	26.78	23	51	41	28	04	01
Horizontal	125	25.86	52	73	51	52	16	06
Inverted	02	50.50	01	01	01	0	01	0
Lingual	01	17.00	0	01	0	01	0	0
Mesial	267	21.77	72	195	132	122	09	03
Vertical	151	23.45	38	113	88	50	06	07
Position								
Position A	251	23.68	82	169	113	109	22	07
Position B	299	23.36	87	212	163	117	08	10
Position C	76	23.58	19	57	41	30	05	0
Class								
Class I	143	23.80	33	110	81	52	04	06
Class II	163	23.54	47	116	90	63	07	03
Class III	324	23.67	109	215	147	143	25	08

Table 14: Radiographic profile of Tooth 38 according the age, sex and race

	n	Age (Mean)	Sex		Race			
			Males	Females	White	Coloured	Black African	Indian
Total	620	25.22	176	444	316	257	31	15
Angulation								
Buccal	06	22.33	1	05	5	1	0	0
Distal	91	26.23	29	62	54	28	7	2
Horizontal	129	26.02	46	83	58	51	15	5
Inverted								
Lingual	1	17.00	0	1	0	1	0	0
Mesial	255	21.42	65	190	130	115	5	4
Vertical	135	22.55	33	102	68	60	3	4
Position								
Position A	207	23.70	67	140	87	100	16	4
Position B	330	23.11	86	244	189	119	12	9
Position C	81	23.47	22	59	40	36	3	2
Class								
Class I	108	22.55	27	81	56	46	1	5
Class II	175	23.00	46	129	92	68	11	4
Class III	337	23.94	103	234	168	143	19	6

Table 15: Radiographic profile of Tooth 48 according the age, sex and race

Using the PAN radiograph third molars were classified as Class I, Class II and Class III (Figure 7). It was discovered that at least 61.88% of patients had one Class III while only 33.91% of patients had two Class III third molars.

Anticipated difficulty can also be determined by duration of the operation. This will be discussed later on.

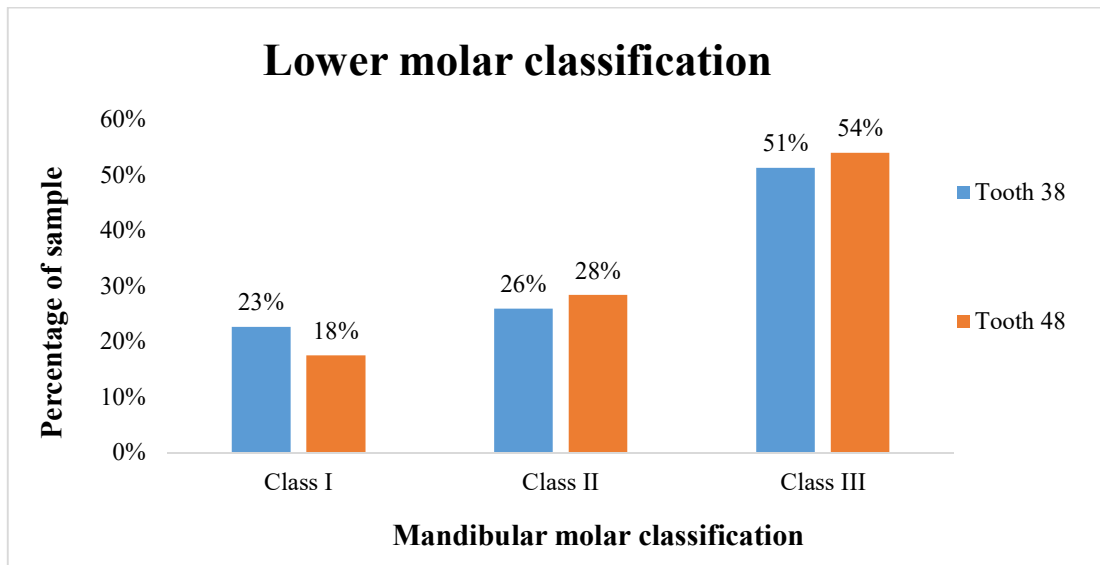


Figure 7: Lower molar classification

6.6 SKILLS LEVEL OF THE OPERATING SURGEON

There were two categories of surgeons that formed part of this study. There were trainee surgeons who are referred to as registrars and qualified Maxillo-Facial and Oral Surgeons who are referred to as specialists.

6.6.1 Description of Operating Surgeons

There were a total of 19 surgeons that performed third molar surgeries during the period that this study was conducted. It consisted of 15 registrars and four specialists. The registrars were further categorized as being junior or senior. A junior registrar would be within one to three years in the training program and a senior registrar would be within four to five years in the training program.

6.6.2 Analysis of Operating Surgeons

94.49% of the third molar surgeries were performed by registrars. The majority of third molar surgeries were performed by junior registrars (65.95%). In addition most of the surgeries were

performed by registrars in their third year of training (24.08%) while the least number of surgeries was done in their final year (12.27%).

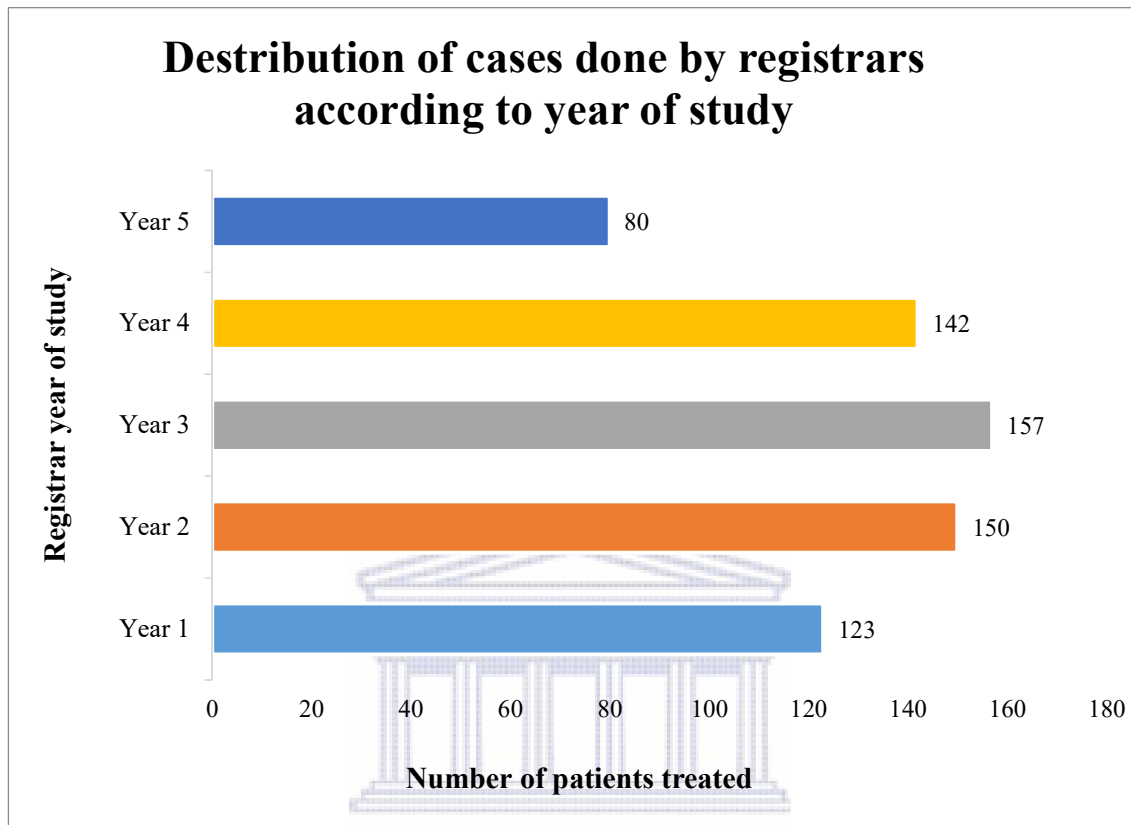


Figure 8: Number of patients seen by registrars according to the year of study

6.6.3 Experience of Operating Surgeons

The surgeons' years of experience ranged from a minimum of five years to a maximum of 44 years. Between the 19 surgeons, they shared a mean of 11.25 years of experience (SD = 5.77). Specialists had 32.42 years (SD = 5.43) of experience vs. registrars with only 10.01 years (SD = 2.42) mean experience.

6.6.4 Intra-operative Complications

In order to get an understanding of the skills level of the operating surgeon the incidence of intra-operative complications between registrars and specialists were also assessed. There was

a 5.07% incidence rate of intra-operative complications. There was no statistically significant difference of intra-operative complications between registrars and specialists.

The only intra-operative complication experienced by the specialists was a patient with excessive bleeding and root fracture of teeth 28 and 38 which were left in situ. All other intra-operative complications were experienced by registrars. Almost two thirds (63.89%) of all intra-operative complications were experienced by junior registrars. The results are depicted in Figure 10.

The duration of the operation and incidence of post-operative complications can also aid in determining the skills level of the surgeon. This will follow in the next section.

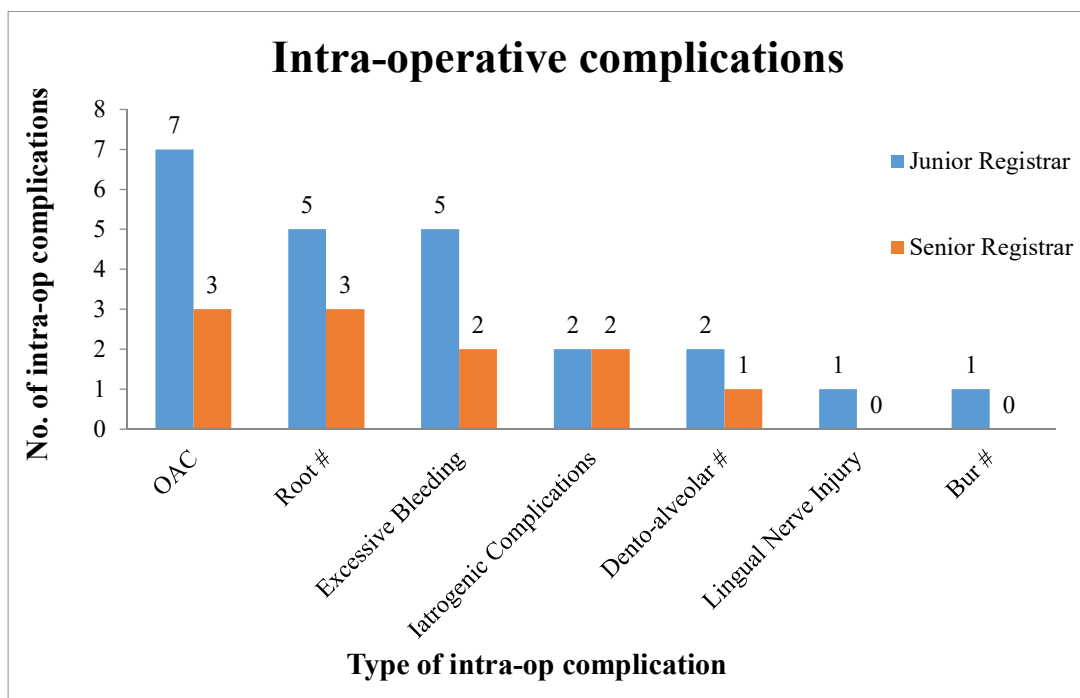


Figure 9: Intra-operative complications experienced by junior and senior registrars

6.7 DURATION OF THE SURGICAL PROCEDURE

The duration of the surgical procedure was recorded in the theatre records. The mean operating time was 62.73 min (SD = 20.08) for the entire sample. The shortest operating time was 20 min while the longest lasted for 185 min. The most common operating time involving 91 patients

was 60 min. 299 theatre cases lasted longer than 60 min. Mean operation time per tooth was 17.9 min. In addition the mean operating time for removing two teeth varied from 42.50 – 62.00 minutes. The mean operating time for removing three teeth was between 57.42 – 63.33 minutes. The duration for removing four teeth was a mean duration of 65.47 minutes.

6.7.1 Duration of surgery influenced by Demographic Profile

A multiple regression analysis was done using age and sex as predictor variables for duration of operation. This test found that age ($p = 0.03$) and sex ($p = 0.0004$) was associated with the duration of the operation ($r^2 = 0.03$).

Operating time for males was generally longer at 67.08 min (SD = 24.17) compared to females (60.99 min) (SD = 17.93). This was significantly different ($p = 0.005$). The average operating time between Coloured (61.82 min) (SD = 20.69), Indian (63.94 min) (SD = 14.74) and White patients (61.91 min) (SD = 18.25) were fairly similar. However, Black African patients had a much longer mean operating time of 76.41 minutes (SD = 27.91). This was significantly different ($p = 0.01$). A linear regression analysis for duration of operation with age, sex and weight was done which found that weight was not associated with the duration of the operation ($p = 0.37$).

6.7.2 Duration of surgery influenced by Operating Surgeon

Specialists had a shorter mean operating time of 59.60 min (SD 14.25) as opposed to registrars (62.91 min) (SD = 20.37). Senior registrars had a shorter mean operating time (58.37 min) (SD = 17.04) over junior registrars (65.25 min) (SD = 21.53). This was statistically significant ($p = 0.0001$). Senior registrars and specialists operated in a shorter time compared to junior registrars. Registrars in their fourth year of study had the shortest mean operating time (56.36 minutes).

Year of study	Number of patient seen	Duration of operation (min)	SD
Year 1	123	69.67	23.38
Year 2	150	69.15	22.22
Year 3	157	58.07	17.16
Year 4	142	56.36	15.58
Year 5	80	61.94	18.93

Table 16: Mean duration of operation per registrar study year

6.7.3 Duration of surgery influenced by Jaw and Tooth Factors

It was found that the shortest mean operating time occurred when surgery was restricted solely to the maxilla (46.25 min) (SD = 21.17). The longest mean operating time resulted when surgery occurred in both jaws (63.88 min) (SD = 19.94). Surgery limited to the mandible only resulted in a mean operating time of 55.49 min (SD = 18.04). The differences were significant ($p < 0.0005$).

With regards to tooth number 18 and angulation, surgically removing horizontally angulated third molars resulted in the shortest mean operating time of 50.00 min (SD = 28.28) while buccally angulated teeth had the longest mean operating time (75.00 min) (SD = 12.91) (Figure 10). However there were only two and four cases of each angulation respectively. Besides these cases the shortest mean operating time was for vertically angulated teeth (62.73 min) (SD = 20.80) while the longest mean operating time was related to mesially angulated teeth (66.94 min) (SD = 18.21). Class A, number 18 tooth had the shortest mean operating time of 59.49 min (SD = 18.00) while Class C had the longest mean operating time of 66.33 min (SD = 21.15) (Figure 11). Tooth number 18 that displayed SA had a longer mean operating time of 64.03 min (SD = 20.51) compared to those that did not (61.80 min) (SD = 15.40).

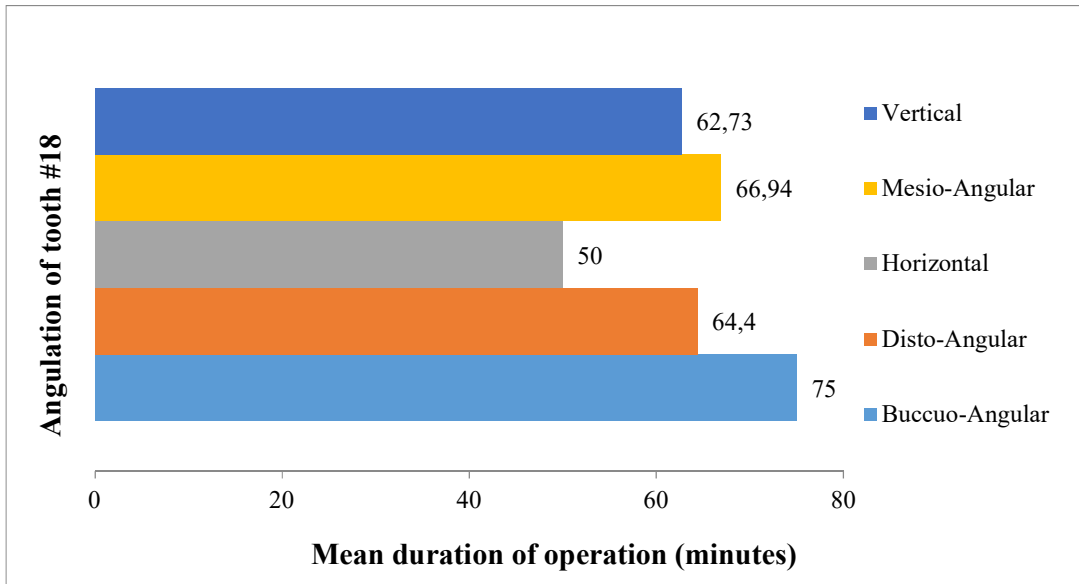


Figure 10: Mean duration of operation according to angulation of Tooth 18

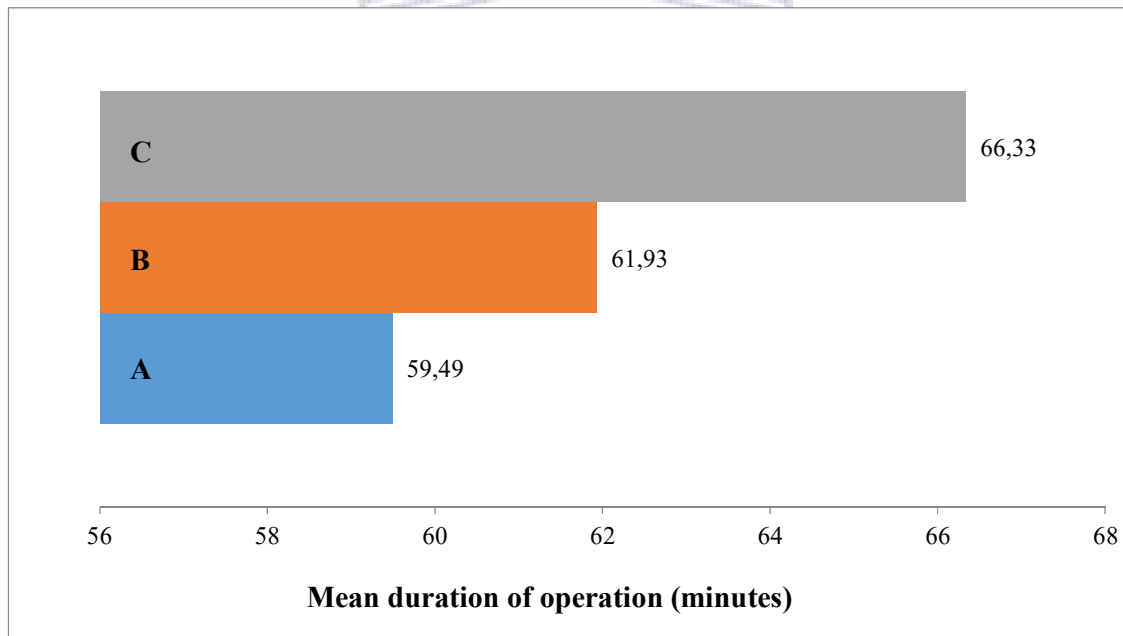


Figure 11: Mean Duration of operation according to Class of Tooth 18

With regards to tooth number 28 and angulation, surgically removing horizontally angulated third molars resulted in the shortest mean operating time of 50.00 minutes while transverse teeth had the longest mean operating time (80.00 min). However in both cases there was only one patient. Besides the previously mentioned angulation types, the shortest mean operating time were for mesially angulated teeth (62.71 min) (SD = 17.59) and the longest mean operating time

were as a result of buccally angulated teeth (73.33 min) (SD = 10.41) (Figure 12). Class A, number 28 tooth had the shortest mean operating time of 58.13 min (SD = 17.43) while Class C had the longest mean operating time of 66.79 min (SD = 20.98) (Figure 13). Tooth number 28 with SA had a longer mean operating time of 64.14 minutes (SD = 20.161) compared to those that did not (58.16 min) (SD = 23.70).

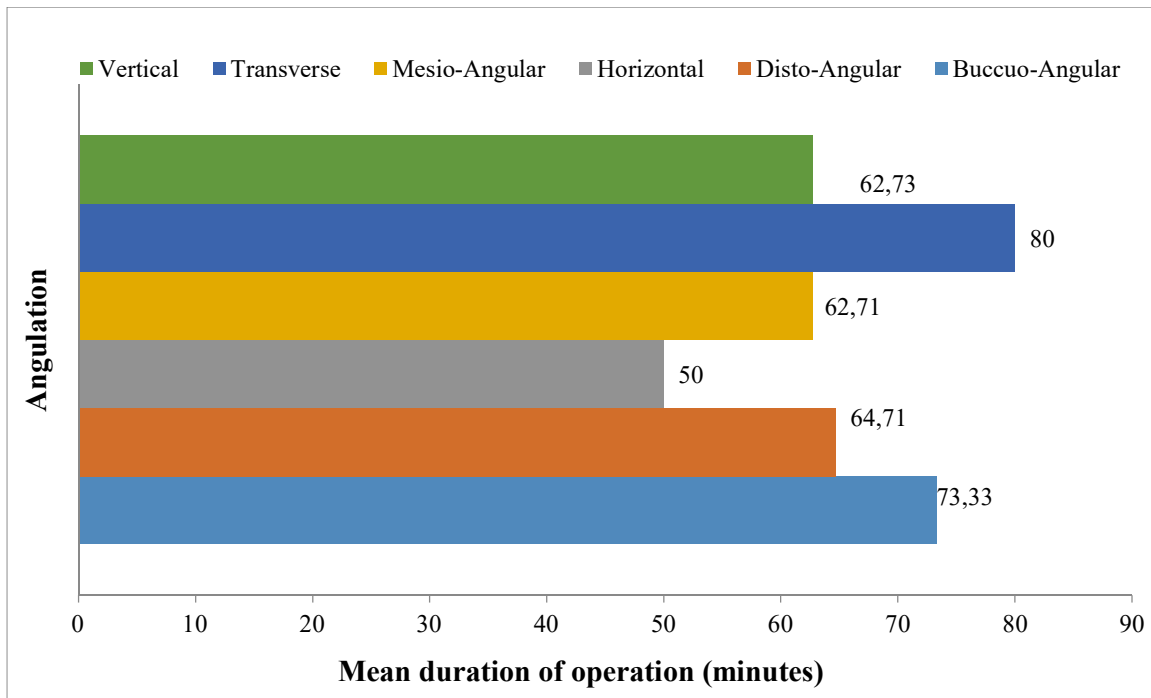


Figure 12: Mean duration of operation according to angulation of Tooth 28

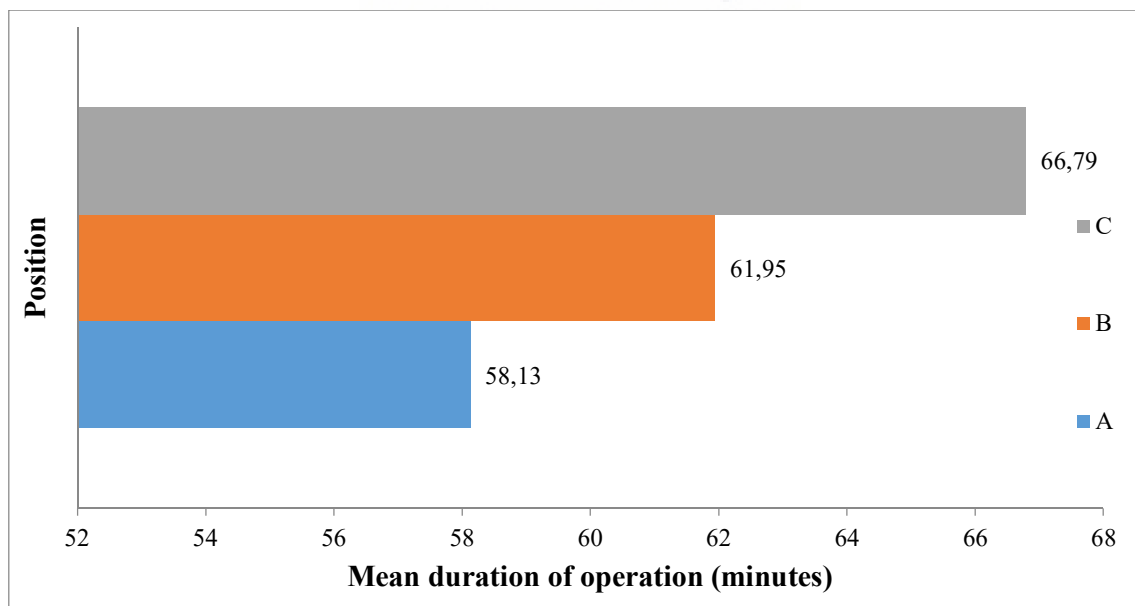


Figure 13: Mean duration of operation according to Class of Tooth 28

With regards to tooth number 38 and angulation, surgically removing buccally angulated third molars resulted in the shortest mean operating time of 55.00 min (SD = 12.02) while lingually angulated teeth had the longest mean operating time (90.00 min) (Figure 14). However, there was only one case of a lingually angulated 38. In addition the next longest mean operating time was for inverted teeth (82.50 min) (SD = 10.61) of which there were only two cases. This was followed by horizontally angulated teeth with a mean operating time of 65.78 min (SD = 21.11). Position A, number 38 tooth had the shortest mean operating time of 62.28 min (SD = 20.27) while Position C had the longest mean operating time of 66.09 min (SD = 22.19) (Figure 15). Tooth number 38 classified as Class I, had the shortest mean operating time of 57.76 min (SD = 17.35) while cases with a Class III had the longest mean operating time (67.77 min) (SD = 21.18).

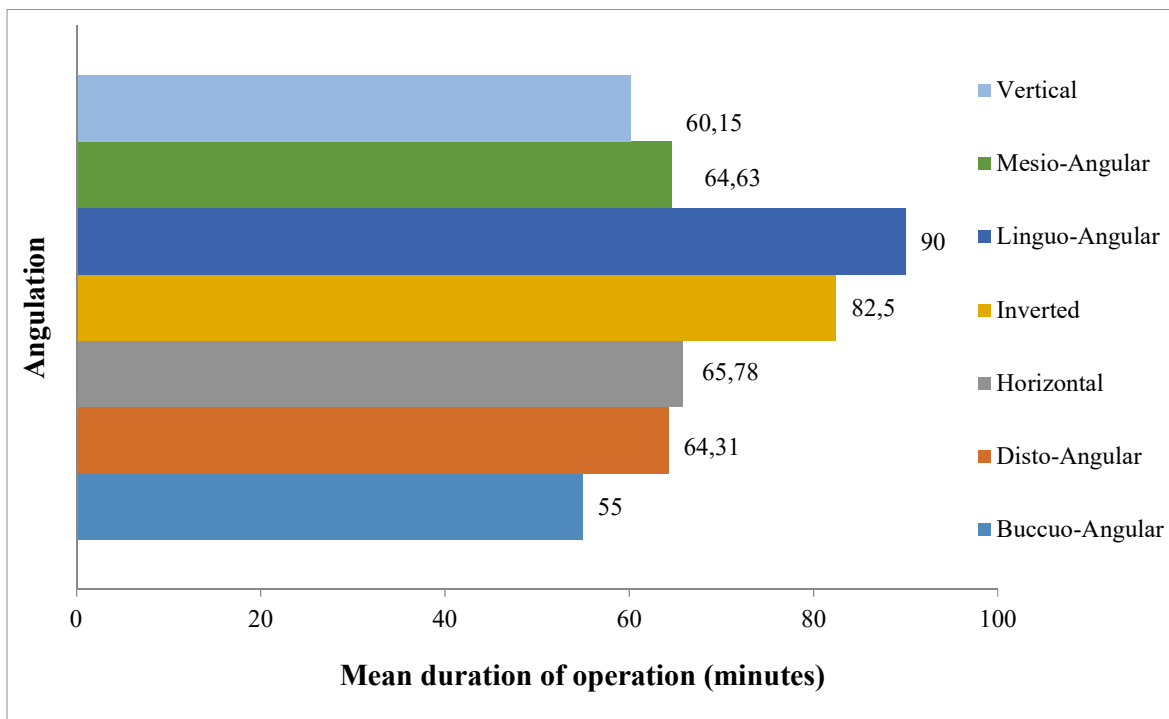


Figure 14: Mean duration of operation according to angulation of Tooth 38

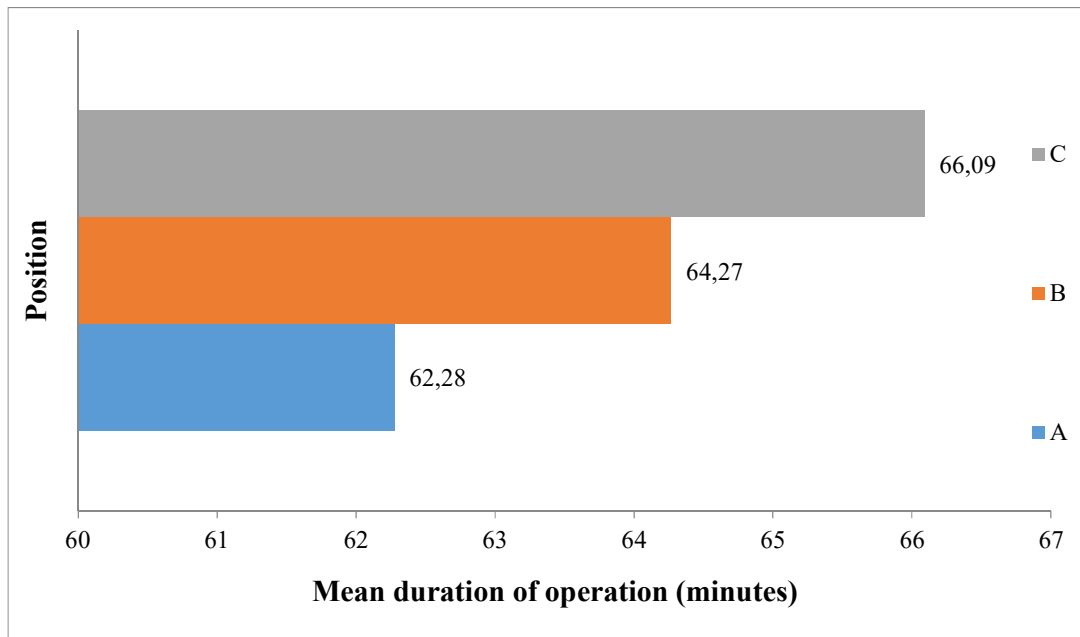


Figure 15: Mean Duration of operation according to position of Tooth 38

With regards to tooth number 48 and angulation, surgically removing lingually angulated (90.00 minutes) and inverted third molars (80.00 min) had the longest mean operating time. However there were only one and three cases of each respectively. Apart from this the longest mean operating time seen in horizontally angulated third molars (68.50 min) (SD = 23.91) and the shortest mean operating time was related to buccally angulated third molars (61.67 min) (SD = 16.33) (Figure 16). There were two cases where the position of tooth 48 was unclassified due there being no adjacent teeth. This had the shortest mean operating time of 60.00 min (SD = 42.43). This was followed by Position A with a mean operating time of 62.80 min (SD = 20.55) while Position C had the longest mean operating time of 67.69 min (SD = 25.08) (Figure 17). Tooth number 48 classified as Class I had the shortest mean operating time of 54.54 min (SD = 14.98) while cases with a Class III had the longest mean operating time (67.52 min) (SD = 20.89).

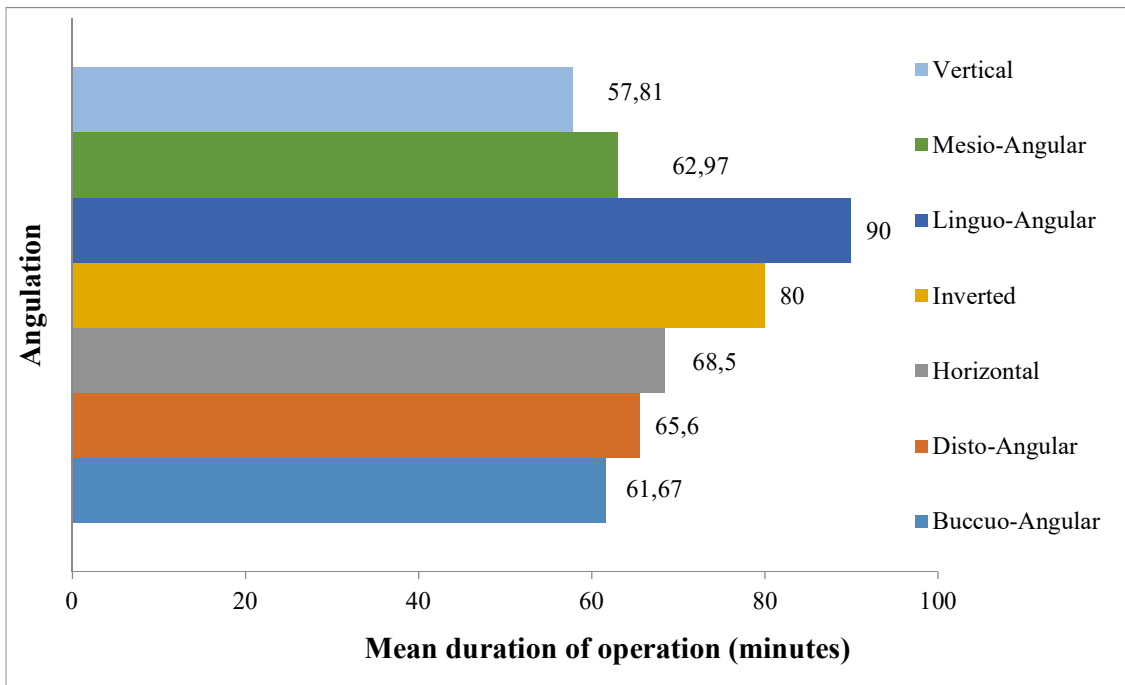


Figure 16: Mean duration of operation according to angulation of Tooth 48

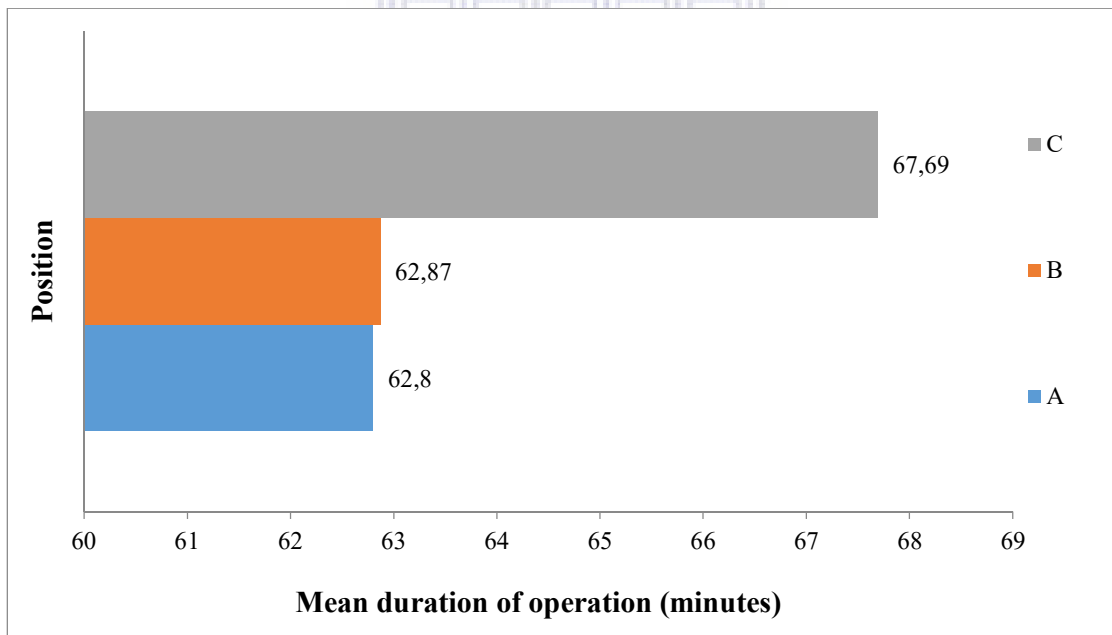


Figure 17: Mean duration of operation according to position of Tooth 48

With regards to the surgical removal of the lower third molars; the shortest mean operating time resulted when there were two Class I teeth (55.16 min) (SD = 15.16). The longest mean operating time occurred when two Class III teeth were present (70.25 min) (SD = 21.21). In

addition there was no association between the proximity of the lower third molar roots to the IANC and operating time. A linear regression test was done which proved ($r^2 = 0.00$ and $p = 0.17$).

There was a significant mean difference in duration of operation between the different classes for lower molars. As per Figure 18, a lower third molar classified as a Class III resulted in a longer duration of operation (67.52 – 67.77 minutes) as opposed to being classified as Class I (54.54 – 57.76 minutes).

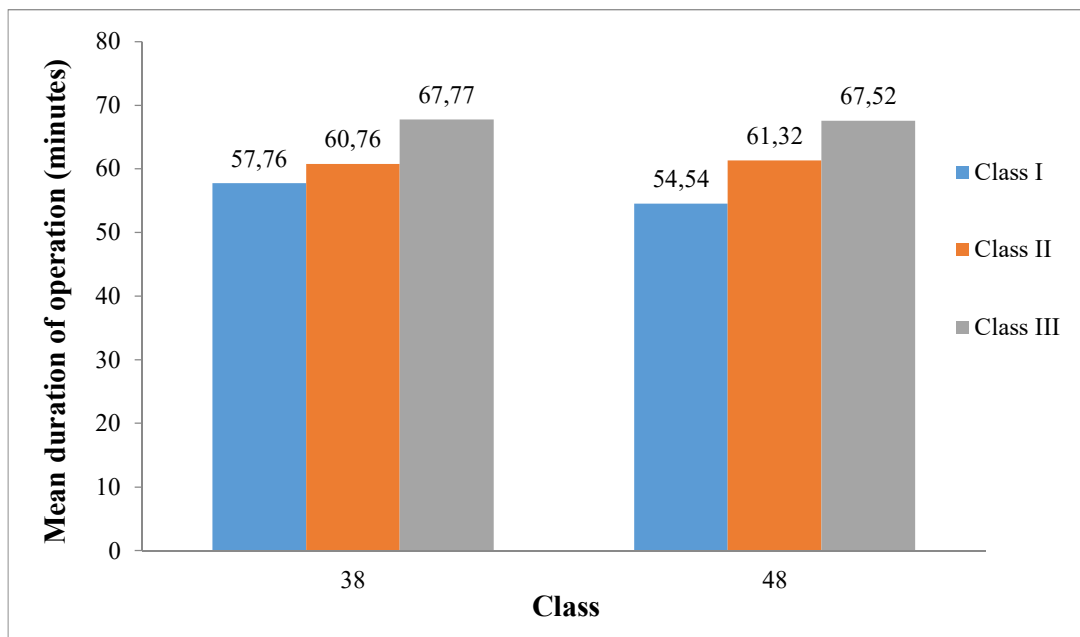


Figure 18: Mean duration of operation (minutes) of classes Tooth 38 vs. Tooth 48

The mean duration of operation was generally longer in patients that were indicated for GA due to SA (63.52 minutes) of their upper third molars. These operations were approximately 10 minutes longer than those cases with no SA. This proved statistically significant with $p = 0.0004$.

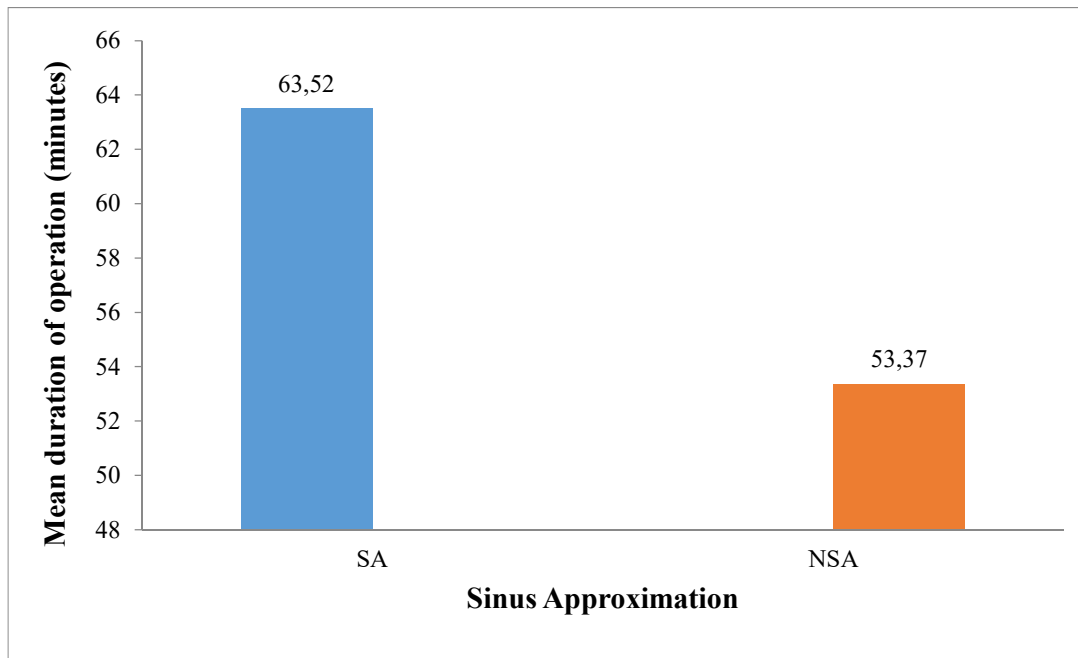


Figure 19: Mean duration of operation (minutes) according to sinus approximation

For upper third molars a tooth being bucco-angulated, mesio-angulated or transverse and Class C with SA resulted in a longer operating time. Likewise for mandibular third molars a tooth being linguo-angulated, inverted or horizontal, Position C and Class III resulted in a longer duration of operation.

6.7.4 Duration of surgery influenced by Patients' Medical History

A statistically significant difference was found between the mean duration of the operation and a patient's level of health ($p = 0.04$). Healthy patients had a longer mean duration of operation (63.45 minutes) (SD = 20.56) compared to patients with medical conditions (58.47 minutes) (SD = 16.45).

6.7.5 Duration of surgery influenced by Intra-operative Complications

The mean duration of the operation among cases where an intra-operative complication was experienced, was 81.57 minutes (SD = 25.60) compared to 61.75 minutes (SD = 19.25) where no intra-operative complication was experienced. This was significantly different ($p < 0.0005$).

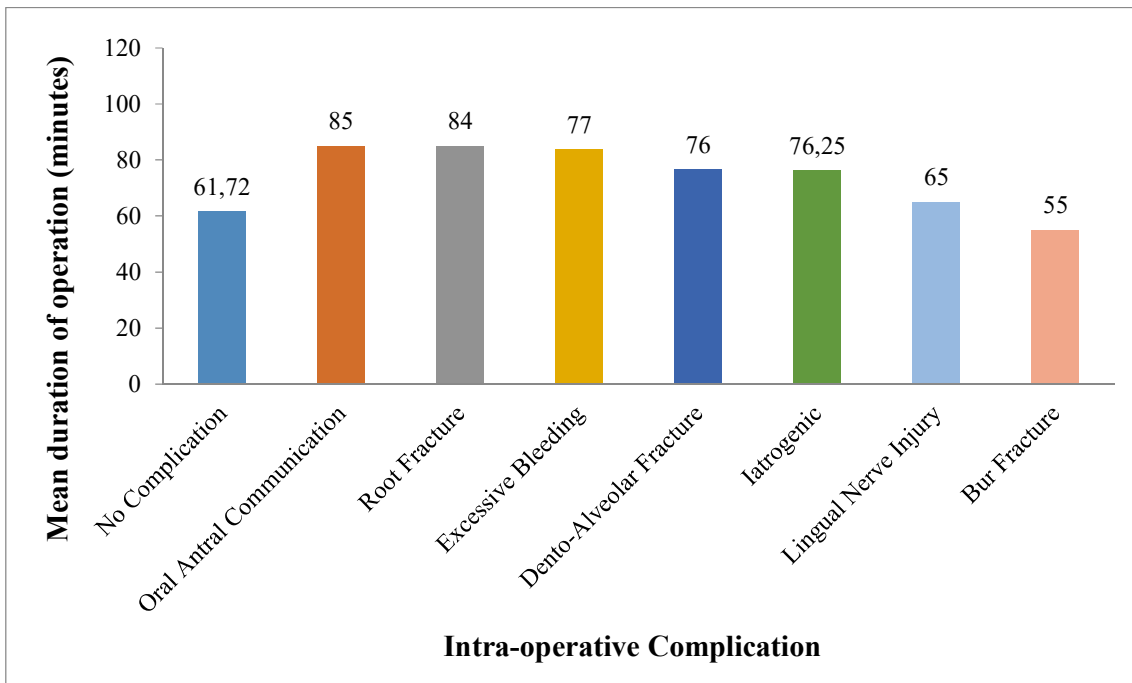


Figure 20: Mean Duration of operation when an Intra-operative complication occurred

6.7.6 Effect of Operation time on Post-Operative Complications

The mean duration of the operation had a direct relation to post-operative complications that were experienced. In cases where a post-operative complication arose the mean duration of the operation was 69 min (SD = 24.99) compared to 61 min where no post-operative complication occurred. This was significantly different ($p = 0.0012$). There were four cases in which neuropraxias were reported post-operatively. This resulted in the longest duration of operation related to complications (92.50 min). Cases with post-operative bleeding took 91.25 min.

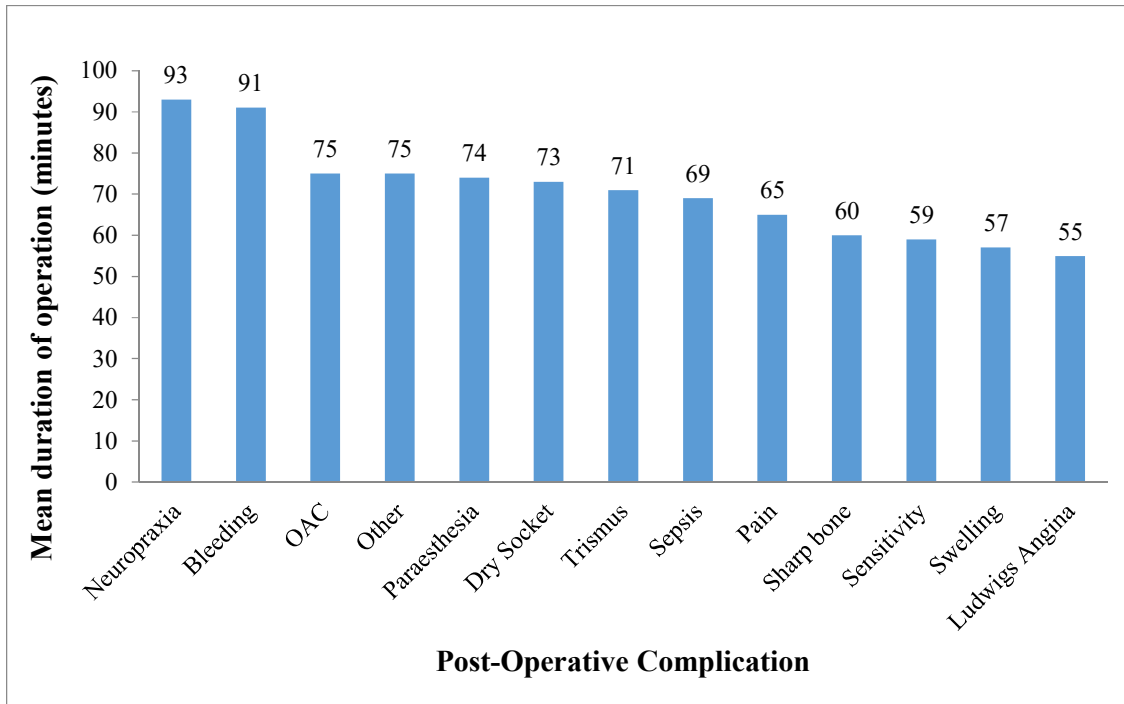


Figure 19: Mean Duration of operation when a Post-Operative complication occurred

6.8 INCIDENCE OF POST-OPERATIVE COMPLICATIONS

There were 141 (20.43%) patients who experienced post-operative complications. The most common complications were paraesthesia (28.41%), sepsis (19.89%) and swelling (15.34%). Dry sockets only accounted for 4.54% of the complications. Other complications such as jaw stiffness, loose sutures, lip lacerations, etc. amounted to 5.11% of the complications. There was only one reported case of a post-operative Oral Antral Communication.

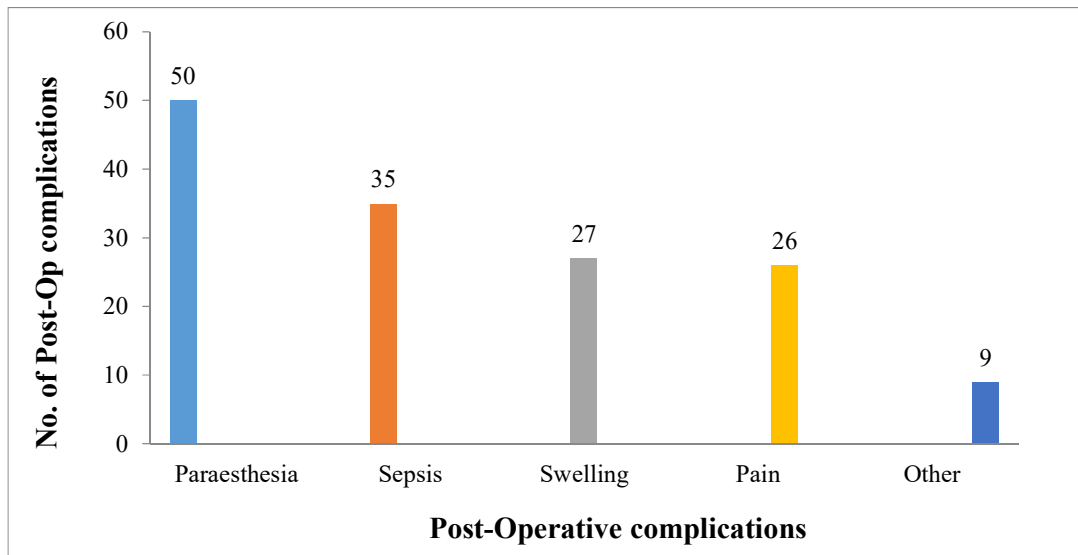


Figure 22: Summary of most common Post-Operative complications

6.8.1 Demographic Profile of Patients with Post-Operative Complications

The mean age of patients that presented with post-operative complications was 26.07 years (SD = 7.74). This proved statistically significant ($p = 0.00003$). There was no association with sex and post-operative complications. More than half of the sample (51.06%) of these patients were White, 39.72% Coloured, and 8.51% Black African. Only one Indian patient had a post-operative complication. The mean weight of patients with post-operative complications was 70.58 kg (SD = 16.77) which proved significant ($p = 0.03$). More than half (59.57%) of patients that were referred experienced a post-operative complication while 95.04% of them did not have a medical aid. 7.80% of patients that presented with a post-operative complication resided out of Cape Town. Patients that had a mean waiting time of 25.79 weeks from the day of consult to the day of operation, experienced post-operative complications such as bleeding, dry socket, trismus paraesthesia, jaw stiffness, pain, swelling and sepsis.

6.8.2 Influence of Main Complaint on Post-Operative Complications

In order to get an understanding if the main complaint of the patient had any relation to post-operative complications the incidence of post-operative complications per Main Complaint was also assessed. There was no association between any of the main complains and experiencing a post-operative complication.

6.8.3 Analysis of Post-Operative Complications amongst Operating Surgeons

Of the 141 cases where post-operative complications arose, 97.87% of these were registrars. Only three cases were experienced by Specialists which included sepsis, paraesthesia and neuropraxia. 65.22% of post-operative complications experienced by registrars occurred with junior registrars. The most number of post-operative complications occurred in the registrars second year of training (25.36%) while the least occurred in their final year (15.22%). Surgeons' who had a mean of 10.52 years (SD = 3.62) experienced post-operative complications such as bleeding, dry socket, paraesthesia, jaw stiffness, pain, swelling, tooth sensitivity, sepsis and sharp bone fragments. This was not statistically significant ($p = 0.09$).

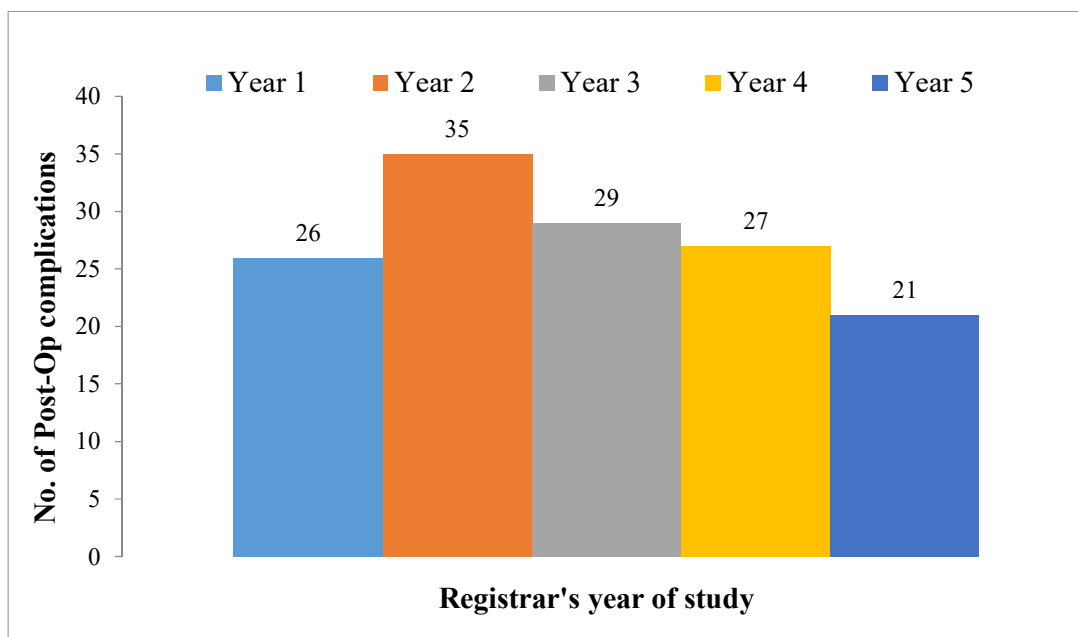


Figure 23: Number of Post-operative complications experienced by Registrars

6.8.4 Influence of Jaw and Tooth Factors on Post-Operative Complications

The incidence of post-operative complications based on tooth factors was also assessed. 65.96% of complications arose when all four third molars needed to be removed. The data revealed that post-operative complications occurred when the mean duration of operation was 68.81 minutes (SD = 24.99) which proved statistically significant ($p = 0.001$). No post-operative complications occurred when the configuration of teeth 18, 28 and 18, 38 were removed. 87.94% of post-

operative complications occurred when surgery was performed in both jaws. Only 17 post-operative complications occurred when surgery was limited to the mandible only. No complications occurred when surgery was restricted to the maxilla only. This proved statistically significant ($p = 0.04$). 7.43% of patients whose lower third molar roots were in close proximity to the IANC experienced post-operative paraesthesia while only 0.59% experienced neuropraxia. There was only one patient with SA who experienced an OAC post-operatively.

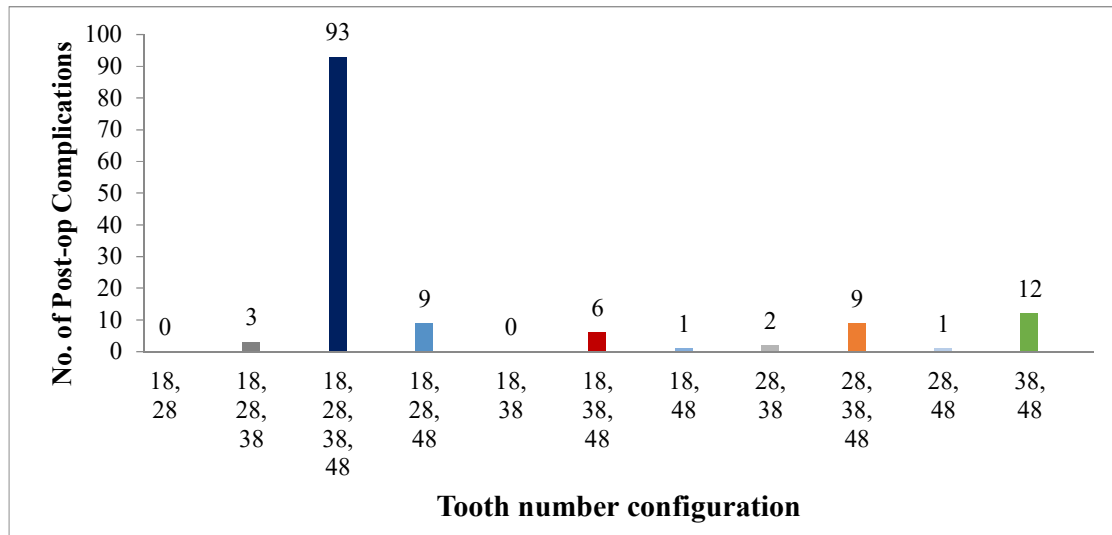


Figure 24: Number of Post-operative complications experienced per tooth number configuration surgically removed

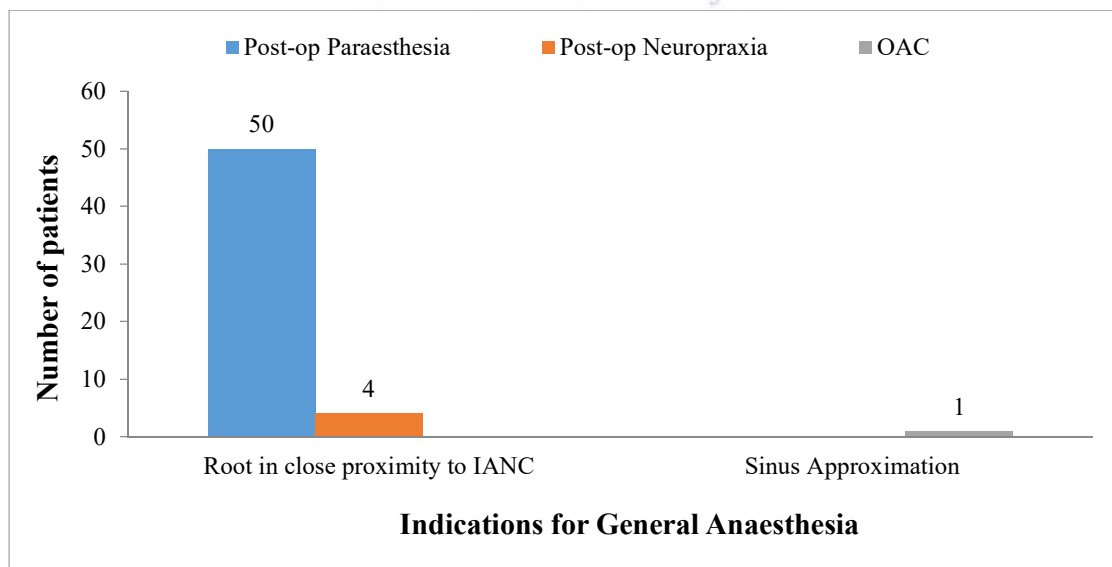


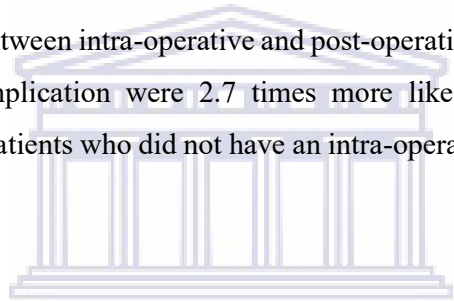
Figure 25: Number of patients who suffered from Post-operative complications as a direct result of the indication for GA

6.8.5 Influence of Medical History on Post-Operative Complications

There was no association found between experiencing a post-operative complication and having a particular medical condition ($p = 0.23$). However, an association was found between a post-operative complication and having an allergy. A patient who had an allergy was 1.8 times more likely to have a post-operative complication (dry socket, paraesthesia, pain, trismus, sepsis and swelling) compared to those with no allergy (Risk ratio = 1.8; $p = 0.01$). Furthermore, a linear regression analysis was performed which found that there was no association between the time a patient waited from the initial consult to the date of surgery and the occurrence of post-operative complications ($r^2 = 0.00$; $p = 0.23$).

6.8.6 Association between Intra-Operative and Post-Operative Complications

An association was found between intra-operative and post-operative complications. Those who had an intra-operative complication were 2.7 times more likely to have a post-operative complication compared to patients who did not have an intra-operative complication (Risk ratio = 2.7; $p = 0.00003$).



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7. DISCUSSION

In this study the demographic profile, clinical data and radiographs of 690 patients who attended third molar surgery under GA at the faculty of dentistry at the University of the Western Cape was assessed. Compared to the literature, this is one of the larger studies and the first comprehensive study to be conducted in South Africa. The only other sizable study found was conducted by Jerjes *et al.* (2010) where 3236 patients formed part of their study. Other large studies such as that of Carvalho and Vasconcelos (2011) involved only 285 patients.

A number of similarities and differences were found when compared to the international scientific literature. This will be addressed in detail in the discussion.

7.1 DEMOGRAPHIC PROFILE

A search of the international scientific literature showed that similar studies were conducted in Denmark (Benediktsdóttir *et al.* 2004), Chapel Hill (Phillips *et al.* 2010), Boston (Susarla and Dodson 2004, 2005, 2013), London (Carvalho *et al.* 2013), Brazil (Jerjes *et al.* 2010) and even Scandinavia (Hugoson and Kugelberg 1988).

7.1.1 Age

The ages of patients included in this study ranged from 14 – 72 years old. The mean age of the sample size was 23.87 years. 60.43% of the sample was between the ages of 20 to 29. In a similar study by Carvalho *et al.* (2013) and Jerjes *et al.* (2010) the mean age was found to be 22.8 years and 24.20 years respectively. Similar results were found when Byahatti (2015) who conducted a study in Karnataka, India. Their sample consisted of patients between 18 – 50 years old with most of their patients between 18 – 30 years of age. Susarla and Dodson (2004) also had a patient sample of between 15 – 65 years old with a mean age of 26.2 years. It is documented that the normal time for eruption of third molars occurs between 17 – 21 years of age and this fact could explain the relation to the surgical removal of third molars when patients are in their twenties.

7.1.2 Sex

Females were the majority of the sample size totalling 71.45% with a male to female ratio of 1: 2.5. In addition it was surprising to note that while females proved to be the majority in the entire population they also proved to be the majority per age category. Females also proved to be the majority in the following studies: 54% Byahatti (2015), 72.5% Carvalho *et al.* (2013) with a male to female ratio of 1: 3 and 75.1% Carvalho and Vasconcelos (2011) with a male to female ratio of 1:3. However, there were studies wherein majority of the sample were actually male. This includes a 66.36% male majority in Pillai *et al.*'s study in 2014 at Chowdhary Hospital and 72.7% male population in the study by Susarla and Dodson (2005). The finding was attributed to variations of the patients' ethnicity and the size of the sample. In a study by Nakagawa *et al.* (2007) the gender proportion of female is to male was found to be 3:1. This indicated that females are more common in attending for third molar surgery than males. The reasons for the female predominance is that females tend to attend the clinic/hospital earlier compared to males was also attributed to their lower level of tolerance and lower pain threshold (Colorado-Bonnin *et al.*, 2006).

7.1.3 Race

In the current study it was noted that the majority of the patients were White in descent (50.72%). Susarla and Dodson (2004) had similar results with a 72% respective majority White patient sample. Looking at the last Census done in Cape Town in 2011 the results show that majority of the population is Coloured (45.4%) followed by 42.7% of the population being White, 8.6% Black African and only 1.4% being Indian (Strategic Development Information and GIS Department, 2012). Possible explanation could be socio-economic factors and access to health care that might still differ for the different population groups in the Western Cape.

7.1.4 Weight

Only access to the patients' weight was available and the height was not recorded. The BMI of the patient could therefore not be calculated. A study conducted by Susarla and Dodson (2013) (Predicting third molar surgery operative time: A validated model) at Massachusetts General Hospital, Boston and another study by Carvalho *et al.* (2013) (Assessment of factors associated

with surgical difficulty during removal of impacted maxillary third molars) at the University of Pernambuco, Brazil recorded the patients BMI. In both studies patients had BMI's within an acceptable range of 18.5 – 24.9. In Carvalho *et al.*'s study in 2013 75.5% of their patients were also within this range. The mean weight of the patients' in this sample was 67.92kgs with majority of the patients (50.29%) between 50 – 69 kilograms. A possible explanation was that most patients presenting for third molars were found to be in the young, active and healthy population group.

7.1.5 Referral status

A study was conducted by Macluskey *et al.* (2005) wherein patients were referred to the tertiary hospital for third molar surgery. Of the 250 patients seen at the primary hospital only 20% were referred for third molar surgery. The reason was attributed to the fact that in the above study patients were referred mainly from dentists. Referrals to Tygerberg Oral Health Centre from other primary or secondary hospitals amounted to only 2.32% of the entire sample.

No specific details regarding demographics on patients' marital status, the distance that they travelled to get to the Operating Centre and their socio economic status could be found in the literature.

7.2 MAIN COMPLAINT AND INDICATIONS FOR THIRD MOLAR SURGERY

7.2.1 Main Complaint

The most common main complaint noted in the clinical notes in this study was that of pain (80.43%). 7.83% of patients were electively referred by orthodontics to have their third molars removed. Pericoronitis was noted as the third most common main complaint (4.78%) followed by clinical notes stating “prophylactic” removal (4.20%). 2.46% of patients presented with TMJ Dysfunction as their main complain. In a study by Macluskey *et al.* (2005) the most common main complaint and indication for third molar surgery was pericoronitis (62%) followed by dental caries (32%). Krishnan *et al.* (2009) reported similar results in their retrospective study. In this study, the most common main complaint and indication for surgery was recurrent pericoronitis (54%), dental caries (31%), followed by orthodontic reasons (2%). The most

common main complaint found in a Nigerian Teaching Hospital was recurrent sepsis (46.7%). Dental caries amounted to 13.3% of the main complaints while prophylactic removal only accounted for 4.2% of the patient sample (Osunde *et al.* 2014). There were differences between the main complaints found in the literature and in this study. The only similarity was the prophylactic removal population (4.20%) in this sample and that of the Nigerian Teaching Hospital. This finding could be attributed to the fact that 56.09% of the patients that attended Tygerberg Oral Health Centre were referred and patient had already received primary treatment via their general practitioners. The main complain of “pain” noted in this study could also have alluded to many other clinical entities such as pericoronitis, caries, TMD and other.

7.2.2 Indications for third molar surgery

Lopez *et al.* (1995) conducted a prospective investigation of 522 patients undergoing third molar surgery where indications for third molar surgery were collected. They discovered that over half the patients did not have clinically sound indications for surgery. The same phenomenon was found in this study. Although it was noted that patients had main complaints and the radiographs indicated that they qualify for third molar surgery, it was not stated in the clinical notes why surgery was specifically indicated.

7.3 INDICATIONS FOR GA

7.3.1 Main Indications for GA

In this study the most common reason for a GA booking included a statement that the third molar was difficult to remove referring to the Classification of the Impaction (99.57%). Furthermore it was noted that lower third molar roots close to the IANC (99.12%) and upper third molars having SA (90.29%) were also indications. Other indications were if all four third molars (67.54%) had to be removed and a patient presented with two Class III lower third molars (33.91%). 4.35% of patients were indicated for GA due to other Orthodontic treatment required to be performed at the same time. One patient was booked for GA due to failure of Local Anaesthetic. There were some similarities in other studies conducted. Obiechina *et al.* (2001) discovered that the number of teeth to be extracted and depth of impaction (Classification of Impaction) was one of the main contributions to the indications for GA in the study. Other

indications included patient preference and patient's level of anxiety. In this study we only had one patient that was indicated for GA due to level of anxiety. Susarla and Dodson (2004) discovered that patients were booked for GA due to expected difficulty of operation. This is attributed to the Classification of the impaction, lower third molar roots being close to the IANC, SA, etc.

7.3.2 Intra-Operative Complications

Intra-operative complications were assessed in order to get an understanding of the complexity of the procedure and why it was indicated for GA. There was only a 5.07% incidence of intra-operative complications in this study sample with OAC being the most common. 1.45% of the entire sample experienced an OAC followed by 1.30% experiencing root fractures and 1.16% who suffered excessive bleeding. This was different to the literature (Sebastiani *et al.* (2014)) wherein maxillary tuberosity fracture was the most common (2.48%) finding, followed by haemorrhage (0.92%) and root fracture (0.62%). Oral antral communications only amounted to 0.31% of the intra-operative complications. If the current study is compared to the scientific literature, Sebastiani *et al.* (2014) found a higher complication rate of 6.19%. However, there were studies that were conducted which had lower intra-operative complication rates such as Bui *et al.* (2003) (2.2%) and Chiapasco *et al.* (2006). Most of the studies were retrospective and it can be assumed that minor complications might not always be recorded and that could explain the higher complication rate found in the study of Sebastiani *et al.* (2014), a prospective study.

7.4 WAITING PERIOD OF THE SURGICAL WAITING LIST

Patients' that attend for third molar surgery to Tygerberg Oral Health Centre generally were placed on a waiting list from the time of consult till the time of operation. The mean waiting time for this sample was 24.17 weeks. In a study by Macluskey *et al.* (2005) performed at a tertiary hospital in Britain, patients had to wait for three to four weeks for the procedure to be carried out. According to Mahomed (2016) the waiting period according to department records at Tygerberg Oral Health Centre was 6 – 8 months documented in a thesis which assessed the change in quality of life of patients while on the third molar surgery waiting list. According to his study with a small sample size of 48, the mean waiting time was 28 weeks with males waiting on average for 25 weeks and females for 30 weeks respectively.

7.5 THIRD MOLAR POSITION AND ANTICIPATED DIFFICULTY OF OPERATION USING RADIOGRAPHIC ANALYSIS

In the current study, 56.17% of the teeth removed in the maxilla were disto-angular and Class C (53.09%). There was a difference in the mandible with the most common angulation being mesio-angular (41.76%) and Position B (50.32%). This is similar to what has been recorded by Winter (1926). Winter (1926) stated that 43% of mandibular impactions were mesio-angular. 99.12% of patients in this sample had roots in close proximity to the IANC while only 46.23% displayed SA. 61.88% of patients had one Class III while 33.91% and two Class III lower third molars. These results differ from other studies. Demirtas and Harorli (2015) investigated the relationship and position of the maxillary third molars to the maxillary sinus. They made use of panoramic images and CBCT. 162 impacted third molars from 100 patients were included in their study. 59.9% of their maxillary third molars were vertical, 14.2% mesio-angular, 9.9% disto-angular and 34% displayed SA. In addition Position B proved to be the most common mandibular impaction which was similar to this study. Carvalho *et al.* (2013) conducted a study and discovered that 78.4% of procedures had a relation between the maxillary sinus and the maxillary third molars. In addition 76.5% of tooth positions were vertical. According to a study by Jerjes *et al.* (2006) 77.6% of lower third molars had roots in close proximity to the IANC. In another study by Jerjes *et al.* (2010) 34.9% of the teeth were vertical followed by 46.9% being mesio-angulated. In addition 78.20% were close to the IANC. Al – Anqudi *et al.* (2014) also revealed that mesio-angular was the most common angulation in his sample (35%) while Position A was the most common in the mandible. In addition 388 were bilateral impactions with 377 being in the mandible. 18% of cases had associated pathology. This study had a total of 1113 bilateral impactions. 537 occurred in the maxilla and 576 in the mandible which differed with Al-Anqudi *et al.* (2014). Carvalho and Vasconcelos (2011) determined that the most common factors in their study was 49.5% vertical angulation, 48.4% Position A, 49.3% close to the IANC and 59.4% Class I.

Byahatti (2015) revealed 49% of his entire sample was mesio-angular. This differed quite significantly with this study and many other studies that were also conducted. Another study that differed quite significantly to the norm was Pillai *et al.* (2014). With regards to the maxilla the most common angulation was vertical (41.4%) followed by mesio-angular (33.3%). However in the mandible vertical angulation was even more common (67.4%) followed by

disto-angular (15.2%). Position A accounted for 43.9%, Position B 34.8% and Position C 21.3%. The differences between the studies could be attributed to varying sizes of the study sample, referral culture, and possible difference in ethnicity of the patients.

7.6 SKILLS LEVEL OF THE OPERATING SURGEON

7.6.1 Skills level between registrars and specialists

This study included a total of 19 surgeons. 15 registrars and four specialists performed the third molar surgery. 94.49% of the surgeries were done by registrars. The combined surgeons' years of experience in this study ranged from five to 44 years with a mean of 11.25 years. More specifically the specialists had 32.42 years mean experience while registrars had 10.01 years mean experience post dental graduation. According to Osunde *et al.* (2014) similar results were found in their study where registrars (56.97%) performed more of the surgeries compared to the specialists (10.6%). In a study conducted by Jerjes *et al.* (2006) 1087 patients were seen by four registrars and three specialists. In this study the majority of the patients (52.3%) were managed by specialists. 80.1% of the teeth were found to be close to the IANC and patients were therefore seen by the specialists. In a similar study by Macluskey *et al.* (2005) it was discovered that specialists saw more patients than registrars. In the study by Susarla and Dodson (2004) and Susarla and Dodson (2005) they shared similar results in terms of years of experience. The surgeons in their 2004 study had a mean experience of 8.8 – 11.1 years with their surgeons having a range of 7 – 36 years of experience in total. In the 2005 study 15 surgeons had a mean of 8.8 – 11.1 years of experience as well.

7.6.2 Intra-Operative Complications experienced by Operating Surgeons

In the current study it was found that there was no statistically significant difference in the intra-operative complications rate between registrars and specialists ($p = 0.48$). The most number of intra-operative complications (seven) occurred with the surgeon group who had 12 years of experience. Surprisingly found in the study, the surgeons with least years of experience had no intra-operative complications. This could be attributed to the fact that the junior surgeons at the Tygerberg Oral Health Centre are assigned easier type of impactions with consultant cover at all time. None of the surgeons with more than 26 years of experience had an intra-operative

complication. The only intra-operative complication experienced by the specialist was a patient with excessive bleeding and root fracture of teeth 28 and 38 which were left in situ. All other intra-operative complications were experienced by registrars. No literature could be found on intra-operative complications between registrars and specialists. Most of the literature is based on post-operative complications.

7.7 DURATION OF THE SURGICAL PROCEDURE

7.7.1 Mean Operating Time

The mean operating time in this study was 62.73 minutes. The shortest operating time was 20 minutes while the longest was 185 minutes. It is important to note that this study included many patients that had less than four third molars in situ. More specifically it was found that the mean operating time for four third molars were 65.47 minutes. This differed significantly with other studies. Benediktsdóttir *et al.* (2004) reveals that in the study 90% of their operations lasted for 25 minutes or less while only 5% lasted for longer than 31 minutes. In a similar study Phillips *et al.* (2010) determined a mean surgery time of 30 minutes. In another study by Obimakinde *et al.* (2013) operating time ranged from 11.05 – 34.10 minutes with a mean operating time of 17.92 minutes. A study that had similar results to this was a study by Sebastiani *et al.* (2014) where 323 teeth were removed (164 maxillary and 159 mandibular third molars) with a mean surgical time of 45 minutes. Their longest duration of operation was 100 minutes and the shortest being 15 minutes.

7.7.2 Influence of Age on Duration of Surgery and Surgical Difficulty

A linear regression analysis was done which found that age was associated with the duration of the operation ($r^2 = 0.01$ and $p = 0.02$). A multiple regression analysis was also done using age and sex. This test found that age ($p = 0.03$) and sex ($p = 0.0004$) was associated with the duration of the operation ($r^2 = 0.03$). According to Phillips *et al.* (2010) younger patients in their study had a shorter operating time of 25 minutes compared to older patients (30 minutes). Obimakinde *et al.* (2013) found that age had a strong correlation with operating time ($p = 0.04$). Similar results are reported with Benediktsdóttir *et al.* (2004) who utilized a logistic regression analysis and attributes that older patients have a two times higher risk of operating time compared to

younger patients. According to Hupp (2009) older patients' bone become increasingly more calcified and less flexible which makes surgery more difficulty.

Akadiri and Obiechina (2009) recorded that demographic, radiographic, and surgical variables are strongly associated with surgical difficulty. They also found that age has been associated as the most consistent factor in the determination of surgical difficulty by many authors. This was attributed to the differences in bone density associated with age. Although bone density is a factor, a higher rate of complications among patients over 25 years old at 29 % vs. younger patients at 18.3% was mostly related to complete root formation (Carvalho and Do Egito Vasconcelos, 2011). Akadiri *et al.* (2009), however, did not find any association between age and surgical difficulty.

7.7.3 Influence of Sex and Race on Duration of Surgery and Surgical Difficulty

Operating time for males was generally longer at 67.08 minutes compared to females (60.99 minutes). The average operating time between Coloured (61.82 minutes), Indian (63.94 minutes) and White patients (61.91 minutes) were fairly similar. However, Black African patients had a much longer mean operating time of 76.41 minutes. In a study by Phillips *et al.* (2010) male patients had a longer operating time (30 minutes) compared to female patients (28 minutes). They noted that more bone needed to be removed in the male group of patients. Susarla and Dodson (2013) and Carvalho and Do Egito Vasconcelos (2011) also agree that ethnicity, age and gender also affect operating time.

Renton *et al.* (2001) also correlates similar findings with other studies that prove sex is a significant factor associated with surgical difficulty. In contrast, Carvalho *et al.* (2013) revealed findings of their study which showed that sex was not a determinant of surgical difficulty.

7.7.4 Influence of Weight on Duration of Surgery and Surgical Difficulty

In the current study, a linear regression analysis was done which found that weight was not associated with the duration of the operation ($r^2 = 0.00$ and $p = 0.37$). In a study by Susarla and Dodson (2013), they found that BMI could affect operating time. As stated before, the patients' BMI could not be recorded in this study due to the fact that their heights were not recorded.

7.7.5 Influence of Operating Surgeon on Duration of Surgery and Surgical Difficulty

Specialists had a shorter mean operating time of 59.60 minutes as opposed to registrars (62.91 minutes) (SD 20.37). Senior registrars had a shorter mean operating time (58.37 minutes) over junior registrars (65.25 minutes). Benediktsdóttir *et al.* (2004) has also claimed that the operating time has been related to factors such as the experience of the surgeon involved, tooth position and severity of the impaction. Susarla and Dodson (2013) found that the number of teeth extracted and the experience of the surgeon will determine the duration of the operation. Yuasa *et al.* (2002) also attributes surgeon experience to varying operating times.

7.7.6 Influence of Jaw and Tooth Factors on Duration of Surgery and Surgical Difficulty

In the current study, patients that surgically removed all four third molars had a longer mean operating time of 65.47 minutes compared to those that removed less than four teeth (57.02 minutes). Susarla and Dodson (2013) also confirm that the number of teeth extracted determine the duration of the operation. In a study by White *et al.* (2003) 64% of patients had bone removed on all four third molars. This was done with a mean operating time of 30 minutes.

In addition the current study found that the shortest mean operating time occurred when surgery was restricted solely to the maxilla (46.25 minutes). The longest mean operating time resulted when surgery occurred in both jaws (63.88 minutes). Surgery limited to the mandible only resulted in a mean operating time of 55.49 minutes. This correlates with the findings of Obimakinde *et al.* (2013) who discovered that mandibular third molar angulations contribute more to an increased operating time ($p = 0.001$). In addition Susarla and Dodson (2013) discovered that mandibular third molars took 1.9 minutes longer to remove than maxillary third molars.

According to the results of this study, upper third molars being bucco-angulated, mesio-angulated or transverse, Class C with SA resulted in a longer operating time. Likewise for mandibular third molars a tooth being linguo-angulated, inverted or horizontal, Position C and Class III resulted in a longer duration of operation. In addition if both lower third molars are being removed and have been attributed with a Class III then we know that duration of operation is also extended. Thus from the above it can be concluded that the position of the third molar

and its relevant classification will have a direct relation to the anticipated difficulty of the surgery. This is highly significant as Susarla and Dodson (2013) and Carvalho and Do Egito Vasconcelos (2011) also attest to the fact that anatomic factors such as Winter's and Pell & Gregory's Classifications, mouth opening, position of the crown, cheek flexibility, morphology of the crown and roots and position of the roots also contribute to how long an operation would take. Susarla and Dodson (2013) discovered that operating time would be longer of the third molar's angulation was horizontal (4.2 minutes longer), mesio-angular (2.8 minutes longer) and disto-angular (1.4 minutes longer). In addition Benediktsdottir *et al.* (2004) found three variables of a third molar that increase operating time: horizontally angulated ($p = 0.014$), two roots ($p = 0.014$) and roots in close proximity to the IANC ($p = 0.003$). Obimakinde *et al.* (2013) showed similar results with angulation of the impacted third molar having a high correlation to increased operating time ($p = 0.01$). In addition they proved that age and angulation together contribute 44.8% risk of increased operating time (regression coefficient = 0.45).

7.7.7 Influence of Intra-Operative Complications on Duration of Surgery and Surgical Difficulty

There was a highly significant correlation between the mean duration of the operation and intra-operative complications in this study. A mean operating time of 81.57 minutes in cases where an intra-operative complication arose proved statistically significant ($p = 0.00$). However this differed significantly with the literature. Sibastiani *et al.* (2014) reports that there was absolutely no association between intra-operative complications and operating time.

7.7.8 Influence of Medical History on Duration of Surgery and Surgical Difficulty

Patients with medical complications were found to have shorter mean operating time (58.47 minutes) compared to healthy patients (63.45 minutes) in the current study. It was also interesting to note that the mean duration of the operation had a direct influence on post-operative complications that were experienced. In cases where a post-operative complication arose the mean duration of the operation was 68.81 minutes which was statistically significant ($p = 0.001$).

7.8 INCIDENCE OF POST-OPERATIVE COMPLICATIONS

7.8.1 Incidence

There was a 20.43% incidence of post-operative complications found in the current study. Of the 176 post-operative complications that took place the most common complications were paraesthesia (28.41%), sepsis (19.89%) and swelling (15.34%). Dry sockets only accounted for 4.54% of complications. There was only one reported case of a post-operative OAC. Mercier and Precious (1992) reported that the rate of sensory nerve damage has been shown to range from 0.5% - 20%. In a study by Khan *et al.* (2014) there was a significant lower post-operative complication rate. They experienced a complication rate of 4.5% which included OAC, dry socket (5.9%) and paraesthesia (1.5%). Bui *et al.* (2003), however had a much higher post-operative complication rate of 30.9%. Benediktsdottir *et al.* (2004) encountered a 2.8% post-operative complication rate of sepsis. Bui *et al.* (2003) experienced post-operative complications such as nerve damage (1%), bleeding (0.7%), OAC (0.3%) and root fracture (0.2%). Mercier and Precious (1992) report the most common post-operative complications include sensory nerve damage, pain, dry socket, trismus, swelling, haemorrhage and sepsis. Other complications that can occur include Oral-Antral Fistulas, iatrogenic damage, buccal fat herniation and mandibular fracture. In addition, pain, trismus and swelling are widely known as the most prominent complications. In the study by Osunde *et al.* (2014) the most common post-operative complication was delayed healing (5.85%), dry socket (2.7%) and nerve injury (0.9%). In a study by Guerrouani *et al.* (2013) the most common post-operative complication was sepsis. Of the 151 patients this affected 7.15% of the sample.

7.8.2 Influence of Age on Post-Operative Complications

The mean age of patients that presented with post-operative complications was 26.07 years which was statistically significant ($p = 0.00003$). Blondeau and Daniel (2007) observed that patients over 24 years of age had a higher incidence of nerve injury. This is similar with the results of this study. Postoperative pain and paraesthesia has been linked to older patients (Benediktsdóttir *et al.*, 2004). In the study by Nakagawa *et al.* (2007) 29.0% of complications were in older patients while only 18.3% of complications occurred in younger patients. Most of

the complications were found in patients over 25 years of age. Osunde *et al.* (2014) also reported that age ($p = 0.03$) was strongly associated to the development of dry sockets.

7.8.3 Influence of Sex on Post-Operative Complications

71.63% of patients who had a post-operative complication in this study were female. Benediktsdottir *et al.* (2004) and Sigron *et al.* (2014) did not find any difference between post-operative complications in any gender in their study. However, Jerjes *et al.* found a definite association between sex and post-operative complications.

7.8.4 Influence of Race on Post-Operative Complications

51.06% of the patients who experienced a post-operative complication in this study were White, 39.72% Coloured, and 8.51% Black African. Only 1 Indian patient had a post-operative complication.

7.8.5 Influence of Operating Surgeon on Post-Operative Complications

Of the 141 cases where post-operative complications arose, 97.87% of these were experienced by registrars. Only three cases were experienced by specialists. Post-operative complications experienced by the specialists were sepsis, paraesthesia and neuropraxia. 65.22% of post-operative complications experienced by registrars occurred with junior registrars. In a study by Jerjes *et al.* (2006) post-operative complications were much higher in cases treated by the registrars as opposed to the specialists. Paraesthesia occurred more with the registrars (7.53%) as opposed to the specialists. The only significant post-operative complication experienced by the specialists was post-operative bleeding ($p = 0.02$). In this study the surgeons' who had a mean of 10.52 years (SD = 3.62) experience, experienced post-operative complications such as bleeding, dry socket, paraesthesia, jaw stiffness, pain, swelling, sensitivity, sepsis and sharp bony fragments. This was not statistically significant $p = 0.09$. However, according to Jerjes *et al.* (2006) registrars were more likely to have post-operative nerve complications as opposed to specialists which can be attributed to the experience of the surgeon. Jerjes *et al.* (2006) also reports that experience of the surgeon has a bearing on the incidence of post-operative complications. In a study by Osunde *et al.* (2014) surgical experience ($p = 0.04$) was strongly associated to the development of dry sockets.

7.8.6 Influence of Jaw and Tooth Factors on Post-Operative Complications

The incidence of post-operative complications based on tooth factors was also assessed. It was discovered that 65.96% of complications arose when all four third molars were removed. The data revealed that post-operative complications occurred when the mean duration of operation was 68.81 minutes (SD = 24.99) which proved statistically significant ($p = 0.001$). No complications occurred when surgery was restricted to the maxilla only. This also proved statistically significant ($p = 0.04$). In addition only 7.43% of patients whose lower third molar roots were in close proximity to the IANC experienced post-operative paraesthesia while only 0.59% experienced neuropraxia. There was only one patient who had SA experienced an OAC post-operatively. Similarly Benediktsdottir *et al.* (2004) found that there was an increased risk of post-operative complications when the tooth was fully impacted ($p = 0.02$). It was further found that operating time was highly associated to post-operative complications. Four of the patients that had post-operative paraesthesia had roots that were in close proximity to the IANC. Osunde *et al.* (2014) also found correlation between proximity of the lower molar roots to the IANC and an increased risk of post-operative paraesthesia. In the study by Oliveira *et al.* (2006) there was a high association between the incidence of post-operative complications and the duration of surgery. Dental surgery that lasted less than 60 minutes had an incidence rate of 9.6% but those surgeries lasting longer than 120 minutes had an incidence rate of 83.33%. In addition they also discovered that the more surgically difficult the operation was the higher the post-operative complication rate. This was also confirmed by Pathak *et al.* (2014). Jerjes *et al.* (2006) also reports that type and depth of impaction as well as level of surgical difficulty is strongly associated to the occurrence of post-operative complications. Sebastiani *et al.* (2014) results differed significantly as they did not find any correlation between operating time and post-operative complications.

7.8.7 Influence of Medical History on Post-Operative Complications

82.27% of post-operative complications occurred in healthy patients while only 14.18% of complications occurred in patients with a history of Allergies. Jerjes *et al.* (2006) reported that a patient's medical condition could have a negative outcome on the incidence of post-operative complications.

7.9 LIMITATIONS OF THIS STUDY

7.9.1 Loss of files

A larger study could have been possible if all the files could have been accessed. 108 files could not be included in this study due to the file numbers being invalid. This was due to either the file number being entered incorrectly in the theatre records or ineligible writing.

7.9.2 Inadequate data

Many of the files had to be excluded due to missing information. Some of the missing data included no records of dates of consultation, no signs and symptoms noted, no diagnosis included, indication for third molar surgery were not noted, indication for GA were not added, etc.

7.9.3 Radiography

There were three main limitations related to radiography. Firstly radiographic quality could not be standardised. Some radiographs were analogue and some digital. This was a retrospective study and hence could not be controlled. The second limitation was a loss of radiographs. Analogue radiographs were stored in the patients' files and due to missing orthopantomographs, these cases had to be excluded. Thirdly, none of the patients in our sample had CBCT imaging performed. Superior information regarding third molar anatomy would have been possible if there was access to CBCT imaging.

7.9.4 Body Mass Index

Unfortunately no data of any of the patients' BMI was recorded and thus could not be included in our analysis. The anaesthetic records only depicted the patients' weight and not height. Therefore the BMI could not be calculated and recorded.

7.9.5 Lack of follow-up reports

It was common that many of the patients' files did not have any record of post-operative visits. This could be seen as a limitation as possible post-operative complications were then not recorded. Lack of follow-up could have been due to socio-economic factors or complications being treated at a local clinic or private dentist.



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8. CONCLUSION

In conclusion, from the results of this study it was discovered that during the period of the study, the main population group that presented at the Tygerberg Oral Health Centre for third molars surgery were mainly White females in their third decade of life. The main complaint of patients was noted as “pain” with a very small percentage documented for prophylactic reasons. Most patients waited approximately six months for surgery while emergencies were given preference. Factors that were considered for GA were number of third molars needed to be removed, the classification of the impaction, and roots in close proximity to the IANC and SA. It was further found that in addition to the difficulty of impaction, the patient demographics, the experience (specialist vs. registrar) of the operating surgeon and incidence of intra-operative complications all affected the duration of the operation. Post-operative complications were found to be strongly associated with a patient’s age and weight and number of teeth removed. As opposed to other studies performed where mostly specialists perform third molars surgery, registrars were the main operating group. Senior registrars experienced less post-operative complications than junior registrars.

This study has definitely provided a better understanding of the demographic profile of the patients that presented for third molar surgery at the Tygerberg Oral Health Centre. In addition significant information is now available on the clinical data and radiographically analysis of these patients.

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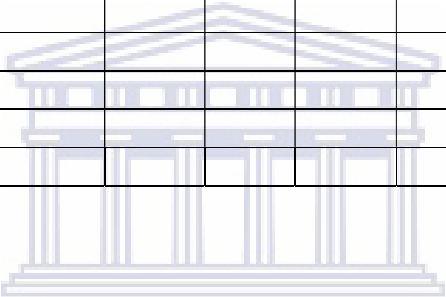
10. APPENDIX

10.1 APPENDIX 1 – DATA COLLECTION SHEET

Department of Maxillofacial and Oral Surgery
Faculty of Dentistry and WHO Oral Health Collaborating Centre
University of Western Cape
Data Collection Sheet

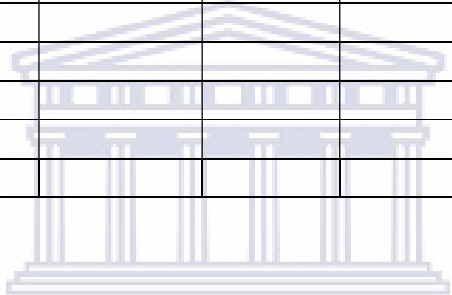
GeoLoc Res	Sub District	Medi Aid	Med Aid Type	Surgeon	RegStudY	YOfExp	Registrar	Specialist	Toothno	All 4	18	28	38	48	Sex	Age	Weight

DurOp(mins)	DistFromHome(kms)	Angulation18	Angulation28	Angulation38	Angulation48	ClassImp18	ClassImp28	PositionImp38	PositionImp48	Class48	Class38	SA18	SA28



UNIVERSITY of the WESTERN CAPE

Healthy	MedHx Type	WaitingTime for Op(Wks)	IndGA	ProxRootToIANC	IntraOpComp	IntraOpCompType	PostOpComp	PostOpCompType



UNIVERSITY of the WESTERN CAPE

10.2 APPENDIX 2 – ETHICS APPROVAL



OFFICE OF THE DIRECTOR: RESEARCH RESEARCH AND INNOVATION DIVISION

Private Bag X17, Bellville 7535
South Africa
T: +27 21 959 2988/2948
F: +27 21 959 3170
E: research-ethics@uwc.ac.za
www.uwc.ac.za

06 December 2016

Dr MR Goolam Nabee & Prof JA Morkel
Faculty of Dentistry

Ethics Reference Number: BM/16/3/5

Project Title: Demographic profile of patients presenting for third molar surgery under general anaesthesia.

Approval Period: 24 November 2016 – 24 November 2017

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval. Please remember to submit a progress report in good time for annual renewal.

The Committee must be informed of any serious adverse event and/or termination of the study.

A handwritten signature in black ink, appearing to read 'Patricia Josias'.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

PROVISIONAL REC NUMBER -130416-030

10.3 APPENDIX 3 -PERMISSION TO CONDUCT RESEARCH AT UWC



30 June 2017

RE: PERMISSION TO CONDUCT RESEARCH AT THE UNIVERSITY OF THE WESTERN CAPE

Name of Researcher : Mahomed Ridhwaan Goolam Nabee
Research Topic : Demographic profile, clinical data and radiographic analysis of patients for third molar surgery under general anaesthesia at the faculty of dentistry at the University of the Western Cape
Date of issue : 30/06/2017
Reference number : UWCRP30617MRGN

As per your request, we acknowledge that you have obtained the necessary permissions and ethics clearances and are welcome to conduct your research as outlined in your proposal and communication with us.

Please note that while we give permission to conduct such research (i.e. interviews and surveys) staff and students at this University are not compelled to participate and may decline to participate should they wish to.

Should you wish to make use of or reference to the University's name, spaces, identity, etc. in any publication/s, you must first furnish the University with a copy of the proposed publication/s so that the University can verify and grant permission for such publication/s to be made publicly available.

Should you require any assistance in conducting your research in regards to access to student contact information please do let us know so that we can facilitate where possible.

Yours sincerely

A handwritten signature in black ink, appearing to read 'A. Shaikjee'.

DR AHMED SHAIKJEE
DEPUTY REGISTRAR: ACADEMIC ADMINISTRATION
OFFICE OF THE REGISTRAR

UWCRP30617MRGN



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WESTERN CAPE