PREVALENCE OF IMPACTED MANDIBULAR THIRD MOLARS IN THE MTWALUME DISTRICT IN KZN

Dr Karensa Govender

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DECLARATION

I, Dr Karensa Govender, hereby declare that the work on which this research report is based, is original (except where acknowledgements indicate otherwise). It is being submitted for a Master in Science of Dentistry degree in the field of Maxillofacial and Oral Surgery to the University of the Witwatersrand. The work within this research report, neither any part of it has been, or shall be submitted for any other degree at this or any other university.

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Dr Karensa Govender

Signed at Durban on this…….………day of……………………………………. 2019.

DEDICATION

I dedicate this research report to my dad, Chips, my mum, Priscilla, my brother Shailen and partner Clyde for their support and encouragement provided throughout the duration of this study.

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To my family, for their consistent and continued support, thank you.

ABSTRACT

Introduction

An impacted tooth is an abnormal dental occurrence, which frequently requires a surgical procedure for removal. Mandibular third molars (M3s) are the most frequently impacted teeth, with little information on the associated causes, patterns and radiographic pathology amongst the South African population.

Aims and objectives

The aim and objectives of this study were to determine the prevalence, type of impactions and identified radiographic analysis of pathology associated with impacted mandibular M3s in the Mtwalume population of KwaZulu-Natal, South Africa.

Materials and Methods

The study sample comprised of 97 patients that presented to the dental clinic at Turton Community Health Centre. Lateral oblique radiographs were analysed for the presence and type of impactions, using Winters (1926) classification. The presence of apical or coronal radiographic pathology amongst different age groups was identified. All impacted mandibular M3s were classified according to these parameters.

Results

The study sample had a male to female ratio of 1:1.4. The overall prevalence of impacted mandibular M3s was 1.02%. The leading age interval was found between 21-30 years. Mesioangular (59.8%) type of impaction was the most common. No significant difference was found between the types of angulation and associated age groups. The leading associated radiographic pathology was caries (39.5%) and the least prevalent pathologies were radiopaque lesions (3.9%) and pericoronal radiolucent lesions (2.3%). A significant difference was found between the angulation of impaction and the specific radiographic pathology such as caries, periodontal bone loss, root resorption and apical radiolucent lesions.

Conclusion

The study showed that impacted mandibular third M3s have a prevalence of 1.02%, which differs from the literature that has shown higher incidence rates among different population groups. Although the study sample from this population was small, one can extrapolate that is a common condition. Furthermore, the study showed that there seems to be a correlation between certain types of angulations (mesioangular and horizontal) and associated pathology (caries, root resorption) The overall distribution of pathology associated with impacted teeth was recorded the highest for caries. This shows an area of concern in oral health education and prevention programs in the area. For this reason, it is recommended that public institutions develop specific screening programs to identify impacted M3s, before severe symptoms or potential pathology develop.

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KEYWORDS

Angulation

Apical

Distoangular

Impacted tooth

Lateral oblique

Mandibular third molars

Mesioangular

Orthopantomograms

Prevalence

Radiolucent

ABBREVIATIONS

M2- Second molar

M3- Third molar

E.g.- Example

CHAPTER 1

INTRODUCTION

The Mtwalume area is located in the rural south coastal region of KwaZulu-Natal (KZN). Turton Community Health Centre is the main public institution providing oral health care to this community. The dentistry department renders services such as extractions, surgical extractions of impacted third molars (M3s), restorations, root canal treatments and management of facial and oral trauma. Over the years, the number of patients presenting with impacted M3s progressively increased. However, it was not possible to manage all cases at a community health centre level and it became imperative that specialised referrals for the majority of patients were required. The overview of the current referral system for impacted M3s requires that patients from this area be referred to Provincial Level Hospitals, located in the Durban area approximately ninety kilometres away from the institution. The transport arrangement to and from these hospitals requires patients to board a bus at the nearest Regional Level Hospital within the district, located thirty-seven kilometres away, from the Mtwalume area. This system poses great financial stress, in a largely poor population, therefore changes should be considered to favour the health and well-being of patients in this community.

Third molar (M3) impactions are often encountered by Dentists and Oral surgeons in daily practice in various population groups. Several studies have been done on impacted M3s in various countries (Eshghpour et al. 2014; Msagati et al. 2013). However, a study on the prevalence, associated age and radiographic analysis of pathology with these teeth has not been done in the Mtwalume area of KZN.

Impacted permanent teeth are frequently seen dental abnormalities and the incidence varies amongst different populations and ethnicities (El-Khateeb et al. 2015). Impaction of a permanent tooth occurs due to the lack of ability of the tooth to completely erupt and may be due to several factors, such as an obstruction in the path of eruption, resulting in failure of the tooth's normal functional position (Eshghpour et al. 2014; Sheikhi et al. 2016). The obstruction could be caused by the surrounding bone, adjacent teeth, the overlying soft tissue and insufficient space for proper eruption (Sheikhi et al. 2016). This situation is pathological and may lead to a variety of clinical conditions such as pericoronitis, periodontitis, caries, adjacent root resorption, cystic lesions and neoplasms (Akarslan and Kocabay, 2009; McCoy, 2012; Mokhtar et al. 2015).

Impacted teeth may occur either in the maxilla or mandible, and a patient may present clinically with more than one impacted tooth in either jaw. Impacted teeth may be diagnosed clinically and with the aid of radiographs such as orthopantomograms (Figure 1.1), lateral oblique and periapical radiographs (Balaji, 2007: 236; Tsabedze, 2012).

The impacted M3 is a common phenomenon and is continuously generating controversy regarding the pattern of their eruption and associated pathological sequelae more than any other tooth in the oral cavity. The mandibular M3 is the most frequently impacted tooth (Eshghpour et al. 2014; Hashemipour et al. 2013; Muhamad and Nezar, 2016), with incidence varying from 9.5% to 68% among different populations.

A study by Obimakinde (as cited by Muhamad and Nezar, 2016) found that mandibular M3s are the most commonly impacted teeth, followed by maxillary M3s, maxillary canines and mandibular canines. Which is in agreement with the findings of El-Khateeb et al. (2015).

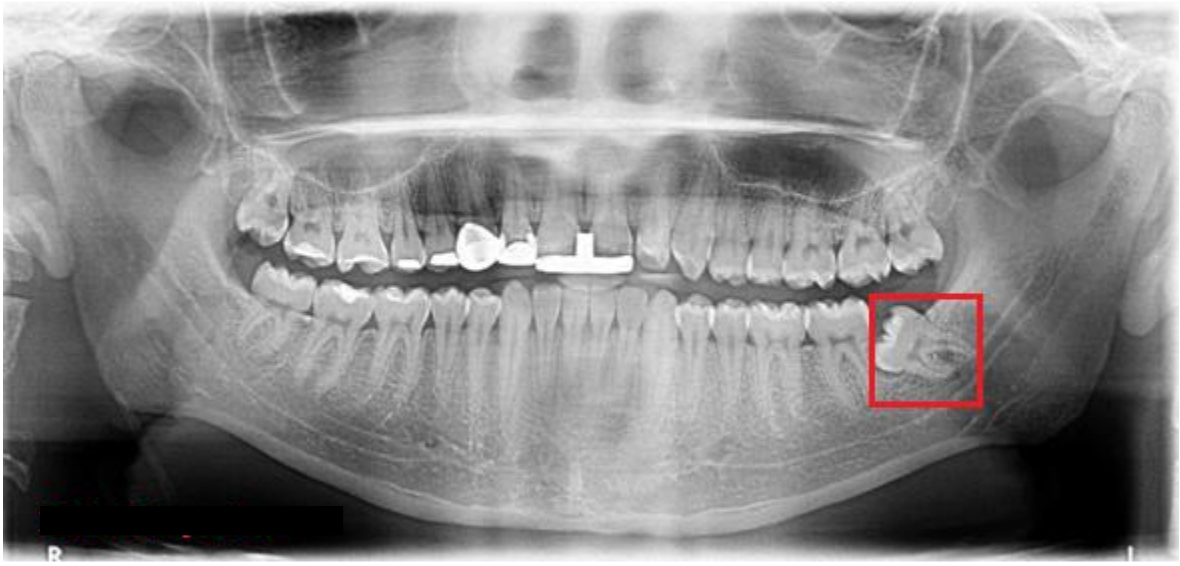


Figure 1.1 Orthopantomogram showing impacted mandibular third molar on left (Ishwarkumar, 2015)

CHAPTER 2

LITERATURE REVIEW

2.1 Definition

A tooth is viewed as impacted when it is partially erupted or completely unerupted, beyond the sequential date of eruption, and will ultimately not assume a normal functional relationship with the other surrounding teeth or tissues in the oral cavity (Balaji, 2007: 230). An impacted tooth is viewed as partially erupted when it is not fully enclosed in the surrounding bone and soft tissues and has communication with the oral cavity. On the other hand, a tooth that is completely impacted is completely embedded in the surrounding bone and has no communication with the oral cavity (Alamgir et al. 2015).

Third molar formation begins between the ages of 4 to 5 years, calcification of the tooth starts between 7 to 10 years and crown completion occurs between 12 to 16 years of age (McCoy, 2012). Eruption times of M3s vary from ages between 16 to 24 years, with a mean age of eruption at 17 years. M3s are the last teeth to erupt bearing a higher risk of being impacted and may occur in both the maxilla and mandible (Muhamad and Nezar, 2016).

2.2 Predisposing factors

Aetiological factors associated with impacted M3s may be local or systemic. Local factors include lack of space, increased density of the overlying or surrounding bone, delayed maturation of the third molars, limited skeletal growth, various obstructions such as thick fibrous alveolar mucosa, odontogenic cysts and tumours (Akarslan and Kocabay, 2009; Alamgir et al. 2015).

Systemic factors include postnatal causes that interfere with child development such as rickets, anaemia, tuberculosis, congenital syphilis and malnutrition (Kaur, 2015;

Tsabedze, 2012). Systemic syndromes associated with impacted teeth include Down's syndrome, cleidocranial dysostosis, Gardner's syndrome, Gorlin-Sedano syndrome, and Yunis-Varon syndrome (Alamgir et al. 2015; Msagati et al. 2013).

Muhamad and Nezar (2016) cited two aetiologies reviewed and described by Svendson and Maertens:

- Lack of space: resulting in insufficient anterior-posterior width, insufficient transverse distance of the alveolar processes in M3 region, wide alveolar shelves and a larger mandibular width at the ramus in relation to the intermolar width.
- Late M3 mineralization and early physical maturation.

There are several other theories explaining the aetiology of M3 impactions such as lack of eruptive force, hereditary causes and inadequate mesial movement of the teeth due to insufficient interproximal attrition (Sheikhi et al. 2016; Tsabedze, 2012).

2.3 Classification of impacted mandibular third molars

2.3.1 Winter's method

The angulations of impacted mandibular M3s can be classified based on the inclination of the impacted M3 to the long axis of the second molar (M2) tooth (Winter, 1926: 42-43). The four categories of impactions identified are described as follows:

- **Vertical impaction:** the crown of the M3 is in a vertical position, its occlusal surface may be in alignment or below the corresponding occlusal surface of the adjacent M2, and the mesial surface of the M3 may or may not contact the distal surface of the M2.

- **Horizontal impaction:** when the M3s occlusal surface has a vertical position compared with the corresponding surface of the M2, and a part or the whole occlusal surface may or may not contact the distal surface of the M2.

- **Mesioangular impaction:** when the occlusal surface of the M3 is in an angular position mesially as compared with the occlusal surface of the M2 and the mesial surface of the M3 may or may not contact the distal surface of the M2.

- **Distoangular impaction:** when the occlusal surface of the M3 is in an angular position distally as compared with the corresponding surface of the M2 and its mesial surface may or may not be in contact with the distal surface of the M2.

Muhamad and Nezar (2016) described the modified classification of the original Winter's classification, which identifies other impaction types such as:

- Buccolingual impaction – which refers to any tooth crown facing a buccal or lingual direction. The inverted type – when a tooth is impacted vertically with the crown facing the inferior alveolar nerve canal.

2.3.2 Quek and colleagues (Quek et al. 2003)

Quek et al. (2003) proposed a classification based on Winter's classification, where the angulations of the impacted mandibular M3s can be calculated by the angle formed between the intersected longitudinal axes of the M2 and M3. They classified the degree of these angles as follows (illustrated in Figure 2.1):

- Vertical impaction: 10° to -10°
- Mesioangular impaction: 11° to 79°
- Horizontal impaction: 80° to 100°
- Distoangular impaction: -11° to -79°
- Others: 111° to -80°
- Buccolingual impaction

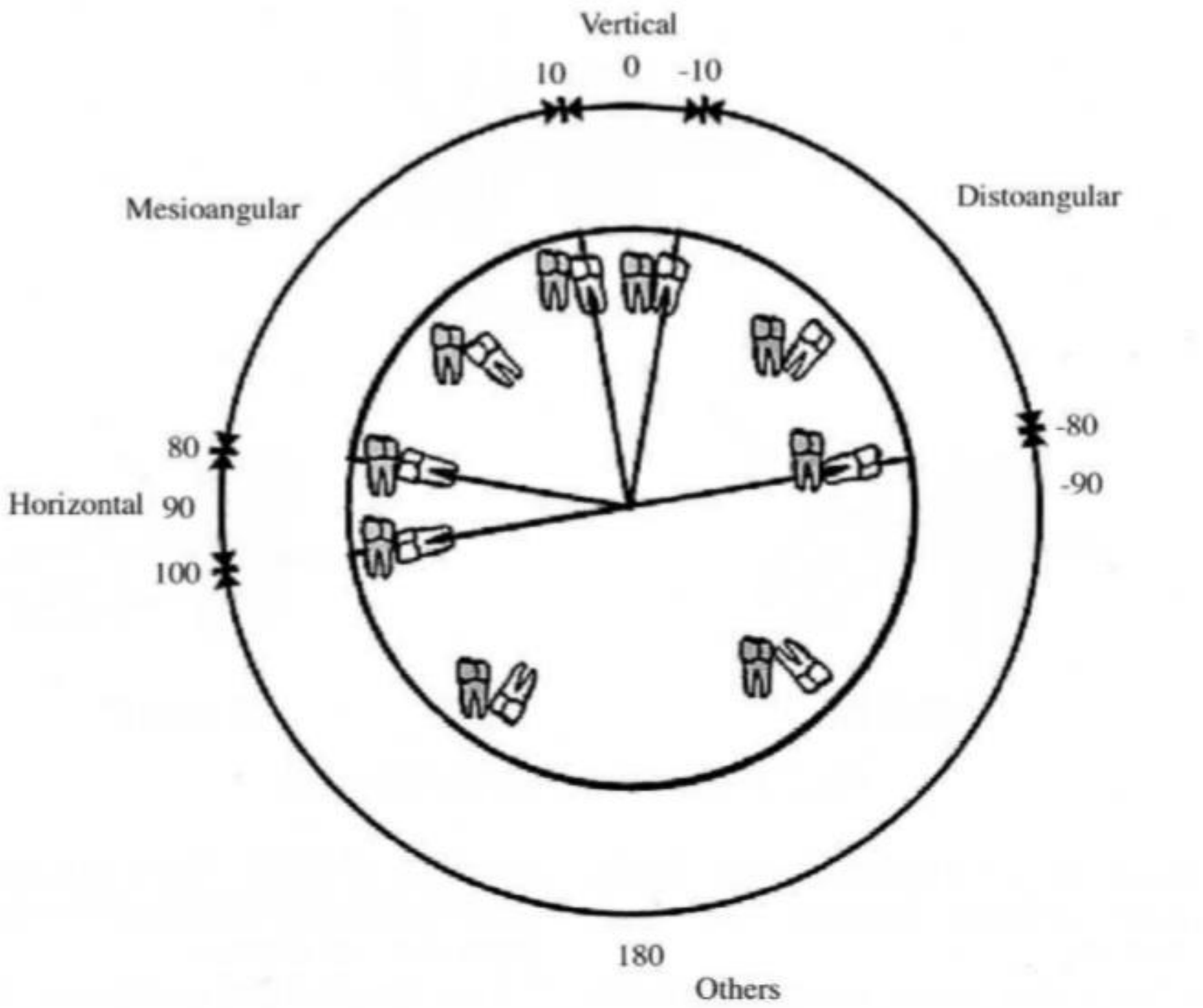


Figure 2.1: Classification of angle of impaction (Quek et al. 2003)

2.3.3 Pell and Gregory method

Impacted M3s may be classified according to Pell and Gregory (1933) based on two parameters:

1. The space available between the M2 and the ramus of the mandible to accommodate the mesiodistal width of the M3, classified into three classes: I, II, II.

2. The depth of the M3 within the bone. The highest portion of the M3s position is determined relative to the occlusal plane and cervical line of the M2. The depth of the M3 is classified in to three positions: A, B, C.

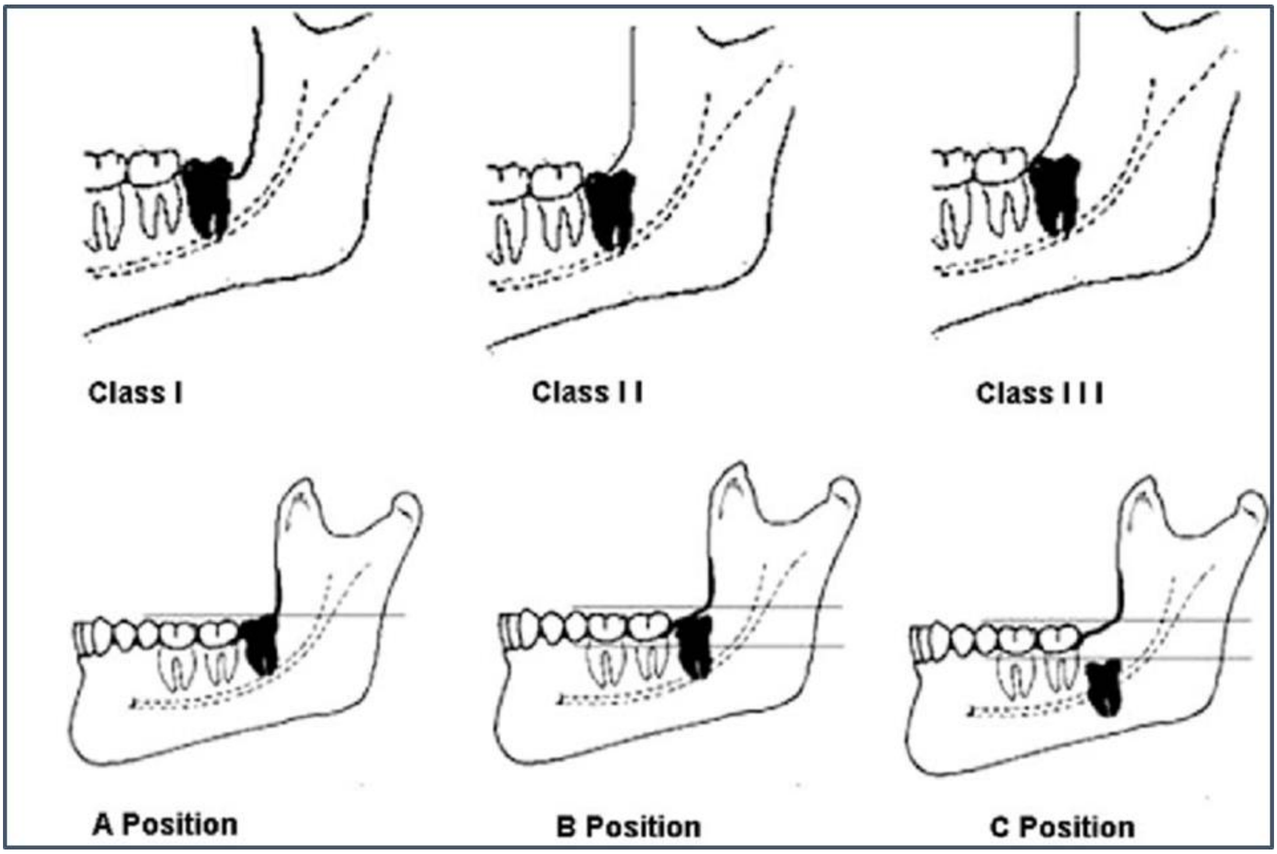


Figure 2.2: Diagram illustrating mandibular M3 positions according to Pell and Gregory method (Watanabe et al., 2009)

2.4 Prevalence of impacted third molars

Several studies conducted reveal that the most frequently impacted permanent tooth is the mandibular M3 (Eshghpour et al. 2014; Hashemipour et al. 2013; Jaffar and Tin-Oo, 2009; Muhamad and Nezar, 2016). Padhye et al. (2013) mentioned that the mandibular M3 accounts for 98% of all impactions. Kaur (2015) reports a prevalence rate for mandibular M3 impaction between 30.7% and 49.3% amongst two different age groups. Whilst Msagati et al. (2013) found 84% of patients with impactions in Tanzania presented with impacted mandibular M3s.

Eshghpour et al. (2014) found that in the Northeast Iranian population the most common angulation types of impacted mandibular M3s were mesioangular (48.67%), horizontal (23.13%) and vertical (15.60%) angulations. Similarly, mesioangular, horizontal and vertical types were found as the most common types in an Arab Israeli, Southeast Iranian and Turkish population respectively (Akarslan and Kocabay, 2009; Hashemipour et al. 2013; Muhamad and Nezar, 2016).

In Nigeria, studies reveal the mesioangular type of impaction as the most frequent, which was similarly found as the most frequent type amongst Korean (45.6%), Chinese (80%), Thai and Spanish (71.5%) populations. Conversely, a study in the Jordanian population differs in that the most common angulations are vertical (61.4%), followed by the mesioangular (18.1%) type. Studies by Sasano et al. 2003 (as cited by Muhamad and Nezar, 2016) found vertical (46%), horizontal (34%), mesial (19.5%) and distal (0.5%) angulations. These differences could be explained by different methods of classification of angulations in these studies (Hashemipour et al. 2013).

2.5 Demographic distribution

Researchers have found variations in gender prevalence. Several studies report a higher female to male incidence of impacted mandibular M3s (Alamgir et al. 2015; Eshghpour et al. 2014; Hashemipour et al. 2013). In contrast, other studies reported a higher male to female incidence of impacted M3s (Kaur, 2015; Muhamad and Nezar, 2016). Quek et al. (2003) explained a proposed theory by Hellman, that a higher incidence of impacted M3s in females could be due to the physical growth pattern of the jaw which ceases earlier in females compared to males, resulting in an anatomically smaller jaw size. Kaur (2015) cited multiple studies by Pillai et al. (2014); Hazza et al. (2006); Gupta et al. (2011) and Phadye et al. (2013) that reported insignificant sexual predilection.

Third molar impactions are commonly presented in young adults. Muhamad and Nezar (2016) reported a 50% incidence of impactions between the ages of 21-30 years, followed by 25.2% incidence between the ages of 31-40 years. Kaur (2015) found 49.3% prevalence of impactions between 21-25 years and 30.7% prevalence between 26 -30-year-old adults. Several studies show a declining incidence with increasing age (Hashemipour et al. 2013; Muhamad and Nezar, 2016; Sheikhi et al. 2016).

2.6 Frequent pathology and complications associated with the impacted third molars

Dental professionals are often faced with making a decision on whether or not to remove impacted mandibular M3s (Polat et al. 2008). Impacted, partially or fully erupted teeth may be asymptomatic for years without clinical symptoms (Akarslan and Kocabay, 2009; Polat et al. 2008). Mandibular M3s may have varying patterns and positions that can lead to a wide range of pathologies (Shahzad et al. 2016). They may present with complications like acute pain, pericoronitis, caries, resorption of adjacent M2, cysts, tumours, periodontal disease, temporomandibular joint dysfunction, crowding and susceptibility to jaw fracture due to weakening of the angle of the mandible (Akarslan and Kocabay, 2009; Hashemipour et al. 2013; Mokhtar et al. 2015; Santhosh et al. 2015).

Polat et al*.* (2008) mentioned a well-defined criterion from a Consensus Development Conference on the removal of third molars held at the National Institute of Health in 1979. The indications for removing impacted M3s included infection, carious lesions that are not restorable, cystic lesions, tumours and destruction of adjacent teeth and tissues.

2.6.1 Pericoronitis

Pericoronitis can be described as a common localized acute inflammatory disease involving mandibular M3s, with a common occurrence in adults between the ages of 18-25 years (McCoy, 2012). The soft tissue that covers an impacted or partially erupted mandibular M3 is called a gingival operculum. Dhonge et al. (2015) describes this site as an ideal area for bacterial growth and is difficult to keep clean, resulting in accumulation of plaque and food debris, that potentiates the inflammatory process of the pericoronal tissues. Pericoronitis may also be caused by other aggravating factors such as occlusal trauma from the opposing tooth or foreign body entrapment beneath the operculum (Dhonge et al. 2015). Recurrent pericoronitis is the main cause for extraction of these teeth (Jaffar and Tin-Oo, 2009). Mesioangular impactions are the most frequent type associated with pericoronitis, followed by the distoangular, vertical and horizontal types (McCoy, 2012; Shahzad et al. 2016).

2.6.2 Dental caries

Dental caries is a chronic infectious process causing the destruction of calcified dental hard tissues by acidic by-products from bacterial fermentation of dietary carbohydrates (Yadav and Prakash, 2016). Some researchers report caries to be the most frequent pathology associated with impacted mandibular M3s. Carious lesions may occur on the adjacent M2 or the impacted M3 itself (Alamgir et al. 2015; Syed et al. 2017).

Impacted or partially erupted M3s provide favourable conditions for bacterial accumulation compared to a fully erupted tooth. As with pericoronitis, plaque and food debris accumulate around the gingiva of a partially enclosed tooth, preventing adequate tooth brushing and flossing resulting in caries formation (Brkić, 2012: 68).

The most common angulations involved with M2 caries are mesioangular and horizontal impactions (Akarslan and Kocabay, 2009; Campbell, 2013). The occlusal surfaces of these impacted teeth (that are partially exposed to the oral cavity) creates plaque retentive crevices against the distal surface of the adjacent M2 that may cause distal cervical caries on the M2 (Chu et al. 2003, Brkić, 2012: 68).

2.6.3 Periodontitis

Periodontal disease is a localized pathological process affecting one or more of the periodontal tissues, which may include the cementum, periodontal ligament, alveolar bone or surrounding gingiva. Often M3s are difficult to clean, allowing accumulation and virulence of periodontal pathogens in the associated area (McCoy, 2012). The occurrence of periodontitis increases with age regardless of whether the M3 is present or not, therefore a higher incidence of periodontitis can be found amongst older patients in relation to impacted M3s (Santosh, 2015). In a study by Polat et al. (2008) distoangular and vertical types of impacted mandibular M3s had a high risk of developing bone loss at the distal aspect, while horizontal and mesioangular types had a high risk for periodontal damage on the adjacent M2.

2.6.4 Root resorption

Impacted M3 teeth are common sites of external resorption at the distal roots of the adjacent M2s. Resorption of adjacent tooth roots is caused by pressure exerted by the impacted tooth. Resorption can be seen on radiographs as irregular scalloped shaped borders on adjacent roots (Kanas and Kanas, 2011).

2.6.5 Odontogenic Cyst and Odontogenic Tumours

The dental follicle is an important part of the tooth germ which surrounds the crown of impacted teeth and plays a vital role during the growth and eruption phase of these teeth. It is identified as a pericoronal radiolucency of approximately 2-2.5mm in width (Haghanifar et al*.* 2014). An increased width above 2.5mm is considered a "radiographic pathology" (Adaki et al*.* 2013). The dental follicle's odontogenic components may be linked to the origin of a number of different types of odontogenic cysts and tumours (Haghanifar et al*.* 2014). These cysts and tumours may be seen in some cases with impacted M3s, however, they are not common (Santosh, 2015). Dentigerous cyst is the most common developmental odontogenic cyst that is always associated with an impacted tooth, most frequently a mandibular M3. Odontogenic keratocysts (OKC) are highly aggressive and are the most commonly occurring odontogenic cysts, arising in individuals between the ages of 10-40 years, but can be seen in all age groups. They mostly occur in the mandibular M3 area (McCoy, 2012). In a study by Alamgir et al. (2015) the diagnosis of OKC was 52.8%, followed by squamous cell carcinoma with 39.6% and 7.5% diagnosed as ameloblastoma.

2.7 Radiographic Techniques

There are several different radiographic techniques that can be used to assess impacted M3s. Some examples include intra-oral techniques like periapical radiographs. Extra-oral techniques such as lateral oblique, orthopantomograms, computed tomography (CT) and skull radiography (Jamil et al. 2017).
The radiograph selected should clearly identify the whole impacted M3, adjacent M2, the surrounding bone, inferior alveolar nerve canal and the anterior border of the ascending ramus of the mandible (Tsabedze, 2012).

2.8 Management of third molars

There is controversy in the literature concerning the management of M3s. Two schools of thought may be outlined regarding the management of M3s. The first school of thought describes the observation and retention of asymptomatic M3s unless they create or become associated with a pathological condition, while the second school of thought describes the prophylactic removal of all M3s that may be asymptomatic and disease-free (Boughner, 2013).

The retention of asymptomatic impacted M3s requires continued monitoring to evaluate the status of the impacted M3. This type of management approach requires that individuals have regular dental screenings so that early detection of any symptoms associated with the respective M3, can be identified and thereafter the suitable treatment may be provided (Mettes et al. 2012).

Asymptomatic M3 is described when the patient does not experience pain or discomfort related to the third molar. The patient may have no complaints of pain and be “asymptomatic”, however, there may be clinical or radiographic signs of pathological changes that can be associated with impacted M3s. Hence, asymptomatic does not mean the patient is disease-free (Devishree et al. 2018). When impacted M3s cause symptoms of pain or pathological changes, such as pericoronitis, swelling, root resorption, periodontal disease and cysts or tumours, removal is then an appropriate treatment decision (McCoy, 2012).

Mettes et al. (2012) found that there is insufficient evidence to refute or support the routine prophylactic removal of impacted M3s. The decision-making process on whether to retain or remove impacted M3s should be based on the best available diagnostic evidence combined with clinical experience (Devishree et al. 2018).

In summary, it is well documented from the literature that the impacted mandibular M3 is a commonly encountered tooth anomaly affecting different population groups which engage the normal eruption age range of M3s. The aetiological factors of impacted M3s may be broadly subdivided into local factors (e.g. lack of space, limited skeletal growth) and systemic factors (e.g. rickets, anaemia). Systemic syndromes (e.g. Down's syndrome, Gardner's syndrome) may also be associated with impacted M3s.

Impacted M3s may be unveiled as incidental radiographic findings during examination or become apparent when associated symptoms develop (Alamgir et al. 2015). These teeth can then be classified according to their depth and angular position within the surrounding bone, using different classification methods, as previously described. Classification systems are important when assessing the difficulty of the surgical extraction procedure and may enable the clinician to reassess the removal of the impacted M3 and select an appropriate treatment, as well as to avoid possible complications (Juodzbalys and Daugela, 2013). Identifying the angular position within the surrounding bone is important, as it also has an impact on the development of clinical symptoms (Yilmaz et al. 2016).

Mandibular M3s have varying patterns and positions that can lead to pathology formation, such as caries, pericoronitis, resorption of adjacent teeth, cystic lesions and tumours (Shahzad et al. 2016). From the literature, certain pathologies (e.g. caries, pericoronitis) may commonly occur in certain types (mesioangular) of impactions. The pathologies described are well-defined criterion, indicating the removal of the M3 as the appropriate treatment modality (Polat et al. 2008). Conversely, an impacted M3 may be asymptomatic and disease-free, and as clinicians, it is imperative to be aware of the potential pathologic conditions frequently associated with these teeth, so that asymptomatic teeth in good health can be preserved (El-Khateeb et al. 2015).

CHAPTER 3

AIM AND OBJECTIVES

3.1 Aim

The aim of the study was to determine the prevalence of impacted mandibular third molars and determine the radiographic analysis of pathology associated with these teeth for patients that presented to the dental clinic at Turton Community Health Centre over a two-year period of March 2016 to March 2018.

3.2 Objectives

The objectives of the study were to determine:

a. The prevalence of impacted mandibular third molars among different age groups.
b. Inter-age group analysis for the type of impactions and pathologies associated with impacted mandibular third molars.
c. The association between the type of impacted mandibular third molars and their radiographic analysis of associated apical/coronal pathology.

3.3 Purpose of the study

A study of this nature has never been done in the rural region of Mtwalume in KwaZulu-Natal. The profile of the population is different from Gauteng and the Western Cape Province where most studies were undertaken. This study may help in human resource planning for the clinic and the province in general. Upon completion of the study, the definitive data will be provided to Regional and District Level Hospitals that receive referrals for impacted mandibular M3s from the Mtwalume population. This may aid in the evaluation and treatment planning for prospective patients from this district.

CHAPTER 4

MATERIALS AND METHODS

4.1 Background of clinical setting

Turton Community Health Centre is a public institution located in Mtwalume of KwaZulu Natal, which is the location where the study material was obtained from. This institution was effectively opened in the year 2012 and since its establishment, public awareness regarding oral health has steadily increased. A study of this nature has never been done in this community. Therefore, the major purpose of the current study was to bring awareness of the increasing number of impacted teeth diagnosed in the area, the challenges faced regarding referral of these cases and the management thereof.

4.2 Study design

A retrospective study was done, patient records and radiographs were examined for mandibular M3 impactions, for the period of March 2016 to March 2018. Only patient records with lateral oblique radiographs were considered for evaluation. Lateral oblique radiographs are the only radiographic technique available at the institution to identify the mandibular M3 impactions. Other types of radiographs such as orthopantomograms and periapical radiographs can be used to identify impacted M3s. However, due to the lack of radiographic equipment at the institution, these radiographs could not be used in the study. The study involved patients with an oral diagnosis of impacted M3s.

The radiographs were taken with the same x-ray unit Shimadzu Model UD150L-40E, manufactured by AXIM.

4.3 Selection of radiographs

4.3.1 Inclusion criteria

- Radiographs of adult patients having one or more impacted mandibular M3s were included in the study.
- Only patient records stipulating ages 17 years or older were included in the study.
- Only patient records with lateral oblique radiographs.

4.3.2 Exclusion criteria

- Radiographs with missing M3s, jaw trauma and those with poor diagnostic quality were excluded from the study.
- Patient records with missing information, such as demographic details and dates on respective radiographs were also excluded from the study.
- Patient records stipulating age < 17years were excluded.

4.4 Sampling

4.4.1 Sample method

The convenient sampling method was used. Available patient records (that met the inclusion criteria) with impacted mandibular M3s were extracted from the dental clinic's database to estimate the prevalence. All dental lateral oblique radiographs, which included impacted mandibular M3s, were collected from patient files. The radiographs were selected randomly. All radiographs were assigned a study number, then randomly shuffled and recorded on a Microsoft Excel spreadsheet.

4.4.2 Sample size

One hundred and thirty-seven radiographs (n= 137) from patient records were collected between the ages of 17 to 52, with a sample total of (n= 97) records analysed. Demographic details from these files were recorded and kept anonymously on a password protected document. A biostatistician was consulted to confirm the minimum (n=96) sample size for statistical analysis, using a 95% confidence level and a 10% precision level using MINITAB statistical software.

4.5 Data recording

Patient records were retrieved from the archives at Turton Community Health Centre. From each file, demographic data concerning age and gender were recorded. Each lateral oblique radiograph was assessed for the presence and types of mandibular M3 impactions. Lateral oblique radiographs were assessed for the angle of impaction and associated radiographic pathology identified. A data collection sheet (Appendix A) was used to record this information for all patient records that met the inclusion criteria of the study.

4.5.1 Angle of impaction

The longitudinal axes of all impacted mandibular M3s and M2s were marked on each radiograph with a ruler. Thereafter a circular protractor calibrated from 0 – 180 degrees was used to measure the angle formed between the intersected longitudinal axes formed between the second and third molars respectively. Using the method proposed by Quek et al. (2003), impactions were classified into the following types:

Vertical - 10º to -10º

Horizontal - 80º to 100º

Mesioangular - 11º to 79º

Distoangular - -11º to -79º

Others - -111º to -80

4.5.2 Radiographic pathology

Each impacted mandibular third molar was analysed to identify any radiographic pathology associated with the impacted tooth. The pathology most frequently found was listed and recorded on a data collection sheet. The pathology identified included:

1. Caries – Appendix B
2. Periodontal bone loss – Appendix B
3. Radiolucent lesion (apical) – Appendix C
4. Radiolucent lesion (pericoronal) – Appendix C
5. Other (e.g. root resorption) – Appendix D

4.6 Intra-examiner reliability

The same examiner measured the angles of impaction and analysed the radiographic pathology associated with the impacted M3 on two separate occasions over a two-week interval.

4.7 Data analysis

For analysis of the prevalence of impacted M3s, summary statistics were used whereby categorical variables (e.g. age groups, gender, type of impaction) were summarized by frequency counts and percentages. Pie charts were used as a graphical summary of individual variables such as gender, while two-way associations between categorical variables such as age groups, angulation of impacted mandibular third molars and radiographic pathologies were expressed in tabular form.

For assessing radiographic pathologies, the Pearson Chi-square test at 5% level of significance was used (with p values supplied) to determine the association between categorical variables such as angulations of impacted mandibular third molars and apical or coronal radiographic pathology. This was also used to determine the association between different type of impactions and pathologies found among different age groups. Incidence rates were expressed as percentages and a 95% confidence level was adhered to for all statistical tests. All statistical procedures were performed on SPSS version 25, running under Microsoft Windows 10. All statistical tests were two-sided, and p values < 0.05 was considered statistically significant.

4.8 Ethical consideration

The research protocol was presented verbally and in writing to an assessor group of the School of Oral Health Sciences that represented the postgraduate committee of the Faculty of Health Sciences at the University of the Witwatersrand. Thereafter approval of research title (Appendix E) followed by provisional approval (Appendix F) was granted.

Permission was sought from Turton Community Health Centre's CEO and Administration manager (Appendix G & H) to access patient records from the institution. After their approval, it was submitted to the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Appendix I). Ethical approval was also granted from the KwaZulu-Natal Department of Health (Appendix J) and a Biomedical Research Ethics Committee from the University of KwaZulu-Natal (Appendix K).

All information collected was kept confidential, and access was only available to the researcher. Patient records that were collected were locked in the researcher's office at the study site. All demographic details and patient diagnoses were recorded on a password protected file to maintain confidentiality at all times.

CHAPTER 5

RESULTS

5.1 The study sample

A total number of 9517 patients presented to the dental department at Turton Community Health Centre during March 2016 to March 2018, with a total of 137 (n=137) patient records collected with mandibular M3 impactions. A total of 97 (n=97) patient records met the inclusion criteria of the study and thus a total of n=97 records were analysed. Forty (n=40) patient records were excluded from the study due to either missing information or missing lateral oblique radiographs.

5.2 Sample demographics

The study sample consisted of 97 patient records, with a male to female ratio recorded at 1:1.4. The minimum inclusion age was 17 years and the maximum age was open to greater than 40 years. The mean age was found at 25.1 years and a standard deviation of 5.9 years (Table 5.1). The overall percentage of females who had impactions were more than males (Figure 5.1).

Table 5.1 Descriptive statistics for age

	N	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**
Age	39	17	44	25.10	5.990

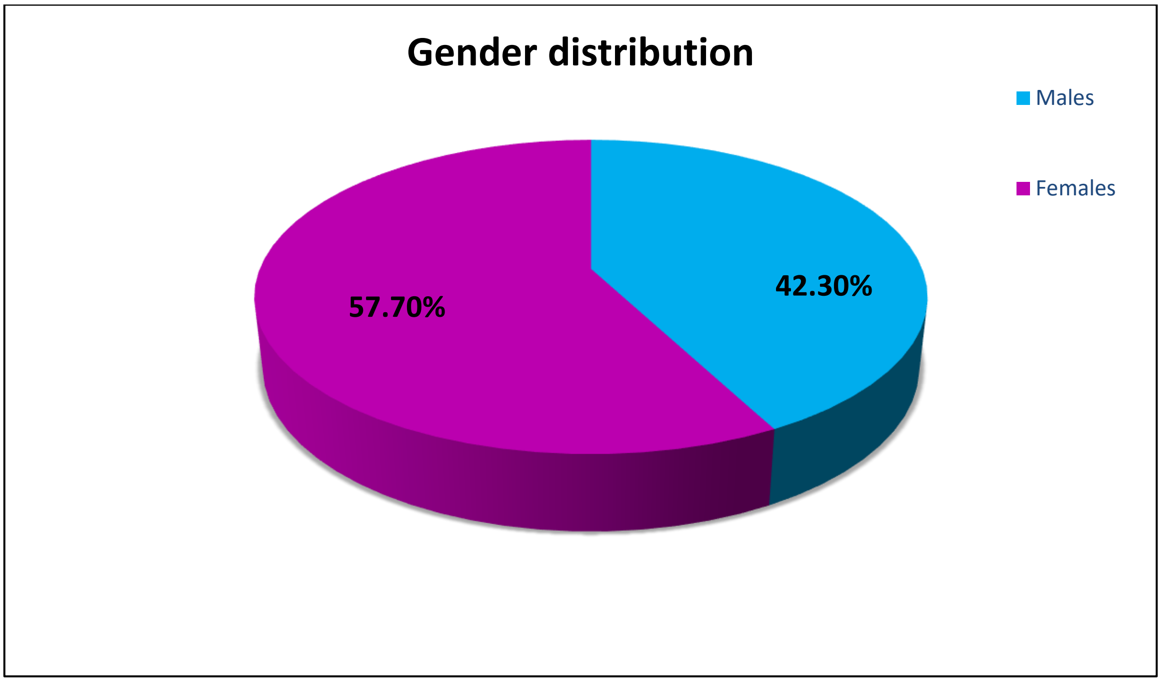


Figure 5.1 Frequency distribution of gender

5.3 Overall prevalence of impacted mandibular third molars

Ninety seven (n=97) lateral oblique radiographs were recorded with impacted mandibular M3s. The overall prevalence of impacted mandibular M3s for this study was 1.02%. The most common age interval was between 21-30 years and the highest prevalent angulation of impaction was the mesioangular type, with the horizontal type found as the least prevalent angulation. Radiographic analysis of pathology revealed caries as the most common pathology, followed by periodontal bone loss and the least prevalent pathology in this study sample was pericoronal lesions.

5.4 Prevalence of impactions among the different age groups

From the 97 samples collected, the age intervals were subdivided into four main groups. Analysis of age in relation to M3 angulation and radiographic pathology was tested. Majority of impacted mandibular M3s was found between the 21-30-year age interval, representing 58.2% and 71.4% for both left and right sides respectively with a

95% Confidence interval of 54.3 – 73.5. This was distantly followed by the 17-20-year age interval and the 31-40-year age interval. The least frequent age group was greater than 40 years which consisted of 3.1% of cases (Table 5.2). The study revealed that impacted mandibular M3s in this population are more common in young adults and that impacted mandibular M3s decreases as age increases.

Table 5.2 Distribution of impaction in the mandible in relation to age

Age groups (Years)	Left	Right	Total	P (%)	95% CI for P
17-20	10 (18.2%)	6 (14.3%)	16	16.5	9.1; 23.9
21-30	32 (58.2%)	30 (71.4%)	62	63.9	54.3; 73.5
31-40	11 (20%)	5 (11.9%)	16	16.5	9.1; 23.9
> 40	2 (3.6%)	1 (2.4%)	3	3.1	-0.3; 6.5
Total	**55 (100%)**	**42**	**97**	**100**	

5.5 Distribution of mandibular third molar angulation in different age groups

The type of M3 angulation was classified according to Winters (1926) classification, using Quek et al. (2003) method for degrees of measurement. In this study, the angle formed between the intersected longitudinal axes between the M3 and M2 were measured and classified accordingly. After analysis of the data, it was observed that the most common type of impaction was mesioangular (59.8%). It was distantly followed by the vertical type, distoangular type and horizontal type respectively. There were no inverted or buccolingual impactions found (Table 5.3).

The most common angulations in the 17-20-year age interval were the mesioangular and vertical types, both sharing equal distribution at 37.5%, followed by horizontal and distoangular angulations at 12.5%. Similarly, the 21-30-year age group had the highest prevalence for the mesioangular type (59.7%), followed by vertical (19.4%), distoangular (14.5%) and horizontal (6.5%) types respectively. The 31-40-year age group had mesioangular (87.5%) and horizontal (12.5%) angulations only. The last group containing patients above 40 years shared equal distribution between mesioangular, vertical and distoangular types with no horizontal angulations recorded. Pearson's Chi-Square test was used to determine the relationship between the angulation of impacted M3s and different age groups. No significant difference ($X2 = 12.04$; $p > 0.05$) was found between the respective age groups and angulations of impacted mandibular M3s.

Table 5.3 Frequency distribution of impacted third molar angulation

Angulation	Total	P (%)	95% CI for P
Vertical	21	21.6	13.4; 29.8
Horizontal	6	6.2	1.4; 10.9
Mesioangular	58	59.8	50.0; 69.6
Distoangular	12	12.4	5.8; 18.9
Total	97	100.0	

5.6 Prevalence of radiographic pathology associated with different age intervals.

The overall distribution of the pathologies recorded were highest for caries (39.5%), followed by periodontal bone loss (15.5%), apical radiolucent lesions (13.2%) and root resorption (10.9%). Radiopaque lesions (3.9%) and pericoronal lesions (2.3%) had the lowest overall distribution related to impacted mandibular M3s.

For all age intervals, caries was the most prevalent pathology recorded. Periodontal bone loss, root resorption and apical radiolucent lesions associated with impacted M3 were highest in the 21-30-year age group. Apical radiolucent lesions were found among all three age intervals between 17-40 years, whilst no lesions were recorded in the above 40-year age group. Pericoronal radiolucent lesions had the lowest overall prevalence and were only found in two out of the four age groups (Table 5.4). When looking at the association between these two variables (age and radiographic pathology) the Pearson's Chi-Square tests revealed there was no significant difference ($X^2 = 15.639$; $p > 0.05$) between age groups and their associated radiographic pathologies.

Table 5.4 Relation between radiographic pathologies and different age groups

Radiographic pathology	Age groups				Total
	17-20	21-30	31-40	> 40	
Caries	6	34	9	2	**51**
	11.8%	66.7%	17.6%	3.9%	**100.0%**
Periodontal bone loss	4	10	6	0	**20**
	20.0%	50.0%	30.0%	0.0%	**100.0%**
Radiolucent lesion (Apical)	3	11	3	0	**17**
	17.6%	64.7%	17.6%	0.0%	**100.0%**
Radiolucent lesion (Pericoronal)	1	2	0	0	**3**
	33.3%	66.7%	0.0%	0.0%	**100.0%**
Radiopaque lesion	1	2	1	1	**5**
	20.0%	40.0%	20.0%	20.0%	**100.0%**
Root resorption	2	7	5	0	**14**
	14.3%	50.0%	35.7%	0.0%	**100.0%**
No pathology	4	13	1	1	**19**
	21.1%	68.4%	5.3%	5.3%	**100.0%**
Total	21	79	25	4	**129**
	16.3%	61.2%	19.4%	3.1%	**100.0%**

5.7 Relationship between angulations of impacted mandibular third molars and apical or coronal pathology

The most frequently occurring angulation with pathologies is the mesioangular type, with a prevalence of 78.3% with caries, 80% with periodontal bone loss, 52.9% with apical radiolucent lesions, 60% with radiopaque lesions and 80% with root resorption respectively. The least prevalent angulation associated with pathology was the horizontal type with 4.3% with caries, 5% with periodontal bone loss, 5.9% with apical radiolucent lesions and 13.3% with root resorption. Using the Chi-Square test a significant ($X^2 = 41.9$; $p < 0.05$) association found between each angulation and pathologies such as caries, periodontal bone loss, root resorption, apical radiolucent lesions (Table 5.5). However, no significant association was found with pericoronal radiolucent lesions (p-value= 0.300) and radiopaque lesions (p-value= 0.145) respectively.

Table 5.5 Third molar angulation and associated radiographic pathology

PATHOLOGY	ANGULATION				Chi-square (p-value)
	Vertical	Horizontal	Mesioangular	Distoangular	
Caries	7	2	36	1	**71.39 (0.000)**
	15.2%	4.3%	78.3%	2.2%	-
Periodontal bone loss	3	1	16	0	**33.20 (0.000)**
	15.0%	5.0%	80.0%	0.0%	
Radiolucent lesion (Apical)	3	1	9	4	**8.18 (0.043)**
	17.6%	5.9%	52.9%	23.5%	
Radiolucent lesion (Pericoronal)	2	0	0	1	**3.67 (0.300)**
	66.7%	0.0%	0.0%	33.3%	
Radiopaque lesion	0	0	3	2	**5.40 (0.145)**
	0.0%	0.0%	60.0%	40.0%	
Root resorption	1	2	12	0	**24.73 (0.000)**
	6.7%	13.3%	80.0%	0.0%	
No pathology	9	1	6	3	**7.74 (0.052)**
	47.4%	5.3%	31.6%	15.8%	
Total	**25**	**7**	**82**	**11**	
	20.0%	**5.6%**	**65.6%**	**8.8%**	

CHAPTER 6
DISCUSSION

6.1 Overview

Tooth impaction is a frequent occurrence in dental practice. Numerous studies have shown variation in the prevalence and distribution of these impacted teeth in different regions of the maxilla or mandible (Chu et al. 2003). Some factors affecting the prevalence of impacted teeth include selected age group, time of eruption, dietary habits and genetics (Ishwarkumar, 2015).

The incidence of impacted M3s particularly in the mandible can be caused by various factors such as reduced overall length of the mandible, increased size of the ascending ramus and greater mesial inclination of mandibular M3s (Kumar et al. 2017).

6.2 Prevalence of impacted mandibular third molars amongst different age groups

In this study, a high prevalence of impacted mandibular M3s were recorded amongst young adults. A mean age of 25.1 years was recorded, this finding is similar to those reported by Qirreish (2005) and Hashemipour et al. (2013) whose mean age was 24.6 years and 26.2 years respectively. The prevalence of impacted M3s showed a decrease amongst older adults above forty-years-old. This decline can be explained by a few prospective cohort studies that showed around 30% to 60% of asymptomatic patients with impacted M3s may develop disease or become sufficiently symptomatic to result in extraction within 4 -12 years after diagnosis (Dodson and Susarla, 2010). The decline in the incidence of impacted M3s associated with increasing age is similar to the findings of Shahzad et al. (2016) that found a total of 5.54% of cases in a 41-50-year age group and only 1.85% of cases in adults above the age of 50. The highest prevalence of impacted M3s was found in the 21-30-year age group, these findings are closely related to that of Muhamed and Nezar (2016) and Chu et al. (2003) that found the highest prevalence in a similar age group (Table 6.1). However, Tsabedze (2012), Kaur (2015) and Sheikhi et al. (2015) recorded the highest prevalence of impacted mandibular M3s between 21-25 years old. As mentioned previously, eruption times of M3s vary between 16-24 years among different population groups (Muhamed and Nezar, 2016). In a South African study on the radiographic profile of symptomatic impacted mandibular M3s in the Western Cape, Qirreish (2005) reported 67.5% of patients were more likely to present with symptomatic impactions between 16 and 25 years old. Therefore, the widespread high prevalence among this second decade may be as a result of more patients seeking dental treatment during this period, either due to symptom development or general awareness of the condition. Patients presenting in the latter half of the second decade may have assumed the tooth would eventually fully erupt, resulting in them presenting at a later age (Gopee and Rikhotso, 2017).

Table 6.1 Highest prevalent age group for impacted mandibular third molars

Study	Year	Population	Age Interval (Years)	Prevalence (%)
Chu et al.	2003	Hong Kong Chinese	20 – 29	55.1
Tsabedze	2012	South African	21 – 25	33.1
Kaur	2015	Indian	21 – 25	49.3
Sheikh et al.	2015	Iranian	21 – 25	25
Shahzad et al.	2016	Pakistani	20 – 25	42.15
Muhamad and Nezar	2016	Arab Israeli	21 – 30	50
Present study	2018	South African	21 – 30	63.9

6.3 Impacted mandibular third molars in relation to gender

The male to female ratio in this study group is 1:1.4 (41:56). The greater distribution of females compared to males is similar to that reported by Eshghpour et al. (2014) and Alamgir et al. (2015). Contrary to our findings, Muhamed and Nezar (2016) and Tsabedze (2012) have reported that there were more males than females who presented with impacted mandibular M3s. These differences could be attributed to differences in growth patterns in each gender.

Females have a shortened duration of growth in the mandible, growth usually ceases when the M3s begin to erupt. These hindrances lead to a higher frequency of impacted mandibular M3s in females (Kumar et al. 2017).

Conversely, a study by Ishwarkumar (2015) discusses a proposed explanation for the higher male frequency of impacted M3s that can be attributed to the smaller mandibular plane (a line running parallel to the inferior border of the mandible) and gonial angle [angle formed between the tangent line to the lower border of the mandible and the tangent line to the distal surface of the ascending ramus and condyle (Al-Shamout et al. 2012)] which is common in males, resulting in lack of space for the M3 to erupt. (Figure 6.1).

Indira et al. (2012) stated that socio-environmental factors (e.g. nutrition, climate, dietary habits, pathologies, etc.) have an influence on growth and development, and consequently the appearance of bones. Additionally, a study by Ishwarkumar (2015) found that the morphometric parameters of the mandible in males are greater than in females, resulting in their larger and more robust bone structure. Consequently, these reasons may explain the findings of the current study, that found M3 impactions are more prevalent in females compared to males, due to the smaller jaw size in females. This finding may also be ascribed to the fact that growth is achieved earlier in females, whereas the growth of the jaw in males continues during the time of M3 eruption, creating space for the M3 to erupt (Hashemipour et al. 2013).

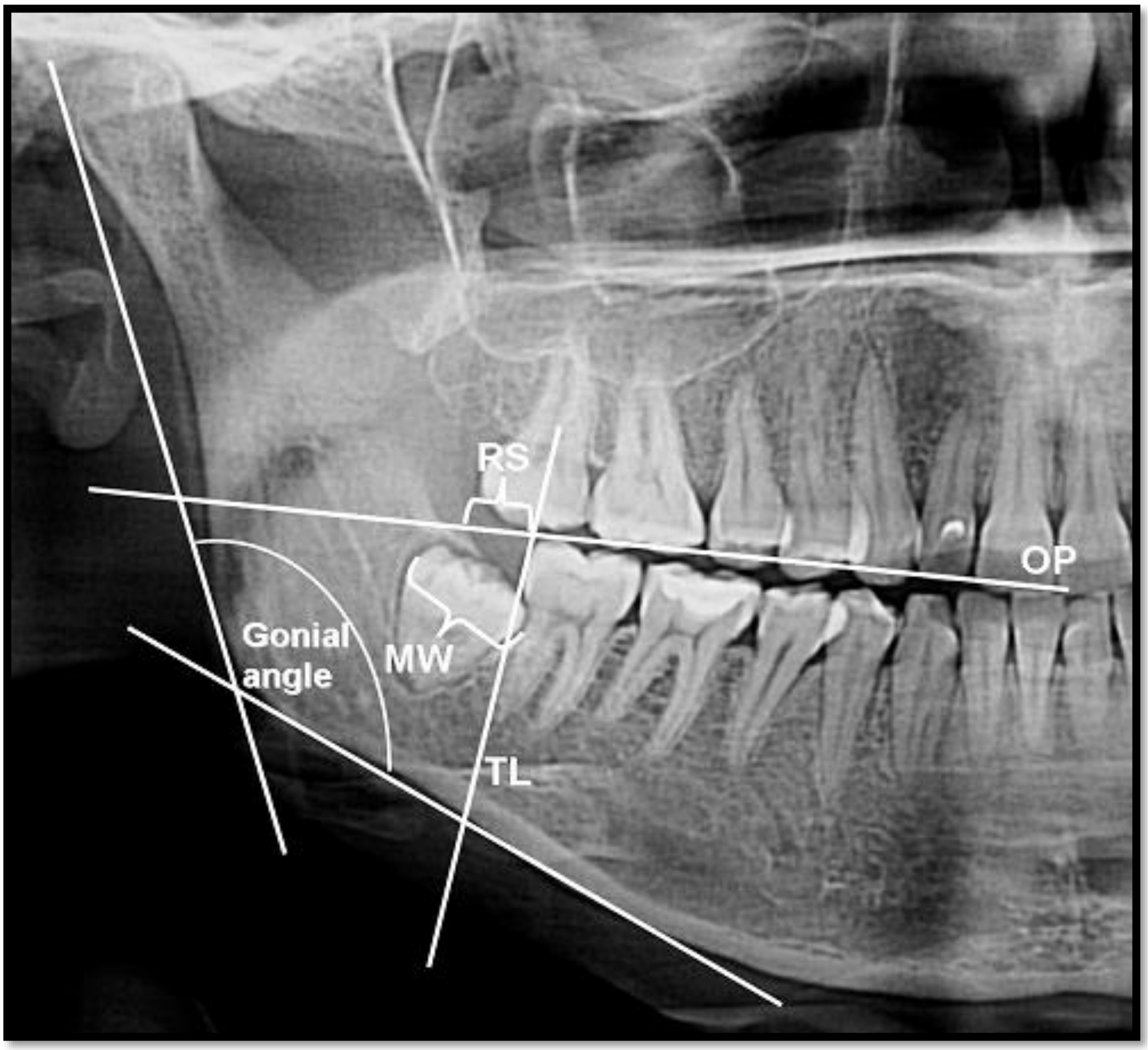


Figure 6.1 Linear and angular measurements on orthopantomogram radiograph (Zelić and Nedeljković, 2013)

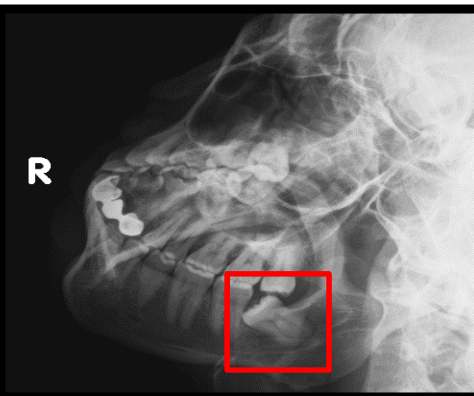
RS- retromolar space, **MW-** mesiodistal width of M3, **OP-** occlusal plane, **TL-** tangent line

6.4 Prevalence of mandibular third molar angulation

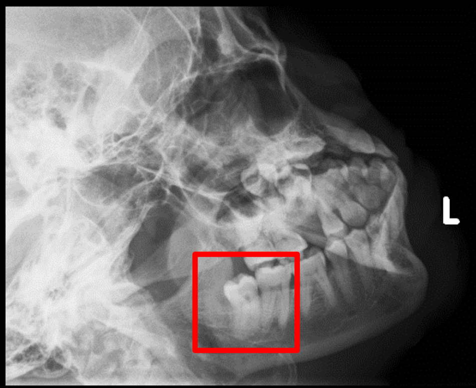
In this study, the most common angulation of impacted mandibular M3s was mesioangular, followed by vertical, distoangular and horizontal types. These findings concur with Tsabedze (2012) and Babiker (2016) who reported mesioangular impactions as the most prevalent in the Gauteng Province and the Western Cape Province of South Africa. This study proposes that these impactions are caused by reduced jaw sizes, which could be due to a common dietary intake among South Africans. Mesioangular impaction types are probably caused by the tooth germs late development and maturation, path of eruption and lack of space in the mandible for the M3 to erupt into a normal position (Gopee and Rikhotso, 2017). Likewise, the results are in agreement with international studies by Muhamad and Nezar (2016), Kaur (2015) and Sheikhi et al. (2016) with studies in an Arab Israeli, Indian and Iranian population that reported a higher prevalence of mesioangular impactions.

Contrary to this study Yilmaz et al. (2016) that found vertical impactions had the highest prevalence, followed by mesioangular, distoangular and horizontal impactions, in a central Anatolian Turkish population. A recent study in an Indian population found the most frequent type was distoangular impactions, followed by vertical, mesioangular and horizontal impactions (Anitha and Devakumari, 2017). The various types are shown in Figure 6.2.

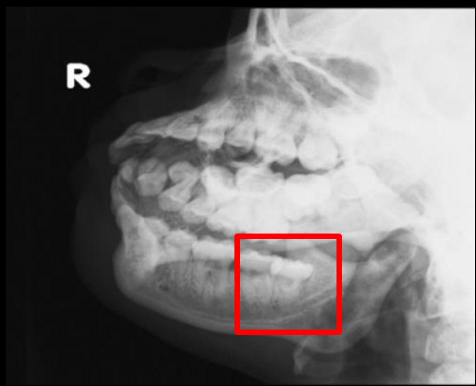
Mesioangular impaction



Distoangular impaction



Vertical impaction



Horizontal impaction

Figure 6.2 Mandibular third molar angulations shown on lateral oblique radiographs

Many theories have been described in previous literature on development and high occurrence of impacted mandibular M3s. For example, if the M3 tooth bud is angulated in a medial position during the initial stages of calcification and root formation, an unfavourable path of eruption will be present resulting in M3 impaction (Juodzbalys and Daugela, 2013).

Miloro (as cited by Ishwarkumar, 2015) describes a differential root growth theory to explain the different angulation patterns. Underdevelopment of the mesial root of the M3 causes a mesioangular impaction, whilst overdevelopment of the mesial root causes over rotation of the M3 resulting in a distoangular impaction. The theory further explains that overdevelopment of the M3 distal root with a mesial curve causes a horizontal impaction.

Furthermore, the literature states dietary influence, such as fibrous diets, which may stimulate jaw growth, together with circumferential abrasion of teeth, providing some space for M3 eruption (Ishwarkumar, 2015). The Mendelian theory further proposes that the coarse nature of the Stone Age diet had caused significant tooth wear, this action would collectively reduce the overall tooth length, thus creating enough space for M3 eruption (Tsabedze, 2012). However, such diets vary among different populations and a soft diet with the lack of fibrous foods in this community may have caused differences in jaw anatomy, resulting in impacted M3s. The results showing the prevalence of different angulations reported in various populations are shown in Table 6.2.

Table 6.2 Prevalence of impacted mandibular third molar angulation according to Winter's (1926) classification

Study	Prevalence of mandibular third molar impactions (%)					
	Population	**Mesioangular**	**Horizontal**	**Vertical**	**Distoangular**	**Others**
Chu et al. (2003)	Hong Kong Chinese	36.9	47.5	6.5	9.9	2.5
Jaffar and Tin-Oo (2009)	Malaysian	52.3	26.4	12.2	9.1	-
Tsazebze (2012)	South African	51.9	13.5	15.5	18.3	0.9
Mokhtar et al. (2015)	Iranian	53.55	13.39	30.08	2.98	-
Yilmaz et al. (2016)	Anatolian Turkish	29	5	53	13	-
Muhamad and Nezar (2016)	Arab Israeli	50	16.5	16.2	15.9	1.5
Anitha and Devakumari (2017)	Indian	23	5	26	46	-
Present study (2018)	South African	59.8	6.2	21.6	12.4	-

6.5 Inter- age group distribution of impacted mandibular third molar angulation and radiographic pathology

The age groups for the study were subdivided into four major categories. Mesioangular impactions were most frequent amongst all age intervals, with the highest prevalence found between 21-30 years at 63.8%. El-Khateeb et al. (2015) reported much higher results with the highest prevalence of mesioangular impactions found in the 21-30-year age group (80.5%) in Saudi patients. Vertical and horizontal impactions were also most prevalent in the 21-30-year age group. Sheikhi et al. (2013) reported different results compared to this study, with vertical (56.8%) and horizontal (18.8%) impactions more prevalent between the ages of 17-21 years. In this study, the least prevalent age group with vertical impactions was above 40 years. The lower incidence in this group could be due to early extraction of the vertical impaction type. Wisdom teeth may be symptomatic during the eruption phase between the ages of 17 to 21 due to the development of certain pathology, such as pericoronitis, that is commonly found in teens and young adults (Dhonge et al. 2015). In such cases, the treatment of choice at public institutions in South Africa would be to extract these teeth. Park (2016) mentions the probability that vertical impactions are more likely to have the lowest level of difficulty during removal, especially with incomplete root formation of the M3. Hence the vertical type is more likely to be removed at a younger age by practitioners at a clinic level, resulting in decreased frequency of this type among the older age groups.

The overall differences in angulation prevalence have population-specific variations, which also can be explained by authors using different methods to classify angulation types (Hashemipour et al. 2013).

The least prevalent impactions were the horizontal type, that had zero impacted M3s recorded in the 31-40-year age group and above 40-year age group respectively. The most common age range for the distoangular impaction was in the 21-30-year age group. The overall low prevalence association may be due to the difference in the number of horizontal and distoangular impactions amongst all various age intervals. No significant difference ($p > 0.05$) was found between age groups and angulations.

The inter-age group analysis for radiographic pathology found caries to be the highest prevalent radiographic pathology across all four age groups. Dental caries is a localised pathologic process, that leads to the destruction of calcified dental tissues. It is caused by the release of acidic by-products from bacterial fermentation of various carbohydrates (Yadav and Prakash, 2016). The high incidence of caries in this study sample may be due to poor oral hygiene practices, inadequate dietary intake and socioeconomic factors. A total of 3 (2.3%) cases between the ages of 17-30 were found with pericoronal radiolucent lesions. Most of these lesions frequently occur in the second decade of life, while some may peak at youth and in middle or old age (Mortazavi and Baharvand, 2016). Therefore, the low prevalence in this study may be due to smaller samples in the older age groups in which these lesions may commonly be found. No significant difference ($p > 0.05$) was found between age groups and radiographic pathologies associated with impacted M3s.

6.6 Association between apical and coronal radiographic pathology with different angulations

The relationship between the angular positioning of mandibular M3s and relative pathology has been reported in previous literature (Mokhtar et al. 2015). In this study, the maximum number of radiographic lesions was recorded in association with mesioangular impactions, which included caries, followed by periodontal bone loss, apical radiolucent lesions and root resorption. Similarly, Polat et al. (2008) described third molars that are inclined mesially are usually associated with pathology such as caries, pericoronitis and root resorption of the adjacent M2. However, pericoronal radiolucent lesions were the least frequent pathology detected and were most common in vertically impacted M3s. No radiographic pathology was recorded on 14.7% of impacted M3s, which is different to studies by Al-Khateeb and Bataineh (2006) and El-Khateeb et al. (2015) that recorded 54% and 68.5% of impacted M3s without radiographic lesions. The significantly higher rates in these studies could be due to the greater sample size analysed.

6.6.1 Caries

Al-Khateeb and Bataineh (2006) reported caries to be the most frequently occurring pathology associated with impacted M3s. Caries was more common on the impacted molar itself (13.6%) than the adjacent second molar (7.9%). In this study, the mesioangular type included the most cases that had carious lesions (78.3%), which is a higher incidence than the results reported by Polat et al. (2008) and Shahzad et al. (2016). Contrary to this study Qirreish (2005) reported caries more commonly associated with horizontal impactions (66.6%) in the Western Cape of South Africa.

The high rate of caries recorded, as mentioned previously, may be due to socioeconomic status, food habits and poor oral hygiene practices. Partially impacted M3s also pose difficulty for routine oral hygiene practices due to inaccessibility of the entire tooth (Brkić, 2012: 68). These challenges together with the accumulation of food debris and virulent bacteria are precursors for caries formation (Babiker, 2016). The poor socioeconomic status of the population has an inverse relation to oral health, largely as a result of food insecurity, defined as inadequate accessibility of food, improper food habits and hunger (Chi et al. 2014). This relationship highlights a higher risk of caries development in such communities.

6.6.2 Periodontal bone loss

Sandhya and Dharman (2016) reported a 34.16% incidence of periodontal bone loss. They describe bone loss associated with impacted wisdom teeth as usually the interdental bone between the impacted M3 and adjacent M2 that frequently occurs with the mesioangular type of impaction. Similarly, in this study, the mesioangular type of impaction was associated with the highest incidence of periodontal bone loss. This could be due to a higher rate of periodontal pathogens accumulating around the gingiva of these teeth, with poor oral hygiene as an aggravating factor, ultimately leading to the development of periodontitis (Campbell, 2013; Santosh, 2015). A total of 15.5% of impacted M3s had surrounding periodontal bone loss.

6.6.3 Root resorption on adjacent second molar

Root resorption is a process associated with physiological or pathological loss of dental hard tissues. External root resorption (inflammatory resorption) is the most common type and is caused by external pressure applied to the tooth, which may be caused by an impacted tooth (Dryl et al. 2015).

In this study root resorption on the adjacent M2 was found in 10.9% of cases. Contrary to this study Chu et al. (2003) found a 0.4% incidence of root resorption, whilst Al-Khateeb and Bataineh (2006) found a 0.3% frequency of root resorption on the adjacent M2.

Mesioangular impactions (80%) had the highest prevalence associated with root resorption. No root resorption cases were found in distoangular impactions. This is comparable to Mokhtar et al. (2015) who found 71.4% root resorption cases associated with mesioangular impactions, with no cases of root resorption with distoangular impactions. The higher number of mesioangular impactions leads to a higher prevalence of this type of impaction (Mokhtar et al. 2015). Root resorption is most common with the mesioangular type probably due to their inclination causing increased pressure exerted on the adjacent M2 as compared with the distoangular types.

6.6.4 Periapical radiolucency

A periapical radiolucent lesion is described as a completely radiolucent area attached to the apical portion of the root of the impacted M3 (Figure 6.3). The lesion may extend to the lateral surface of the root, but not above the cementoenamel junction (Al-Khateeb and Bataineh, 2006).

In this study, periapical radiolucent lesions were found at 13.2% and were commonly associated with a carious impacted mandibular M3. This is a slightly larger incidence compared to Al-Khateeb and Bataineh (2006) that reported a 9.5% prevalence. These lesions may be related to the high number of deep carious lesions found in the study, that result in irreversible pulpitis formation, which may ultimately cause periapical pathology formation. The prevalence of periapical radiolucencies associated with impacted M3s was highest with the mesioangular type, followed by the distoangular type. Horizontal angulation had the least association with periapical radiolucencies and this is due to horizontal angulations having the lowest prevalence found in this study. This low association of the horizontal type may also be due to a majority of these teeth, found either completely enclosed within the surrounding bone, had no carious lesion association or had minimal caries not yet extending into the pulpal tissue.

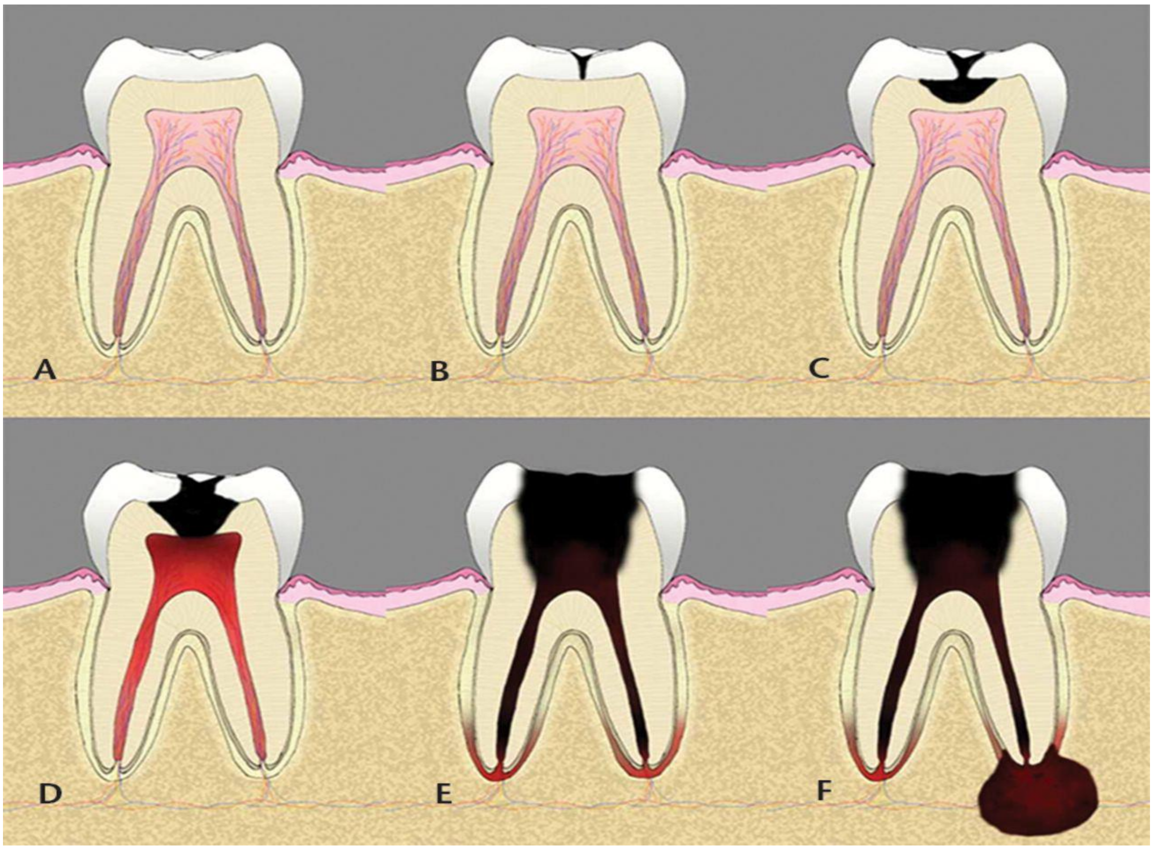


Figure 6.3 Diagram representing progression of apical periodontal disease (Chapman et al. 2013). **A-** normal tooth; **B-** cavity formation; **C-** cavity extending into dentin; **D-** pulpitis; **E-** apical periodontitis; **F-** advanced apical periodontitis.

6.6.5 Pericoronal radiolucency

Pericoronal radiolucency is the most commonly found radiographic pathology associated with impacted or embedded teeth found during routine examination (Anand et al. 2015). A prevalence rate of 6.2% of cyst and tumour growth has been described in the literature, with distoangular and vertical angulations found as the most common types associated with cyst development (Alamgir et al. 2015).

This study revealed pericoronal radiolucent lesions associated with impacted mandibular M3s comprising of 2.3% of cases with vertical angulation association recorded as the most common. However, no significant difference was found between pericoronal lesions and different angulations of impacted M3s. Similar to this study, Al-Ramil et al. (2018) reported a 1.5% prevalence of pericoronal radiolucent lesions in a Saudi Arabian population. However, studies by Al-Khateeb and Bataineh (2013) and Polat et al. (2008) showed a higher prevalence at 14.7% and 5.8 % in a Jordanian and Turkish population respectively.

With such vast differences found among various populations, it is important for clinicians to remember radiographic analysis of pericoronal radiolucent lesions may not correlate with the histopathologic assessment of these lesions. Therefore, early detection and management of such findings are imperative when treating patients (Anand et al. 2015).

6.6.6 Radiopaque lesions

There are different types of radiographic pathology associated with impacted teeth that exhibit radiopaque characteristics on radiographs. Examples of radiopaque lesions that are likely to occur in the posterior region of the mandible, associated with the M3 includes calcifying epithelial odontogenic tumours, ameloblastic fibro-odontomas and odontomas (Mortazavi and Baharvand, 2016). In this study, radiopaque lesions were identified at an overall prevalence of 3.9%, with only mesioangular and distoangular types associated with these lesions. No significant difference (p=0.145) was found with these lesions and specific angulations. Therefore, to aid in diagnostic procedures, factors such as the site of the lesion (maxilla or mandible) age, sex, and radiographic features are more important rather than the type of M3 angulation involved.

6.7 Limitations of this study

During this study, one of the major limitations were improper record keeping. Missing information and undated radiographs resulted in many exclusions from the study. Jaw trauma cases (e.g. mandibular fractures) were excluded from the study due to missing radiographs from patient records. Due to this, the sample size was reduced. Further studies with larger sample sizes are required to test the correlation between age, angulation and radiographic findings related to impacted mandibular M3s.

A major concern with this study was the application of the methodology when measuring the angle formed between the intersected longitudinal axes of the second and third molar. Care and accuracy were applied during this process to yield optimal results.

CHAPTER 7
CONCLUSION

This study was the first attempt at investigating the prevalence of impacted mandibular M3s in a sample of population living in the rural south coastal area of Mtwalume. The main findings of the study included a higher female incidence of impacted mandibular M3s compared to males with young adults between the ages of 21-30 having the highest distribution of impacted M3s. These findings are comparable to Tsabedze (2012), who reported a prevalence of 58.8% of impactions among a 21-30-year age group in Pretoria, South Africa and Babiker (2016) that found the highest prevalence among a 16-27-year age group in Cape Town, South Africa. Thus, this representation in different regions of the country supports our suggestion that young adults have a higher probability of presenting with impacted mandibular M3s.

The study noted the most prevalent type of impacted teeth was the mesioangular type with the least prevalent found as the horizontal type. This is similar to other South African studies by Tsabedze (2012) and Gopee and Rikhotso (2017) that reported 51.9% and 46.46% of mesioangular impactions respectively. No significant association was found between angulation and age. When comparing this study with the literature locally and internationally over the last decade, a conclusion can be drawn that impacted M3s vary amongst different population groups and these differences in association with the multiple potential contributing factors, implies possible changes in the presence and types of impactions in the future. For that reason, it is suggested that future research be conducted to examine differences and/or changes in the results from previous studies.

Among all the pathology identified in the study, caries was found to be the most prevalent across all age intervals. Caries progression may cause irreversible pulpitis of the tooth. In this study impacted M3s with caries had a higher incidence of associated periapical radiolucent pathology, which shows progression of the disease. The overall high prevalence of pathology associated with impacted teeth shows an area of concern in oral health education and prevention programs in the area. The current financial strain on the health care system and lack of equipment, especially at a clinic level, relies on public institutions to focus on these key prevention programs.

Hence, the data recorded in this study may encourage public institutions to develop specific screening programs to identify impacted M3s, before severe symptoms or potential pathology develop. Since not all radiographic pathology present with symptoms, this routine screening process may assist with proper clinical assessment and treatment planning.

The results of this study could also serve as baseline data for future studies on impacted mandibular M3s, and such studies should incorporate the Pell and Gregory (1933) classification. Assessing the depth and space of the impacted M3 may assist in determining the level of difficulty related to surgical removal of these teeth and if appropriate referral is required.

Other recommendations:

- The study was conducted over two years. However, I believe a longer time frame would have yielded a better overview of the number of patients that present with impacted M3s.

- During the study the presence of impacted maxillary M3s were noted, however, these teeth were not analysed as part of the study. Including impacted maxillary M3s could further expand similar studies.

Although prophylactic removal versus retention of asymptomatic impacted M3s is still a debate across the world, I suggest annual examination of impacted M3s to detect early signs of potential pathology before complications arise. In this way treatment or appropriate referral may be provided before symptoms develop.

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DATA COLLECTION SHEET

Please tick where applicable

SECTION A: RECORD EXAMINATION

Study number:_________________________

Age: _________________________________

Gender:______________________________

Age distribution

17-20 years	
21-30 years	
31-40 years	
>40 years	

SECTION B: RADIOGRAPHIC EXAMINATION

Site of Impaction

Right mandibular arch	
Left mandibular arch	

Angulation of Impacted Mandibular Third Molar

Vertical	
Horizontal	
Mesioangular	
Distoangular	
Other (specify):	

Associated Radiographic Analysis of Pathology

Caries	
Periodontal bone loss	
Radiolucent lesion (Apical)	
Radiolucent lesion (Pericoronal) Size (mm):	
Radiopaque lesion	
Other (specify):	

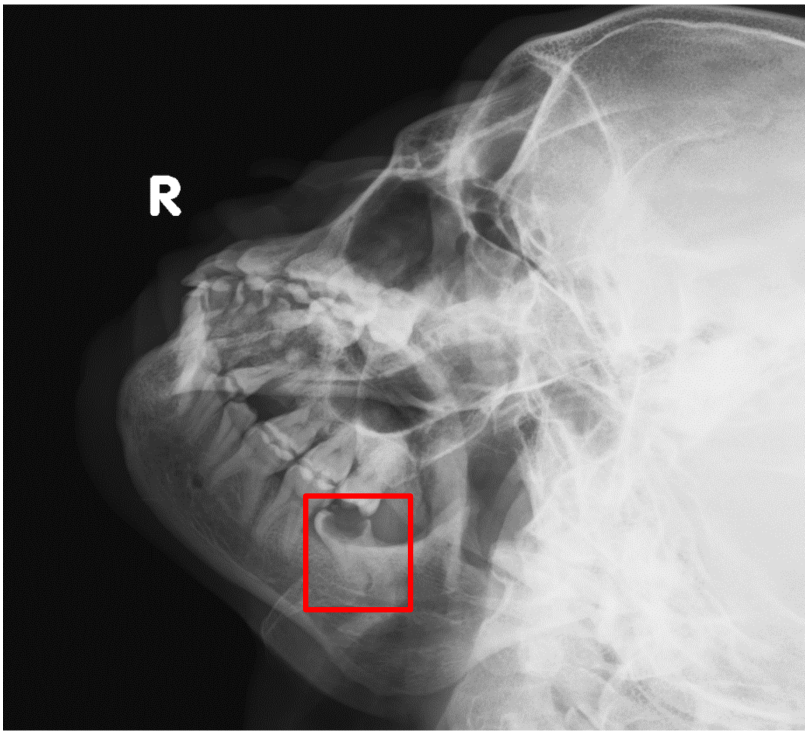

Figure 4.1 Caries on impacted M3 on right

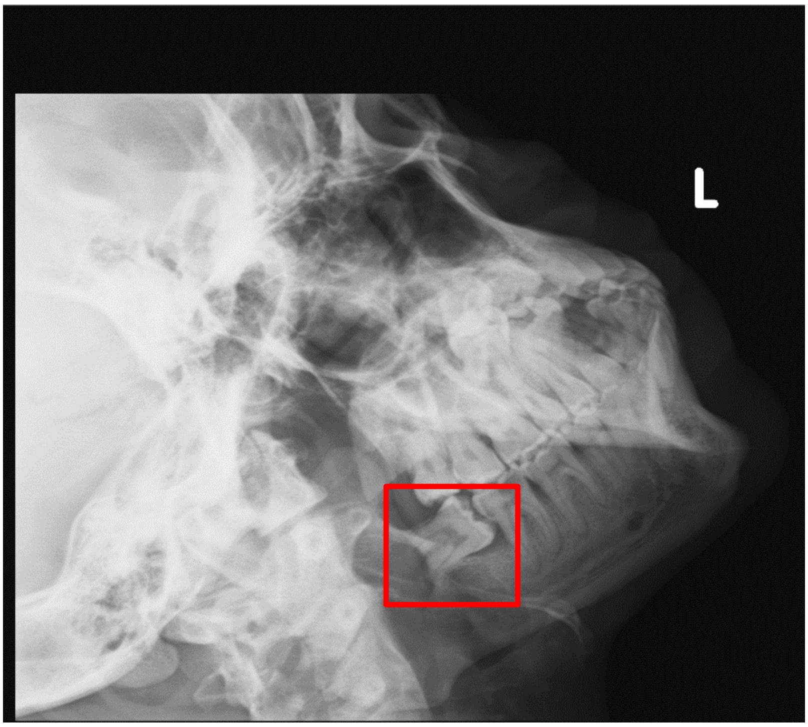

Figure 4.2 Periodontal bone loss mesial to impacted M3 on left

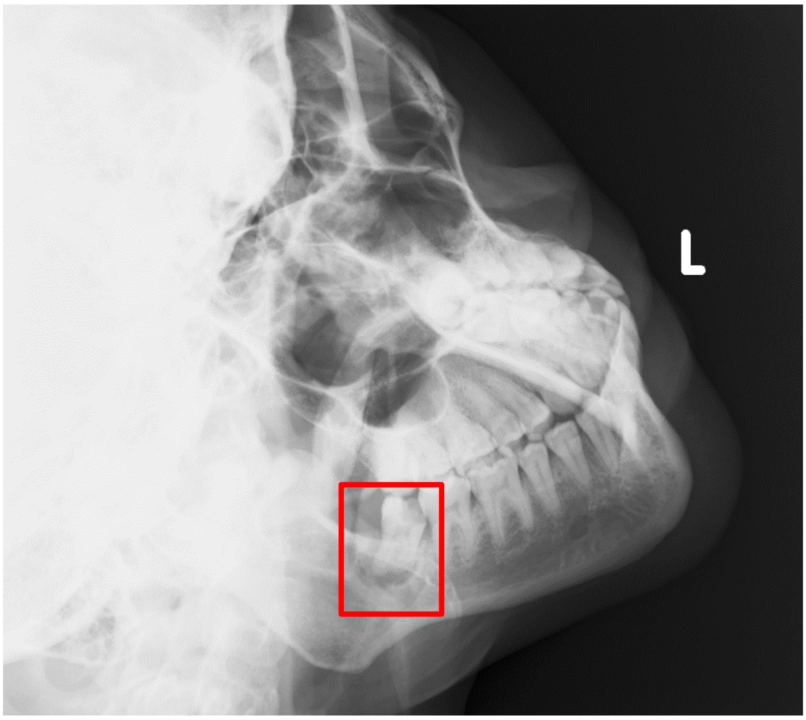

Figure 4.3 Periapical radiolucent lesion on impacted M3 on left

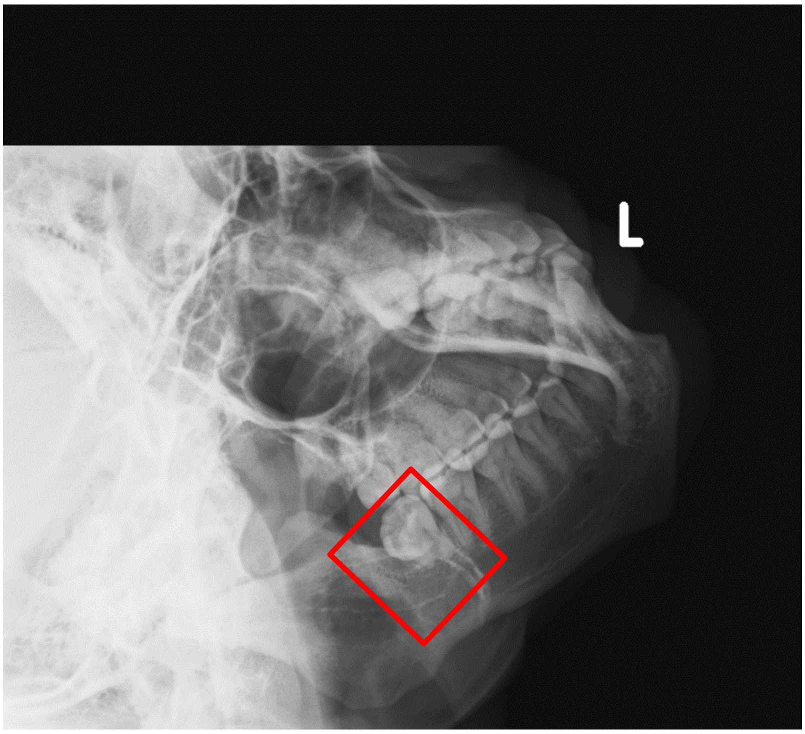

Figure 4.4: Coronal radiolucent lesion on distal side of impacted M3 on left

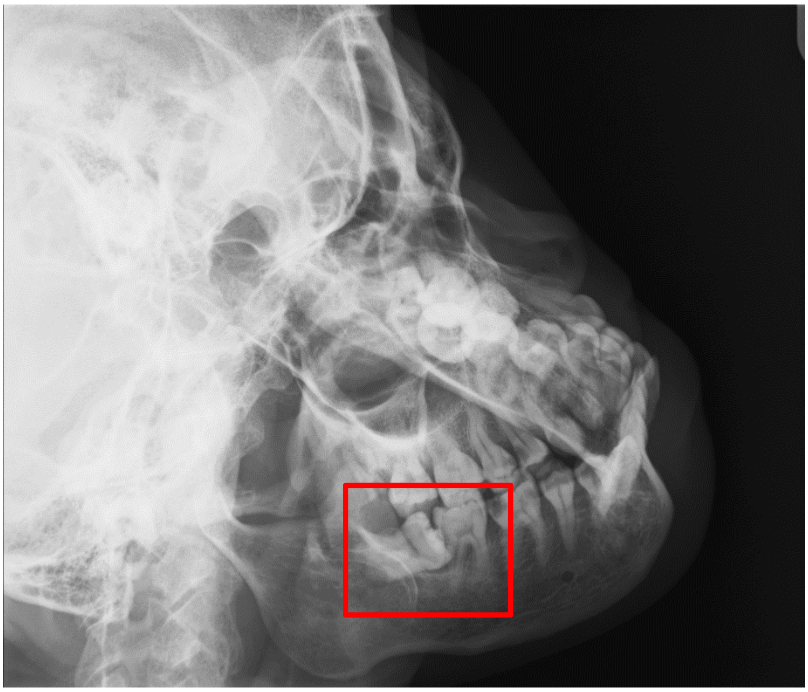

Figure 4.5: Distal root resorption on M2 caused by impacted M3 on left

APPENDIX E

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference:
E-mail: sandra.benn@wits.ac.za

Mrs Sandra Benn

15 May 2018
Person No: 308143
PAG

Dr K Govender
P O Box 561833
Chatsworth
4030
South Africa

Dear Dr Govender

Master of Science in Dentistry: Approval of Title

We have pleasure in advising that your proposal entitled *Prevalence of impacted mandibular third molars in the MTWALUME District in KZN* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

18 July 2018

To Whom It May Concern

SUBJECT: CONFIRMATION OF PROVISIONAL STUDY APPROVAL
(This letter is not a clearance certificate - not yet cleared)
Protocol Ref No: M180602
Protocol Title: The prevalence of impacted mandibular third morals in the Mtwalume district in Kwa-Zulu Natal
Principal Investigator: Dr Karensa Govender
Department: Maxillofacial and Oral Surgery

This letter serves to confirm that the Human Research Ethics Committee (Medical) has granted provisional approval for the above mentioned study subject to receipt of written permission to do the study from the CEO of the study site and if required from the Gauteng Provincial Research Committee (GPRC).

Please note that this provisional approval letter does not permit data collection/secondary data analysis or any other form of research. Research may only be started when an applicant has received the final clearance certificate from the HREC (Medical) Secretariat.

Should you have any queries, you may contact me at tel: 011 717 1234/2700/2656 or by email Mapula.Ramaila@wits.ac.za or HREC-Medical.ResearchOffice@wits.ac.za

Yours Faithfully,

....

Miss Mapula Ramaila
Administrative Officer
Human Research Ethics Committee (Medical)

UNIVERSITY OF THE WITWATERSRAND
OFFICE OF THE DEPUTY VICE CHANCELLOR RESEARCH
18 JUL 2018
RESEARCH OFFICE
HREC (Medical)
JOHANNESBURG

Research Office Secretariat: Faculty of Health Sciences, Phillip Tobias Building, 3rd Floor, Office 304, Corner York Road and 29 Princess of Wales Terrace, Parktown, 2193 Private Bag 3, Wits 2050 I **T**+27 (0)11-717-1234/2656/2700/1252 **E:** Mapula.Ramaila@wits.ac.za I **Office E** HREC-Medical.ResearchOffice@wits.ac.za IWebsite: www.wits.ac.za/research/about-our-research/ethics-and-research-integrity/

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:

Ward 19, Mnafu Area, Turton, Mthwalume, 4186
Private Bag X07, Hibberdene, 4220
Tel: 0399726001, Fax: 0399726098 Email: sipho.ntshalintshali@kznhealth.gov.za
www.kznhealth.gov.za

TURTON COMMUNITY HEALTH CENTRE

DATE: 2018/05/28	ENQUIRIES: Dr. SD Ntshalintshali
To: Dr. Karensa Govender	**From:** Dr. SD Ntshalintshali CEO / Medical Manager Turton CHC

Subject: Permission to conduct research

Dear Dr Govender,

I have reviewed your proposal to conduct research at Turton Community Health Centre entitled *"Prevalence of impacted mandibular third molars in the Umthwalume District in KZN"*, and you are hereby granted permission based on the following conditions:

1. Please ensure that the conduct of the study is in line with the stipulations of the KZN Health Act of 2009 and the National Health Act (Act 61 of 2003).
2. Turton CHC has the right to withdraw this permission at any time if the study does not follow the Department of Health policies.
3. This research may only commence once a Biomedical Research Ethics Committee has granted the study full approval.
4. Final approval must be granted by the KZN Health Research and Knowledge Management Unit.
5. The researchers must communicate the findings of the research to the institution before the findings are published.
6. Any Turton CHC resource required to conduct this study including staff time be declared upfront before commencement of the research for consideration by the CHC management.
7. Please ensure that there shall be no distraction in the rendering of patient care, and you will adhere to all policies, protocols and guidelines of the Department of Health with regards to this research.
8. Patient confidentiality to be observed at all times.

APPROVED/~~NOT APPROVED~~

2018 -05- 29

TURTON COMMUNITY HEALTH CENTRE

Date

Dr SD Ntshalintshali
CEO / Medical Manager
Turton CHC

Fighting Disease, Fighting Poverty, Giving Hope

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:
SYSTEMS DEPARTMENT
TURTON CHC

Private Bag X 07 Hibberdene 4235
Umzumbe Magistrate Court Road Ward 19Mnafu Area
Mtwalume 4186
Tel: 039 972 6067 Fax: 039 972 6069 Email:isaac.cele@kznhealth.gov.za
www.kznhealth.gov.za

Enquiries: Mr I.A Cele
Extension: 6003
Date: 30/05/2018

Dear Dr. Karensa Govender

Subject: Permission to conduct research on medical records:

According to Kwazulu-Natal department of Health, PROMOTION OF ACCESS TO INFORMATION ACT NO2 of 2000, access to record information is to be sought by the Head of Department, which you have been granted. You are therefore granted permission to do this exercise provided that the conditions laid down by the Chief Executive Officer are being followed. Kindly note that patient information must be kept confidential at all times.

Your coorperation will be highly appreciated.

Thank you,

Isaac Cele
Systems Manager
Turton CHC

Fighting Disease, Fighting Poverty, Giving Hope

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Dr Karensa Govender

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180602

NAME: (Principal Investigator) Dr Karensa Govender

DEPARTMENT: Maxillofacial and Oral Surgery
Turton Community Health Centre
Dental Department

PROJECT TITLE: The prevalence of impacted mandibular third molars in the Mtwalume district in Kwa-Zulu Natal

DATE CONSIDERED: 29/06/2018

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr M. Mabongo

APPROVED BY: Dr CB Penny, Chairperson, HREC (Medical)

DATE OF APPROVAL: 18/09/2018

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in June and will therefore be due in the month of June each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature ____________ Date ____________

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX J

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

Physical Address: 330 Langalibalele Street, Pietermaritburg
Postal Address: Private Bag X9051
Tel: 033 395 2805/ 3189/ 3123 Fax: 033 394 3782
Email: [illegible]
www.kznhealth.gov.za

DIRECTORATE:
Health Research & Knowledge Management

HRKM Ref: 340/18
NHRD Ref: KZ_201808_038

Dear Dr K Govender
University of the Witwatersrand

Approval of research

1. The research proposal titled **'The prevalence of impacted Mandibular Third Molars in the Mthwalume District in KZN'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at Turton Community Health Centre.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

E Lutge

Dr E Lutge
Chairperson, Health Research Committee
Date: 03/09/18

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UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

RESEARCH OFFICE
BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769 - Fax: 27 31 260-4609
Email: BREC@ukzn.ac.za
Website: http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx

15 October 2018

Dr K Govender
Department of Maxillofacial and Oral Surgery
Wits University
g.karensa@gmail.com

Dear Dr Govender

Protocol: The prevalence of impacted mandibular third morals in the Mtwalume district in KwaZulu-Natal.
Degree: MMed
BREC Ref No: RECIP516/18

I wish to advise that your request dated 25 July 2018 requesting BREC approval for the above protocol has been noted by the Chair of the Biomedical Research Ethics Committee (BREC). Your correspondence dated 16 August 2018 and 02 October to BREC correspondence dated 31 July 2018 and 16 August 2018 has also been noted by BREC.

The chair has now granted approval to your request for Reciprocity. The following have been noted by BREC:

1. Wits Human Research Ethics Committee (HREC) approval - M180602
2. KZN DoH permission dated 06 September 2018

This approval will be noted at the next full BREC meeting to be held on 13 November 2018.

Yours sincerely

Prof V Rambiritch
Chair: Biomedical Research Ethics Committee