MAKERERE IVERSITY

COLLEGE OF HEALTH SCIENCE

SCHOOL OF DENTISTRY

PREVALENCE, RADIOGRAPHIC PATTERNS, AND PATHOLOGIES ASSOCIATED WITH IMPACTED THIRD MOLARS AMONG PATIENTS 20-39 YEARS OLD ATTENDING SELECTED HOSPITALS IN KAMPALA, UGANDA.

BY

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A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF DENTISTRY IN ORAL & MAXILLOFACIAL SURGERY

OCTOBER 2025.

DECLARATION

I Okundua Isaac do hereby declare that this proposal has been compiled by me and the views expressed therein are mine. Full acknowledgments are given where assistance was sought or where other views were quoted, source of references have been indicated.

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Date.....20/06/2023

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APPROVAL

I, OKUNDUA ISAAC, do hereby declare that all the work contained in this is my original work and has not been submitted for any award in any institution of higher learning.

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DEDICATION

I wish to dedicate this book to the Almighty God for his protection and guidance throughout my Master of Dentistry (Oral & Maxillofacial Surgery). I also dedicate this research to my family: My parents, the Late Joseph Obale and My Mother, Lenura Driciru, My Wife, Trust Tumwesigye; my Children, Audrey Letasi, Alden Aitasi, Maria Obrey Ayikoru, and my Siblings, Francis Aluma Obale, Monica Aluru, Sunday Geriga, Candiru Jane, and Vincent Acidri, for their cooperation, support, and understanding that allowed me to go through this program.

Lastly, I dedicate this research to My Uncle, Mr. Edema Nicholas Babanga, and his Family. I was strengthened by the love, support, and advice of my late Aunt Mary, a very special person. May God rest her soul in peace.

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I appreciate my classmates, the late Dr Muwanguzi Paul (RIP) and Dr Othieno Henry Misanga, for enduring the struggle together.

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ACRONYMS AND ABBREVIATIONS

IOPA	Intraoral Periapical X-rays
MAKDSH	Makerere University Dental School and Hospital
MNRH	Mulago National Referral Hospital
OMFS	Oral and Maxillofacial Surgery
OPG	Orthopantomogram
SHS-HD &REC	School of Health Sciences Higher Degree and Research Ethics
UCU	Uganda Christian University
WHO	World Health Organisation

LIST OF OPERATIONAL DEFINITIONS

An ankylosed tooth was defined as a tooth whose roots fused directly to the surrounding alveolar bone, causing the tooth to become embedded and unable to move with the local elimination of the periodontal ligament (Biederman, 1962).

An ectopic eruption was defined as a situation in which a tooth erupted away from its normal position and was placed in the position of another tooth in an abnormal location. (John H Campbell, 2013)

An unerupted tooth: In this study, an unerupted tooth was defined as a tooth that had not penetrated the oral mucosa or emerged through the gum line as it should, and was most likely to erupt (Balaji & Balaji, 2023; Nagaraj et al., 2016).

A supernumerary tooth: This was defined as an extra tooth or an additional tooth to the normal permanent or deciduous teeth series (Garvey et al., 1999; Malik, 2012).

Eruption: Tooth eruption was defined as the movement of the developing tooth from its non-functional position in the alveolar bone to its final functional position in the oral cavity (occlusal plane) (John H Campbell, 2013).

Impacted tooth: An impacted tooth in this study was defined as one that cannot fully erupt at its projected age of eruption or normal functional occlusion (Hupp et al., 2017b).

Malposed tooth: This was defined as an unerupted or erupted tooth, which is in an abnormal position in the maxillary or mandibular dental arch (Adeola et al., 2023; Malik, 2012).

Abstract

Introduction: Third molars are the most frequently impacted teeth, with prevalence and patterns varying across populations. In Uganda, data on third molar impaction remains limited.

Objective: To determine the prevalence, radiographic patterns, and associated pathologies of impacted third molars in selected hospitals in Kampala, Uganda.

Materials and Methods: A retrospective review of 1130 orthopantomograms from patients attending Mulago National Referral Hospital, Makerere University Dental Hospital, and Mengo Hospital between January 2019 and May 2024 was conducted. Radiographs were assessed for impaction prevalence, angulation, depth, ramus relationship, and associated pathologies using standard criteria. Data were analysed using SPSS with descriptive statistics and chi-square tests ($p < 0.05$).

Results: Impacted third molars were present in 31.0% of cases, with no significant sex difference ($p = 0.284$). Bilateral impactions were most common (28.6%).

Mandibular impactions were 3.5 times more frequent than maxillary.

Mesioangular impaction predominated in the mandible (50.6%), while vertical angulation was most common in the maxilla (47.4%). Level A impaction was most frequent in the mandible (61.5%) and level B in the maxilla (62.6%). No significant side predilection was observed.

Conclusion: Third molar impactions are moderately prevalent in Kampala, predominantly affecting the mandible with characteristic angulation and depth patterns. These findings support the need for targeted oral health interventions and improved diagnostic capacity.

CHAPTER ONE: INTRODUCTION

1.0 Background to the Study

An impacted tooth is one that is unable to fully erupt into its proper functional occlusion/location by the expected age of eruption (Hupp et al., 2017b).

Third molars are the most commonly impacted teeth, accounting for 98% of all impactions.(Hatem et al., 2016). Global prevalence ranges from 18.8% to 68.6%, influenced by geographic and racial differences in facial growth, jaw, and tooth size.(Ahmad et al., 2021) European studies report high impact rates (up to 73%), while African studies show lower rates of 9.2% in Nigeria, 15.8% in Kenya, and a higher prevalence of 84% in a Tanzanian hospital-based study(Juodzbalys & Daugela, 2013; Msagati et al., 2013; Mwaniki & Guthua, 1996; Osunde & Bassey, 2016). No published data currently exists on impaction patterns in Uganda, though local literature notes average eruption ages of 17.5–18 years for boys and 18.2–18.6 years for girls (Kutesa et al., 2019) Impacted teeth can lead to various pathologies and are best extracted early, despite risks such as paraesthesia, dry socket, pain, swelling, trismus, infection, and bleeding.(Osunde et al., 2014; Ryalat et al., 2018; Shaari et al., 2023). Understanding impaction-related diseases is essential for diagnosis and management, especially since distal and horizontal impactions complicate surgery. Common pathologies include caries, root resorption, bone loss, cysts, tumours, and increased risk of mandibular fractures.(Ahmad et al., 2021; Hupp et al., 2017a). The Pell & Gregory and Winter's classifications are most commonly used to categorise impactions.

However, there is no data on the patterns of impacted third molars among the Ugandan population.

Thus, the purpose of this study was to determine the prevalence, pattern, and pathologies associated with impacted third molars among patients who visited the selected hospitals in Kampala, Uganda.

1.1 Problem Statement

Impacted third molars present a global health concern, and their extraction is one of the most common dental surgical interventions (Alvira-González et al., 2017). The prevalence of impacted third molars in two East African countries was previously reported as 1.6% (Mwaniki & Guthua, 1996), 21.3% (Lema, 2002) and 84%(Msagati et a, 2013) in Kenya and Tanzania, respectively. However, there is no published data from Uganda, although unpublished reports from the Outpatient Dental Department of Mulago National Referral Hospital (MNRH) suggest that third molar extractions were among the most frequently performed procedures, and data

from Mulago National Referral Hospital (MNRH) (2021) showed that about 70% of surgical extractions were impacted 3rd molars. Additionally, nothing is known about the radiographic patterns of impacted third molars and associated pathologies in Uganda.

1.2 Study Justification

This study explored the prevalence, radiographic patterns, and associated pathologies of impacted third molars among patients aged 20–39 years attending selected hospitals in Kampala, Uganda. Due to the lack of dental X-ray facilities in most public healthcare settings, many impactions and related conditions go undetected, forcing dentists to rely solely on clinical judgment, which has led to mismanagement and serious complications. Additionally, there is no standardised protocol for prioritising surgical intervention among patients with impacted third molars. The results from this study may help:

- Quantify the burden of impacted third molars in our hospital settings.
- Clinicians to screen the patients and prioritise them for appropriate and timely interventions to prevent potential complications
- Increase public awareness and inform policymakers to increase funding for training more oral and maxillofacial surgeons to offer early interventions like surgical extractions.
- May be the basis of further research.
- The Government can equip Public Health Centre IV and all district-level hospitals with periapical X-rays and orthopantomography machines for the proper diagnosis and management of patients with impacted third molars.

1.3 Significance of the study

Studying the prevalence, radiographic patterns, and pathologies of impacted third molars is scientifically significant for the following reasons:

Predicting Complications: Radiographic patterns (like angulation and depth) are crucial indicators of potential complications such as infections, cysts, and root resorption of adjacent teeth.

Surgical Difficulty: The position and angulation of an impacted third molar help clinicians assess the complexity of a potential extraction, allowing for proper surgical planning and the selection of appropriate equipment and time.

Preventive Strategies: Identifying the prevalence and types of impactions helps in developing strategies for prophylactic extraction or regular monitoring, reducing the incidence of serious pathologies later in life. Public Health and Regional Guidelines

Region-Specific Care: The prevalence of impacted third molars varies significantly by geographic region and demographic factors. Studying these variations helps create region-specific guidelines that are more effective for local populations.

Baseline Data: Such studies provide essential baseline data for specific populations, enabling public health officials to understand the burden of the problem and allocate resources effectively. Understanding Aetiology and Risk Factors

Investigating Causes: By examining demographic and regional factors along with impaction patterns, researchers can gain insights into the underlying causes of third molar impaction.

Identifying High-Risk Groups: Studies can identify specific populations at higher risk for impaction and associated complications, facilitating targeted screening and intervention programs. Improving Diagnostic Accuracy

Diagnostic Enhancement

Subtle Pathology Detection: Improves recognition of early signs like bone loss or radiolucency, enhancing diagnostic precision.

1.4 Research questions

1. What is the prevalence of impacted third molars among patients aged 20-39 years attending selected dental facilities in Kampala City, Uganda?
2. What are the radiographic patterns of impacted third molars among patients aged 20-39 years attending selected dental facilities in Kampala City, Uganda?
3. What are the common pathologies associated with impacted third molars among patients in Kampala City, Uganda?

1.5 Purpose / General Objective

The purpose of this study was to determine the prevalence of impacted third molars, radiographic patterns, and associated dental pathologies among patients attending selected dental facilities in Kampala, Uganda.

1.5.1 Specific Objectives

1. To determine the prevalence of impacted third molars among patients aged 20-39 years attending selected dental hospitals in Kampala using radiographic findings.
2. To describe the patterns of impacted third molars among patients aged 20-39 years attending selected dental hospitals in Kampala using digital orthopantomogram (OPG).

3. To determine the pathologies associated with impacted third molars among patients 20-39 years attending selected hospitals in Kampala.

1.6 Conceptual framework

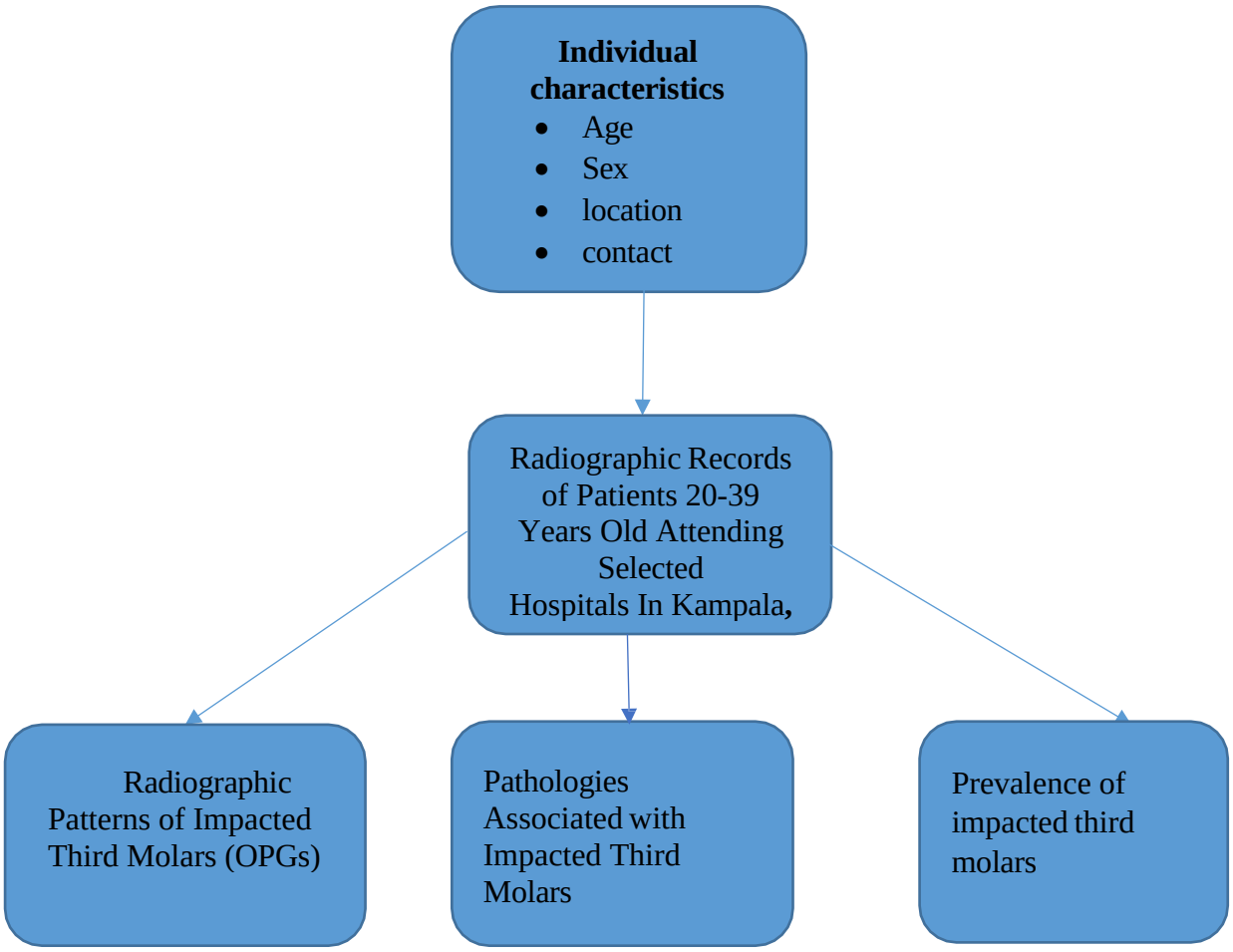


Figure 1: Conceptual Framework

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Third molars and maxillary canines are the most commonly impacted teeth, with third molars comprising 98% of all cases, with mandibular third molars being the most affected.(M. Al-Dajani et al., 2017; Hatem et al., 2016). Eruption typically occurs between ages 17 and 25 but may continue into the late third decade.(Hupp et al., 2017b) Prevalence of impaction is highest among young adults and decreases with age. Globally, impaction rates vary due to racial and geographic differences in facial growth.

In 9–25% of individuals, third molars never erupt, with mandibular impactions more frequent and significantly higher in female (Santosh, 2015). This gender difference is possibly explained by Hellman's theory, which suggests that male jaws continue to grow after the third molar eruption.(M. Al-Dajani et al., 2017; J. H. Campbell, 2013; Malik, 2012)

Radiographic Patterns(Winter Classification),

Studies show that mesioangular horizontal and vertical angulations are the most prevalent patterns. Mesioangular, horizontal, and vertical angulations are the most frequently observed in the lower jaws, while Vertical and distoangular positions are more common in the maxillae.(Al-Madani et al., 2024; Alhajj et al., 2024)

Depth (Pell and Gregory Classification):

.Tooth impaction levels are classified by depth using the Pell and Gregory system, which assesses the position of the impacted tooth relative to the occlusal plane and cervical line of the adjacent molar. Levels B and C are commonly seen in the mandible, while levels A and B are typical in the maxilla.(Ahmad et al., 2021; Pinto et al., 2024a) The Pell and Gregory class classification evaluates the space in the mandibular ramus: Class I indicates sufficient space, Class II partial coverage, and Class III complete coverage.

Associated Pathologies

Common associated pathologies include caries in adjacent second and the impacted third molars, root resorption, periodontal pockets, cysts and pathological fractures.

Clinical Considerations

Asymptomatic Nature: Most impacted third molars do not cause symptoms.

Monitoring: Regular monitoring with radiographs is crucial to identify and address potential pathological changes early.

Early Evaluation: Proactive dental evaluation is essential for preventing complications and improving outcomes, particularly in populations with a high prevalence of third molar impaction and related pathologies, such as those in Uganda. This study used digital panoramic radiographs from three well-equipped hospitals to assess the angular position and depth of impacted third molars using Winter's and Pell and Gregory's classifications.

Aetiology of impacted third molars

Impacted teeth fail to erupt due to factors such as physical barriers, insufficient space, and eruption obstructions. Common causes include dental crowding, supernumerary teeth, odontogenic cysts and tumours (especially odontomas), incorrect positioning, adjacent teeth, dense surrounding bone, ectopic tooth bud location, and root trauma.(J. H. Campbell, 2013; Malik, 2012)

2.1 Prevalence of impacted third molars

Studies reveal significant variation in third molar impaction prevalence and eruption age. Globally, the mean prevalence is 24.40%.(Pinto et al., 2024b; Sujon et al., 2022) In Europe, impactions affect about 73% of young adults, with eruption typically between ages 17 and 21, but possibly extending to 26 years. In Sweden, 72% of individuals aged 20–30 were reported to have impacted third molars(Dodson & Susarla, 2014). Impaction is less common in Africa than in Asia and Europe.(Braimah et al., 2018; Shaddad et al., 2018; Yahaya et al., 2024) Nigerian adults show a 9.2% prevalence, with mandibular third molars erupting as early as age 14(Osunde & Bassey, 2016). Tanzania reports a 21.3% rate(Lema, 2002; Sujon et al., 2022). No data is currently available for Uganda.

2.2 Distribution of the impacted third molars

Research consistently shows that mandibular third molars are more frequently impacted than maxillary ones, though the pattern of impaction varies among individuals. Patients may present with one to four impacted third molars. A study in North-Eastern Peninsular Malaysia found that 70% had all four impacted(Ahmad et al., 2021). Another study reported double impactions as the most common (61.9%), followed by four (28.7%), three (7.6%), and single impactions as the least frequent. These findings align with studies by Quek, Morris, and Pillai, which also found double impactions to be most prevalent, contrasting with the Malaysian data. Overall, impaction distribution lacks a consistent pattern.(Pillai et al., 2014; S. L. Quek et al., 2003)

2.3 Patterns of third molar impactions

Patterns are often categorised radiographically and provide information on angulation, depth, and arch length, or, in the case of mandibular third molars, by their proximity to the anterior aspect of the ascending mandibular ramus. Dental X-rays and thorough clinical examinations should always be used to make the diagnosis of impacted third molars. The preferred radiograph for assessing the condition of impacted third molars is a panoramic radiograph. The following are the criteria used for the assessment of the patterns for third molar impactions:

1. Winter's Classification (1926)
2. Pell and Gregory Classification (1933)
3. Quek et al. (2003) introduced the Measurement of Angulation of Impaction
4. Combination of Winter and Quek Classification
5. Maxillary Third Molars' Classification

This study used two classification systems to determine patterns of impacted third molars: Pell and Gregory's classification, which assesses the depth and the relationship of the impacted molar to the anterior ramus of the mandible, and Winter's classification, which evaluates the angle formed between the long axis of the impacted third molar and that of the adjacent tooth.

2.3.1 Winter's Classification: Angulation

The most commonly used classification involves the determination of the angulation of the long axis of the impacted third molar with respect to the adjacent second molar. Winter's classification of third molars includes the following angulations: Mesioangular, Distoangular, Vertical, Horizontal, Buccolingual, and others. See figure1 (Hashemipour et al., 2013; Winter, 1926).

Mesioangular impaction: This is the case where the third molar's impacted crown is angled mesially toward the second molar's distal aspect, as seen in Figure 1A. It accounts for roughly 43% of all impacted lower third molars worldwide and is the most prevalent kind of third molar impaction (Hupp et al., 2017a).

Horizontal impaction: This is a type of impaction in which the impacted tooth is thought to be horizontal, as shown in Figure B. This type of impaction occurs when the third molar's long axis is at a right angle (90°) from that of the second molar. Less commonly, in roughly 3% of all mandibular impacts (Hupp et al., 2017a; Hupp et al., 2013; Peterson, 2003).

Vertical impaction is the situation where the second molar's long axis and the impacted tooth's long axis are parallel. The maxilla has the highest frequency, with the second-highest frequency occurring in around 38% of all mandibular third molar impactions (Hupp et al., 2017b).

Distoangular impaction is the one where the third molar's long axis is inclined away from the second molar. It involves the tooth with the most difficult angulation for extraction, and its probability is not common, accounting for only about 6% of all impacted third molars (Hupp et al., 2017). This impaction is the most difficult to extract because the tooth has an extraction pathway that runs into the mandibular ramus and thus requires adequate bone clearance.

A transverse impaction is one in which a tooth erupts in a horizontal position in the buccolingual direction. A tooth's crown surface may face either the buccal or lingual direction. (Hupp et al., 2017b)

Below are some of Winter's classifications of impacted third molars, adapted from a textbook of oral and maxillofacial surgery:

(A**) Mesioangular, (B) Distoangular, (C) Vertical, (D) Horizontal; (E) Bucco-version/angular, (F) Linguo version/angular; and (G) Inverted** as in Fig. .1

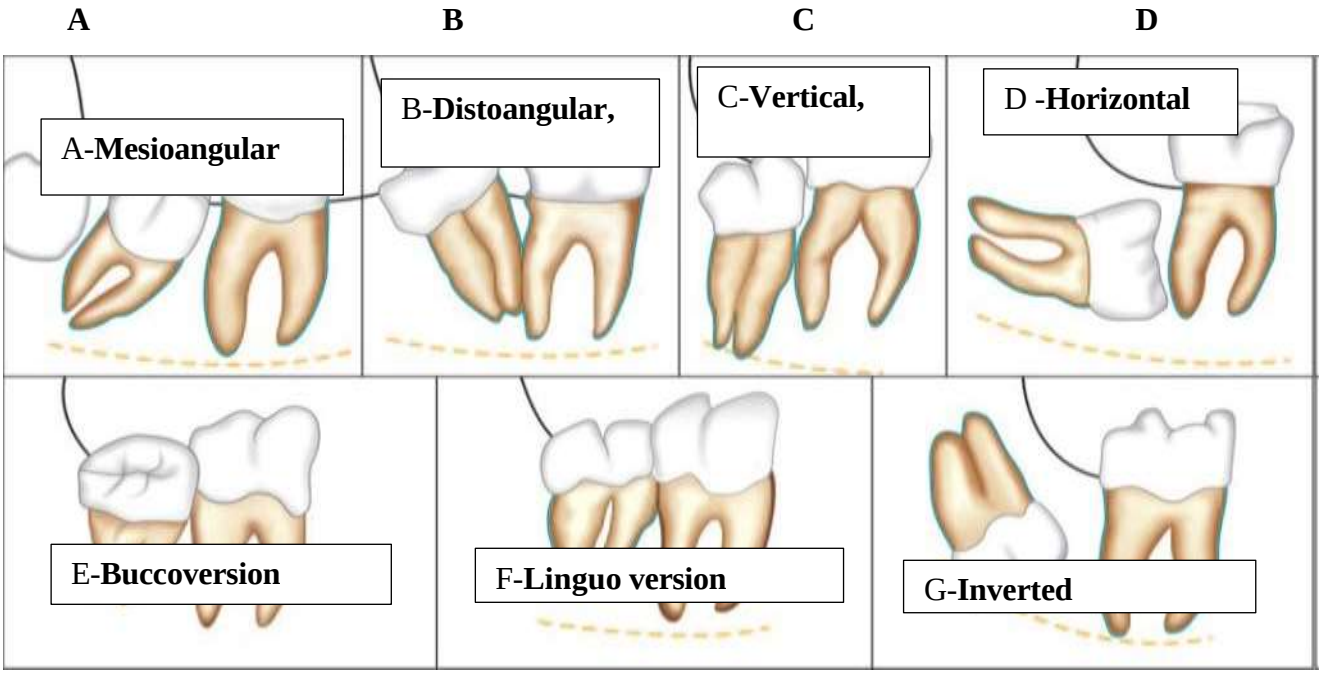


Figure 2: Prevalence of the different patterns according to Winter's classification (adopted from Oral and Maxillofacial Surgery-Neelima Anil Malik BDS MDS (Bom) FIAOS)

Different countries have shown varied patterns of angulation, according to the literature; however, several Studies have shown that mesioangular impaction is the most common type of impacted third molar angulation (Ahmad et al., 2021; Hupp et al., 2017a). Nevertheless, some investigations found that vertical angulation was most predominant. Vertical impaction was the most common pattern in the maxilla and mandible; meanwhile, mesioangular impaction was the second most frequent impaction in the mandible, while Disto-angular impaction ranked second in the maxilla (Mahmoud Al-Dajani et al., 2017). The 20-30 age group has been reported to have the highest prevalence of impaction, but it decreased in the 30-40 age group (Braimah et al., 2018).

Quek et al. 2003 and Hashemipour et al.2013 observed that vertical angulation occurs more frequently in the maxilla, while mesioangular impaction of the third molar is the most common angulation in the mandible (Hashemipour. et al., 2013; Quek et al., 2003). Mesioangular impaction was the most prevalent kind, occurring in roughly 34.6% of patients, according to a study on Africans, specifically Libya, and was followed by vertical (31.3%). Studies in East Africa, namely in Tanzania at the Muhimbili National Hospital in Dar es Salaam, found that the mesioangular pattern of third molar impaction was the most common (76%) and the horizontal pattern, second (Msagati et al., 2013).

In the second study from Dar es Salaam, general dental clinics, it was observed that mesioangular was the most common type, comprising 60% of the third molar impactions seen in this study, followed by vertical (17%), distoangular, and the least common type was horizontal (8%) (Lema, 2002). In Kenya, D. Mwaniki and S.W. Guthua reported that mesioangular was the most common, followed by horizontal.(Mwaniki & Guthua, 1996).

2.3.2 Pell and Gregory Classification

This categorisation comprises a division based on the third molar's relationship to the ramus and the depth of impaction.

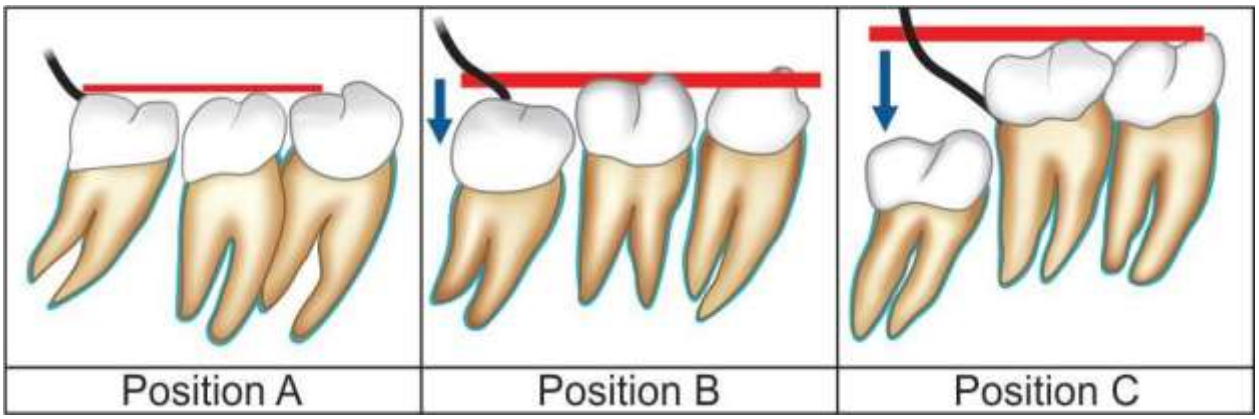


Figure 3: Classification of Mandibular Third molars according to Depth of Impaction(adopted fromOral and Maxillofacial Surgery-Neelima Anil Malik BDS MDS (Bom) FIAOS)

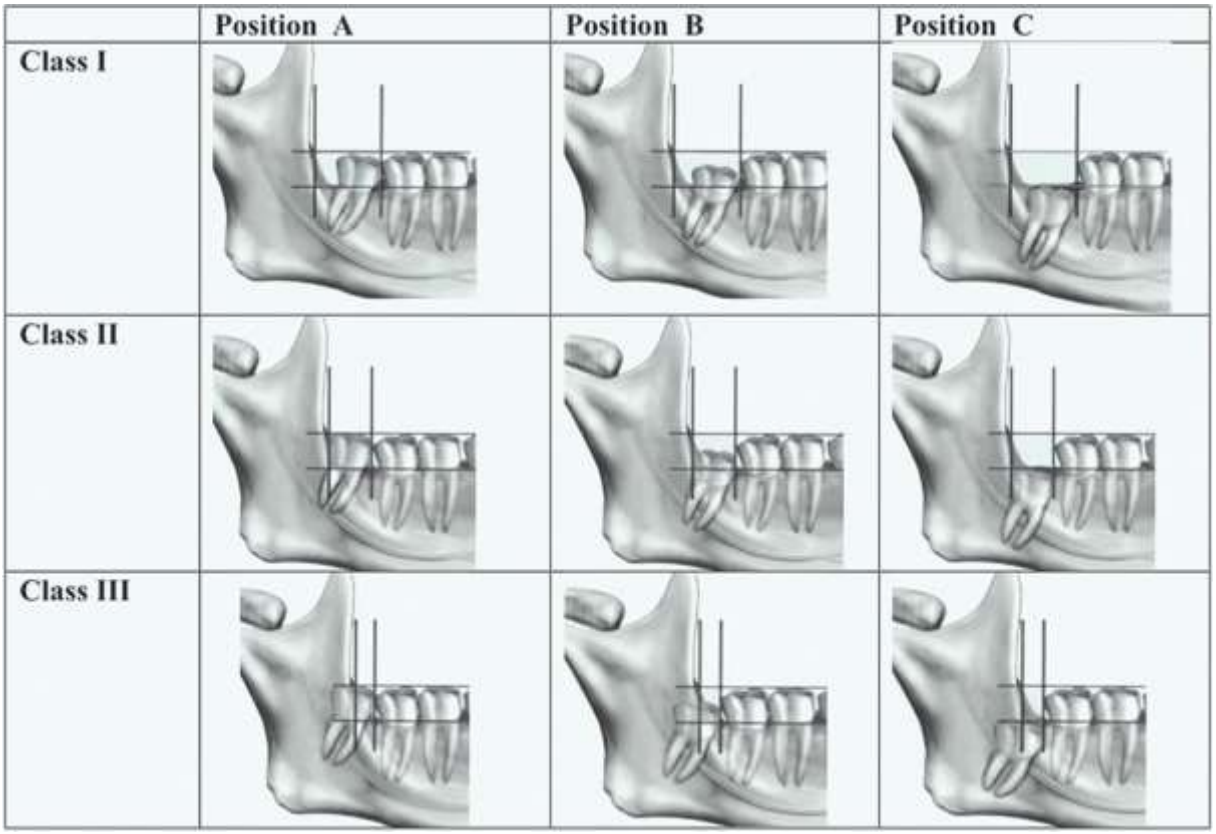


Figure 4: Classification of Mandibular Third molars according to Depth of impaction and the Relationship of the impacted lower third molar to the ramus of the mandible

a) This classification is based on the depth of the impacted third molar in relation to the height of the neighbouring second molar. Pell and Gregory also proposed this classification scheme, which is known as the Pell and Gregory A, B, and C classification. The depth of the impacted tooth determines the degree of surgical difficulty in this categorisation, which means that the

degree of difficulty increases as the depth of the buried tooth increases. The surgery gets significantly more challenging as the tooth becomes harder to reach, harder to section, and harder to prepare purchase points. The depth can be determined based on the relationship between the occlusal surface of the adjacent second molar to that of the impacted maxillary or mandibular third molar (Pell, 1933; Vilela & Vitoi, 2011).

A **class A impaction** is one in which the impacted tooth's crown surface is parallel to or nearly parallel to the second molar's occlusal plane. In other words, the tooth is not buried in the bone as shown in Figure 2A.

A Class B impaction will be defined as an impacted tooth with an occlusal surface that is between the occlusal plane and the second molar's cervical line. In this category, the impacted tooth is partially buried.

A **Class C impaction** is defined as one in which the tooth is completely buried in the bone; that is, the impacted tooth's occlusal surface lies below the second molar's cervical line.

Pell and Gregory Classification (Pell and Gregory classes 1, 2, and 3)

b) Relationship of the impacted lower third molar to the ramus of the mandible and the second molar

This classification is based on the space available distal to the second molar (Pell, 1933; Vilela & Vitoi, 2011). In this classification, the third molar crown's location is compared in relation to the ramus. This reflects an increasing amount of bone that is ramus covering the tooth crown in a mesiodistal dimension.

The third molar will be classified as belonging to Class 1 if there is enough room for it to erupt while still being spaced apart from the ascending ramus's anterior border and the distal side of the second molar (Class I: Anterior to the border). A case falls into Class II if the third molar's mesiodistal breadth is smaller than the distance between the anterior border of the ramus and the second tooth's distal side. It suggests that the third molar's distal part of the crown is covered in bone from the ascending ramus.

(Class II: Half of the crown is covered by the border**.)**

Class III: In this form of impaction, there is no room at all, and the third molar is entirely entrenched in the bone from the ascending ramus. As can be seen in Figure 3, this makes it difficult to access and ultimately remove the tooth. (Class III: Crown completely embedded into the ramus).

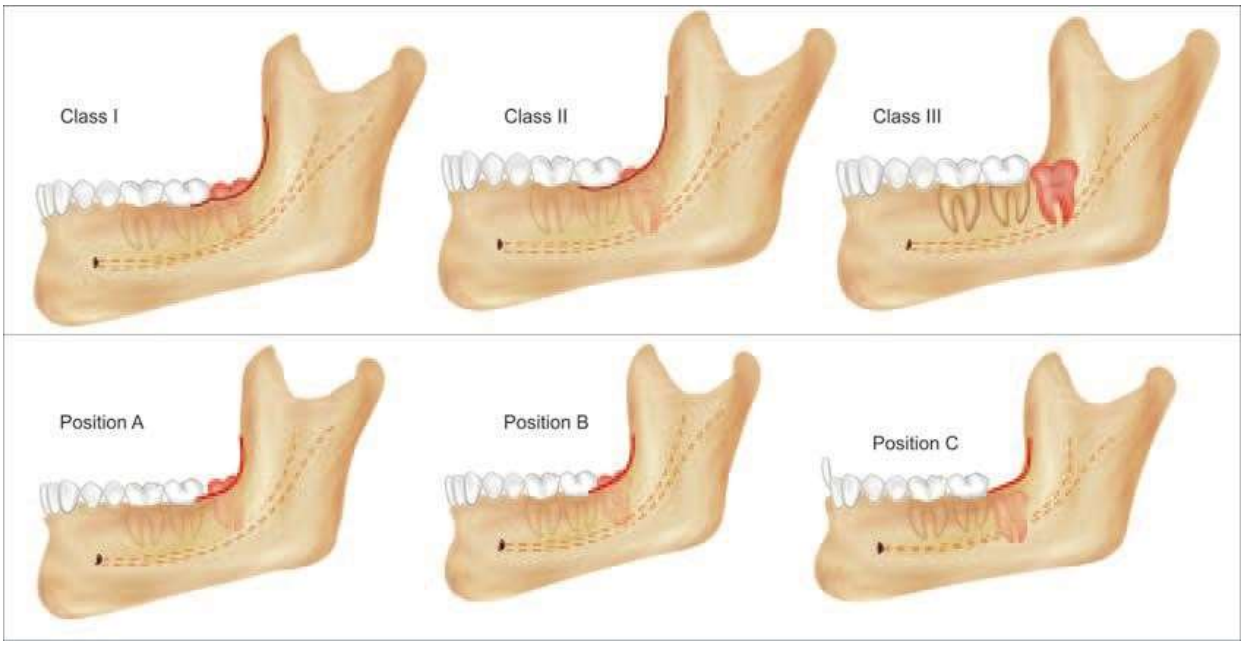


Figure 6

Figure 5: A and B: Pell and Gregory: A (I. II, III) (B) positions A, B, and C (*adopted from Oral and Maxillofacial Surgery-Neelima Anil Malik BDS MDS (Bom) FIAOS)*

Prevalence of different patterns according to Pell and Gregory's criteria

Studies have shown that different regions and nations have varying prevalences. For instance, a study in the Northern region of Saudi Arabia found that 53.5% of participants had level A in their mandible and maxilla, while levels C and B were not common (Mahmoud Al-Dajani et al., 2017).

The most common pattern of third molar impaction, according to a study done in North-Eastern Peninsular Malaysia, was IIA (61.67%), whereas the least common pattern was IIIC (12.0%) (Ahmad et al., 2021).

The most prevalent positions in the Italian population, according to Monaco et al, were Class A (56%) and Class II (63%), while the most prevalent class, according to Obiechina et al, was IIA (31%) (Ahmad et al., 2021; Monaco et al., 2004).

According to a study examining the patterns of third molar impactions in the Libyan population, level B was most prevalent in the mandible and level C in the maxilla. This was consistent with the findings of Quek et al. (2003, Sandhu et al., and Padhye et al. Hattab et al. observed that 72.7% of mandibular third molars were in Class II, followed by 24.8% in Class I and 2.5% in Class III, and found that the maxilla had higher levels of Level B than the mandible. There has been no clear report about the prevalence of third molar impaction in East

Africa as per Pell and Gregory's criteria. This classification has the advantage of generating the optimal treatment strategy and weighing the benefits and drawbacks of the surgical procedure. Therefore, it is essential to assess the pattern of the impacted third molars so that, by utilising a variety of patterns for impacted third molars, the likelihood of intraoperative issues or the degree of surgical difficulty can be predicted. For instance, extraction of the position C molar is more difficult than the position B molar, and extraction of the position B molar is more difficult than the extraction of the position A molar.

2.4 Pathologies associated with impacted third molars

Radiographic findings have identified several pathologies associated with impacted third molars, including periodontal pocket formation, bone loss around adjacent teeth, mandibular fracture susceptibility, caries in both impacted and adjacent teeth, root resorption, and odontogenic cysts and tumours. A study in North-Eastern Peninsular Malaysia found 28% of subjects had such pathologies, with caries being most common (15.38%), a rate higher than those reported in Oman, Turkey, and Jordan, but lower than in Kenya (46.4%) and Tanzania (32%)(Ahmad et al., 2021; Al-Anqudi et al., 2014; Axell & Johansson, 1993; Mwaniki & Guthua, 1996; Polat et al., 2008) Other Sub-Saharan African studies noted caries (27.4%) and periodontal pockets (23.7%) as frequent issues, while South African histopathological data showed 14% of cases involved ameloblastoma(Braimah et al., 2019; Mohammed et al., 2019). Most cases occur between ages 21 and 25, though older patients show more pathology due to delayed presentation. Younger individuals (16–25) tend to have fewer associated conditions. In Kenya and Tanzania, caries prevalence linked to impaction was 46% and 45.2%, respectively, with few cases presenting mandibular fractures.(Msagati et al., 2013; Mwaniki & Guthua, 1996).%. Msagati Simon et al. found that only a small number of patients, about 12, presented with fractures of the mandibular angle as their primary complaint (Msagati et al., 2013). This Ugandan study is the first of its kind. It aims to inform preventive strategies for managing impacted third molars, which can also compromise mandibular bone support and increase fracture risk, especially in contact sport participants.

The following shows the different pathologies associated with impacted molars.

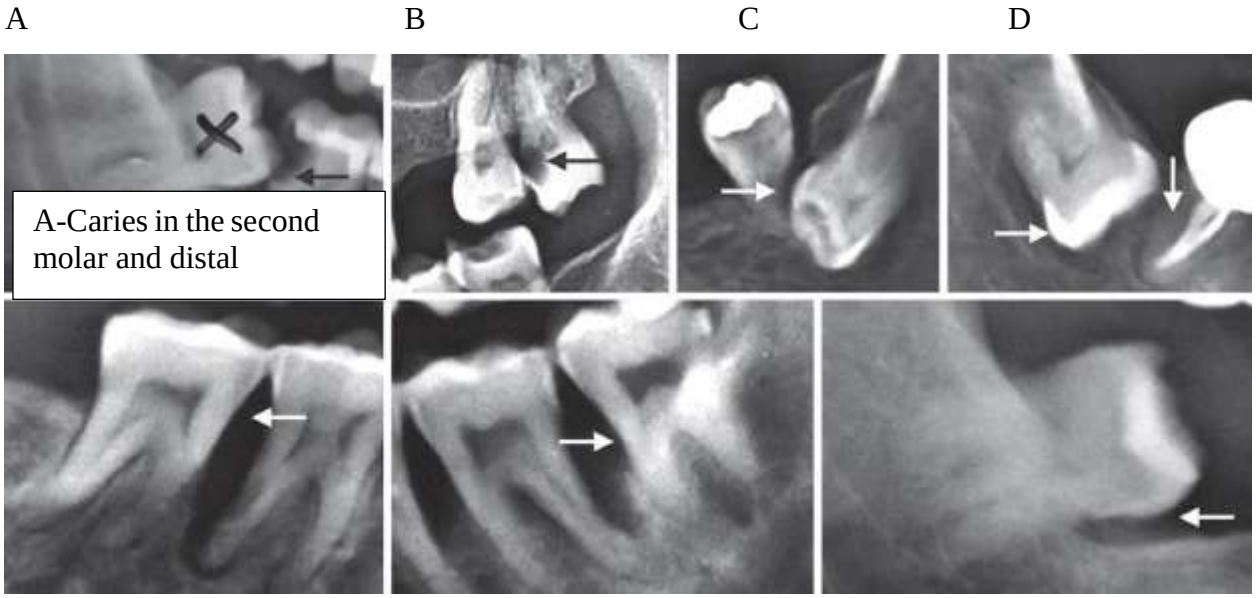


Figure 6: Title. The following shows the different pathologies associated with impacted molars. (adopted from Oral and Maxillofacial Surgery-Neelima Anil Malik BDS MDS (Bom) FIAOS)

A Caries in the second molar and distal periodontal pocket;

B Supraerupted upper third molar with caries;

C Resorption of the second molar;

D Follicular space around impacted lower third molar;

(E to G) The periodontal pocket between the second and third molars.

CHAPTER THREE: METHODOLOGY

3.0 Study Design and Period

This was a retrospective study of radiographic records of patients who attended selected dental hospitals from January 2019 to May 2024.

3.1 Study setting

This study was conducted in three selected hospitals in Kampala City, Uganda: Mulago National Referral Hospital (MNRH) - Dental and Oral & Maxillofacial Surgery units, Makerere University Dental School Hospital (MAKDSH), and Mengo Hospital Dental Department. These hospitals were chosen for their national recognition, high dental patient volume, and advanced radiology services. MNRH is a government-owned national referral centre for complex cases; Mengo Hospital is a reputable, privately owned, church-based community hospital; and MAKDSH is the dental arm of Makerere University College of Health Sciences, serving both as a care provider and training facility for dental students.

The Dental and Oral and Maxillofacial Surgery Department of Mulago Hospital: Mulago National Referral Hospital, is a government-owned tertiary and teaching hospital affiliated with Makerere University College of Health Sciences. Located on Mulago Hill in Kampala, it has a 2,000-bed capacity and serves as a national referral centre, especially for lower health facilities, due to its specialised services and advanced imaging like digital OPG. Its Dental and Oral & Maxillofacial Clinics handle around 2,000 patients monthly, primarily aged 10–40, attended by a multidisciplinary team of oral health professionals**.**

Makerere University Dental School Hospital (MAKDSH): Makerere University Dental School Hospital (MAKDSH), located on Makerere Hill in Kampala, is the teaching hospital for Uganda's largest public university. Situated about 2km from the city centre, it serves both public and private dental patients, mainly university students. Renowned for its advanced digital X-ray imaging, it receives nationwide referrals and is staffed by highly skilled specialists offering a range of dental and oral maxillofacial services.

Mengo Hospital is located in the capital and largest city of Uganda, Kampala. It is a private, community-based, religious hospital. Approximately 5 kilometres (3 miles) by road southwest of Mulago National Referral Hospital, the hospital is situated on Namirembe Hill in Lubaga Division in Northwestern Kampala. Mengo Hospital is located around 5 miles away from the city's commercial centre by road. It's the oldest medical facility in Uganda,and was founded by Albert Cook in 1897.

Due to the hospital's better X-ray and Dental departments, the institution is now affiliated with UCU Medical School. It has state-of-the-art dental equipment and highly specialised staff to offer cost-effective and quality dental care. The hospital was once a rural community hospital, but now it has all the amenities of a modern urban hospital.

3.2 Study Population /Study Materials

The study was conducted on the radiographic records, which are orthopantograms (OPGS) of patients who were seen during the period of study.

3.3 Study Participants /Study Materials

All radiographic records of patients between the ages of 20 and 39 years were taken at the selected dental hospitals.

Case Definition: For a third molar to be considered impacted, it had to satisfy two conditions:(1) the roots of the third molar must have been completely formed except for horizontally or transversely impacted molars, and (2) there must have been no functional occlusion on the third molar occlusal surface. Horizontally or transversely impacted molars, which were unlikely to erupt, were included even if their roots were not completely formed.

3.3.1 Selection Criteria: Inclusion and Exclusion Criteria.

3.3.2 The inclusion criteria

The study selected radiographs of patients with evidence of impacted third molars using the mentioned criteria in those selected dental hospitals that met the inclusion criteria.

- Radiographs of patients aged 20- 39 years old.
- Presence of a good-quality OPG in the patient record, and a complete patient record
- Complete root formation of third molars except for horizontally and transversely impacted third molars
- Presence of the adjacent second molar.

3.3.3 The exclusion criteria will be

The study excluded radiographs of patients that showed the presence of any craniofacial anomalies, congenital deformities, or syndromes.

3.4 Sample size determination

Cochran's formula was used to estimate the population because it was unknown, and being a quantitative study, it was the most appropriate.

$n_0 = (Z^2 * p * (1-p)) / e^2$.

'n_0'= is the initial sample size, 'Z'= is the z-score for the desired confidence level, 'p'= is the estimated proportion of the population with the attribute of interest, and 'e ' = the desired margin of error. A common practice is to use a z-score of 1.96 for 95% confidence and a proportion (p) of 0.5 when the attribute's prevalence is unknown, as this maximises the required sample size. Z=1.96, P=0.5, e=0.05

n_0 (Initial Sample Size)=(**1.96^2x0.5x(1-0.5)/0.05^2**

=1.96x1.96x0.5x0.5/0.05x0.05

=3.8416x0.25/0.0025

=0.9604/0.0025

=384 **participants**

Considering a design effect due to clustering at the level of hospital and the same patient having four third molars, the computed sample size was multiplied by 4x 384=1536

10/100x1536=154

This was adjusted by 10% (154) to cater for missing data. Therefore, the minimum sample size will be 1690 participants.

But since I had worked on the sample size using this Kish &Leslie formula previously, I maintained it as it was 1130 participants.

Study variables: The study variables included Independent Variables and dependent variables.

IndependentVariables

These are factors that were examined for their potential influence on outcomes and they included:

Demographic Variables

Age: May affect impaction prevalence and pattern.

Sex: Gender-related differences in impaction are commonly assessed.

Jaw Location: Impaction rates differ between the maxilla and mandible.

Radiographic Parameters

Characteristics of third molars (e.g., angulation, position) were considered independent if analysed for their impact on pathology.

DependentVariables

These were outcomes measured in relation to the independent variables they included:

Prevalence of Impaction: Presence or absence of third molar impaction.

Radiographic Patterns: Types of impaction (e.g., mesioangular, vertical, distoangular).

Angulation: Classified using Winter's and Pell & Gregory systems.

Location: Left/right, unilateral/bilateral positioning of impacted molars.

Position and Level: Depth and spatial orientation within the jaw.

Associated Pathologies

Caries: Decay on adjacent second molars.

Cysts/Abscesses: Peri-coronal radiolucencies.

Resorption: Structural damage to neighbouring teeth or tissues.

Table 1 Criteria for diagnosing pathologies associated with impacted 3rd molars.

Diagnosis	**Criteria**
Caries	Radiographically clear carious lesion in the impacted teeth or the adjacent teeth.
Periodontal bone loss	Radiolucency of the periodontal bone loss on the distal aspect of the second maxillary and mandibular molars was measured from the cement-enamel junction to the marginal bone level.
Root Resorption	A clear loss of substance in the root of the adjacent tooth due to direct contact between it and the impacted tooth.
Cysts/ tumours	The completely radiolucent area encompassing the crown of the fully impacted teeth, respectively, the third molars

3.5 Sampling techniques

The Simple Random Sampling method was employed. All radiographic records taken from January 2019 to February 2024 that met the inclusion criteria were included in the study till the sample size was obtained.

3.6. Data Collection Procedure

Radiographic records were retrospectively extracted using software and sent to a laptop or desktop, where they were assessed and traced out on digital panoramic radiographs. Six dental

surgeons, trained as research assistants, two per hospital were instructed by the principal investigator (PI) to interpret radiographs and review all OPGs from the selected institutions. Before data collection, they underwent training and calibration in a standardisation session and assessed thirty OPGs in a pilot study to ensure intra-examiner reliability. At each hospital, the two examiners selected OPGs meeting the inclusion criteria and evaluated them for impacted third molars, including their number, angulation, level of eruption, depth, retromolar space, and associated pathologies. The PI resolved any diagnostic disagreements.

Angular position

The angulation of impacted third molars was evaluated using panoramic radiographs traced according to Winter's classification. Impaction was defined as the absence of functional occlusion on the crown surface and the angle formed by the intersection of the longitudinal axes of the second and third molars. This angle was measured to determine the angulation, following Winter's method (1926), and a standardised angular classification was applied to minimise visual assessment errors.

Vertical impaction: 10 to -10

Mesioangular impaction: 11 to 79

Horizontal impaction: 80 to 100

Distoangular impaction: -11 to -79

Other: 111 to - 80

A positive degree indicated an intersection located above the occlusal plane, while a negative degree indicated an intersection located below the occlusal plane.

The Pell and Gregory classification was used to determine the depth and relationship of the anterior ramus of the mandible to impacted mandibular third molars. The distance from the ramus of the jaw to the distal aspect of the second molar (retromolar space) was determined. Using the patient's OPG, the researcher checked for any lesions on the third molar that were impacted or any other neighbouring molars, for any bone loss or periodontal pockets, as well as any other associated pathologies.

The depth of impaction

According to Pell and Gregory's classification, the relationship between the third molar's occlusal surface and the adjacent second molar's cementoenamel junction was noted as follows (Hupp et al., 2017b; Pell, 1933; Vilela & Vitoi, 2011)**.**

Position A: the crown portion of the impacted third molar on the same level or above the occlusal plane of the adjacent second molar.

Position B: The crown portion of the impacted third molar is located below the occlusal plane but above the cervical line of the adjacent second molar.

Position C: The crown of the impacted third molar is below the cervical line of the adjacent second molar.

Relation to the ramus of the mandible for impacted third molars

According to Pell and Gregory's categorisation, the available retromolar space is determined by measuring the distance between the anterior border of the ascending ramus on the occlusal surface and the mesiodistal breadth of the third molar crown as follows (Pell & Gregory, 1942; Vilela & Vitoi, 2011).

Class I: The available space was sufficient to accommodate the mesiodistal width of the impacted third molar.

Class II: The available space was less than the mesiodistal crown width of the impacted third molar.

Class III: The impacted third molar was located completely within the mandibular ramus.

Figure 7 MeasurementswithCorelDRAWinPAN

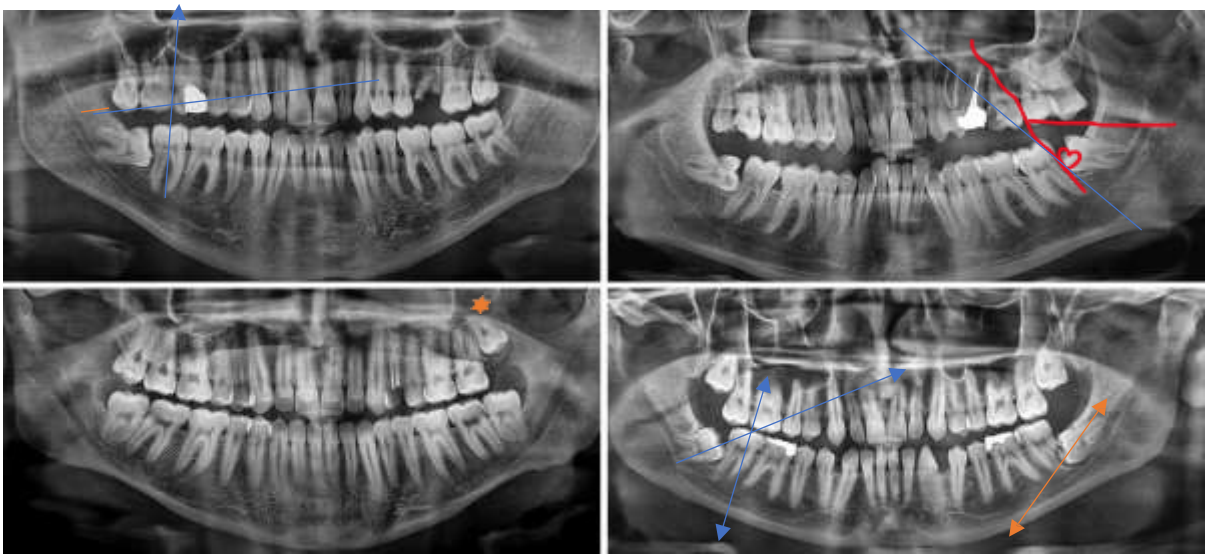
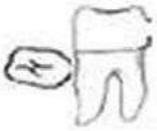


Table 2: Winter's classification adopted from Hashemipour et al. (62)

Type of Angulation	Jaw	
	Mandibular	Maxillary
Vertical		
Mesioangular		
Horizontal		
Distoangular		
Buccolingual		
Others		
		
		

Level of impaction for impacted third molars

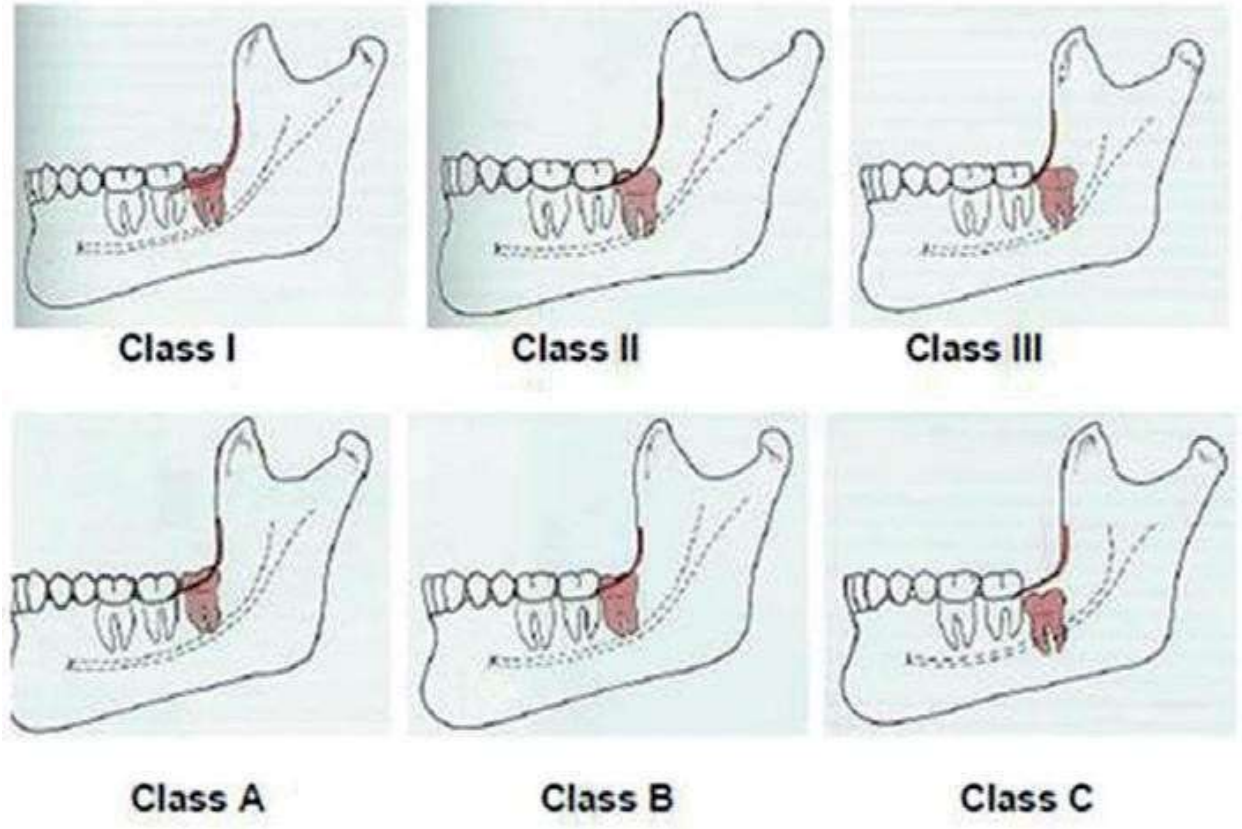


Figure 8: Pell-Gregory classification based on depth and relation to the ramus(adopted from Oral and Maxillofacial Surgery-Neelima Anil Malik BDS MDS (Bom) FIAOS)

3.6.1 Examiners and Standardisation Session

The examiners were two dental surgeons at each Hospital. To achieve calibration and build examiner consensus, examiners were trained and calibrated in a standardisation session held one week before the start of the study. Under the direct supervision of the PI, each examiner evaluated independently 20 OPGs for impacted third molars and rated their levels of eruption as well as their angulations and associated pathologies. A random sample of thirty (30) OPGs was re-examined unknowingly by the examiners to assess intra-examiner reliability. Whenever a diagnostic disagreement was encountered, examiners discussed those cases and established consensus about the diagnosis. To determine the level of agreement for intra- and inter-examiner reliability, kappa analysis was performed due to the nominal categorical nature of the variables.

3.6.2 Intra- and Inter-Examiner Reliability

The overall intra- and inter-examiner reliability showed outstanding reliability ($\kappa > 0.80$). All κ values had a p-value < 0.001. Levels of intra-examiner agreement were 0.85. The Kappa scores

of inter-examiner agreement among the four examiners ranged from 0.78 to 0.85 for the third molar level of eruption, and from 0.77 to 0.84 for angulation.

3.7 Data collection instrument

The data collection instrument was adapted from a checklist used in a similar previous study (Hatem et al., 2016). The data collection tool consisted of three sections. Section I captured information regarding demographic variables, including age, sex, date of birth, region, address, and ethnicity. Section II captured information regarding the presence of impaction, the pattern of impaction using angulation, the level of eruption, and the retromolar distance. Whereas Section III captured information regarding the associated dental pathologies.

The checklist is attached as Appendix I.

3.7.1 Data management and analysis

Data was entered and analysed using the Statistical Package for the Social Sciences (SPSS), Version 19.00 (IBM Corp., and Chicago, Illinois, USA).

Data were summarised using descriptive statistics using means (SD) or proportions, and percentages for all variables. Numerical variables were summarised using means and Standard Deviation (SD) while categorical variables were summarised using proportions, frequencies, and percentages. Pearson's Chi-square test was used to test the association between different categorical variables.

Data management: All data, including patient identification and X-rays, were kept confidential and only accessed by authorised personnel.

3.8 Ethical considerations

Permission to conduct the study was obtained from the School of Dentistry, and ethical approval was granted by the School of Health Sciences Higher Degree and Research Ethics Committee (SHS-HD & REC), as attached as Appendix V. Subsequently, administrative clearance was sought at all the study sites. Waiver of informed consent was sought from the SHS-HDREC, Appendix IV.

3.9 Dissemination of the Results

The results of the study are available at the School of Dentistry, the Oral and Maxillofacial Unit, Makerere University College of Health Sciences, Sir Albert Cook Medical School Library, and the School of Graduate Studies, Makerere University. The work will also be submitted to local and international journals for publication.

CHAPTER FOUR: RESULTS

4.1 Socio-demographic characteristics of participants

A retrospective study was carried out using a total of 2100 OPGs. Of these, 1130 OPGS fulfilled the inclusion criteria. The mean age of the participants was 30, and the standard deviation (SD) was 6.01. 793 (70.2%) radiographic records were obtained from Mulago Hospital, 198 (17.5%) from Mengo Hospital, and 139 (12.3%) from Makerere University Dental Hospital. Overall, there was nearly an equal distribution of males and females, with no significant difference in gender. In this study, mean and standard deviation were used because the characteristics of the data were approximately normally distributed and symmetrical.

Table 3: Socio-demographic characteristics of study participants

Demographic characteristic	**Frequency (n=1130)**	**Percentage (%)**	**Mean (Years)**	**Standard deviation SD**
Age			30.0	6.01
Sex				
Female	570	50.4		
Males	560	49.6		
Location distribution				
Mulago hospital	793	70.2		
Mengo hospital	198	17.5		
Makerere University Hospital	139	12.3		
Total	1130	100		
Prevalence of impacted molars				
Number of OPGs with no Impaction	780	69.0		
OPG with impacted molars	350	31.0		
Total	1130	100		

4.1 Prevalence of impacted third molars among patients aged 20-39 years attending selected

In this study, the overall prevalence of impacted third molars was 31% (350 OPGs out of 1130). Of the 1130 valid OPGs, 350(30.97%) reported at least one impacted third molar. There were 720 impacted third molars in the 350 OPGS.

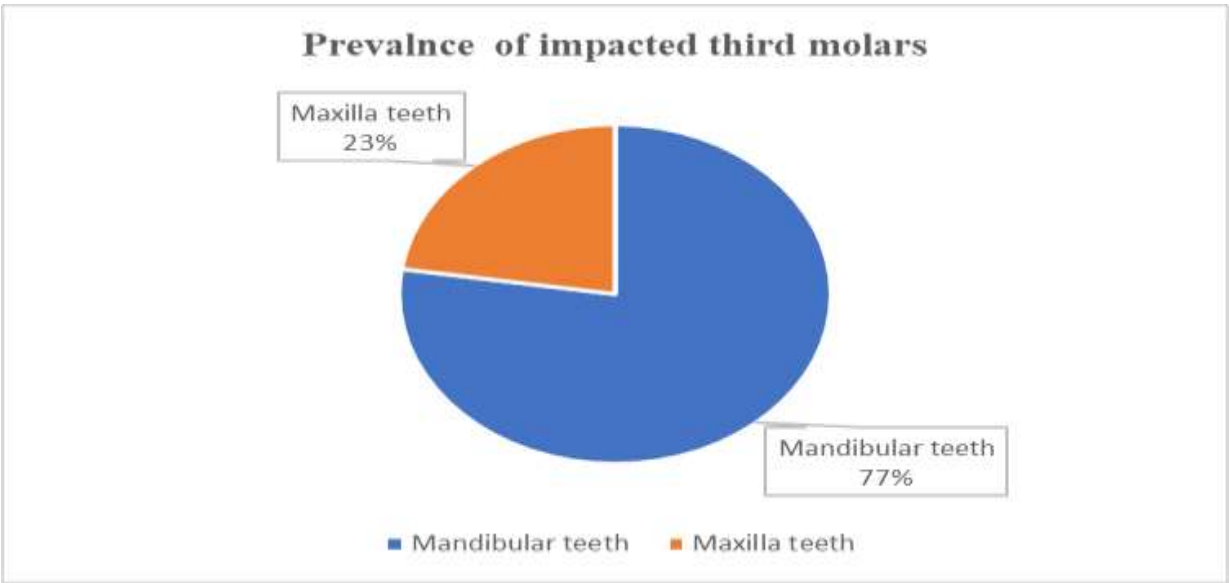


Figure 9: Pie chart showing the prevalence of impaction in the mandible vs the maxilla

Table 4. Prevalence of third molar impaction by side of impaction.

Jaw level	Right (n)	Left (n)	Total (N)	Percentage (%)
Maxilla	76	87	163	22.6
Mandible	265	292	557	77.4
Total	341	379	720	100.0

Comparison between mandibular and maxillary impacted third molars

Of the 720 total impacted third molar teeth, 163(23%) were in the maxilla and 557 (77%) were in the mandible. The impacted mandibular third molars were 3.5 times more prevalent than the maxillary third molars, with a prevalence of 77% for mandibular third molars and 23% for maxillary third molars. (95% CI: 3.5–4.76; *P* <0.001). (Table 4, Table 5, and Figure 8). The proportion of impacted mandibular third molars was significantly greater than that of impacted maxillary third molars. There was no significant difference in prevalence between the right and left sides; therefore, these data were pooled.

Prevalence of impacted third molars according to particular teeth

The most frequently impacted third molars were 38s, with a prevalence of 40.6% (292 out of 720), and were followed by 48 (36.8%, 265 out of 720). Maxillary impacted third molars were

less frequent compared to their counterparts. The left side was involved more than the right, 52.6% (379 out of 720) & the right side 47.4%(341 out of 720), respectively (Table 4).

Different molar combinations

There were variations in the prevalence of different impacted third molar combinations. The bilateral third molar impaction combination was the most common one. Bilateral mandibular third molars (38, 48) accounted for (135, 38.6%), and were the most common combination, followed by all four-molar combination (18,28,38,48), with percentages of (98,28%) followed by one impacted third molar, 76 OPGS (21.70%), and three molar combinations were the least with a percentage of (41) 11.70% (Table 5)

Figure 10: shows the OPGs of a participant with bilateral impactions.

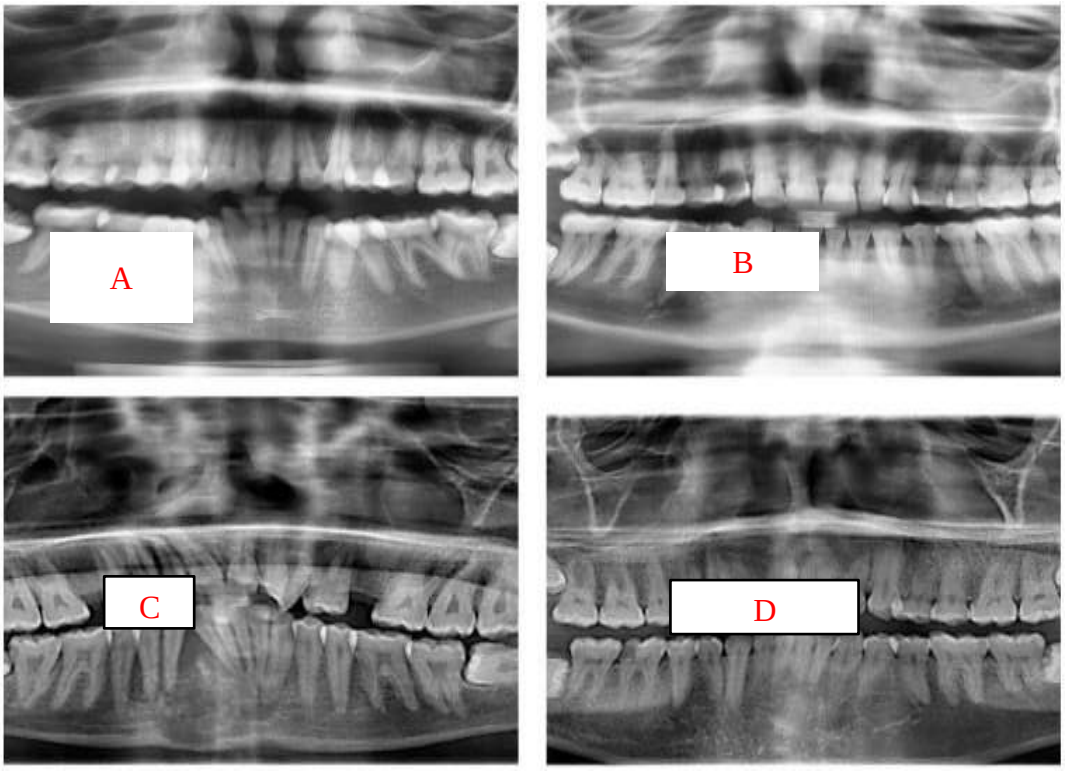


Table 5: The Table shows the Prevalence of impacted 3rd molars on the OPGs. (n=350)

No. of impacted teeth /OPGS		**Frequency**	
		n	Percentage
Particular tooth impacted	18	28	07.9
	28	41	11.8
	38	170	48.7
	48	111	31.6
Total		350	100.0
Molar combination	One-third molar impaction	76	21.7
	Two-thirds molar impactions	135	38.6
	Three 3rd molar impactions	041	11.7
	Four 3rd molars impacted	098	28.0
Total		350	100.0

4.3 Variation of prevalence of third molar impactions with demographic variables, age, and gender.

Impacted third molars were most prevalent in young adults, peaking at 45.7% in the 20–25 age group, with a progressive decline observed in older age brackets.

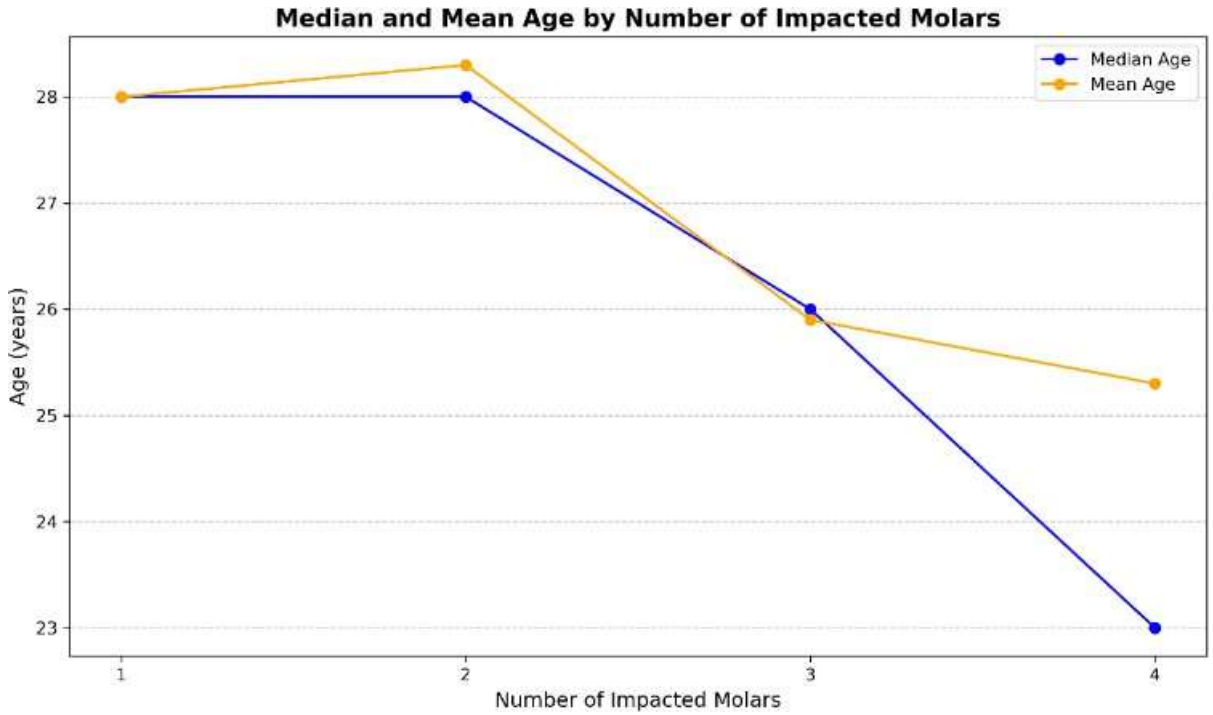
Variation with Sex

Of the 570 female participants, 176 had at least one impacted third molar, compared to 174 out of 561 males. Although the odds ratio (1.012) suggested a marginally higher likelihood in females, the sex-based distribution was not statistically significant (Tables 4 and 6).

Table 6: Prevalence of impacted third molars by demographics on the OPGS (n=350**)**

Age in years	**Age ranges**	**Frequency (N)**	**percentage (%)**
	20-25	160	45.7
	26-30	91	26
	31-35	63	18
	36- 40	36	10.3
Total		350	100
Gender	male	174	49.7
	female	176	50.3
Total		350	100
Hospitals	Mengo	58	16.6
	Makerere	42	12.0
	Mulago	250	71.4
Total		350	100

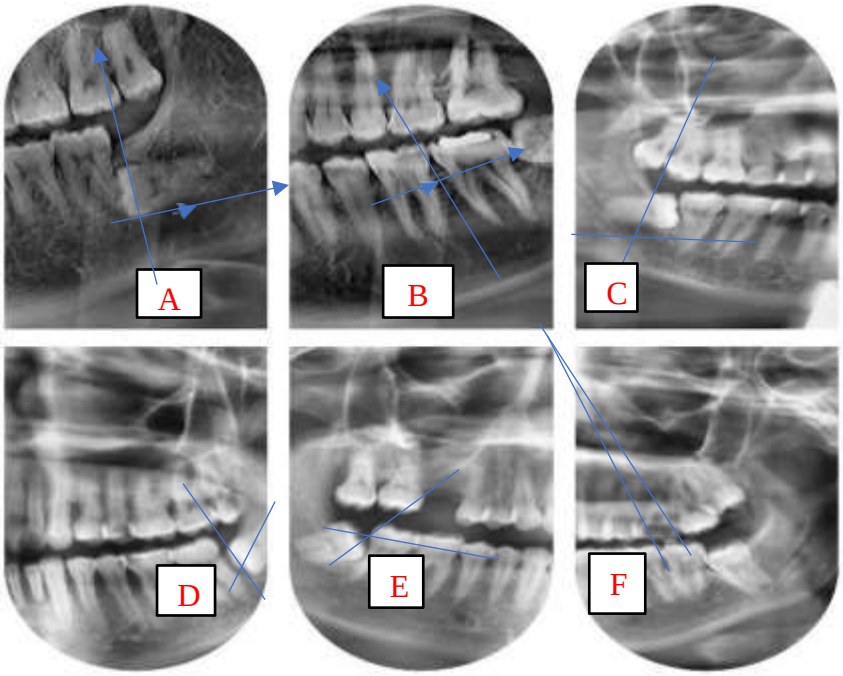
Figure 11: A graph showing the prevalence of third molar impactions by age among patients aged 20-28 years.



4.2 Patterns of impacted third molars among patients aged 20-39 years attending selected

4.2. 1 Patterns of impacted third molars using Winter's classification

Figure 12: shows the OPGs of a participant with different angulations of impacted third molars.



A = Bucco Lingual

B= Meswangular

C & E = Horizontal

D = Inverted

F= Distoangular

4.3. The Angulation of Impacted Third Molars

Mesioangular impaction was the most prevalent third molar pattern overall (43.5%, 313/720), followed by vertical impaction (31.3%, 225/720).

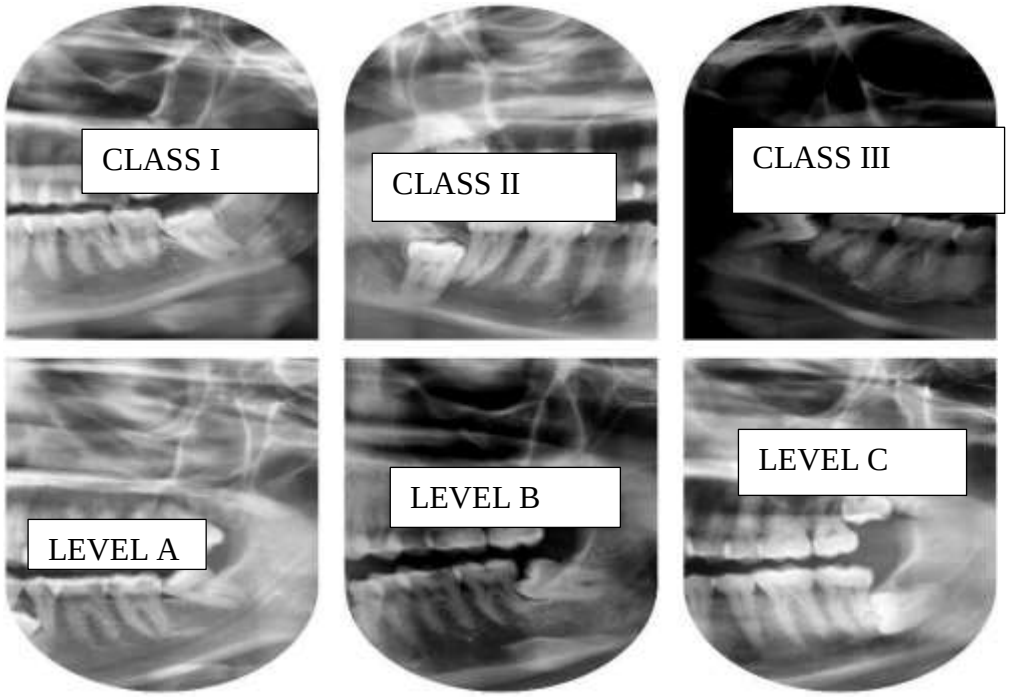
In the mandible, mesioangular impactions dominated (50.5%, 281/557), whereas vertical impactions were most common in the maxilla (47.2%, 77/163).

Table 7: Patterns of impacted third molars following Winter's classification of impaction

Impacted 3rd molars	**Angulations of the impacted third and their Frequencies and percentages**						
Impacted third molars	Mesio-angular	Disto-angular	Bucco-lingual	Vertical	Horizontal	Others	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
18	17(30.4)	15(22.1)	5 (4.1)	34(39.2)	0.0	5(4.1)	76(100)
28	15(18.6)	19 (26.3)	6 (4.5)	43(47.4)	0.0	4(3.2)	87 (100)
38	147(50.3)	2(0.7)	2(0.7)	80(27.4)	61(20.9)	0.0	292(100)
48	134(50.6)	3(1.1)	1(0.4)	68(25.4)	57(21.5)	2(0.7)	265(100)
Total	313(43.5)	39(5.4)	14(1.9)	225(31.3)	124(17.2)	11(1.5)	720(100)

4.3.1 Result for patterns of impacted teeth according to Pell and Gregory's classification. Pell and Gregory's classification is used to categorise the level of impaction based on depth and relationship to the ramus of the mandible**.**

Figure 13: shows the OPGs of impacted third molars with different levels according to Pell and Gregory.



The Depth of Impaction in the Mandible

An assessment of the level of impaction of third molars using the Pell and Gregory classification demonstrated that most of the impacted third molars, 334 out of 720(46.4%), were positioned at level A, where 45.1% (325 out of 720) were at level B, and 9.9%(71 out of 720) at level C.

The Depth of Impacted Third Molars in Both Jaws

Considering the different jaws, most of the impacted third molars in the maxilla were positioned at Level B, that is, 61.5% (46 out of 76) for the right and 51.7% (45 out of 87) on the left, Table 7. Conversely, in the mandible, the majority of them were positioned on level A, that is, 50.0% (146 out of 292)of the impacted third molars on the left side, 45.3% (120 out of 265) on the right side. All mandibular third molars (38 and 48) had the highest level of A, whereas all maxillary third molars (18 and 28) had the highest level of B (Table 8).

4.3.2 Retromolar relationship

Class I ramus relationship was the most frequently encountered relationship in mandibular impacted third molars (347 out of 557,) 62.3%, followed by Class II (177 out of 557) 31.8% and Class III (33 out of 557) 5.9% (Table 8).

A combination of the level of impaction, as determined by the depth and ramus relationship.

Results of this study indicated that the most predominant pattern of impaction according to Pell and Gregory classification was Class IA (50.1%). Class I relationship was frequently encountered, 50.1%(174 out of 367), followed by 1B, 31.1% (108 out of 367) and the least was 1C 18.7% (65 out of 367) In comparison, Class IIA observed 48 % (85 out of 177), class IIB 43.5 (77 out of 177) and class II C 8.5% (15 out of 177)

There was no level IIIA encountered, level IIIB was 36.4 %(12 out of 33), and level IIIC was 63.6% (22 out of 33)

The least observed combination level was level III A, and the most commonly observed was 1A overall (Table 9).

Table 8: Patterns of impacted third molars following Pell and Gregory's classification of impaction

	The Depth of Impacted Third Molars			
molars	**Position A**	**Position B**	**Position C**	**Total**
Molar 18	24 (30.8%)	46 (61.5%)	6, (7.7%)	76
Molar 28	34 (38.6%)	45 (52.3)	8 (9.1%)	87
Molar 38	146 (50.0%)	118 (40.4%)	28 (9.6%)	292
Molar 48	120 (45.3%)	116 (43.8%)	29 (10.9)	265
Total				557
	Retromolar relationship			
	Class 1	Class II	Class III	Total
Molar 38	181(62.0%)	99 (33.9%)	12 (4.1%)	292
Molar 48	166 (62.6%)	78 (29.4%)	21(7.9%)	265
Total	347	177	33	557

Table 9: Ramus classification and level of eruption tabulation.

Position	**A (%)**	**B (%)**	**C (%)**	**Total (%)**
Class				
ClassI	174, (50.1%)	108, (31.1%)	65 18.7%	347(62.3%)
Class II	85, (48%)	77, (43.5%0)	(15 8.5%)	177 (31.8%)
Class III	0, (0%)	12, (36.4%)	21 (63.6%)	33 (5.9%)
Total	259, (46.5%)	197, (35.4%)	101, (18.1%)	557 (100%)

4.3.3 Pathologies associated with impacted third molars among patients 20-39 years attending selected hospitals in Kampala.

Most Common Pathologies:

Caries of adjacent and impacted third molars were the leading pathology (41.7%, 295/707), followed by periodontal bone loss (29.4%, 208/707).

Least Common Pathologies:

Pathological fractures (1.9%, 14/707) and odontogenic tumours/cysts (1.3%, 9/707) were the least frequent. These were exclusively associated with mandibular impactions; none were observed in the maxilla.

Jaw Distribution:

Pathologies were predominantly linked to mandibular third molars:

Tooth 38 (left mandible): 42.4%

Tooth 48 (right mandible): 40.0%

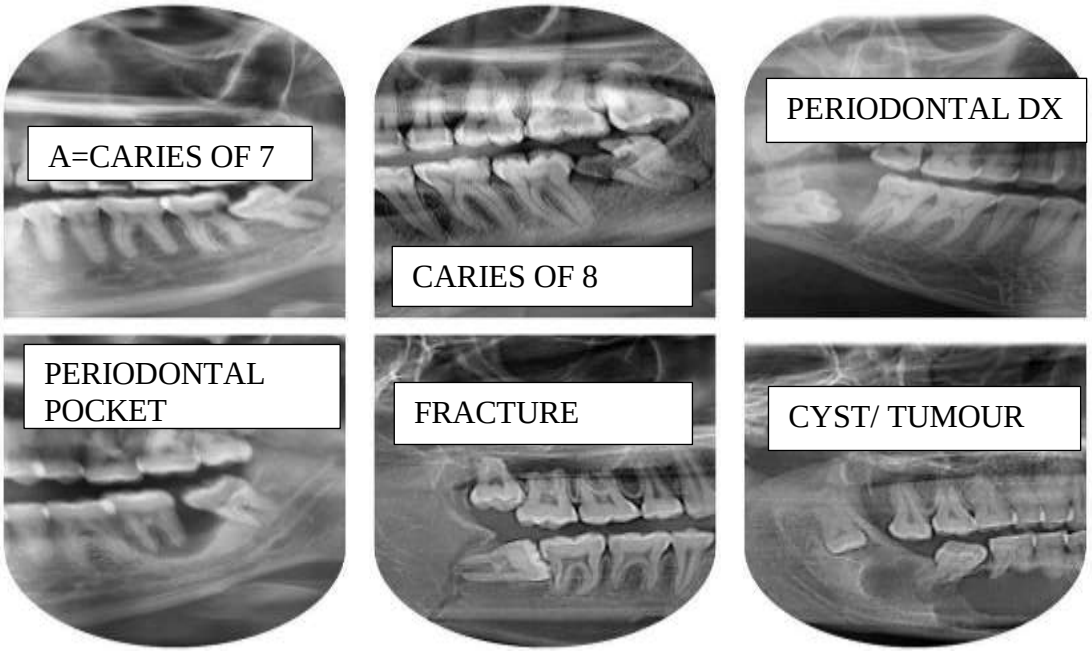
The left mandible (tooth 38) showed the highest prevalence across most pathological conditions.

Table 10: Pathologies associated with impacted third molars

(n=720)

Pathologies/Conditions	**Molar 18**	**Molar 28**	**Molar 38**	**Molar 48**	**Total (n)**
Caries of the 2nd molars	32	21	125	117	295(41.7)
Caries of the 3rd molars	18	12	34	33	97(13.7)
Periodontal pockets	16	15	93	84	208(29.4)
Root resorption of the adjacent molars, 2nd molars	7	4	38	36	85 (12)
Pathological fractures	0	0	7	7	14(1.9)
Cysts /Tumours	0	0	3	6	9(1.3)
No pathology					10(1.4)
Total number (%)	73(10.3)	52(7.3)	300 (42.4)	283(40.0)	720 (100)

Figure 14: shows OPGs with pathologies associated with impacted third molars



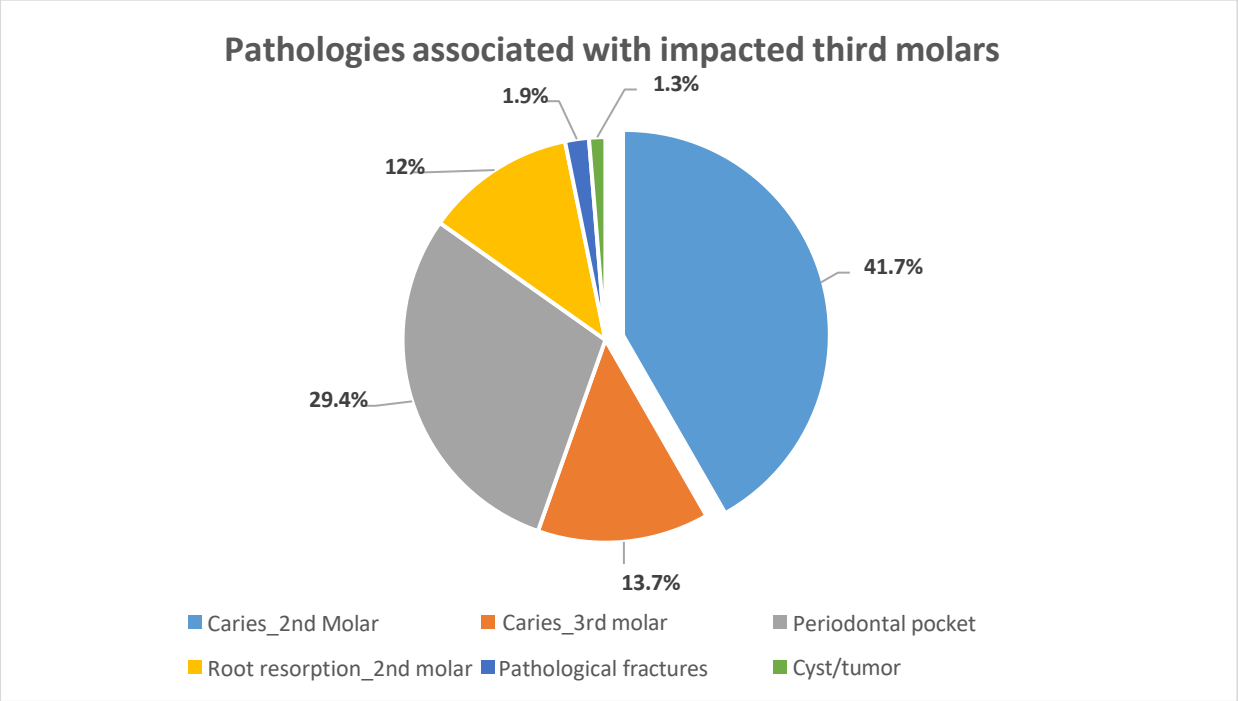
A= Caries of adjacent tooth

B = Caries of Impacted molar

C = Periodontal Pocket

D = Periodontal Pocket E = Fracture F = cyst / Tumor

Figure 15: A pie showing the pathologies associated with impacted third molars.



CHAPTER FIVE: DISCUSSION

5.0 Key Findings and Clinical Implications

5.1Prevalence of impacted third molars

The study set out to determine the prevalence of impacted third molars using radiographic records from patients aged 20–39 years attending selected hospitals in Kampala. This age range was chosen based on evidence that third molar eruption typically completes between 17 and 24 years, with full root formation by age 20 and jaw growth completed by 17. By age 20, it becomes possible to distinguish between normal eruption and impaction. The upper age limit of 39 was based on findings that horizontally impacted or unerupted molars by the third decade are unlikely to erupt, although eruption may extend beyond previously assumed timelines.

The study revealed a moderately high prevalence of impacted third molars at 31%, aligning with findings from Hong Kong (27.8%) and Jordan (33%), and confirming the global burden of this dental issue(Chu et al., 2003; Hattab, 1997). However, the results differed from other similar studies reporting higher prevalence in Asia (43.1%) and lower in Europe (24.5%), suggesting that geographic, ethnic, environmental, and genetic factors may influence jaw and tooth development, thereby affecting impaction rates (El-Khateeb et al., 2015; Latt et al., 2015). Bilateral impactions were the most common pattern observed, accounting for about one-third of cases, consistent with Quek et al. (2003), though lower than their reported 63%. These findings further support the existence of regional and ethnic variations in third molar impaction prevalence and underscore the need for tailored management and prevention strategies in high-prevalence areas.

5.2 Comparison of Mandibular and Maxillary and right and left

The study revealed that mandibular third molar impactions were 3.5 times more prevalent than maxillary ones, with a statistically significant difference ($P<0.05$), aligning with findings from most previous studies. However, contrasting evidence from Gebeyehu & Abaynew (2024) and Hashemipour et al. (2013) reported higher impaction rates in the maxilla.

Mandibular third molars typically erupt during late adolescence or early adulthood, often after the jaw has reached its full size. This timing can result in inadequate space for proper eruption, leading to impaction. Additionally, the angulation of the tooth, such as mesioangular or horizontal positioning, can hinder eruption if space is insufficient. Genetic factors influencing jaw and tooth size may also contribute to impaction risk in certain populations(Hassan, 2011) The predominance of mandibular impactions underscores the need for clinicians to closely evaluate the mandibular region during third molar assessments. Contributing factors include

limited space in the retromolar area, narrow alveolar arches, delayed molar maturation, and early physical development.

Impacted third molars can cause complications such as cysts, tumours, pericoronitis, periodontal disease, root resorption of adjacent teeth, and, in rare cases, mandibular fractures—especially when impactions occur near the jaw angle. Understanding these risks is essential for effective dental management.

The study also found no significant difference in impaction prevalence between the left and right sides of the jaw, consistent with other research. However, observed variations such as slightly higher prevalence on the left carry implications for surgical planning, risk assessment, and treatment strategies. These side-specific differences may affect surgical complexity, symptom presentation, and outcomes, highlighting the importance of thorough bilateral evaluation and the need for further research to guide clinical decision-making.

Variation of the prevalence with age and sex

The study demonstrated a chronological decline in the number of impacted third molars with increasing patient age. This trend aligns with findings by Chaari et al.2023) and Khouri et al. 2022) who reported peak prevalence rates of 79.6% and 59.2%, respectively, among individuals aged 20–30 years. The reduction in impaction with age may be attributed to early tooth loss, which creates space for previously impacted molars to erupt, or to age-related changes such as periodontal bone loss and gingival recession that make impactions more detectable.

Regarding sex distribution, females showed a slightly higher prevalence of impacted third molars (50.3%) compared to males (49.7%), though the difference was statistically insignificant ($p = 0.085$). This observation supports existing literature suggesting that anatomical factors such as smaller jaw dimensions in females may contribute to higher impaction rates. Additionally, jaw growth in females typically ceases around the time of third molar eruption, while in males, continued mandibular growth during this period may allow sufficient space for eruption(Gebeyehu & Abaynew, 2024). Delayed or limited mandibular development in females, particularly around menarche, may further increase impaction risk, whereas ongoing growth in males may reduce it.(Hagar et al., 2019; Hassan, 2011; Kumar et al., 2017)

Lastly, the higher number of female participants may also reflect greater health-seeking behaviour among women, contributing to their increased representation in the study.

Patterns and associated pathologies

The study chronologically and scientifically revealed that mesio-angular impaction was the most common pattern of third molar impaction overall, accounting for over two-thirds of cases (62.3%). This was followed by vertical (31.3) and disto-angular impactions. In the maxilla, vertical angulation(47.2%) was most prevalent, followed by disto-angular, mesio-angular, and buccolingual impactions, with no horizontal impactions observed. These findings contrast with those of Topkara et al. (2013), who reported disto-angular impactions as the most frequent, suggesting ethnic and regional differences in impaction patterns and the need for localised data to guide clinical management.

The study also assessed the depth of impaction using levels A, B, and C, which estimate the vertical position of the third molar relative to the adjacent second molar. Level A was the most common in both the mandible (62.6%) and maxilla (61.5%), followed by Level B (31.7% in the mandible and 34.7% in the maxilla), while Level C was least frequent (6% in the mandible and 8.4% in the maxilla). These results align with studies by Hattab et al. and Hugoson & Kugelberg, but differ from findings by Quek et al., Sandhu & Kaur, and Padhye et al., indicating variability across populations.(Alhajj et al., 2024; Gupta et al., 2020; Hattab, 1997) These variations in angulation, depth, and retromolar space have significant implications for surgical planning. Angulation types such as mesioangular, distoangular, vertical, and horizontal affect the complexity of extraction. For instance, distoangular impactions may interfere with the mandibular ramus, while horizontal impactions often require extensive bone removal and carry a higher risk of nerve damage. Therefore, understanding these anatomical and positional differences is essential for optimising surgical outcomes and minimising complications.

Depth of Implication: Deeper impactions (Level B and C) often mean more bone needs to be removed, increasing surgical complexity and the potential for complications**.**

Retromolar Relationship:

The retromolar space, located behind the second molar, plays a critical role in determining whether the third molar can erupt. A reduced retromolar space increases the likelihood of impaction and complicates surgical procedures. Additionally, the relationship between the impacted tooth and the anterior border of the mandibular ramus, classified by Pell and Gregory into Classes I, II, and III, affects surgical access and complexity. These anatomical factors are essential for planning surgical approaches, including flap design and bone removal.

In this study, the most impacted mandibular third molars were classified as Class I (62.3%), followed by Class II (31.3%) and Class III (6%), indicating that a majority had sufficient mesiodistal space between the second molar and the ascending ramus, a favourable condition

for eruption. These findings are consistent with previous studies by Alfadil & Almajed (2020), Dodson & Susarla (2014), and Gupta et al. (2020).

Pathological conditions related to impacted third molars were observed in 28% of subjects, a higher rate than reported in similar studies. The most frequent pathology was caries in adjacent molars and the impacted third molars (54.4%), followed by periodontal bone loss (29%). The caries prevalence in this study exceeded that reported in Oman (4%), Turkey (5%), Jordan (8–14%),(Al-Anqudi et al., 2014; Polat et al., 2008) and was slightly higher than the 46% reported in Kenya by Mwaniki et al.1996 and Braimah et al. 2019These findings underscore the clinical significance of monitoring impacted third molars for associated pathologies and the need for region-specific preventive strategies.

5.3 Clinical Impact and Recommendations

The study's findings carry important clinical implications, beginning with the observed high prevalence of impacted third molars and associated pathologies such as caries in adjacent and impacted teeth. These results underscore the need for early radiographic evaluation, consideration of prophylactic removal, and promotion of preventive oral hygiene practices—particularly in Kampala's population.

Given the higher prevalence among younger adults, especially in late adolescence when impactions first become detectable, targeted screening during this period is recommended. Early identification of at-risk individuals may facilitate timely intervention and reduce complications like pericoronitis, cyst formation, and damage to adjacent teeth.

In daily oral surgical practice, managing impacted third molars is a routine yet complex decision. While extraction is straightforward when pathology is present, controversy remains over removing asymptomatic third molars. Importantly, asymptomatic does not mean disease-free, as pathology may progress silently. Therefore, assessing tooth position and eruption status is essential for optimal treatment planning

Impacted third molars are more commonly extracted in younger patients due to pericoronitis, whereas caries becomes a more frequent indication in older individuals. Additionally, unerupted third molars are often removed in younger patients for orthodontic reasons—such as preserving treatment outcomes, facilitating distal movement of posterior teeth, or preventing second molar eruption interference.

Given the surgical challenges and risks associated with mandibular third molar removal, especially in asymptomatic cases, conservative or preventive approaches may be more appropriate, particularly for older patients. Future regional guidelines should incorporate these

findings to balance early intervention benefits against the risks of disease progression in untreated cases.

5.4 Future Research Directions

The study provides a comprehensive overview of the prevalence of impacted third molars' radiographic patterns and associated pathologies, highlighting significant geographic and demographic variations. It suggests that impacted third molars are a prevalent condition worldwide, with implications for public health and clinical practice. The findings suggest that studies employing standardised diagnostic criteria and a broader geographic range will enhance the generalizability and reliability of the findings. More balanced geographic representation and studies with standardised protocols will improve the accuracy and applicability of future research in this area. The findings could encourage young adults to be screened for impacted teeth earlier, and contribute to the development of strategies to efficiently tackle pathologies derived from impacted teeth through prevention, eliminating the risk of lack of treatment.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.0 Conclusion

The study provides a comprehensive overview of radiographic patterns and diseases associated with impacted third molars, highlighting regional and demographic differences. It highlights the prevalence of these problems, highlighting the need for proper diagnosis and management. The findings also serve as a baseline for future research aimed at improving oral care and reducing the burden of third molar impaction.

6.1 General Recommendations

Future studies should address the limitations identified in this study, particularly through other studies that can better elucidate the natural progression of impacted third molars. Additionally, studies employing standardised diagnostic criteria and including a broader geographic range will enhance the generalizability and reliability of the findings. More balanced geographic representation, as well as studies with standardised protocols, would improve the accuracy and applicability of future research in this area. Ultimately, these efforts may inform more effective and tailored management strategies for impacted third molars.

To health workers

Awareness should be created among health workers on how to screen and manage impacted third molars.

They should be trained on how to manage and refer patients accordingly.

To researchers

The results of this study will lay a strong foundation for further studies in the area. This will serve as a gold standard by which researchers can create more comprehensive, inclusive investigations that cover a greater range of variables and demographics. Additionally, the findings of this study may influence oral health-related healthcare policy in Uganda, including guidelines for treating impacted third molars.

Clinical recommendations for treating impacted third molars in Uganda could be developed as a result of this study, helping dental professionals make evidence-based decisions in their practice. This will facilitate a better understanding of the diagnosis.

To health facilities and institutions

This study provides important new information about the frequency and distribution of impacted third molars in Kampala. Dentists, oral and maxillofacial surgeons, and other medical professionals who treat impacted third molars could greatly benefit from this material. Treatment planning and patient care can be improved with a thorough understanding of the

prevalence, pattern, and associated pathologies. Additionally, especially in our context, this study will add to the corpus of existing knowledge on third molar impaction.

For academic institutions, dental schools, and researchers interested in oral health and dental pathology, it can serve as an instructional tool.

6.2: Study limitations

1. **Age Range Restriction**:

The study's focus on a specific age group (20-39 years) may not accurately represent the full spectrum of impaction prevalence and patterns across all age groups. While some studies suggest that the highest prevalence occurs between 25 and 35 years old, this age range may not account for individuals who are younger or older.

2. Hospital Selection Bias:

The study's focus on selected hospitals may introduce bias, as patient types may differ based on location, socioeconomic status, or services, potentially over- or underrepresenting certain impaction patterns or pathologies.

3. Radiographic Limitations:

Panoramic radiographs are useful for assessing impaction and related pathologies, but they may not always detect early stages of certain conditions. For instance, dental caries can be difficult to detect on the distal surface of the second or third molar. Variations in radiographic techniques across hospitals can affect the consistency and accuracy of results. Some pathologies may require advanced imaging techniques like CBCT for accurate diagnosis.

4. Generalizability to the Wider Ugandan Population:

The findings from Kampala can not be directly generalizable to other regions of Uganda due to potential differences in demographics, healthcare access, and oral health practices. Factors like diet, oral hygiene practices, and genetic predispositions could vary across different regions and affect the prevalence and patterns of impacted third molars.

5. Lack of Longitudinal Data:

A cross-sectional study (like this one) provides a snapshot in time and might not capture the long-term progression of impacted third molars and their associated pathologies.

Longitudinal studies, which follow patients over time, would be needed to understand the natural history of impacted third molars and the factors that influence their development.

6. Potential for Undiagnosed Cases:

The study reveals that some individuals may not report impacted third molars due to lack of symptoms or lack of dental care, leading to underreporting. Some pathologies associated with impaction may be asymptomatic or mild, and patients may not be aware of them. The study

was retrospective, analysing radiographs from only three dental facilities in Kampala city, and may not represent all Ugandans' data. No clinical information or patient history was obtained.

REFERENCES

Adeola, O., Fatusi, O., Njokanma, A., & Adejobi, A. (2023). Impacted Mandibular Third Molar Prevalence and Patterns in a Nigerian Teaching Hospital: A 5-Year Retrospective Study. *BioMed, 3*(4), 507-515. https://www.mdpi.com/2673-8430/3/4/40

Ahmad, P., V'Vian, T., Chaudhary, F., Chaudhary, A., Haseeb, A., Yaqoob, M., & Asif, J. (2021). Pattern of Third Molar Impactions in North-Eastern Peninsular Malaysia: A 10-Year Retrospective Study. *Nigerian Journal of Clinical Practice*, *24*(7), 1028-1036. https://doi.org/10.4103/njcp.njcp_499_20

Al-Anqudi, S. M., Al-Sudairy, S., Al-Hosni, A., & Al-Maniri, A. (2014). Prevalence and pattern of third molar impaction: a retrospective study of radiographs in Oman. *Sultan Qaboos University Medical Journal*, *14*(3), e388.

Al-Dajani, M., Abouonq, A. O., Almohammadi, T. A., Alruwaili, M. K., Alswilem, R. O., & Alzoubi, I. A. (2017). A cohort study of the patterns of third molar impaction in panoramic radiographs in Saudi population. *The open dentistry journal*, *11*, 648.

Al-Dajani, M., Abouonq, A. O., Almohammadi, T. A., Alruwaili, M. K., Alswilem, R. O., & Alzoubi, I. A. (2017). A Cohort Study of the Patterns of Third Molar Impaction in Panoramic Radiographs in Saudi Population. *Open Dent J*, *11*, 648-660. https://doi.org/10.2174/1874210601711010648

Al-Madani, S. O., Jaber, M., Prasad, P., & Maslamani, M. (2024). The Patterns of Impacted Third Molars and Their Associated Pathologies: A Retrospective Observational Study of 704 Patients. *J Clin Med*, *13*(2). https://doi.org/10.3390/jcm13020330

Alhajj, M. N., Amran, A. G., Alhaidary, S., Amran, A. N., Al-Sosowa, A. A., Abdulghani, E. A., & Halboub, E. (2024). Prevalence and pattern of third molars impaction in a large Yemeni sample: a retrospective study. *Scientific Reports*, *14*(1), 22642. https://doi.org/10.1038/s41598-024-73556-9

Alvira-González, J., Figueiredo, R., Valmaseda-Castellón, E., Quesada-Gómez, C., & Gay-Escoda, C. (2017). Predictive factors of difficulty in lower third molar

extraction: A prospective cohort study. *Med Oral Patol Oral Cir Bucal*, *22*(1), e108-e114. https://doi.org/10.4317/medoral.21348

Axell, T., & Johansson, K. (1993). Oral health in Tanzanian village. *Odonto-stomatologie tropicale*, 15-20.

Balaji, S., & Balaji, P. P. (2023). *Textbook of Oral and Maxillofacial Surgery-E-Book: Textbook of Oral and Maxillofacial Surgery-E-Book*. Elsevier Health Sciences.

Biederman, W. (1962). Etiology and treatment of tooth ankylosis. *American Journal of Orthodontics*, *48*(9), 670-684.

Braimah, R., Dawood, A., Alsalah, Y., Agbaje, H., Alalharreth, N., & Alsawas, N. (2019). Complications Associated with The Occurrence of Impacted Mandibular Third Molars in Saudi Arabian Sub-Population: Najran Province Experience. *American Journal of Biomedical Science & Research*, *3*. https://doi.org/10.34297/AJBSR.2019.03.000669

Braimah, R. O., Ibikunle, A. A., Taiwo, A. O., Ndukwe, K. C., Owotade, J. F., & Aregbesola, S. B. (2018). Pathologies Associated with Impacted Mandibular Third Molars in Sub-Saharan Africans. *Dentistry and Medical Research*, *6*(1), 2-6. https://doi.org/10.4103/dmr.dmr_20_17

Campbell, J. H. (2013). Pathology associated with the third molar. *Oral and Maxillofacial Surgery Clinics*, *25*(1), 1-10.

Campbell, J. H. (2013). Pathology associated with the third molar. *Oral Maxillofac Surg Clin North Am*, *25*(1), 1-10, v. https://doi.org/10.1016/j.coms.2012.11.005

Chu, F., Li, T., Lui, V., Newsome, P., Chow, R., & Cheung, L. (2003). Prevalence of impacted teeth and associated pathologies-a radiographic study of the Hong Kong Chinese population. *Hong Kong Medical Journal*.

Dodson, T. B., & Susarla, S. M. (2014). Impacted wisdom teeth. *BMJ Clinical Evidence*, *2014*.

El-Khateeb, S. M., Arnout, E. A., & Hifnawy, T. (2015). Radiographic assessment of impacted teeth and associated pathosis prevalence. Pattern of occurrence at different ages in Saudi male in Western Saudi Arabia. *Saudi Med J*, *36*(8), 973-979. https://doi.org/10.15537/smj.2015.8.12204

Garvey, M. T., Barry, H. J., & Blake, M. (1999). Supernumerary teeth-an overview of classification, diagnosis and management. *Journal-Canadian Dental Association*, *65*(11), 612-616.

Gebeyehu, T., & Abaynew, Y. (2024). Prevalence and patterns of third molar impaction among Ethiopians in Addis Ababa: A retrospective pilot study. *Scientific Reports*, *14*(1), 8952.

Gupta, P., Naik, S. R., Ashok, L., Khaitan, T., & Shukla, A. K. (2020). Prevalence of periodontitis and caries on the distal aspect of mandibular second molar adjacent to impacted mandibular third molar: A guide for oral health promotion. *Journal of family medicine and primary care*, *9*(5), 2370-2374.

Hagar, A. A., Helmi, J. M., Al-Jawfi, K. A., Al-dilami, A., & Al Wesabi, M. A. (2019). Prevalence of impacted teeth among a sample of yemeni population and their association with sex and age. *J. oral res.(Impresa)*, 343-350.

Hashemipour, M. A., Tahmasbi-Arashlow, M., & Fahimi-Hanzaei, F. (2013). Incidence of impacted mandibular and maxillary third molars: a radiographic study in a Southeast Iran population. *Medicina oral, patologia oral y cirugia bucal*, *18*(1), e140.

Hashemipour., Tahmasbi-Arashlow, M., & Fahimi-Hanzaei, F. (2013). Incidence of impacted mandibular and maxillary third molars: a radiographic study in a Southeast Iran population. *Med Oral Patol Oral Cir Bucal*, *18*(1), e140-145. https://doi.org/10.4317/medoral.18028

Hassan, A. H. (2011). Mandibular cephalometric characteristics of a Saudi sample of patients having impacted third molars. *The Saudi dental journal*, *23*(2), 73-80.

Hatem, M., Bugaighis, I., & Taher, E. M. (2016). Pattern of third molar impaction in Libyan population: A retrospective radiographic study. *The Saudi Journal for Dental Research*, *7*(1), 7-12.

Hattab, F. N. (1997). Positional changes and eruption of impacted mandibular third molars in young adults: a radiographic 4-year follow-up study. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, *84*(6), 604-608.

Hupp, J. R., Tucker, M., & Ellis, E. (2017a). Contemporary oral and maxillofacial surgery. *surgery*, *16*, 2.

Hupp, J. R., Tucker, M. R., & Ellis, E. (2013). *Contemporary oral and maxillofacial surgery-e-book: contemporary oral and maxillofacial surgery-e-book*. Elsevier health sciences.

Hupp, J. R., Tucker, M. R., & Ellis, E. (2017b). *Contemporary oral and maxillofacial surgery* (Vol. 32013). Mosby.

Juodzbalys, G., & Daugela, P. (2013). Mandibular third molar impaction: review of literature and a proposal of a classification. *J Oral Maxillofac Res*, *4*(2), e1. https://doi.org/10.5037/jomr.2013.4201

Kumar, V. R., Yadav, P., Kahsu, E., Girkar, F., & Chakraborty, R. (2017). Prevalence and pattern of mandibular third molar impaction in Eritrean population: a retrospective study. *J Contemp Dent Pract*, *18*(2), 100-106.

Kutesa, A. M., Rwenyonyi, C. M., Mwesigwa, C. L., Muhammad, M., Nabaggala, G. S., & Kalyango, J. (2019). Dental age estimation using radiographic assessment of third molar eruption among 10–20-year-old Ugandan population. *Journal of Forensic Dental Sciences*, *11*(1), 16-21. https://doi.org/10.4103/jfo.jfds_34_19

Latt, M. M., Chewpreecha, P., & Wongsirichat, N. (2015). Prediction of difficulty in impacted lower third molars extraction; review literature. *M Dent J*, *35*(3), 281-290.

Lema, P. (2002). A study to determine the prevalence of impacted third molars among patients seen in Dar es Salaam Dental Clinics. *Tanzania Dental Journal*, *9*(2), 5-7.

Malik, N. A. (2012). *Textbook of oral and maxillofacial surgery*. JP Medical Ltd.

Mohammed, M., Mahomed, F., & Ngwenya, S. (2019). A survey of pathology specimens associated with impacted teeth over a 21-year period. *Medicina oral, patologia oral y cirugia bucal*, *24*(5), e571.

Monaco, G., Montevecchi, M., Bonetti, G. A., Gatto, M. R. A., & Checchi, L. (2004). Reliability of panoramic radiography in evaluating the topographic relationship between the mandibular canal and impacted third molars. *The Journal of the American Dental Association*, *135*(3), 312-318.

Msagati, F., Simon, E. N., & Owibingire, S. (2013). Pattern of occurrence and treatment of impacted teeth at the Muhimbili National Hospital, Dar es Salaam, Tanzania. *BMC oral health*, *13*, 1-6.

Mwaniki, D., & Guthua, S. (1996). Incidence of impacted mandibular third molars among dental patients in Nairobi, Kenya. *pathology*, *32*, 17-19.

Nagaraj, T., Balraj, L., Irugu, K., Rajashekarmurthy, S., & Sreelakshmi. (2016). Radiographic assessment of distribution of mandibular third molar impaction: A retrospective study. *Journal of Indian Academy of Oral Medicine and Radiology*, *28*(2), 145-149. https://doi.org/10.4103/0972-1363.195125

Osunde, O., & Bassey, G. (2016). Pattern of impacted mandibular third molars in Calabar, Nigeria [Article]. *African Journal of Medical and Health Sciences*, *15*, 14. https://link.gale.com/apps/doc/A456259985/HRCA?u=anon~c3af3dbb&sid=googleScholar&xid=9b36eaf1

Osunde, O., Saheeb, B., & Bassey, G. (2014). Indications and risk factors for complications of lower third molar surgery in a nigerian teaching hospital. *Ann Med Health Sci Res*, *4*(6), 938-942. https://doi.org/10.4103/2141-9248.144919

Pell, G. J. (1933). Impacted mandibular third molars: classification and modified techniques for removal. *Dent Digest*, *39*, 330-338.

Pell, G. J., & Gregory, G. T. (1942). Report on a ten-year study of a tooth division technique for the removal of impacted teeth. *American Journal of Orthodontics and Oral Surgery*, *28*(11), B660-B666.

Peterson, L. J. (2003). Contemporary oral and maxillofacial surgery. *(No Title)*.

Pillai, A. K., Thomas, S., Paul, G., Singh, S. K., & Moghe, S. (2014). Incidence of impacted third molars: A radiographic study in People's Hospital, Bhopal, India. *Journal of oral biology and craniofacial research*, *4*(2), 76-81.

Pinto, A. C., Francisco, H., Marques, D., Martins, J. N., & Caramês, J. (2024a). Worldwide Prevalence and Demographic Predictors of Impacted Third Molars—Systematic Review with Meta-Analysis. *Journal of Clinical Medicine*, *13*(24), 7533.

Pinto, A. C., Francisco, H., Marques, D., Martins, J. N. R., & Caramês, J. (2024b). Worldwide Prevalence and Demographic Predictors of Impacted Third Molars—Systematic Review with Meta-Analysis. *Journal of Clinical Medicine*, *13*(24), 7533. https://www.mdpi.com/2077-0383/13/24/7533

Polat, H. B., Özan, F., Kara, I. s., Özdemir, H., & Ay, S. (2008). Prevalence of commonly found pathoses associated with mandibular impacted third molars based on panoramic radiographs in Turkish population. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, *105*(6), e41-e47.

Quek, Tay, C., Tay, K., Toh, S., & Lim, K. (2003). Pattern of third molar impaction in a Singapore Chinese population: a retrospective radiographic survey. *International journal of oral and maxillofacial surgery*, *32*(5), 548-552.

Quek, S. L., Tay, C. K., Tay, K. H., Toh, S. L., & Lim, K. C. (2003). Pattern of third molar impaction in a Singapore Chinese population: a retrospective radiographic survey. *Int J Oral Maxillofac Surg*, *32*(5), 548-552.

Ryalat, S., AlRyalat, S. A., Kassob, Z., Hassona, Y., Al-Shayyab, M. H., & Sawair, F. (2018). Impaction of lower third molars and their association with age: radiological perspectives. *BMC oral health*, *18*(1), 58. https://doi.org/10.1186/s12903-018-0519-1

Santosh. (2015). Impacted mandibular third molars: Review of literature and a proposal of a combined clinical and radiological classification. *Annals of medical and health sciences research*, *5*(4), 229-234.

Shaari, R. B., Awang Nawi, M. A., Khaleel, A. K., & AlRifai, A. S. (2023). Prevalence and pattern of third molars impaction: A retrospective radiographic study. *J Adv Pharm Technol Res*, *14*(1), 46-50. https://doi.org/10.4103/japtr.japtr_489_22

Shaddad, M. A., Ahmed, A. A., Abuaffan, A. H., & Yousif, Y. O. (2018). Prevalence and Pattern of Impacted Third Molar in a Sample of Sudanese Population. *Indian Journal of Dental Education*, *11*(4).

Sujon, M. K., Alam, M. K., Rahman, S. A., & Noor, S. N. F. M. (2022). Third molar impactions prevalence and pattern among adults using 5923 digital orthopantomogram. *Bangladesh Journal of Medical Science*, *21*(3), 717-729.

Vilela, E. M., & Vitoi, P. A. (2011). Study of position and eruption of lower third molars in adolescents. *RSBO Revista Sul-Brasileira de Odontologia*, *8*(4), 390-397.

Winter, G. B. (1926). Impacted mandibular third molar. *St. Louis: American Medical Book*, *41*.

Yahaya, A., Kaura, M. A., OGBOZOR, B. E., Ka'abu Abdulrazak, A., OLOHIGBE, A., EWANSIHA, G., & BAMGBOSE, B. O. (2024). Radiographic Study of the Prevalence and Pattern of Impacted Mandibular Third Molars in a Northern Nigerian Population. *Nigerian Dental Journal*, *32*(3).

APPENDICES

APPENDIX I: CHECK LIST

SECTION 1: PARTICULARS

1. NAME:
2. ADDRESS:
3. SEX:
4. DATE OF BIRTH:
5. AGE:

SECTION 2: PRESENCE OR ABSENCE OF IMPACTED 3rd MOLARS

Yes	No	Impaction third molar present or absent (yes/no)

SECTION 3: NUMBER OF IMPACTED 3rd MOLARS AND THEIR DISTRIBUTION

No impacted 3rd molars	Right Maxilla (18)	Left Maxilla (28)	Left Mandible (38)	Right Mandible (48)

SECTION 4: PATTERN OF IMPACTED 3rd MOLARS AS PER WINTER'S

Angulations of impaction	Right maxilla 18	Left maxilla 28	Right mandible 48	Left mandible 38
Mesioangular				
Distoangular				
Vertical				
Horizontal				
Buccolingual				
Others				
Total				

SECTION 5: PATTERN OF IMPACTED THIRD MOLAR BY PELL AND GREGORY

(RAMUS RELATIONSHIP)

Sex	**Male**		**Female**	
Impacted Molars	**Right Mandible Left**		**Right Mandible Left**	
levels				
1				
11				
111				
Totals				

SECTION 6: PATTERN OF IMPACTED THIRD MOLAR BY PELL AND GREGORY

(DEPTH OF IMPACTION)

Teeth position	**Right maxilla left**		**Right mandible left**		**Total**
	18	**28**	**38**	**48**	
Sex					
Depth (levels)					
A					
B					
C					
Total					

SECTION 7: COMMON PATHOLOGIES ASSOCIATED WITH 3RD MOLARS

Pathologies	Right Maxilla Left		Right Mandible Left	
	18	28	38	48
Caries of the Impacted Tooth				
Caries of the adjacent tooth				
Root resorption				
Periodontal pocket/ bone loss				
Fractures				
Cysts and Tumours				
Total				

SECTION 8: DISTRIBUTION OF PATHOLOGIES WITH DIFFERENT TYPES OF IMPACTED TEETH

Pathology	**Mesio-angular**	**Vertical**	**Horizontal**	**Disto-angular**	**Others**	**total**
Caries of the third molar						
Caries of the second molar						
Periodontal pocket						
Root resorption of the second molar						
Cyst/tumour						

APPENDIX II: BUDGET

ITEM ITEM	QUANTITY	UNIT COST	TOTAL COST
IRB	**IRB Fees**	**100,000**	**100,000/=**
Stationery and printing	**1**	**1,300,000**	**1,300,000/=**
Allowance for research assistants	**1097 checklists**	**2000 per checklist**	**2,194,000/=**
Airtime and transport	**1**	**400,000**	**400,000/=**
Statistician	**1**	**1,000,000**	**1,000,000/=**
Internet	**1**	**600,000**	**600,000/=**
TOTAL			**5,594,000/=**

APPENDIX III: TIMELINES

ACTIVITY	Sept 2023	Sept 2023	Oct 2023	Nov2022	Dec 2023	Jan 2024	Feb 2024
Proposal development							
IRB Approval							
Data collection							
Data Analysis							
Report writing							
Dissertation defense							
Dissemination of results							

APPENDIX IV: SHOWING AWAIVER OF CONSENT

MAKERERE UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF DENTISTRY

OKUNDUA ISAAC

15TH AUGUST,2023

RE: APPLICATION FOR WAIVER OF CONSENT

I am pleased to inform you that the Department of Dentistry Research Committee, at a meeting Convened on 27th February 2023, voted to approve my research proposal titled PREVALENCE, RADIOGRAPHIC PATTERNS, AND PATHOLOGIES ASSOCIATED WITH IMPACTED THIRD MOLARS AMONG PATIENTS 20-39 YEARS OLD ATTENDING SELECTED HOSPITALS IN KAMPALA, UGANDA.

Therefore, as an investigator, I am required to ensure that the participant's rights and welfare are observed and that consent is obtained before collecting data from participants. however, this may not apply to my topic because it's a retrospective study and will only involve reviewing radiographs of participants that were taken during the study period (not involving patients directly).

I kindly request that your office permit me to go ahead.

Your positive response will be highly appreciated

Thanks

Yours faithfully,

DR OKUNDUA ISAAC

APPENDIX V: INSTITUTIONAL REVIEW BOARD APPROVAL

MAKERERE UNIVERSITY
P.O. Box 7072 Kampala, Uganda
E-mail: healthsciences.irb@gmail.com
deanshs@chs.mak.ac.ug
Tel: 256 0200903786
Tel: 256 414 531533
Fax: 256 414 531533

COLLEGE OF HEALTH SCIENCES
SCHOOL OF HEALTH SCIENCES
OFFICE OF THE DEAN

MAKERERE UNIVERSITY
SCHOOL OF HEALTH SCIENCES
APPROVED
VALID UNTIL
★ 22 FEB 2025 ★
RESEARCH & ETHICS COMMITTEE
P. O. BOX 7072, KAMPALA

22/02/2024

To: Isaac Okundua

Makerere University
0782808628/0752527747

Type: Initial Review

Re: MAKSHSREC-2023-583: RADIOGRAPHIC PATTERNS, PREVALENCE, AND ASSOCIATED PATHOLOGIES OF IMPACTED THIRD MOLARS AMONG PATIENTS 20-39 YEARS IN SELECTED CLINICS IN KAMPALA

I am pleased to inform you that at the **147th** convened meeting on **26/09/2023**, the Makerere University School of Health Sciences REC meeting voted to approve the above referenced application.
Approval of the research is for the period of **22/02/2024** to **22/02/2025.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **22/02/2025** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by Makerere University School of Health Sciences REC:

No.	Document Title	Language	Version Number	Version Date
1	Protocol	English	revised protocol pdf	2024-02-15
2	Data collection tools	ENGLISH	Version 2 -28,Nov-2023	2023-11-28
3	Department minutes	ENGLISH	PDF	2023-09-03
4	Application for waiver of informed consent if applicable to your study	ENGLISH	PDF	2023--
5	CVs of the investigators		PDF	2023-09-03

Yours Sincerely

Kalidi Rajab
For: Makerere University School of Health Sciences REC