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A 21-year retrospective histopathological evaluation of cysts and tumours associated with impacted teeth

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A 21-year Retrospective Histopathological Evaluation of Cysts and Tumours Associated with Impacted Teeth

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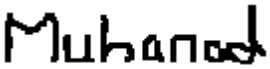
A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfillment of the requirements for the degree of Master of Science in Dentistry.

School of Oral Health Sciences, Faculty of Health Sciences
University of the Witwatersrand, South Africa Johannesburg, 2018.

DECLARATION

I, Muhanad Mohammed declare that this research report is my own work. It is being submitted for an MSc degree in Oral Pathology at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University, and all the sources I have used or quoted have been indicated and acknowledged by complete references.

M. Muhanad



6 June 2018.

DEDICATION

To my father and extended family for their support and encouragement. To my most loving Fiancée, Areich Ziada, for her forbearance and moral support throughout this project. To her I am deeply indebted, and it is wish much devotion and love that I dedicate this work to her.

ABSTRACT

Background

Odontogenic cysts and tumours may be observed in association with impacted teeth. There are no published reports on the histopathological characterisation of cysts and tumours associated with impacted teeth in South Africa. This study aims to determine the relative frequencies and the clinico-pathological features of these lesions in a South African population sample, and to compare the data with information available in the literature.

Methods

The histopathology records of all specimens associated with impacted teeth were collected over a 21-year period from 1996 to 2016 from the files of the Department of Oral Pathology, School of Oral Health Sciences at the University of the Witwatersrand. Clinical data and histological diagnoses were reviewed and analysed.

Results

Out of a total of 24,542 pathology specimens, 407 (1.7%) specimens were associated with impacted teeth in 390 patients. Pathological lesions were diagnosed in 389 (95.6%) cases while 18 (4.4%) specimens represented non-pathological dental follicular tissue. The median patient age was 24 years (3-88 years) with males accounting for 64.9% of the patients. The 11-20 year age group showed the highest overall frequency of pathological lesions associated with impacted teeth, while the 41-50 year age showed the lowest frequency. Dentigerous cyst was the most commonly diagnosed lesion accounting for 63.4% and 43% of all lesions

diagnosed in males and females respectively. No significant association was found between the age of the patient and the biological potential of lesions associated with impacted teeth.

Conclusions

The frequency of histopathological diagnoses associated with impacted teeth significantly reduces with an increase in age. The findings of this study show similar trends to some previously published reports from other geographic areas. The information gathered in this study provides a local data base of the frequencies of odontogenic cysts and tumours associated with impacted teeth which may assist clinicians in formulating differential diagnoses.

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my supervisors, Dr. Farzana Mahomed and Dr. Sizakele Ngwenya who taught and guided me all the way. Thank you for your excellent guidance, caring, patience, monitoring and constant encouragement throughout the learning process, it was much appreciated.

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ABBREVIATIONS

AB: Ameloblastoma

AOT: Adenomatoid odontogenic tumour

CEOT: Calcifying epithelial odontogenic tumour

COC: Calcifying odontogenic cyst

DF: Dental follicle

DC: Dentigerous cyst

EC: Eruption cyst

GOC: Glandular odontogenic cyst

IPC: Inflammatory paradental cyst

OC: Odontogenic carcinoma

OKC: Odontogenic keratocyst

Od: Odontoma

OOC:Orthokeratinized odontogenic cyst

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CHAPTER 1

INTRODUCTION

Impacted teeth are teeth which fail to erupt into their proper functional location (Peterson, 1998). Failure of tooth eruption may be due to lack of space in the jaw, abnormal positioning of the tooth, dense overlying bone or soft tissue or a pathological lesion that constitutes a physical barrier in the eruption path of the tooth (Shahzad *et al.,* 2016). There is a considerable volume of literature written about the pathological changes associated with impacted teeth. In the majority of these studies the frequency of association of pathological changes were looked at in partially or completely impacted third molar teeth only (Glosser and Campbell, 1999; Adelsperger *et al.,* 2000; Rakprasitkul, 2001; Baykul *et al.,* 2005; Saravana and Subhashraj, 2008; Vigneswaran and Shilpa, 2015; Shahzad *et al.*, 2016). Further, the question of a positive association between increasing age and the prevalence of pathological changes associated with impacted teeth is not fully resolved (Punwutikorn *et al.,* 1999; Saghravanian *et al.,* 2007; Gunduz *et al.,* 2011; Seyedmajidi and Nafarzadeh, 2013). Additionally, in most studies the pathological changes associated with impacted teeth were categorised based on the clinical and radiological findings alone (van der Linden *et al.,* 1995; Kinard and Dodson, 2010; Stathopoulos *et al.,* 2011). The pathological changes found included pericoronitis, inflammatory radiological changes in the surrounding bone, caries in the adjacent second molar, periodontal bone loss of the adjacent tooth, root resorption of the adjacent tooth (van der Linden *et al.,* 1995; Knutsson *et al.,* 1996; Punwutikorn *et al.,* 1999) and radiological signs of odontogenic cysts or tumours (Stanley *et al.,* 1988; Punwutikorn *et al.,* 1999; Gunduz *et al.,* 2011; Khosa *et al.,* 2014; Sandhya and Dharman, 2016).

The World Health Organisation classification of odontogenic cysts and tumours comprises 30 different entities (El-Naggar *et al.,* 2017). Many of these entities share overlapping radiological features, including presentation in association with an impacted tooth. Despite the similar radiological features, the therapeutic modalities that are advocated for the different entities can vary considerably making accurate distinction between them of paramount importance. Histopathology remains the gold standard for the diagnosis of pathological lesions associated with impacted teeth (Stathopolous *et al.,* 2011). Based on the histological diagnosis, which provides information about biological behaviour or aggressiveness of the lesion, treatment may consist of conservative enucleation of the lesion with little to no chance for recurrence, to enucleation with supplemental cryotherapy or peripheral ostectomy to a hemi-resection of the affected side of the jaw (Neville *et al.*, 2015).

While many reports in the literature discuss the prevalence of cyst and tumour development associated with impacted teeth, only a few studies have investigated the prevalence of pathological lesions associated with impacted teeth based on histological diagnosis (Curran *et al.,* 2002; Saghravanian *et al.,* 2007; Vigneswaran and Shilpa, 2015; Dovigi *et al.,* 2016). The general consensus from these studies is that the dentigerous cyst is the most prevalent lesion among the odontogenic pathologies associated with impacted teeth (Curran *et al.,* 2000; Dovigi *et al.,* 2016; Shin *et al.,* 2016). These studies were conducted in different countries while characterisation of the types of cysts and tumours associated with impacted teeth at a South African tertiary hospital has not yet been verified.

CHAPTER 2

2.0. LITERATURE REVIEW

2.1. Distribution of odontogenic cysts and tumours associated with impacted teeth in relation to the age of the patient

Odontogenic cysts and tumours associated with an impacted tooth can occur over a wide age range. When compared to other odontogenic cysts, the prevalence of the dentigerous cyst rises markedly during the second decade of life, peaks during the third decade and then declines (Shear and Speight, 2008), whereas odontogenic keratocysts can occur at any age but more than half are reported between the second and fourth decades of life (Neville *et al.,* 2015). Philipsen and Reichart, (1998) pointed out that cases of unicystic ameloblastoma associated with an unerupted tooth show a mean age of 16 years as compared to 35 years in the absence of an impacted tooth.

Many reports in the literature have shown that the third decade of life manifests the highest prevalence of cysts and tumours associated with an impacted tooth (van der Linden *et al.,* 1995; Glosser and Campbell, 1999; Baykul *et al.,* 2005; Wali *et al.,* 2012). Other researchers have, however, shown the highest frequency of cysts and tumours associated with impacted teeth in the second decade of life (Punwutikorn *et al.,* 1999; Saghravanian *et al.,* 2007; Seyedmajidi and Nafarzadeh, 2013). By contrast, Curran *et al.,* (2002) showed that there was a strong relationship between increasing age and pathological lesions associated with impacted teeth. In their study,

although the frequency of pericoronal lesions submitted for histopathological examination decreased with age, the ratio of pathologic lesions to normal dental follicular tissue was found to increase with age (Curran *et al*., 2002). Sixty-five percent of the follicular (pericoronal) variant of odontogenic keratocysts in their study occurred in the fourth decade or later while most odontogenic keratocysts are generally reported to be more common before the age of 40 years (Neville *et al.*, 2015).

Shin *et al* (2016) also pointed out that the proportion of cysts and tumours associated with an impacted tooth increased with age in their study where 0.41% - 0.71% of lesions were seen in patients under the age of 30 years and 7.69% - 20.93% in patients older than 50 years. Similarly, another study showed that the incidence of cysts and tumours associated with an impacted tooth increased with age, with 27.1% presenting in patients older than 35 years while 13.5% presented in patients younger than 35 years (Khosa *et al*., 2014). As far as malignant lesions are concerned, Curran *et al* (2002) reported all malignant lesions associated with impacted teeth occur from the fifth to the eighth decade of life.

2.2. Distribution of odontogenic cysts and tumours associated with impacted teeth in relation to the gender of the patient

There is conflicting data on the prevalence of pathologies associated with impacted teeth between males and females. Investigations on the prevalence of cystic changes around an impacted tooth show an increased trend in the male when compared to the female in some studies (Stathopoulos *et al.*, 2011; Patil *et al*., 2014; Shin *et al*., 2016). It has been speculated that the male

predominance may be due to males undergoing extraction of an impacted third molar tooth more often than females (Shin *et al*., 2016). A study on the prevalence of cysts and tumours associated with impacted third molar teeth showed a 67% prevalence of cysts in men and a 33% prevalence in women, while a 64% and 36% prevalence of tumours were found in women and men respectively (Patil *et al*., 2014). In the same way, another study showed a male predominance for cysts associated with impacted teeth, whereas tumours showed a female predominance (Stathopoulos *et al*., 2011). A study by Daley *et al.* (1994) showed that both cysts and tumours associated with impacted teeth are more common in males. On the contrary, another study on the frequency of cysts and tumours around impacted teeth showed an equal distribution between males and females (Glosser and Campbell, 1999) and yet another study showed that the prevalence of pathologies around impacted teeth is more common in females than in males (Yıldırım *et al.*, 2008).

2.3. Distribution of odontogenic cysts and tumours associated with impacted teeth in relation to the site of the lesion

Impaction can occur in any tooth in the oral cavity, but the most common impacted tooth is the third molar and in particular the mandibular third molar (Chu *et al*., 2003). In the maxilla after the third molar, the second most common impacted tooth is the maxillary canine followed by supernumerary teeth. In the mandible, the most commonly impacted tooth following the third molar is the mandibular canine followed by the second premolar (Stanley *et al*., 1988). Most studies in the literature looked at pathologies associated with impacted third molars (Baykul *et*

al., 2005; Saravana and Subhashraj, 2008) and there is little information on pathologies associated with impacted teeth other than the third molar (Curran *et al*., 2002).

Khosa *et al*. (2014) reported a higher prevalence of cysts and tumours with impacted mandibular third molars (20.6%) as compared to impacted maxillary third molars (5.2%). Another study on the impacted third molar tooth reported a 20% prevalence of cysts in the maxilla and an 80% prevalence in the mandible, whereas the prevalence of tumours was 95% in the mandible and 5% in the maxilla (Patil *et al*., 2014). Güven *et al*. (2000) showed that 68% of cysts associated with an impacted tooth occurred in the mandible and only 8% in the maxilla. Stapholous *et al*. (2011) found 76% of cysts associated with an impacted mandibular tooth and 24% in the maxilla, while 20% of tumours associated with an impacted tooth were found in the maxilla and 79.2% in the mandible. Muzio *et al*. (2017) reported that dentigerous cysts are found mostly in the mandible with a prevalence of 83.8%. The majority of studies show no significant difference in the frequency of pathologies associated with impacted third molar teeth on the right and left sides (Adelsperger *et al*., 2000; Gunduz *et al*., 2011; Khosa *et al*., 2014).

2.4. Histopathological characterisation of odontogenic cysts and tumours associated with impacted teeth

The absence of clinical symptoms and radiographical evidence associated with impacted teeth does not always mean the absence of pathology (Yıldırım *et al.*, 2008). Although various studies based on the radiographic assessment of lesions associated with the crowns of impacted teeth have revealed that a pericoronal radiolucency less than 3 mm in width may be considered

normal (van der Linden *et al*., 1995; Stathopoulos *et al*., 2011), other authors have linked histopathology with a radiographic "normal" follicular space and found that the incidence of the development of cysts and tumours around an impacted tooth is more than generally suspected based on radiographic assessment alone (Glosser and Campbell, 1999; Adelsperger *et al.*, 2000; Rakprasitkul, 2001). As an example, the distinction between dentigerous cysts and normal dental follicle cannot always be carried out by radiological assessment alone. A histological study was performed on 96 impacted third molar teeth without radiographic evidence of pathology and found that one-third of the cases were dentigerous cysts (Glosser and Campbell, 1999).

The prevalence of cysts and tumours occurring around impacted third molars differs greatly in various studies, showing a wide range from 0.001% to 32.9% (Girod *et al*., 1993; Curran *et al*., 2002; Baykul *et al*., 2005). Most of the studies in the literature show a relatively low prevalence of cyst and tumour development associated with an impacted third molar (Guven *et al*., 2000; Vigneswaran and Shilpa, 2015). It has been speculated that one of the possible reasons for this observation may be because the pericoronal tissues are discarded after surgical removal of the impacted teeth rather than submitted for histopathological examination thereby precluding the histopathological characterisation of many pericoronal lesions (Stathopolous *et al*., 2011; Vigneswaran and Shilpa, 2015).

Odontogenic cysts and tumours are asymptomatic in their early phase of development. Small lesions are usually completely asymptomatic and may be discovered during routine radiographic examination or when radiographs are taken to determine the reason for failure of the tooth to erupt (Shear and Speight, 2008). These lesions can grow to a considerable size. Large lesions

typically become symptomatic and often cause a painless expansion of the surrounding bone. When these lesions become secondarily infected they are typically associated with pain and swelling (Neville *et al*., 2015).

Studies in the literature suggest that concerning cystic lesions and tumours associated with impacted teeth, the dentigerous cyst is the most common among all the other pathologies (Curran *et al*., 2000; Dovigi *et al*., 2016; Shin *et al*., 2016). The dentigerous cyst most commonly affects the mandibular third molar, but it can also develop around the maxillary canine, the maxillary third molar, the mandibular second premolar, a deciduous tooth, a supernumerary tooth or an odontoma (Curran *et al*., 2000). In some studies, the second most common cyst associated with an impacted tooth was the odontogenic keratocyst (Rakprasitkul, 2001; Lee *et al*., 2014; Patil *et al*., 2014;), with its prevalence ranging from 0.96% to 17.6% of pathologies associated with impacted teeth (Rakprasitkul, 2001; Lee *et al.*, 2014; Vignewsaran and Shilpa, 2015). Radiographically, the dentigerous cyst typically shows a unilocular radiolucent lesion that is associated with the crown of an unerupted tooth. Large dentigerous cysts may give the impression of multilocularity due to persistence of bone trabeculae within the radiolucency. Radiographic findings are, however, not diagnostic for a dentigerous cyst because odontogenic keratocysts, ameloblastomas and many other odontogenic tumours may have radiographic features that are essentially identical to those of a dentigerous cyst (Shear and Speight, 2008).

Odontogenic cysts and tumours vary in their biologic potential. Dentigerous cysts can destroy a significant amount of bone; odontogenic keratocysts have the potential for recurrence and may be associated with nevoid basal cell carcinoma syndrome (Shear and Speight, 2008).

Ameloblastomas and calcifying epithelial odontogenic tumours cause widespread tissue destruction, tend to recur, cause facial deformity, and have the potential for malignant transformation (El-Naggar *et al*., 2017). Current literature regarding the biological behavior of odontogenic lesions classifies adenomatoid odontogenic tumour, odontoma, dentigerous cyst, inflammatory paradental cyst, dental follicle, calcifying odontogenic cyst, orthokeratinised odontogenic cyst and eruption cyst as of low biological potential (indolent lesions); while ameloblastoma, odontogenic keratocyst, glandular odontogenic cyst and odontogenic carcinoma are classified as lesions of high biological potential or locally aggressive lesions (Neville *et al*., 2015).

Of note, the majority of studies in the literature that discuss the prevalence of cyst and tumour development associated with impacted teeth have used data collected from analysis of radiographs, including some with long-term follow-up but without histological confirmation of the diagnosis (Punwutikorn *et al*., 1999; Gunduz *et al*., 2011; Khosa *et al*., 2014; Sandhya and Dharman, 2016). In one study, 666 patients with pathological lesion associated with impacted teeth were reviewed, but a histological diagnosis other than "cyst" was not reported in 28 patients (Knutsson *et al*., 1996). In addition, many published reports that have included information specifying the histopathological diagnosis of the lesion associated with an impacted tooth are single or group case reports ranging from one to three patients (Girod *et al*., 1993; Jayam *et al*., 2014; Sarode *et al*., 2017).

Vigneswaran and Shilpa (2015) conducted a retrospective study over a six-year period on the histological diagnosis of pathologies associated with impacted mandibular third molars and found

a 24.1% prevalence of dentigerous cyst associated with impacted third molars, followed by ameloblastoma (15.7%), odontogenic keratocyst (14.3%) and two cases of squamous cell carcinoma. Similar to the study by Vigneswaran and Shilpa (2015) most studies looked at pathologies associated with impacted third molar teeth only. Consequently, there is very limited information in the literature on the frequencies of specific types of odontogenic cysts and tumours occurring in association with the less frequently impacted teeth.

Studies in the literature report that the most common odontogenic neoplasm associated with an impacted tooth is the ameloblastoma (Stathopoulos *et al*., 2011; Shin *et al.,* 2016). Up to 85% of cases occur in the mandible, particularly in the posterior mandible (Neville *et al,* 2015). The incidence of ameloblastoma occurring around impacted teeth differs greatly in various studies, showing a wide range from 0.2% to 15.7% (Al-Khateeb and Bataineh, 2006; Jin-Hyeok Lee *et al.*, 2014; Vigneswaran and Shilpa, 2015). In a radiographical and histopathological study on 176 pathologies associated with impacted mandibular third molars over a 5-year period, it was pointed out that 5.7% were ameloblastoma (Shin *et al.,* 2016).

On the other hand, Saghravanian *et al* (2007) report odontomas as the most common tumour associated with impacted teeth. Odontomas are not true neoplasms but rather hamartomatous lesions which occur predominantly in the first two decades of life. They occur in the maxilla more often than in the mandible, and they are often associated with an unerupted tooth (Neville *et al.*, 2015). In a retrospective study on 160 lesions associated with impacted teeth, odontomas represented 5% of the lesions (Saghravanian *et al.,* 2007). In addition to ameloblastomas and odontomas, other tumours not uncommonly associated with impacted teeth include adenomatoid

odontogenic tumour and odontogenic myxoma. A study was conducted based on clinical, radiographical and histological assessments on 5,486 impacted third molars and pointed out that 1.16% of the specimens were diagnosed as tumours which included ameloblastoma, odontoma and odontogenic fibroma (Patil *et al.,* 2014). In a retrospective histopathologic evaluation of 2,646 pericoronal tissue biopsies, Curran *et al* (2002) showed that 32.9% of the specimens were diagnosed as odontogenic cysts and tumours, while 67.1% were diagnosed as normal follicular tissue. In order of descending frequency, the prevalence of odontogenic cysts and benign tumours were characterised as follows; dentigerous cysts, odontogenic keratocysts, odontomas, ameloblastomas, calcifying epithelial odontogenic tumours and odontogenic myxoma (Curran *et al.,* 2002).

As far as malignant lesions associated with impacted teeth are concerned, primary malignancies such as intraosseous squamous cell carcinoma and intraosseous mucoepidermoid carcinoma are described (Neville *et al.,* 2015). The incidence of malignant lesions associated with impacted teeth is, however, relatively low (Patil *et al.,* 2014). In a retrospective histopathological study of pathologies associated with impacted teeth, Curran *et al* (2002) report six malignant lesions associated with impacted teeth; namely four cases of squamous cell carcinoma, one intraosseous mucoepidermoid carcinoma and one odontogenic carcinoma. The six malignant lesions constituted 0.6% of all pathologies associated with impacted teeth. A study by Güven *et al* (2000) on pathologies associated with impacted third molars reported one case of squamous cell carcinoma and one case of fibrosarcoma which represented 0.02% of all pathologies associated with impacted third molars. Patil *et al* (2014) conducted a study on 5,486 impacted third molars and reported that 3% were squamous cell carcinoma and 1% were mucoepidermoid

carcinoma. Similarly, a study done by Vigneswaran and Shilpa (2015) reports two cases of squamous cell carcinoma which constituted 0.007% of all samples in their study. Moreover, Al-Khateeb and Bataineh (2006) conducted a study on 2,432 impacted mandibular third molars and pointed out that squamous cell carcinoma constituted 0.008% of their study sample.

In summary, there are many studies in the literature that have evaluated pathologies associated with impacted teeth but most of these studies were based on clinical and radiographic investigation. There are consequently only a few studies where the data is derived from the histopathological evaluation of pathologies associated with impacted teeth (Curran *et al.,* 2001; Saghravanian *et al.,* 2007; Vigneswaran and Shilpa, 2015; Dovigi *et al.,* 2016). Further, no histological study on the types and frequencies of pathologies associated with impacted teeth has thus far been performed in a South African population sample.

2.5. Rationale for conducting this study

Histopathological characterisation of pathologies associated with impacted teeth at a South African tertiary hospital has not yet been verified. This study will also allow for comparison of the data obtained with previously published reports on this subject from other geographic areas. The data from this study may also serve to guide the clinician's index of suspicion when treating patients with impacted teeth.

CHAPTER 3

3.0. AIM AND OBJECTIVES

3.1. AIM

This study aims to report the findings of histologically diagnosed pathologies associated with impacted teeth in a South African population sample.

3.2. OBJECTIVES

a. To determine the frequency of submission of tissue specimens associated with impacted teeth to an oral and maxillofacial pathology diagnostic service.

b. To describe the demographic (age and sex) characteristics of the patients in this study.

c. To identify the most frequently diagnosed pathologies associated with impacted teeth.

d. To determine if there is an association between age, sex, impacted tooth type and the histological diagnosis.

e. To determine if there is an association between age and the prevalence of pathological lesions associated with impacted teeth.

f. To determine if there is an association between age and the pathological potential (indolent versus aggressive) of lesions associated with impacted teeth.

CHAPTER 4

4.1. Study design

This retrospective study was carried out by means of a review of the histopathology reports of all cases in the files of the Department of Oral Pathology, School of Oral Health Sciences at the University of the Witwatersrand. These records were retrieved over a 21-year period (January 1996 to December 2016).

4.2. Inclusion criteria

- Patients from whom tissue specimens associated with one or more impacted teeth were obtained by incisional biopsy, excisional biopsy or jaw resection and submitted for a histological diagnosis.
- Fully and partially impacted teeth.
- Deciduous and permanent teeth.
- Dental follicular tissue.

4.3. Exclusion criteria

- The study excluded all cases where the histological diagnosis was inconclusive due to inadequate tissue, suboptimal representation of lesional tissue or insufficient clinical data.

4.4. Data collection and analysis

The histopathology reports were reviewed, information collected and recorded on a standard data collection form (Table 1). To avoid duplication, specimens of the same lesion submitted as an incisional biopsy and subsequently as an excisional specimen were distinguished and filtered out to prevent duplication of the data.

Table 1: Data collection form

Case No	Age	Sex	Impacted tooth number	Histological diagnosis

A database was created using Microsoft Excel (Microsoft, Redmond, WA). The database was transferred to a statistical package (Stata version 14) for analysis. The study population was divided into six age groups: group 1 (1-10 years), group 2 (11-20 years), group 3 (21-30 years), group 4 (31-40 years), group 5 (41-50 years) and group 6 (51 years and older). The purpose of dividing the subjects into these age groups was to determine the frequency of pathological lesions relative to age and to allow for comparison with earlier studies (Curran *et al*, 2002). Fischer's exact test was used to measure association between demographic characteristics (age and sex), impacted tooth type and histological diagnosis. The Fischer's exact test was used because more than 20% of the cells analysed showed expected frequencies that were less than 5. Binary logistic regression was further used to determine the dimension of relationship between histological diagnosis and demographic characteristics (age and sex). Mann U Whitney was used to determine

the association between age and pathological potential of the lesion. Level of significance was set at $P < 0.05$.

4.5. Ethical considerations

The protection of the rights of human research subjects were taken into consideration. The study subjects remained anonymous. An application for ethical clearance was obtained from the Human Research Ethics Committee at the University of the Witwatersrand (Ethics clearance number: M170812; Appendix A). Permission was also obtained from the Head of School of Oral Health Sciences and the Head of the Department of Oral Pathology to conduct the study.

CHAPTER 5

5.0. RESULTS

5.1. The frequency of histological diagnoses associated with impacted teeth

A total of 24,542 tissue specimens were submitted for histopathologic examination during the study period. Of these, 407 (1.7%) tissue specimens were associated with impacted teeth in 390 patients. Tissue specimens were submitted from two or more sites associated with impacted teeth in thirteen patients (Appendix E).

5.2. Demographic characteristics of the patients in this study

The mean age of the patients was 25.3 ±15.2 years with males accounting for 64.9% of the patients. Patients aged 21-30 years accounted for 29.2% of the study population, followed by patients aged 11-20 years (28.5%). The 41-50 year age group comprised the fewest number of patients (7.4%).

Table 2*:* Demographic characteristics of all patients in this study

Demographics	**Patients**	
Sex (n=390)	**N**	**%**
Male	253	64.9
Female	134	34.3
Not known	3	0.8
Age group in years (n=390)		
≤10	53	13.6

11-20	111	28.5
21-30	114	29.2
31-40	45	11.5
41-50	29	7.4
≥51	30	7.7
Not known	8	2.1
Age (years), Median	24 (3-88)	

5.3. The frequency of non-pathological (dental follicle) and pathological lesions associated with impacted teeth

The dentigerous cyst (56.5%) and ameloblastoma (14%) were most frequently diagnosed in this population (Table 3).

Table 3: Frequency of histological diagnoses for the lesions in this study

Histological diagnosis (N=407)	**N**	**%**
Dentigerous cyst	230	56.5
Ameloblastoma	57	14
Odontogenic keratocyst	25	6.1
Inflammatory paradental cyst	23	5.7
Dental follicle	18	4.4
Adenomatoid odontogenic tumour	18	4.4
Odontoma	16	3.9
Calcifying odontogenic cyst	7	1.7
Orthokeratinised odontogenic cyst	6	1.5
Eruption cyst	3	0.7
Glandular odontogenic cyst	2	0.5
Calcifying epithelial odontogenic tumour	1	0.2
Odontogenic carcinoma	1	0.2
Total	**407**	

Of the 57 cases of ameloblastoma, tumour subtyping was documented in the histopathology report in 48 cases. There were 28 (58.3%) cases of conventional ameloblastoma and 20 cases (41.7%) of unicystic ameloblastoma. Of the 20 unicystic ameloblastomas, there were eight cases of type 1, five cases of type 2 and seven cases of type 3 as shown in Figure 1.

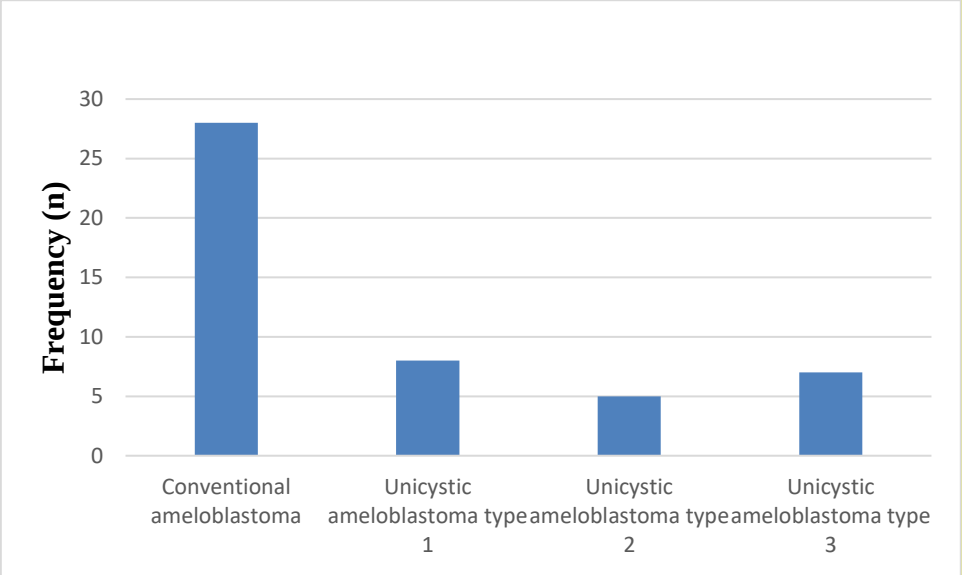


Figure 1: Frequency of ameloblastoma subtypes

5.4. Descriptive analysis of histological diagnoses according to age and gender

The dentigerous cyst was the most commonly diagnosed lesion across all decades (Table 4). Dentigerous cyst (n=53) and ameloblastoma (n=24) were most commonly diagnosed in the 21-30 year age group, while the 11-20 year age group showed the overall highest frequency of histologically diagnoses (n=122) associated with impacted teeth. Glandular odontogenic cysts were found in older patients (median age; 46 years) when compared to other lesions, while eruption cysts were usually seen under the age of 10 years (median; 9 years) (Table 5). Patients

diagnosed with odontoma were slightly older (median; 18.5 years) than patients diagnosed with adenomatoid odontogenic tumour or calcifying odontogenic cyst (Table 5). Ameloblastoma was diagnosed in males and females at a similar age (Table 5). Odontoma, dentigerous cyst and odontogenic keratocyst were diagnosed at a slightly older age in males compared to females (Table 5).

Table 4: Histological diagnoses according to patient age in decades

Histological diagnosis	**Age in decades, n**						
	≤10	**11-20**	**21-30**	**31-40**	**41-50**	**≥51**	**NS**
Dentigerous cyst	39	51	53	30	21	27	9
Ameloblastoma	3	22	24	7	1	0	0
Odontogenic keratocyst	3	11	9	2	0	0	0
Inflammatory paradental cyst	0	3	14	1	3	2	0
Dental follicle	2	8	8	0	0	0	0
Adenomatoid odontogenic tumour	2	13	2	1	0	0	0
Odontoma	0	9	2	2	2	1	0
Calcifying odontogenic cyst	1	3	2	0	0	0	1
Orthokeratinised odontogenic cyst	0	2	2	1	0	1	0
Eruption cyst	3	0	0	0	0	0	0
Glandular odontogenic cyst	0	0	0	0	2	0	0
Calcifying epithelial odontogenic tumour	0	0	0	1	0	0	0
Odontogenic carcinoma	0	0	1	0	0	0	0
Total	**53**	**122**	**117**	**45**	**29**	**31**	**10**

Table 5: Histological diagnoses according to age and sex

Histological diagnosis	Age in years					
	Total		Male		Female	
	Median	Range	Median	Range	Median	Range
Dentigerous cyst	24	(3-88)	25	(3-88)	21	(3-75)
Ameloblastoma	21	(6-45)	21	(6-45)	22	(10-35)
Odontogenic keratocyst	17	(6-35)	19	(8-35)	16.5	(6-27)
Inflammatory paradental cyst	26	(18-76)	26	(20-76)	25.5	(18-60)
Dental follicle	18	(5-30)	18	(10-24)	17	(5-30)
Adenomatoid odontogenic tumour	14	(6-38)	14	(11-28)	13.5	(6-38)
Odontoma	18.5	(12-77)	32	(15-41)	17	(12-77)
Calcifying odontogenic cyst	14	(9-22)	12.5	(9-21)	18	(14-22)
Orthokeratinised odontogenic cyst	24	(17-66)	24	(17-66)	-	-
Eruption cyst	9	(8-9)	8.5	(8-9)	9.0	(9)
Glandular odontogenic cyst	46.0	(45-47)	47.0	(47)	45.0	(45)
Calcifying epithelial odontogenic tumour	33	(33)	-	-	33	(33)
Odontogenic carcinoma	29.0	(29)	-	-	29	(29)

The mean age at diagnosis for conventional ameloblastoma was 24.8 years and that of unicystic ameloblastoma was 17.9 years (Table 6). Although the combined (conventional and unicystic) male to female ratio for ameloblastoma was 1.3:1 (Table 7), the male to female ratio for conventional ameloblastoma was 1:1.2, while the ratio of males exceeded females for unicystic ameloblastoma (2.3:1) (Table 6).

Table 6: Sex and age (years) distribution for conventional and unicystic ameloblastoma

	Males (n)	**Females (n)**	**Mean, SD**	**Median, range**
Conventional ameloblastoma	13	15	24.8 ±7.5	24.8 (12-45)
Unicystic ameloblastoma	14	6	17.9 ±6.7	16 (6-37)
Total	27	21		

Table 7: Histological diagnoses according to sex

Histological diagnosis	**Male**		**Female**		**Ratio**	
	N	**%**	**n**	**%**	**M: F**	**Sex not specified**
Dentigerous cyst	166	63.4	61	43	2.7:1	3
Ameloblastoma	32	12.2	25	17.6	1.3:1	0
Odontogenic keratocyst	14	5.3	11	7.7	1.3:1	0
Inflammatory paradental cyst	17	6.5	6	4.2	2.8:1	0
Dental follicle	5	1.9	13	9.2	1:2.6	0
Adenomatoid odontogenic tumour	10	3.9	8	5.6	1.3:1	0
Odontoma	5	1.9	11	7.7	1:2.2	0
Calcifying odontogenic cyst	4	1.5	3	2.1	1.3:1	0
Orthokeratinised odontogenic cyst	6	2.3	0	0	0	0
Eruption cyst	2	0.8	1	0.7	2:1	0
Glandular odontogenic cyst	1	0.4	1	0.7	1:1	0
Calcifying epithelial odontogenic tumour	0	0	1	0.7	0	0
Odontogenic carcinoma	0	0	1	0.7	0	0
Total	262		142		1.8:1	3

The dentigerous cyst was the most commonly diagnosed lesion in males and females, accounting for 63.4% and 43% of all lesions diagnosed in males and females respectively. All the lesions

shown in Table 7 were seen more commonly in males, except for dental follicle and odontoma which were more common in females.

5.4.1. Statistical analysis for association between age and the frequency of histological diagnoses associated with impacted teeth

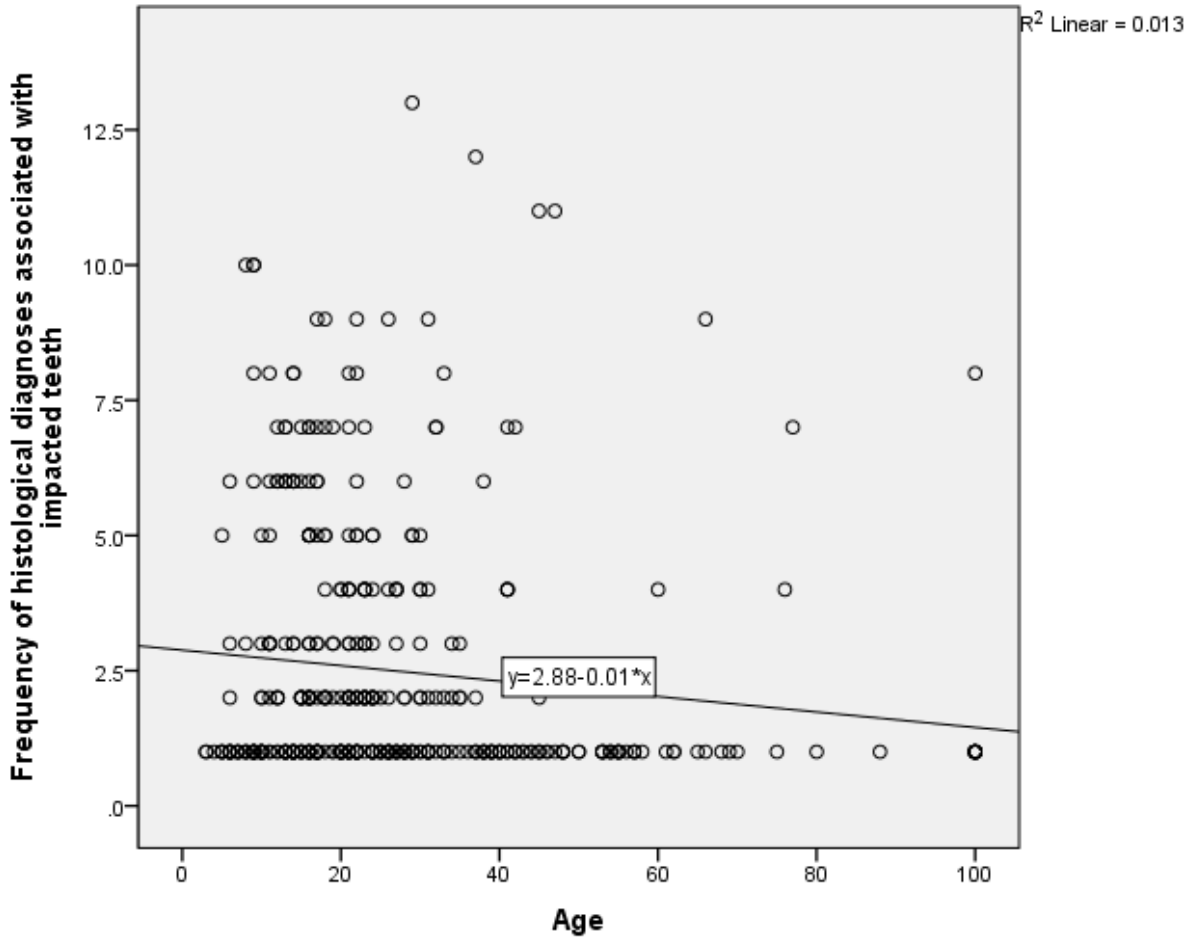


Figure 2: Scatter plot representation of the frequency of histological diagnoses for lesions associated with impacted teeth in relation to patient age

As illustrated in Figure 2, the frequency of histological diagnoses for lesions associated with impacted teeth reduces with an increase in age. The Mann U Whitney test revealed that the reduction in age and diagnosis is statistically significant, $P < 0.05$ ($P = 0.00$).

5.4.2. Statistical analysis for association between sex and the frequency of histological diagnoses across six age groups

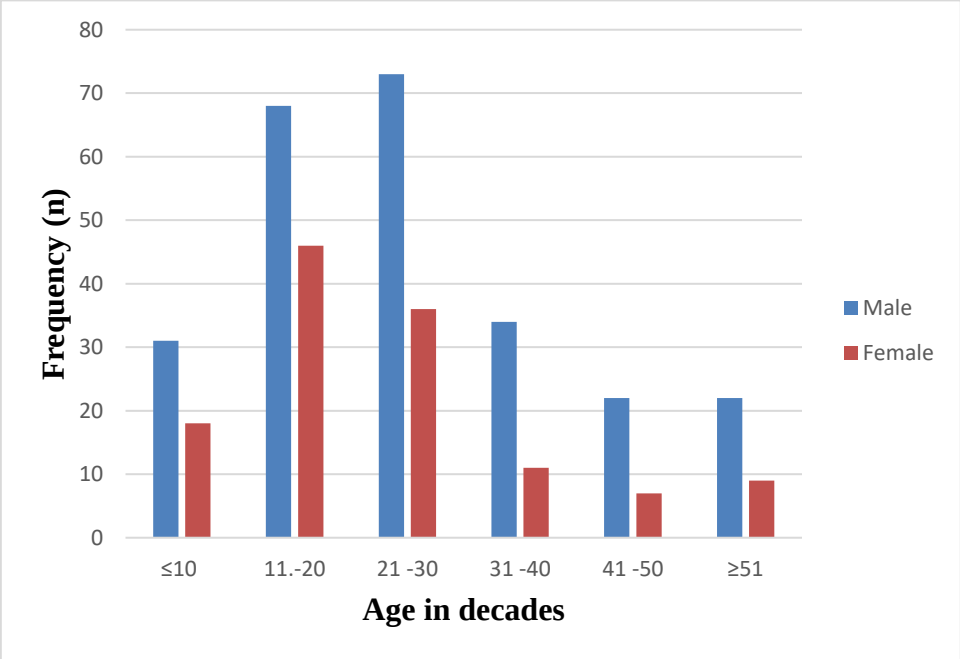


Figure 3: Frequency of histological diagnoses in relation to patient age and sex

The difference between the number of histological diagnoses between males and females (Figure 3) was analysed using the X^2 test. The result showed that there was a significant difference, with males significantly more commonly affected across all six age groups (P= 0.01) .

5.4.3. Statistical analysis for association between the histological diagnosis and demographics

In order to test for an association between the histological diagnosis and demographics (age and sex), the data was analysed using Fischer's exact test.

Table 8: Association between histological diagnosis and patient demographics

Histological diagnosis	Sex		*P*=value	Age in decades (n)						*P*=value
	Male (n)	Female (n)		≤10	11-20	21-30	31-40	41-50	>50	
Dentigerous cyst	166	61	0.00*	39	51	53	30	21	27	0.00*
Ameloblastoma	32	25	0.31	3	22	24	7	1	0	0.00*
Odontogenic keratocyst	14	11	0.34	3	11	9	2	0	0	0.43
Inflammatory paradental cyst	17	6	0.48	0	3	14	1	3	2	0.01*
Dental follicle	5	13	0.01*	2	8	8	0	0	0	0.32
Adenomatoid odontogenic tumour	10	8	0.52	2	13	2	1	0	0	0.03*
Odontoma	5	11	0.02*	0	9	2	2	2	1	0.17

As shown in Table 8, sex showed a significant association with dentigerous cyst, dental follicle and odontoma (P <0.05), while age showed a significant association with dentigerous cyst, ameloblastoma, inflammatory paradental cyst and adenomatoid odontogenic tumour (P <0.05). Further analysis using binary logistic regression was carried out to determine the predictive effect the demographic characteristics of age and gender have on the histological diagnosis of lesions associated with impacted teeth. The results of the binary logistic regression analysis are presented in Table 9 and Table 10.

Table 9: Binary logistic regression for data on histological diagnosis and patient age in decades

Diagnosis	Age in decades	N	OR	*P*-values	95% CI
Dentigerous cyst	≤10	39	4.04	0.00	1.99-8.19
	11-20	51	Ref	Ref	Ref
	21-30	53	1.20	0.48	0.72-2.00
	31-40	30	2.72	0.01	1.35-5.50
	41-50	21	3.80	0.00	1.57-9.27
	≥51	27	10.06	0.02	1.60-106.27
Ameloblastoma	≤10	3	0.28	0.04	0.08-0.98
	11-20	22	Ref	Ref	Ref
	21-30	24	1.21	0.56	0.64-2.30
	31-40	7	0.84	0.71	0.33-2.12
	41-50	1	0.17	0.09	0.02-1.30
	≥51	0	-	-	-
Inflammatory paradental cyst	≤10	0	-	-	-
	11-20	3	Ref	Ref	Ref
	21-30	14	5.53	0.01	1.55-19.76
	31-40	1	0.90	0.93	0.09-8.91
	41-50	3	4.69	0.07	0.89-24.56
	≥51	2	2.71	0.29	0.43-16.96
Adenomatoid odontogenic tumour	≤10	2	0.34	0.16	0.07-1.55
	11-20	13	Ref	Ref	Ref
	21-30	2	0.15	0.01	0.03-0.68
	31-40	1	0.19	0.12	0.02-1.51
	41-50		-	-	-
	≥51		-	-	-

The age category 11-20 years was used as reference and the binary logistic regression showed that age is not a predictor for the dentigerous cyst and inflammatory paradental cyst. For ameloblastoma, although the results suggest that patients under the age of 10 years are 0.28 times less likely to develop this tumour, the sample size for this age category consisted of only three

cases. Similarly for adenomatoid odontogenic tumour, the sample size in the 21-30 year group consisted of only two cases, thereby precluding definitive conclusions.

Table 10: Binary logistic regression for data on histological diagnosis and sex

Diagnosis	**Sex**	**N**	**OR**	***P*-value**	**95% CI**
Dentigerous cyst	Male	166	2.33	0.00	1.53-3.52
	Female	61	Ref	Ref	Ref
Dental follicle	Male	5	Ref	Ref	Ref
	Female	13	5.14	0.00	1.95-15.70
Odontome	Male	5	Ref	Ref	Ref
	Female	11	4.25	0.01	1.45-12.49

The binary logistic regression shows that the odds of a male being diagnosed with dentigerous cyst is 2.33 more than that in a female, however, the confidence interval crossed 1. The odds of a female to be diagnosed with dental follicle and odontoma is 5.14 and 4.25 more respectively than a male, however, the confidence intervals were also greater than 1. These results indicate that sex is not a predictor of histological diagnosis for these lesions.

5.4.4. Statistical analysis for association between the histological diagnosis and tooth type

In this study there were 407 impacted teeth with either an associated pathological lesion or dental follicle that was submitted for histological evaluation. In 71 cases the impacted tooth number was not specified while four dentigerous cysts were associated with supernumerary teeth (Appendix E). Tooth number was specified in 332 cases and among them there were associated four primary teeth (Table 11). As shown in Table 11, tooth 48 (n=92) and 38 (n=87) were the most commonly impacted teeth, with the dentigerous cyst being most commonly diagnosed in both impacted lower third molars, while for maxillary central incisors the frequency of dentigerous cysts were equal.

Table 11: Histological diagnoses in relation to tooth type

Tooth type	Histological diagnosis (n)													
	DC	**AB**	**OKC**	**IPC**	**DF**	**AOT**	**Od**	**COC**	**OOC**	**EC**	**GOC**	**CEOT**	**OC**	**Total**
48	52	19	4	10	3	0	1	0	3	0	0	0	0	92
38	49	13	5	13	4	0	2	0	1	0	0	0	0	87
23	14	0	2	0	3	5	0	3	0	0	0	0	0	27
13	9	0	2	0	1	2	2	1	0	0	0	0	0	17
43	4	5	3	0	0	1	0	1	0	0	1	0	0	15
11	5	0	0	0	0	0	5	1	0	2	0	0	0	13
21	5	0	0	0	3	0	3	0	0	0	0	0	0	11
33	2	2	1	0	0	1	1	0	1	0	1	0	0	9
35	6	0	1	0	0	0	0	0	0	0	0	0	0	7
18	6	0	1	0	0	0	0	0	0	0	0	0	0	7
45	3	1	0	0	0	0	0	0	0	0	0	0	0	4
37	4	0	0	0	1	0	0	0	0	0	0	0	0	5
44	3	1	0	0	0	1	0	0	0	0	0	0	0	5
47	1	3	0	0	1	0	0	0	0	0	0	0	0	5
28	2	0	1	0	1	0	0	0	0	0	0	0	0	4
46	3	0	0	0	0	0	1	0	0	0	0	0	0	4
12	1	0	0	0	0	2	0	0	0	0	0	0	0	3
25	3	0	0	0	0	0	0	0	0	0	0	0	0	3
34	2	0	0	0	0	1	0	0	0	0	0	0	0	3
36	1	0	0	0	0	0	0	0	0	0	0	1	0	2
51	1	0	0	0	0	0	1	0	0	0	0	0	0	2
14	1	0	0	0	0	0	0	0	0	0	0	0	0	1
15	1	0	0	0	0	0	0	0	0	0	0	0	0	1
22	1	0	0	0	0	0	0	0	0	0	0	0	0	1
24	1	0	0	0	0	0	0	0	0	0	0	0	0	1
26	1	0	0	0	0	0	0	0	0	0	0	0	0	1
53	0		1	0	0	0	0	0	0	0	0	0	0	1
64	1	0	0	0	0	0	0	0	0	0	0	0	0	1

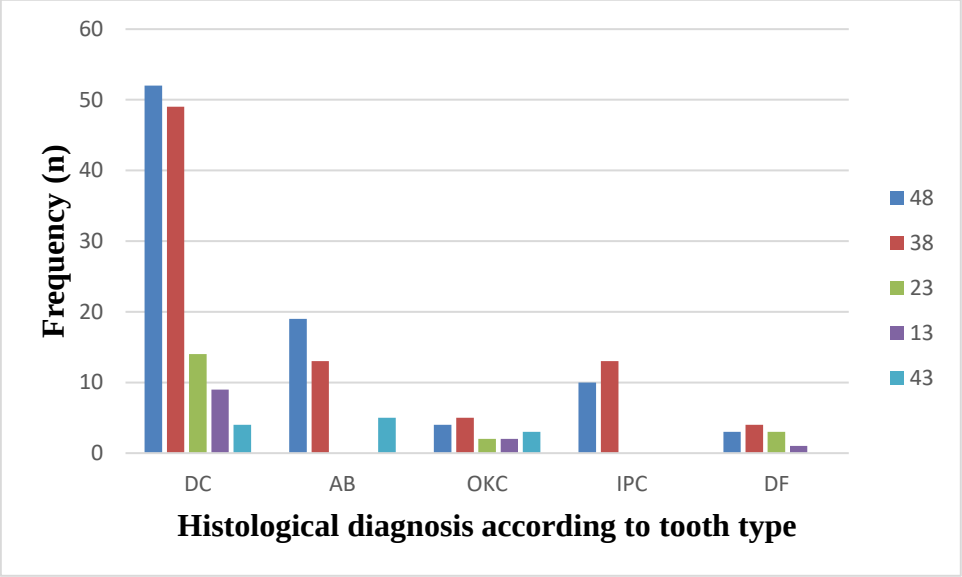


Figure 4: Most common histological diagnoses in the most commonly impacted teeth

In order to assess whether there is an association between the impacted tooth type and the histological diagnosis, the five most commonly impacted teeth in this study (Figure 4) were analysed along with the most frequent histological diagnoses using Fisher's exact test (Table 12).

Table 12: 5×5 Contingency table for association between histological diagnosis and tooth type

	Histological diagnosis (n)				
Tooth type	**DC**	**AB**	**OKC**	**IPC**	**DF**
48	52	19	4	10	3
38	49	13	5	13	4
23	14	0	2	0	3
13	9	0	2	0	1
43	4	5	3	0	0
***P*-values**	0.17	0.01*	0.06	0.17	0.33

The Fisher's exact test showed a significant association between ameloblastoma and impacted teeth 48, 38 and 43 (P=0.01).

6. Statistical analysis for association between age and the biological potential of lesions associated with impacted teeth

In order to statistically analyse for a possible association between the biological potential of the lesion and age, the following lesions were classified as lesions of low biological potential (indolent lesions); adenomatoid odontogenic tumour, odontoma, dentigerous cyst, inflammatory paradental cyst, dental follicle, calcifying odontogenic cyst, orthokeratinised odontogenic cyst and eruption cyst; while ameloblastoma, odontogenic keratocyst, glandular odontogenic cyst and odontogenic carcinoma were classified as lesions of high biological potential.

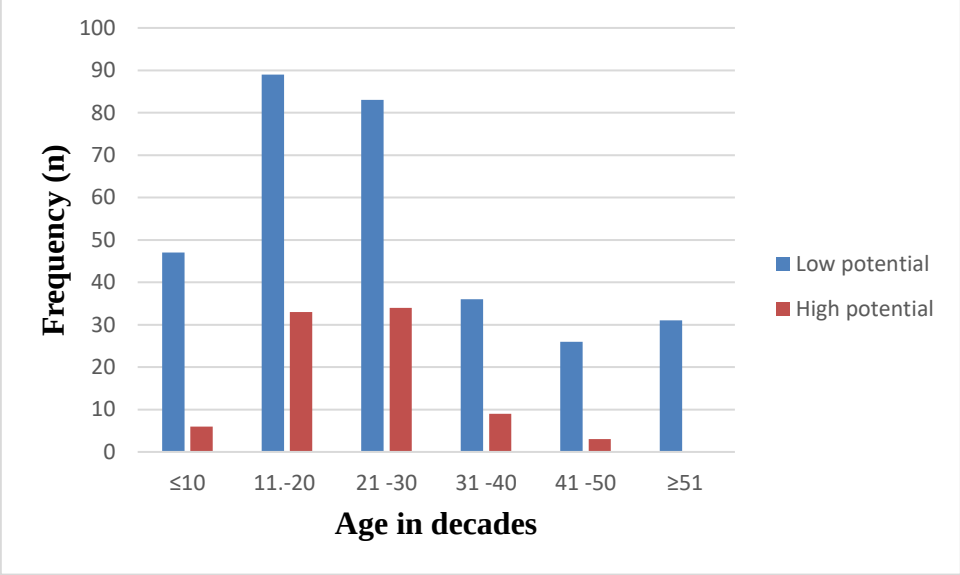


Figure 5: Biological potential of lesions associated with impacted teeth according to age in decades

Lesions of low biological potential showed the highest frequency of histologically diagnosed lesions for all age groups. The 11-20 year age group had the highest frequency of indolent lesions (n=89), while the 21-30 year age group showed the highest frequency for lesions of high biological potential (n=34) closely followed by age group 11-20 (n=33) as shown in Figure 9 above. Using Mann U Whitney there was, however, no significant association between age and the biological potential of the lesion, U=12332.00, *P*=0.052.

CHAPTER 6

DISCUSSION

Radiolucencies associated with impacted teeth are commonly encountered in dental practice. They may represent a dilated dental follicle or they may represent a pathological entity. Histopathological interpretation remains the gold standard for accurate diagnosis of the pericoronal radiolucency, which can undoubtedly present a diagnostic dilemma when relying solely on radiographic features. This retrospective study, spanning a 21-year period, reports on the histopathological findings of tissue specimens that were associated with impacted teeth and submitted to an oral pathology diagnostic service. A total of 24,542 tissue specimens were submitted for a histological diagnosis to the Department of Oral Pathology at the University of the Witwatersrand from January of 1996 to December of 2016. Of these, 407 (1.7%) specimens were from patients who were radiologically diagnosed with dental follicle, cyst or tumour associated with dental impaction. A search of the English language literature on the frequency of tissue specimens submitted with or without the associated impacted tooth to an oral pathology biopsy service yielded only one previous study. In the latter study, specimens described by the contributor as being lesions associated with the crown of an unerupted tooth represented 7.6 % (2.646/35.000 tissue specimens) of the total number of submissions to an oral pathology biopsy service. One of the possible reasons for this sevenfold higher frequency reported by Curran *et al.* (2002) compared to the current study, may be related to the fact that 67.1% (1.776/2.646) of all tissue specimens in the former study represented dental follicle; while in this study only 18 (4.4%) specimens represented dental follicle. Some authors have suggested that a pericoronal space of greater than 2.5mm on an intraoral radiograph and greater than 3mm on a rotational

panoramic radiograph should be regarded as potentially pathological (Farah and Savage, 2002). In these instances histological criteria for differentiating between dental follicle and dentigerous cyst is based on the microscopic appearance of the epithelial lining, where a squamous epithelial lining would favour a dentigerous cyst over a hyperplastic dental follicle (Curran *et al*., 2002). The pericoronal tissue associated with an impacted tooth is, however, not always submitted for histological examination and presently there is no universally accepted protocol concerning submission of recoverable soft tissue associated with extracted teeth (Stathopoulos *et al.,* 2011).

The age range of the patients in this study was 3 to 88 years (median age 24 years). The highest frequency of pathologies associated with impacted teeth occurred in the 21-30 year age group (n=114; 29.2%) followed by the 11-20 year age group (n=111; 28.5%), while the age range from 41 to 50 years showed the lowest number (n=29; 7.4%) of pathologies associated with an impacted tooth (Table 2). By contrast, in the study by Curran *et al.* (2002) when stratified for age, the ratio of pathologic lesions to non-pathologic follicular tissue increased with age. These results of this study are, however, similar to the findings reported by Vigneswaran and Shilpa (2015) where the peak incidence of pathologies associated with dental impaction occurred between the age group 20 and 30 years and the lowest incidence of pathology (10%) occurred in the oldest age group of patients, however, the latter age range was not specified in their paper. In the report by Knutsson *et al.* (1996) the majority of the cysts were found in patients aged 20 to 29 years. The mean age of patients who presented with cysts and tumours associated with dental impaction was 33.9 years and 30.6 year respectively in the study by Maaita (2000), bringing to fore the second and third decade as being the age group at highest risk for the development of cysts and tumours associated with impacted teeth.

Males formed 64.9% (253/390) of our study population and were almost twice more likely than females (134/390; 34.3%) to have a biopsy submitted for a histological diagnosis of suspected pathology associated with an impacted tooth. This male predominance was significantly higher for all decades studied (Figure 5). This finding is in agreement with most studies (Al-Khateeb and Bataineh, 2006; Saghravanian *et al.*, 2007; Saravana and Subhashraj, 2008; Vigneswaran and Shilpa, 2015; Shin *et al.*, 2015) where it was reported that odontogenic cysts and tumours associated with an impacted tooth are more common among males than females. However, there are a few earlier studies where odontogenic cysts in association with impacted teeth were found more often in females than in males (Rakparsitkul., 2001; Yıldırım *et al.*, 2007), while genetic factors have been implicated, the reasons for these sex differences are still unknown.

The most frequently diagnosed lesion in this study was the dentigerous cyst (56.5%) (Table 4). This result compares favourably with some earlier studies (Rakprasitkul., 2001; Saghravanian *et al.*, 2007; Lassemi *et al.*, 2014). However, other studies showed a relatively greater prevalence of dentigerous cysts than the finding of the present study. Patil *et al.* (2014) reported a 66.6% prevalence for the dentigerous cyst, while Shin *et al* (2016) conducted a study on 176 samples associated with impacted mandibular third molars over a period of five years and also reported a higher incidence (76.6%) of dentigerous cyst compared to our finding. Moreover, Curran *et al.* (2002) reported an 86.6% prevalence of dentigerous cyst among all lesions associated with an impacted tooth. By contrast, a surprising low prevalence of dentigerous cyst has been reported by other studies at rates of 24.1% (Vigneswaran and Shipla, 2015), 23.3% (Wali *et al.*, 2012), 14.1% (Yildirum *et al.*, 2007), 7% (Al-Khateeb and Bataineh, 2006) and 4% (Gbolahan *et al.*,

2008) (Table 15). Adelsperger *et al* (2000) conducted a histological-based study on 100 impacted third molar teeth with pericoronal radiolucencies less than 2mm and pointed out that 34% of the tissue specimen showed histological features in keeping with dentigerous cyst. Moreover, Glosser and Campbell (1999) conducted a histological study on 96 "dental follicles on radiographs" and reported that 33% of these represented early dentigerous cysts. These studies show that histological examination of follicular tissue after impacted tooth extraction can reveal dentigerous cysts in patients without radiological evidence of cystic changes. It is therefore possible that the lower prevalence of dentigerous cysts in some studies may be related to radiographic examination only without histological confirmation of the soft tissue findings associated with the impacted tooth.

Table 13: A comparison of the prevalence of odontogenic cysts and tumours associated with impacted teeth between the current study and those of previous studies.

	DC (%)	AB (%)	OKC (%)	IPC (%)	DF (%)	AOT (%)	Od (%)
Present study	56.1	13.8	6.6	5.6	4.6	4.4	3.9
Shin *et al* 2016	76.7	5.7	17.6	-	-	-	-
Vigneswaran and Shipla 2015	24.1	15.7	14.3	-	-	-	-
Patil *et al* 2014	66.6	15.6	8	-	2.5	-	3
Lassemi *et al* 2014	54	-	-	-	-	-	-
Wali *et al* 2012	23.3	-	-	-	76.7	-	-
Stathopoulos *et al* 2011	33	5	6.9	-	48.4	-	3.5
Saravana and Subhashraj 2008	46	-	-	-	54	-	-
Gbolohan *et al* 2008	4	-	-	0.7	10	-	-
Saravana and Subhashraj 2008	46	-	-	-	54	-	-
Yıldırım *et al* 2007	14.1	-	2.5	-	77	-	-
Saghravanian *et al* 2007	58.7	-	-	-	-	-	5
Al-Khateeb and Bataineh *2006*	7	2.2	1.9	0.7	-	-	-
Curran *et al* 2002	86.6	1.5	8.2	-	-	-	-
Sutas Rakparsitkul 2001	50.96	0.96	1.92	-	41.35	-	-
Adelsperger *et al* 2000	34	-	-	-	66	-	-
Glosser and Campbell 1999	32.2	-	-	-	-	-	-

In the present study, 57 (14%) lesions were diagnosed as ameloblastoma. This result concurs with those of other studies. Curran *et al.* (2002) reported a 13% frequency for ameloblastoma which is comparable to the present study. Other studies were done by Patil *et al.* (2014) and Vigneswaran and Shipla (2015) who reported prevalence rates of 15.6% and 15.7% respectively which are slightly higher compared to our result. However, different results have been obtained by other authours who reported much lower prevalence rates of ameloblastoma in the order of 0.96% (Rakprasitkul., 2001), 2.2% (Al-Khateeb and Bataineh, 2006), 5.0% (Statbopoulos *et al.,* 2011) and 5.7% (Shin *et al.,* 2016).

This study further pointed out the subtypes of ameloblastoma that presented in association with an impacted tooth. Tumour subtyping was documented in the histopathology report according to the macroscopic and histological findings on the resected specimen. The prevalence for the ameloblastoma clinico-pathological subtypes were 49.12% for conventional ameloblastoma, 14.03% for type 1 unicystic ameloblastoma, 8.77% for type 2 unicystic ameloblastoma and 12.28% for type 3 unicystic ameloblastoma while the ameloblastoma subtype was not specified in 15.78% of the cases. The mean age of patients with conventional ameloblastoma presenting with an impacted tooth was 24.8 years and was seen slightly more often in females than males. Effiom *et al.* (2017) reported a mean age of 36 years for patients with conventional ameloblastoma. The current study findings suggest that when conventional ameloblastoma occurs in association with an impacted tooth they tend to present at a younger age. In the study by Effiom *et al.* (2017) this tendency was seen in unicystic ameloblastomas without an associated impacted tooth, which presented in an older age group (mean age of 35.2 years) compared to the unicystic ameloblastomas with an associated impacted tooth. In the former study the

demographic characteristics of patients with conventional ameloblastoma presenting with and without an associated impacted tooth was not, however, studied. Future studies comparing these two subgroups are need to clarify the contention that conventional ameloblastoma with an associated impacted tooth presents at a significantly younger age than those without an associated impacted tooth.

In a global survey on unicystic ameloblastomas (Philipsen and Reichart, 1998), a mean age of 16.5 years was shown at the time of diagnosis of unicystic ameloblastoma occurring in association with an impacted tooth with a male-female ratio of 1.5:1. Similar findings were recorded in the present study with the mean age of patients with unicystic ameloblastoma being 17.9 years with a male: female ratio of 2.3:1. The study sample in most previous studies on unicystic ameloblastoma comprises a mixture of unicystic ameloblastoma cases i.e. cases with and without an associated impacted tooth. This makes accurate comparison with a cohort comprising exclusively of patients presenting with ameloblastoma in association with an impacted tooth difficult. Although a small number, the study by Ng *et al.* (1989) comprised exclusively of unicystic ameloblastomas presenting in association with an impacted tooth. In their study, only one of the seven cases was of the type 3 category of unicystic ameloblastoma, four were categorised as type 2 and 2 cases as type 1. On the contrary, while type 1 unicystic ameloblastoma was the most common unicystic ameloblastoma subtype in the present study, this was closely followed by type 3, with type 2 being the least common. Several studies have shown that type 3 unicystic ameloblastoma has a recurrence rate similar to conventional ameloblastoma after conservative surgical removal and in the 2017 WHO classification of odontogenic tumours; it was recommended that type 3 unicystic ameloblastoma should be recognised as having the

same biological potential as conventional ameloblastoma. Further studies are awaited to clarify whether this subtype should be classified as a variant of unicystic ameloblastoma or as conventional ameloblastoma.

The frequency of odontogenic keratocysts associated with an impacted tooth (also known as follicular variant of odontogenic keratocyst) was 6.1% in our study, a finding which is similar to some studies (Curran *et al.*, 2002; Stathopoulos *et al.*, 2011; Patil *et al.*, 2014). It has been shown that most odontogenic keratocysts presenting in the third molar area are of the non-follicular type and are due to pathologic changes in cell rests of Serres or from proliferations of basal cells in the overlying oral epithelium (Shear and Speight, 2008). Data from reports in the literature describe a relatively small number of patients who present with the follicular variant of odontogenic keratocyst (Altini and Cohen, 1982; Tsukamoto *et al.*, 2001). This study showed that while the prevalence of the follicular variant of odontogenic keratocyst may be relatively low compared to the dentigerous cyst, the risk of odontogenic keratocyst presenting with impacted teeth is not negligible.

This study revealed a 5.7% frequency rate for inflammatory paradental cysts that are submitted for histological evaluation. The histological findings of the inflammatory paradental cyst are not diagnostic in isolation and require clinical correlation i.e. a history of pericoronitis in association with a partially erupted third molar that triggers the formation of this cyst. Of note, only a few studies reported on inflammatory paradental cysts with frequencies ranging from 0.7% to 3.7% (Al-Khateeb and Bataineh, 2006; Gbolohan *et al.*, 2008; Jin-Hyeok Lee *et al.*, 2014). The absence of histologically diagnosed inflammatory paradental cysts in the remaining studies

shown in Table 15 may be due to study design where lesions presenting in association with partially erupted third molars were excluded from these studies, which included only fully impacted teeth.

Eighteen cases (4.4%) of adenomatoid odontogenic tumour are reported in the present study. The adenomatoid odontogenic tumour usually presents in association with an impacted maxillary canine. We are, however, unable to compare it's prevalence with other studies on pathologies associated with impacted teeth as almost all previous studies included only pathologies in association with impacted third molars. In the study by Curran *et al.* (2002) which included all impacted teeth, interestingly no cases of adenomatoid odontogenic tumour were reported (Table 15).

The frequency of odontomas associated with an impacted tooth and submitted for a histological diagnosis was found to be 3.9% in the present study which corresponds closely to some earlier studies (Curran *et al.,* 2002; Stathopoulos *et al.,* 2011; Patil *et al.,* 2014). Odontomas are hamartomatous lesions that are generally considered to be the most common odontogenic "tumour". Their relatively low prevalence rates in histological studies may be due to many being diagnosed on radiological grounds alone without tissue being submitted for histological confirmation of the diagnosis. In the present study 4 of the 7 cases of calcifying odontogenic cysts and 2 dentigerous cysts were associated with odontomas. While the possibility of an odontoma may be suspected on the radiological findings, the diagnosis of dual or associated pathology cannot be only be determined following histological examination of the lesion,

highlighting the importance of submitting all surgically removed tissue for histopathological evaluation.

As far as the distribution of specific histological diagnoses in relation to sex and age is concerned, with the exception of odontomas which were found twice more commonly in females than males, the remaining odontogenic cysts and tumours affected males more than females (Table 7). While a recent clinico-pathological study which analysed 69 cases of odontomas also found a female predilection, there is no consensus among authors regarding gender predilection and odontomas (Bereket *et al.*, 2015). Although some differences exist in the literature, there seems to be a general agreement on equal gender distribution (Hisatomi *et al.*, 2002).

In this study, patients in their second decade of life showed the highest frequencies of odontomas, odontogenic keratocysts (follicular or pericoronal variant) and adenomatoid odontogenic tumours (follicular type). This is in keeping with the general trend of age distribution for odontomas and adenomatoid odontogenic tumours but not that of odontogenic keratocysts. In the study by Curran *et al.* (2002) pericoronal odontogenic keratocysts tended to occur at a later age compared to the current study. Further 92% of the odontogenic keratocysts in this study were diagnosed in patients before the fourth decade. Shear and Speight (2008) reported that in general odontogenic keratocysts present before the age of 40 years, however, in the study by Curran *et al.* (2002) 65% of follicular type odontogenic keratocysts presented in the fourth decade or later. Our findings thus refute their suggestion that there is a strong relationship between increasing age and the development of pathosis specifically with reference to odontogenic keratocyst and ameloblastoma.

With regard to the frequency of submission of tissue associated with an impacted tooth for a histological diagnosis, similar to the study by Curran *et al.* (2002), the frequency of submissions decreased significantly with age in this study (Figure 3). In contrast to the former study, however, this study showed 84.2% of pathologies associated with impacted teeth presented under the age of 40 years and only 15.8% in patients older than 40 years. This study also showed that the number of patients diagnosed with dentigerous cyst, ameloblastoma and inflammatory paradental cyst was highest in patients in the 21-30 year age group, while the number of patients diagnosed with adenomatoid odontogenic tumour was highest in patients in the 11-20 year age group, both of which significantly exceeded the other age groups (P <0.05). Similarly, dentigerous cysts were diagnosed significantly more often in males than in females while normal dental follicular tissue and odontomas were more commonly diagnosed in females (P <0.05). The predictive effect of age and gender on the histological diagnosis of lesions associated with impacted teeth was not, however, confirmed when the data was further analysed using univariate binary logistic regression.

Impacted teeth most frequently associated with pathologies, in order of decreasing frequency, were the right and left mandibular third molars followed by the left and right maxillary canines, and the right mandibular canines. In the unicystic ameloblastoma category, tooth type was specified in 14/20 cases, of which all 14 cases occurred in association with impacted mandibular third molars, while with conventional ameloblastomas four cases were seen in association with impacted lower canines and two cases in association with impacted lower premolars (Table 11). Statistical analysis for a possible association between the most commonly impacted teeth in this

study and the occurrence of dentigerous cyst, ameloblastoma and odontogenic keratocyst showed a significant association between the lower right mandibular third molar and ameloblastoma (P=0.01). In the study by Stathopoulos *et al.* (2011) 0.27% of the lower third molars were associated with ameloblastoma development in a group of Greek patients, while in this study 16.84% of the third molars were associated with ameloblastoma. It remains to be explored whether this difference may be related to genetic or environmental factors.

As mentioned earlier, many of the lesions that present in association with an impacted tooth share similar radiological features, however, their therapeutic modalities can vary considerably and accurate distinction between them is therefore important. Based on the histological diagnosis, which provides information about the biological behaviour or aggressiveness of the lesion, treatment may consist of conservative enucleation of the cyst with little to no chance for recurrence, to enucleation with supplemental cryotherapy to a hemi-resection of the affected side of the jaw (Stoelinga, 2012). On the basis of the difference in treatment modalities, lesions with little or no risk for recurrence and which are treated by simple surgical enucleation were categorised in this study as lesions of low biological potential. These lesions included the adenomatoid odontogenic tumour, odontoma, dentigerous cyst, inflammatory paradental cyst, calcifying odontogenic cyst, orthokeratinised odontogenic cyst and the eruption cyst; while lesions that have a high risk for recurrence, necessitating more than simple enucleation for adequate treatment were categorised as lesions of high biological potential. These lesions included odontogenic keratocyst, ameloblastoma glandular odontogenic cyst and odontogenic carcinoma. The data in this study demonstrates that lesions of low biological potential exceeded those of high biological potential across the first five decades of life (Figure 5), while in patients

over the age of 50 years no lesions in the high biological potential category were recorded. This finding is probably related to the fact that most lesions in the high biological potential category in this study comprised odontogenic keratocysts and ameloblastoma, which presented at a mean age of 19 years and 21.5 years respectively. In the study by Tsukamoto *et al.* (2001) the mean age reported for non-syndromic patients with follicular odontogenic keratocysts was 46.4 years, while in the study by Altini and Cohen (1982) 81% (13/16) patients with follicular odontogenic keratocysts were between the ages of 10 and 29 years. While the follicular odontogenic keratocysts in the current study presented more than two decades earlier than in the study by Tsukamoto *et al.* (2001) the findings are closer to those of Altini and Cohen who also conducted their study in a South African population. This further highlights the geographical variation in the demographic profile of patients who present with similar lesions across different parts of the world.

Although the majority of patients with ameloblastoma are between ages 30 and 60 years, the average age at the time of diagnosis has been estimated to be approximately 42.3 and 30.4 years in Europe and Africa respectively (Lawal *et al.*, 2013; Oomens and van der Waal, 2014). In the South African setting it is tempting to speculate that when ameloblastomas in general present in association with impacted teeth they present a decade earlier (21.5 years) than the aforementioned estimation for African patients. Further studies comparing the clinico-pathological profile of ameloblastoma with and without an associated impacted tooth in the South African context is required to clarify this observation.

CHAPTER 7

7.0. CONCLUSIONS

- This retrospective study shows that 1.7% of all tissue specimens submitted for a histological diagnosis to the Department of Oral Pathology at the University of the Witwatersrand were associated with impacted teeth.
- Pathological lesions were diagnosed in 389 (95.6%) of these cases while only 18 (4.4%) specimens were non-pathologic dental follicular tissue.
- The median age of the patients was 24 years (3-88 years) with males accounting for 64.9% of the patients.
- The most prevailing histopathological diagnoses, in descending order of frequency were dentigerous cyst, ameloblastoma, odontogenic keratocyst, inflammatory paradental cyst, adenomatoid odontogenic tumour, odontoma, calcifying odontogenic cyst, orthokeratinised odontogenic cyst, eruption cyst, glandular odontogenic cyst, calcifying epithelial odontogenic tumour and odontogenic carcinoma.
- The dentigerous cyst was the most commonly diagnosed lesion in males and females, accounting for 63.4% and 43% of all lesions diagnosed in males and females respectively.
- With the exception of dental follicle and odontoma, which were more common in females, all the lesions were seen more commonly in males.
- The frequency of histopathological diagnoses associated with impacted teeth reduces with an increase in age. The 11-20 year age group showed the overall highest frequency of pathological lesions associated with impacted teeth, while the 41-50 year age showed the lowest frequency.

- No significant association was found between age and the biological potential of lesions associated with impacted teeth.
- No intra-osseous non-odontogenic pathological lesions were encountered in this study.
- The information gathered in this study shows similar trends to previously published reports from other geographic areas. It provides a local data base of the frequencies of the various pathological lesions associated with impacted teeth which may assist clinicians in formulating differential diagnoses.

7.2. LIMITATIONS OF THIS STUDY

- Radiographic interpretations were not considered other than the radiographic findings reported by the submitting clinician documenting an associated impacted tooth.
- Insufficient clinical data in the archived histopathology reports.
- The findings of this study do not represent the actual incidence of pathologies associated with impacted teeth in South Africa, but rather the relative frequency of histologically diagnosed lesions associated with impacted teeth at a South African oral pathology diagnostic service.

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APPENDICES

Appendix A: Ethical clearance

R14/49 Dr Muhanad Hashim Salman Mohammed Mohammed

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M170812

NAME: (Principal Investigator)	Dr Muhanad Hashim Salman Mohammed Mohammed
DEPARTMENT:	Oral Health Pathology - School of Oral Health Sciences
PROJECT TITLE:	A 21-Year Retrospective Histopathological Evaluation of Cysts and Tumours Associated with Impacted Teeth
DATE CONSIDERED:	25/08/2017
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Farzana Mahomed and Dr Sizakele Ngwenya
APPROVED BY:	Professor C. Penny, Co-Chairperson, HREC (Medical)
DATE OF APPROVAL:	05/09/2017

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in August and will therefore be due in the month of August each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Muhanad
Principal Investigator Signature

5/9/2017
Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix B: Title Approval

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

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

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

21 September 2017
Person No: 1502849
PAG

Dr MHS Mohammed
House No 100,street No 1
Block2/3 R Center
Almazad North, Khartoum North
13311
Sudan

Dear Dr Mohammed

Master of Science in Dentistry: Approval of Title

We have pleasure in advising that your proposal entitled *A 21-year retrospective histopathological evaluation of cysts and tumours associated with impacted teeth* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix C: Permission from CEO of Wits Oral Health Centre

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

WITS ORAL HEALTH CENTRE
Private Bag X15 Braamfontein, Johannesburg, 2017
Enquiries: Ms Tumelo Marule
Tel: (011)488-4893, Fax 086 406 3196
E-mail: Tumelo.Marule@wits.ac.za

7 August 2017

Dr M Mohammed
MSc Dent Student
Oral Pathology
Faculty of Health Sciences
University of the Witwatersrand
Johannesburg

REGARDING: PERMISSION TO CONDUCT RESEARCH BY COLLECTING DATA FROM THE RECORDS AT THE DEPARTMENT OF ORAL PATHOLOGY..

REFERENCE :HRRC/AUG/03/2017

It is my pleasure to grant final approval to utilize resources at Wits Oral Health Centre in order to conduct your research.
The Hospital Research and Risk Committee allocated a unique reference number to this application – Kindly quote this reference number in all future correspondence regarding this research.

Please note that the Hospital Research and Risk Committee should be informed of the estimated date the research will commence, as well as regular status reports until the research has been concluded. Within a month after conclusion of the research project, a written report must be submitted to the Head of School/CEO, summarizing the final result/outcome as well as the recommendations made based on the research concluded.

Regards,

(Acting HOS)

Prof MS Nemutandani
CEO/Head of School

Appendix D: Permission from Oral Pathology Department

Department of Oral Pathology
School of Oral Health Sciences
Faculty of Health Sciences
3E22, 3rd floor, Wits Medical School
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Private Bag 3, Wits 2050, South Africa
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Secretary: Phindile.Mashinini@wits.ac.za

19 July 2017

Human Research Ethics (Medical)
Research Office
Faculty of Health Sciences
University of the Witwatersrand

Dear Sir/Madam

RE: PERMISSION TO CONDUCT A STUDY IN THE DEPARTMENT OF ORAL PATHOLOGY

I, **Dr Sizakele P Ngwenya**, in my capacity **as Head of the Department of Oral Pathology** grant **Dr Muhanad Mohammed** permission to access the Department's histopathological reports to retrieve demographic and clinicopathological data as specified in his data collection sheet. This research is in partial fulfilment towards an MDent (Oral Pathology degree), for her study entitled:

A 21 year retrospective histopathological evaluation of cysts and tumours associated with impacted teeth.

Yours Sincerely,

DR SP NGWENYA
HOD: ORAL PATHOLOGY

Appendix E: Raw Data

Case No	Age	Gender	Impacted tooth number	Histological diagnosis
1	28	M	43	Adenomatoid odontogenic tumour
2	39	M	23	Dentigerous cyst
3	10	M	NS	Dentigerous cyst
4	17	F	NS	Dental follicle
5	18	M	23	Dental follicle
6	21	F	NS	Ameloblastoma
7	14	M	NS	Adenomatoid odontogenic tumour
8	21	F	38	Dentigerous cyst
9	54	F	48	Dentigerous cyst
10	55	M	NS	Dentigerous cyst
11	25	M	23	Dentigerous cyst
12	16	F	48	Ameloblastoma
13	28	F	NS	Dentigerous cyst
14	13	M	NS	Dentigerous cyst
15	62	M	13	Dentigerous cyst
16	13	M	13	Adenomatoid odontogenic tumour
17	17	F	35	Dentigerous cyst
18	45	M	NS	Dentigerous cyst
19	14	F	NS	Dentigerous cyst
20	55	M	48	Dentigerous cyst
21	48	M	48	Dentigerous cyst
22	29	F	13	Dental follicle
23	29	F	23	Dental follicle
24	29	M	48	Dentigerous cyst
25	21	M	38	Inflammatory paradental cyst
26	6	M	NS	Ameloblastoma
27	32	M	38	Odontoma
28	16	F	NS	Adenomatoid odontogenic tumour
29	26	M	37	Dentigerous cyst
30	21	F	38	Inflammatory paradental cyst
31	31	M	38	Inflammatory paradental cyst
32	9	F	23	Dentigerous cyst
33	7	M	22	Dentigerous cyst
34	32	M	11	Odontoma
35	11	F	13	Odontogenic keratocyst
36	21	M	43	Ameloblastoma
37	21	M	33	Ameloblastoma
38	5	F	34	Dentigerous cyst

39	26	M	46	Dentigerous cyst
40	14	F	23	Adenomatoid odontogenic tumour
41	38	M	NS	Dentigerous cyst
42	9	F	11	Eruption cyst
43	23	M	48	Inflammatory paradental cyst
44*	20	M	38, 48	Inflammatory paradental cysts
45	30	M	38	Dentigerous cyst
46	30	F	21	Dental follicle
47*	16	F	37, 38, 23	Dental follicle, Dental follicle, Dentigerous cyst
48	42	M	35	Dentigerous cyst
49	6	M	NS	Dentigerous cyst
50	39	M	38	Dentigerous cyst
51	10	F	NS	Dentigerous cyst
52	8	M	11	Dentigerous cyst
53	18	M	NS	Ameloblastoma
54	14	F	21	Dentigerous cyst
55	29	F	NS	Odontogenic carcinoma
56	14	F	35	Dentigerous cyst
57	16	F	13	Odontogenic keratocyst
58	37	F	15	Dentigerous cyst
59	14	F	35	Dentigerous cyst
60	15	M	48	Ameloblastoma
61	9	F	36	Dentigerous cyst
62	21	M	NS	Ameloblastoma
63	11	M	NS	Dentigerous cyst
64	21	M	38	Dentigerous cyst
65	46	M	33	Dentigerous cyst
66	19	M	18	Odontogenic keratocyst
67	13	F	51	Odontoma
68	14	F	35	Dentigerous cyst
69	26	M	48	Ameloblastoma
70	17	F	11	Odontoma
71	NS	M	NS	Dentigerous cyst
72	10	F	NS	Odontogenic keratocyst
73	10	M	NS	Dentigerous cyst
74	NS	F	38	Dentigerous cyst
75	15	M	21	Dentigerous cyst
76	48	M	38	Dentigerous cyst
77	68	M	48	Dentigerous cyst
78	22	M	NS	Dentigerous cyst
79	15	M	21	Odontoma

80	15	F	NS	Ameloblastoma
81	8	M	NS	Odontogenic keratocyst
82	11	M	43	Dentigerous cyst
83	41	M	11	Odontoma
84	66	M	48	Dentigerous cyst
85	24	M	38	Dentigerous cyst
86	41	M	38	Dentigerous cyst
87	55	M	13	Dentigerous cyst
88	9	M	23	Dentigerous cyst
89	39	M	NS	Dentigerous cyst with supernumerary tooth
90	14	M	38	Odontogenic keratocyst
91	7	M	NS	Dentigerous cyst
92	42	M	NS	Dentigerous cyst
93	22	M	48	Dentigerous cyst
94	22	F	48	Dentigerous cyst
95	17	M	43	Odontogenic keratocyst
96	18	F	48	Ameloblastoma
97	19	M	48	Dentigerous cyst
98	31	M	48	Dentigerous cyst
99	17	M	48	Dentigerous cyst
100	26	M	48	Dentigerous cyst
101	31	M	38	Dentigerous cyst
102	8	M	11	Eruption cyst
103	9	M	23	Dentigerous cyst
104	16	M	48	Ameloblastoma
105	50	F	NS	Dentigerous cyst
106	4	F	64	Dentigerous cyst
107	22	M	48	Dentigerous cyst
108	22	F	38	Dental follicle
109	39	M	NS	Dentigerous cyst
110	27	M	38	Inflammatory paradental cyst
111	28	M	48	Dentigerous cyst
112	39	M	25	Dentigerous cyst
113	28	M	NS	Dentigerous cyst
114	38	M	11	Dentigerous cyst
115	10	M	23	Dentigerous cyst
116	77	F	11	Odontoma
117	31	F	38	Dentigerous cyst
118	45	M	38	Dentigerous cyst
119	19	F	21	Odontoma
120	58	F	38	Dentigerous cyst

121	21	F	23	Odontogenic keratocyst
122	13	F	46	Odontoma
123	27	M	48	Inflammatory paradental cyst
124	17	M	23	Dentigerous cyst
125	21	M	38	Odontogenic keratocyst
126	15	M	28	Dentigerous cyst
127	21	M	13	Calcifying odontogenic cyst
128	20	M	48	Dentigerous cyst
129	33	M	NS	Dentigerous cyst
130	13	M	NS	Odontogenic keratocyst
131	11	M	23	Adenomatoid odontogenic tumour
132	9	M	NS	Dentigerous cyst
133	88	M	48	Dentigerous cyst
134	75	F	48	Dentigerous cyst
135	18	M	23	Dental follicle
136	15	M	38	Dentigerous cyst
137	14	M	11	Calcifying odontogenic cyst
138	23	M	38	Inflammatory paradental cyst
139	20	M	48	Dentigerous cyst
140	21	M	NS	Dentigerous cyst
141	57	F	43	Dentigerous cyst
142	7	F	24	Dentigerous cyst
143	33	F	36	Calcifying epithelial odontogenic tumour
144	22	M	38	Dentigerous cyst
145	27	M	48	Dentigerous cyst
146	20	M	38	Dentigerous cyst
147	9	M	NS	Dentigerous cyst
148	33	M	NS	Dentigerous cyst
149	22	F	38	Odontogenic keratocyst
150	14	M	NS	Adenomatoid odontogenic tumour
151	16	M	38	Ameloblastoma
152	53	F	NS	Dentigerous cyst
153*	13	F	37, 47	Dentigerous cysts
154	24	F	38	Ameloblastoma
155	29	M	48	Dentigerous cyst
156	16	M	48	Dentigerous cyst
157	16	M	38	Odontogenic keratocyst
158	25	M	38	Dentigerous cyst
159	40	F	38	Dentigerous cyst
160	25	M	48	Dentigerous cyst
161	23	M	48	Ameloblastoma

162	55	M	43	Dentigerous cyst
163	12	M	NS	Dentigerous cyst
164	31	M	38	Dentigerous cyst
165	44	M	38	Dentigerous cyst
166*	14	F	18, 38, 48	Dentigerous cysts
167	80	M	38	Dentigerous cyst
168	5	F	47	Dental follicle
169	20	M	38	Dentigerous cyst
170	28	F	38	Ameloblastoma
171	29	F	48	Dentigerous cyst
172	19	M	18	Dentigerous cyst
173	20	F	38	Dentigerous cyst
174	25	F	48	Dentigerous cyst
175*	26	M	28, 48	Dentigerous cysts
176	24	F	NS	Ameloblastoma
177	23	M	38	Odontogenic keratocyst
178	17	M	NS	Ameloblastoma
179	36	M	38	Dentigerous cyst
180	13	M	38	Dentigerous cyst
181	5	NS	NS	Dentigerous cyst
182	54	M	38	Dentigerous cyst
183	26	M	13	Dentigerous cyst
184	19	M	48	Odontogenic keratocyst
185	21	M	13	Dentigerous cyst
186	5	F	37	Dentigerous cyst
187	57	M	NS	Dentigerous cyst
188	28	M	18	Dentigerous cyst
189	NS	NS	23	Dentigerous cyst
190	44	F	48	Dentigerous cyst
191	18	M	38	Dentigerous cyst
192	65	M	23	Dentigerous cyst
193	22	M	48	Dentigerous cyst
194	18	M	38	Ameloblastoma
195	13	F	23	Adenomatoid odontogenic tumour
196	24	F	38	Ameloblastoma
197	10	M	21	Dental follicle
198	22	M	38	Dentigerous cyst
199	18	M	48	Odontoma
200	9	M	NS	Dentigerous cyst
201	17	M	44	Adenomatoid odontogenic tumour
202	11	M	43	Calcifying odontogenic cyst

203	35	F	38	Ameloblastoma
204	33	M	48	Dentigerous cyst
205	41	M	48	Inflammatory paradental cyst
206	33	M	48	Ameloblastoma
207	12	F	13	Odontoma
208	16	F	13	Odontoma
209	14	M	33	Dentigerous cyst
210	11	F	35	Odontogenic keratocyst
211	42	F	33	Odontoma
212	10	NS	45	Dentigerous cyst
213	9	M	NS	Eruption cyst
214	10	F	43	Ameloblastoma
215	16	M	35	Dentigerous cyst
216	47	M	33	Glandular odontogenic cyst
217	13	M	NS	Dentigerous cyst
218	26	M	48	Orthokeratinised odontogenic cyst
219	42	M	11	Dentigerous cyst
220	9	M	NS	Dentigerous cyst
221	24	M	38	Dentigerous cyst
222	12	M	43	Ameloblastoma
223	60	F	38	Inflammatory paradental cyst
224	12	M	13	Adenomatoid odontogenic tumour
225	76	M	48	Inflammatory paradental cyst
226	17	M	38	Dentigerous cyst
227	17	M	48	Dentigerous cyst
228	8	F	45	Dentigerous cyst
229	10	M	44	Dentigerous cyst
230	5	M	45	Dentigerous cyst
231	35	F	46	Dentigerous cyst
232	14	F	23	Odontogenic keratocyst
233	7	M	14	Dentigerous cyst
234	11	M	NS	Ameloblastoma
235	24	F	43	Odontogenic keratocyst
236	27	M	38	Dentigerous cyst
237	27	M	13	Dentigerous cyst
238	28	F	38	Dentigerous cyst
239	3	M	51	Dentigerous cyst
240	37	M	38	Ameloblastoma
241	24	F	38	Ameloblastoma
242	21	F	21	Dental follicle
243	48	F	21	Dentigerous cyst

244	29	F	38	Dentigerous cyst
245	21	M	38	Dentigerous cyst
246	17	M	38	Dentigerous cyst
247	3	F	12	Dentigerous cyst
248	37	M	25	Dentigerous cyst
249	55	M	NS	Dentigerous cyst
250	38	F	12	Adenomatoid odontogenic tumour
251	26	M	48	Dentigerous cyst
252	NS	F	48	Dentigerous cyst
253	24	F	48	Dentigerous cyst
254	13	M	NS	Adenomatoid odontogenic tumour
255	9	F	23	Adenomatoid odontogenic tumour
256	22	M	33	Adenomatoid odontogenic tumour
257	40	M	48	Dentigerous cyst
258	69	M	38	Dentigerous cyst
259	28	M	38	Ameloblastoma
260	31	F	38	Dentigerous cyst
261	24	M	48	Dentigerous cyst
262	9	M	23	Dentigerous cyst
263	22	F	23	Calcifying odontogenic cyst
264	54	M	48	Dentigerous cyst
265	6	F	53	Odontogenic keratocyst
266	41	M	13	Dentigerous cyst
267	30	M	38	Inflammatory paradental cyst
268	6	M	21	Dentigerous cyst
269	21	F	21	Odontoma
270	14	F	23	Calcifying odontogenic cyst
271	15	F	48	Dentigerous cyst
272	24	F	48	Dentigerous cyst
273	53	F	48	Dentigerous cyst
274	66	M	48	Orthokeratinised odontogenic cyst
275	22	M	48	Orthokeratinised odontogenic cyst
276	21	M	NS	Ameloblastoma
277	8	M	11	Dentigerous cyst
278	15	F	12	Adenomatoid odontogenic tumour
279	38	M	48	Dentigerous cyst
280	18	F	38	Inflammatory paradental cyst
281	24	M	38	Dentigerous cyst
282	30	M	33	Odontogenic keratocyst
283	10	F	NS	Dentigerous cyst
284	27	F	43	Odontogenic keratocyst

285	15	F	48	Ameloblastoma
286	12	F	23	Adenomatoid odontogenic tumour
287	12	F	NS	Ameloblastoma
288	13	M	11	Dentigerous cyst
289	15	M	43	Ameloblastoma
290	43	M	38	Dentigerous cyst
291	56	M	13	Dentigerous cyst
292	17	M	NS	orthokeratinised odontogenic cyst
293	22	M	38	Dentigerous cyst
294	23	M	48	Odontogenic keratocyst
295	10	M	48	Ameloblastoma
296	17	M	34	Adenomatoid odontogenic tumour
297	21	M	38	Dentigerous cyst
298*	NS	M	38, 48	Dentigerous cysts
299	45	M	45	Ameloblastoma
300	34	M	47	Ameloblastoma
301	16	F	38	Ameloblastoma
302*	NS	M	38, 48	Dentigerous cysts
303	12	M	NS	Ameloblastoma
304	47	M	NS	Dentigerous cyst
305	6	M	NS	Dentigerous cyst
306	9	M	23	Calcifying odontogenic cyst
307	NS	M	NS	Dentigerous cyst with supernumerary teeth
308	31	M	34	Dentigerous cyst
309	37	M	44	Dentigerous cyst
310	18	M	38	Orthokeratinised odontogenic cyst
311	35	M	44	Ameloblastoma
312	35	M	48	Odontogenic keratocyst
313	NS	F	NS	Calcifying odontogenic cyst
314	20	F	48	Dentigerous cyst
315	17	F	NS	Dentigerous cyst
316	45	M	48	Dentigerous cyst
317	23	M	38	Inflammatory paradental cyst
318	32	M	NS	Dentigerous cyst with supernumerary teeth
319	30	M	38	Inflammatory paradental cyst
320	17	F	NS	Odontogenic keratocyst
321	15	F	48	Ameloblastoma
322	6	M	21	Dentigerous cyst
323	30	F	NS	Ameloblastoma
324	48	F	13	Dentigerous cyst
325	21	M	48	Dentigerous cyst

326	12	M	13	Dentigerous cyst
327	16	F	38	Ameloblastoma
328	6	F	NS	Adenomatoid odontogenic tumour
329	38	M	23	Dentigerous cyst
330	6	M	NS	Dentigerous cyst
331	19	M	48	Ameloblastoma
332*	53	M	38, 48	Dentigerous cysts
333	46	M	NS	Dentigerous cyst
334	22	M	47	Ameloblastoma
335	21	M	48	Inflammatory paradental cyst
336	18	F	48	Ameloblastoma
337	31	M	33	Orthokeratinised odontogenic cyst
338	38	M	18	Dentigerous cyst
339	28	M	NS	Dentigerous cyst
340	6	M	NS	Dentigerous cyst
341	23	F	48	Ameloblastoma
342	13	M	NS	Dentigerous cyst
343	30	M	NS	Ameloblastoma
344	27	F	18	Dentigerous cyst
345	10	F	NS	Dentigerous cyst
346	22	F	48	Dental follicle
347	34	M	28	Odontogenic keratocyst
348	23	M	48	Ameloblastoma
349	50	M	48	Dentigerous cyst
350	8	F	NS	Dentigerous cyst
351	41	F	48	Inflammatory paradental cyst
352*	17	M	38, 48	Dentigerous cysts
353	45	F	43	Glandular odontogenic cyst
354	30	M	48	Dentigerous cyst
355	40	M	23	Dentigerous cyst
356	70	M	48	Dentigerous cyst
357	20	M	NS	Dentigerous cyst with supernumerary teeth
358	24	F	48	Inflammatory paradental cyst
359*	24	M	38, 48	Dental follicles
360	31	F	48	Ameloblastoma
361	27	F	38	Inflammatory paradental cyst
362	22	F	48	Ameloblastoma
363	16	M	48	Ameloblastoma
364	27	F	38	Dentigerous cyst
365	23	F	48	Odontogenic keratocyst
366	61	F	43	Dentigerous cyst

367	23	M	33	Ameloblastoma
368	43	M	48	Dentigerous cyst
369*	20	M	38, 48	Dentigerous cysts
370	6	M	44	Dentigerous cyst
371	29	F	38	Dentigerous cyst
372	23	M	38	Ameloblastoma
373	40	M	NS	Dentigerous cyst
374*	16	F	28, 38, 48, 18	Dental follicle, Dental follicle, Dental follicle, Dentigerous cyst
375	41	M	38	Inflammatory paradental cyst
376	25	F	43	Ameloblastoma
377	23	F	38	Odontoma
378	20	F	47	Ameloblastoma
379	24	F	38	Ameloblastoma
380	32	F	48	Ameloblastoma
381	22	M	38	Dentigerous cyst
382	23	M	48	Inflammatory paradental cyst
383	57	M	26	Dentigerous cyst
384*	16	M	37, 46	Dentigerous cysts
385	16	F	11	Odontoma
386	26	F	23	Dentigerous cyst
387	23	M	NS	Dentigerous cyst
388	26	M	48	Inflammatory paradental cyst
389	34	F	25	Dentigerous cyst
390	22	M	48	Ameloblastoma