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St. Paul's Hospital Millennium Medical College

Title: Determination of magnitude and histopathologic patterns of odontogenic tumors & Cysts in St. Paul Hospital Millennium Medical college, Addis Ababa, Ethiopia, Over the period of 4 years from 2018 to 2022

Investigator: Dr. Selamawit Tufer (MD, Pathology resident)

Research thesis to be submitted to Department of pathology, St. Paul's Hospital Millennium Medical College in Partial Fulfillment of the Requirements for specialty in pathology.

June, 2022

Addis Ababa, Ethiopia

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Advisor: Dr. Desalew Gedamu (MD, Pathologist)

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St. Paul's Hospital Millennium Medical College Department of pathology	
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Title of the research	Determination of magnitude and histopathologic patterns of odontogenic tumors in St. Paul Hospital Millennium Medical college, Addis Ababa, Ethiopia, Over the period of 4 years from,2018 to 2022
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Abbreviations and Acronyms

IOSCC - Primary Intraosseous squamous cell carcinoma

KCOT - Keratocystic Odontogenic tumor

OT - Odontogenic Tumor

OC - Odontogenic Cyst

SPHMMC - St. Paul Hospital Millennium Medical College

WHO - World Health Organization

Summary

Background: Odontogenic tumors and cysts are rare and heterogeneous group of diseases specifically seated in jaw bones. Odontogenic tumors originate from odontogenic tissue by epithelial or mesenchymal proliferation or both. These tumors have variable clinical and histopathologic features.

Objectives: The objective of the study was to assess the magnitude and Histopathologic types of odontogenic tumors and cysts diagnosed in Saint Paul's Hospital Millennium Medical College over the period of 4 years from May 2018 to May 2022.

Methods: Retrospective study was conducted on biopsy results of odontogenic tumors and cysts based on 2017 World Health Organization classifications. The data was collected from electronically archived files in Saint Paul's Hospital Millennium Medical College, pathology department. Data was analyzed by using Statistical Packages of Social Sciences version 25.0.

Results: In this study there were total of 213 signed out maxillary and mandibular odontogenic tumor. The neoplastic cases were predominant accounting for 131(61.5%), from which 127(59.6%) cases were benign and 4(1.9%) were malignant. Non-neoplastic tumors(cyst) accounted for 82(38.5%). Overall Ameloblastoma was the most common odontogenic tumor in current study accounting for nearly a third, 79(34.3%), of all tumors followed by radicular cyst 33(15.5%), Odontogenic Keratocystic 19(9%), and dentigerous cyst 16(7.5%). There were 4 malignant odontogenic tumors in this study. 3(1.4%) were ameloblastic carcinomas and 1(0.45%) was Clear cell odontogenic carcinoma. Out of 82 non-neoplastic tumors radicular cysts were the most prevalent accounting for 33(40.2%) of the cases followed by Odontogenic Keratocystic 19(23.2%) and dentigerous cyst 16(19.5%). Majority of odontogenic tumors were diagnosed in male patients accounting for 120(56.3%) & 93(43.7%) were female patients with male to female ratio of 1.3:1. The age range was between 1 year to 80 years, with mean age of 29.6 years. The mandible was predominant site origin accounting for 57.7% of all odontogenic tumors.

Conclusions: The most common odontogenic tumor was ameloblastoma in current study. The most common non-neoplastic tumor(cyst) was radicular cyst. Histopathologic patterns of these tumors were diverse and varying from country to country. Benign tumors were common in young age group with peak at 3rd decade but malignant tumors were observed at advanced age. Generally mandible of male patients was common site of origin.

Key words: Odontogenic tumors, Odontogenic cyts, Ameloblastoma, Saint Paul's Hospital Millennium Medical College, Ethiopia

1. Introduction

1.1 Background

Odontogenic tumors (OT) and cysts are rare and heterogenous group of diseases specifically seated in jaw bones. Odontogenic tumors originate from odontogenic tissue by epithelial or mesenchymal proliferation or both. These tumors have variable clinical and histopathologic features.

Despite their rarity there is a great variety of types with numerous transitional forms. This has resulted in many classification attempts. The WHO had been revising the 1992 and 2005 versions. Recently, in 2017 WHO classifications of Odontogenic tumors have been published with modifications. But the major categorization of epithelial, mesenchymal and mixed remains for both benign and malignant tumors [19, 5].

Many retrospective studies have been conducted in different parts of the world to assess the distribution of odontogenic tumors & cysts. These studies have shown different distribution rates ranging from 1 to 32% [16]. The overall and relative frequency of individual odontogenic tumors differ from region to region and these variations are attributed to variations in geographic or cultural settings [16,15,17].

Since there is limited information in the literature about the prevalence of Odontogenic tumors & cysts in Ethiopia, the objective of the present study was to establish the frequencies and types of odontogenic tumors and cysts by using 2017 WHO Histopathologic classification and to compare the results with those found in similar studies from other parts of the world.

1.2 Statement of the problem

The mandible and maxilla differ in no significant way histologically from those of any other bones in our body. Their peculiarity is derived from their close proximity to the mucosal surface of the oral cavity and the fact that they enclose the odontogenic apparatus, a highly specialized structure that gives rise to a large variety of malformative, inflammatory, and neoplastic conditions [14].

The odontogenic compartment is unique in the sense that it contains primitive embryonic structures from early fetal development to about 25 years of age. They have a combined ectodermal and mesodermal derivation; the mesodermal component has the added peculiarity that it originates from the neural crest (the so-called ectomesenchyme) [14].

Nests of odontogenic epithelium (with or without their associated mesenchymal counterparts) are normally found in the jaw and have the potential to develop into cysts or tumors. Those nests located in the alveolar mucosa and resulting from the breakup of the dental lamina are referred to

as *rests of Serres*, whereas those embedded within the periodontium are known as *rests of Malassez* [14].

Epithelial-lined cysts are quite common in the jaws. The overwhelming majority of these cysts are derived from remnants of odontogenic epithelium present within the jaws. Another source of cysts in this region is related to the breakdown of ectodermal lining cells during the union or fusion of the various embryonic processes of the region, through the formation of entrapped epithelium-lined nests [14]. In general, these cysts are subclassified as either inflammatory (eg. Radicular cyst) or developmental (eg. Dentigerous cyst).

A dentigerous cyst (follicular cyst) is a cyst that surrounds the crown of an unerupted tooth and is attached to the neck of this tooth. Dentigerous cysts are quite common. In larger series [6], they comprise almost 17 % of all cases, only surpassed by radicular cysts. In most instances, they are associated with the maxillary canine or the mandibular third molar tooth. Dentigerous cyst are lined by thin and regular epithelial lining which is 2-4 layer thick.[14].

Radicular cysts are located at the root tips of teeth in which the pulp has become necrotic, mostly due to advanced tooth caries. It arises from the epithelial rests of Malassez and develops when pulpal inflammation has led to the formation of a periapical granuloma. Radicular cysts are lined by non-keratinizing squamous epithelium. This epithelial lining may be thin and atrophic, especially in case of inflammatory changes. Radical cysts are the most common cysts in the jaw. A study done on prevalence and distribution of Odontogenic cysts in Sicily showed predominance of radicular cysts (84.5%) over dentigerous cyst (11.4%) [7]. In another study done in Mexico on odontogenic cysts based on gender there was a slight male (52.5%) dominance over females(47%) [8].

Odontogenic tumors are neoplasms that develop exclusively in gnathic bones and they tend to develop towards tooth structures. Most Odontogenic tumors are benign, but some show locally aggressive growth and a high rate of recurrence.

The tumors may be generated at any stage in the life of an individual. Knowledge of basic clinical features such as age, gender, and location can be extremely valuable in developing differential diagnosis of Odontogenic tumors as well as guidance in diagnosis and treatment. Some of the most common and clinically significant odontogenic tumors are discussed as follow:

Ameloblastoma

It is the most frequent odontogenic neoplasm [9] occurs most often in the mandible, particularly posteriorly. It may occur at any age, but the peak reported incidence is in the fourth decade. Mandibular tumors are painless and slow-growing swellings, which characteristically produce multicystic or soap-bubble radiolucencies

Growth is by local expansion and infiltration with destruction of adjacent tissues. Untreated cases may reach a substantial size and extension of tumor from the bone into adjacent soft tissue is an unfavorable sign. Local recurrence occurs in 15% to 20% of cases. Ameloblastomas in the maxilla occur in an older age group and have a poorer prognosis. A higher recurrence rate after surgery exists, probably related to the different bone structure in the maxilla and earlier spread into extraosseous soft tissues and the paranasal sinuses.

The most common type of ameloblastoma is the conventional or solid-multicystic type [10]. Furthermore, distant metastases have been documented in rare instances, especially to the lungs but also to the central nervous system.

Odontoma

By definition, an odontoma has to include all the calcified dental tissues. These are hamartomas and are amongst the most frequent of the odontogenic tumors [1]. Odontomas are either detected as incidental radiologic findings or, less frequently, as slow-growing swellings in adolescence. They are often associated with unerupted teeth and are a cause of failed eruption of permanent teeth in young people. Two variants are identified with differing clinical and histologic features. Complex odontomas - are most frequently found in the posterior mandible and are composed of a mixture of dental hard tissues with no resemblance to a tooth.

Compound odontomas - are most common in the anterior maxilla and consist of numerous small, often irregularly shaped teeth.

Data from the literature shows differences in the relative frequencies of these Odontogenic tumors. Several reports on series of odontogenic tumors from different countries have documented distinct geographic variations in tumor prevalence, with main difference being the relative incidence of Ameloblastoma and Odontoma [1, 15].

In many literatures including those in Brazil, made on Odontogenic tumors, Analysis of 127 cases during a 30 year period showed Odontoma(50.40%) being the commonest followed by Ameloblastoma(30.70%) [1]. There was comparable result in Canadian study, with Odontomas (51.53%) and being commonest followed by Ameloblastoma(13.52%) [17]. But these results were not in agreement with other studies done in Africa including Ethiopia, with Ameloblastoma being the commonest of all odontogenic tumors [2,15, 16].

The most common anatomical location involved by odontogenic tumors include the mandible followed by maxilla [1,16]. Majority of odontogenic tumors were benign and few cases were malignant. [2,15,16].

Ameloblastic carcinomas

A rare primary epithelial odontogenic malignant neoplasm. It is the malignant counterpart of ameloblastoma. Most cases arise de novo, but some arise in pre-existing ameloblastomas. The

posterior segments of the jaws are the most common site, with half to two thirds of all lesions occurring in the mandible [19]. It is possible that at least some of the reported intraosseous squamous cell carcinomas (IOSCC) of the jaw represent ameloblastic carcinomas with a marked degree of squamous change; others appear to arise in keratocysts and other types of odontogenic cyst. [14]. May literature showed that the incidence of Ameloblastic carcinoma are rare, a study done In Greek to assess the frequency and distribution of odontogenic tumor, out of 652 cases of OT 1 (0.2 %) case of Ameloblastic carcinoma was identified In 70-year-old female patient. The tumor occupying an extended area of the body of the right mandible. [11]. Another study In Nigeria Ladeinde et al [18]. A study of 319 case of odontogenic tumor, Ameloblastic carcinoma accounted for about 7 (2.2%) of the cases 4 female and 3 male. The age range was 16-85. 5 of them were In the mandible and 2 In the maxilla.

Odontogenic myxoma/Myxofibroma

A benign odontogenic neoplasm characterized by stellate and spindle-shaped cells dispersed in an abundant myxoid extracellular matrix. When a greater amount of collagen is evident, the term "odontogenic myxofibroma" may be used. In most studies, odontogenic myxoma is the third most frequent odontogenic tumour (after odontoma and ameloblastoma). It has been estimated to account for 2- 5% of cases in Africa, China and USA. The patient age range of reported cases is 1- 73 years, with most cases diagnosed in the second to fourth decades of life [19].

In the Brazilian study Santos JN et al [1]. odontogenic myxoma accounted for 6 (4.72%) of the 127 cases being the fourth most common with 1:1 male to female ratio. With regard to the location 1 (2.63%), anterior maxilla, 1 anterior mandible (5%), 2 (14.29%) posterior maxilla and 2 (3.92%) posterior mandible. The mean age for female was 30.3 years and 23.6 years for male. Another study done In Egypt [13]. Analysis of 82 cases, odontogenic myxoma/myxofibroma was the fourth most common accounting for about 7 (8.5%) cases. Of this 2 were male and 5 were female with male to female ratio of 1:2.5. The age ranges were 0-30 years. Most (6) of the them were in the mandible and only one patient had maxillary disease.

In another study Bruktawit k et al [2]. Odontogenic myxoma were the second most common benign OT accounting for 14 (8.6%) only preceded by ameloblastoma. Regarding age distribution 5 patient were In the range of 0-19 years, 7 patient 20-39 years and 2 patient were 40 and above. Most (10) of them were male and 4 female with male to female ratio of 2.5:1. Regarding the location 11 were located in the mandible and 3 occurred In the maxilla.

Odontogenic fibroma

Is a rare neoplasm of mature fibrous connective tissue, with variable amounts of inactive-looking odontogenic epithelium, with or without evidence of calcification. There are two clinical variants: intraosseous or central odontogenic fibroma and extraosseous or peripheral odontogenic fibroma. Peripheral odontogenic fibroma is more common than central odontogenic fibroma, occurs twice as frequently in females as in males, and has an age peak in the second to fourth

decades of life. Odontogenic fibroma occurs with relatively equal frequency in the maxilla and mandible [19]. Odontogenic fibroma differs microscopically from myxoma by the presence of fibrous tissue and the more frequent occurrence of odontogenic epithelial rests. Odontogenic fibroma can be simulated microscopically by the normal dental follicle around the crown of an unerupted tooth. In contrast to myxomas, they tend not to recur and can be treated more conservatively [14].

Canadian study Daley TD, et al [17]. Of 40,000 consecutively accessioned oral biopsies from the Oral Pathology Diagnostic Service, University of Western Ontario, London, Canada, were reviewed. From a total of 445 (1.11%) odontogenic tumors, 392 (0.98%) were lesions from patients in the usual local drawing area of the biopsy service 53 were referred from distant centers. From the local population, peripheral odontogenic fibromas were 36(8.93%) next to odontoma and ameloblastoma and Central odontogenic fibroma were 25(4.85%). Another study done in Nigeria [15]. odontogenic fibroma were seen in only 4 patient, 3(75%) female and 1(25%) male. The age range was 38-45 years. All of them were in the maxilla.

1.3 Significance of Study

Data from the literature shows differences in the relative frequencies of these tumors. Several reports on series of odontogenic tumors from different countries have documented distinct geographic variations in tumor prevalence. There are few studies done in Ethiopia regarding odontogenic tumors. Even it is more limited data our hospital. So the aim of this study was to fill this gap by studying histopathologic patterns of odontogenic tumors with age, site and gender distribution by using 2017 WHO Histopathologic classification of Odontogenic tumors. It also compared findings from this study with other similar studies from different parts of the world. In addition to filling these gaps this study will be used as reference for other researchers in this topic.

2. Literature review

There are variety of literatures done all over the over the world about Odontogenic tumors (OT). One such study done was in Brazil with analysis of 127 cases during a 30year period (1970-1991), which showed odontoma (50.40%) to be the commonest Odontogenic tumor followed by Ameloblastoma (30.70%). The prevalence of OT was greater in females (60%) and (36.22%) in males. The peak age of occurrence were in the 2nd and 3rd decades of life for both tumor types. Age of patients ranged from 4-82years, average 26.6years. The highest incidence was observed in 2nd decade of life(45.31%). The main anatomic location was the mandible (54.33%) and maxilla affected in (40.15%) of cases. 39 cases were identified as Ameloblastoma and these accounted for 30.70% of all tumors. The cases occurred in 22Females and 17males. The 3rd and 5th decades were the most affected. Age ranged from 12-71years. All cases occurred exclusively in the mandible. Of these, 35

cases(89.7%) were solid/multicystic, 3cases(7.69%) were unicystic and 1case(2.56%) were peripheral Ameloblastoma. Histologically ameloblastoma were classified in one of the following patterns, follicular 8 cases(20.5%) plexiform 10cases(25.64%)and follicular-plexiform 12cases(30.76%),basal cell variant 2 cases(5.1%) Acathomatous and granular variant each accounting one cases(2.56%) peripheral ameloblastoma and desmoplastic variants have been also observed [1]

From the western literature on OT was done by Daley TD, et al.[17] on Relative incidence of Odontogenic tumors and oral and jaw cysts in a Canadian population. From 40,000cases reviewed from oral biopsies from the oral pathology diagnostic service, from a total of 445 cases(1.11%)odontogenic tumors , 392(0.98%)were lesions from patients in the usual local drawing area of the biopsy service, 53 were referred from distant centers. From the local population, Odontomas were by far the most common tumor 51.53%followed by Ameloblastomas 13.52 and Peripheral Odontogenic Fibroma 8.93%. Locally Radicular periapical cyst were the most common Odontogenic cyst 65.15% followed by Dentigerous cysts 24.08% and the Odontogenic keratocyst 4.88%.[27]

Rafael LA et al. [3] Odontogenic tumors : clinical and pathology study of 238 cases 15 years' experience .OT were 4.76%of all biopsied lesion within the studied period.The mean age was 30.7 years, 57% of the patients were male. The Keratocystic Odontogenic tumor was the most prevalent histological type 30%. Followed by the Ameloblastoma 23.7% [3] its frequency was lower compared to published reports adebayo et al. 48% [15].

From studies done in Africa , one was done by Adebayo ET et al.[15] A review of 318 cases odontogenic tumors in kaduna , Nigeria. There were 990 tumor and tumor like lesion in the oral and perioral structures, of which 318 were Odontogenic tumors (32%). 12 histopathologic types of OT were found with more benign(n=314;99%) than malignant(n=4;1%). Ameloblastoma made up 233(73%) of the tumors, followed by Odontogenic Myxoma (n=9; 3%) and Adenomatoid OT (2%). At least 8 cases of Ameloblastomas recurred out of 60 follow up. Among 275 surgically treated odontogenic tumors , enucleation was performed in 64 cases(23%), dentoalveolar segment resection with preservation of lower mandible(n=33,12%) ,segmental resection(n=168;61%)and composite resection(n=9;3%)and 1 case was inoperable.

Odukoya O. et al [16] Odontogenic tumors: Analysis of 289 Nigerian cases. Analysis of 289cases of OT in pathology service of the Lagos University teaching Hospital during a period of 21years were analyzed and categorized according to the WHO classification of OT.OT accounted for 19% of jaw tumors. Ameloblastoma accounted for 58.5% of OT. It was most common and showed predilection for males and posterior mandible. 94.8% of OT are benign , while malignant OT accounted for 5.2% with odontogenic carcinoma accounting for 14(4.84%) and odontogenic sarcoma 1(0.35%) [16].

Mosqueda Taylor et al. Odontogenic cysts. Analysis of 856 cases. There were a total of 856 odontogenic cysts of these, 449(52.5%) occurred in men, 403 in women (47%) and in 4 cases (0.5%) gender was not stated. The most frequently recognized OC were Radicular cyst (342)cases Dentigerous cyst(283) and Odontogenic keratocyst(184)cases[8].

A study on Prevalence and distribution of Odontogenic cysts in Sicily Tortorici et al [7] 1986-2005 showed 1,310cysts of jaw were diagnosed in 12,197 individuals. From these 1273 cysts were classified as Odontogenic and only 37 were non odontogenic. In the former group, the most frequent lesions were radicular cysts (84.5%) followed by Dentigerous cyst (11.4%). Infected Radicular cysts were observed in male gender, young age and anterior maxilla. Unlike the Dentigerous cysts, frequency of Radicular cyst decreased from 10.4% in1986-1995 to about 8% in 1996-2005. And concluded that the decreasing trend with time could be attributed to possible improvement oral health behavior [7].

An Africa study done in Egypt, Retrospective study of 82 cases of OT over 15 years period ,79 (96.3%) were benign and only 3 (3.7%) were malignant .The most frequent lesion was ameloblastoma (41.5%), followed by keratocystic odontogenic tumor (19.5%), odontoma (13.4%), odontogenic myxoma (8.5%), adenomatoid odontogenic tumor(3.7%), and calcifying epithelial odontogenic tumor (3.7%). Primary intraosseous carcinoma (2 cases; 2.4%) was the most frequent malignant tumor, followed by malignant ameloblastoma (1 case; 1.2%). Regarding gender and age, 53.7% of all of the tumors occurred in males and 46.3% in females. The male female ratio was 1.1:1 for benign tumors and 2:1 for malignant tumors. The peak age of incidence was the second and third decades of life. Patients' age ranged from 4 to 80 years, with a mean age of 29.57 years. The mandible was the most frequently affected jaw, corresponding to 82.9% of the cases, and the maxilla was affected in 17.1% of the cases, with overall maxilla-mandible ratio of 0.2:1[13].

A study done at St. Paul's Hospital, Bruktawit k. et al.[2] Odontogenic tumors in Ethiopia 8 years retrospective study, showed from a total of 448 patients reviewed, only 163 patient records were complete and suitable for the study. 88(54%) of the study subjects (163) were males and the remaining 75(46%) were female. Mean age of patients was 34years, range between 8 and 80 years. 132 (81%) of OT were benign, the rest 31(19.0%) were malignant. 126(77.3%) of OT occurred in the mandible, and the remaining 37(22.3%) were in maxilla. 135(82.8%) had primary surgical treatment. Ameloblastoma 75(46%) was most frequent type followed by Odontogenic Myxoma (8.6%). Primary Intraosseous squamous cell carcinoma (IOSCC) was the most common type of malignant OT which accounted for 26(16.8%) of the cases with 16 male and 10 female patients with male to female ratio of 1.6:1.

A study over 40 years done to analyze the frequency and distribution of odontogenic tumors in a Greek population, Chrysomali et al.[11] A total of 652 cases of odontogenic tumors

were reported. Of these, 651 (99.8%) were benign and only 1 (0.2%) was malignant. Keratocystic odontogenic tumor was the most frequent lesion (52.7%), followed by odontoma (18.9%) and ameloblastoma (16.1%). The mean age of patients was 38.0 years with a wide range (2.5-92 years). Odontomas were classified histologically as complex in 73 cases (59.3%) and as compound in 50 cases (40.7%). The third most frequent lesion was ameloblastoma (16.1%). Histologically, ameloblastomas were classified in 1 of the following patterns: follicular (34.1%), mural (23.4%), plexiform (16.0%), acanthomatous (9.6%), peripheral (6.4%), unicystic (6.4%), granular cell (1.0%), basal cell (1.0%), acanthomatous-plexiform (1.0%), and follicular plexiform (1.0%). Calcifying cystic OT and odontogenic myxoma comprised each for 2.6% of OTs, followed by odontogenic fibroma (2.4%) and calcifying epithelial OT (1.4%). The frequency of other benign OTs ranged between 1.2% and 0.8%. One case of ameloblastic carcinoma was the only malignant entity, accounting for 0.2% of all tumors. 53.5% of all OTs occurred in males and 46.5% in females. The overall male-female ratio was 1.2:1. Regarding the anatomical site, the mandible was the mostly affected site for most tumors, and for overall it is 66.7%, with a mandible-maxilla ratio of 2:1.

Another study done in India, A total of 120 cases of odontogenic tumors were reported over 9 years period the most frequent histological type was ameloblastoma (40.83%), followed by keratocystic odontogenic tumor (37.5%), odontoma (11.66%) and Adenomatoid odontogenic tumor (5.8%). Of the 120 odontogenic tumors, all were benign. Among these 70(58.3%) were in males and 50(41.6%) were in females (male- female ratio 1.4:1). 88(73.3%) tumors were encountered in the mandible and 32(26.6%) in the maxilla, with an overall mandible: maxilla ratio of 2.75:1. Ameloblastoma, showed a very high predilection for the mandible with 90% of the cases occurring in the mandible with a ratio of 8.8:1. Age distribution showed a peak occurrence in the third decade, 85% of the cases occurring between the second and fifth decades. Ameloblastoma, the most common tumor in this study showed 71.42% of the cases occurring in the third to fifth decades. KCOT showed 88.88% of the cases occurring in second to fifth decades [12].

3. Objectives of the study

3.1 General objective

- To determine the frequencies and histopathologic patterns of odontogenic tumors

and cysts diagnosed in Saint Paul Millennium Medical college, Addis Ababa, Ethiopia, from 2018 to 2022

3.2 Specific objective

- Identify distribution of Odontogenic tumor & cyst cases by age and gender.
- To identify the frequent anatomic location of the Odontogenic tumors & cyst
- To determine the frequency of distribution of Odontogenic tumors & cyst with their respective histopathology.
- To compare and contrast other study findings in the reports from around the world with that of the findings from the present study.

4. Methods and Materials

4.1 Study Area

The study was conducted at Saint Paul Millennium Medical College, pathology department which is found in Addis Ababa, Ethiopia. It is one of the Multi-specialty medical college in the country with vast majority of the cases investigated at this department being patients who are referred from all over the country.

4.2 Study Design and Period

Cross-sectional retrospective descriptive study was performed over the period of 4 years from May 2018 up to May 2022.

4.3 Study population

All cases of odontogenic tumors & cysts diagnosed and reported during the study period.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

- Complete medical and demographic records of patients.
- Cases with unambiguous histopathological diagnosis.
- Cases of odontogenic tumors under the 2017 WHO Classification will be included in the study.

4.4.2 Exclusion criteria

- Incomplete medical records of patients
- Unclear histopathologic diagnosis

4.5 Study variables

4.5.1 Dependent variables

- Histopathologic diagnosis

4.5.2 Independent variables

- Age of the patient
- Anatomic site of the lesion
- Gender of the patient

4.6 Data collection and Analysis

4.6.1 Data collection procedure

Data was collected from the anatomic pathology electronically recorded archives registered from May, 2018–May, 2022 and subjected for review of the demographic, clinical, gross, microscopic, and final diagnosis.

4.6.2 Data processing and Analysis

Collected data was cross checked and entered and analyzed by using SPSS (Statistical Packages of Social Sciences) version 25.0.

5. Ethical considerations

Proposal was submitted to the department of pathology and approvals was obtained from the ethical review committee of the department of pathology and the institutional review board and research and publication committee of the medical College.

6. Work plan and Budget

Table 1: Work plan and budget

No.	Activity	Time frame	Participants	Resource	Budget	Remark
1	Proposal preparation and submission	June15-20,2022	1	Laptop Internet Stationeries	1700	-
2	Comment and feedback by advisor	June 25, 2022	1	-	-	-
3	Obtain ethical approval	July 10,2022	1	Stationeries	100	-
4	Data collection	July 12 ,2022	Investigator with 5 assistants	Stationeries Laptop Transport Meal	19,900	-
5	Data analysis	July 25, 2022	1	Stationeries Internet Laptop	3,300	-
6	Final thesis defence	According to the department schedule	-	-	25,000	-

7. Results

There were total of 1050 oral and maxillofacial specimens evaluated in our hospital b/n the year 2018 to 2022. From these 244 cases were from mandible and maxilla. Out of these, 31 were excluded due to ambiguous & descriptive diagnosis. So total of 213 signed out maxillary and mandibular cases were included in the current study.

The neoplastic cases were predominant accounting for 131(61.5%), from which 127(59.6%) cases were benign and 4(1.9%) were malignant. Non-neoplastic tumors(cysts) accounted for 82(38.5%) (Figure1). Overall Ameloblastoma was the most common odontogenic tumor in current study accounting for nearly 1/3rd,79(34.3%), of all tumors followed by radicular cyst 33(15.5%), OKC 19(9%), and dentigerous cyst 16(7.5%) (Table2).

120 (56.3%) of the study subjects were males and 93(43.7%) were females, with a M:F ratio of 1.3:1 (Figure 2). The minimum age was 1 years and maximum was 80 years, with a mean age of 29.6years.The predominant site of tumor is mandible which accounted for 123(57.7%) and maxilla accounted for 90(42.3%) (Figure3).

Among the 131 neoplastic tumors ameloblastoma was the leading one accounting for 79(60.3%) followed by odontogenic myxofibroma13(10%),calcifying odontogenic cyst 9(7%) and odontogenic myxoma 7(5.3%). Ameloblastoma occurred in the mandible accounting for 67(84.8%) and the reaming 12(15.2%) occurred in maxilla. 49(62%) of them were male & 30(38%) of them were female, with a M:F ratio of 1.6:1.The mean age of the patients was 31years.8(64.54%)odontogenic myxofibroma were diagnosed in female patients and predominant in mandible and the remaining 5 (38.46%) were in male and arises from maxilla. The minimum and maximal ages of patients with odontogenic myxofibromas were of 1year and 60 years respectively with a mean age of 33years (Table 3).

Four malignant tumors were identified out of which 3(1.4%) were ameloblastic carcinomas & all of them occurred in mandible, the age of the patients were73 year old male,40 year old female and 25 year old male.Clear cell odontogenic carcinoma was the other malignant tumor.The patient was a 62 years old male & the tumor site was mandible (Table 3).

In this study there were 82 non-neoplastic tumors(cysts). Among these non-neoplastic tumors radicular cysts were the most prevalent accounting for 33(40.2%) followed by OKC 19(23.2%) and dentigerous cyst 16(19.5%). The age range of radicular cyst was 4 years to 80 years with a mean age of 33 years. 21(63.6%) of them were male and 12 (36.4%) were female, with M: F ratio of 1.75:1. 23(69.7%) of the cases occurred in maxilla and 10(30.3%) occurred in the mandible. More than half, 11(57.9%), of OKC occurred in maxilla and 8(42.1%) occurred in mandible with slight female predominance with the minimum and maximum ages of 8 and 50 years respectively and the mean age was 32years. Dentigerous cysts were the 3rd most common non-neoplastic tumor(Cyst).predominantly arising from maxilla and having female

predominance in this study. Benign odontogenic cysts were diagnosed in the age range of 1 to 50 years and the mean age was 26years with male predominance and preference to Maxilla (Table 4).

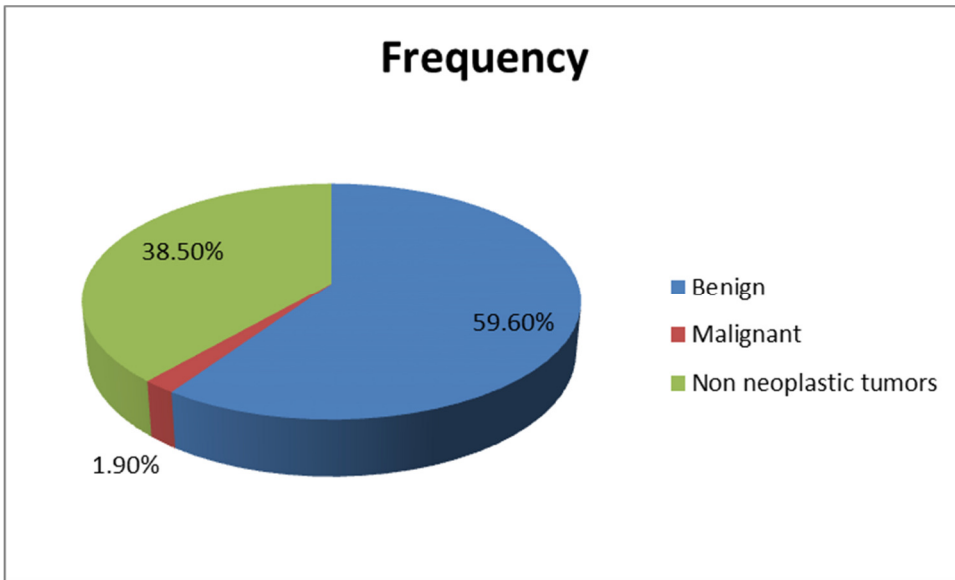


Figure 1. General category of odontogenic tumors & cysts

Table 2. Distribution histopathologic patterns of odontogenic tumors & cysts

Histopathologic pattern	Count	Present
Ameloblastoma	79	34.3%
Radicular cyst	33	15.5%
OKC	19	9%
Dentigerous cyst	16	7.5%
Benign odontogenic cyst	14	6.6%
Odontogenic Myxofibroma	13	6.1%
Calcifying odontogenic cyst	9	4.2%
Odontogenic myxoma	7	3.3%
Odontoameloblastoma	6	2.8%
Ameloblastic fibroma	4	1.9%
Adenomatoid odontogenic tumor	4	1.9%
Odontoma	3	1.4%
Ameloblastic carcinoma	3	1.4%
CEOT	2	0.9%
Clear cell odontogenic carcinoma	1	0.45%
Total	213	

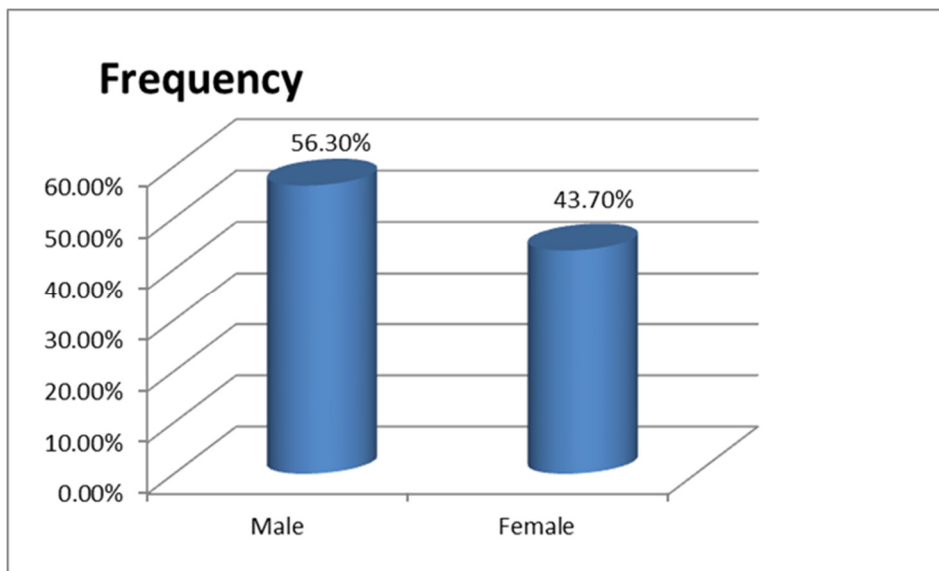


Figure 2. Distribution of Odontogenic tumor & cyst by Gender

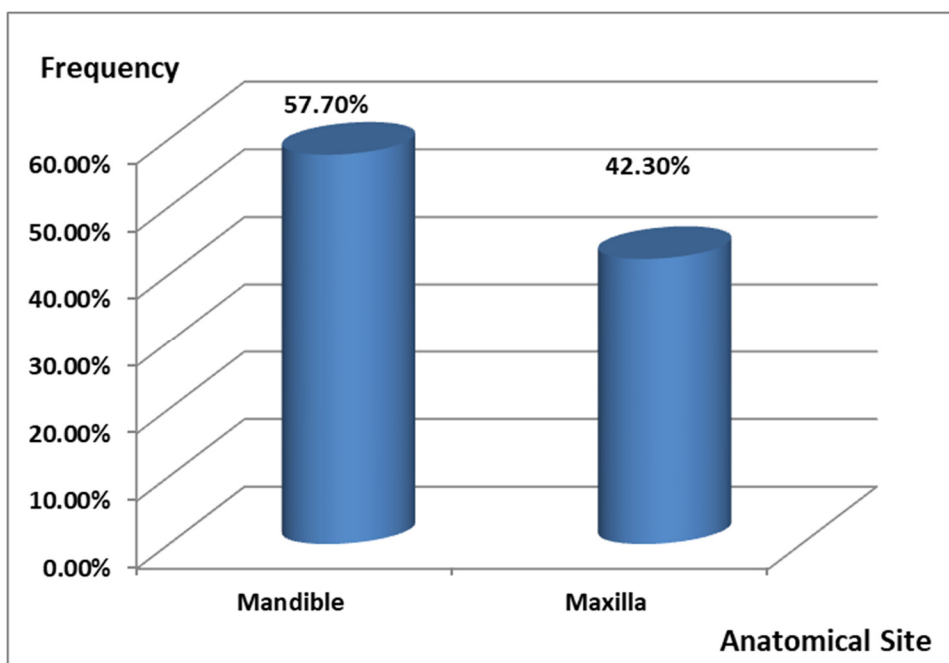


Figure 3. Distribution of odontogenic tumors & cyst based on site

Table 3. Histopathologic distribution of neoplastic tumors per site, gender and tumor behavior

Histopathologic type	Frequency by site		Frequency by gender		Tumor behavior	Total
	Maxilla	Mandible	Male	Female		
Ameloblastoma	12(15.2%)	67(84.8%)	49(62%)	30(38%)	Benign	79

Odontogenic myxofibroma	5(38.5%)	8(61.5%)	5(38.5%)	8(61.5%)	Benign	13
Calcifying odontogenic cyst	4(44.4%)	5(55.6%)	5(55.6%)	4(44.4%)	Benign	9
Odontogenic myxoma	5(71.4%)	2(28.6%)	1(16.7%)	6(83.3%)	Benign	7
Odontoameloblastoma	2(33.3%)	4(66.7%)	3(50%)	3(50%)	Benign	6
Ameloblastic fibroma	0	4(100%)	2(50%)	2(50%)	Benign	4
Adenomatoid odontogenic tumor	3(75%)	1(25%)	1(25%)	3(75%)	Benign	4
Odontoma	2(66.7%)	1(33.3%)	1(33.3%)	2(66.7%)	Benign	3
CEOT	1(50%)	1(50%)	0	2	Benign	2
Ameloblastic carcinoma	0	3(100%)	2(66.7%)	1(33.3%)	Malignant	3
Clear cell odontogenic carcinoma	0	1(100%)	1(100%)	0	Malignant	1
Total						131

Table 4. Distribution of non-neoplastic tumor(cysts) per age, site and sex

Histopathologic pattern	Site of tumor		Sex		Age in years			Total
	Mandible	Maxilla	Male	Female	Minimum	Maximum	Mean	
Radicular cyst	10	23	21	12	4	80	33	33
OKC	8	11	9	10	8	50	32	19
Dentigerous cyst	5	11	7	9	1	50	24	16
Benign odontogenic cyst	4	10	11	3	1	50	26	14
Total								82

8. Discussion

In current study the neoplastic tumors were the most prevalent accounting for 131(61.5%) of cases. Benign and malignant neoplastic odontogenic tumors were 127(59.6%) and 4(1.9%) respectively. Non-neoplastic tumors(cysts) accounted for 82(38.5%) of cases in this study. In many other similar studies benign tumors were the most prevalent among odontogenic tumors which go with the findings of current study. In study from Nigeria which was done by Adebayo ET et al., on 318 cases, 314(99%) were benign and 4(1%) were malignant [15]. Still in other similar study 94.8% of odontogenic tumors were benign, while 5.2 % were malignant [16]. In other study 96.3% of neoplastic odontogenic tumors were benign and the remaining 3.7% were malignant (13). In contrast to current study the prevalence of malignant odontogenic tumors was higher in one study which accounted for 19 % odontogenic tumors [2].

Overall Ameloblastoma was the most common odontogenic tumor in current study accounting for nearly 1/3rd, 79(34.3%), of all tumors followed by radicular cyst 33(15.5%), OKC 19(9%), and dentigerous cyst 16(7.5%). These findings agree with other similar studies done in different African countries including Ethiopia. Eight year retrospective study done by Bruktawit k et al (Ethiopia) on odontogenic tumors reported Ameloblastoma as the most common histopathologic pattern [2]. In other study the most frequent odontogenic lesion was ameloblastoma (41.5%), followed by keratocystic odontogenic tumor (19.5%), odontoma (13.4%), odontogenic myxoma (8.5%), adenomatoid odontogenic tumor (3.7%), and calcifying epithelial odontogenic tumor (3.7%) (13). Similar findings reported from studies done at Nigeria [15, 16]. In study done by Varkhede A and colleague (India) the most frequent histological type of odontogenic tumor was ameloblastoma (40.83%), followed by OKC (37.5%), odontoma (11.66%) and Adenomatoid odontogenic tumor (5.8%) [12]. In studies from Brazil and Canada the most common odontogenic tumors were Odontoma 50.40% and 51.53% followed by Ameloblastoma 30.70% and 13.52% respectively which disagree with findings of the current study. In our study pure odontoma accounted for only 1.4% of overall odontogenic tumors [1, 17]. In one similar study OKC was the most common odontogenic tumour accounting for 30% followed by the Ameloblastoma that accounted for 23.7% [3]. In other study done by Chrysomali.et.al (Greece) OKC was the most frequent tumor (52.7%), followed by odontoma (18.9%) and ameloblastoma (16.1%) (11).

120 (56.3%) of the study subjects were male & 93(43.7%) were female, with a M:F ratio of 1.3:1. These findings agree with findings of many other studies. Similar study done by Bruktawit k. et al. 54% of patients with odontogenic tumor were males and the remaining 46% were female [2]. In other study 53.5% of all odontogenic tumors occurred in males and 46.5% in females with male to female ratio of 1.2:1 [11]. In still other study 53.7% of Odontogenic tumors occurred in males and 46.3% in females with male to female ratio of 1.1:1 for benign tumors and 2:1 for malignant tumors (13). In Rafael LA et.al study 57% of the patients with odontogenic tumors were male [3]. In study from India 58.3% of cases with odontogenic tumors were males

and 50(41.6%) were females with male to female ratio 1.4:1 (12). In other study 60% of Odontogenic tumors were diagnosed in females [1] which disagree with current study finding.

The minimum age was 1 years and maximum was 80 years, with a mean age of 29.6years. These findings agree with other study in which age of patients ranged from 4-82 years with average 26.6 years [1]. In Rafael LA et al. study the mean age of patients with odontogenic tumors was 30.7 years which is slightly higher than our findings [3]. In other similar study the Patients' age ranged from 4 to 80 years, with a mean age of 29.57 years (13). In other study the mean age was of patients with odontogenic tumors was 34years with the range of 8 to 80 years (2). The mean age as high as 38.0 years with a wide range of 2.5-92 years was reported in study done by Chrysomali.et.al (11).

The predominant site of tumor is mandible which accounted for 123(57.7%) followed by maxilla accounted for 90(42.3%) of odontogenic tumors in our study. The findings agree with findings from other studies in which majority of odontogenic tumors arises from Mandible. In one study more than $\frac{1}{2}$ (54.33%) of odontogenic tumors were mandibular origin and 40.15% were maxillary origin [11]. In other study the mandible was the most frequently affected site accounting for 82.9% of cases and the maxilla was affected in 17.1% of the cases [13]. Still in other study 77.3% of odontogenic tumors occurred in the mandible, and the remaining 37(22.3%) were in maxilla [2]. 66.7% odontogenic tumors were mandibular origin in one other study with a mandible to maxilla ratio of 2:1[11]. In other study 73.3% Odontogenic tumors were encountered in the mandible and 26.6% in the maxilla with mandible: maxilla ratio of 2.75:1 [12].

Among the 131 neoplastic tumors ameloblastoma was the leading one accounting for 79(60.3%) followed by odontogenic myxofibroma 13 (10%), calcifying odontogenic cyst 9(7%) and odontogenic myxoma 7(5.3%). These findings agree with other studies. In study done by Adebayo ET, ameloblastoma was the most common neoplastic odontogenic tumor accounting for 73% (15). In study done by Odukoya O. et.al, ameloblastoma accounted for 58.5% and was more common in posterior mandible male patients [16].

In current study ameloblastoma occurred in the mandible accounting for 67(84.8%) and the remaining 12(15.2%) occurred in maxilla. 49(62%) of them were male & 30(38%) of them were female, with a M:F ratio of 1.6:1. The mean age of the patients is 31years with a minimum & maximum age of patients being 11years & 70 years respectively. These finding are consistent with Odukoya O. et al study in which ameloblastoma showed predilection for males and mandible [16]. In other similar study, 90% of ameloblastoma occurred in the mandible with mandible to maxilla ratio of 8.8:1 and the peak age was in the third decade with 85% of cases occurring between the second and fifth decades [12].

In current study , 8(64.54%) odontogenic myxofibromas were diagnosed in female patients and predominant in mandible and the remaining 5 (38.46%) were in males and arised from maxilla.

The minimum and maximal ages of patients with this tumor were 1 year and 60 years respectively with a mean age of 33 years. In other studies from Africa, China and USA odontogenic Myxofibroma accounted for 2- 5% of cases.[19]. In study done by Santos JN et al odontogenic myxoma accounted for 6(4.72%) [1]. In other similar study from Egypt odontogenic myxoma/Myxofibroma was the fourth most common odontogenic tumor accounting for about 7 (8.5%) cases [13]. The patient age range of reported cases was 1-73 years, with most cases diagnosed in the second to fourth decades of life which agree with the findings of current study [19]. The mandible was the most common site of odontogenic Myxofibroma in other similar study that agrees with our study [6]. In study done by Bruktawit k et al [2] Odontogenic myxomas were the second most common benign odontogenic accounting for 14(8.6%). In current study odontogenic myxoma was more common in maxilla and common in female patients which disagree with other study in which majority occurred in mandible and more common in males with M:F ratio of 2.5:1[2].

In current study there were 4 malignant odontogenic tumors out of which 3(1.4%) were ameloblastic carcinomas and 1(0.45%) was Clear cell odontogenic carcinoma. All of them occurred in mandible, and majority occurred in male with age range of 25 to 73 years. In study from Greek to assess the frequency and distribution of odontogenic tumors ameloblastic carcinoma accounted for 1(0.2 %) of cases [11]. In study from Nigeria ameloblastic carcinoma accounted for about 7(2.2%) of the cases with the age range of 16-85 years [18]. Ameloblastic carcinoma is a rare primary epithelial odontogenic malignant neoplasm in literature [19]. Primary Intraosseous squamous cell carcinoma (IOSCC) was the most common type of malignant odontogenic tumor in other study which disagrees with current study [2].

In current study there were 82 non-neoplastic tumors(cysts).Among these non-neoplastic tumors radicular cysts were the most prevalent accounting for 33(40.2%) followed by OKC 19(23.2%) and dentigerous cyst 16(19.5%).These findings are consistent with other studies.According to Daley TD, et al study Radicular(periapical cyst) were the most common odontogenic cyst accounting for 65.15% followed by dentigerous cysts (24.08%) and the odontogenic keratocyst (4.88%) [17]. In Mosqeda Taylor et al. study regarding distribution of Odontogenic cysts Radicular cysts were the most prevalent accounting for 40% followed by dentigerous cyst (33%) and Odontogenic keratocyst (22%) (8). According to Tortoricis et al. study on the prevalence and distribution of Odontogenic Cysts, radicular cysts were the most prevalent one accounting for 84.5% followed by dentigerous cyst accounting for 11.4% [7]. In other study dentigerous cysts were the second most common accounting for 17% only surpassed by radicular cysts [6].

In current study the age range of radicular cyst was 4 years to 80 years with a mean age of 33 years. 21(63.6%) of them were male and 12 (36.4%) were female, with M: F ratio of 1.75:1. 23(69.7%) of the cases occurred in maxilla and 10(30.3%) occurred in the mandible. More than half, 11(57.9%), of OKC occurred in maxilla and 8(42.1%) occurred in mandible with slight female predominance with the minimum and maximum ages of 8 and 50 years respectively and

the mean age was 32years. Dentigerous cysts were the 3rd most common non-neoplastic tumors(cyst) predominantly arising from maxilla and having female predominance in this study. Benign odontogenic cysts were diagnosed in the age range of 1 to 50 years and the mean age was 26years with male predominance and preference to Maxilla.In another study done in Mexico odontogenic cysts showed slight male (52.5%) dominance over females (47%) [8].

9. Conclusion

In current study the neoplastic tumors were the most prevalent accounting for 131(61.5%) of cases. Benign and malignant neoplastic odontogenic tumors were 127(59.6%) and 4(1.9%) respectively. Non-neoplastic tumors(cyst) accounted for 82(38.5%) of cases in this study. The most common benign neoplastic tumor was ameloblastoma and the most common non-neoplastic tumor was radicular cyst. The most common malignant odontogenic tumor was ameloblastic carcinomas. Majority of odontogenic tumors were diagnosed in male patients with M:F ratio of 1.3:1. The age range was b/n 1 year to 80 years, with mean age of 29.6years.The mandible was predominant site origin accounting for 57.7% of all odontogenic tumors.

10. Recommendation

This study was mainly restricted on assessment of distribution of odontogenic tumors & cysts over neoplastic behavior, histopathologic pattern, site of origin, sex and age. Further Clinicopathological correlation study is recommended.

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Annex

Table 5. Data collecting format

Biopsy numbers	Age	Gender	Site of tumor	Histopathologic type