DECLARATION

This dissertation is my original work and has not been presented for a degree in any other university.

Signed.....

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DEDICATION

This work is dedicated to Michael and Daniel the two people who have sacrificed a lot with me in my pursuit of higher learning.

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ABBREVIATIONS

C/F	-	Clinical Features
DSH	-	Dental School Hospital of the University of Nairobi
KNH	-	Kenyatta National Hospital
=	-	Equal to
<	-	Less Than
>	-	More Than
OPG	-	Orthopantomogram
OT	-	Odontogenic Tumours
OC	-	Odontogenic Cysts
EAMJ	-	East African Medical Journal
M: F	-	Male to Female ratio
SCC	-	Squamous Cell Carcinoma
WHO	-	World Health Organization
FCOD	-	Florid Cemento-Osseous Dysplasia

ABSTRACT

Introduction

Tumours and tumour-like conditions of the jawbones have similar clinical presentations irrespective of the underlying pathology. These tumours even when histologically benign cause gross disfiguring of the affected patients. Their diagnoses depend both on imaging features and histology.

Objectives

The aim of the study was to underline the importance of Radiology in the diagnosis of tumours and tumour-like conditions of the jawbones; to ascertain the age and sex distribution, relative frequency and anatomical distribution of these lesions. This study also evaluated the correlation between the radiological and histopathological diagnoses of these lesions and compared these findings with studies done elsewhere.

Methods

This was a five year retrospective descriptive study from January 2000 to December 2004 undertaken in the two main referral institutions of dental pathology in Kenya; namely Kenyatta National Hospital, Dental Unit and Dental School Hospital of the University of Nairobi. It included consecutive patients seen at the two institutions during the period of study with the relevant clinical diagnosis and complete histopathological and radiological records. The imaging modality reviewed was the Orthopantomogram. A correlation was then made between the radiological and histopathological diagnoses and the results presented with the aid of tables.

Results

A total of 181 cases were recorded over a five year period. Odontogenic tumours were the most frequent tumours (47.5%). The most prevalent tumour overall was Ameloblastoma (38.7%) followed by Odontogenic Keratocyst (9.9%). The overall mean age was 28.9 years. Overall there was no statistically significant gender predominance. The average duration of illness was 34.7 years. Jaw tumours showed a predilection for the mandible. In at least 82.3% of cases, the radiological and histopathological diagnoses correlated.

Conclusion

There is a high level of correlation between radiological and histopathological diagnoses which is essential for optimal patient care.

INTRODUCTION

Odontogenic tumours and other lesions related to the jawbones have for years been recognized as to present clinical, radiological and histopathological challenges. Jaw tumours are rare, accounting for 1.3% of all tumours registered in the United States of America [1]. However, the accompanying morbidity to the individual patient is often devastating.

Radiology plays a key role in the detection and management of these lesions. This is especially important in the early stages, as the clinical features of the different lesions are often subtle and non-specific and may be relatively occult [2].

Early research seemed to indicate that the African jaw was particularly susceptible to tumours [3, 4]. Later research done at Kenyatta National Hospital (KNH) shows that although the incidence is not as high as was previously thought, jaw tumours and tumour-like conditions are indeed more common in Africans than in studies done on Caucasian populations and tend to pursue a more aggressive clinical course [5].

The management of these conditions is usually quite involving with far reaching impact on fundamental aspects of life such as breathing, eating, speech, hearing and cosmesis. As such, comprehensive clinical, radiological and histopathological correlation is important for their definitive diagnosis. The degree of overlap in the radiological features of these lesions may lead to mismanagement or delayed management of the malignant lesions. However the level of radiological and histopathological correlation is not well documented both globally and locally.

The aim of this study was to examine the correlation between radiological and histopathological diagnoses in KNH and Dental School Hospital, University of Nairobi in the period between January 2000 and December 2004 (inclusive). It concentrated on the patients who were evaluated using Orthopantomography (OPG). The radiographic results were then correlated with the biopsy report findings.

LITERATURE REVIEW

The tumours and tumour-like growths arising from the jaw constitute a heterogeneous group of lesions which are particularly interesting. However, there are few published studies that tell us about the frequency of these lesions. So far, epidemiologists in the African region appear to have paid scanty attention to the incidence of these lesions yet the serious morbidity arising from these locally destructive lesions can be quite distressing. In the available studies, difficulty in comparison of frequency figures is compounded by the non-uniformity of the inclusion and exclusion criteria used in categorizing jaw tumours [5].

In a 25-year retrospective study of odontogenic tumours (OT) in Chile, Ochsensius et al. [8] recorded 362 cases. The frequency of OT as a percentage of all pathological specimens was 1.29%. Benign tumours comprised 99.4% of all tumours and malignant tumours 0.6%. The average patient age was 25.2 years for both sexes. The most common benign tumour was Odontoma (45%), followed by Ameloblastoma (20.6%). Solitary cases of odontogenic carcinosarcoma and ameloblastic fibroodontosarcoma comprised the malignant tumours.

In a 42-year retrospective study on OT in China, Yong Lu et al. [9] recorded 759 cases. The mean patient age was 29.3 years. Benign tumours constituted 93.9% while malignant tumours were only 6.1%. The most frequent benign tumours were Ameloblastoma (58.6%) and Odontogenic myxoma (8.4%). Malignant Ameloblastoma was the most frequent malignant tumour.

An 18-year retrospective study of childhood oral tumours in Jordan carried out by Maaita et al. [10] recorded 172 cases. OT were found in 58 cases, with Odontoma being the most common (53.9%) and Ameloblastoma (27.8%) coming second.

Ogunsalu et al. [11] in Jamaica reported 32 cases of benign fibro-osseous lesions of the jawbones in a 15-year retrospective study. The most common lesions were fibrous dysplasia (46.9%) and ossifying fibroma (31.3%). The average age for these two lesions was 26 years.

A 15-year retrospective study of OT by Simon et al. [12] in Tanzania recorded 213 cases. Fifty-five percent of tumours were seen in patients below 30 years of age. Ameloblastoma

was the most common tumour constituting 73.7% of the total. Odontogenic myxoma was second at 10.3%.

In Nigeria, a 14-year retrospective study of Odontogenic cysts (OC) by Arotiba et al.[13] found that OC constituted 8.8% of all oral lesions (715 cases). Of these 61.9% were radicular cysts and 19% were dentigerous cysts. The peak incidence was in the second decade of life (44.4%).

In a 15-year retrospective study on the clinico-pathological analysis of jaw tumours and tumour-like conditions in Kenya, Wakiaga et al.[5] recorded 568 cases. The study covered the period between 1978 and 1992. Jaw tumours constituted 0.54% of all surgical specimens and 18.3% of tumours of the oral region. The peak incidence (excluding Burkitt's lymphoma) was in the second and third decades of life. Apart from Ameloblastoma and Burkitt's lymphoma, all the major tumours showed a slight female preponderance. The commonest lesions were Ameloblastoma (31%), Burkitt's lymphoma (24.7%) and Ossifying Fibroma (15%).

In a one-year prospective study of 100 patients with jaw tumours at KNH in 1988, Dr Sanjay V. Maroo[2] correlated the clinical and radiological findings of jaw tumours. The study was done between December 1986 and October 1987. Different radiographic techniques were used and of these 74 were Orthopantomograms (OPG). Majority of the patients were in the under-ten age group and most suffered from Burkitt's lymphoma. In the 11 – 30 year age group the most common tumour was Ameloblastoma; while in patients over 30 years Squamous Cell Carcinoma (SCC) of the oral cavity was the most common tumour. Overall, Ameloblastoma was the most common lesion (21%), SCC second (17%) and Burkitt's lymphoma was third (14%). OT accounted for 42% of all the tumours, fibro-osseous lesions, 10% and cystic lesions, 11%. This study also concluded that OPG was the radiological investigation of choice in detecting multiquadrant involvement.

ANATOMY OF THE JAWBONES

The term "Jawbones" refers to two bones that together make a large contribution to the facial skeleton, namely the maxilla and the mandible. The presence of epithelial tissue within the marrow of the maxilla and mandible is one of the dissimilarities between the jaws and other bones of the skeleton. The source of this epithelium is both odontogenic and non-odontogenic. Odontogenic epithelium is the remnant of enamel organs of teeth or the dental lamina and is found in both jawbones. Non-odontogenic epithelium is only found in the maxilla and is the remnant of the epithelium covering the embryonic processes giving rise to the maxilla. The presence of developing and mature dental tissues accounts for odontogenic lesions which are not encountered in other bones [2].

THE MAXILLA

The maxilla is found between the floor of the orbit and the gum margin [14]. It contributes a large share in the formation of the facial skeleton. It is made up of a body and several processes.

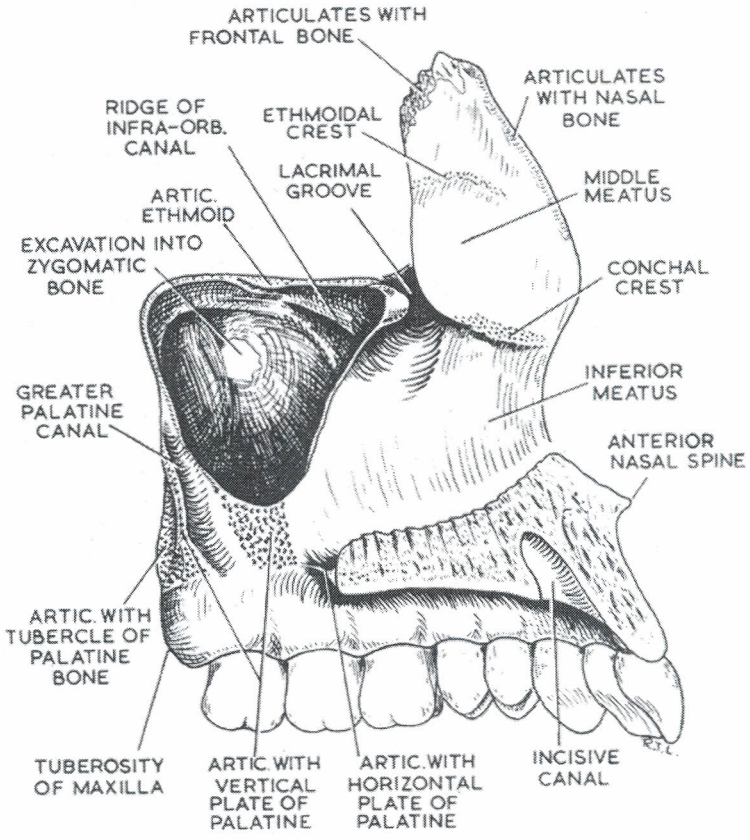


Fig. 1: Illustration of maxillary bones

The anterior surface of the body of the maxilla contains the nasal notch medially, the anterior nasal spine, infra-orbital foramen, incisive fossa and the canine fossa.
In the frontal view three processes are seen. These are the frontal process which articulates with the nasal bone anteriorly, the lacrimal bone posteriorly and the frontal bone superiorly; the zygomatic process which articulates with the zygomatic bone and the alveolar process which bears sockets for the upper teeth.

The maxilla wholly ossifies in membrane. A primary center appears in the body of the maxilla above the canine fossa at six weeks intrauterine life. The premaxilla ossifies a week later and is overlapped by bone from the primary center.

THE MANDIBLE

The mandible is the largest and strongest bone of the face. It has a horseshoe shaped body that lodges teeth and a pair of rami that project upwards from the posterior ends of the body. The rami provide attachment to various muscles. It is the second bone to ossify in the body. The primary ossification centers (one for each half of the body) appear about the sixth week of intrauterine life [15]. Bony union of the two halves takes place during the first year of life at the symphysis menti.

The Body

Each half of the body has outer and inner surfaces, and upper and lower borders. Several features are found on the outer mandibular surface[14]. The symphysis menti located at the junction of the two halves. The mental protuberance is a median triangular projection. The mental foramen located below the premolar interval. The oblique line is the continuation of the anterior border of the ramus. The incisive fossa is a depression below the incisors.

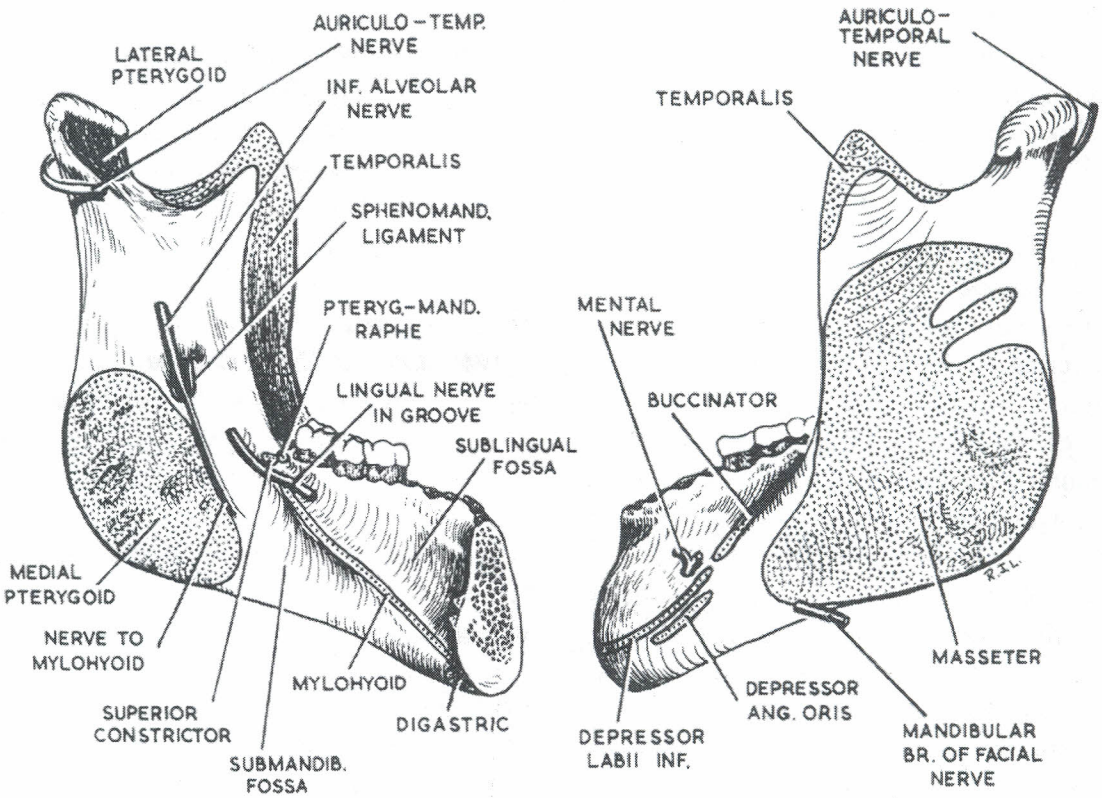


Fig. 2: Illustration of the mandibular bones

The inner surface contains several features. The mylohyoid line runs obliquely from the area below the third molar to median area below the genial tubercles. The submandibular fossa lodges the submandibular salivary gland. The sublingual fossa lodges the sublingual salivary gland. The genial tubercles (these are four in number) as well as the mylohyoid groove are also located on the inner surface.

The upper border is also known as the alveolar border and bears sockets for the teeth. The lower border is also known as the base. At the midline the base shows an oval depression called the digastric fossa.

The Ramus

The ramus is quadrilateral in shape and has [15] two surfaces (lateral and medial), four borders (upper, lower, anterior and posterior), a coronoid process and a condyloid process.

The medial surface contains the mandibular foramen at the level of the occlusal surfaces of the teeth; the mandibular canal which descends into the body of the mandible and opens at the mental foramen; the lingula (a sharp, tongue-shaped projection at the anterior margin of the mandibular foramen) and the mylohyoid groove.

The upper border is thin and curved downwards forming the mandibular notch. The lower border is the backwards continuation of the base of the mandible. The anterior border is thin while the posterior border is thick.

The coronoid process is a flattened, triangular, upward projection from the antero-superior part of the ramus. The condyloid process is a strong upward projection from the postero-superior part of the ramus. It is made up of several features. The head is covered by fibrocartilage and articulates with the temporal bone to form the Temporo-mandibular joint. The neck is the constriction below the level of the head and the pterygoid fovea (a depression on its anterior surface).

The mandible provides attachment for various muscles including the muscles of mastication, the strap muscles and the superior constrictor muscle, among others. Various vessels and nerves are also situated in the mandible including the mental vessels and nerves, the inferior alveolar vessels and nerves and the lingual nerve among others.

PATHOLOGY

The tumours and tumour-like conditions arising from the jawbones constitute a heterogeneous group of lesions arising mainly due to the presence of epithelial tissues within these bones. Jaw tumours are broadly grouped into benign and malignant conditions. Benign tumours can further be subdivided into odontogenic tumours (OT), non-odontogenic tumours, odontogenic cysts and fibro-osseous lesions. Malignancies affecting the jawbones include both primary bone tumours and metastatic disease. Further sub-classification is done using the WHO classification of 1992 (appendix 2).

PATHOLOGY 1: BENIGN ODONTOGENIC TUMOURS

Ameloblastoma

This is a benign, locally aggressive epithelial OT which is also known as Adamantinoma of the jawbones. It accounts for 11% of OT [16].

Socio-demographic characteristics

The peak age of occurrence is in the fourth decade but tumours have been recorded to occur at any age. Ameloblastomas show no sex predilection.

Clinical presentation

The mandible is more affected than the maxilla [17] with >80% presenting as a painless swelling of the jawbones.

Histology

Five classical patterns are recognized histologically [18, 19]: Follicular type (most common), Plexiform type, Acanthomatous type, Basal cell type and the Granular type. 2 histological variants have been added recently: Unicystic type and the Desmoplastic type [19].

Radiological features

Ameloblastomas range from unicystic [20] to multilocular in shape with well-defined, corticated, smooth and curved peripheries. In the maxilla however the periphery may be ill-defined. The internal structure of the tumour is completely radiolucent if the lesion is small. The multilocular cystic lesions are larger posteriorly with coarse and curved internal septa. The solid form is associated with loculations showing a honeycomb-like appearance. The lesions cause considerable effects on surrounding structures including: displacement of teeth, tooth root resorption, potential for considerable bone expansion and loss of the

anterior border of the coronoid process. Recurrent tumours are associated with considerable sclerotic bone reaction surrounding a collection of small cyst-like spaces.

Odontoma

Odontomas are considered to represent hamartomas and account for two-thirds of all OT.

Socio-demographic characteristics

These lesions show a peak during the second decade but may occur at all ages [21, 22]. The male to female ratio (M: F) = 1:1.

Clinical presentation

These lesions are almost always asymptomatic. Failure of tooth eruption may be the only presenting sign (50% of cases) while 27% of patients present with a dentigerous cyst. The maxilla and mandible are equally affected with the most common site being the anterior maxilla especially between the canines[22]. Complex odontomas occur commonly in posterior portion of jaw while compound odontomas are mainly in the anterior portions.

Histology

Two classic types have been described[8]: complex odontoma and compound odontoma. In some cases mixed odontomas may be found.

Radiological Features

Complex odontomas may be roughly oval/ round/ lobulated in shape while compound odontomas are usually irregular. Both histological types have a well-defined cortex surrounding an adjacent band of soft tissue. The internal structure of the lesion is characteristically very radiopaque compared to bone. The organization of the internal structure of the complex odontoma is haphazard while that of the compound odontoma is more organized with unusually shaped tooth-like structures (denticles).

Calcifying Epithelial Odontogenic Tumour

This is a rare benign neoplasm accounting for < 1% of all OT.

Socio-demographic characteristics

Most of the lesions are seen in 40 year old patients but may occur at any age. There is no recorded gender predilection.

Clinical presentation

These tumours when symptomatic present as painless, slowly enlarging masses.

Tumours are mainly in the mandible with a ratio of 2:1. They are mainly located in the premolar – molar area associated with an unerupted tooth [8].

Histology

The microscopic appearance is reported as characteristic sheets of polyhedral cells with well-defined eosinophilic cytoplasm and hyperchromatic nuclei.

Radiological features

Calcifying epithelial odontogenic tumours may be irregular or cystic in shape. Cystic lesions have well-defined and corticated peripheries while the irregular tumours appear ill-defined. Small unilocular lesions have radiolucent centers while others have variable amounts of calcification internally. Larger tumours have a multilocular or honeycomb appearance. These tumours usually displace teeth and often prevent tooth eruption.

Ameloblastic Fibroma

This is a benign mixed epithelial-mesenchymal neoplasm representing 2% of all OT

Socio-demographic characteristics

Ameloblastic fibroma mainly occurs during the second decade of life with >70% of tumours occurring in patients younger than 20 years of age. M: F = 1:1.

Clinical presentation

Most lesions present with clinical symptoms including swelling, pain or failure of tooth eruption. Seventeen percent (17%) are incidental radiological findings. Over 80% of the tumours are located in the mandible mainly posteriorly. Occasionally they maybe found in the pericoronal position or in the superior aspect of alveolar process.

Histology

Both epithelial and mesenchymal components are present in this tumour. The epithelium is in strands and budding islands within a loose connective tissue stroma.

Radiological features

The lesions are generally cystic while larger lesions are usually multilocular. Most tumours are well-defined and corticated. However if the lesion is in a superior position the periphery may be delicate.

Ameloblastic fibromas are often radiolucent but may have fine, curved trabeculae. Various effects have been recorded on surrounding tissues including: prevention of tooth eruption, tooth displacement, rarely tooth resorption while larger lesions cause bone expansion.

Ossifying and Cementifying Fibroma

This is a benign fibroosseous neoplasm composed of varying amounts of immature hard tissues in a background of fibrovascular connective tissue

Socio-demographic characteristics

Ossifying and cementifying fibromas mainly occur during the third and fourth decades of life. A marked male predominance has been documented in literature with a ratio of 4:1.

Clinical presentation

These lesions are generally asymptomatic but may cause local enlargement. Mandibular lesions account for 75 to 80% of cases and lesions may be multiple [23].

Histology

The microscopic picture is that of various amounts of hard tissue in very cellular fibrovascular tissue.

Radiological features

Most tumours are irregular though some may be round or oval in shape. The periphery is usually well-defined but may be ill-defined and blend in with the surrounding. The internal structure consists of a mixture of radiolucent and radiopaque tissue with a predominance of calcified material. Patterns may vary from granular, "cotton-wool", flocculent to ground glass. The presence of septa may give a multilocular appearance. Some lesions may appear as cyst-like structures with a radiolucent center. These fibromas may displace teeth, rarely cause tooth resorption, have a potential for massive jaw expansion or cause displacement of inferior alveolar canal and floor of antrum.

Odontogenic Myxoma

This is a benign mesenchymal neoplasm accounting for 3% of all OT [22].

Socio-demographic characteristics

Tumours mainly occur in the second and third decades of life; with an age range of one to 76 years [23]. There is a slight female preponderance of 1:1.3.

Clinical presentation

These lesions usually present as painless slowly enlarging jaw masses. Mandible: maxilla= 1.5:1. Tumours in the mandible are mainly found in the ramus and molar regions. In the maxilla they mainly occupy the premolar – molar regions.

Histology

The histological picture is that of very loose fibrillary connective tissue interspersed with stellate fibroblasts and occasionally islands of odontogenic epithelium

Radiological features

These tumours are usually irregular in shape with a minority appearing cystic. They usually have ill-defined borders but bone expansion may be associated with trabeculae giving "sun-ray" spiculated appearance. Odontogenic myxomas are usually multilocular with characteristically thin, etched straight septa. They may displace teeth, grow around teeth with little movement or rarely cause tooth root resorption.

Adenomatoid Odontogenic Tumour

This is a benign epithelial neoplasm accounting for 3% of OT

Socio-demographic characteristics

The peak age of occurrence is during the second decade of life with >70% of patients under 20 years of age [24, 25].M: F = 2: 3.

Clinical presentation

Adenomatoid odontogenic tumours generally present as an intra-oral swelling. Sixty-five percent are located in the maxilla, mainly in the anterior segments [26].

Histology

These tumours are described histologically as sheets and islands of epithelial cells with formation of rosettes, duct-like spaces and whorls. Cystic spaces with foci of calcification are common and tumour cells are surrounded by thick fibrous connective tissue capsule.

Radiological features

On imaging the tumours present with curved borders and a cyst-like appearance. Many are well-defined with a peripheral cortex while others are ill-defined. Their internal structure ranges from totally radiolucent to punctate calcifications with cloud-like appearance. They may cause displacement of teeth, prevent tooth eruption or considerable jaw expansion.

Ameloblastic Fibroodontoma

This is a benign mixed neoplasm accounting for 2% of OT

Socio-demographic characteristics

Over 60% occur in the first decade of life with an average age of eight years. A slight male predominance of 1.3: 1 is quoted [5].

Clinical presentation

Most tumours are asymptomatic or may present as a painless swelling. Sixty-two percent (62%) are located in the mandible, mainly in the posterior segments.

Histology

The microscopic picture contains components of both ameloblastic fibroma and odontoma

Radiological features

Ameloblastic fibroodontomas are well-circumscribed with cortication of some segments. They may have one or several small fragments of tooth material and may either displace teeth, prevent tooth eruption or cause considerable jaw expansion.

Cementoblastoma

This is a benign mesenchymal neoplasm accounting for <1% of OT

Socio-demographic characteristics

They mainly occur in the second and third decades of life with an average age under 25 years. M: F = 3: 2.

Clinical presentation

Pain is a significant symptom associated with swelling and tooth displacement. Sixty percent (60%) occur in the mandible, mainly in the molar and premolar regions.

Histology

Sheets of hard tissue intermingled with very vascular and cellular connective tissue; exhibits plump hyperchromatic cementoblasts.

Radiological features

The tumours are usually circular and are well-defined by a radiopaque band of reactive bone. The internal structure is radiopaque with the greatest density at the center (spoked-wheel pattern). They may cause tooth root resorption, considerable jaw expansion with maintenance of outer cortical plates or displacement of inferior alveolar nerve canal.

PATHOLOGY 2: BENIGN NON-ODONTOGENIC TUMOURS

Osteoma

Osteomas are benign lesions that are thought to represent hamartomas. They may be endosteal or subperiosteal in origin.

Socio-demographic characteristics

These tumours mainly develop during the sixth decade of life but have range of 16 to 74 years [5]. There is a female predilection of 1: 3.

Clinical presentation

Mandibular condyle, angle of mandible, frontal sinus, maxillary sinus

Patients present with either a painless, slowly enlarging mass (usually) or they may be an incidental finding. In a few occasions they have been reported to present with signs of sinus obstruction.

Histology

Compact (ivory) osteoma is composed of dense lamellar cone with few small medullary spaces. The trabecular (spongy) osteoma is composed of trabecular bone with varying amounts of fatty hematopoietic marrow and loose connective tissue in large medullary spaces [27].

Radiological features

These tumours are usually round or oval in shape. They are attached by a broad base (or rarely by a stalk) to the parent bone with a smooth, well-defined and well-corticated periphery. Internally the compact osteoma has a homogeneous radiopaque appearance with granular texture while the cancellous type has a trabecular pattern. They commonly have no effect on parent bone but may cause displacement of the surrounding soft tissue and mandibular condyle.

Central Giant Cell Granuloma

This is a benign reactive lesion characterized by the presence of numerous multinucleated giant cells.

Socio-demographic characteristics

Central giant cell granulomas usually occur during the first two decades of life with an average age of 21years. Male to female ratio = 1: 1.4.

Clinical presentation

The Lesion is usually a painless, enlarging mass with mobile or displaced teeth. The mandible is affected in two-thirds of cases mainly in the anterior segments.

Histology

Microscopically they are described to have very cellular connective tissue stroma with little intercellular matrix and numerous multinucleated giant cells dispersed throughout the lesion.

Radiological features:

Tumours are usually irregular in shape and may appear undulating while a few are multilocular. The margins are commonly ill-defined and can appear invasive. Small lesions are radiolucent; others have a barely detectable radiopaque granular haze with wide, ill-defined septae. These granulomas may destroy the lamina dura, cause displacement of teeth or extensive root resorption.

Melanotic Neuroectodermal Tumour of Infancy

These are benign pigmented neoplasms arising from neural crest remnants.

Socio-demographic characteristics

Over 95% occur under the age of one year with no gender bias reported.

Clinical presentation

This tumour mainly presents as a pigmented swelling with displacement of the deciduous central incisors. Seventy percent are in the anterior maxilla. Other sites include the mandible, epididymis, thigh, mediastinum, zygoma, shoulder, skull, brain and other tissues.

Histology

Epithelial cells and round dark cells with varying amounts of melanin pigment

Radiological features

This primitive tumour is usually irregular and may cause circular expansion of the maxilla. The margins are commonly ill-defined, simulating a malignant tumour. They are very destructive with no perceptible surrounding bone reaction.

Osteoblastoma

Osteoblastoma is a benign neoplasm representing 1% of all primary bone tumours.

Socio-demographic characteristics

The average age of tumour occurrence is 17 years with a range of 5 to 37 years. There is a male predominance of 2: 1.

Clinical presentation

Pain and swelling are the most common symptoms with most lesions being centrally located although a few have a periosteal location.

Histology

Microscopic picture is that of rows of plump osteoblasts producing abundant trabeculae of osteoid and immature bone.

Radiological features

Osteoblastomas are usually irregular or round to oval in shape with margins that are well-delineated by a variable wide band of bone sclerosis. Internally they have radiolucent centers or a mixed radiolucent-radiopaque pattern. They may show significant bone expansion, destroy the lamina dura, cause displacement of teeth or extensive root resorption.

PATHOLOGY 3: MALIGNANCIES AFFECTING THE JAWS

Osteogenic Sarcoma of the Jaws

This is a malignant bone neoplasm that is bone producing. It is the second most common primary malignant neoplasm of bone constituting 20% of all sarcomas [28]. Only 7% of the lesions are found in the jaws. Overall incidence in the United States is 0.07 per 100,000 population per year [28, 29].

Socio-demographic characteristics

Most lesions occur in the third to fourth decades but the age range is 12 to 79 years. Males are more commonly affected than females.

Clinical presentation

This is usually as a painless or painful mass with rapid growth, toothache, proptosis, loose teeth, nasal obstruction and mucosal ulceration. The serum alkaline phosphatase levels are raised. The mandible is more commonly affected than the maxilla.

Radiological features

The cardinal radiological signs include: a single ragged or ill-defined radiolucency; an expansile jaw mass with or without cortical defect; short linear areas of radiolucency in inferior cortical bands in mandibular lesions; discontinuity in antral or nasal wall cortices; ballooning of the inferior cortical band; granular or sclerotic appearance of bone; new periosteal bone reaction with accompanying destruction; "Sun-ray" or "hair-on-end" appearance; localized increased density of a cortical margin and a Codman's triangle.

Ancillary radiological signs include: symmetric widening of periodontal ligament, a soft tissue mass associated with a destructive or productive osseous lesion; loss of adjacent lamina dura and laminar periosteal new bone formation.

African Burkitt's Lymphoma

This is a high-grade, non-Hodgkin's lymphoma of B-cell lineage, characterized by a translocation of the distal parts of chromosomes 8 to 14 [27].

Socio-demographic characteristics:

Endemic African Burkitt's lymphoma affects children 3 to 14 years of age [23, 30]. The American form affects an older age group with a range of 2 to 60 years [7]. There is a male predominance of 2: 1.

Clinical presentation

Burkitt's lymphoma involves the mandible, maxilla, retroperitoneum, kidneys, liver, ovaries and endocrine glands. Extranodal involvement is the norm and large tumours affect the jawbones and abdominal viscera. The jaw is the initial focus in about 50% of patients [27]. Growth is rapid with a potential doubling time of 24 hours. They loosen teeth and destroy alveolar bone and rapidly involve the paranasal sinuses and orbits.

Radiological features

These are said to precede clinical signs and symptoms.

The cardinal radiological signs include: an expansive jaw lesion; multiple well-defined or ill-defined osteolytic lesions starting as discrete zones and then coalescing; ballooning, expansion, erosion or perforation of bony cortex of the jaw with soft tissue involvement; destruction of lamina dura (initial sign) and displacement of teeth and tooth buds.

The ancillary radiological signs include: excessive eruption for the amount of tooth root formation; effacement of bone trabecular pattern; effacement of the cortex of maxillary sinus or orbit; sunray spiculation of periosteal bone and cortical destruction.

Hodgkin's Lymphoma

Hodgkin's Lymphoma is characterized by Reid-Steinberg cells. It accounts for 0.7% of all malignancies, with osseous involvement in 10 to 20% of cases [31].

Socio-demographic characteristics

Peak age of occurrence for this lymphoma is 15 to 35 years with smaller peaks at nine to eleven years and 75 to 80 years [27]. Males are more commonly affected than females.

Clinical presentation

The jaws are involved in less than one percent, usually the mandible [31]. Pain often precedes radiological evidence and regional lymph nodes inevitably affected.

Radiological features

Cardinal signs include: a large soft tissue mass; ill-defined radiolucency in bone; sclerotic bone reaction in 14% of cases; mixed blastic/ lytic reaction in six percent; osseous resorption beneath involved lymph nodes and multiple areas of punched-out radiolucency. Ancillary radiological signs include: cortical loss adjacent to lesion with concurrent periosteal reaction in five percent and loss of the lamina dura.

Non-Hodgkin's Lymphoma

This lymphoma is characterized by the absence of Reid-Steinberg cells.

Socio-demographic characteristics

This is a tumour of patients who are 60 to 70 years of age and is rare before 10 years. Males are more commonly affected than females.

Clinical presentation

Maxillary antrum is frequently affected however if antral lesions are excluded then the mandible is a more common site than the maxilla. Nodal disease is the most common presentation. Extranodal disease occurs in five to twenty five percent and of these, five percent involve bone. Gnathic lesions may invade the jawbones or arise in them.

Radiological features

Cardinal radiological signs include: an ill-defined radiolucent lesion; lesions that are generally more destructive than Hodgkin's disease and are poorly demarcated from normal bone.

The ancillary radiological signs include: multiple areas of destruction separated by normal appearing bone; effacement of normal bony architecture; loss of lamina dura; tooth displacement; subperiosteal new bone formation; widened bony cortex; premature tooth loss and bone expansion.

Multiple Myeloma

Multiple myeloma is a multifocal plasma cell cancer of bone. It is the commonest primary bone malignancy in adults (constitutes 53% of primary bone tumours).

Socio-demographic characteristics

It mainly affects patients 50 to 70 years of age and is rare below 30 years. Males are more commonly affected than females.

Clinical presentation

Patients present commonly with pain, swelling, and numbness of the lip as well as mobility of the teeth. Lesions are widespread in the jawbones but the mandible is more often affected than the maxilla.

Radiological features

Cardinal radiological signs include: multiple punched-out radiolucencies in the jaws; well-defined, uncorticated margins which occasionally appear ragged and bone lesions that are separated by normal or nearly normal bone.

Ancillary radiological signs include: loss of bone density; generalized loss of lamina dura in late disease; periapical radiolucency may be the first sign; cortical thinning and pathological fractures.

Chondrosarcoma

Chondrosarcoma is a malignant cartilaginous tumour arising de novo in bone or soft tissue. It accounts for 10% of primary bone malignancies.

Socio-demographic characteristics

The age range for jaw lesions is 20 to 50 years. Males and females are equally affected.

Clinical presentation

Both the mandible and maxilla are affected in equal proportions. In the maxilla, anterior sites are favored while in the mandible posterior sites are favored. Patients may present with pain, swelling, facial deformity, proptosis, gingival bleeding and mobility of the teeth.

Radiological features

Cardinal radiological signs include: mixed radiolucent and radiopaque lesion; ground-glass appearance; sun-ray spiculation and flocculent internal structures

Ancillary radiological signs include: widened periodontal ligament space; sinus opacification; adjacent soft tissue mass usually with cortical destruction and moth-eaten bone alternating with normal bone.

Metastatic Disease to the Jaws

These are lesions that are localized to bone and microscopically verified to originate from a known primary tumour. 1% of all malignancies metastasize to the jaws [7].

Socio-demographic characteristics

Tumours mainly occur in the sixth decade and males and females are equally affected.

Clinical presentation

Mandibular lesions account for 85% of the jaw lesions and generally present with pain, swelling, numbness, paraesthesia and mobility of the teeth.

Radiological features

Cardinal radiological signs include: well-circumscribed but uncorticated lytic lesions in the posterior mandible; lesions that are irregular in shape and lesions initially discrete but coalesce with increase in size.

Ancillary radiological signs include: bone expansion; soft tissue calcification accompanying extraosseous or periosteal metastases; rarely lesions that are osteoblastic and generalized loss of lamina dura.

PATHOLOGY 4: CYSTS OF THE JAWS

Calcifying Odontogenic Cyst

These are developmental lesions arising from odontogenic epithelial remnants in the gingivae or jaws that may occasionally behave aggressively [32]. They account for 3:10,000 oral biopsies.

Socio-demographic characteristics

Peak age is in the second decade and tumours usually below the age of 40 years. Males and females thought to be equally affected.

Clinical presentation

70% of these are found in the maxilla, usually anteriorly [22]. Lesions present as localized slow growing masses, occasional pain, tooth displacement or non-eruption.

Radiological features

Cardinal radiological signs include: initially unilocular or multilocular radiolucency with discrete well demarcated margins; "salt and pepper" pattern of calcification and the lesion may be a homogeneous radiolucency.

Ancillary radiological signs include root resorption.

Dentigerous Cyst

These are cysts arising in the follicular region of an unerupted tooth attached to its cemento-enamel junction in the cervical region. It is reported to be the second most common odontogenic cyst.

Socio-demographic characteristics

Dentigerous cysts occur in the second and third decades of life [33]. Male to female ratio is 1.6: 1.

Clinical presentation

Clinical symptoms are generally absent though non-eruption of a tooth may be an indicator. Bone expansion in large lesions as well as crackling or crepitation on palpation may be the only signs. The third molar regions of the mandible and maxilla and also the maxillary canine regions [34] are the sites of predilection.

Radiological features

Cardinal radiological signs include: well-defined unilocular radiolucency associated with the crown of an unerupted tooth with well defined and sharp bony margins; symmetrical envelopment of the crown and tooth displacement.

Ancillary radiological signs include: trabeculations which may overlie the cyst with an erroneous impression of multilocularity; loss of the bony cortex from the margins suggesting suppuration or malignancy and loss of visualization of the lamina dura with larger cysts.

Odontogenic Keratocyst

Odontogenic keratocysts are odontogenic cysts lined by keratinizing epithelium which exhibit an aggressive biologic behavior. They represent 5 to 15% of all jaw cysts [22].

Socio-demographic characteristics

These cysts occur during the second and third decade of life [22] with a male to female ratio of 1.3: 1.

Clinical presentation

Keratocysts are usually an incidental finding and bone expansion is considered a late sign. There are high recurrence rates after inadequate surgery (62%) [35]. Mandible is affected twice as often as the maxilla, usually in the posterior body and ramus. Maxillary cysts occur in the third molar area.

Radiological features

Cardinal radiological signs include: well circumscribed radiolucency with smooth margins and thin radiopaque borders, scalloped margins in unilocular lesions; larger lesions may be multilocular while most lesions are unilocular with 40% found adjacent to an unerupted tooth.

Ancillary radiological signs include: extensive mandibular involvement which may precede bone expansion and tooth displacement and resorption.

Lateral Periodontal Cyst

This is a non-keratinized, non-inflammatory, developmental intraosseous cyst adjacent or lateral to the root of a tooth. It is directly associated with the periodontal membrane. Its prevalence was reported as 1.6% of odontogenic cysts in one series [13].

Socio-demographic characteristics

Lateral periodontal cysts occur in the fifth and sixth decades of life with an age range 20 to 85 years. More men are affected with a ratio of 2: 1.

Clinical presentation

These cysts follow an insidious clinical course. Most are asymptomatic and are found as incidental findings on radiography. Clinically a few present as a small soft tissue swelling in or inferior to the interdental papilla. Most periodontal cysts occur in the mandibular premolar and canine regions towards the facial aspect of the alveolus.

Radiological features

The only cardinal radiological sign is that of a well-delineated radiolucency with an opaque margin along the lateral surface of the root of the tooth.

Radicular Cyst

A radicular cyst is an inflammatory cyst that derives its epithelial lining from proliferation of the small odontogenic epithelial residue of Malassez rests in the periodontal ligament [36]. It is the most common cyst of the oral and perioral regions constituting one half to three quarters of oral cysts in most studies [37].

Socio-demographic characteristics

Peak age is from the third to the sixth decades of life [22] with a male preponderance.

Clinical presentation

Radicular cysts are usually asymptomatic and are discovered incidentally. Bone expansion is rare and if it occurs is a slow process. Long standing cysts may be destructive. The presence of a non-vital tooth is required for diagnosis of a Radicular cyst. The mandible is mainly affected.

Radiological features

Cardinal radiological signs include: a radiographic appearance similar to that of periapical granuloma and a round to ovoid radiolucency with narrow opaque margin that is continuous with the lamina dura of the involved tooth.

Ancillary radiological signs are mainly: root resorption in long standing lesions; window in periosteum and displacement of anatomical structures.

Residual Cyst

Residual cysts are cysts that are left behind after a tooth is removed.

Socio-demographic characteristics

The older age group more affected and the cysts show a male preponderance.

Clinical presentation

These cysts are usually related to a previous inflammatory periapical lesion. A missing tooth may be a sign while large lesions are associated with jaw expansion. Mandibular premolar region is the main site involved.

Radiological features

Cardinal radiological signs include: a radiographic appearance is similar to that of periapical granuloma except for missing tooth and a round to ovoid radiolucency with narrow opaque margin.

Aneurysmal Bone Cyst

This is a non-neoplastic lesion of bone consisting of several cavities filled with blood and without an endothelial or epithelial lining. They constitute only 1% of all non-odontogenic, non-epithelial cysts of the jaws and 1% of all Aneurysmal Bone Cysts (ABC) occur in the jaws [22].

Socio-demographic characteristics

These cysts are found predominantly in young persons, rarely manifesting after the third decade of life. They show no gender predilection.

Clinical presentation

Almost all lesions affect the mandible, especially the posterior body and vertical ramus. Patients present with swelling of overlying soft tissues caused by bony expansion, perforation of the cortex, pain and tenderness on palpation.

Radiological features

Cardinal signs include: radiolucent expansile mass; well-defined and well corticated borders; overlying cortex may be effaced when gross ballooning of the jaw is present; commonly multilocular and a mixed radiolucent and radiopaque lesion is not uncommon. Ancillary signs include: displacement of mandibular canal without erosion; vascularity demonstrated on angiography and a high uptake on radionuclide imaging.

PATHOLOGY 5: FIBRO-OSSEOUS LESIONS

Fibrous Dysplasia

This is the idiopathic, benign, developmental replacement of normal medullary cavity by fibrous tissue and immature woven bone [38]. It is the most common tumour-like condition of bone. Craniofacial involvement occurs in 25% of monostotic form and 50% of polyostotic form [31]

Socio-demographic characteristics

Fibrous dysplasia is common in childhood and adolescence [11]. Males and females are thought to be equally affected.

Clinical presentation

Majority of the lesions are found in the maxilla especially the zygomatic process, mandibular lesions are mainly in the molar area. It presents as a localized slow growing mass, painless, facial asymmetry, abnormal spacing of teeth with malocclusion. Growth tends to cease in the late teenage years.

Radiological features

Cardinal signs include: an initially radiolucent lesion that is either unilocular or multilocular; mottled radiopacity in intermediate stage; densely radiopaque with time; ground-glass appearance on extraoral radiographs; "Peau d'orange" appearance on intraoral radiographs and poorly defined margins.

The main ancillary sign is a fusiform rather than a spherical outline.

Florid Osseous Dysplasia

This is an idiopathic progressive patchy sclerosis of the jaws which may be familial.

Socio-demographic characteristics

Patients are mostly 25 years and above with females (mainly Black women) being more frequently affected than men.

Clinical presentation

Florid osseous dysplasia is usually asymptomatic unless osteomyelitis is superimposed and is generally an incidental finding. 90% involve the mandible while 60% involve all four jaw quadrants [11].

Radiological features

Cardinal signs include: multiple sclerotic masses; occasionally a thin radiolucent peripheral band; "Pagetoid" cotton wool appearance; coalescence to form a single lobulated diffuse mass and a "Ground-glass" appearance of alveolar bone with loss of periodontal ligament space.

Ancillary signs include: a zone of normal bone which separates the lesion from the lower mandibular cortex; an extension of lesions to the surface of the mandibular edentulous ridge; slight jaw expansion in some cases and tooth displacement is uncommon.

Periapical Cemental Dysplasia

These are idiopathic multiple reactive lesions in periapical bone. It accounts for less than 1% of fibro-osseous lesions affecting the jawbones [39].

Socio-demographic characteristics

Peak age is 40 years; rare before 20 years. Females (mainly Black women) are more frequently affected than men.

Clinical presentation

Periapical cemental dysplasia is generally an incidental finding which commonly affects the mandibular incisor region.

Radiological features

Cardinal signs depend on the stage of the disease: Stage I: Periapical radiolucencies with intact periodontal ligament space; Stage II: "Cotton wool" radiopacity with an apical radiolucency that has a target-like appearance and Stage III: Radiopaque lesion (simulates florid osseous dysplasia).

The main ancillary sign is the presence of a sclerotic rim around lesions in some cases particularly at their lower borders.

PAGET'S DISEASE

Paget's disease is an idiopathic, slowly progressive disease of bone characterized by abnormal resorption and deposition with sclerosis and expansion of affected bones. It occurs in 1% of the population and affects the jaws in 20% of cases [27].

Socio-demographic characteristics

This condition is common in the elderly with a range of 55 to 85 years. It is unusual below 40 years with a male predominance = 2: 1.

Clinical presentation

Maxilla is affected twice as frequently as the mandible. There is bone pain and deformity in the initial phase. Later bone expansion occurs with abnormal teeth spacing and inability to close the mouth fully.

Radiological features

Cardinal signs depend on the stage of the disease. Early stages: patchy osteoporosis and generalized radiolucency. Intermediate stage: mixed radiolucency and radiopacity; "driven snow" coarse trabeculation. Final stage: "cotton wool" radiopacities and enlarged bones. Ancillary signs include: Hypercementosis; loss of lamina dura; obliteration of periodontal ligament spaces and external root resorption.

Cherubism [40]

Cherubism is a rare dysplasia of bone usually inherited as an autosomal dominant condition (autosomal recessive variants exist). A rare condition, it is usually familial but non-familial forms exist.

Socio-demographic characteristics

This is usually an early childhood condition with males and females being affected equally.

Clinical presentation

Maxilla and mandible are affected equally and symmetrically. It is a painless, disfiguring disease with symmetrically swollen cheeks particularly over the angles of the mandible. It gradually increases until puberty and thereafter regresses spontaneously.

Radiological features

Multilocular osteolytic lesion with dislocated teeth, bone expansion and tooth aplasia.

THE ROLE OF ORTHOPANTOMOGRAPHY

Orthopantomography utilizes the principle of tomography in which specialized x-ray equipment blurs out the shadows of superimposed structures to show more clearly the principal structures within a given plane that is being examined[41]. Orthopantomographic equipment uses a system of synchronized rotary movements between the x-ray tubes and an extra-oral film in a curved cassette as they move around the patient's head in opposite directions producing a panoramic roentgenogram of a curved surface. The tube follows the shape of the mandibular curve during the exposure and at the same time the curved cassette rotates on its own axis. A narrow vertical slit diaphragm at the tube port closely collimates the x-ray beam. In this way a full-mouth examination is possible with a single exposure. Tomography and the use of screen-film combination however results in images showing less image detail than intraoral images.

The success of this technique depends upon accurate positioning of the patient's head without which there would be image unsharpness as the plane of focus would not be centered on the alveolar margin.

Advantages of Orthopantomography (OPG)

It provides a general survey of the dental condition of a patient. The examination of children and edentulous patients by intra-oral technique is difficult but this technique is of great value in these cases.

Image acquisition is relatively fast and simple without the need for intraoral manipulation

Reduction of the radiation dose to the patient to about a third of the dose received from a full mouth series of 14 intra-oral films.

The upward angulation of the x-ray beam directs the beam away from the gonads.

Disadvantages of OPG

It cannot be used for bedridden patients due to difficulty in positioning.

It cannot be used for patients who cannot or are unwilling to co-operate due to the long exposure time used (19 seconds)

There is the potential for image distortion as the horizontal and vertical magnification are determined by different mechanisms and vary independently as a function of the location of a structure within the image layer.

RESEARCH QUESTION

What is the pattern of presentation of tumours and tumour-like conditions involving the jawbones in Kenya and what is the level of correlation between the radiological and histopathological diagnoses of these tumours and tumour-like conditions?

JUSTIFICATION

Jaw tumours and tumour-like lesions though rare, are a major cause of debility and deformity. These lesions often have similar clinical presentations but are radiologically dissimilar. A good example is the case of ossifying fibroma versus fibrous dysplasia both of which clinically present as progressive slow-growing painless tumours. Radiologically they are only differentiated by the presence of a well-demarcated border in ossifying fibroma while in fibrous dysplasia the border is diffuse and merges with normal bone[42]. Early detection is vital to the effective management of all these lesions and this is heavily dependent on the radiologist and clinician's diagnostic acumen. Mourshed [43] in 1964 stressed the importance of early radiological diagnosis of dentigerous cysts leading to early surgical intervention thereby avoiding the advanced stages of the disease with the associated complications and deformities. In addition, clinically dormant or asymptomatic cysts may be recognized on routine radiography leading to early treatment.

The decision on whether or not to perform a biopsy on jaw lesions usually hinges on its radiological appearance. However these features are highly variable, even in the case of an individual tumour, leading to diagnostic uncertainty. Radiological expertise therefore needs to be improved so as to assist in the management of these often disfiguring lesions.

Studies correlating the radiological and histopathological appearances of jawbone tumours have not yet been undertaken in Kenya. A related study by Maroo [2] in 1988 correlated radiological and clinical presentations of jaw lesions but did not include the histopathological diagnosis. While there have been a few studies which addressed the epidemiological and clinical aspects of these jaw lesions[2,5,8,10,11,12,16,23], there were no reports in the literature on studies that correlated radiological and histopathological patterns of jaw tumours. The importance of such studies and their contribution to patient management would be very significant as they would increase the diagnostic acumen of both the radiologists and maxillo-facial surgeon leading to early and timely treatment of the patients.

Thus this study will serve as an audit as well as a means to help stimulate interest in this particular area of radiology while adding new knowledge on the role of radiology on the diagnosis of these tumours.

OBJECTIVES

Broad Objective

The main objective of this study was to determine the pattern of presentation and the level of correlation between the radiological and histopathological diagnoses of jaw tumours and tumour-like lesions in patients seen at KNH and the Dental School Hospital of the University of Nairobi.

Specific Objectives

The specific objectives of this study were to determine the age and sex distribution as well as the relative frequency of the lesions under study as well as the anatomical distribution of these lesions in the jawbones. The study also aimed at correlating the radiological diagnoses and the histopathological diagnoses of these lesions.

MATERIALS AND METHODOLOGY

Study Area

This study was conducted at the Kenyatta National Hospital (KNH), Dental Unit and the Dental School Hospital of the University of Nairobi (DSH) using records stored in their records departments.:

Both of these centers are the leading referral centers for dental lesions in Kenya. They are teaching institutions with experienced dental and maxillofacial surgeons on staff as well as registrars and undergraduate students. In addition, both institutions are equipped with theaters where the biopsies are obtained and have fully equipped Pathology departments where the specimens are reviewed.

Study Population

This consisted of all patients seen at these two study areas between January 2000 and December 2004 (inclusive) with available records of: a clinical diagnosis of a jaw tumour or tumour-like lesion; OPG film(s) and a histopathological report of the biopsy specimens.

Study Design

This was a cross-sectional descriptive retrospective study.

Sample Size Determination

This was determined using Fisher's formula.

$n = Z^2 P (1-P) / d^2$

Where, n = sample size

Z = standard normal deviate value corresponding to 95% confidence level (=1.96)

P = estimated proportion of jaw tumours to other tumours. The American value was used, therefore P = 1.3%[1]

d = degree of precision set at 5%

$n = 1.96^2 \times 0.013 \times 0.987 / 0.05^2 = 20$ patients per annum.

This was a five year retrospective study so the expected sample size was multiplied by five

$n = 20 \times 5 = 100$ patients.

This figure was regarded as a minimum sample size and was exceeded during the study duration.

The actual number of patients studied was 181.

Sampling Method

All consecutive patients managed for the relevant conditions within the specified period of time and who met the inclusion criteria outlined below were included in the study.

Inclusion and Exclusion Criteria

Inclusion Criteria:

Patients of all age groups were considered who had a clinical diagnosis of tumour or tumour-like condition of the maxilla and mandible. Records that were required for inclusion into the study were the availability of OPG films as well a histopathological report from the tissue biopsy.

Exclusion Criteria:

The following conditions were excluded from the study: primary inflammatory lesions of the jaw; lesions secondary to trauma; tumours of the maxillary sinus and conditions originating from the salivary glands, oral tissues, dental tissues and surrounding soft tissues.

Materials and Procedures

The relevant records and radiographs were obtained from the records departments of the two institutions. Information on the names and patient numbers of the study subjects were obtained from both the theatre lists and the day books of the two institutions covering the period under study. The patient's particulars i.e. hospital number, X-ray number, age, sex, concise relevant clinical history and date of x-ray were obtained from the patients file and entered into the data collection sheet (Appendix 1).

The OPG was the only radiographic modality reviewed. This was to try and maintain consistency as it is the only plain radiographic technique that depicts the jawbones in their entirety in one exposure. The types of OPG machines in use at the two centers during the relevant period were: KNH – Yoshida Panoura 10 model no 35-927835F1 year of manufacture 1976 and DSH – CGR elliptix model no. 46-154870G2 year of manufacture 1978.

The principal investigator, using the format outlined in the data collection sheet (appendix 1), studied the OPG without first looking at the recorded radiological or histopathological diagnosis so as to avoid bias and came up with a preliminary diagnosis. The same films were then further discussed by a panel which included the principal investigator and

qualified radiologists and the final radiological diagnosis was agreed upon. A record was then made of the final radiological diagnosis.

The histopathological reports of the tissue biopsies were obtained from the patient's file and noted on the data collection form. Where necessary (e.g. in the case of missing reports) further clarification was obtained from the pathology departments and records departments of the two institutions.

A correlation was then made of the radiological and the histopathological diagnoses. Where the final radiological diagnosis and the histopathological diagnosis differed, the radiological diagnosis was further reviewed to assess the overlapping radiological features and expand on the differential diagnoses.

Data Analysis

A separate data collection sheet (appendix 1) was used for each patient. This data was then entered into a computer and analyzed using Statistical Package for Social Sciences (SPSS) version 10.0 and Epi.info 2000. Data cleaning was done by running frequencies and all missing data was corrected by confirmation using the questionnaires.

Statistical analysis was carried out. Descriptive and inferential statistics were used for both continuous and categorical variables. Descriptive statistics for continuous variables were measures of central tendency and dispersion. Descriptive statistics for categorical variables were proportions and frequency distributions. Inferential statistics were used to determine associations and the significance level used was $\alpha = 0.05$.

Chi-Square test was used to test for association or difference e.g. sex incidence of malignant versus benign tumours, sex incidence of solitary versus multiple tumours and cross tabulation of number of lesions versus radiographic density.

Fisher-Exact test using Epi.info 2000 was done for the following since the χ^2-test could not be done due to inadequate cell count i.e. cross tabulation of solitary and malignant lesions versus malignant and benign lesions. Sensitivity and specificity test was used to correlate the radiological and histopathological diagnoses. Independent t-test was used determine the age difference in the two study centers.

Study Limitations

Some patients' records were incomplete, inadequate or lost hence they had to be excluded from the study.

The quality of some radiographs was not optimal due to either poor quality of the original OPG, poor storage of the films or image degradation due to poor processing techniques.

There was a period of delay in obtaining data due to reliance on uncooperative records clerks to gain access to relevant records.

ETHICAL CONSIDERATIONS

Before commencement of this study, the proposal was submitted to the Ethical Committee of KNH and written consent for the study was obtained.

The patients' names were not used in this study in order to maintain confidentiality.

This was a retrospective study and did not involve direct patient contact; therefore the patient did not incur any danger or expense, in addition therefore there was no need for a signed consent.

The results of this study will be delivered to the KNH Ethical Committee to assist them form a database for future study and reference and to facilitate any possible improvements in patient management.

RESULTS

Complete records of 181 patients with a clinical diagnosis of a jaw tumour were reviewed. Of these 95 (52.5%) were from KNH and 86 (47.5%) were from DSH. Sixty six (66) patients were excluded from the study due to incomplete records. Forty two (42) had no OPG, nine had no biopsy reports and 15 were missing both the OPG and the biopsy reports.

Demographic characteristics

Overall, the patients ranged in age from 4 - 71 years (mean average age, 29.2 years; median age, 26 years). There was no statistically significant age difference in the two centers using the independent t-test (T= P>0.05 [0.087]).

There were 81 (44.8%) male patients and 100 (55.2%) female patients. This difference was not statistically significant (χ_2 =1.994; 1df; P>0.05 [0.158]).

In the male patients benign tumours accounted for 73 cases while malignant tumours accounted for eight cases. In the female population benign tumours were found in 96 cases and malignant tumours were found in four cases. There was no statistically significant difference between gender and benign versus malignant tumours (χ_2 = 2.497; 1df; P>0.05 [0.114]).

The average age for patients with benign tumours was 29.4 years (95% CI 27.1 – 31.7); age range was 4 - 71 years with a peak occurring between 11 to 30 years (55%). The average age for patients with malignant tumours was 23.7 years (95% CI 16.4 – 30.9), age range of 6 - 38 years with a peak occurring between 21 to 40 years.

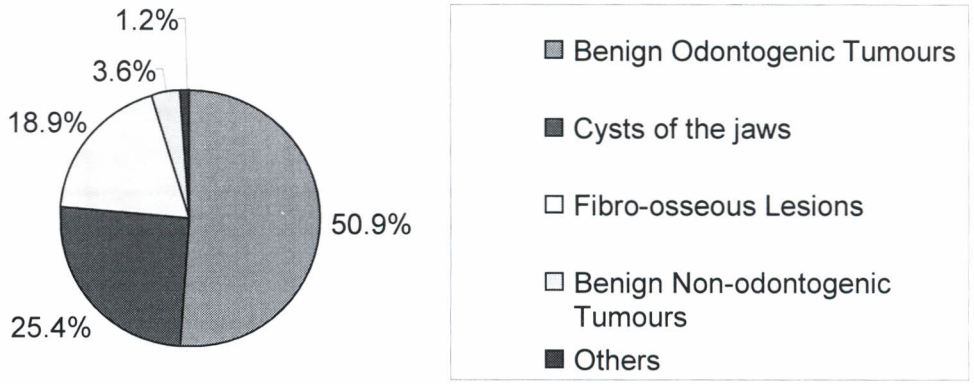
Clinical presentation

Clinical symptoms at presentation (when stated) included swelling (n = 177), pain (n = 64), and infection (n = 28). Four lesions were incidental findings. Duration of illness ranged from 1 - 288 months with a mean of 34.7 months.

Frequency of lesions

Overall 28 different lesions were confirmed on histopathology. Benign bone tumours were the majority (n = 169, 93.4%), while malignant tumours accounted for 12 cases (6.6%). Benign tumours were further sub-divided into broad classifications as depicted in Chart 1.

Chart 1: Broad Classification of Benign Jaw tumours and Tumour-Ike conditions



The prevalence of the various individual histopathological entities in these groups was as shown in the tables below:

Table 1: Frequency of Benign Odontogenic Tumours

Diagnosis	Frequency	Percentage (%) of Odontogenic Tumours	Percentage (%) of all lesions
Ameloblastoma	70	81.4	38.7
Ameloblastic Fibroma	5	5.8	2.8
Odontoma	4	4.7	2.2
Odontogenic Myxoma	4	4.7	2.2
Adenomatoid odontogenic tumour	2	2.3	1.1
Odontogenic Tumour	1	1.2	0.6

Table 2: Frequency of Cysts of the jaws

Diagnosis	Frequency	Percentage (%) of Odontogenic Cysts	Percentage (%) of all lesions
Odontogenic Keratocyst	18	41.9	9.9
Dentigerous Cyst	17	39.5	9.4
Radicular Cyst	7	16.3	3.9
Calcifying Odontogenic Cyst	1	2.3	0.6

Table 3: Frequency of Fibro-osseous Lesions

Diagnosis	Frequency	Percentage (%) of Fibro-osseous Lesions	Percentage (%) of all lesions
FCOD	12	37.5	6.6
Ossifying Fibroma	10	31.2	5.5
Fibrous Dysplasia	9	28.1	5.0
Fibrous Hyperplasia	1	3.1	0.6

Table 4: Frequency of malignancies affecting the jawbones

Diagnosis	Frequency	Percentage (%) of other malignancies	Percentage (%) of all lesions
Osteogenic Sarcoma	6	46.2	3.3
Malignant Ameloblastoma	2	15.4	1.1
Non-Hodgkin's Lymphoma	1	7.7	0.6
Plasmacytoma	1	7.7	0.6
Fibrosarcoma	1	7.7	0.6
Malignant Fibrous Histiocytoma	1	7.7	0.6

Table 5: Frequency of Benign Non-odontogenic tumours

Diagnosis	Frequency	Percentage (%) of Odontogenic Tumours	Percentage (%) of all lesions
Eosinophilic Granuloma	2	33.3	1.1
Giant Cell Tumour	1	16.7	0.6
Osteoblastoma	1	16.7	0.6
Osteoma	1	16.7	0.6
Central Giant Cell Granuloma	1	16.7	0.6

Single cases of bony exostosis and chronic osteomyelitis were documented.

Location of tumours

There were 138 lesions located in the mandible, 36 lesions within the maxilla and seven lesions affected both jawbones.

In the mandible bilateral lesions were the most common (n = 38, 26.2%) followed by tumours in the right body (n = 28, 19.3%). Maxillary tumours were mainly in the left alveolar process (n = 9, 20.9%), while tumours of the right alveolar process, right molar area and bilateral lesions occurred equally (n = 9, 16.3% for each location).

Benign tumours were mainly in the mandible (n = 131), the maxilla (n = 31), and affecting both jaws (n = 7). The locations for malignant tumours were the mandible (n = 7), and the maxilla (n = 5)

All the tumours were intraosseous in origin involving either the cancellous region (n = 157), or involving both the cancellous and cortical regions (n = 24).

Number of lesions

Tumours were either solitary (n = 169), or multiple (n = 12). Solitary tumours were more prevalent in female patients (n = 89), than in male patients (n = 80) but this was not statistically significant (χ_2 = 1.994; 1df; P>0.05 [0.158]). Multiple tumours were also more in female patients (n = 11), than in male patients (n = 1) which was statistically significant (χ_2 = 6.894; 1DF; P<0.05 [0.009]).

Correlation between radiological and histopathological diagnoses

The sensitivity of the radiological diagnosis as compared with the histopathological diagnosis was 82.3%. This was statistically significant as it corresponded with a positive predictive value of 82.3% using the sensitivity and specificity test. Radiology tended to over-diagnose Ameloblastoma, FCOD, peripheral cemental dysplasia and calcifying odontogenic cyst while it tended to under-diagnose the rest.

The differing figures were as shown overleaf in Table 6.

Table 6: Correlation between radiological and histopathological diagnoses

Jaw Tumour	Radiological Diagnosis (*n* =)	Histopathological Diagnosis (*n* =)
Ameloblastoma	85	70
FCOD	13	12
Fibrous Dysplasia	8	9
Odontogenic Keratocyst	14	18
Adenomatoid Odontogenic Tumour	1	2
Odontogenic Myxoma	3	4
Peripheral Cemental Dysplasia	1	0
Calcifying Odontogenic Cyst	2	1
Bony Exostosis	0	1
Fibrosarcoma	0	1
Malignant Fibrous Histiocytoma	0	1
Fibrous Hyperplasia	0	1
Chronic Osteomyelitis	0	1
Giant Cell Tumour	0	1

Ameloblastoma

Ameloblastoma was the most common lesion diagnosed with a prevalence of 38.7% of all the tumours reviewed by both radiology and histopathology.

Socio-demographic characteristics

The tumour mainly occurred in the third and fourth decades accounting for 67.2% of the tumours. The average age for patients with Ameloblastoma was 31.7 years (95% CI 28.9 – 34.4) with an age range from 15 to 65 years.

There was no statistically significant gender bias with 55.3% of the tumours occurring in female patients and 44.7% occurring in male patients.

Clinical presentation

The average duration of illness was 55 months (95%CI 38.1 – 71.9) with a range from 1 - 288 months.

Most of the tumours (n = 51) were painless, 33 presented with pain and in one case the presence or absence of pain was not indicated.

Tumours were associated with infections in 10 cases while in two cases the presence or absence of infection was not indicated.

Osseous location of the tumour

Majority of the lesions occurred in the mandible (n = 84, 98.8%), while one tumour (1.2%) was in the right alveolar process of the maxilla.

Table No. 7: Mandibular location of Ameloblastoma

Position in mandible	Frequency (n =)	Percentage (%)
Bilateral	21	24.7
Right body	14	16.5
Right extensive	12	14.1
Left body	9	10.6
Left extensive	9	10.6
Right angle and body	8	9.4
Left ramus and angle	5	5.9
Right ramus and angle	4	4.7
Right ramus	1	1.2
Left angle and body	1	1.2
Total	84	98.8

General radiological characteristics

All the tumours occurred as solitary lesions. Of the tumours diagnosed radiologically as Ameloblastoma 66 were radiolucent, 18 were of mixed density while one was purely radiopaque. A soft tissue mass was found associated with only five of these tumours.

Majority of the tumours were well-demarcated ($n = 51$), moderately well demarcated tumours were 23, eight were not well-demarcated and three were un-demarcated. Scalloped margins were found in 72 cases, sclerosed margins in six cases, irregular margins in five cases and ill-defined margin in two cases.

Ameloblastomas generally had a thin cortex ($n = 60$), while a thick cortex was seen in 11 cases, no cortex in nine cases and poor cortication in five cases. Only one of the lesions was found to be encapsulated. An undulating border was the most common subtype ($n = 72$), eight were smooth edged, four were irregular and one had an infiltrative border. Multilocular tumours were seen in 73 cases versus 12 which were unilocular. Only five of these tumours showed internal calcifications.

Effect on the surrounding bone

Majority of the tumours were found to cause bone expansion (92.9%). The bone cortex was broken in 34 cases, thinned in 25 cases, intact in 21 cases, thickened in three cases and intact but displaced in two cases. A laminar periosteal reaction was demonstrated in only one case which had secondary infection of the tumour site. The mandibular canal was invaded in 39 of the tumours, displaced in 24 of these tumours or remained intact in 22 cases.

Effect on the adjacent teeth

Most of the tumours were not primarily associated with teeth (84.7%). The teeth adjacent to the tumour were found to be displaced 83.5% of cases. There was no association with unerupted teeth in 69 of the tumours and 14 of the tumours were associated with uneruption. Seventy point six percent (70.6%) of the tumours resulted in root resorption in the adjacent teeth. The lamina dura and the periodontal membrane were found breached in 91.8% cases. The main distinguishing features in Ameloblastoma were an expansile solitary well-demarcated multilocular radiolucent tumour with scalloped margins, a thin cortex and an undulating border. The tumours caused tooth displacement and root resorption.

Correlation between the radiological and histopathological diagnoses

The differing diagnoses which had been labeled as Ameloblastoma were as shown in Table no 8 overleaf.

The sensitivity of radiological diagnosis was 98.6% (positive predictive value = 81.2%) while the specificity was 85.6% (negative predictive value = 98.9%).

Table No. 8: Correlation between radiological and histopathological diagnoses

Histopathological Diagnosis	Radiological Diagnosis all (85) Ameloblastoma
Ameloblastoma	69
Osteogenic Sarcoma	1
Fibrous Dysplasia	1
Odontogenic Keratocyst	5
Odontogenic Myxoma	1
Ameloblastic Fibroma	4
Fibrosarcoma	1
Malignant Fibrous Histiocytoma	1
Giant Cell Tumour	1
Malignant Ameloblastoma	1
Total	85

Odontogenic Keratocyst

Odontogenic keratocyst was the second most common lesion diagnosed with a prevalence of 9.9% by both radiology and histopathology.

Socio-demographic characteristics

Peak age group affected by the tumour was from second to the fourth decades accounting for 77.7% of the tumours. The average age for patients was 29.1 years (95% CI 21.9 – 36.2) with an age range from 8 - 59 years.

There was a female predominance with 83.3% of tumours being reported in female patients and 16.7% in male patients.

Clinical presentation

The average duration of illness was 29.6 months (95%CI 15.3 – 43.9) with a range from two to 108 months.

The tumours were mainly painless (72.2%). Only two cases were associated with infection of the jawbones.

Osseous location of the tumour

Majority of the lesions occurred in the mandible (n = 10, 71.4%), while two of the tumours (14.3%) were in the maxilla. Two of the cases (14.3%) had tumours involving both of the

jawbones. Two (2) of the maxillary tumours were extensive involving the whole bone, while solitary cysts were found in the right alveolar process and in the right molar area.

Table No. 9: Mandibular locations of Odontogenic keratocyst

Position in mandible	Frequency (n =)	Percentage (%)
Bilateral	4	28.6
Right body	2	14.3
Right angle and body	2	14.3
Left body	1	7.1
Left extensive	1	7.1
Left ramus and angle	1	7.1
Right angle	1	7.1
Total	12	85.7

General radiological characteristics

All the tumours were in the cancellous part of the bone. The majority occurred as solitary lesions (85.7%). All the tumours were radiolucent. There was no associated soft tissue mass demonstrated. The majority of tumours were well-demarcated with scalloped margins (n = 11), while the rest were moderately well demarcated (n = 3).

Odontogenic keratocysts generally had a thin cortex with smooth edged borders (n = 10). None of the lesions was encapsulated.

Unilocular tumours were seen in 10 cases versus four which were multilocular. None of these tumours showed internal calcifications.

Effect on the surrounding bone

Bone expansion was demonstrated in 64.3% of the tumours. The bone cortex was intact in eight cases, thinned in five cases and intact but displaced in one case. No associated periosteal reaction was demonstrated. The mandibular canal was intact in eight cases, displaced in four cases and invaded in two of these tumours.

Effect on the adjacent teeth

Fifty percent (50%) of the cysts were found to be associated with teeth. The teeth adjacent to the tumour were found to be displaced 85.7% of cases. There was no association with unerupted teeth in eight cases (57.1%). Root resorption in the adjacent teeth was

demonstrated in 57.1%. The lamina dura and the periodontal membrane were breached in 85.7% of the tumours.

The main distinguishing features were an expansile solitary well-demarcated unilocular radiolucent tumour with scalloped smooth margins and a thin cortex associated with teeth.

Correlation between the radiological and histopathological diagnoses

The differing diagnoses which had been labeled as Odontogenic keratocyst were as shown in Table No. 10 below:

Table No. 10: Correlation between radiological and histopathological diagnoses of odontogenic keratocyst

Histopathological Diagnosis	Radiological Diagnosis all (14) Odontogenic Keratocyst
Odontogenic Keratocyst	10
Dentigerous Cyst	2
Ameloblastoma	1
Radicular Cyst	1
Total	14

The sensitivity of radiological diagnosis for Odontogenic keratocyst was low = 55.5% (positive predictive value = 71.4%) while the specificity was high = 97.6% (negative predictive value = 95.2%).

Dentigerous Cyst

Dentigerous cyst was the third most common lesion diagnosed with a prevalence of 9.4%.

Socio-demographic characteristics

The peak age group affected by the tumour was in the first and second decades accounting for 72.0% of the tumours. The average age for patients was 17.4 years (95% CI 1.7 – 23.1) with an age range from 5 - 40 years.

The gender distribution of the tumours was almost equal with 52.9% occurring in males and 47.1% in females.

Clinical presentation

The average duration of illness was 14.2 months (95%CI 3.3 – 25.1) with a range from 1 - 72 months. Patients complained of pain in 12 cases (70.6%). There was clinical infection of the tumour site in 13 cases (76.5%).

Osseous location of the tumour

The majority of lesions occurred in the mandible (n = 10, 58.8%), while seven of the tumours (41.2%) were in the maxilla. Four of the maxillary tumours were in the left alveolar process while solitary lesions were found in the right alveolar process, right molar area and one was centrally located.

Table No. 11: Mandibular location of dentigerous cyst

Position in mandible	Frequency (n =)	Percentage (%)
Right body	4	23.5
Left extensive	3	17.6
Left body	2	11.8
Right ramus	1	5.9
Total	10	58.8

General radiological characteristics

All the tumours were solitary and were found in the cancellous part of the bone. Most of the tumours were radiolucent (n = 15), one was radiopaque and one had a mixed lucent and opaque pattern. There was no associated soft tissue mass demonstrated. The majority of tumours were well-demarcated (n = 15, 88.2%). Scalloped margins were found in 12 cases. Dentigerous cysts generally had a thin cortex (n = 15). None of the lesions was encapsulated. A smooth edged border was the most common subtype (n = 16). Unilocular tumours were the majority accounting for 16 cases while one case was multilocular. The internal structure of the tumours was variable in all the lesions. None of these tumours showed internal calcifications.

Effect on the surrounding bone

Bone expansion was demonstrated in 70.6% of the tumours. The bone cortex was intact in 14 cases. No associated periosteal reaction was demonstrated. The mandibular canal was intact in 12 cases, displaced in four cases and invaded in one of these tumours.

Effect on the adjacent teeth

Ninety four point one percent (94.1%) of the cysts were found to be associated with teeth. The teeth adjacent to the tumour were found to be displaced 82.4% of cases. There was an association with unerupted teeth in all but one of the cases accounting for 94.1%. Tooth

Osseous location of the tumour

Majority of the lesions occurred solely in the mandible (n = 9, 69.2%), one tumour (7.7%) was only in the maxilla while three tumours involved both jawbones.

Of the lesions involving the mandible eight were bilateral, three were in the right body while one was in the left body.

Three of the maxillary lesions were extensive involving both halves while one was centrally placed.

General radiological characteristics

Multiple lesions were found in seven cases while solitary lesions were found in six cases. All the tumors involved only the cancellous bone. Majority of the FCOD lesions were radiopaque (n = 10), two were of mixed density while one was radiolucent. A soft tissue mass was found associated with only one of these tumours. Majority of the tumours were un-demarcated (n = 7). The margins of the lesions were variable ranging from irregular (n = 5), un-defined (n = 5), scalloped (n = 2) to sclerosed (n = 1).

FCOD lesions generally were uncorticated in 11 cases. Only three of the lesions were found to be partially encapsulated. Ill-defined borders were found in nine cases while undulating borders were present in four cases.

Non-loculated lesions were the majority occurring in 12 cases. The internal structure of the tumours was either granular (n = 11), granular and septated (n = 1) or mixed (n = 1).

None of these tumours showed internal calcifications.

Effect on the surrounding bone

Bone expansion was associated with seven of these lesions while no bone expansion was demonstrated in six cases. The bone cortex was intact in the majority of cases (n = 11).

None of these lesions was associated with a periosteal reaction of the overlying bone.

The mandibular canal was intact in eight cases, displaced in three cases and invaded in two cases.

Effect on the adjacent teeth

Most of the lesions were not primarily associated with teeth (76.9%). The teeth adjacent to the tumour were not displaced in nine cases. There was no association with unerupted teeth in 12 of these lesions. No resorption of the roots of the adjacent teeth was found in 69.2%. The lamina dura was blurred in 10 cases. The periodontal membrane was breached in eight cases and intact in four cases.

The main distinguishing feature was that of multiple, ill-defined radiopaque uncorticated lesions with granular internal structures. Most of the lesions showed no primary association with teeth but caused blurring of the lamina dura.

Correlation between the radiological and histopathological diagnoses

There was only one case in which the radiological and histopathological diagnoses differed. In this case the histopathological diagnosis termed the lesion as a case of Chronic Osteomyelitis.

The sensitivity for radiological diagnosis was 100.0% (positive predictive value = 92.3%) while the specificity was 99.4% (negative predictive value = 100.0%)

Ossifying Fibroma

Ossifying fibroma was the fifth most common lesion diagnosed with a prevalence of 5.5% of all the tumours reviewed by both radiology and histopathology.

Socio-demographic characteristics

The tumour mainly occurred in the second and third decades accounting for 70.0% of the tumours. The average age of patients with ossifying fibroma was 23.2 years (95% CI 14.4 – 31.9) with an age range from 4 - 50 years.

There was statistically significant gender bias with 70.0% of the tumours occurring in female patients and 30.0% occurring in male patients.

Clinical presentation

The average duration of illness was 16.2 months (95%CI 0.7 – 33.0) with a range from 2 - 72 months.

Pain as a presenting symptom was found in only two cases with majority of the tumours (n = 7) were painless. In one case there was no indication whether pain was present or not.

Tumours were generally not associated with infections (n = 8), while in one case there was associated infection and in one case there was no documentation either way.

Osseous location of the tumour

Majority of the lesions occurred in the mandible (n = 7, 70.0%), while three tumours were in the maxilla (30%)

In the mandible four tumours were located in the left body while there were solitary tumours in the left ramus and angle, right body and right ramus regions.

Solitary tumours were demonstrated in the left alveolar process, right alveolar process and right molar area of the maxillae.

General radiological characteristics

All the lesions diagnosed to be ossifying fibroma were solitary.

Majority of the lesions involved only the cancellous bone ($n = 9$) while in one case both the cortical and cancellous bone were involved.

The radiographic density of the tumours ranged from mixed lucent and opaque in four cases, lucent in four cases and opaque in two cases.

None of the tumours was associated with a soft tissue mass.

Majority of the tumours were well-demarcated ($n = 5$, 50.0%), two were moderately well demarcated, two were not well-demarcated and one was un-demarcated.

The margins of the lesions were variable ranging from sclerosed ($n = 3$), undefined ($n = 3$), scalloped ($n = 2$), to irregular ($n = 2$).

Ossifying fibromas had a thin cortex in five cases, were un-corticated in three case, had a thick cortex in one case and were poorly corticated in one case.

Ninety percent (90.0%) of the lesions were not encapsulated with partial encapsulation demonstrated in only one case.

Smooth edged borders were seen in five cases, undulating borders in two cases, ill-defined borders in two cases and sharp sclerotic borders in one case.

Non-loculated tumours were the majority occurring in six cases while three tumours were unilocular and only one tumour was multilocular.

The internal structure of the tumours was either granular ($n = 7$) or mixed ($n = 3$).

Only three of these tumours exhibited internal calcifications.

Effect on the surrounding bone

Bone expansion was evident in nine of these cases with only one tumour not associated with bone expansion.

The bone cortex was intact in the majority of cases ($n = 6$) while it was thinned in four cases.

None of these lesions was associated with a periosteal reaction in the overlying bone.

The mandibular canal was intact in six cases and displaced in four cases.

Effect on the adjacent teeth

Most of the lesions were not primarily associated with teeth (90.0%). The teeth adjacent to the tumour were displaced in the majority of cases ($n = 7$). Only one case of ossifying fibroma was associated with an unerupted tooth.

Resorption of the roots of adjacent teeth was found in 60.0% of the cases.

The lamina dura was breached in nine cases. The periodontal membrane was breached in eight cases.

The main distinguishing feature was that of a solitary expansile well-demarcated non-loculated corticated mass of mixed density. Majority of the lesions were granular and caused both tooth displacement and root resorption.

Correlation between the radiological and histopathological diagnoses

There was absolute correlation between both the radiological and histopathological diagnoses of the tumours thought to be ossifying fibroma (sensitivity and specificity = 100.0%).

Fibrous Dysplasia

Fibrous dysplasia was the sixth most common lesion diagnosed with a prevalence of 5.0% of all the tumours reviewed by both radiology and histopathology.

Socio-demographic characteristics

The tumour mainly occurred in the second and third decades accounting for 87.5% of the tumours with the majority occurring between the ages of 11 and 20 years. The average age of patients with fibrous dysplasia was 20.9 years (95% CI 16.5 – 25.3) with an age range from 13 - 31 years.

Fibrous dysplasia was diagnosed in five female patients and in three male patients.

Clinical presentation

The average duration of illness was 90.3 months (95%CI 29.2 – 152.3) with a range from 2-192 months.

Pain was not a presenting feature. In only one case was the presence of infection a presenting complaint.

Osseous location of the tumour

Majority of the lesions occurred solely in the maxilla (n = 4, 50.0%), while two tumours were solely in the mandible and two tumours involved both jawbones.

Of the maxillary lesions, two were in the right molar area while solitary lesions were located in the right alveolar process, right antrum, left molar area and one involved both halves.

Lesions involving the mandible were either bilateral (n = 2), in the right body (n = 1) or extensively involving the right mandible (n = 1).

General radiological characteristics

The majority of lesions diagnosed as fibrous dysplasia were solitary ($n = 6$) while in two cases multiple lesions were demonstrated.

Seven of the lesions involved only the cancellous bone while one lesion involved both the cortical and the cancellous bone.

The radiographic density of the tumours ranged from opaque in four cases, mixed lucent and opaque in three cases and lucent in one case.

None of the tumours was associated with a soft tissue mass.

The majority of tumours were un-demarcated ($n = 6$, 75.0%), one tumour was well-demarcated and one was not well-demarcated

The margins of the lesions were variable ranging from undefined ($n = 4$), sclerosed ($n = 2$), to irregular ($n = 2$).

Fibrous dysplasia lesions were generally uncorticated ($n = 6$).

All the lesions diagnosed as fibrous dysplasia were not encapsulated.

Seventy five percent (75.0%) of these lesions had ill-defined borders.

Non-loculated tumours were the majority occurring in six cases while two tumours were multilocular.

The internal structure of the tumours was either granular ($n = 7$) or granular and septated ($n = 1$). None of these lesions was associated with calcification.

Effect on the surrounding bone

Bone expansion was evident in seven of these cases with only one case not associated with bone expansion.

The bone cortex was intact in the majority of cases ($n = 5$) while it was thinned in four cases.

None of these lesions was associated with a periosteal reaction in the overlying bone.

The mandibular canal was intact in five cases and invaded in three cases.

Effect on the adjacent teeth

Most of the lesions were not primarily associated with teeth (87.5%). The teeth adjacent to the tumour were displaced in the majority of cases ($n = 6$).

No case of fibrous dysplasia was associated with unerupted teeth.

Resorption of the roots of adjacent teeth was not a documented radiological feature.

The lamina dura was breached in seven cases. The periodontal membrane was breached in two cases.

The main distinguishing feature was that of a solitary expansile mass with ill-defined borders and of either radiopaque or mixed density. Most were granular and caused tooth displacement and breaching of the lamina dura.

Correlation between the radiological and histopathological diagnoses

Radiologically, eight cases of fibrous dysplasia were diagnosed while on histopathology eleven cases were diagnosed. Of the three differing cases, two had been labeled as Ossifying fibroma and one as Ameloblastic fibroma radiologically.

The sensitivity of radiological diagnosis for fibrous dysplasia was 77.7% (positive predictive value = 87.5%) while the specificity was 99.4% (negative predictive value = 98.84%).

ILLUSTRATIONS

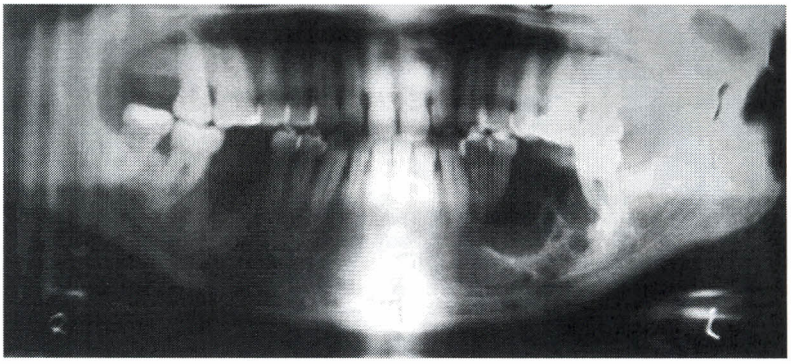


Figure 3: 42-year-old male patient with 7-year history of painless left lower jaw swelling. OPG shows poorly demarcated multilocular lesion with minimal jaw expansion.
Diagnosis: Ameloblastoma left body of mandible.

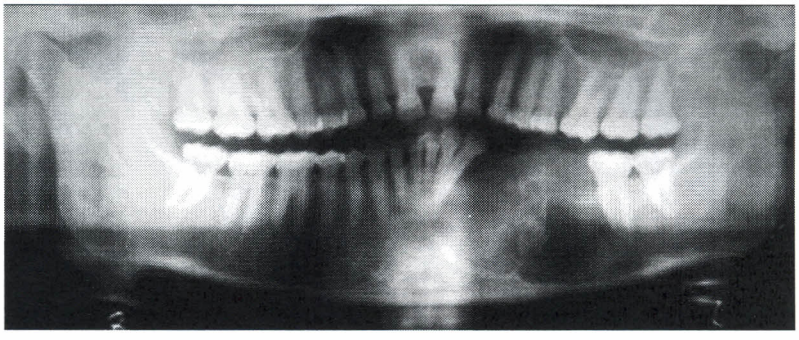


Figure 4: 25-year-old male presenting with painless left mandibular swelling. OPG shows moderately well-defined multilocular cystic lesion with missing teeth.
Diagnosis: Ameloblastoma.

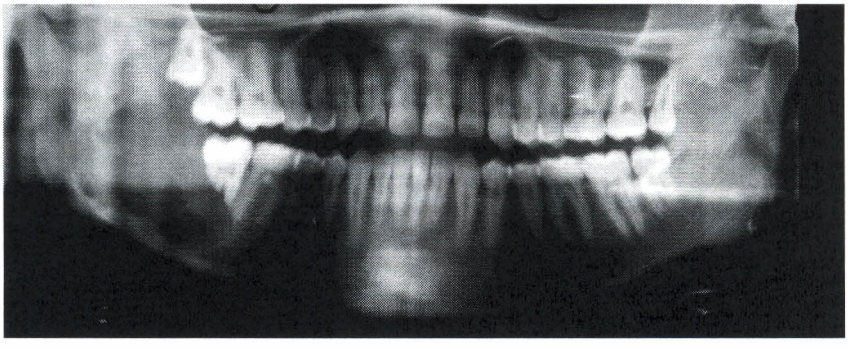


Figure 5: 26-year-old male with 9-month history of painless right lower jaw swelling. OPG shows moderately well-defined multilocular radiolucent mass with adjacent tooth resorption.
Diagnosis: Cystic Ameloblastoma angle and body of right mandible.

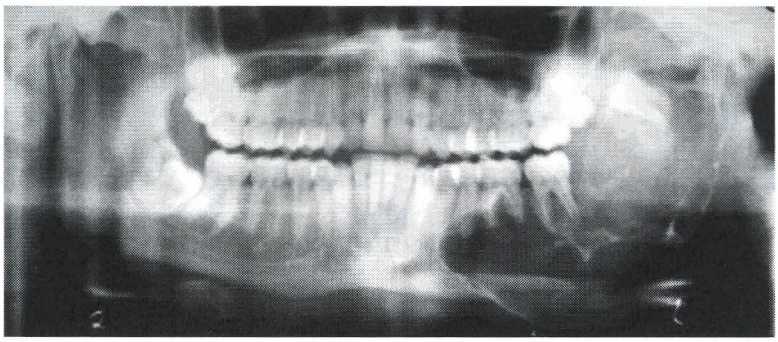


Figure 6: 23-year-old male patient with 4-year history of painless left lower jaw swelling. OPG shows large well-defined multilocular radiolucent lesion involving the whole of the left mandible.

Diagnosis: Ameloblastoma left mandible

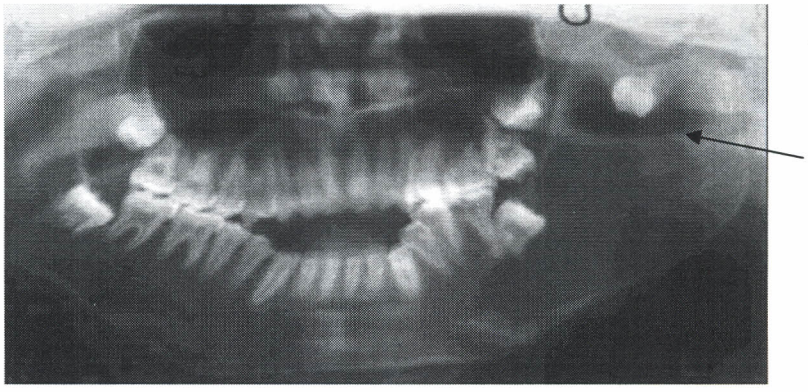


Figure 7: 27-year-old male with 8-year history of left lower jaw swelling associated with intra- and extra-oral discharging sinuses. OPG shows well-defined expansile unilocular radiolucent mass with an air-fluid level in ramus and body of left mandible (arrow).

Diagnosis: infected Ameloblastoma

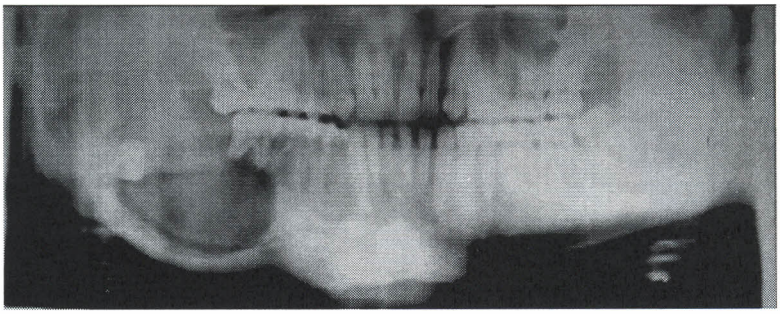


Figure 8: 15-year-old male patient with sudden onset of pain in the right lower jaw swelling that had been present for 4 months. OPG shows a well-defined cystic lesion with a hazy internal structure and sclerotic margins associated with the crown of an unerupted tooth.

Diagnosis: Infected dentigerous cyst in right molar and premolar region

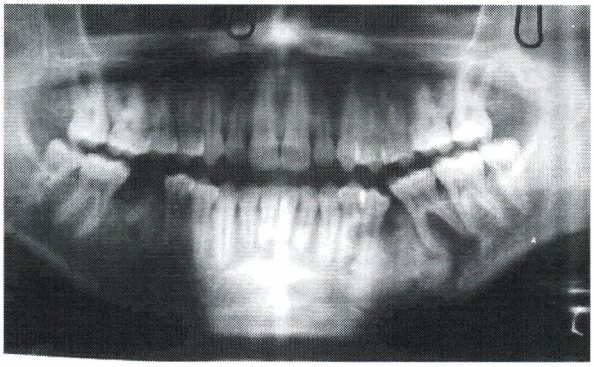


Figure 9: 28-year-old female patient presenting with left lower jaw pain with a discharging sinus. OPG shows ill-defined sclerotic lesions associated with the roots of the molar teeth in all four quadrants. The left mandibular region shows irregular lucencies and cortical breakthrough consistent with infection. **Diagnosis**: FCOD.

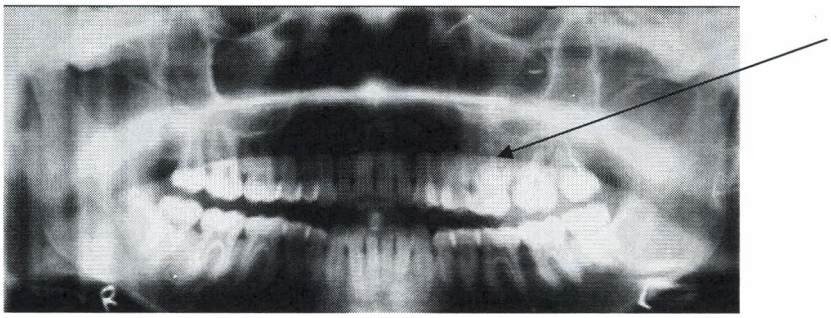


Figure 10: 18-year-old female with 10-month history of painful left maxillary swelling. OPG shows ill-defined diffuse radio-opaque lesion with tooth resorption and expansion of the periodontal membrane of 27 (arrow).
Diagnosis: Osteogenic sarcoma.

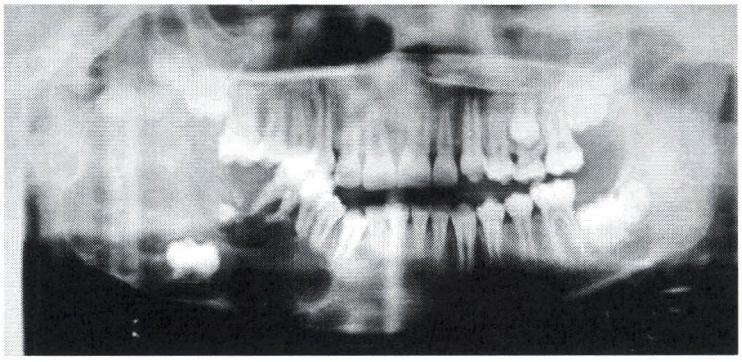


Figure 11: 11-year old male patient with 3-month history of right lower jaw swelling. OPG shows well-demarcated multilocular radiolucent tumour with scalloped margins and internal calcifications. The cortex is thinned but unbroken and there is an unerupted tooth.
Diagnosis: Ameloblastic fibroma - ramus and body of right mandible.

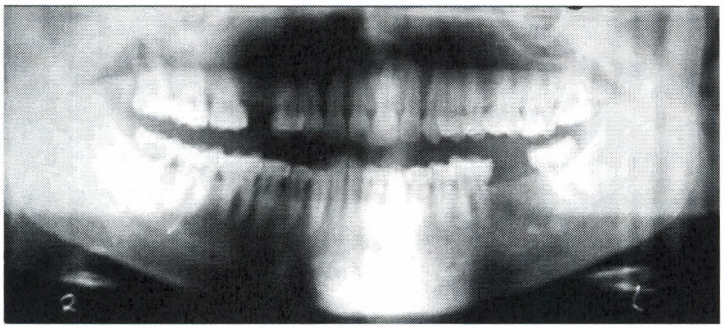


Figure 12: 30-year old female patient presenting with loose teeth. OPG shows ill-defined radiopaque lesion associated with denticles.

Diagnosis: Odontoma in left mandibular premolar region.

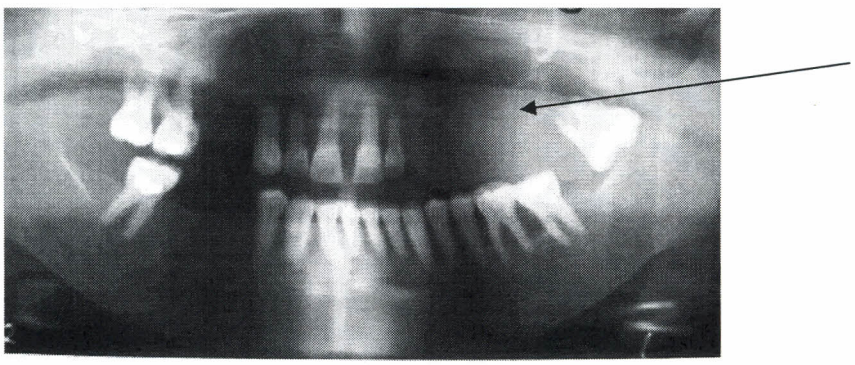


Figure 13: 54-year-olf female patient with one year history of left upper jaw swelling. OPG shows poorly demarcated, uncorticated, multilocular radiopaque mass associated with missing teeth (arrow).

Diagnosis: Osteoblastoma left maxillary alveolar process.

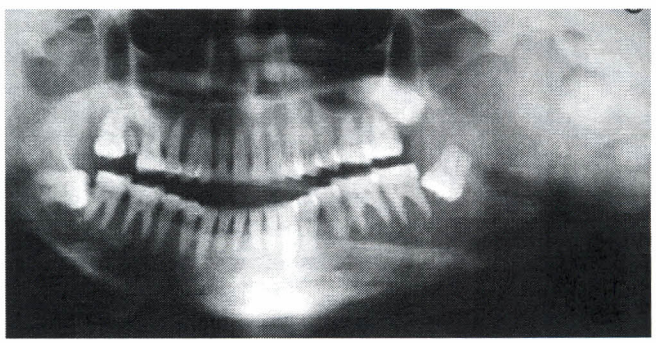


Figure 14: 47-year-old female with 4-month history of painful left lower jaw swelling. OPG shows an extensive, un-demarcated mixed lucent/opaque mass extending from the ramus to the anterior aspect of the body of the left mandible. The anterior aspect of the tumour shows matrix mineralization.

Diagnosis: Calcifying epithelial odontogenic tumour undergoing sarcomatous change.

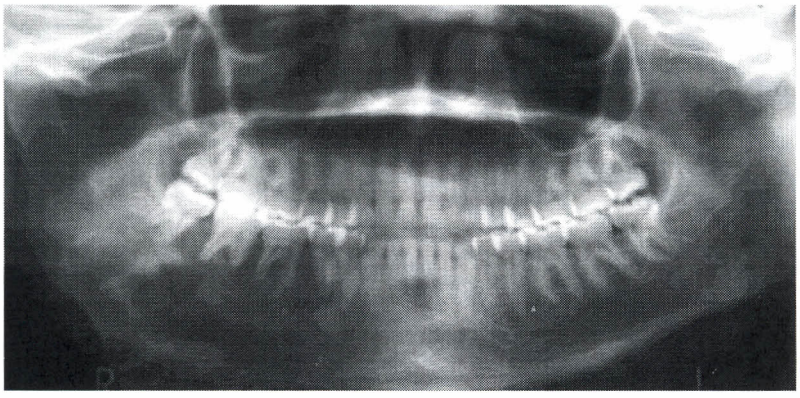


Figure 15: 19-year-old female patient with 5-month history of right mandibular swelling. OPG shows well-defined expansile multilocular lucent lesion with tooth resorption.
Diagnosis: Giant Cell Tumour of body of right mandible.

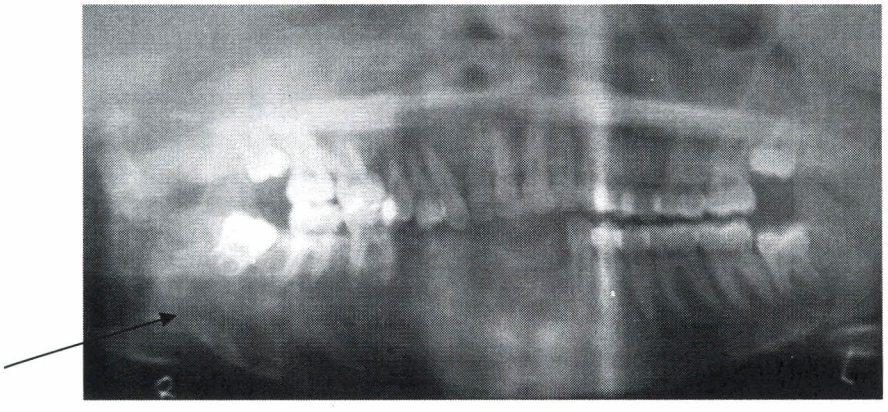


Figure 16: 13-year-old male with 2-year history of progressive painless right lower jaw swelling and loss of teeth. OPG shows an ill-defined expansile lesion involving the whole of the right mandible with ground glass internal structure (arrow).
Diagnosis: Fibrous Dysplasia.

DISCUSSION

In this five year retrospective study of tumours and tumour-like conditions of the jawbones, a total of 181 cases were reviewed using both radiographic films and histopathology reports from both the centers in the study. Of these, 95 (52.5%) were from KNH and 86 (47.5%) were from DSH. Sixty six (66) patients were excluded from the study due to incomplete records. The radiological findings were used to determine the pattern of occurrence for the individual tumours and were correlated with the gold standard; the histopathology report. The study considered both odontogenic and non-odontogenic tumours affecting the jawbones.

Burkitt's lymphoma is known to be the commonest tumour affecting the jawbones with reported prevalence rates of 44.6% in a Kenyan study by Kamunvi et al[30]. However it had to be excluded from this study as it mainly presents in the general pediatric clinics and as such these cases are not reviewed in the maxillo-facial units. Only three cases of Burkitt's lymphoma were encountered during the course of this study.

Demographic characteristics

Tumours of the jawbones showed a wide age range from 4 - 71 years corresponding to previous studies done by Yong Lu et al in China[9], Simon et al in Tanzania[12] and Onyango et al in Kenya[23].

The average age of patients in this study was 29.2 years with a median age of 26 years which also corresponded to Yong Lu et al[9] (29.3 years) and Simon et al[12] (30.0 years).

In this study no statistically significant gender bias was demonstrated in benign lesions with 73 cases (43.2%) occurring in males and 96 cases (56.8%) occurring in females. Yong Lu et al[9] reported a male to female ratio of 1.1:1 for benign lesions. Ochsensius et al[8] reported a ratio of 1.14:1 for benign lesions.

Malignant tumours however were more common in male patients (66.7%). Yong Lu et al[9] reported similar findings with a statistically significant male predominance of malignant tumours (male: female = 2.1:1).

Clinical presentation

Clinical symptoms at presentation (when stated) included swelling (n = 177), pain (n = 64), and infection (n = 28). Four lesions were incidental findings. The duration of illness before presenting at a healthcare facility was generally prolonged ranging from one month to 288 months with a mean of 34.7 months. Comparable findings have been reported in previous African studies. Simon et al[12] in Tanzania reported a range of one month to more than 15

years with a mean of three years. Wakiaga et al[5] in Kenya reported a range of 1 - 325 months with a mean of two to three years, with a longer duration of symptoms for slow growing lesions.

Frequency of lesions

Overall 28 different lesions were confirmed on histopathology. Odontogenic tumours accounted for 53.0%, cysts 23.8%, fibro-osseous lesions 12.2%, malignancies affecting the jawbones 6.6%, benign non-odontogenic tumours 2.2% and other lesions 2.2%. These figures differed from those found in a previous Kenyan study by Wakiaga et al[5] who reported odontogenic tumours in 39.8%, lymphomas in 31.7%, fibro-osseous lesions in 22.2% and malignancies affecting the jawbones in 6.3%. The main differences in the figures were most likely due to the exclusion of Burkitt's lymphoma from the present study as it was the second most prevalent lesion (24.7%) in the previous study. Another contributing factor in the study by Wakiaga et al[5] was the large number of lesions ($n = 69$) which were simply listed as unspecified lesions.

Benign bone tumours were the majority accounting for 169 cases (93.4%), while malignant tumours accounted for 12 cases (6.6%). Wakiaga et al[5] reported malignant tumours to occur in 6.0%.

The commonest histopathological entities in this study were Ameloblastoma (38.7%), Odontogenic Keratocyst (9.9%), Dentigerous Cyst (9.4%), Florid Cemento-Osseous dysplasia (FCOD) (6.6%), and Ossifying Fibroma (5.5%).

Location of tumours

In general there was a predilection for mandibular lesions accounting for 76.2% of the lesions. This is comparable to the study in China where the mandible to maxilla ratio was 3.2:1[9]. Simon et al[12] reported mandibular lesions in 90.2% of cases in Tanzania. Wakiaga et al[5] reported that most tumours had a predilection for the mandible except fibrous dysplasia, giant cell granuloma and Burkitt's lymphoma.

This predilection was likely due to the greater proportion of odontogenic epithelium occurring in the mandible as a result of the presence of the non-odontogenic epithelium which was exclusive to the maxilla[2].

Ameloblastoma

Ameloblastoma was the most common lesion diagnosed with a prevalence of 38.7%. This was in keeping with studies done in various regions including a prevalence of 58.6% by Yong Lu et al[9]in China, 48.9% by Ajayi et al[44] in Nigeria, 73.7% by Simon et al[12] in Tanzania, 31.0% by Wakiaga et al[5] and 21.0% by Maroo[2] in Kenya. The variance in the quoted prevalence rates for Ameloblastoma is mainly due to the non-uniformity of inclusion criteria of the tumours reviewed in the different studies. Some studies included tumours of the oral soft tissues and paranasal sinuses which were not considered in this study.

However in studies done in Europe and South America the findings were slightly different. In Estonia, Tamme et al[21] reported that the most common tumour was Odontoma accounting for 34.6% while Ameloblastoma was second accounting for 25.3%. In Chile, Ochsensius et al reported Odontoma in 45.0% followed by Ameloblastoma in 20.6%.

This appears to validate the long held belief that Ameloblastoma is more common in Blacks than in Whites[5]. Despite these numerous studies no scientific basis has been found to explain the predilection of Ameloblastoma for the Black jaw.

Socio-demographic characteristics

The tumour mainly affected patients between the ages of 20 and 40 years with an average age of 31.7 years. This was similar to findings in China[9], Estonia[21], Nigeria[44], Tanzania[12] and previous Kenyan[2, 5] studies.

There was no statistically significant gender bias with 55.3% of the tumours occurring in female patients and 44.7% occurring in male patients in keeping with other studies worldwide[2, 5, 9, 12, 21, 44].

Clinical presentation

The average duration of illness was 55 months with a range from one month to 288 months. The most striking thing with these tumours was their large size at presentation attributed at least in part to neglect and poor access to health care. Most of the tumours (n = 51) were painless. Tumours were associated with infections in only 10 cases.

Osseous location of the tumour

Majority of the lesions occurred in the mandible (98.8%). Ochsensius et al[8] reported that 81.1% of Ameloblastomas occurred in the mandible. Tamme et al[21] recorded mandible to maxilla ratio of 2.8:1. Simon et al reported 97.0% of the tumours in the mandible. Dr Sanjay Maroo in 1988 reported that 85.7% of Ameloblastomas occurred in the mandible.

Majority of the mandibular lesions were extensive lesions involving the posterior body and the ramus of each mandible or extending to involve both jawbones. This was in keeping with the findings in other studies[2, 5,12,21,44]

The only tumour involving the maxilla was in the right alveolar process. This was in keeping with previous reports where maxillary Ameloblastoma favored the alveolar process as it contains the odontogenic epithelium[2, 7].

Imaging findings

Ameloblastomas occurred as solitary lesions which were predominantly radiolucent (n = 66, 77.6%). An associated soft tissue mass was found associated with only five of these tumours. Majority of the tumours were well-demarcated with scalloped margins, an undulating border and a thin cortex. Only one of the lesions was found to be encapsulated. Majority of the tumours were multilocular (n = 73, 85.9%). This was similar to the study by Maroo[2] where 85.7% of the tumours were multilocular. Only five of these tumours showed internal calcifications.

Majority of the tumours were found to cause bone expansion (92.9%) as compared to 100.0% in the study by Maroo[2]. An associated laminar periosteal reaction was demonstrated in only one case in which there was concurrent infection. The mandibular canal was disrupted in most cases.

Ameloblastomas were associated with tooth displacement in 83.5% of cases. Fourteen (14) of these tumours were associated with unerupted teeth while in two cases the teeth were already extracted. Dr S. Maroo reported displacement of teeth in 21.4% and missing teeth at the site of the lesion in 50.0%. This difference in frequencies was most likely due to the difference in times of presentation. Seventy point six percent (70.6%) of the tumours resulted in root resorption in the adjacent teeth.

Correlation between the radiological and histopathological diagnoses

The radiological and histopathological diagnoses were found to correlate in 81.2%. Radiological diagnosis was both highly sensitive (98.6%) and specific (85.6%). The differing diagnoses which had been labeled as Ameloblastoma by radiological features but were found to be otherwise on histopathology included mainly Odontogenic Keratocyst and Ameloblastic fibroma which accounted for 64.3% of the differing diagnoses. The radiographic features of these tumours were found to be similar to those of the other tumours that had been confirmed as histologically as being Ameloblastoma. Ameloblastoma characteristically were more multilocular and larger in size than these other tumours.

Odontogenic Keratocyst

Odontogenic keratocyst was the second most common lesion diagnosed with a prevalence of 9.9%. They normally represent 5 – 15% of all jaw cysts[22] and differ from other odontogenic cysts in that they have a biologically aggressive behavior with a tendency to extend along bony cancellous spaces and a considerably high rate of recurrence.

In this study odontogenic keratocyst was the most common of the odontogenic cysts (41.9%). Koseoglu et al[36] in a five year prospective study on Odontogenic cysts in Turkey found that Odontogenic cysts were the most common form of cystic lesions that affect the maxillofacial region. In their study Odontogenic keratocysts were found to be second in prevalence to Radicular cysts with frequencies of 59% and 27% respectively.

Arotiba et al in a 15 year retrospective study on odontogenic cysts in Nigeria reported that Odontogenic keratocyst was second to Radicular cyst in frequency, 61.9% to 14.3% respectively.

Wakoli et al[45] reported an incidence of 25.0% for keratocysts as compared to 63.9% for radicular cysts.

The main difference in the documented frequencies was mainly due to the fact that these studies were primarily geared towards cysts only and did not take into account other lesions of the jawbones. The difference was also explained by the fact that most radicular cysts are asymptomatic and do not grow to a large size therefore they may not have presented to these to referral institutions. Keratocysts and Ameloblastoma also have the same histological origin and therefore their prevalence rates in a given population would be similar[13].

Socio-demographic characteristics

Odontogenic keratocysts mainly affected patients in their second to the fourth decades of life with an average age of 29.1 years. This was similar to findings by Scholl et al[22] in Connecticut, USA where the patients were mainly in the second to fourth decades. Arotiba et al[13] reported a mean age of 29.3 years. In this study there was a female predominance with 83.3% of tumours being reported in female patients. Arotiba et al[13] reported a slight female preponderance. This is unlike other studies where the male to female ratio averaged 1.3:1[36].

Clinical presentation

The average duration of illness was 29.6 months. The tumours were associated with pain in 27.8%. Only two cases were associated with infection of the jawbones. Koseoglu et al[36] reported pain as a presenting symptom in 16.6% of the patients.

Osseous location of the tumour

Majority of the lesions occurred in the mandible (n = 10, 71.4%), while two of the tumours (14.3%) were in the maxilla. Two of the cases (14.3%) had tumours involving both of the jawbones. Majority of the tumours involved the molar and ramus regions. Maxillary tumours also had a predilection for the posterior regions. Koseoglu et al[36] documented that 79.1% of keratocysts in their series occurred in the mandible with a predilection for the molar and ramus regions. Similar findings were reported by J. Li et al[46] in Japan.

Imaging findings

Majority of the keratocysts presented as solitary, well-demarcated radiolucent lesions with scalloped margins. Odontogenic keratocysts generally were unilocular with a thin cortex, smooth-edged borders and no encapsulation. This is in keeping with previous studies[22, 36, 46]. Bone expansion was demonstrated in 64.3% of the tumours. The bone cortex was thinned in only five cases. This is in line with other studies which report cortical thinning in some keratocysts[22, 36, 46].

Forty two point nine percent (42.9%) of the keratocysts were associated with an impacted tooth. J. Li et al[46] found an association with impacted teeth in 46.7%. The teeth adjacent to the tumour were found to be displaced 85.7% of cases. Root resorption in the adjacent teeth was demonstrated in 57.1%.

Correlation between the radiological and histopathological diagnoses

The radiological and histopathological diagnoses were found to correlate in 71.4%. The differing histopathological diagnoses included a dentigerous cyst (2), Ameloblastoma (1) and Radicular cyst (1). The two labeled as Dentigerous cysts were associated with an impacted tooth appearing to be in a dentigerous arrangement. One case showed a large multilocular tumour with features in keeping with an Ameloblastoma. The last tumour presented as periapical radiolucencies and was labeled radiologically as a Radicular cyst. Odontogenic keratocyst characteristically are unilocular with a thin cortex and are found associated with teeth as well as causing tooth root resorption.

Dentigerous Cyst

Dentigerous cyst was the third most common lesion diagnosed with a prevalence of 9.4%. It was the second most common odontogenic cyst after Odontogenic keratocyst (39.5%). This differed from most maxillo-facial radiology literature which listed dentigerous cysts as being only second to Radicular cysts[7]. Dentigerous cysts are reported to be the most common type of non-inflammatory odontogenic cyst. Koseoglu et al[36] documented a prevalence of 14.0%

making them third to radicular cysts and odontogenic keratocysts. Simon et al[12] in Tanzania reported that dentigerous cysts were second only to radicular cysts in frequency. This variance in reported figures was likely due to a "reversed harvesting effect" i.e. these cysts were generally painless and patients only presented when they grew to a large size leading to under-reporting. This was likely due to socio-economic factors which generally led to late presentation at healthcare facilities.

Socio-demographic characteristics

Peak age group for patients with dentigerous cyst was in the first and second decades with an average age of 17.4 years. Most of the previous African studies report a peak during the second and third decades with an average age of 18 years[12, 36]. Dunsche et al[33] in a review of 101 cases is Germany however reported a mean age of 46.5 years underlining the long held view that jaw lesions generally occurred at an earlier age group in the Black race. No gender predilection was demonstrated in keeping with previous studies.

Clinical presentation

The average duration of illness was 14.2 months. Patients complained of pain in 12 cases (70.6%). There was clinical infection of the tumour site in 13 cases (76.5%). This was in variance with the general tenet that dentigerous cysts were asymptomatic[12, 22]. However the presence of infection was the main reason the patients presented to the health care facilities and the underlying pathology was found as an incidental finding. This then conformed to other studies which state that uncomplicated cysts caused no symptoms until the swelling became noticeable[36].

Osseous location of the tumour

Dentigerous cysts most commonly involved the mandible (58.8%). The cysts mainly involved the posterior aspect of the mandibular body on either side. This is in line with previous studies which situate them mainly involving the area of the third molar. In the maxilla the most common location found in this study was the left alveolar process. Koseoglu et al[36] reported the most common maxillary position to be around the maxillary canine.

Imaging findings

Dentigerous cysts mainly presented radiologically as solitary, well-demarcated, unilocular, radiolucent cysts with scalloped margins, smooth-edged borders and a thin cortex. None of the lesions was encapsulated. None of these tumours showed internal calcifications. This was in keeping with previous studies[22, 36]

Bone expansion was demonstrated in 70.6% of the tumours. The bone cortex was however intact in the majority of cysts with no associated periosteal reaction. The mandibular canal was intact in 12 out of 17 cases.

Ninety four point one percent (94.1%) of the cysts occurred adjacent to the crown of an unerupted tooth. The teeth adjacent to the tumour were found to be displaced 82.4% of cases. Tooth root resorption in the adjacent teeth was not a prominent feature and was only demonstrated in six cases. These findings were in keeping with previous studies[22, 36].

Correlation between the radiological and histopathological diagnoses

The radiological and histopathological diagnoses were found to correlate in 82.4%. The differing histopathological diagnoses included odontogenic keratocysts (2) and Fibrous hyperplasia (1). Extremely large dentigerous cysts become multilocular and often develop undulating borders due to uneven rates of expansion through areas of varying bone density; the resulting radiographic appearance is comparable to a large odontogenic keratocyst or an Ameloblastoma[22].

Florid Cemento-Osseous Dysplasia (FCOD)

FCOD was the fourth most common lesion diagnosed with a prevalence of 6.6%. FCOD is defined as an idiopathic progressive patchy sclerosis of the jaws[7]. It was the most common fibro-osseous lesion in this study accounting for 37.5%% of these lesions which is in keeping with the study by Torpet et al[40].

Socio-demographic characteristics

The tumour mainly occurred in the fifth and sixth decades with an average age of 50.4 years. This is in keeping with previous studies which report the tumour to occur after the age of 25 years[7, 12]. Ogunsalu et al[11] in a review of fibro-osseous lesions in Jamaica reported cases in female patients aged 47 to 70 years.

There was female predominance with 84.6% of the tumours occurring in female patients in keeping with the available literature and previous studies where male to female ratios as high as 1:9 have been reported[2, 7, 11, 12].

Clinical presentation

The average duration of illness was 17.9 months. Majority of the tumours had pain as a presenting symptom and there was concurrent infection of the tumours in these cases. This was in keeping with previous statements that FCOD were usually asymptomatic unless osteomyelitis was superimposed[7].

13 reported cases of ossifying fibroma in Africa which showed a mean age ranging between 18.6 to 29.5 years.

There was statistically significant gender bias with 70.0% of the tumours occurring in female patients. This was in keeping with previous cases that reported a female preponderance[11, 42].

Clinical presentation

The average duration of illness before presentation to hospital was 16.2 months. Pain as a presenting symptom was documented in only two cases. Only one case was associated with infection. This was in keeping with available literature which stated that Ossifying fibroma was generally an asymptomatic lesion[7, 11].

Osseous location of the tumour

Majority of the lesions occurred in the mandible (n = 7, 70.0%), while three tumours were in the maxilla (30%). This is similar to previous literature which site the mandible as the most common site[5, 7, 11, 42]. Mandibular tumours were mainly in the body of the left mandible. Maxillary tumors were evenly distributed in both alveolar processes and the right molar area.

Imaging findings

Ossifying fibroma mainly presented as a solitary, well-demarcated lesion with smooth-edged borders of variable radiographic density within the cancellous bone. This was in keeping with previous literature which stated that the radiological appearances of ossifying fibroma were variable depending on the maturity of the lesion[42]. Most of the tumours were corticated (60.0%) while only one lesion was partially encapsulated.

Majority of the tumours were non-loculated (60.0%) with a granular (n = 7) or mixed (n = 3) internal structure. Internal calcifications were only demonstrated in three of these tumours. Ninety percent (90.0%) of these tumours were associated with bone expansion. The bone cortex was intact in the majority of cases (n = 6). The mandibular canal was displaced in four out of the 10 cases of ossifying fibroma.

The teeth adjacent to the tumours were displaced in the majority of cases (n = 7, 70%). Only one case ossifying fibroma was associated with an unerupted tooth. Resorption of the roots of adjacent teeth was found in 60.0% of the cases. This is contrary to previous literature which reported that tooth resorption was rare with ossifying fibroma[7]. The late presentation of the cases in this study could account for this high prevalence of tooth resorption.

The lamina dura was breached in nine cases. The periodontal membrane was breached in eight cases.

Correlation between the radiological and histopathological diagnoses

There was absolute correlation between both the radiological and histopathological diagnoses of the tumours thought to be ossifying fibroma.

Fibrous Dysplasia

Fibrous dysplasia was the sixth most common lesion diagnosed with a prevalence of 5.0%. It was the third most common fibro-osseous lesion accounting for 28.1% of these lesions. In Jamaica, Ogunsalu et al[11] reported fibrous dysplasia to be more common than ossifying fibroma accounting for 46.9%. Onyango et al[23] in Kenya in 1995 reported fibrous dysplasia to be the second most common fibro-osseous lesion affecting the jawbones after ossifying fibroma. In that series it accounted for 20.3% of these lesions.

Socio-demographic characteristics

The tumour mainly occurred in the second and third decades (87.5%) with the majority of tumours occurring between the ages of 11 and 20 years. The average age of patients with fibrous dysplasia was 20.9 years. These findings were similar to those in literature. Ogunsalu et al[11] reported a mean of 25.8 years. Dr D. O. Awange[39] in his 1992 literature review on reported cases of fibrous dysplasia in Africa found that the mean age group was between 16.5 and 33.0 years with a peak age mostly in the second and third decades. Fibrous dysplasia was diagnosed in five female patients and in three male patients. The sex distribution in literature varies from a higher prevalence in females to equal sex incidence which was thought to reflect a ratio of the gender architecture of the affected regions[39]. Dr S. Maroo[2] in KNH in 1988 documented three cases of fibrous dysplasia all of which occurred in female patients.

Clinical presentation

The average duration of illness was 90.3 months. This prolonged duration of illness before presentation in a health care facility is in keeping with other reported cases of fibrous dysplasia[11, 39, 40]. In Dr S. Maroo's study[2] the average duration of symptoms was 36 months. None of the tumours was associated with pain as a presenting complaint which is characteristic for fibrous dysplasia[7, 11, 39, 40]. In only one case was infection of the jawbone a presenting complaint.

Osseous location of the tumour

Majority of the lesions (50.0%) occurred in the maxilla, 25.0% of the tumours involved both jawbones and 25.0% were in the mandible. Majority of the maxillary lesions involved the

right maxilla while the mandibular lesions were mainly in the molar region. Previous studies also confirm this maxillary predominance[11, 23 39, 40].

Imaging findings

Fibrous dysplasia mainly occurred as solitary lesions (75%) within the cancellous bone which were of variable radiographic density. Seventy five percent (75.0%) of the tumours were un-demarcated, uncorticated and had ill-defined borders with variable margins. Non-loculated tumours were the majority occurring in six cases while two tumours were multilocular. Unilocular and multilocular tumours have been documented in the initial stages of fibrous dysplasia[7, 40]. The internal structure of the tumours was mostly granular ("ground-glass" appearance). None of these lesions was associated with calcification. In literature the radiological features were documented as being varied but typically showed a ground-glass appearance on extraoral radiographs[7, 39].

Bone expansion was evident in seven out of the eight cases.

The teeth adjacent to the tumour were displaced in the majority of cases ($n = 6$) though no case of fibrous dysplasia was associated with unerupted teeth. Resorption of the roots of adjacent teeth was not a documented radiological feature. Torpet et al[40] stated that the presence of root resorption would indicate an alternative diagnosis. The lamina dura was breached in seven cases. The periodontal membrane was breached in two cases. Dr S. Maroo[2] documented loss of lamina dura in all the cases of fibrous dysplasia in his study.

Correlation between the radiological and histopathological diagnoses

Radiologically eight cases of fibrous dysplasia were diagnosed while on histopathology eleven cases were diagnosed. The differing diagnoses included ossifying fibroma (2) and ameloblastic fibroma (1). In both these cases the pathologist was not furnished with an adequate radiological report which would have indicated the presence of a well-defined border thereby changing the diagnosis.

CONCLUSION

The following conclusions were drawn from this study:-

Jaw tumours and tumour-like conditions, though rare, are important clinical entities which present with gross disfigurement in the study population especially as the mean duration of symptoms before presentation to a health care facility is long.

Aside from jaw swelling these conditions are mostly asymptomatic further contributing to the delay in seeking out definitive treatment.

Odontogenic tumours are the most common tumours affecting the jawbones.

Overall, jaw tumours show no sex predilection. However malignant tumours showed a definite male predominance.

Tumours affecting the jawbones have a predilection for the mandible.

When the different radiographic characteristics of a tumour mass are reviewed individually it is possible to give an accurate radiological report in at least 82.3% of cases.

RECOMMENDATIONS

1. In order to get better management outcomes there is need to educate the population on the nature of the lesions and advantages of early treatment. This may require that the primary health care providers implement community education programs on the benefits of regular dental check-ups.

2. More studies are required to document the true frequencies of these lesions in our population. In addition these studies need to be standardized so as to allow easy comparison of the results worldwide.

3. A study on malignant jaw tumours with a larger sample size is needed to further investigate the gender predilection found in this study.

4. Clinicians, radiologists and pathologists should work as a combined team in the management of these conditions so as to increase the preoperative diagnostic accuracy which may further improve healthcare provision.

APPENDIX 1 - DATA COLLECTION SHEET

Patient's Study No..... X-ray No.....

Institution..... Hospital No.... .....

Age.....

Sex: 01: M 02: F.

Date of OPG..... Date of Biopsy.....

Biopsy Lab No. .....

Brief Clinical History.....

.....

.....

Pain: 01 – Yes 02 – No **Infection**: 01 – Yes 02 – No

OPG FINDINGS

1. Position of lesion:	01 - Mandible	Mandible position.....
	02 – Maxilla	Maxilla position.....
	03 - Both jaws	
2. Site within bone	01 - Cortical	
	02 - Cancellous	
	03 - Both cortical & cancellous	
	04 - Extraosseous	
3. Number of lesion	01 - Solitary	
	02 - Multiple	
4. Overall radiographic density of lesion	01 - Radiolucent	
	02 - Radiopaque	
	03 - Mixed lucent/opaque	
5. Apparent origin of lesion	01 - Intraosseous	
	02 - Extraosseous	
	03 - Indeterminate	
6. Associated soft tissue mass	01 - Present	
	02 - Absent	

7. Margins	01 - Well-demarcated	
	02 - Moderately well-demarcated	
	03 - Not well-demarcated	
	04 - Un-demarcated	
8. Margin subtypes	01 - Sclerosed	03 - Irregular
	02 - Scalloped	04 - Other
9. Cortication	01 - Thick cortex	03 - Poorly corticated
	02 - Thin cortex	04 - Un-corticated
10. Encapsulation	01 - Total	
	02 - Partial	
	03 - Absent	
11. Border subtypes	01 - Smooth edged	
	02 - Undulating benign	
	03 - Sharp sclerotic	
	04 - Punched out	
	05 - Ragged "moth-eaten"	
	06 - Infiltrative malignant border	
	07 - Other	
12. Loculation	01 - Unilocular	
	02 - Multilocular	
	03 - Non-loculated	
13. Trabeculation	01 - Absent	04 – Increased
	02 - Blurred	05 – Blurred & increased
	03 – Diminished	06– Blurred & decreased
14. Internal structure subtypes	01 - Granular	04 – Other
	02 - Honeycombed	05 – Granular & septated
	03 - Septated	
15. Calcifications	01 - Present	
	02 - Absent	
16. Bone expansion	01 - Present	
	02 - Absent	
17. Bone cortex	01 - Intact	04 - Thickened
	02 - Intact but displaced	05 - Broken
	03 - Thinned	

18. Periosteal reaction	01 - Absent
	02 - "Hair-on-end"
	03 - Laminar
	04 - Other
19. Mandibular canal	01 - Intact
	02 - Displaced
	03 - Invaded
20. Association with tooth	01 - Yes
	02 - No
21. Tooth displacement	01 - Present
	02 – Absent
	03 – Teeth extracted
22. Association with uneruption	01 - Present
	02 – Absent
	03 0 Teeth extracted
23. Tooth root resorption	01 - Present
	02 – Absent
	03 – Teeth extracted
24. Lamina Dura	01 - Intact
	02 – Breached
	03 – Teeth extracted
	04 - Blurred
25. Periodontal membrane	01 - Intact
	02 - Breached
	03 – Teeth extracted
	04 - Widened

Final radiological diagnosis .....

Histopathological diagnosis .....

26. Do radiological and histopathological diagnoses match: 01 – Yes

02 – No

APPENDIX 2 - WHO CLASSIFICATION OF ODONTOGENIC TUMOURS (1992, 2nd Edition) [6]

1. **Neoplasms and other tumours related to the Odontogenic apparatus**

1.1 **Benign**

1.1.1 *Odontogenic epithelium without Odontogenic ectomesenchyme*

1.1.1.1 Ameloblastoma

1.1.1.2 Squamous odontogenic tumour

1.1.1.3 Calcifying odontogenic tumour (Pindborg tumour)

1.1.1.4 Clear cell odontogenic tumour

1.1.2 *Odontogenic epithelium with odontogenic ectomesenchyme, with or without dental hard tissue formation*

1.1.2.1 Ameloblastic fibroma

1.1.2.2 Ameloblastic fibrodentinoma (dentinoma) and ameloblastic fibro-odontoma

1.1.2.3 Odontoameloblastoma

1.1.2.4 Adenomatoid odontogenic tumour

1.1.2.5 Calcifying odontogenic cyst

1.1.2.6 Complex odontoma

1.1.2.7 Compound odontoma

1.1.3 Odontogenic ectomesenchyme with or without included odontogenic epithelium

1.1.3.1 Odontogenic fibroma

1.1.3.2 Myxoma (odontogenic myxoma, myxofibroma)

1.1.3.3 Benign cementoblastoma (cementoblastoma, true cementoma)

1.2 Malignant

1.2.1 Odontogenic carcinomas

1.2.1.1 Malignant Ameloblastoma

1.2.1.2 Primary intraosseous carcinoma

1.2.1.3 Malignant variants of other odontogenic epithelial tumours

1.2.2 *Malignant changes in odontogenic cysts*

1.2.2.1 Odontogenic sarcomas

1.2.2.2 Ameloblastic fibrosarcoma (ameloblastic sarcoma)

1.2.2.3 Ameloblastic fibrodentinosarcoma and ameloblastic fibro-odontosarcoma

1.2.2.4 Odontogenic carcinosarcoma

2. Neoplasms and other lesions related to bone

2.1 Osteogenic neoplasms

2.1.1 *Cemento-ossifying fibroma (cementifying fibroma, ossifying fibroma)*

2.2 Non-neoplastic bone lesions

2.2.1 *Fibrous dysplasia of the jaws*

2.2.2 *Cemento-osseous dysplasias*

2.2.2.1 Periapical cemental dysplasia (periapical fibrous dysplasia)

2.2.2.2 Florid cemento-osseous dysplasia (gigantiform cementoma, familial multiple cementomas)

2.2.2.3 Other cemento-osseous dysplasias

2.2.3 *Cherubism (familial multilocular cystic disease of the jaws)*

2.2.4 *Central giant cell granuloma*

2.2.5 *Aneurysmal bone cyst*

2.2.6 *Solitary bone cyst (traumatic, simple, haemorrhagic bone cyst)*

2.3 Other tumours

2.3.1 *Melanotic neuroectodermal tumours of infancy (melanotic prognoma)*

APPENDIX 3 - CLASSIFICATION OF ODONTOGENIC CYSTS

1. Radicular cysts
2. Dentigerous cysts
3. Odontogenic keratocyst
4. Eruption cyst
5. Lateral periodontal cyst
6. Primordial cyst
7. Calcifying odontogenic cyst

APPENDIX 4 - OTHER MALIGNANCIES AFFECTING THE JAW [7]

1. Osteogenic sarcoma
2. Chondrosarcoma
3. Rhabdomyosarcoma
4. Multiple Myeloma
5. Burkitt's lymphoma
6. Leukemia
7. Ewing's sarcoma
8. Hodgkin's lymphoma
9. Non-Hodgkin's lymphoma
10. Metastases

APPENDIX 5 – PROJECT BUDGET

	Kshs.
Literature Research	10,000
Computer and Stationery	15,000
Computer Data Entry and Data Analysis	15,000
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