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# Primary Bone Tumours at a Tertiary Health Centre in North Central Nigeria: A Ten Year Retrospective Review

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***Authors' contributions***

*This study was carried out by all the authors working in collaboration. Author AMD conceptualized the study and wrote the first draft of the manuscript. Authors POA, KVB, EI and AJO performed the literature search, data collection and analysis. Author BMM edited the manuscript. All Authors reviewed and approved the final Manuscript.*

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## ABSTRACT

**Aims:** This study is aimed at documenting the histopathological pattern of primary bone tumours in a tertiary health care centre in North Central Nigeria. These tumours are classified based on their biological nature and histological types. The gender distribution, age distribution and anatomical site of occurrence were also documented.
**Study Design:** This is a hospital-based retrospective and descriptive study.
**Place and Duration of Study:** Department of Histopathology, Jos University Teaching Hospital, Jos, Plateau State in North-Central Nigeria between 1st January 2006 to 31st December 2015.
**Materials and Methods:** We reviewed all histopathologically diagnosed primary bone tumours diagnosed at the Department of histopathology Jos University Teaching Hospital from 1st January 2006 to 31st December 2015. Corresponding patient demographic data such as age, sex and

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anatomical site involved were obtained from case files, surgical pathology records and the cancer registry. Archived slides and re-cut slides from tissue blocks were reviewed.
**Results:** A hundred and twenty-eight cases were included in the study, amounting to approximately 13 cases per year. Benign tumours accounted for 64.8% of cases while 35.2% were malignant. The commonest benign bone tumours diagnosed are Osteochondroma (27.7% of benign lesions) and Fibrous dysplasia (25% of benign lesions). Osteosarcoma was the commonest malignant bone lesion accounting for 55.5% of the malignant lesions. The second decade was the peak period of occurrence of both benign and malignant bone tumours. There was an overall male predominance and the commonest bones affected were the tibia, femur and craniofacial bones.
**Conclusion:** Primary bone tumours demonstrated a tendency to occur more commonly in young patients with the male gender more frequently affected. The long bones of the lower limb and craniofacial bones were commonly involved.

*Keywords: Primary bone tumours; Histopathology.*

## 1. INTRODUCTION

Primary neoplasms of bone are a small but significant proportion of human tumours. Globally primary bone tumours account for only 0.2% of overall human tumour burden [1]. The uncommonness of this group of tumours has contributed to the paucity of meaningful and useful data about the relative frequency, incidence rates and risk factors of the various subtypes of bone tumours [1]. Most bone tumours arise de-novo from somatic mutations; however numerous factors such as chemotherapy, irradiation, foreign bodies, bone infarcts and pre-existing bone lesions have been implicated [2]. The aetiology of bone cancers is better established than their benign counterparts [3].

The classification of bone tumours by the World Health Organization (WHO) has been relatively unaltered over the years, with the framework and concept of the original classification widely accepted [4]. This classification is based on the line of histological differentiation, in many instances reflecting the type of intercellular matrix material produced [4]. The current WHO classification of bone tumours (2013) has made a few changes in its content and structure compared to the previous classification (2002) [5].

Surveillance, Epidemiology and End Results (SEER) database from 2008-2012 indicates a gradual rise in the incidence of bone and joint cancer (rising about 0.4% each year over a 10-year period between 2003-2012). The lifetime risk of developing a bone and joint cancer was estimated to be 0.1% based on 2010-2012 data. In general, the incidence of bone and joint cancers is higher in whites than in blacks and higher in males than in females, with patients less than 20 years accounting for the majority of afflicted individuals [6].

This is a retrospective study aimed at documenting the histopathological pattern of primary bone tumours at the Jos University Teaching hospital. The age, sex, and anatomical site of occurrence of the various tumours will also be documented.

## 2. MATERIALS AND METHODS

This was a retrospective review of all cases of primary bone tumours diagnosed at the histopathology department of the Jos University Teaching Hospital (JUTH), Jos, North-central Nigeria between 1$^{st}$ January 2006 to 31$^{st}$ December 2015. Materials consisted of Archival slides, tissue blocks, surgical pathology register, cancer register entries and case files of all cases of primary bone tumour diagnosed during this period. The patient age, sex and site of tumour involvement were obtained. The archived slides and new slides cut from paraffin blocks were stained with haematoxylin and eosin (in cases of missing or faded slides), and were reviewed by the authors of this article. Special stains such as Von kossa was employed to demonstrate osteoid in some cases of osteosarcoma and Immunohistochemistry was used to confirm diagnosis of equivocal cases such as plasmacytoma, Burkitt lymphoma and Ewing's sarcoma. The world health organization classification of primary bone tumours 2013 was adopted. The data obtained was analyzed using Epi info 7 (version 3.5.4) and presented in tables.

## 3. RESULTS

One hundred and twenty-eight cases were diagnosed in the period of the study. This

accounted for 0.69% of the 18,494 surgical pathology samples processed in the histopathology laboratory in the period of the study. There were approximately 13 cases of primary bone tumour seen per year. Fifteen different diagnostic entities were made, amongst which chondrogenic tumours predominated (32.8%) followed closely by osteogenic tumours (28.9%) (Table 1). Amongst the 128 tumours seen 83 cases (64.8%) were benign while 45 (35.2%) were malignant (Table 2). The commonest benign bone tumours were osteochondroma and fibrous dysplasia, while the commonest malignant bone tumour was osteosarcoma. There was an overall male predominance, with a male to female ratio of 1.3:1 (Table 2). The peak period of occurrence was in the second decade of life (11-20 years) accounting for 36% of cases (Table 3). Patient ages ranged from 2 years to 77 years and the mean age at diagnosis was 25.6±15.7 years. About half of all cases of primary bone tumours (49.2%) occurred in patients 20 years or less. The commonest anatomical sites of tumour occurrence were the craniofacial bones (maxilla, mandible and other skull bones), the tibia and the femur accounting for 21.9% (28), 21.1% (27) and 17.2% (22) of cases respectively (Table 4). Amongst the 28 cases in the craniofacial bones 12 occurred in the maxilla, 10 occurred in the mandible and the remaining 6 occurred in other craniofacial bones (temporal, frontal and mastoid bones).

## 4. DISCUSSION

Primary bone tumours accounted for a small proportion of all surgical pathology specimens received (0.69%). The approximately 13 cases diagnosed per year correlates with an average of 10 to 15 cases per year documented in similar institutions in Nigeria [2,7-9]. This study showed an overall male predominance with a male to female ratio of 1.3:1. A male predominance is also documented in similar studies from other parts of Nigeria and several international studies of the same type [2,8-12].

The peak age group at diagnosis of both benign and malignant bone tumours occurred in the second decade. Similar peak periods of occurrence have been documented by other authors [8-10,13].

**Table 1. Histopathological pattern of 128 primary bone tumours using WHO 2013 classification [3]**

| Tumour group | Biologic nature | Histologic type | Frequency (%) |
|---|---|---|---|
| Osteogenic tumours | **Benign** | Osteoid osteoma | 7 (5.47%) |
| | | Osteoma | 5 (3.91%) |
| | **Malignant** | Osteosarcoma | 25 (19.5%) |
| Total group 1 | | | 37 (28.9%) |
| Chondrogenic tumours | **Benign** | Osteochondroma | 23 (17.9%) |
| | | Chondroma | 10 (7.81%) |
| | **Malignant** | Chondrosarcoma | 9 (7.03%) |
| Total group 2 | | | 42 (32.8%) |
| Tumours of undefined neoplastic nature | **Benign** | Fibrous dysplasia | 21 (16.4%) |
| (Tumour-like lesions) | | Aneurysmal bone cyst | 3 (2.34%) |
| | | Osteofibrous dysplasia | 1 (0.78%) |
| Total group 3 | | | 25(19.5%) |
| Haematopoietic | **Malignant** | Plasmacytoma | 5 (3.91%) |
| Tumours | | Burkitt lymphoma | 2 (1.56%) |
| Total group 4 | | | 7 (5.46%) |
| Miscellaneous tumours | **Malignant** | Ewing sarcoma | 3 (2.34%) |
| | | Undifferentiated pleomorphic high grade sarcoma of bone | 1 (0.78%) |
| Total group 5 | | | 4 (3.12%) |
| Osteoclastic tumours | **Benign** | Osteoclastoma | 10 (7.81%) |
| Fibrohistiocytic tumours | **Benign** | Non ossifying fibroma | 3 (2.34%) |
| Total | | | 128 (100%) |

**Table 2. Table showing distribution of primary bone tumours in relation to gender**

| Histologic type | Gender | | | |
|---|---|---|---|---|
| | Male | Female | Total (%) | M:F |
| **Benign Tumours** | | | | |
| Osteochondroma | 10 | 13 | 23 | 0.8:1 |
| Fibrous dysplasia | 10 | 11 | 21 | 0.9:1 |
| Osteoclastoma | 4 | 6 | 10 | 0.7:1 |
| Chondroma | 8 | 2 | 10 | 4:01 |
| Osteoid osteoma | 4 | 3 | 7 | 1.3:1 |
| Osteoma | 2 | 3 | 5 | 0.6:1 |
| Non-ossifying fibroma | 1 | 2 | 3 | 0.5:1 |
| Aneurysmal bone cyst | 2 | 1 | 3 | 2:01 |
| Osteofibrous dysplasia | 1 | 0 | 1 | 1:00 |
| **Malignant Tumours** | | | | |
| Osteosarcoma | 15 | 10 | 25 | 1.5:1 |
| Chondrosarcoma | 8 | 1 | 9 | 8:01 |
| Plasmacytoma | 3 | 2 | 5 | 2.5:1 |
| Ewing sarcoma | 2 | 1 | 3 | 2:01 |
| Burkitt's Lymphoma | 2 | 0 | 2 | 2:0 |
| Undifferentiated High Grade Sarcoma of Bone | 0 | 1 | 1 | 0:1 |
| **Total** | **72** | **56** | **128** | **1.3:1** |

**Table 3. Age distribution of 128 primary bone tumours**

| Histologic type | Age distribution (years) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | >60 | Total (n) |
| **Benign Tumours** | | | | | | | | |
| Osteochondroma | 4 | 8 | 6 | 1 | 1 | 2 | 1 | **23** |
| Fibrous dysplasia | 2 | 8 | 5 | 4 | 1 | 1 | - | **21** |
| Osteoclastoma | 1 | 4 | 3 | 1 | - | 1 | - | **10** |
| Chondroma | 1 | 3 | - | 3 | 1 | 2 | - | **10** |
| Osteoid osteoma | 1 | 4 | 1 | 1 | - | - | - | **7** |
| Osteoma | - | - | - | 4 | - | 1 | - | **5** |
| Non-ossifying fibroma | 1 | 1 | - | 1 | - | - | - | **3** |
| Aneurysmal bone cyst | - | 2 | 1 | - | - | - | - | **3** |
| Osteofibrous dysplasia | 1 | - | - | - | - | - | - | **1** |
| **Malignant Tumours** | | | | | | | | |
| Osteosarcoma | 6 | 12 | 4 | 2 | - | - | 1 | **25** |
| Chondrosarcoma | - | - | 1 | 5 | 2 | - | 1 | **9** |
| Plasmacytoma | - | - | - | - | 3 | 2 | - | **5** |
| Ewing sarcoma | - | 3 | - | - | - | - | - | **3** |
| Burkitt Lymphoma | - | 1 | 1 | - | - | - | - | **2** |
| Undifferentiated high grade pleomorphic sarcoma of bone | - | - | - | - | 1 | - | - | **1** |
| **Total n (%)** | **17 (13.2)** | **46 (35.9)** | **22 (17.2)** | **22(17.2)** | **9 (7)** | **9 (7)** | **3 (2.3)** | **128(100)** |

**Table 4. Anatomical site distribution of 128 primary bone tumours**

| | Anatomical sites | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Histologic type** | **Craniofacial bones** | **Clavicle** | **Scapula** | **Humerus** | **Radius** | **Ulna** | **Hand bones** | **Iliac Bone** | **Femur** | **Tibia** | **Fibula** | **Foot bones** | **Total** |
| **Benign Tumours** | | | | | | | | | | | | | |
| Osteochondroma | - | - | 2 | 6 | 1 | 1 | 2 | - | 2 | 5 | 1 | 3 | 23 |
| Fibrous dysplasia | 16 | - | | - | - | 1 | 1 | - | - | 2 | - | 1 | 21 |
| Osteoclastoma | 1 | - | - | - | - | - | 2 | - | 1 | 4 | - | 2 | 10 |
| Chondroma | - | 2 | - | - | - | - | 2 | - | - | 2 | - | 4 | 10 |
| Osteoid osteoma | 2 | - | - | - | 1 | - | - | - | 1 | 1 | 1 | 1 | 7 |
| Osteoma | 3 | - | - | - | - | - | - | - | 1 | - | - | 1 | 5 |
| Non-ossifying fibroma | 2 | - | - | - | 1 | - | - | - | - | - | - | - | 3 |
| Aneurysmal bone cyst | 1 | - | - | - | 1 | - | - | - | 1 | - | - | - | 3 |
| Osteofibrous dysplasia | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 |
| **Malignant Tumours** | | | | | | | | | | | | | |
| Osteosarcoma | 1 | - | - | 2 | - | - | - | 3 | 9 | 9 | | 1 | 25 |
| Chondrosarcoma | - | - | - | 2 | - | - | - | 2 | 3 | 2 | | - | 9 |
| Plasmacytoma | - | - | - | 1 | - | - | - | 2 | 2 | - | | - | 5 |
| Ewing sarcoma | - | - | - | - | - | - | - | - | 2 | 1 | | - | 3 |
| Burkitt Lymphoma | 2 | - | - | - | - | - | - | - | - | - | | - | 2 |
| Undifferentiated high grade pleomorphic sarcoma | - | - | - | 1 | - | - | - | - | - | - | | - | 1 |
| **Total n (%)** | **28 (21.9)** | **2 (1.6)** | **2 (1.6)** | **12 (9.4)** | **4 (3.1)** | **2 (1.6)** | **7 (5.5)** | **7 (5.5)** | **22 (17.2)** | **27 (21.1)** | **2 (1.6)** | **13 (10.2)** | **128(100)** |

The commonest anatomical site of bone tumour diagnosis was craniofacial bones (21.8% cases). The tibia (21.1% cases) and the femur (17.2% cases), were the second and third most common sites of bone tumour diagnosis in this study. This correlates with findings documented in Zaria Northwestern Nigeria by Mohammed. et al whereby the commonest site of bone tumour diagnosis was the face [2]. In contrast, the tibia and femur were the commonest sites of primary bone tumour diagnosis in other studies from Nigeria, Cameroon and India [8-10,14]. Fibrous dysplasia accounted for 57% of tumours occurring in craniofacial bones. The relatively high frequency of fibrous dysplasia in this study appears to skew the topographic distribution towards the craniofacial site.

Chondrogenic tumours (32.8%) were the predominant group of tumours and were closely followed by osteogenic tumours (28.9%). This correlates with findings in Enugu (South-East Nigeria), Lagos (south-west Nigeria), India and the USA in which chondrogenic tumour featured prominently [8-11].

Benign bone tumours occurred more frequently than their malignant counterpart and accounted for 64.8% of all primary bone tumours in this study. Similar findings have been reported in other Nigerian and international studies [2,8-10,14]. Very few studies from around the world show a predominance of primary malignant bone tumours over their benign counterpart [11].

Osteochondroma was the most common benign bone tumour diagnosis in this study, accounting for 27.7% of benign bone tumours and showed a female predominance (M:F 0.8:1). The peak age of occurrence was in the second decade, with 34% of cases diagnosed between 11-20 years. The commonest sites of Osteochondroma diagnosis in this study were the Humerus (26%) and Tibia/Fibula (26%). In Ethiopia, India, Mexico and Portugal, osteochondroma was also documented as the commonest benign bone tumour accounting for 41%, 40.5%, 43.7% and 45.3% of benign bone tumours respectively. A peak occurrence in the second decade was also observed by other authors in Nigeria and India [2,8-10]. Osteochondroma is the most frequently occurring benign bone tumour globally, with a male predominance widely reported [3,15]. The female predominance in our study may be due to a better health-seeking behaviour and cosmetic concerns amongst women in our environment [16]. Osteochonromas usually stop growing at the time of growth plate closure [17]. A very small proportion of the solitary tumours evolve into chondrosarcomas, but the incidence may be higher in the cases with multiple lesions [17].

Fibrous dysplasia accounted for 25.3% of benign bone tumours, and was slightly less frequent than osteochondromas. This study showed an almost equal frequency of fibrous dysplasia in both gender, with a slight female predominance (M:F 0.9:1). The second decade of life was the peak period of occurrence of fibrous dysplasia (38% of cases) and a majority of cases involved craniofacial bones (76% of cases). The frequency of fibrous dysplasia as a percentage of benign bone tumours documented in other studies from Nigeria appears to vary with geographical region. In Zaria North-Western Nigeria fibrous dysplasia accounted for 33.8% of benign bone tumours while it only accounted for 6.6% in Lagos in the South-Western region [2,8]. In Ethiopia (12.7%), Cameroon (15%) China (14.1%) and India (4.3%) the reported percentages were significantly lower than our findings [10,11,13,14]. The finding of craniofacial bones as the commonest site of fibrous dysplasia in our study is also reported by authors from Nigeria, Ethiopia and other parts of the Globe [2,3,9,13]. This lesion can present as the monostotic and polyostotic forms. The polyostotic form is usually seen in association with McCune-Albrights Syndrome, in which there is unilateral distribution of lesions with other features such as (endocrine dysfunction, precocious puberty in female individuals, and areas of cutaneous hyperpigmentation) [15,17].

Primary malignant bone tumours represented 35.2% of all cases of primary bone tumours seen in this study. They occurred less frequently than their benign counterparts. This finding correlates with local and international studies with a few exceptions [2,8,9,11]. Primary malignant bone tumours represented 1.79% of cancers diagnosed in JUTH during the period of this study, this figure is higher than the 0.53% documented in Ibadan South-Western Nigeria [18].

Primary malignant bone tumours occur less frequently than benign bone tumours but are clinically more important. In the developing countries primary malignant bone tumours occur more commonly than secondary bone tumours, while secondary bone tumours are commoner in developed countries [1,8,14].

Osteosarcoma is by far the commonest of the primary malignant bone tumours in this study and accounted for 55.5% of the primary malignant bone tumours diagnosed during the period of review. Abdulkareem et al (50%) and Omololu et al (61%) both in south-western Nigeria, documented similar findings [8,18]. Osteosarcoma accounted for a higher proportion of primary malignant bone tumours in Enugu, South-Eastern Nigeria (80.1%) and Ethiopia (70%) [9,14]. Studies from Australia, Thailand, Pakistan and England conducted by Blackwell et al (35.7%), Pongkripetch et al (39.9%) Shah et al (38%) and Arora et al (34.4%) also documented Osteosarcoma as the commonest primary malignant bone tumour but accounting for a lower proportion compared to our findings [19-22].

Osteosarcomas occurred more frequently in males in this study with a male to female ratio of 1.5:1. This correlates with findings in Ibadan south-west Nigeria with a male to female ratio of 1.6:1 [18]. In Lagos which is also in south west Nigeria Abdulkareem et al, reported all cases of osteosarcoma in males, while another study in Zaria northwest Nigeria reported a higher incidence in the female gender (M:F. 0.7:1) [2,8]. A slight female bias was also documented by Shah et al in Karachi Pakistan [19]. Globally a male predominance is well established [3,23]. The peak period of diagnosis of osteosarcoma in this study is in the second decade, with patients in this age group accounting for 45% of cases. This correlates with observations in Ibadan wherein 50% of Osteosarcomas occurred in the second decade [18]. Osteosarcomas have a bimodal age distribution, however most local studies showed only one peak [3,8,9,18]. The absence of a second peak in most Nigerian studies including this one may be due to a lower life expectancy, with a small cohort of older patients. Rapid skeletal growth occurs in younger patients and is thought to predispose patients to having this tumour [18]; however, more established risk factors such as radiation therapy and genetic predisposition such as Li-fraumeni syndrome have not been well established in developing countries such as Nigeria. The commonest sites of osteosarcoma diagnosis in this study were the femur and tibia, (72% of cases), this correlates with findings in Lagos south-western Nigeria but is at variance with findings by Mohammed A. et al in Zaria North-west Nigeria where facial bones were the commonest site of diagnosis of osteosarcoma [2,8]. Globally studies have consistently showed the femur and tibia to be the commonest sites of osteosarcoma diagnosis [6,24].

## 5. CONCLUSION

In general, the pattern and demographics of primary bone tumours seen in this study at the Jos University Teaching Hospital is similar to that reported in other studies from within and outside Nigeria.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

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## COMPETING INTERESTS

The authors of this research article declare there are no competing interests.

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