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Multiple Exostosis Disease: Study of 20 Senegalese Cases

Moustapha Niasse[1*], Adama Bah[2], Lamine Sarr[3], Fatou Sow Diouck[1], Jan René Nkeck[4], Arsène Irung[1], Omar Ndong[1], Yaye Aminata Niang Guèye[1], Saïdou Diallo[1], Charles Bertin Diémé[3]

[1]Rheumatology Department, CHU Aristide Le Dantec, relocated to the C.O.U.D. Hospital, Cheikh Anta Diop University of Dakar, Dakar, Senegal
[2]Rheumatology Department, Ignace Deen National Hospital, Conakry, Guinea
[3]Orthopedics and Traumatology Department, Aristide Le Dantec Hospital, Cheikh Anta Diop University of Dakar, Dakar, Senegal
[4]Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Yaoundé, Cameroon
Email: *moustaphaniasse4@yahoo.fr

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Abstract

Background: Multiple exostosis (ME) is rarely reported in sub-Saharan Africa. This study aimed to describe the epidemiological, diagnostic and prognostic features of ME in Senegalese patients. **Methods:** A retrospective study was conducted, including all patient records from the Rheumatology Department at Aristide Le Dantec University Hospital between January 2016 and August 2025, for which an ME diagnosis had been made. Osteochondroma was diagnosed based on clinical and radiological evidence. Chondrosarcoma was confirmed by pathology. **Results:** Twenty cases were identified, including 18 men and 15 familial cases originating from three families. The prevalence among first-degree relatives was 10.18%, compared to 3.7% among second-degree relatives. The consanguinity rate was 55%. The median age at apparent disease onset was 9 years (range 1 to 18 years), and at diagnosis it was 28 years (range 9 to 58 years). Exostoses were located at the metaphyses of the limb bones in 90% of cases and at the axial skeleton in 65% of cases. The upper limbs were affected in 40% of cases and the lower limbs in 90%. The osteochondromas were painless in 12 cases (60%) and painful and growing in eight cases (40%). The number of osteochondromas recorded per patient ranged from 2 to 17. All patients had sessile exostoses. Two of them also had pedunculated exostoses. Bone deformities resulting in limb inequality were observed in seven cases. Vascular compression was recorded in two cases, one of which progressed to chondrosarcoma resulting in death due to pulmonary metastases. **Conclusion:** This is the largest series reported in Sub-Saharan Africa. The results reveal a high degree of familial aggregation and emphasize the importance of identifying cases within families for the early diagnosis and prevention of complications.

Keywords

Multiple Exostosis Disease, Osteochondromas, Senegal

1. Background

Exostoses are benign bone tumours. Solitary exostoses are common, accounting for 20% to 50% of bone tumours. They are often secondary to environmental factors, particularly osteomyelitis, trauma and radiation exposure during childhood [1]. Multiple exostoses (ME) is a hereditary condition that is autosomal dominant [2] [3]. It is one of the rarer forms of osteopathy. Its prevalence is estimated at 1 in 50,000 people in Western populations. This study aimed to describe the epidemiological, diagnostic, prognostic and therapeutic profile of multiple exostoses in Senegalese patients, and to establish the status of this rare disease in sub-Saharan Africa.

2. Methods

This was a retrospective cross-sectional study conducted between January 2016 and August 2025 in the Rheumatology Department of Aristide Le Dantec Hospital, currently relocated to the C.O.U.D. Hospital (*Centre des Œuvres Universitaires de Dakar*). We collected data on all patients with multiple exostoses. The diagnosis was based on the following arguments:

-Epidemiological: gender, age at apparent onset of the disease, and age at diagnosis.

-Clinical: presence of visible and palpable bone swellings at the metaphyses of long bones and the axial skeleton.

-Radiological: radiological confirmation of exostosis.

-Pathology: histological confirmation of exostosis, with or without signs of malignancy.

For each confirmed case of multiple exostoses, a family survey was conducted to search for other cases of the same disease among relatives. This survey was carried out among first-degree (parents, siblings or children), second-degree (uncles, aunts or grandparents) and third-degree (first cousins) relatives. The information provided by the index cases was used to construct a pedigree. The parents identified by the propositus who had osteochondromas were summoned. These parents were examined and investigated with their informed consent. At the end of the investigation, the familial and sporadic forms were specified.

For each observation, we specified the following data:

-Epidemiological data.

-Clinical data: number and location of exostoses, painful or painless.

-Associated signs: bone deformity, bone shortening.

-Biological data: presence or absence of inflammatory syndrome, abnormalities on calcaemia, phosphatemia and parathormone.

-Radiological data: the form of the exostoses (sessile or pedunculated).

-Prognostic factors: compression of neighbouring organs, osteochondroma fracture, malignant transformation.

-Treatments: therapeutic abstention, conservative (medical) treatment, surgical removal.

3. Results

A total of 20 observations were collected from 18 men and two women. The median age at the apparent onset of the disease was 9 years (range: 1 to 18 years), and at the time of diagnosis, it was 28 years (range: 9 to 58 years). On average, it took 19 years (range: 8 to 57 years) to receive a diagnosis. Five of the patients had sporadic forms of the disease, while 15 had familial cases. The latter came from three families. The overall prevalence in these families was 13.88%. The prevalence among first-degree relatives was 10.18%, compared to 3.7% among second-degree relatives. Third-degree relatives were unaffected. The consanguinity rate among the families was 55%.

Exostoses were located at the metaphyses of the limb bones in 90% of cases (**Figure 1**) and at the axial skeleton in 65% of cases (**Figure 2**). The upper limbs (shoulders, elbows and wrists) were affected in 40% of cases, while the lower limbs (hips, knees and ankles) were affected in 90% of cases. The axial topography is described in **Table 1**. The osteochondromas were painless in 12 cases (60%), while in the remaining eight cases (40%), they were painful and increased in volume. All of these patients were at the end of their growth phase. The number of osteochondromas recorded per patient ranged from 2 to 17. The rheumatological examination also revealed limb inequality in seven cases. These consisted of forearm curvature in five cases (**Figure 2**) and valgus knee deformity in two cases.

Table 1. Description of exostoses located in the axial skeleton.

Axial Bones Affected	Number of Cases
Spine	4
Iliac bones	3
Scapulae	3
Ribs	2
Clavicles	1

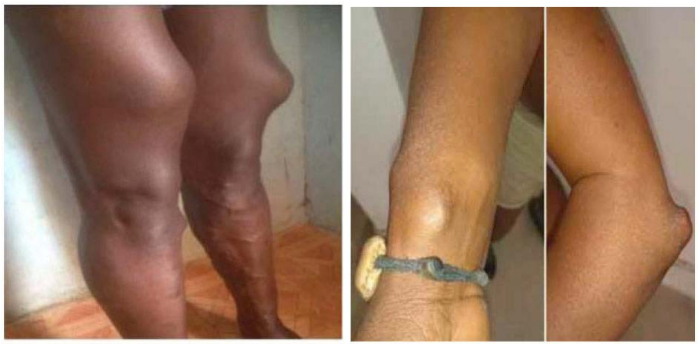

Figure 1. Images of peripheral exostoses located at the metaphyses of the limbs. *The patient on the right, who is also shown in **Figure 4**, wears an amulet given to him by a healer.*

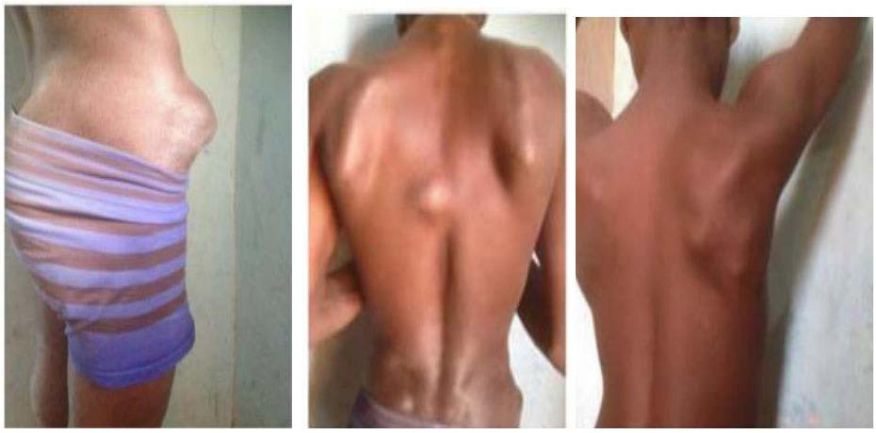

Figure 2. Exostoses in our patients located on the left iliac bone, the dorsal spine and the right scapula.

Biological tests showed no signs of an inflammatory syndrome. The sedimentation rate, C-reactive protein levels and serum protein electrophoresis results were all normal. Calcium and phosphate levels were also normal. Standard X-rays revealed sessile exostosis in all cases. In two cases, these were associated with pedunculated forms. CT angiography was performed in three patients and magnetic resonance imaging in one of them, in addition to standard radiography. CT angiography revealed superficial and deep venous compression in the lower limbs of both patients (**Figure 3**). The exostoses had been noticeable to those around the patient since the age of two, and after 39 years of progression, a large, painful mass had developed in the left iliac bone. Although surgical removal was performed, recurrence occurred after two years (**Figure 4**), ultimately causing death from pulmonary metastases leading to respiratory distress. Initially, the patient had consulted a traditional healer (**Figure 1**), but the hyperalgesic nature of the exostosis ultimately forced him to visit the rheumatology department at the hospital. Biological explorations showed an inflammatory syndrome, with a sedimentation rate of 95 mm/h, C-reactive protein of 133.64 mg/L, and microcytic anaemia of 11 g/dL. Serum calcium was 85.25 mg/dL and serum creatinine was 7.9 mg/dL. An abdominal and pelvic CT scan, followed by magnetic resonance imaging, showed a large tumour formation centred on the left iliac bone, with abdominal and parietal development portions (**Figure 4**). There was infiltration of the gluteal muscles and the left psoas. The left kidney was pushed forward, as was the bladder, rectum and sigmoid colon to the right.

Histological examination of the biopsy sample revealed malignant degeneration to grade I chondrosarcoma. The technical platform did not permit immunohistochemical examination or genetic testing of the biopsy piece. The patient's condition deteriorated, resulting in respiratory failure and death in the context of cachexia and pulmonary metastasis. Apart from this patient, the other seven cases of active exostoses had also undergone surgery (**Figure 5**). No other cases after surgical recurrence of osteochondromas were noted. These seven patients did not experience a recurrence of exostosis after surgery. The other exostoses that were

not operated on remained stable. The follow-up period was 8 years.

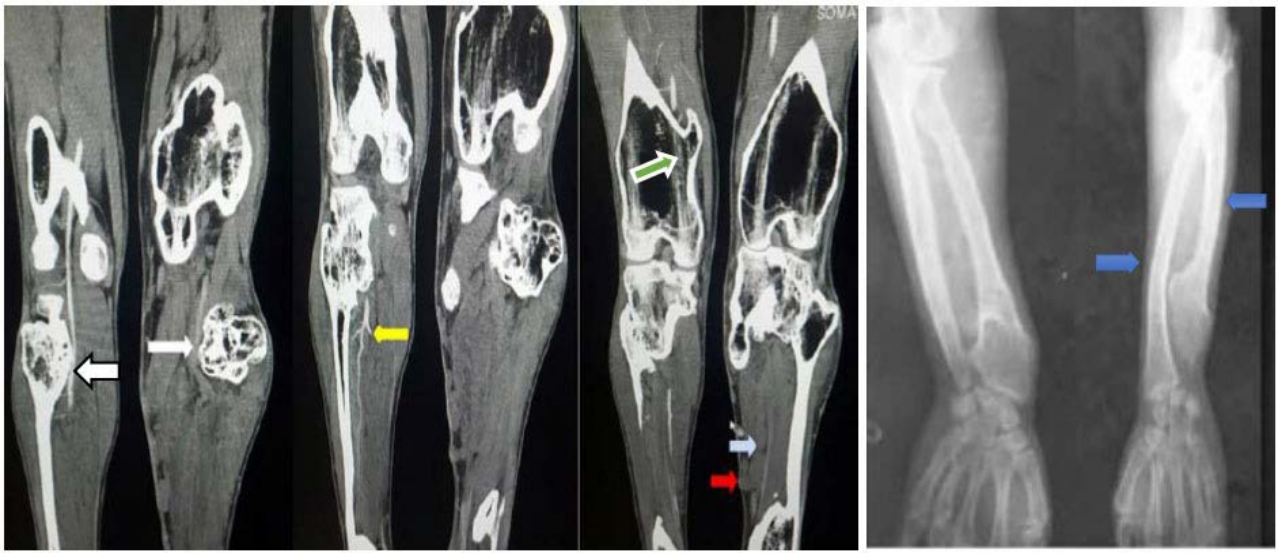

Figure 3. Angioscanner of a patient's lower limbs and X-rays of both arms showing the exostoses. *The pathognomonic radiological sign, which is the continuity of the medullary spaces between the osteochondroma and the supporting bone, is indicated by the green arrow. Close contact between the exostosis of the upper end of the left tibia and the left popliteal artery* (*white arrow*). *Contrast uptake of the right leg tripod, unlike its counterpart* (*yellow arrow*). *Deep venous dilatation* (*light blue arrow*) *and varicose veins in the superficial network* (*red arrow*). *The X-ray of the patient on the right* (*also shown in* ***Figure*** 1) *shows curvature of the bones of the left forearm with shortening of the ulna* (*dark blue arrows*).

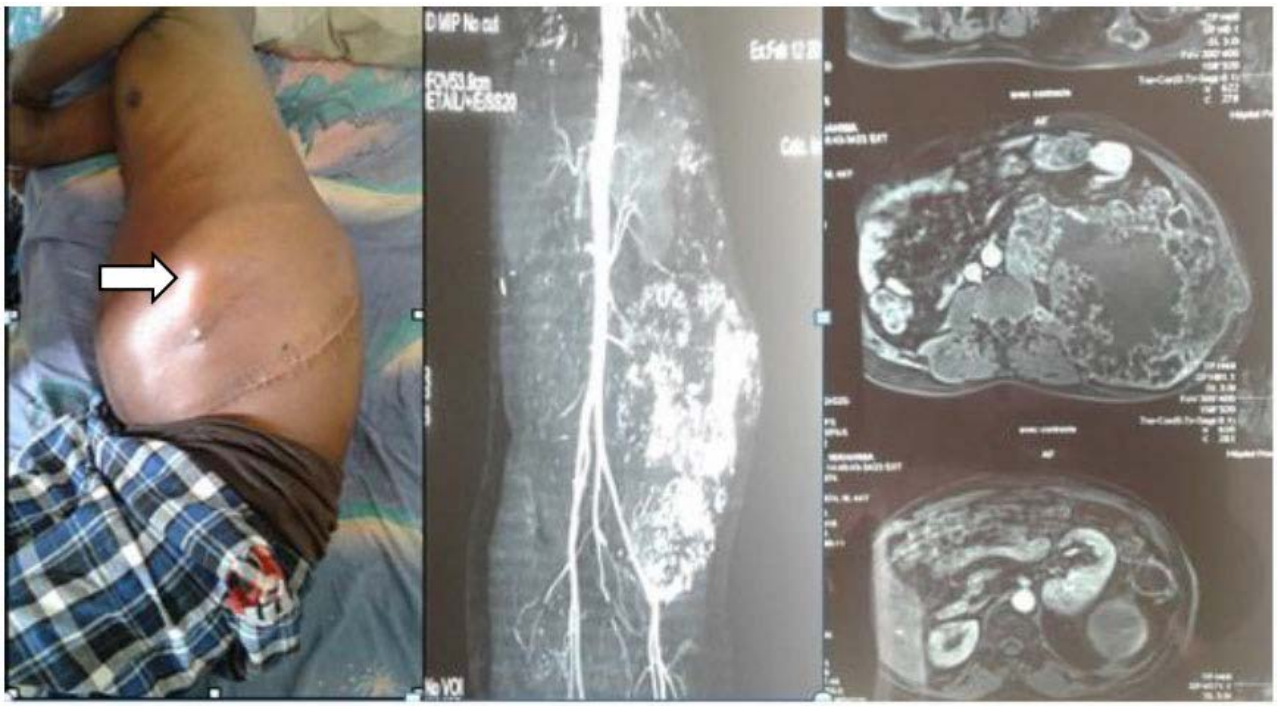

Figure 4. Images reported a recurrence of the tumor two years after surgery. *Mass centered in the left iliac bone perceptible on clinical examination* (*a*). *It invades the surrounding organs on the CT scanner* (*b*) *and magnetic resonance imaging* (*c*).

4. Discussion

We report cases of multiple exostoses in black African subjects. This series includes 16 patients seen between 2016 and 2019 [4]-[6], and since then, four other cases have been added. Our study is in accordance with the data in the literature in terms of epidemiology, diagnosis, prognosis and treatment.

From an epidemiological perspective, multiple exostosis is a rare condition. It is estimated to affect 1 in 50,000 people in Western populations [3]. Our 20 observations were recorded over a period of nine years, representing an annual incidence rate of 2.22. This suggests that the condition is rare in our context. In sub-Saharan Africa, we have only been able to record 16 cases of multiple exostosis disease over the last 25 years (**Table 2**) [7]-[16]. Combined with our own observations, these cases define an incidence rate of 1.44 per year. The male predominance in our study is consistent with existing literature [1] [3]. The average age at apparent onset of the disease in our patients was nine years, indicating a juvenile onset of the condition. This early onset of multiple osteochondromas is documented in the literature. Indeed, multiple exostoses develop during growth, making this a childhood and adolescent pathology [17].

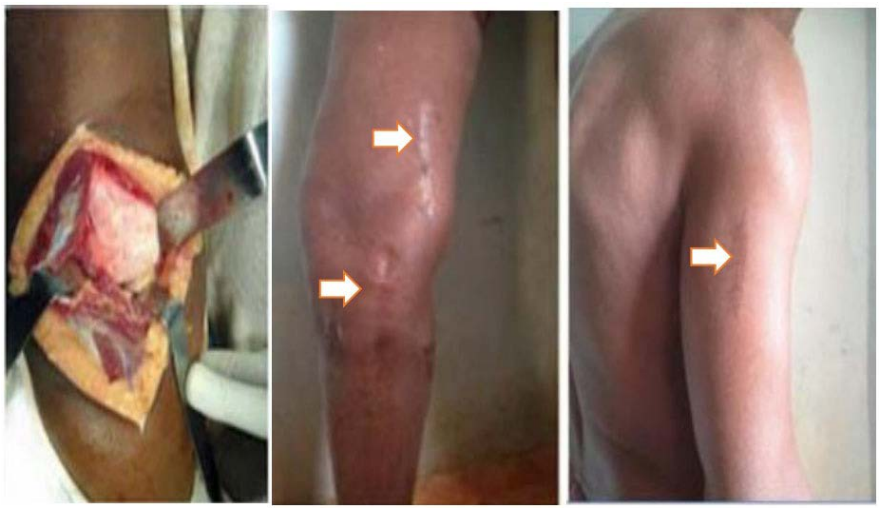

Figure 5. Surgical removal of exostoses in some of our patients.

Table 2. Overview of multiple exostoses disease in sub-Saharan Africa.

Country	South Africa [7]	Congo Brazzaville [8]	Ivory Coast [9]	Nigeria [10] [11]	Burkina Faso [12]	Niger [13]	Rwanda [14]	Mali [15]	Ghana [16]	Total or median
Years	1999	2001	2002	2009 2010	2013	2015	2018	2020	2023	1999-2023 (25 years)
Number of cases	2	4	1	4	1	1	1	1	1	16
Age at diagnosis (years)	NS	14, 18, 20, 21	22	5, 8, 9, 13	14	15	11	15	12	14, 07 (8 - 22)
Age at onset of disease (years)	NS	NS	NS	NS, 2, 3, 6	5	7	3	8	NS	4, 85 (2 - 8)

Continued

Familial cases	NS	2	NS	2	0	0	NS	0	NS	4
Peripheral involvement	2	4	1	4	1	1	1	1	1	16
Axial involvement	2	0	0	0	1	1	0	1	0	5
Axial topography	Spine	-	0	-	Spine	Rib	-	Spine	0	Spine: 4 Rib: 1
Bone deformities	0	4	1	2	1	0	0	0	1	9
Vascular compression	0	0	0	0	0	0	0	0	0	0
Nerve compression	2	0	0	0	1	0	0	1	0	4
Type of neurological damage	SCC	-	-	-	SCC	-	-	SCC	0	SCC: 4
Chondrosarcoma	0	1	0	0	0	1	0	0	0	2

NS: not specified; SCC: spinal cord compression.

In our study, late diagnosis in adulthood was more often related to the painless nature of the disease, which often resulted in delayed consultation. Thus, the average diagnostic delay for our patients was 19 years, ranging from 8 to 57 years. Exostoses are diagnosed through clinical and radiological examination. During clinical examination, exostotic masses are primarily found at the metaphyses of long bones, particularly around the knees (including the lower ends of the thighs and upper legs) [17] [18]. This preferential location of exostoses reflects their pathogenesis; they are often absent from bones with membranous ossification (e.g., the bones of the face and cranial vault) and present in bones with endochondral ossification (e.g., long bones, vertebrae, and the base of the skull) [17]-[19]. However, our patients presented with exostoses in less commonly described locations, particularly the ilium, scapula, clavicle and ribs [20] [21].

Radiologically, the pathognomonic sign revealed by computed tomography in one of our patients was the continuity of the medullary spaces of the supporting bone and the osteochondroma, which was covered by a cartilaginous cap [22]. When this sign is observed, pathological examination is no longer required for a definitive diagnosis. Therefore, clinical examination and standard radiography and/or computed tomography are sufficient for diagnosing exostosis [19] [22]. The radiographic forms observed in our study are consistent with those described in the literature. These are the sessile form, which was observed in all patients, and the pedunculated form, which was identified in two cases.

Multiple exostosis, unlike solitary exostosis, is a genetic disorder [3]. Transmission is autosomal dominant with 100% penetrance [3]. Genotyping tests were not performed on our patients due to a deficiency in the technical facilities at our hospitals; however, genetic determinism is suggested in familial forms with predominant involvement of first-degree relatives. According to Feingold J, to demonstrate that a disease is familial, one can, for example, show that the disease is more common among first-degree relatives of patients than in the general population [23]. Furthermore, the frequency of the disease is lower among second-degree rel-

atives, and even lower among third-degree relatives [23].

In Western [3] and North African [21] literature, the genetic abnormality found is a loss-of-function mutation in the EXT 1, EXT 2 and EXT 3 genes. These tumour suppressor genes, located respectively on chromosomes 8q23-q24, 11p11-p12 and the short arm of chromosome 19, encode glycosyltransferases that catalyse the polymerisation of heparan sulphates (proteoglycans located on the surface of cells and in the extracellular matrix) [3] [19]. The mutations will result in a deficiency of heparan sulphate [3]. Heparan sulphate chains act as co-receptors in numerous metabolic signalling pathways, such as FGF, TGF, PTHrp, Wnt, and Indian Hedgehog (Ihh). The integrity of these signalling pathways is essential for the various stages of chondrocyte maturation at the growth plate during endochondral ossification [3]. Heparan sulphate deficiency causes a decrease in Wnt and TGF activity in the growth plate. However, BMP and Ihh pathway activity is amplified [3]. The result is a defect in perichondral ossification, replaced by chondrocyte proliferation, as well as the creation of an ectopic growth plate [3]. The patient presents with both ectopic bone growth and bone shortening [3] [19], as was the case with our patients. At the end of growth, exostoses are often stable. The onset of pain or any increase in volume after growth has stopped indicates a resumption of osteochondroma activity. This situation was observed in 8 of our patients. We also noted vascular compression in two patients. Vascular complications are rare, observed in 11% of cases [24]. A review of the literature listed 57 cases of vascular complications of osteochondroma of the lower limbs from 1965 to 2013 [4]. These include vessel compression, stenosis, occlusion, thrombosis, arteriovenous fistulas and pseudoaneurysm formation [24] [25]. These vascular complications appear to result from the "trapping" of vascular structures by adjacent exostoses [24].

Involvement of the popliteal artery, found in our study, is the most common vascular complication (91% of cases) due to the frequent location of osteochondromas at the lower end of the femur and upper end of the tibia [24]. The associated venous compression, which is unusual, was a novel feature of this observation.

From a therapeutic standpoint, prophylactic surgery to remove the exostosis is not routinely recommended [25]. Surgery should be performed on active exostoses, which were observed in eight of our patients. Other indications for surgical treatment include compression of neighbouring vascular and/or nervous organs, and disabling bone deformities requiring realignment osteotomy [3] [19] [25]. Resumption of activity and the location of osteochondromas in the pelvic and shoulder girdles are predictive signs of malignant transformation [25] [26]. This includes pain, increased volume, and a cartilage cap greater than 2 cm. The most common secondary cancer associated with exostoses is chondrosarcoma [26] [27]. This serious complication occurs in 1% - 3% of cases and was the cause of death from lung metastases in one of our patients. In this patient, factors contributing to sarcomatous degeneration were the pelvic location of the osteochondromas,

resumption of activity after growth cessation, and delay in consultation. The factors that contributed to sarcomatous transformation in this patient were the pelvic location of the osteochondromas, the resumption of activity after growth ceased, the delay in consultation and recurrence after surgery [28].

5. Conclusion

Multiple exostosis is a rare condition in sub-Saharan Africa, with an estimated prevalence of 1.44 cases per year over the past 25 years. It predominantly affects males. The apparent age of onset is 9 years, though diagnosis is usually confirmed around the age of 28 years. Osteochondromas are primarily located in the metaphyses of the long bones and are rarely found in the axial skeleton. Rheumatological complications, such as bone deformities and neurological compression, have been reported. Sarcomatous degeneration has affected two other patients in addition to the case presented here. Due to the risk of malignant transformation, regular monitoring of exostoses is necessary.

Conflicts of Interest

The authors declare no conflict of interest.

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