NON METABOLIC CAUSES OF PATHOLOGICAL FRACTURES IN KENYATTA NATIONAL HOSPITAL

By

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A DISSERTATION IN PART FULFILLMENT

FOR THE DEGREE OF

MASTERS OF MEDICINE (SURGERY)

2003

DECLARATION

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THIS DISSERTATION IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY UNIVERSITY.

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DEDICATION

I dedicate this dissertation to my parents Mr. and Mrs. Oburu and to my brothers and sisters Millicent, Paul, Pamela, Peter, William and Joan. No amount of words can adequately express my deep sense of gratitude to all of you for your endless encouragement and support.

AKNOWLEDGEMENT

I am grateful to my supervisor Prof. John E. O. Ating'a for his expert advice, steadfast support and constant encouragement. He has with much thoroughness guided me through this dissertation.

I would also extend my gratitude to Mr. Olimbe of the radiology department for enabling me to access the X-rays of the patients seen in the study and the staff of the pathology department for availing the relevant slides.

I am grateful to Prof Ogendo, Dr Mbori Ngacha and Dr Mark Awori for their positive criticism and in put. I could not have written this dissertation without their support.

I am thankful to Boniface Ager for his expert artistic skills in editing the graphs and images.

I also acknowledge the Kenyatta National Hospital Ethical and Research Committee for giving me permission to carry out the study.

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ABBREVIATIONS

ESR	- Erythrocyte sedimentation rate
PSA	- Prostatic Specific Antigen
FNA	- Fine Needle Aspiration
PMMA	- Polymethylmethacrylate
Ca	- Carcinoma
CT	- Computerised Tomography
MRI	- Magnetic Resonance Imaging

SUMMARY

This was a prospective study over a period of 10 months from the month of April 2002 to January 2003. The purpose of the study was to determine the pattern of non metabolic causes of pathological fractures in Kenyatta National Hospital. The study assessed the causes, sites, presentation and management of non metabolic causes of pathological fractures at the hospital.

Methodology: Patients with non metabolic causes of pathological fractures admitted to the orthopaedic wards were recruited into the study. Demographic data, data on the cause of the fracture, site of the fracture, presentation and management of the patient was collected. This data was analysed and presented in tables, charts and graphs.

Results: Thirty eight patients with 53 fractures were recruited into the study. The age range was between 1 to 74 years with a peak age in the sixth decade, the male to female ratio was 1:1. The prevalence of non metabolic pathological fractures among patients with fractures was 2.62%. The most common causes of these fractures were malignant causes which formed 47% of the fractures followed by infection with 31% of the fractures. Osteomyelitis formed 100% of all the peadiatric pathological fractures. The lower limb was the most common site of pathological fractures in which 47% of these fractures were located followed by the spine with 43%. Patients with spinal fractures presented with two main complaints, that of back pain and difficulty in walking. Trivial trauma was the most common complaint of patients with appendicular skeleton fractures,

found in 45% of these patients. The management of these fractures was mainly conservative.

Conclusions: While there are some differences in the causes of these fractures from what is documented in literature, the sites and presentations concur. The most common cause of non metabolic pathological fractures was malignancy and osteomyelitis was established as the most common cause of pathological fracture in children.

Recommendations: Studies should be carried out to assess the management outcomes of the individual causes of pathological fractures especially those due to malignancy and osteomyelitis. Another study should also be carried out on all the causes of pathological fractures including metabolic bone disease in order to establish the complete picture of these fractures.

INTRODUCTION

By examining mummies, researchers have traced metastatic bone disease (one of the most common causes of pathological fractures) to as far back as 2400 years ago. Pre Colombian Incas and Egyptians of the third and fifth dynasties are reported to have had metastasis. In the late 19th and 20th century, pathological fractures were viewed as terminal events.

There are a wide variety of conditions that can give rise to non metabolic cause of pathological fractures. These include: -

- Development disorders of bones e.g. osteogenesis imperfecta, osteopetrosis, Olliers disease,
- Fractures through infected bone,
- Tumours
- Tumour like conditions

Typically the fracture occurs during normal activity or after minor trauma. Failure of bone under these circumstances should alert the surgeon as to the possibility of a pathological fracture. Successful management of the fracture is altered by the

pathological condition. Therefore the surgeon must recognise, diagnose and treat the underlying disease process.

Pathological fractures do indeed present a major challenge to the surgeon. Management of these fractures will go a long way to alleviate pain although it may not add days to the life of a patient, it will certainly improve the quality of the patient's life.

LITERATURE REVIEW

Springfield and Brower [1] acknowledge that reference to pathological fractures often brings to mind fractures caused by metastatic disease. In their review of the causes and management of these fractures they concentrate mainly on pathological fractures due to metastatic disease. Harrington [2] also discusses pathological fractures but his focus is on fractures that are caused by metastatic spinal disease. Most literature on pathological fractures put emphasis on metastatic fractures [3].

Wilson [4] considers pathological fracture as an entity by itself. He reviews all the causes and management of pathological fractures. In other literature where non metastatic causes of pathological fractures are considered the fracture is usually, mentioned as a complication and the sites and presentation of this fracture is not specifically considered. [5, 6]

In our local set up Githae [7] in 1991 found that there were 79 patients with 108 metastatic pathological fractures over a period of 10 years from 1978 to 1988 at Kenyatta National Hospital. There is no record of a prospective study with regards to metastatic pathological fractures or of any other cause of pathological fracture. Anecdotal evidence from rotations in the orthopaedic ward suggests that there may be more cases of metastatic pathological fracture than was reported by Githae. [7]

There are a number of conditions that can cause non metabolic pathological fractures. All these cannot be discussed together as they present differently. Furthermore their management also differ. In order to adequately review the non-metabolic causes of pathological fractures it is prudent to categorize them. Thus in this review there are 4 categories as follows [4]: -

1. Pathological fractures due to metastatic disease.

2. Pathological fractures due to primary malignancy.

3. Pathological fractures due to benign bone disease.

4. Pathological fractures due to infection.

PATHOLOGICAL FRACTURES DUE TO METASTATIC DISEASE

CAUSES

Metastasis to bone with destruction of the skeleton system is a common problem in patients older than 50 years of age. Bone is the third most common site of metastatic disease after the liver and the lungs [8]

The majority of metastasis to bone originates from carcinomas in five major visceral organs, breast, prostate, lung, kidney and thyroid. [9]. Weinstein [3] states that carcinomas are much more likely to metastasize than sarcomas.

McClain and Weinstein [10] in a review of 2748 patients noted that 60% of spinal column metastasis arise from one of the four primary types; breast, lung, prostate or lymphoreticular malignancy including lymphoma and myeloma. In their study they note that although rarely mentioned, tumours of the gastrointestinal system result in a considerable number of spinal metastasis.

In a review of 328 patients with pathological fractures due to metastasis, Fitts et al [11] had 59% with primary malignancy in the breast, 9.9% secondary to prostatic carcinoma. In another series of 45 patients Koskinen et al [12] had 47% of primary malignancy in the breast, 16% with lung primary tumours and 37% spread over various primary sites. The breast has been shown by other authors [13] to be the commonest site of primary tumour in metastatic pathological fractures.

In our local setup there is a different picture with regards to causes of pathological fractures. In Githae's [7] retrospective study which included pathological fractures due to malignancy the breast was the commonest cause with 37% of the fractures. Prostate cancer had 22%, multiple myeloma 20% and thyroid 4% of the patients. In his study there is no mention of carcinoma of the lung as a cause of pathological factures. This is in contrast to what McClain [10] and Koskinen [12] found. The study by Githae [7] is the only one that has been done with regards to pathological fractures in our set up. A study by Kungu [14] mentions the sites of metastatic bone disease but not the causes of metastasis. It also does not address whether there were any fractures associated with the metastasis.

SITES

Although metastasis to the lung and the liver are more common than that of bone, they are often asymptomatic until shortly before the patients succumb to their disease. Frassica et al [9] explain that metastasis to the bone causes major problems for the cancer patient including uncontrollable pain, forced immobilization, pathological fractures and hypercalcemia.

Papapoulos [15] states that skeletal metastasis are predominantly in the axial skeleton especially to spine, to ribs and the pelvis. Frassica et al [9] lists the skeletal distribution of bone metastasis as the spine, pelvis, ribs, skull and proximal long bones. They explain

that these particular locations correspond to the sites of erythrocyte production (bone marrow).

In Kenyatta National Hospital, Kungu [14], reporting on tumours of bone and cartilage had 20 metastatic tumours. Of these 7, had metastasis to the femur, 5 to the spine and 3 to the pelvis.

In a study of 122 pathological fractures due to metastatic neoplastic disease, Fitts et al [11] had most of his fractures in the lower limb with 41% as fractures in the femur, 20% as fractures of the spine followed by the clavicle and humerus with 19.7%. This picture is different from what Githae [7] reported in which most of the fractures were in the spine. According to him, 56.4% had spinal fractures, 36.7% had fractures in the femur while with 7.6% had fractures in the humerus.

Weinstein [3] maintains that the spine is the most common site of skeletal metastasis irrespective of the site of primary tumour. This is due to the blood supply and sinusoidal vascular distribution. Jaffe [16] notes that about 69% of patients who die of malignancy have evidence of spinal metastasis on careful postmortem examination and as many as 85% of Ca Breast patients will also develop metastasis. Some of these are asymptomatic prior to the patients' demise. Both metastatic and primary tumour affect the spine but according to Harrington [2] metastatic tumours are so common that they account for 40 times as many patients as all other forms of bone cancers combined

The location of the lesion within the bone also differs for benign and for malignant disease. The majority of malignant tumours, both primary and metastatic, originate anteriorily and involve the vertebral body and possibly one or both pedicles [3]

The pelvis and femur are common sites of metastatic involvement [17]. The pelvis is the second most common site of metastatic disease (after the vertebral column) and the femur is the third. Sim [18] states that the femur accounts for two thirds of all long bone pathological fractures; most involve the proximal femur because of the high stresses in that region. He further explains that pathological fractures of the hip most frequently involved the femoral neck (approximately one half), 20% occur in the intertrochanteric region.

Metastases are much less likely to occur in the upper extremity than in the pelvis and lower extremity. In extensive postmortem examinations of patients who died of cancer, Jaffe [16] found 85% had osseous metastasis. Of these, 69% were in the vertebrae, 41% in the pelvis, 25% in the femur and 25% in the ribs. Considerably fewer than 20% were in the upper extremity. Similar findings were recorded by Clain [17]. Rock [19] states that of the upper extremity lesions, the humerus is the most common site accounting for 50% of the cases. The remaining lesions are attributed to the scapulae. Lesions below the elbow are relatively rare and account for less than 1% of osseous metastasis. The two common histological types of tumours that metastasize to the forearm, hand and wrist is lung and renal cell carcinoma. In Githae's [7] study only 7.6% of the fractures were in the humerus.

PRESENTATION

Carnesale [20] explains that metastatic tumours of bone present in one of three clinical settings. First, and this setting occurs only occasionally, a patient with spine or extremity pain arrives in the physician's office without a history of a known primary tumour. Second, a patient may have a pathological fracture, with or without a history of a known primary tumour. Third and most common, a patient with a known primary tumour is seen with a painful lesion in the spine or extremities. The patient is usually an adult in middle or late life with a lesion in the proximal portion of the extremities or in the spine. Spinal metastases may be asymptomatic.

Any patient who presents with a fracture occurring spontaneously after mild trauma should raise suspicion for the possibility of a pathological fracture [1]. In Githae's [7] study 13% of the patients gave a history of trauma preceding the fracture. Of these 8% had a fracture in the femoral shaft, 4% had fractures in the femoral neck and 1% had a fracture in the spine.

Pain due to tumour destruction is dull at onset and steadily intensifies as it progresses. Harrington [2] describes this pain as being of gradual onset, relentlessly progressive over weeks or months, worse at night, and unassociated with significant elevations of white blood cell count or sedimentation rate. Patients wake up at night with severe pain that may not be managed by non-narcotic analgesia and may require narcotic analgesia for the discomfort. Sim et al [21] identified lumbar and sacral neoplasms in 23 patients, and they concurred with Harrington's [2] description of the pain.

Harrington [22] describes spinal symptoms as developing from one of the following:

1. Expansion of the cortex of the vertebral body by tumour mass with fracture and invasion of paravertebral soft tissues.

2. Compression or invasion of adjacent nerves.

3. Pathological fracture caused by vertebral destruction.

4. Development of spinal instability and / or

5. Compression of the spinal cord.

During history taking certain features alert the surgeon. The chief complaint is pain, which occurs in 85% of all the patients [23].

With more central neural involvement, motor deficits usually precede sensory changes because of the typically anterior location of cord compression [2]. Weakness which is rarely the first symptom observed, is noted in 40% of patients with spinal tumour. It is usually over the extremities, and may not become apparent until months or years after the onset of back pain. The rapidity of onset of muscle weakness has a considerable bearing on the prognosis Constans et al [24] reported 160 of 600 patients who had an acute onset

with a delay of less than 48 hours between manifestation of initial symptoms and appearance of maximal neurological compromise. These patients do not have a good prognosis. Tarlov and Herz [25] demonstrated experimentally that even major neurological compromise caused by gradual cord compression was reversible for a longer period than was compromise due to acute cord compression.

Spinal deformity, which can be, associated with the onset of pain, usually results from paraspinous muscular spasm. Gilbert et al [26] describe bowel and bladder dysfunction as presenting before diagnosis of metastatic fracture in as many as half of the patients with cord compression. Compression at the conus medularis may on rare occasions, lead to isolated sphincter dysfunction. One should also be on the lookout for weight loss, anorexia or fatigue.

History and Physical Examination

A careful detailed history and physical examination may identify conditions that present with pathological fractures.[23] One also wants to establish circumstances surrounding the injury so as to get information about the strength of the bone. Any history of infection or malignancy should be sought.

A detailed review of the systems is also essential. Unintentional weight loss, anorexia or fatigue should be identified. Smokers should be questioned about frequency and type of cough, heamoptysis or increasing dyspnea on excertion. Gastrointestinal malignancies

are suggested by change in character, quality and diameter of stool, bleeding from the rectum, constipation and incontinence. Genitourinary tumuors should be suspected with change in urinary patterns, such as frequency, hesitancy, incontinence or hematuria. A change in appearance of the breast, the presence of a nipple discharge or positive family history should be sought [23].

Physical examination includes careful palpation for lymphadenopathy in the neck, supraclavicular fossa, axilla and inguinal region. The thyroid and the breast are examined. A per rectal exam is performed to rule out rectal masses or a prostatic nodule and to quantify the rectal tone.

Radiography

Springfield and Brower [1] suggest that attention should be focused on the initial lesion and overall quality of bone. Diagnostic clues in radiography are generalised osteopenia, periosteal reaction, thinning of the cortices, and abnormal radiodensity in bone or soft tissues.

Metastatic deposits are usually eccentric and involve the cortex. In evaluating radioluscent lesions in bone Springfield [27] observes that metastatic carcinoma has a propensity to be located at the junction of the metaphysis and the diaphysis.

Small radioluscent lesions that are surrounded by a rim of reactive bone without endosteal reaction are most likely benign. Lesions that erode the cortex but are confined within the periostuem are either benign or low grade malignant. Lesions that erode the cortex and are not contained by the periosteum are most probably malignant. Osteosclerotic lesions include osteosarcoma and chondrosarcoma. One pathognomonic lesion of metastatic disease is an avulsion fracture of the lesser trochanter [28].

Other bones at risk of metastatic disease should be accessed. A skeletal survey is used to identify other lesions within the appendicular skeleton, pelvis, and axial skeleton [23]. Plain X rays should be obtained of bones at risk. These include the humerus, the pelvis and both femurs together with a chest and spine X-ray. A whole body bone scan may also aid in establishing other sites of metastasis.

Work Up

Lenfunk [8] lists investigations for patients with pathological fractures which include:

- Complete blood count with differential and ESR, liver function tests, blood biochemistry and coagulation screen.

- PSA (Prostatic specific antigen). A PSA of more than 20 ng/mL is associated with significant risk of bone metastasis while one which is less than 10 is unlikely to have involved bone. Partin et al [29] found that when the PSA level is greater than 10

ng/mL, the risk of extraprostatic cancer is increased greatly. In the same study, he noted that 80% of men with PSA levels greater than 20 ng/mL had extraprostatic disease.

- To assess risk of carcinoma of the breast and lung a chest x-ray is mandatory. Mammography is also recommended.

- Abdominal ultrasound is an appropriate method of evaluating the kidneys. Urinalysis and urine cytology is simple and will screen for occult cancers. Electrophoresis of urine may reveal multiple myeloma. A bone scan may detect an occult renal cell carcinoma due to collection of radioisotope in the tumour.

- Palpation of the thyroid gland is an adequate screen for thyroid malignancy. However there are other screening methods for thyroid nodules e.g. radioisotope scan and ultrasonography.

- To investigate multiple myeloma serum electrophoresis, a skull and skeletal x-rays should be done and the urine should be investigated for Bence Jones proteins.

- Bone scan: a period of two to eighteen months would be necessary before a lesion identified on bone scan could be visualised on plain x-ray. Bone scan using technetium will determine whether the lesion is monostotic or polyostotic. Monostotic lesions need to be evaluated as primary bone tumours. Springfield [27]

describes Technetium-99m bone scanning as the most efficient method of screening the entire skeleton for unsuspected bone lesions. He suggests that whenever more than one lesion is seen on the plain radiograph or there is a significant risk of other bone lesions (e.g., metastatic carcinoma, myeloma, eosinophilic granuloma, or Ollier's disease), a Tc-99m bone scan should be obtained.

- Recently, newer biochemical markers of bone metabolism have been evaluated for their specificity in monitoring metastatic bone disease. These immunoassays have included markers of osteoblastic activity (bone Gla protein and procollagen-I carboxyterminal peptide) and osteoclastic activity (deoxypyridinoline and pyridinoline-crosslinked carboxyterminal telopeptide)[30]. In a prospective study, 150 patients who had bone metastasis were compared with 233 patients who did not. The patients were evaluated with respect to the predictability of bone involvement on the basis of several bone-metabolic markers (bone-Gla protein, procollagen-I carboxyterminal peptide, deoxypridinoline, and pyridinoline-crosslinked carboxyterminal telopeptide)[30]. Osteoblastic markers were elevated mainly in osteoblastic lesions, whereas most osteolytic or mixed lesions demonstrated elevated levels of osteoclastic markers [30].

- Other modes of scanning that may be used include a CT scan and a MRI. Weinstein [3] notes the value of both especially in the management of spinal lesions. CT scan offers improved sensitivity in detection of spinal neoplasm. Lesions are also picked up at an earlier time in their development. This investigation is vital in planning surgical

approaches and tumour resection. Computerized tomography is also useful with regards to CT directed needle biopsy which is accurate and safe and has replaced open or percutanoues trocar biopsy in most of the centres. An MRI effectively delineates the extent and pattern of marrow involvement within an affected vertebra. MRI also readily defines the relationship of the lesion to the spinal cord, meninges and paravertebral tissue [3]. However due to sensitivity to marrow destruction, it may overestimate vertebral destruction. It may be limited in distinguishing between acute osteoporosis leading to a traumatic fracture from neoplastic fractures. Either biopsy or follow up MRI 6 to 8 weeks after may be appropriate in this circumstance [1].

Biopsy

A histological diagnosis is necessary to confirm what the history and other investigations may have led us to suspect. This step is perhaps the most crucial, yet it remains the most frequent source of error in the management of musculoskeletal tumours. [23] The biopsy should always be carefully planned.

Biopsy techniques include incisional biopsy, percutaneous needle biopsy or excisional biopsy. There are three types of percutaneous needle biopsy i.e. fine needle aspiration, Tru Cut needle and Large bore needle or Trephine biopsy. Fine needle aspiration biopsy is done with a gauge 23 and yields material that is suitable for cytologic examination. Dollahite et al [31] in a study of 766 patients concluded that a core biopsy would yield more tissue and it is well suited for lesions in the spine and the pelvis. Histologicaly,

incisional biopsy has been considered the procedure with the greatest accuracy and reliability. An incisional biopsy is best suited for difficult cases. An open biopsy is best for the difficult cases. Springfield and Brower [1] described how a biopsy should be planned and taken. They state that the needle track or incision should be positioned so that it can be excised if a subsequent resection needs to be done. With an open biopsy, minimal spreading is best, neurovascular bundles should not be exposed, and muscle should be split rather than using the standard dissection between muscles. After pathological tissue has been obtained and a diagnosis made (or it has been confirmed that adequate tissue has been obtained), thorough hemostasis should be obtained before closing the wound. Postoperative hematomas contain tumour cells and have to be treated just like the primary tumour.

SPECIFIC TREATMENT

Improvements in the oncologic management of patients with bone tumours have resulted in increased survival as presented by McKenna [32]. Due to current treatment, the life expectancy of patients with metastatic tumour has improved. If a patient has widespread metastasis to many organs internal fixation may not be warranted. Parrish and Murray [33] outlined that one of the criteria for fixing these fractures is that the patient should have a life expectancy of 6 weeks. The first step in management is to establish that the primary malignancy is identified and managed.

Impending Fractures

On a number of occasions a patient may be seen who has a metastatic deposit but without a fracture. The surgeon in this case has to decide when to prophylactically fix this fracture or not.

In 1976 Harrington et al [34] proposed additional guidelines based on evaluation of plain radiographs. They considered the lesion at risk in causing a pathological fracture to be those that:

- Were greater than 2.5 cm in diameter,
- Destroyed 50% of the cortex or
- Painful despite treatment with radiation

In 1989 Mirels [35] proposed a scoring system for diagnosing impending pathological fracture in long bones.

Table 1: Mirels Score of Pathological Fractures

VARIABLES	SCORE		
	1	2	3
Site	Upper limb	Lower limb	Peritrochanter
Pain	Mild	Moderate	Severe
Lesion	Blastic	Mixed	Lytic
Size	< 1/3	1/3 - 2/3	> 2/3

As seen on Plain radiograph, maximum destruction of cortex in any view.

The maximum possible score is 12. If lesion scores 8 or above, prophylactic fixation is recommended before radiotherapy.

Broos [36] et al are in agreement with Dijkstra et al [37] that an impending fracture should be fixed with open reduction and internal fixation before it breaks, as patients will do better.

Algan and Horowitz [38] demonstrated that the results of open reduction and internal fixation for lesions about the hip were similar to those of the same operative procedure performed for non metastatic lesions.

In 1970 Parrish and Murray [33] proposed the following guidelines for operative intervention

- The patient's general condition must be sufficiently good and life expectancy long (more than 6 weeks) to justify procedure.

- The surgeon must be convinced that the operation will be more beneficial than closed treatment.

- The quality of bone proximal and distal to the fracture site must be adequate for stable fixation.

- The procedure must expediate mobilization of the patient.

Advantages of prophylactic fixation of these fractures include decreased morbidity, shorter hospital stay, easier rehabilitation, more immediate pain relief, faster and less complicated surgery and less blood loss during surgery.

Metastatic Spinal Fractures

Non Operative Treatment:

Most patients with metastasis do not develop progressive spinal instability or neurological involvement and can be treated successfully by systemic chemotherapy,

local irradiation or temporary bracing. Various tumours will vary in sensitivity to radiotherapy, as illustrated in the table below.

Table 2: Radiosensitivity of Common Metastasis [2]

HIGH SENSITIVITY	MODERATE SENSITIVITY	LOW SENSITIVITY
Myeloma	Colon	Renal
Lymphoma	Breast	Thyroid
	Prostate gland	Melanoma
	Lung	Metastatic sarcoma
	Squamous cell	

Even among those who sustain pathological fractures due to metastatic lesions many would still benefit from temporary bed rest, soft tissue bracing and radiotherapy as those with pathological compression fractures due to osteoporosis. In fact 80% may be treated with non operative modalities [39]. Radiotherapy is effective in relieving pain and leads to recovery in early neurological compromise, when the tumour extends to the epidural space.

Operative Management:

The principle indications of operative intervention are progressive neurologic deterioration and intractable spine pain which is unresponsive to radiation or bracing. Other indications include radioinsensitive tumours, recurrence of cord compression following adequate local irradiation and presumed metastasis if the tumour is occult.

Three decades ago operative intervention usually meant laminectomy and decompression. The results for advance spinal metastasis were dismal and the majority patients did not improve. Instead progressive spinal deformity and instability usually developed as a result of this procedure.

Whether laminectomy provides patients who have cord compression any significant benefit beyond that provided by radiotherapy is debatable [26]. Constans [24] and associates showed some improvements with laminectomy. Gilbert et al [26] demonstrated that radiotherapy alone was as effective as decompressive laminectomy (with or without radiation) in treatment for epidural cord compression. After either treatment fewer than 50% regained the ability to walk.

Nicholas et al [40] noted that skeletal metastases affect the vertebral body more often than the posterior elements. The evolution of anterior spinal decompression has dramatically improved clinical results of metastatic disease [41]. The anterior approach to the thoracolumbar spine developed by Hodgson and Stock [42] has steadily increased in popularity for the treatment of anterior spinal lesions.

Siegal and Siegal [43] in a prospective study of epidural tumours chose anterior approach and decompression for lesions located ventral to the cord and a posterior laminectomy for lesions located dorsally. In their series only 40% of patients treated with laminectomy regained ability to walk, while 80% of vetebrectomy patients regained the ability to walk. Furthermore, postoperative complaints were frequent with the laminectomy group due to

poor wound healing as these operations had been performed on irradiated tissue. This is similar to what Fidler [44] reported where seventeen patients with pathological fractures of the thoracolumbar spine which had not responded to conservative treatment were surgically managed. All had compression of the spinal cord and/or severe pain. All (except one treated by lateral rhachotomy) were treated by anterior decompression followed by stabilisation; when the lesion was below T2 the spine was stabilised anteriorly, and when it was higher posterior instrumentation was used. Sixteen of the 17 patients benefited from the procedure. In discussing the poor results of laminectomy, he explains that the poor results are not surprising, considering that the cause of the compression usually lies anterior to the cord; anatomically, a posterior approach to such a lesion thus seems fraught with danger.

If one has combined anterior and posterior cord compression, (Napkin compression) anterior and posterior approaches will be helpful [2].

Following anterior approach and resection of the tumour, Harrington [2] gives the option that the resected vertebral body should be replaced with polymethylmethacrylate and incorporate a destruction fixation device that secures the cement mass into the adjacent normal vertebral end plates. Fixation devices like Knodt rod, Pezinian destruction device, among others, may be used.

When posterior fixation is necessary, a number of devices are available and this selection should be based on severity of posterior bony destruction. These include the Harrington destruction and compression rods or Luque instrumentation and sublaminar wiring [3].

In summary where there is minimal or no bone destruction and cord compression is due to soft tissue extension of the metastasis, emergency radiation is recommended. Patients with major neurological compromise or spinal instability and those with intractable back pain should be considered for decompression.

Pelvis and Femur

The major goal in management is to relieve pain and to restore function and ambulation. Sim [18] advises that conservative management has a very limited role. The argument against conservative management is the development of medical complications associated with prolonged bed rest. These include decubitus ulcers, pneumonia and urinary tract infection as well as difficulty in nursing. Peculiar to systemic malignancy and enforced immobilization is the development of disseminated intravascular coagulopathy and malignant hypercalcemia.

Surgical management will depend on location of the fracture, extent of bone destruction, general condition of the patient and expected length of survival. Treatment of these fractures should be individualised and the surgeon should choose a device that will provide the best fracture stability.

Femoral neck fractures: Replacement arthroplasty is the treatment of choice for femoral neck fractures. There are a number of techniques are available. One could either use bipolar arthroplasty or total hip replacement. Harrington [45] reported less than 1% complication of migration of endoprothesis. An endoprothesis may be used unless the acetabulum is grossly involved. Of great importance is that one should take an X-ray of the whole length of femur as it may reveal a distal lesion. Lane et al [46] in a study of in 167 consecutive pathological or impending fractures of the hip treated by endoprosthetic replacement from 1975 to 1978, reports that there was dramatic relief of pain in all patients. Either a long-stem femoral end prosthesis or a total prosthetic hip was used. The ambulatory status was significantly enhanced in those patients who were able to walk but it was not in the gravely ill.

Post operatively one should consider dislocation precautions and partial weight bearing for 6 weeks after surgery.

Peritrochanteric Fractures: These fractures may be managed by the use of a dynamic hip screw or femoral prosthesis. Some proponents of dynamic hip screw first drill a hole into the head of the femur and then insert polymethylmethacrylate. Following this the screw is inserted into the head of the femur. A number of surgeons like Lane et al [46] and Sim et al [47] are in agreement that a prothesis should be used because of the extent of proximal and distal destruction of bone.

Subtrochanteric fractures are usually managed by either a Zickel nail or a Russel Taylor reconstruction rod. The Zickel nail is the usual implant for lesions in the subtrochanteric region of the femur, but gives some problems e.g. failure of fixation [48]. The Russell-Taylor reconstruction nail, because of its load sharing properties, is biomechanically suited for the subtrochanteric area and the bending strength of its shaft is comparable to the Zickel nail. Weikert and Schwartz [49] describe the use of intramedullary nails, in this case Russel Taylor reconstruction nails, in the treatment of 14 patients with pathological subtrochanteric fractures and coexisting metastases in the femoral shaft. After nailing, all patients were free from pain and regained mobility. They were followed up clinically and radiologically until death from the primary disease. There were no mechanical failures even when a less than ideal reduction had been achieved. The Russel Taylor reconstruction rod successfully met their goals of treatment for impending subtrochanteric fractures. There were no mechanical failures or technical complications. All patients walked better, and all but one had pain relief. The Russel Taylor reconstruction rod has definite advantages for treating these lesions

Femoral shaft lesions if small may be treated with radiation. Intramedullary nails manage large lesions. These may be preferably interlocked. If the lesion is extremely extensive intramedullary methylmethatcrylate may be beneficial. In one study of seventy-two pathological fractures associated with tumours other than carcinoma of the breast in the long bones of the extremities, sixty patients were treated over a five-year period at Roswell Park Memorial Institute. In this study Douglass et al [50] reported that pain was relieved in 91 per cent of the patients treated by internal fixation, in 59 per cent of those

treated by irradiation, and in 45 per cent of those treated by other means. Among patients with lower-extremity fractures, 61 per cent of those treated by internal fixation became ambulatory, whereas only 23 per cent of those treated by other methods were able to walk. Internal fixation of these pathological fractures appeared to be the best treatment

Lesions of the pelvis: Metastatic involvement of pelvis is a frequent clinical problem resulting in pain and depends on location and extent of the disease. Lesions in the non-weight bearing potion may be treated by radiotherapy and protected weight bearing [18].

Pathological fracture in the periacetabular area presents a management challenge. If there is minor involvement i.e. only a small area is involved, there is sufficient bone for conventional fixation of an acetabular component. In some cases there is deficiency of walls of the acetabulum as well as superior part of the globe. In these cases a protusio ring such as the Oh-Harris device transmits the stresses from the intact rim, avoiding stresses on the involved medial and lateral aspects of the globe [51]. An acetabular mesh may be used to prevent extrusion of the cement to the medial wall.

Some patients have massive involvement of the acetabulum with extensive bone loss. Harrington's [52] advice in this case is that techniques have been developed that are used to transmit stresses away from the acetabulum which has been destroyed by tumour into the superior part of the ilium and sacrum. This will involve reconstruction of the area around the acetabulum. As it is a very extensive procedure it should be reserved for patients with potential prolonged survival.

Upper Extremity Fracture

Rock [19] notes that upper extremity involvement interferes with patients' ability to feed themselves and perform routine hygiene and perineal care.

Treatment options include non-surgical medical management, palliative surgical stabilization and surgical care. Non-surgical management is reserved for small symptomatic lesions not at risk of fracture and patients who are not going to use external aids for ambulating and for extensive upper extremity involvement. These patients may be treated with radiation therapy [53] and or chemotherapy or hormonal treatment and dynamic splintage of the upper extremity to minimize fracture translation and pain [54].

Humeral head fractures and large humeral head lesions that remain painful after irradiation are treated by standard cemented hemiathroplasty. The goal of this procedure is pain relief and preservation of existing function. If the involved area includes upper humeral shaft one may use custom proximal humeral replacement which may have an intramedullary rod that extends to remaining uninvolved shaft [19].

Shaft fracture may be managed by interlocking intramedullary nails which offer the advantage of minimal exposure. Redmond et al [55] performed a retrospective study of thirteen patients who had had sixteen pathological fractures of the shaft of the humerus secondary to metastatic disease. All but one fracture was stabilized with interlocking intramedullary nailing with use of a closed technique. Fourteen extremities had a return to

nearly normal function within three weeks after nailing. Relief of pain was rated as good or excellent in all but one patient.

However, Rock [19] advises that an actual pathological fracture warrants open reduction, removal of tumour and augmentation of selected fixation device with polymethylmethacrylate. Rigid fixation is important for both pain relief and eventual healing. A compression plate is an alternative to an intramedullary nail.

Metastatic fractures distal to the elbow may be treated by a 3.5 mm compression plate securing 6 cortices on each side of the lesion. Metastatic lesion to the hand are unusual [56] and are usually due to lung cancer.

PATHOLOGICAL FRACTURES DUE TO BENIGN BONE DISEASE

Cystic Lesions

Most of the benign lesions will need some form of surgery with the exception of unicarmeral bone cysts. Spontaneous healing of a pathological fracture does not occur regularly.

A unicameral cyst of a bone is one of the most common causes of a pathological fracture in children and young adolescents. [4] It presents in childhood and adolescence as a metaphyseal lesion. Lenfunk [5] describes it as being most commonly located in the proximal humerus (67%) and proximal femur (15%). The cysts may be initially active near the growth plate. They may be asymptomatic or present as pathological fracture or as an incidental finding.

An elevated level of prostaglandin (PGE_2) in fluid aspirated where the cyst is active has been reported [57]. Other reports include elevation of interleukin 6 and interleukin 1, which are reported to stimulate osteoclasts.

Springfield [27] lists unicameral bone cysts as one the four types of tissue in the bone that do not contain calcification or ossification and will therefore appear radiolucent. Radiographically you observe a well defined central osteolytic area with a sclerotic margin. Usually it is located in the metaphysis but moves to the diaphysis during growth.

Treatment is by steroid injection; methylprednisolone injection repeated at two monthly intervals. A review showed 80 percent good results in ninety patients from the simple injection of 80 to 200 mg of methylprednisolone acetate with an average two to three injections administered as an outpatient procedure[58]. Success rates of 60-80% have been reported. Steroids injections are reported to reduce PGE_2. Curettage and bone graft is the normal method for managing this fracture, especially if the lesions occur in weight bearing bone of the lower extremity. In a retrospective study done by Gakuu [59] of 24 patients with unicameral bone cyst in Kenyatta National Hospital, 18 were managed by curettage and bone grafting, 4 were managed by curettage alone and 2 patients declined surgery. Seventy three percent of the patients managed surgically had good results following management. Santori, Ghera and Castelli [60] reported successful treatment of unicameral cyst using flexible intramedullary nails. Roposch et al [61] managed 32 patients with a unicameral bone cyst with flexible intramedullary nailing. They concluded that flexible intramedullary nailing provides early stability, which allows early mobilization and thus obviates the need for a plaster cast and decreases the prevalence of the most common complication: a pathological fracture. This method of treatment also allows for an early return to normal activity.

Aneurysmal Bone Cyst is a non neoplastic vasocystic tumour, usually occurring below twenty years of age in at least 85% cases [5]. It may occur primarily in previously normal bone or a pre-existing lesion. An aneurysmal bone cyst may present with swelling, tenderness and pain. Thirty to forty percent are grafted onto another primary lesion such as a giant cell tumour, chondroblastoma, fibrous dysplasia, chondromyxoid fibroma,

eosinophilic granuloma, simple cyst, osteoblastoma and non ossifying fibroma [62] Pathological fractures are common due to eccentric location of the lesion. Springfield [27] describes it as radioluscent and appearing in the first two decades up to the age at closure of the growth plates (14 or 15 for girls and 16 to 17 for boys) and that it may be confused for a malignant lesion. It is located in the metaphyses of lower extremity long bones and more in the lower extremity than in the upper extremity.

Treatment depends on location and aggression of the lesion. A slow growing aneurysmal bone cyst may just be observed as it may regress. Carnesale [57] recommends that most lesions should be treated with curettage and that radiotherapy should be avoided as it may carry a risk of sarcomatous change. Recurrence of 25% happens following curettage and therefore one may need to do wide excision.

Giant Cell Tumour is usually benign solitary and aggressive. They constitute 10% of bone lesions. It is a commonly benign but locally aggressive lesion of unknown etiology and occurs chiefly in men between 20-50 yrs after epiphyseal closure [5]. It always begins in the epiphysis and extends to the area under the articular surface. Most giant cell tumours are commonly seen in the distal femur, proximal tibia and distal radius. A pathological fracture may occur in 10-15% of the cases [57].

It may present with pain and swelling and pathological fracture. The radiological appearance is usually in the epiphysis extending up to the joint surface without marginal

sclerosis, the cortex is thinned and fractures ballooned. It is also described as having a soap bubble appearance.

Management is by intralesional excision by extended curettage. Curettage alone has a high local recurrence rate 50%. Curettage is "extended" into the bone by a few millimeters by either using a burr, liquid nitrogen or phenol. The cavity is filled with bone graft or cement. Blackley et al [63] in a prospective study of 59 patients concluded that despite the high rates of recurrence reported in the literature after treatment of giant-cell tumour with curettage and bone-grafting, the results of their study suggested that the risk of local recurrence after curettage with a high-speed burr and reconstruction with autogenous graft with or without allograft bone is similar to that observed after use of cement and other adjuvant treatment. It is likely that the adequacy of the removal of the tumour rather than the use of adjuvant modalities is what determines the risk of recurrence.

Amputation is reserved for massive local recurrence, malignant change or infection and radiotherapy is reserved for unresectable tumour.

Fibrous Dysplasia is a fibro-osseuos pathological entity of undetermined aetiology characterised by expanding fibro ósseous tissue in the interior of affected bones and is predominantly a lesion of the growing skeleton [64]. In this condition normal medullary bone is replaced by variable amounts of structurally weak fibrous and osseous tissue. Incidence is 5-20% of benign lesions. Usually it is monostotic. It affects children and

adolescents with a minimum age of onset 8yrs. The lesion is more in males than females although the polyostotic form that is seen in Albright's [64] syndrome is more in females.

This tumour is located in the ribs as the most common site. The lower limbs are more involved than the upper limbs and lesions may be craniofacial. The polyostotic form may present with pain and fracture in 85% of cases [65]. The X-ray shows a lucent lesion in the medullary spaces. Fibrous dysplasia is said to have a ground glass or hazy matrix, which is imparted by the fine spicules of dysplastic bone [62]. Polyostotic fibrous dysplasia can frequently be diagnosed radiographically due to the presence of multiple lesions that may also lead to characteristic deformities like Shepherds Crook deformity of proximal femur.

Treatment will involve curettage and bone grafting. Stephenson et al [66] concluded that closed treatment of a symptomatic lesion in the upper extremity generally provides satisfactory results in patients who are less than eight years old. Neither closed treatment nor curettage and bone grafting is adequate treatment for a symptomatic lesion in the lower extremity. Internal fixation should be strongly considered in these grown patients. The devices for fixation include intramedullary rods, sliding hip screws and compression plates.

PATHOLOGICAL FRACTURES DUE TO PRIMARY MALIGNANT DISEASE

These include fractures due to multiple myeloma and other primary malignancies.

Multiple Myeloma

Multiple myeloma is a malignant proliferation of plasma cells that involves more than 10 percent of the bone marrow. It is a prototype primary malignancy of the bone associated with malignant plasma cells that secrete monoclonal immunoglobulins into the serum, the urine or both. [67] In investigating its origins Kyle [68] describes how in 1850, MacIntyre published the first complete clinical and pathological narration of "a case of mollities and fragilitas ossium accompanied with urine strongly charged with animal matter." The term "multiple myeloma" was first used to describe the presence of multiple tumours originating in the bone. Grethlein [6] describes myeloma as a disease that can be insidious in onset and can cause systemic ailments, including infection and renal failure, as well as local catastrophes, including pathological fractures and spinal cord compression. Although patients benefit from treatment (i.e., longer life, less pain, fewer complications), currently no cure exists. The risk of developing multiple myeloma appears to be higher in populations of lower socioeconomic status, particularly where diagnostic services are unavailable. [69]

Multiple myeloma is the most common primary cancer of the bones in adults. [67] It accounts for 1% of all malignant disease and slightly more than 10% of hematological malignancies. The annual incidence of multiple myeloma is 4 per 100,000 increasing

with aging. The median age of patients at the time of diagnosis is 61 years. It is more common in men and blacks.[70]

Presentation: Grethlein[6] states that the symptoms of myeloma are due to bone pain, pathological fractures, weakness, anemia, infection (often resulting from pneumococcal infection), hypercalcemia, spinal cord compression, or renal failure.

Bone pain: This is the most common presenting symptom. Sá and Papelbaum [70] report that 70% of patients have bone pain at presentation. The lumbar vertebrae are one of the most common sites of pain.

Pathological fractures are very common; 93% of patients have more than one site of bony involvement. A common presentation is a severe bony event. In accordance with Kyle [68] a pathological fracture is the presenting feature in 30 percent of cases.

The symptoms that concern physicians are back pain, weakness (the most common cause of weakness in patients with myeloma is anemia, which may be quite severe), numbness, or dysesthesias in the extremities. This complication occurs in approximately 10-20% of patients at some time during the course of disease. [6] Following a study of 75 patients with myeloma diagnosed at the Kenyatta National Hospital, Mukiibi and Kyobe [71] found that a combination of: anaemia (81.3%), osteolytic lesions on X-ray skeletal survey (80%), bone pains (66.7%) and an ESR above 50mm/hr (77.3%) formed an important diagnostic tetrad. There were 32% of patients with pathological fractures in this study. A lower figure of 14.1% of patients with pathological fractures was reported by Leleu et al

[72] in a study of 27 patients in Treichville University Hospital in Abidjan although they had 70% of patients presenting with bone pain.

Diagnosis: Grethlein [6] states that the diagnosis of multiple myeloma is confirmed when bone marrow plasmocytosis (>10%), lytic bone lesions and monoclonal immunoglobulin in serum or urine is found.

Treatment:

Standard therapy for multiple myeloma includes alkylating agents administered with prednisone [70]. The most commonly used alkylating agent is melphalan (Alkeran). Melphalan, 9 mg per m^2, is given orally with 100 mg of prednisone on days 1 through 4. Courses of therapy are repeated at four- to six-week intervals for at least one year.

Other treatment modalities include alfa interferon (Intron A), combination chemotherapy, radiotherapy and stem-cell marrow transplantation. Alfa interferon reduces growth of myeloma colonies and the plasma cell labeling index in vitro, and prolongs the plateau phase. Alfa interferon can be used as monotherapy or together with melphalan and prednisone during the induction phase of treatment. In addition, it appears that response to chemotherapy is better following use of alfa interferon.[73]

Wallington et al [74] advise that for local control, local radiotherapy, decompression surgery, or both, may be necessary to treat lytic bone lesions, particularly those involving the spine with resulting cord compression. Radiation therapy is useful in the control of

local pain from lytic lesions. This view is also echoed by Weinstein [3] who adds that because of the radiosensitivity of the tumour, surgical treatment has less influence. He states that surgical therapy should only be considered in spinal myeloma when there is cord compromise or spinal instability. Patients with advanced multiple myeloma may benefit from monthly intravenous infusions of pamidronate which is a biphosphonate. Berenson[75] carried out a large randomized, double-blind study and showed a reduction in skeletal events when bisphosphonate was used as an adjuvant to chemotherapy. Pamidronate may not alter the overall length of survival but may be useful in preventing osteoporosis and pathological fractures.

Other Primary Tumours

In a retrospective study of patients with osteogenic sarcoma occurring in Kenya from 1968 to 1978, Mbindyo et al [76] found 251 cases, representing between 89% and 100% of the predicted number. Larsson et al [77] notes the prognosis of patients with primary malignant bone tumours with a pathological fracture is worse than for those without. Treatment depends on the extent of fracture displacement. Patients having minimal displaced fractures may be treated as those without fracture. Patients with grossly displaced fracture may have to be amputated.

A chest X-ray should be obtained for those patients but a CT scan of the lung is a better investigation. Patients who present with clinical evidence of mental dysfunction (e.g. memory abnormalities, seizure, and confusion) a CT of the brain is indicated. Abnormal liver function test or full heamogram may mean that one has to do an abdominal ultrasound or CT scan.

During biopsy the surgeon should perform a biopsy of tissues of a distance from the fracture. Mankin et al [78] advice that when soft tissue is associated with the tumour, a needle biopsy is adequate but where there is limited extraosseous tissue and a fracture callous had developed, open biopsy is better and preferred.

Internal fixation of these fractures is not recommended. If one is not going to do surgical resection e.g. myeloma or lymphoma of bone, the fracture should be treated closed. A radical amputation is the best oncologic treatment of the sarcoma requiring surgical resection e.g. osteosarcoma, chondrosarcoma and fibrosarcoma. It is also the best treatment if one has an associated grossly displaced pathological fracture.

Limb-salvage resection has recently become more popular than when it was first developed, and it is often chosen by patients who have osteosarcoma. [79] Relative contraindication to limb salvage surgery includes pathological fracture. A pathological fracture may spread the tumour through the fracture heamatoma, beyond the normal anatomic barrier and make it extremely difficult for the surgeon to perform an appropriate wide resection. This recommendation is made on the basis of the assumption that a limb-sparing resection in these patients would have an unacceptably high risk of local recurrence, and thus might jeopardize patient survival. Springfield [80] acknowledges that presently, the orthopaedic oncologic community is undecided on the question of whether a pathological fracture through an osteosarcoma increases the risk of either local recurrence after a limb-sparing resection or death.

Scully [81] and colleagues gathered retrospective data from members of the Musculoskeletal Tumour Society in an attempt to determine whether the presence of a pathological fracture in an osteosarcoma has prognostic significance with regard to rates of local recurrence or survival. They concluded that patients with an osteosarcoma who sustain a pathological fracture, whether treated with an amputation or a limb-sparing resection, have an increased risk of local recurrence and death compared with patients who do not have a fracture. In this retrospective study, patients who had limb-sparing resections were most likely selected for these procedures because they had "favorable" tumour and fracture patterns. Patients whose fractures healed during the chemotherapy period had a better prognosis than did those whose fractures did not heal. This observation suggests that the response of the tumour to chemotherapy is important in determining the prognosis in terms of local recurrence and death. Scully and colleagues have provided support in this study for the concept that, in patients with a pathological fracture in an osteosarcoma, limb-sparing surgery can be safely performed.

Carnesale [82] describes various surgical procedures that have been used in other centres including the Campbell's clinic for resection of primary tumours while performing limb salvage surgery. These include resection of the proximal femur and then reconstruction of the hip using either custom-made femoral head prosthesis or a total hip arthroplasty. Resection of entire femur and reconstruction using hip and knee replacement arthroplasty has also been described. Other procedures include hemipelvectomy and partial or complete resection of the pubis or the ischium.

The involvement of various disciplines cannot be over emphasized and Tillman [83] and his colleagues say that treatment of these patients is multidisciplinary involving the orthopaedic surgeons, pathologists, radiologists, oncologists, radiotherapists palliative care specialists, cancer nurses and pain specialists.

PATHOLOGICAL FRACTURES DUE TO INFECTION

In a prospective study of heamatogenous osteomyelitis in children in Kenyatta National Hospital, Ngetich [84] had 5 patients out of the 73, who had a pathological fracture at the time of presentation. Epps et al [85] reported that among 30 patients treated for sickle cell osteomyelitis, one developed a pathological fracture. Hematogenous osteomyelitis is described by Boland [86] primarily as a disease of childhood and occurs most frequently between the ages of 5 and 15 years. Males are affected three times more frequently than females. Ogunjumo [87] analysed fifty-six cases of chronic pyogenic osteomyelitis encountered over a period of 1 year (1976-1977) and found that males were more often affected than females with a sex ratio of 1.4:1.

Dormans and Drummond [81] state that unexplained bone pain and fever should suggest osteomyelitis until proved otherwise. This is especially true if there was a previous history febrile illness and pain suggesting an acute infection. Systemic symptoms usually subside, but one or more foci in the bone may still contain purulent material, infected granulation tissue, or a sequestrum. Ngetich [84] found that pain and swelling were the most common modes of presentation with a percentage of 84% and 76% respectively. These patients may also present with a non healing ulcer, sinus tract drainage, chronic fatigue, malaise and reduction in the use of the extremity (e.g. reluctance to ambulate, if the lower extremity is involved).

Despite the fact that pathological fractures from osteomyelitis are a relatively common condition, Wilson [4] notes that little has been written about it. It usually occurs in the shaft of long bone. Warner [89] explains that because the involucrum is sometimes insufficient, the shaft of a long bone may fracture during the acute or subacute stage of osteomyelitis before immobilization has been started. Later, because the bone has become dense and brittle, it also may fracture.

Warner [89] describes scanning procedures that have been used to diagnose ostoemyelitis. He states that Gallium citrate has been used to localize inflammatory lesions and that it can be useful in osteomyelitis when it is used in conjunction with technetium scanning. Indium 111–labeled leukocytes have been suggested for differentiating between osteomyelitis and reactive bone formation. When the indium scan was negative, it was sensitive for ruling out osteomyelitis.

Management of this fracture will involve a number of surgical procedures. Active infection is controlled by appropriate antibiotics given parenterally and locally and augmented by surgical exploration when indicated e.g. in draining of an abscess or removal of sequestra. Small sequestra may be removed but large sequestra removal should be deferred until an involucrum is well established. Large gaps may be filled by bone graft as advocated by Wilson [4].

Both Warner [89] and Wilson [4] argue against the use of plates and medullary nails that have been used to fix infected fractures. Warner[89] instead advocates for external fixation and cast immobilization. Bone transport using the Ilizarov method may be employed.

STUDY JUSTIFICATION

1 Pathological fractures present a major management challenge to the orthopaedic surgeon. Review of our local literature reveals that no prospective study has been done on these fractures. Although Githae [7] had carried out a study on pathological fractures his was a retrospective study and it was done ten years ago. Patterns may have changed. A prospective will also not be subjected to errors of inaccessibility of files.

2 No study has been done on other non metabolic causes of pathological fractures. The study by Githae [7] was limited to fractures caused by metastatic bone disease. It did not include fractures caused by other non metabolic conditions e.g. osteomyelitis. This study will therefore provide additional information on other non metabolic causes of pathological fractures.

3 Anecdotal evidence from working in the peadiatric orthopaedic ward suggests that osteomyelitis contributes a significant percentage to these fractures. Review of the local literature does not reveal documentation of this.

4 By studying the pattern of these fractures and the treatment options, we will be able to analyze the work load of the fractures in the wards and whether the patients were given the best available options of treatment. This will enable the hospital to plan for better management of patients with pathological fractures in the future

AIMS AND OBJECTIVES

Objective:

To determine the pattern of non metabolic causes of pathological fractures and their management in Kenyatta National Hospital.

Aims:

i) To determine the number of patients seen with non metabolic pathological fractures in Kenyatta National Hospital over a ten month prospective period.

ii) To determine the prevalence of these fractures among all the fractures admitted to the orthopaedic wards during this ten month period.

iii) To determine the causes of these fractures.

iv) To define the sites of the fractures.

v) To determine the presentation of these fractures

vi) To determine the management options accorded to the patients.

MATERIALS AND METHODS

STUDY DESIGN AND TIME FRAME

This was a prospective descriptive study over a period of 10 months, between April 2002 and January 2003.

STUDY SETTING

The study was carried out in the orthopaedic wards of Kenyatta National Hospital which is a teaching and referral hospital that also serves as a point of primary care for many people in Nairobi. There are three adult orthopaedic wards and one paediatric orthopaedic ward. The adult wards admit patients on a rotational basis daily. The paediatric orthopaedic ward admits patients daily. The number of patients admitted to the adult wards is about 8 to 12 per admission. The number of patients admitted to the paediatric ward is about 4 to 5 per admission.

INCLUSION CRITERIA

All patients with a non metabolic cause of a pathological fracture admitted to the orthopaedic wards.

EXCLUSION CRITERIA

1. Patients refusing to consent to the study.
2. Patients with pathological fractures due to metabolic causes.
3. Patients from amenity wards

4. Patients admitted to the medical or paediatric wards.

Patients with metabolic causes were excluded from the study because of the investigations that one would have to undertake in order to diagnose the most common cause i.e. osteoporosis. Two forms of radiologic assessment are used in the evaluation of patients with metabolic bone disease: radiographs and densitometric scans. The latter was found to be expensive and not available to the author. The approval sought from the ethical committee was thus restricted to non metabolic causes.

SAMPLE SIZE

The sample size was estimated using the formula provided for by Lwanga and Lemesha[90].

$$n = \frac{Z^2P(1-p)}{d^2}$$

where

z = standard normal variant corresponding to the 95% Confidence interval, and is 1.96

p = expected prevalence of patients with pathological fractures A value of 3.5 % was used. (estimated prevalence January 2002)

d = the required precision of the estimate (0.05)

q = (100-p) %

and therefore

$$n = \frac{1.96^2 \times 0.035\,(1-0.035)}{(0.05)^2} = 51.9$$

The sample size was estimated to be 52 patients

The prevalence rate was derived from point prevalence value of patients with pathological fractures from patients admitted with fractures in the orthopaedic wards during the month of January 2002 which was 3.5%. In January there were about 200 fractures admitted with 7 non metabolic pathological fractures. There were no local prevalence values from review of literature. Githae [7] did not give a prevalence value in his study. Schurman and Amstutz [91] reported a prevalence of 2.6% pathological fractures in patients with carcinoma of the breast. This value was however limited to patients with Ca breast.

Records in the orthopaedic wards were also reviewed for the number of admissions between the months of January to March 2002. It was established that during this time the there were approximately 4 admissions per ward with pathological fractures. Therefore the average admissions per month in all the four wards combined was 4. The estimated number of patients in a period of about 13 months was 52. This is similar to the figure of 52 that is obtained by calculation. Hence the study was estimated to take 13 months.

ETHICAL CONSIDERATIONS

1. Permission to carry out the study was sought from the Ethical and Research Committee of Kenyatta National Hospital.
2. All information obtained from the study was treated with utmost confidentiality and used only in the study.

3. Consent was sought from the patient or the guardian before the patient was included in the study.

DATA COLLECTION.

The wards were visited after admission and the fractures admitted were noted. The patients with pathological fractures were then noted. Due to other responsibilities of the principle investigator when it was not possible to see patients after admission, ward visits were done on the same week and admissions with fractures were noted. The patients with pathological fractures were then reviewed. Upon consenting, the demographic data of the patient was taken. Data was collected by the use of a questionnaire designed for the study (Appendix 1). A history was taken from the patient and a physical examination done to try and establish the presentation, the site and the cause of the fracture. The patients were then investigated. In all patients a full blood count and kidney function tests were carried out as baseline investigations. All patients were admitted with x-rays as it is the policy of the hospital to perform x-rays on all patients with fractures before admission. Depending on the suspected cause other investigations were carried out and these included the following

- Liver Function Tests: In patients with neoplastic fractures
- A prostatic specific antigen in all patients with suspected carcinoma of the prostate.
- A chest x-ray for patients with a suspected malignant cause
- Serum electrophoresis and urine electrophoresis for patients with suspected multiple myeloma

- Abdominal ultrasound to rule out liver and abdominal metastasis
- CT Scan and MRI scan to evaluate spinal lesion
- A biopsy was done for suspected benign bone lesions and on patients with suspected malignancies.

Patients were to be seen weekly to establish what the results of the investigations were. During the weekly visits follow up on their progress in management was made.

LIMITATIONS

Due to lack of funds the principle investigator could not employ someone to aid in data collection and he had to make numerous visits to the ward.

DATA ANALYSIS

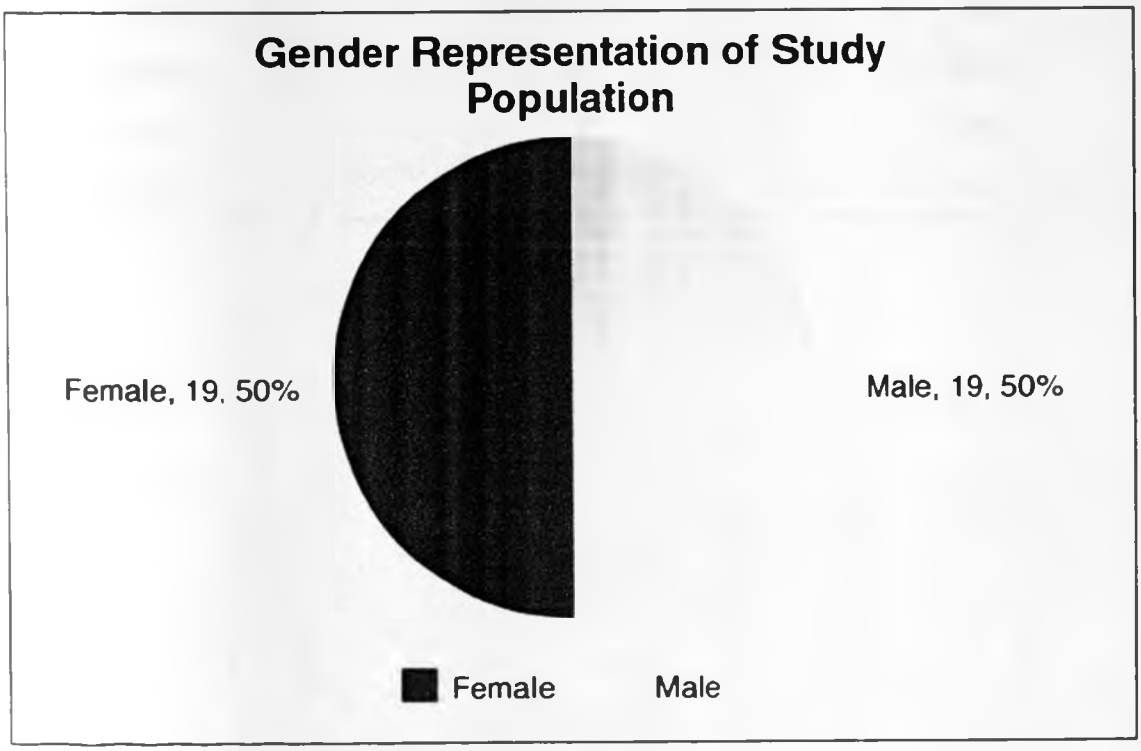
The data was entered and analyzed using Microsoft Excel version 2002 software. Proportions and means of relevant variables such as demographic characters, causes, sites, presentation and management of the fractures were derived and presented in tables, graphs and charts.

RESULTS

1. Characteristics of the study population.

A total of 38 patients were seen during the period of April 2002 and January 2003. The male:female distribution is as shown in figure 1 below.

Fig 1: Gender Distribution of Patients with Pathological Fractures



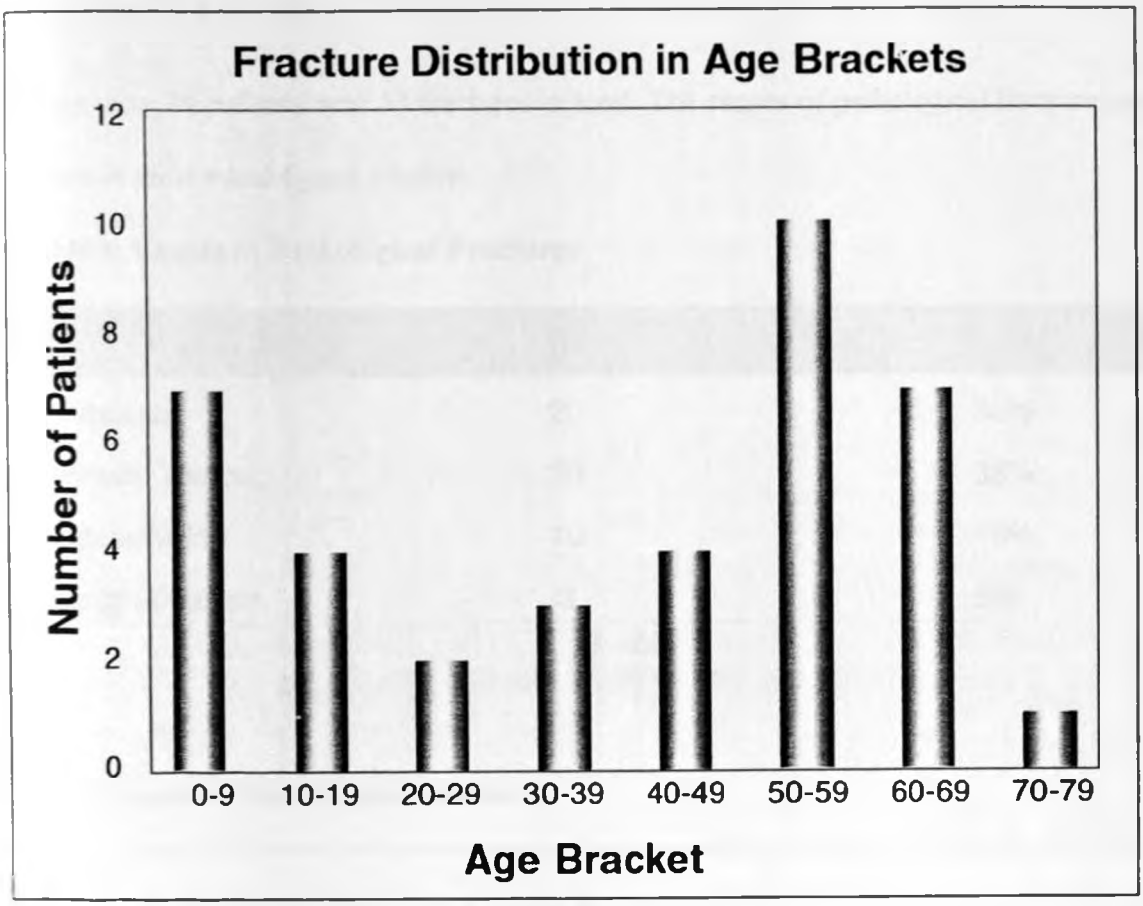
The total number of fractures in the group of patients was 53. There were twenty nine patients each with 1 fracture, four patients had two fractures each, four patients had three fractures each and one patient had four fractures. The patients ranged in age from 1 to 74

years with a mean age of 40 years and standard deviation of 22.5 and a median age of 46 years. The age distribution is represented in the table 3 and fig 2 below.

Table 3: Age Distribution

AGE BRACKET	NUMBER OF PATIENTS	PERCENTAGE
0-9	7	18%
10-19	4	11%
20-29	2	5%
30-39	3	8%
40-49	4	11%
50-59	10	26%
60-69	7	18%
70-79	1	3%

Fig 2: Age Distribution



Prevalence

During the months of April 2002 to January 2003 there were 2020 fractures admitted to the orthopaedic wards. Of these 53 were non metabolic pathological fractures. The average number of fractures admitted per day in the orthopaedic wards was 7.26. **The prevalence rate** of non metabolic pathological fractures among fractures admitted to the orthopaedic wards was 2.62% as shown in the calculation below:-

$$\frac{53}{2020} * 100 = \mathbf{2.62\%}$$

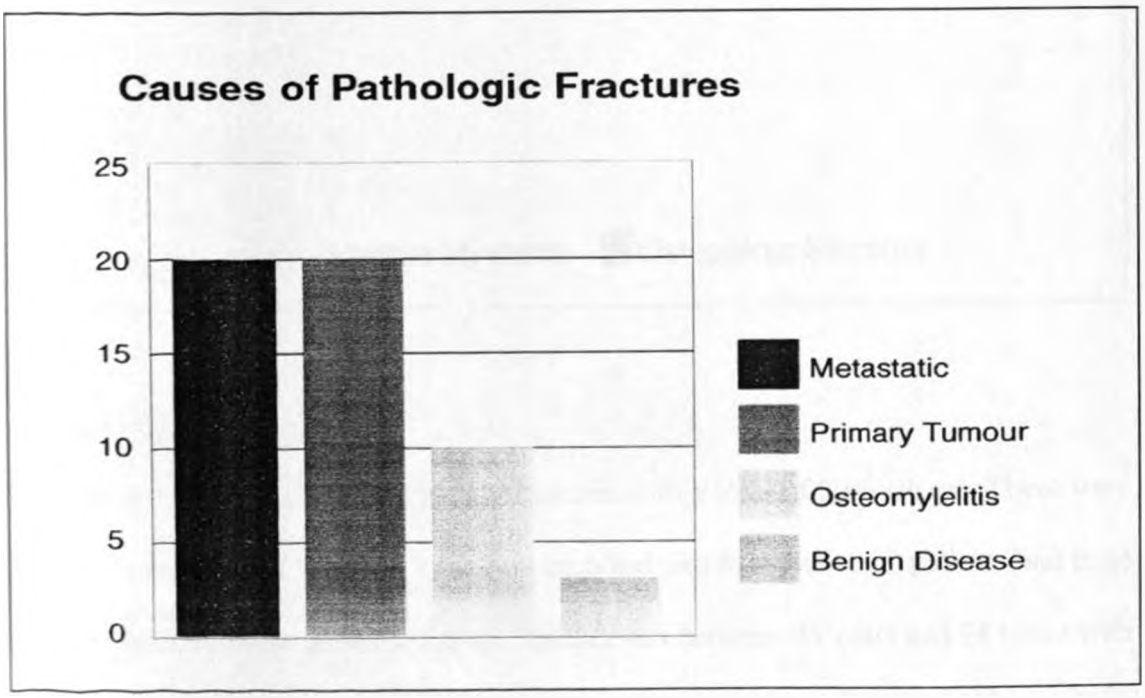
2. Causes of Fractures

There were 38 patients with 53 fractures in total. The causes of pathological fractures are shown in table 4 and figure 3 below.

Table 4: Causes of Pathological Fractures

CAUSES	NUMBER OF FRACTURES	PERCENTAGE
Metastatic	20	38%
Primary Tumour	20	38%
Osteomyelitis	10	19%
Benign Disease	3	5%

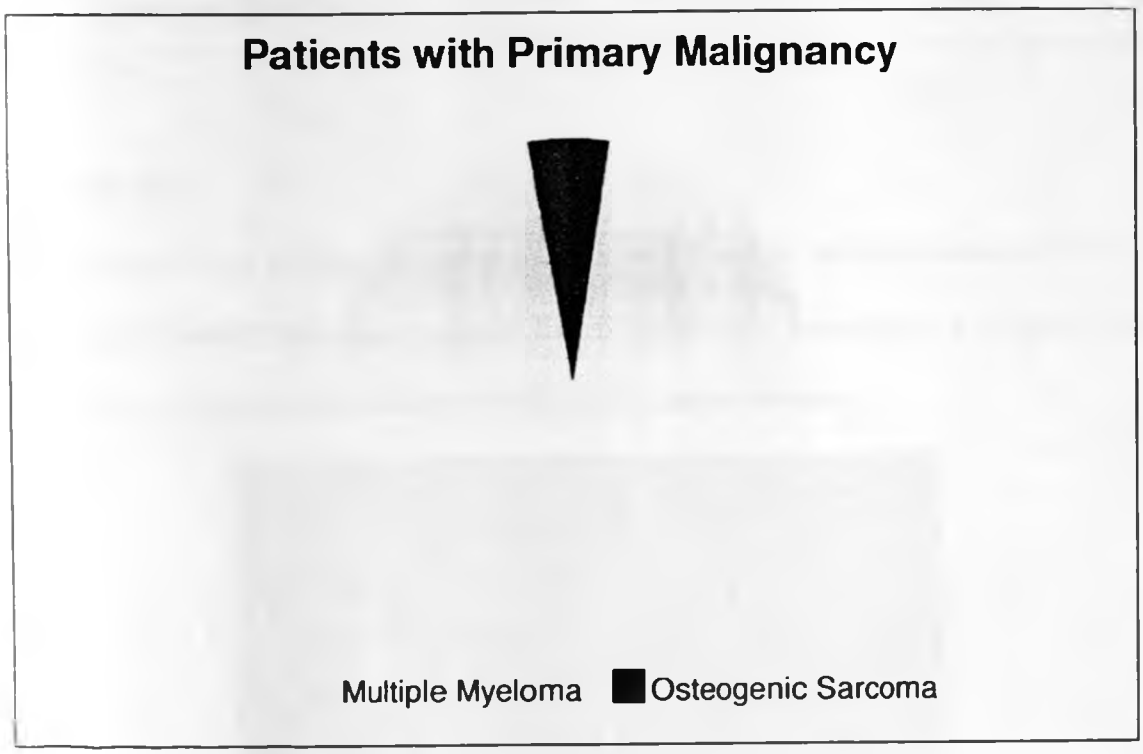
Fig 3: Causes of Pathological Fractures



Primary Malignancy

There were 11 patients with primary malignancy. The patients with multiple myeloma were 10 in number with 19 fractures (95%). Only one patient had a fracture due to osteogenic sarcoma. This is depicted in the graph below.

Fig 4: Pie Chart of Patients with Primary Malignancy



Metastatic Disease

There were 14 patients with metastatic fractures with a total of 20 fractures. There were 10 patients each with 1 fracture, 2 patients each had two fractures and 2 patients had three fractures each. In these patients, the age bracket was between 35 years and 74 years with a mean age of 57 years and a standard deviation of 9.7.

Causes of metastatic fractures are shown in Table 5 below.

Table 5: Patients with metastatic pathological fractures

CAUSE	NUMBER OF FRACTURES	PERCENTAGE
Ca Breast	6	30%
Ca Prostrate	6	30%
Unknown	6	30%
Ca Thyroid	1	5%
Squamous Cell Ca	1	5%

Osteomyelitis

Seventy percent of patients with osteomyelitis were found in the first decade and 30% in the second decade with an age range of 1 to 16 years and a mean age of 8.5 years. There were 7 males (70%) and 3 females (30%) who had these fractures.

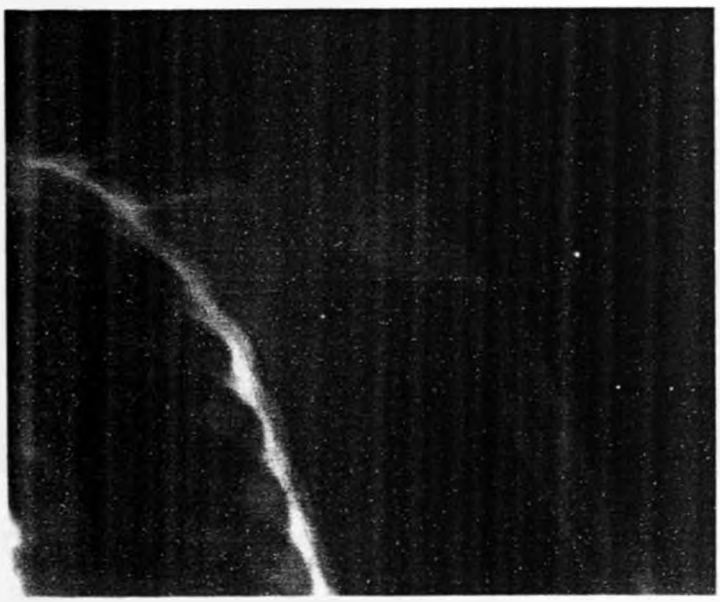


Fig 5 One of the paediatric patients with osteomyelitis.

Others

There were 3 other patients with different causes of pathological fractures. One patient had giant cell tumour while another had polyostotic fibrous dysplasia. Unicameral bone cyst was the cause of fracture in the third patient. The X-rays and slides of various patients are shown below :-

Fig 6 Patient with Giant cell tumour seen during the study.

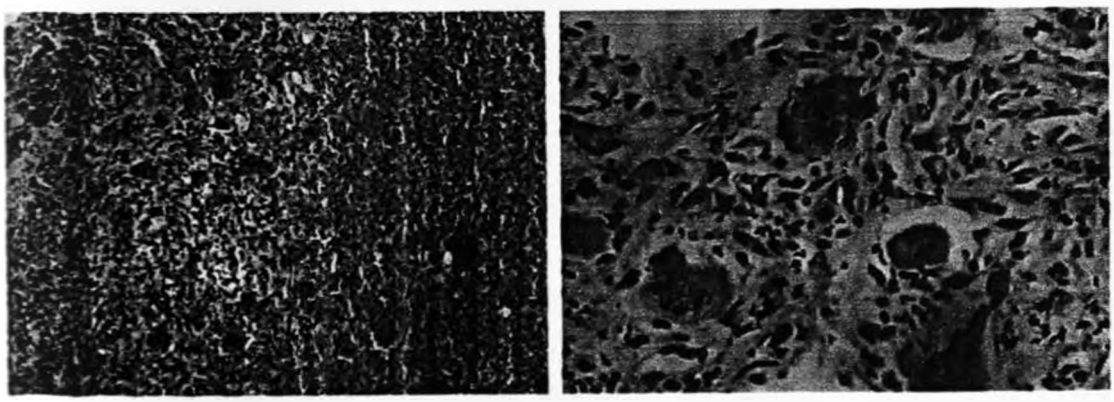


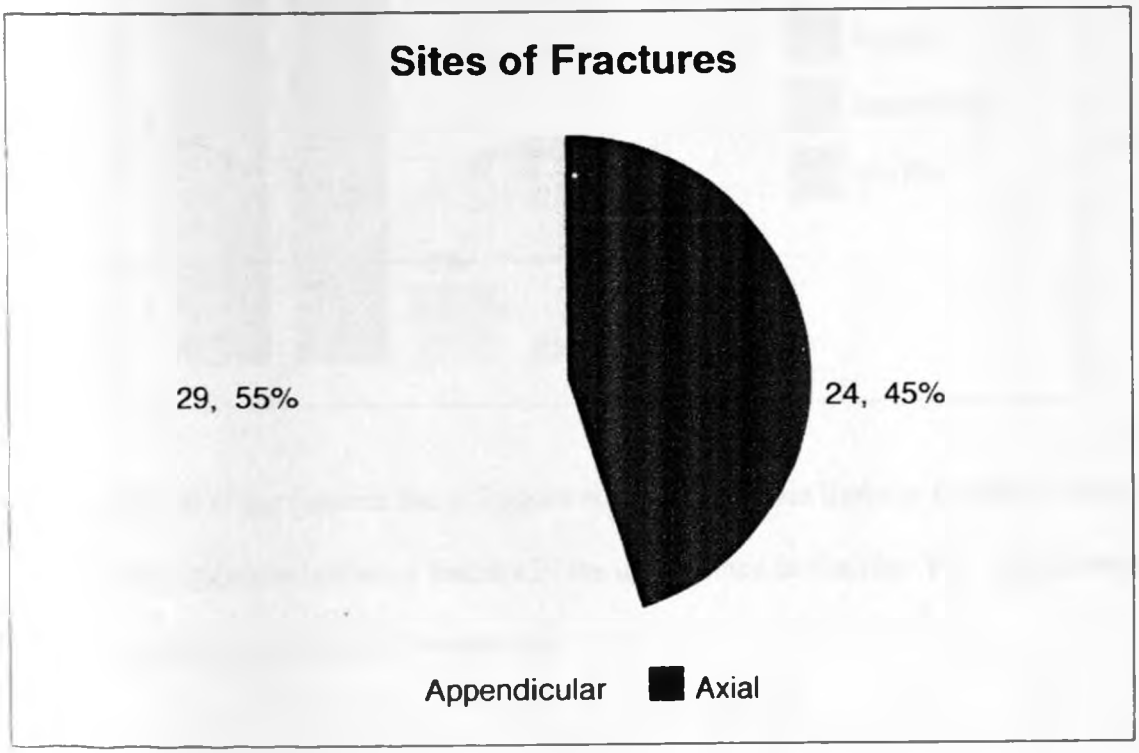
Fig 7 Histology slides of the same patient at *10 and *40 respectively showing multinucleated giant cells

Fig 8 X-ray of a patient with fibrous dysplasia is shown below.

3. Site of Fracture

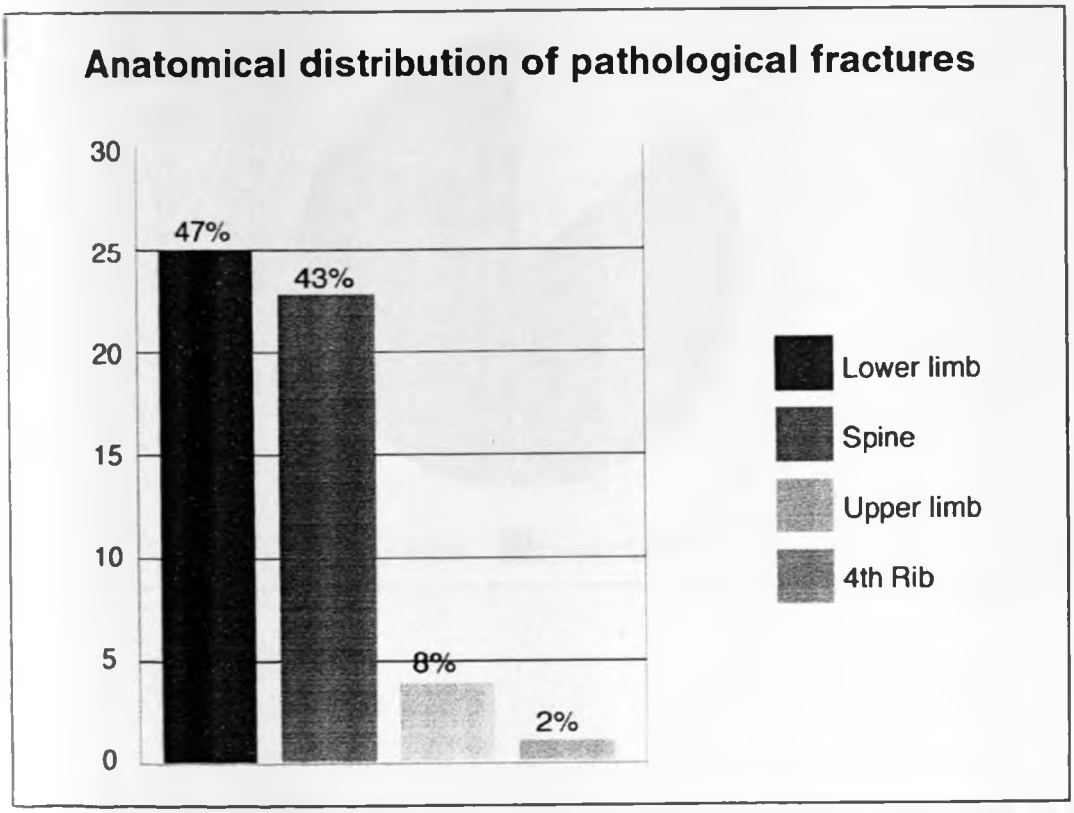
The fractures were distributed both in the axial skeleton and the appendicular skeleton. There were 24 fractures (45%) in the axial skeleton, of all these 23 fractures were in the spine and 1 fracture was in the fourth rib. There were 29 fractures (55%) in the appendicular skeleton with 25 (47%) in the lower limb and 4 fractures (8%) in the upper limb. Distribution of fracture sites are depicted in fig 5 below.

Fig 9: Site of Fracture



A bar chart showing the anatomical distribution of the fractures is shown in fig 10 below.

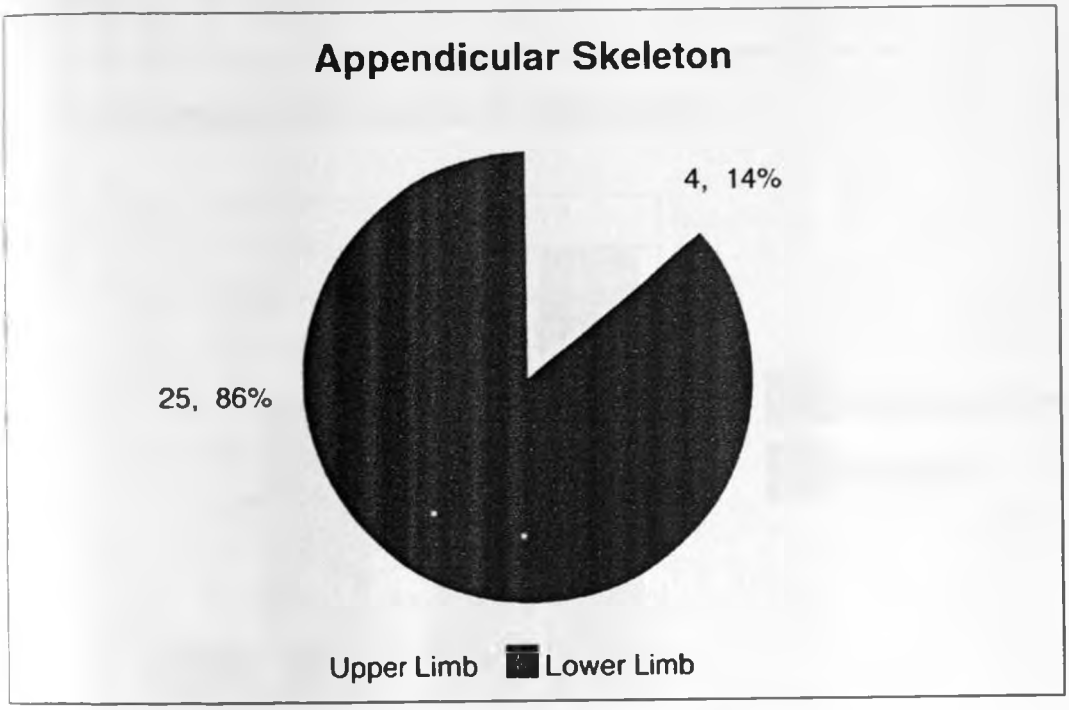
Fig 10 : Anatomical distribution of pathological fractures



Ninety percent of the patients had a fracture either in the lower limbs or the spine. In only 10% of the patients was there a fracture in the upper limbs or the ribs. The ratio between axial to appendicular skeleton fractures was 1:1.2.

The location of the appendicular fractures are shown in figure 11 below.

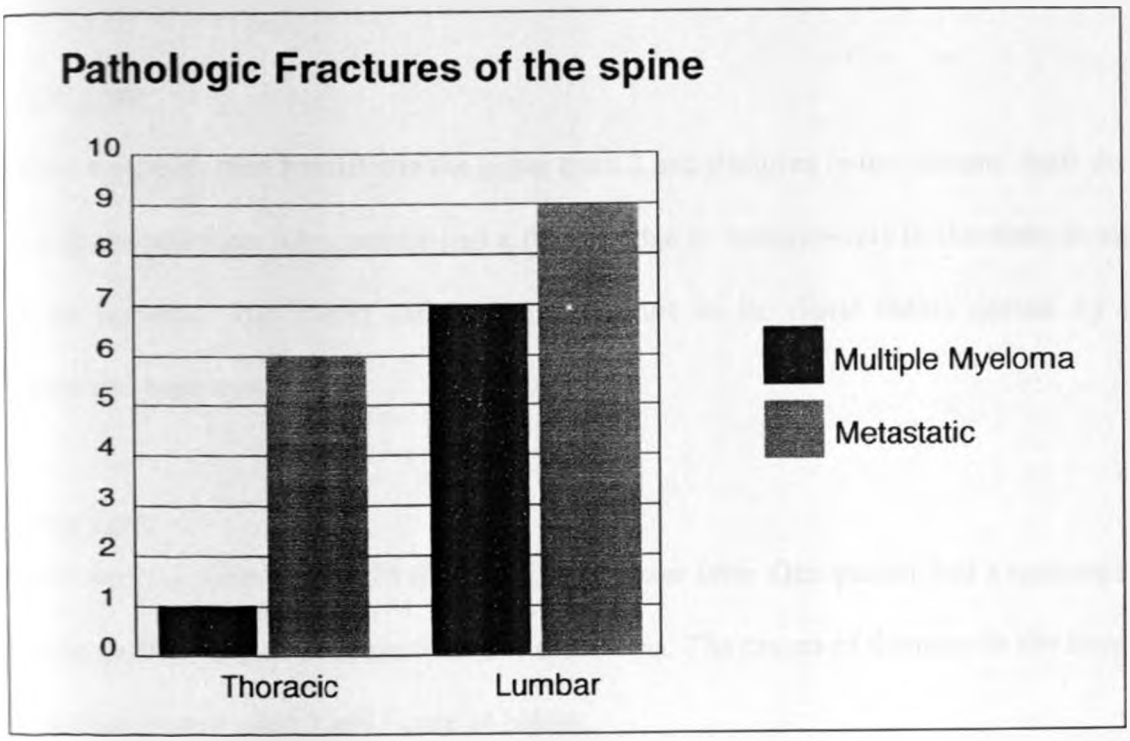
Fig 11: Site of Appendicular Fractures



Spine

Of the fractures that were in the spine, 7 were found in the thoracic region and 16 were found in the lumbar region. A comparison of the metastatic disease fracture pattern of the spine and multiple myeloma fracture pattern of the spine is shown in figure 12 below.

Fig 12: Comparison of metastatic disease and multiple myeloma fracture patterns of the spine.



The patients with pathological spine fractures ranged in age from 35 to 65 years with a mean age of 55.1 years and a standard deviation of 9.9. The median age was 55.5 years. The ratio between fractures in the thoracic region to those in the lumbar region was 1:2.3. The distribution of the causes of malignant fractures in the spine is shown in table 6 and figure 13 below.

patients had three fractures each. The ratio of patients with primary malignancy to those with secondary malignancy was 1:1.8.

Upper Limb

Of the 4 patients with fractures in the upper limb 2 had fractures in the humeral shaft due to multiple myeloma. One patient had a fracture due to osteomyelitis in the metaphyses of the humerus. The fourth patient had a fracture at the distal radius caused by a unicameral bone cyst.

Lower Limb

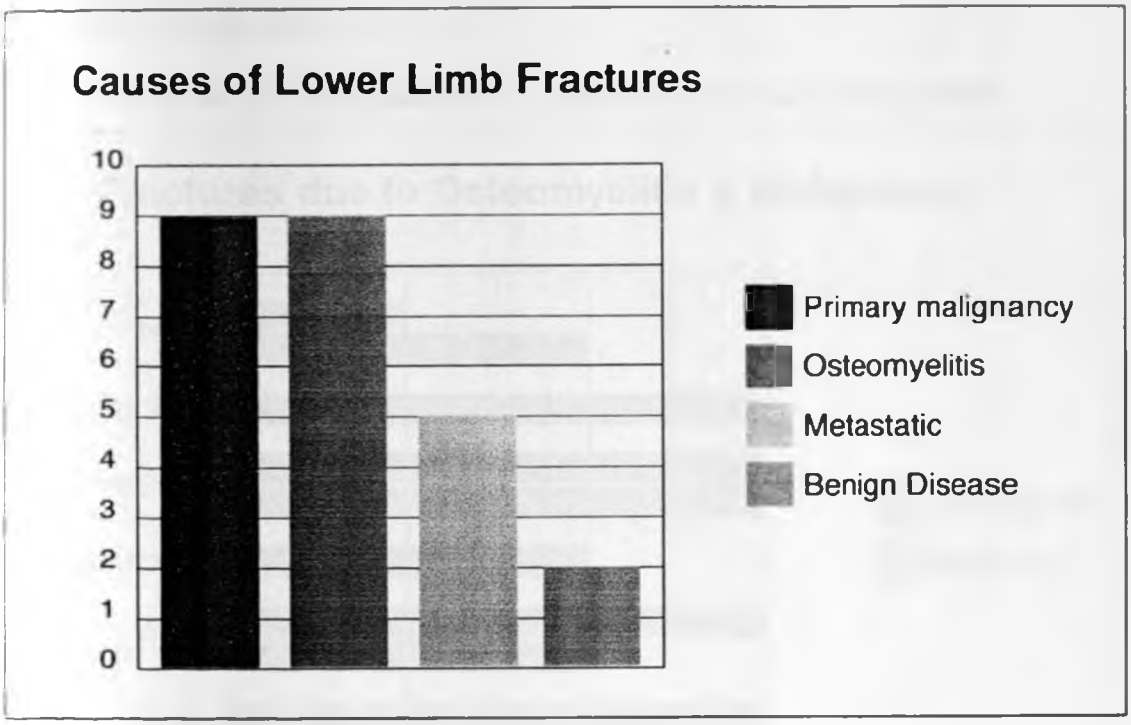
There were 22 patients with 25 fractures in the lower limb. One patient had a metastatic tumour in the fibula due to squamous cell carcinoma. The causes of fractures in the lower limb are shown in table 7 and figure 14 below.

Table 7: Causes of Pathological Fractures in the Lower Limb

CAUSES	NUMBER OF FRACTURES	PERCENTAGE
Primary malignancy	9	36%
Osteomyelitis	9	36%
Metastatic	5	20%
Benign Disease	2	8%

Twenty one patients had one fracture in the lower limb and one patient had four fractures in the lower limb. Malignancy formed 56% of all fractures in the lower limb.

Fig 14: Causes of Pathological Fractures in the Lower Limb



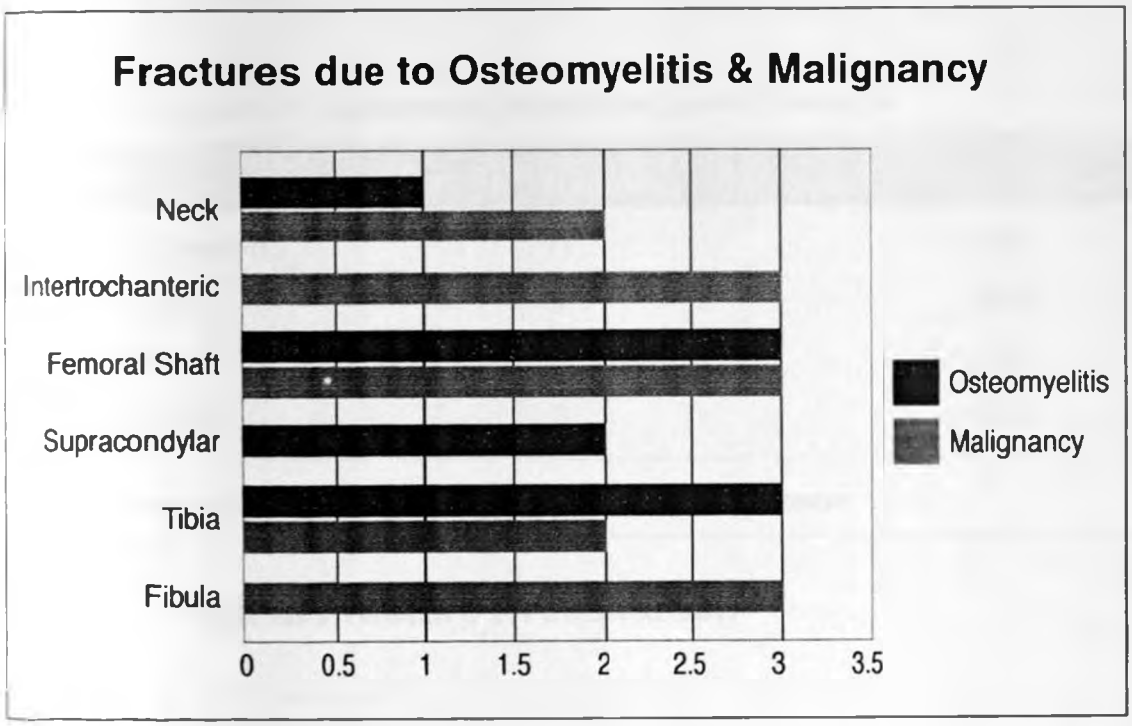
The location fractures in the lower limbs is shown in table 8.

Table 8: Location of Fractures in Lower Limbs

SITE	NUMBER OF FRACTURES	PERCENTAGE
Femoral Shaft	6	24%
Tibia	5	20%
Intertrochanteric	5	20%
Supracondylar	3	12%
Femoral Neck	3	12%
Fibula	3	12%

A comparison of the location of the malignant fractures and fractures due to osteomyelitis is shown in the graph below.

Fig 15: Comparison of the location of the malignant causes and osteomyelitis



The patients with pathological fractures due to malignancy and infection in the lower limb ranged in age from 1 to 74 years with a mean age of 33.1 years and a median age of 35.5 years. The ratio between fractures due to infection to those due to malignancy was 1:1.6.

The patient with giant cell tumour had the fracture in the supracondylar region of the femur. The patient with fibrous dysplasia had the fracture in the intertrochanteric region. The intertrochanteric region was also the location of the fracture in the patient with osteogenic sarcoma.

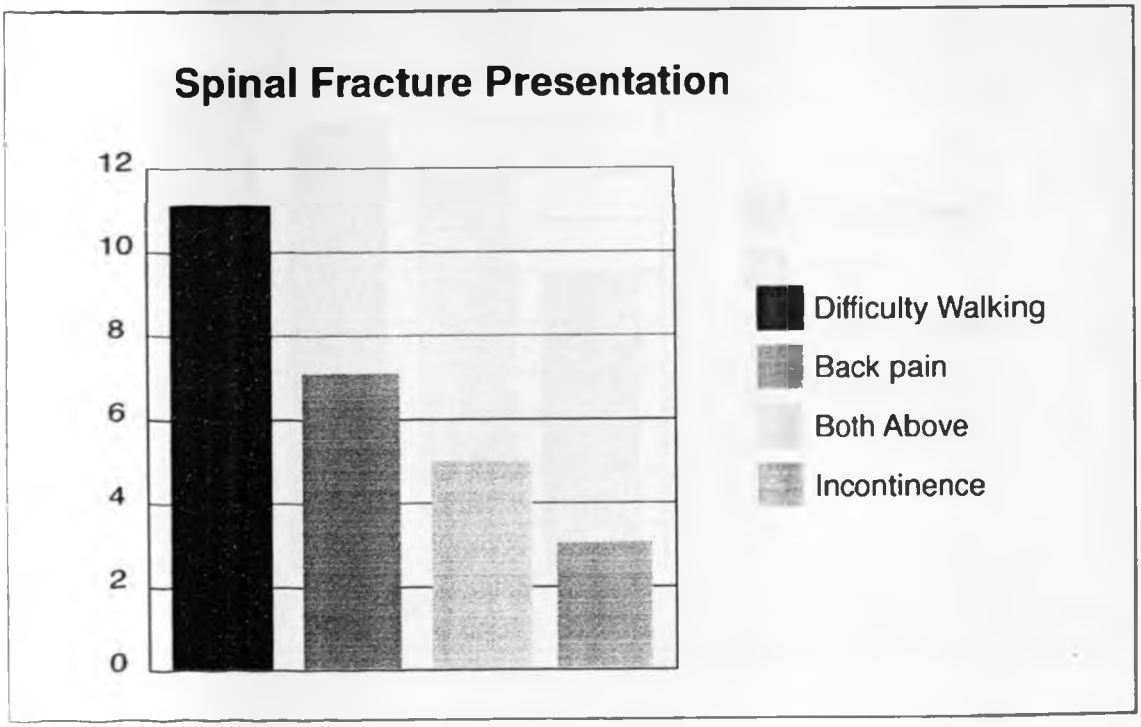
4. Clinical Presentation

The symptoms are tabulated and depicted graphically in table 9 and figure 16 below.

Table 9: Symptoms of Patients with Pathological Spinal Fractures

PRESENTATION	NUMBER OF PATIENTS	PERCENTAGE
Difficulty Walking	11	79%
Back Pain	7	50%
Both Above	5	36%
Incontinence	3	21%

Fig 16: Symptoms of Patients with Pathological Spinal Disease

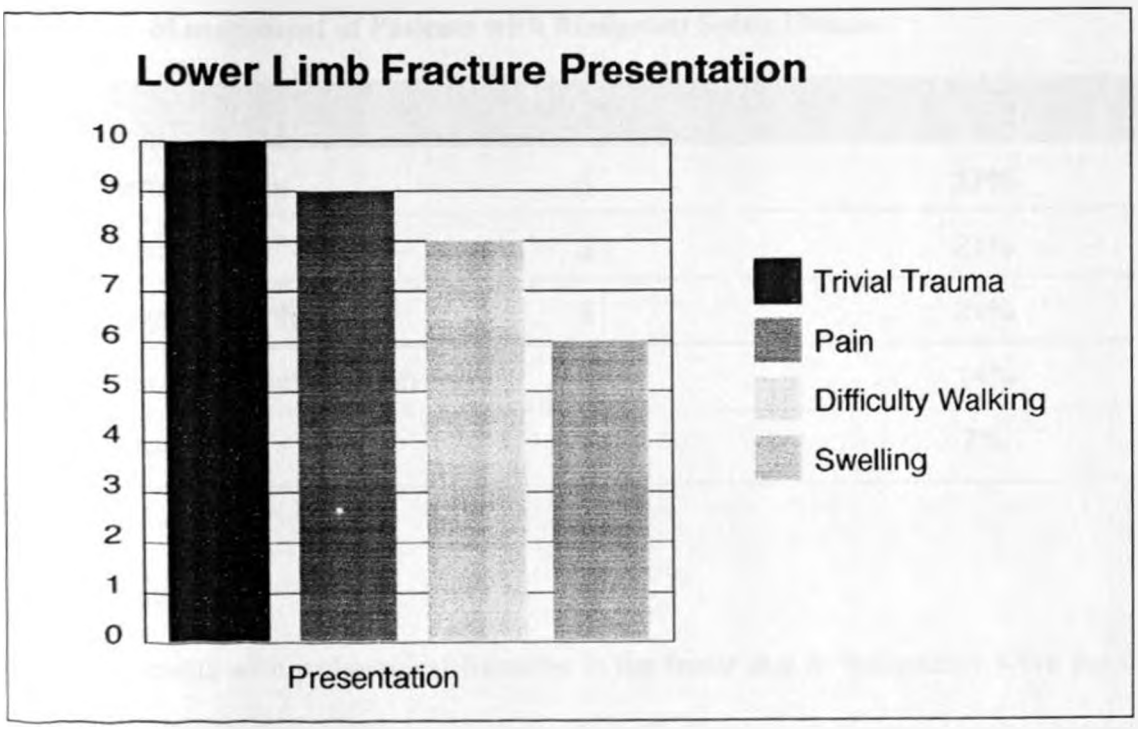


The presentation of lower limb fractures is shown in table 10 and figure 17 below.

Table 10: Presentation of Lower Limb Fractures

PRESENTATION	NUMBER OF PATIENTS	PERCENTAGE
Trivial Trauma	10	45%
Pain	9	40%
Difficulty Walking	8	36%
Swelling	6	27%

Fig 17: Presentation of Lower Limb Fractures



5. Management

All the 14 patients with malignant fractures in the spine were managed for their conditions. Of these patients, 2 (21%), one with Ca prostate and another with an unknown cause were managed with anterior decompression. Of the patients who received radiotherapy, two had Ca breast and one had Ca thyroid. One patient with Ca prostate was managed by hormonal therapy using orchidectomy. Five patients who had multiple myeloma were given chemotherapy with mephalan, prednisone and analgesics. The management modalities are summarized in table 11.

Table 11: Management of Patients with Malignant Spine Disease

MANAGEMENT	NUMBER OF FRACTURES	PERCENTAGE
Chemotherapy	5	37%
Radiotherapy	3	21%
Analgesics only	3	21%
Anterior Decompression	2	14%
Hormonal	1	7%

Lower Limb

All the patients with pathological fractures in the femur due to malignancy were put on traction. Four patients with lower limb fractures due to malignancy were managed surgically. One patient with metastatic fracture in the neck of the femur had an Austin Moore prosthesis inserted. The other patient with an intertrochanteric fracture due to osteogenic sarcoma was disarticulated. A third patient was inserted a K nail in the femoral shaft

The patient with squamous cell carcinoma to the fibula was amputated. All patients with multiple myeloma in the lower limb received chemotherapy. The management of patients with lower limb malignant fractures is summarized in table 12.

Table 12: Management of Patients with Lower Limb malignant Fracture

MANAGEMENT	NUMBER OF PATIENTS	PERCENTAGE
Traction	8	72%
Chemotherapy	1	9%
Surgery only	4	36%
Traction & Chemotherapy	3	27%

All 9 patients with osteomyelitis were managed with antibiotics. Surgical intervention was done in only 3 patients (33%). The surgical procedure done was incision and drainage in one patient, sequestrectomy in the other patient and multiple sequestrectomies and bone grafting in the last patient. The management of patients with lower limb osteomyelitis is summarized in table 13.

Table 13: Management of Patients with Lower Limb Osteomyelitis

MANAGEMENT	NUMBER OF FRACTURES	PERCENTAGE
Traction	4	45%
Surgery	3	33%
Antibiotic Only	2	22%

Of the patients with benign bone conditions two were managed surgical by curettage. In addition to curettage the patient with giant cell tumour had packing with polymethylmethacrylate and internal fixation as shown below.

Figure 18: Management of patient with giant cell tumour

DISCUSSION

The male to female ratio of patients was 1:1, with a peak age of occurrence at 50 to 59 years in which 26% of the patients were found. The age distribution of the patients was related to the cause of the fractures and most of the patients were in the age bracket of 50 to 59 years with 10 patients (26%) and least being those above 70 years of age, 1 patient (3%).This is mainly due to the fact that the majority of the fractures were caused by malignant bone disease due to either metastatic disease or primary malignancy in the form of multiple myeloma. Patients with metastatic disease usually present above the age of 40 years [3]. Multiple myeloma which also formed 95% of all primary bone malignancies in this study has a median age of diagnosis at 62 years [67], although Mukiibi and Kyobe [71] reported a peak age in the sixth decade for multiple myeloma. In Githae's [7] study the majority of the patients were in their fifth decade as was the case in this study.

Patients in the first and seventh decades each formed 18%. The reason for this is that all patients with osteomyelitis which formed 12% of the fractures presented in the first and second decade. These findings are consistent with Boland's [86] writing that osteomyelitis is primarily a disease of childhood and it occurs most frequently between the ages of 5 and 15 years. The high percentage of patients in the seventh decade was contributed by patients with metastatic disease and multiple myeloma.

A retrospective study was done by Githae [7] in 1991 of pathological fractures due to metastatic bone disease from 1978 to 1988 (10 years). Although not a metastatic fracture, multiple myeloma was also included in Githae's [7] study. The number of patients over 10 years was 79 patients with 108 fractures. In this prospective study there were 24 patients with 39 fractures as causes of malignant pathological fractures in a period of 10 months which is more than a third of all the fractures seen in Githae's [7] study. The number of fractures seen in this study over a period of ten months is four times the average number that were seen by Githae [7] every ten months. This study shows that what may have been reported to be the annual incidence of pathological fractures due to metastatic disease in 1991 was under reported. This is probably due to the fact that in a retrospective study one may not access all the data due to inadequate coding of the disease conditions associated with pathological fractures. It is also possible that the number of patients that were seen during this study may have increased compared to the time that Githae [7] carried out his study, however, this cannot explain the large disparity in the numbers.

The prevalence rate of non metabolic pathological fractures among other fractures admitted during this ten month period was 2.62%. This is lower that the estimated prevalence of 3.5% that had been estimated before the study begun. The prevalence rate provides additional information as the previous retrospective study did not calculate the prevalence rate of pathological fractures among other fractures between 1978 and 1988.

Causes

The majority of patients had pathological fractures due to malignancy which included those due to primary malignancy who formed 38% of all the fractures. Similarly the patients with metastatic fractures also formed 38% of all the fractures. The second was osteomyelitis with 10 fractures (19% of all the fractures).

Malignant: Malignancy due to metastatic disease and primary bone neoplasm formed a total of 76 % of fractures. This was expected as had been stated by Springfield and Brower. [1]

Of the patients with malignant fractures, the proportions in descending order was Multiple myeloma 48%, Ca Breast 15%, Ca prostate 15%, Unknown causes 15%, Ca Thyroid 3%. In the study by Githae [7], Ca Breast was 37 %, Multiple myeloma was 20 %, Ca Prostate was 20 % and Ca thyroid 4 %. Although the figures for Ca Breast and Multiple myeloma differ, the other causes of the malignant fractures have similar figures i.e. Ca Prostrate and Ca Thyroid compare. The higher percentage of patients with Multiple Myeloma may have been due to the improved ability to diagnose this condition from the time Githae [7] carried his study.

In a study of 2,748 patients, McLain and Weinstein [10] found that Ca Lung was the primary malignancy in 14% of the patients. In another series, Koskinen [12] had 47% with primary malignancy in the breast, 16% with lung primary tumours and the other 37% spread over the other tumours. In both Githae's [7] study and this prospective study there

was no case reported as metastatic Ca Lung. The reason for this is that unlike in the developed world where Ca Lung is the most common cause of death from malignancy in both men and women [92] it is not a very common cause of death in this country or not picked up Kenyatta National Hospital.

One interesting patient presented with a malignant pathological fracture due to Squamous Cell Ca. of the leg. This tumour metastasised to the adjacent fibula. Although Squamous Cell Ca is not listed as one of the common causes of pathological fractures, one case is reported by Eygen and Stuyck [93]. In a case of the month report in the Belgian orthopaedic web site they describe a similar patient who was 72-year old woman, who was admitted for treatment of a left tibial fracture. The fracture had occurred after a minor injury 8 weeks before and had been treated with a cast in another hospital. A more aggressive treatment had not been undertaken because of the presence of a long-standing venous ulcer of the lower leg. This ulcer was present for more than 30 years and had always been treated with ointments.

In this study the cause of the metastatic pathological fractures was not established in 15% of the patients. This is higher than what Githae [7] found as his study was unable to establish the cause in 10% of the patients. This is also higher than figures of 3 – 10% quoted in other series [94]. However it falls within the limits of 5-15% of all malignancies that Shahab [95] describes as unknown cause of pathological fractures. One should however not forget that Steckel et al [96] advise that if a primary tumour is not found

despite vigorous search then it should not be sought for as it may not affect the management of the patient.

Osteomyelitis: In all children with pathological fractures i.e. 100%, the cause was osteomyelitis. Prior to the study, only anecdotal evidence had pointed out that osteomyelitis was a common cause of pathological fractures. In a prospective study of heamatogenous osteomyelitis in children in Kenyatta National Hospital over a period of one year, Ngetich [84] had about 7% of 73 patients who had a pathological fracture at the time of presentation. Despite the high percentage of patients and proportion of fractures little in the literature has been written about pathological fracture due to osteomyelitis [4]. Extensive literature review of both local and foreign publications did not reveal osteomyelitis as the most common cause of pathological fracture in children. One reason for this could be that chronic osteomyelitis is not as common in the western countries where patients may get access to health care as it is in our local set up. In fact in the six months of rotations that the author had in the orthopaedic wards, in over 90% of all the children with pathological fractures, it was due to osteomyelitis. In literature, unicameral bone cyst is considered one of the most common causes of pathological fracture in children[4], but in our set up it seems to be osteomyelitis.

Other Conditions: There were three patients who were classified as having pathological fractures due to benign bone conditions. One had a unicameral bone cyst while another female patient of 26 years had giant cell tumour. The third patient had polyostotic fibrous dysplasia. These formed only 5% of all non metabolic causes of pathological

fractures reflecting the small percentage of others causes apart from malignancy and infection.

Sites

The largest percentage of fractures were located in the appendicular skeleton which constituted 55%. The reason for this is that fractures in the appendicular skeleton were caused by metastatic disease, primary malignancy and osteomyelitis. Fractures in the spine were only due to metastatic disease and primary malignancy. Although the number of fractures due to malignancy was more in the spine than in the appendicular skeleton, osteomyelitis constituted 19% of all the fractures and thus the total number of fractures in the appendicular skeleton was more than those in the axial skeleton.

However most of the malignant fractures, 23 out 39, which is 59% of the fractures were in the spine. Sim [18] notes that vertebral column is the most common site of skeletal metastasis. Most of the other malignant fractures were located in the lower limb. This is in keeping with what Rock [19] states that a malignant pathological fracture is less likely to occur in the upper extremity than in the pelvis and lower extremity. Only 5% of patients with malignant lesions were in the upper limb and this is in keeping with what Jaffe [16] found in extensive post mortem examination of patients who died of cancer in which he found that considerably fewer that 20% of these fractures were in the upper limb.

Spine: Of the pathological spine fractures, 65% were due to metastatic disease and 36% due to primary malignancy in the form of multiple myeloma. The most common cause of malignant spinal fractures was multiple myeloma with 36% of the patients, 21% of the patients had Ca Breast and 21% of the patients had a fracture due to Ca prostate. These figures differ slightly with studies carried out elsewhere. In a study of 2748 patients with fractures in the spine McLain and Weinstein [10] found that Ca Breast constituted 21% of all lesions in the spine comparable to what was found in this prospective study in Kenyatta National Hospital. McLain et al [10] also found that Ca lung constituted 14% of all these patients. Patients with multiple myeloma were 9% and those with Ca prostate were 7.5%. Ca of the lung was not present in this prospective study for reasons stated above that the condition is not as common in our setup. The figures for multiple myeloma in this prospective study were much less than what McClain found their study. The reason may be that although multiple myeloma is the commonest cause of malignancy in the spine [23], prompt diagnosis and management with chemotherapy and other means like biphosphonates may mean that they will not develop pathological fractures when managed in a centre where such facilities are available. Another reason could be that multiple myeloma is more common in blacks [70] and in lower socioeconomic groups.

Seventy percent of patients with malignant pathological fractures were found in the lumbar region while 30% of the fractures were found in the thoracic region. There were no fractures in the cervical and sacral vertebrae. This compares to what Githae [7] found in which 60 % of the patients with neoplastic spinal fractures had their tumours located in the lumbar spine.

The specific site in the vertebrae was in the anterior aspect of the body of the vertebrae as is the observation by other authors. [8]

Lower Limb: The two most common causes of fractures in the lower limb were those due to malignant neoplasms, 56% and osteomyelitis with 36% of the fractures.

The femoral shaft was the most common site constituting 24% of the fractures in the lower limb, followed by the tibia and the intertrochanteric region which both had 18%. The high percentage of fractures in the femoral shaft compared to other regions was due to the fact that it was the common site of fractures due to neoplasm and osteomyelitis.

The site with the most fractures due to malignancy in the lower limb was the femur. The proximal femur had more than half of the fractures in the femur and this corresponds with what was stated by Sim [44] that the proximal femur due to high stresses in that region sustains most of the lower limb metastatic fractures.

Ninety percent of the pathological fractures due to osteomyelitis were located in the lower limbs with 60% being located in the femur. The lower extremities were more involved in pathological fractures due to osteomyelitis than the upper limbs. This finding is consistent with what was found by Ng'etich [84] and Okoroma and Agbo [97] in that bones of the lower extremities were more commonly involved, than those of the upper extremities. This may be related to the higher likelihood of trauma in the lower limbs which usually precedes the development of acute osteomyelitis and hence the

development of chronic osteomyelitis which may finally culminate in the development of a pathological fracture. The lower limb is also weight bearing and hence with the stress it has to bear the incidence of pathological fractures is higher.

The site of the fracture in the patient with giant cell tumour was at the distal femur and is the one classically described in literature [5] as being the most common site for giant cell tumours. In Blackley et al [63] study, thirty tumours (51 percent) were in the distal end of the femur, fifteen (25 percent) were in the proximal end of the tibia, eight (14 percent) were in the proximal end of the femur, three (5 percent) were in the distal end of the tibia, two (3 percent) were in the proximal end of the humerus, and one (2 percent) was in the distal end of the radius. The patient with fibrous dysplasia presented with a fracture in the intertronchanteric region which is usually the site in 9% of the fractures. [65]

Upper Limb: In the upper limb one patient had a pathological fracture in the metaphysis of the humerus due to chronic osteomyelitis which is the usual site of osteomyelitis. There was a teenage boy with unicameral bone cyst in the distal radius which is not the common site of this lesion as it is usually located in the proximal femur and humerus [55]. Of the 32 patients studied by Roposch et al [61] two patients had fractures in the distal radius.

Presentation

Spine: The principal symptoms that patients with malignant spinal fractures presented with included back pain, inability or difficulty in walking, incontinence of stool and urine

and parathesia. The most common complaint was inability or difficulty in walking which was present in 11 out of 14 patients i.e. 79 % of the patients and this was principally due to weakness of the lower limbs. The seventy nine percent of patients in this study who presented with lower limb weakness compares with what Weinstein [3] has noted that up to 70% of patients with spinal malignant pathological fractures present with weakness of the limbs by the time of diagnosis.

In this study 50% of the patients presented with back pain. This is described as the most consistent complaint. [23] This figure is low as compared to what is quoted in some literature of up to 80 % [23] of patients with pathological malignant fracture. Thirty six percent of the patients presented with both back pain and difficulty in walking due to weakness, with the weakness presenting after the back pain. This had been noted by Harrington [2] who explains that weakness of the extremities may not become apparent until months or years after the onset of back pain. This shows that a large percentage of patients in our set up present relatively late, months or years after the symptoms begun. Githae [7] in his study noted that it could be that the patients presented early but it took some time to get to the referral hospital.

There were 21% of patients with malignant pathological fractures of the spine presenting with incontinence of urine and stool. These patients also had inability to walk due to motor weakness. Harrington [2] explains that loss of sphincter control is thought to be a late phenomenon and usually occurs only in patients with profound involvement. This again shows the characteristic late presentation of our patients.

Lower Limb: In this study, 45% of patients with lower limb fractures had a history of trivial trauma prior to the fracture. This was the most common complaint of pathological fractures in the lower limb. The hallmark of presentation of a pathological fracture is a fracture that occurs after mild trauma. [1] Trivial trauma as a presentation was only found with appendicular skeleton fractures. These results compare with what Githae [7] found that 32% patients with lower limb fractures presented with a history of trivial trauma. In Githae's [7] study there was a history of trivial trauma in only 2% of patients with spinal fracture.

The next common symptom of presentation was pain that was present in 40% of the patients and difficulty in walking in 36% of patients with lower limb fractures. The difficulty in walking in a number of cases was due to the instability of the fracture and pain elicited when the patient attempted to walk.

Swelling as a symptom was exclusively found in patients with osteomyelitis. Swelling is one of the symptoms that patients with osteomyelitis present with as noted by some authors.[81] Ngetich [84] found that pain and swelling were the most common modes of presentation with a percentage of 84% and 76% respectively. Patients with malignancy also present with swelling however in this study it was not one of the major complaints among the patients with fractures due to malignancy either primary or secondary.

Upper Limb: In this study 75% of patients with upper limb fracture had bone pain. There was a history of a trivial trauma in one patient as well as history of swelling at the

fracture site in one patient with fracture due to osteomyelitis. It is not extremely unusual to have patients appear with large destructive lesions of the upper extremity that are asymptomatic and are detected by routine scintigraphy or skeletal survey [19]. Such was the case in one patient who had a fracture in the humerus and who presented with chest pain due to a fracture in the 4th rib. The fracture in the humerus was discovered during a skeletal survey.

Management

Spine: All patients with multiple myeloma received analgesics and chemotherapy. The chemotherapeutic agents that were given were prednisone and mephalan. No patient was offered radiotherapy or decompression surgery. Some of these patients may have benefited form radiotherapy or surgery as 3 of them had inability to walk due to cord compression. In these 3 patients ambulation was never achieved.

In 21% (n=3) of patients with metastatic carcinoma of the spine, radiotherapy was administered. In two patients there was a report of improvement in terms of pain relief and one patient also gained the ability to walk. This reflects what Gilbert et al [26] had already established that radiotherapy alone was as effective as decompressive laminectomy (with or without radiation) in treatment of epidural compression

Anterior decompression surgery was offered to 14% (n=2) of the patients with metastatic spinal disease. One of them had Ca prostate while in the other the cause was unknown. This is a significant change from what was done in Kenyatta National Hospital over ten years ago. In the study by Githae [7] there were 43 patients with vertebral fractures and only 2 of them had laminectomy. Although 14% is a small figure it is a positive change as a number of authors [43, 44] report poor outcome following laminectomy as compared to anterior decompression. In this prospective study no patient was managed by laminectomy. However more effort should be placed in the overall surgical management of these patients.

Lower Limb: One of the 2 patients with malignant fractures at the neck of the femur had surgical intervention through an Austin Moore prosthesis. This patient was able to be mobilized and received significant pain relief. This supports what Lane [46] and his associates found that endoprosthetic replacement produces pain relief, improves function and restores ambulation. One other patient with pathological fracture due to osteogenic sarcoma at the intertrochanteric region was disarticulated. All other patients with neoplastic fractures in the proximal femur i.e. one in the neck and three in the intertrochanteric region received no surgical intervention. In the two patients with multiple myeloma and fractures in the intertrochanteric region there was no ambulation despite the use of chemotherapy.

The ineffectiveness of conservative treatment was further shown by the management of malignant femoral shaft fractures. One patient with a femoral shaft fracture had a K nail

inserted and she was later ambulated. Of the two patients that were managed by traction and chemotherapy, none of them were ambulated.

By and large in this study, the patients were managed by conservative means in lower limb fractures. Sim [18] in his review article states that there is little role for conservative management of pathological fractures in the hip and in the femur and that it should be considered only in the terminally ill patient and occasionally non-ambulatory patients who can be treated non-surgically. In a terminal patient, treatment might include simple support with pillows and skeletal traction [18]. One problem is that effective prolonged immobilsation in bed is difficult to achieve and relief of pain requires large doses of narcotic analgesics. Most of the patients in this study were treated by conservative means either by traction or by bed rest. The reason for this could be that there is a lot of pressure from the many patients in the wards with other conditions who equally need theatre space especially the trauma patients. The other reason is that some of the patients present late and debilitated and traction and bed rest are the only options for management.

There were 33% of patients with osteomyelitis in the lower limbs that were managed by surgical intervention. In one patient only incision and drainage was done and in another patient sequestrectomy was done. One patient with an intertrochanteric fracture had long term management of her fracture. This patient had been transferred from a hospital in Busia in which a surgical procedure had been done but they did not state which procedure. While in Kenyatta National Hospital she had multiple sequestrectomies and as a result the patient developed significant bone loss. In order to replace the bone loss the

patient had bone grafting first using a fibula bone graft to fill the defect. This however did not take and the patient was again grafted by a homograft of bone from a patient who had an Austin Moore prosthesis inserted, the head of the femur being processed and used to graft this patient.

Whatever management options that were chosen, successful management of patients with pathological fractures due to osteomyelitis was difficult. This is shown by the multiple surgeries that the patient with the fracture in the intertrochanteric region had and also the repeated admission of a number of these patients.

The patient with a pathological fracture due to unicameral bone cyst had curettage and bone grafting from the iliac crest. This is the treatment that has been advocated by Gakuu [59] and others [5, 57].

The patient with giant cell tumour had an interesting management course. She was managed by curettage but had a recurrence. This patient was taken to theatre again and curettage and bone cementing with internal fixation was done. Blackley et al [63] established that the adequacy of the removal of the tumour rather than the use of adjuvant modalities is what determines the risk of recurrence.

CONCLUSIONS

1 The prevalence of non metabolic pathological fractures among other fractures admitted to the ward was 2.62%.

2 The number of cases of malignant pathological fractures seen in this study of ten months was four times as many as the average number seen in ten months in a previous retrospective study done in the same hospital, reflecting that the cases may have been underreported in the previous study.

3 The most common cause of pathological fracture was malignancy either due to metastatic or primary bone malignancy.

4 In children, osteomyelitis is the most common cause of pathological fractures in our set up. Although this was anecdotal before it had not been documented in locally available literature.

5 The peak age of patients with pathological fractures is the sixth decade.

6 The sites of pathological fractures seen in descending order are the lower limb, the spine and the upper limbs. This is different from previous studies which just focused on malignant causes and therefore reported the spine as the most common site.

7 The major complaints in patients with spinal pathological fractures were back pain and difficulty in walking, while trivial trauma was the most common complaint in patients with appendicular skeleton fractures.

8 Although a few patients received surgical intervention most of patients were managed by conservative means, including those with metastatic appendicular fractures where most authors recommend surgical management.

RECOMMENDATIONS

1. Studies should be done to assess the management outcomes of the individual causes of pathological fractures especially those due to malignancy and osteomyelitis. This will enable us to define the best management options of patients with pathological fractures due to conditions like osteomyelitis of which little has been written in our local literature.

2. A study should be done on all the causes of pathological fractures including those due to metabolic disease. This will give a complete picture of the pattern and prevalence of pathological fractures in our set up.

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APPENDICES

1. Questionnaire

2. Sample Consent Form

Appendix 1: Questionnaire

Name _____

Age _____

Sex _____

Unit Number _____

Date of Admission _____

Site

Skull _____
Pelvis _____
Upper Limb _____
Lower Limb _____
Spine _____

Cause

Infection _____
Primary Malignancy _____
Metastatic Malignancy _____
Benign Bone condition _____
Metabolic Bone Disease _____
Other _____

Investigation

Full heamogram and ESR _____
Liver Function test _____
Urea and Electrolytes _____
Blood Biochemistry _____
Other Blood Investigations _____
Radiology
X-ray _____
CT Scan _____
CXR _____
Ultrasound _____
Bone Scan _____
MRI _____
Biopsy _____

Pattern of presentation

Pain _____
Fever _____
Neurological deficiency _____
Incontinence _____
Inability to walk _____

Management

Medical
Antibiotics _____
Analgesics _____
Chemotherapy _____
Analgesic _____
Other _____

Surgical
ORIF _____
External Fixators _____
Curettage _____

Radiotherapy _____

Conservative
Traction _____
POP _____

Other _____

Date of Discharge/Death _____

Planned Follow-up _____

Appendix 2: **Sample Consent Form**

STUDY ON NON METABOLIC CAUSES OF PATHOLOGICAL FRACTURES IN KENYATTA NATIONAL HOSPITAL

This is a study of certain types of fractures known as pathological fractures. The purpose is to determine what bone diseases cause these fractures, on which sites of the human skeleton the fractures occur, how patients with these fractures will present at the hospital and what are the ways in which these patients are managed. Your participation as a patient will involve answering some questions and a physical examination. Participation in this study is voluntary and the information will be treated with utmost confidence. This consent can be withdrawn at anytime and failure to participate or withdrawal of the consent will not affect your treatment.

I have understood the explanation by Dr. Oburu who is carrying the aforementioned study.

I agree to participate on the study on my own free will and I will agree to do the following:-

(i) To be interviewed concerning my injuries and the answers to be recorded by the interviewer.

(ii) And to be examined physically.

I have also understood that my participation is completely voluntary and that I can withdraw my consent at any point and that such withdrawal will not affect my treatment in anyway. The information I give will be treated with utmost confidence and my name will not be included in the results.

1. Consent by the patient:

I _____ of _____

Hereby consent to my inclusion in the aforementioned study the nature and effect of which have been explained to me by Dr. Ezekiel Oburu.

Signature (patient) _____ Date_____

Witness (researcher) _____ Date _____

2. Consent by Parent/Guardian (delete as appropriate).

I hereby consent to the inclusion of _____

in the aforementioned study the nature and effect of which have been explained to me by Dr. Ezekiel Oburu.

Signature (patient) _____ Date_____

Witness (researcher) _____ Date _____

KENYATTA NATIONAL HOSPITAL
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P.O. Box 20723, Nairobi.

Tel: 726300-9
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Telegrams: "MEDSUP", Nairobi.
Email: **KNHplan@Ken.Healthnet.org**

Ref: KNH-ERC/01/1677 **Date: 11 February 2003**

Dr. Oburu Ezekiel
Dept. of Surgery
Faculty of Medicine
University of Nairobi

Dear Dr. Oburu,

RESEARCH PROPOSAL "NON METABOLIC CAUSES OF PATHOLOGICAL FRACTURES IN KENYATTA NATIONAL HOSPITAL" (P91/8/2002)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and approved the revised version of your above cited research proposal.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF. A. N. GUANTAI
SECRETARY, KNH-ERC

Cc **Prof. K.M. Bhatt, Chairperson, KNH-ERC**
The Deputy Director (C/S), KNH
The Dean, Faculty of Medicine, UON
The Chairman, Dept. of Surgery, UON
Supervisor: Prof. J.E.O. Atinga, Dept. of Orthopaedic Surgery, UON
CMRO