Histological Pattern, Anatomical Location and Spinal Instability of Patients with Spinal Tumors Attended at Kilimanjaro Christian Medical Centre from Jan 2018 to Aug 2021

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Abstract

Background: Spinal tumours are commonly encountered in neurosurgical practice, and accounts for about 5% of all bone tumors. Usually affects all age groups from 6–84 years, with an increasing trend of new patients. Most of the patients present to our setting at a very late stage and so are prone to complications such as spine instability. Spinal tumors can be both primary from the spine itself or metastatic from common primary lesions, such as thyroid, breast in females, lungs, liver, kidney, prostate in males and ovary in females. Back pain, limb weakness and sometimes paralysis are the foremost presenting complaints. With the aid of radiographic imaging, histopathology examination of soft tissue and bone biopsy a spinal tumour diagnosis is made.

Objective: This study was aimed at determining the histological pattern, common anatomical location and spinal instability of patients with spinal tumors attended at KCMC from Jan 2018 to Aug 2021.

Methodology: This was a hospital based, analytical cross-sectional study, which included all patients with spinal tumors attended at KCMC, from Jan 2018 to Aug 2021. Data was extracted from orthopedics theatre biopsy book registry and pathology/cancer registry retrospectively. Patients' information and radiological findings were traced through hospital electronic system. Then structured checklist was employed to abstract the

data following the socio-demographic information, common complaint, clinical presentation, anatomical location, histological diagnosis, radiological findings and spinal instability was assessed using SINS (Spinal Instability Neoplastic Score) data was entered and analyzed by SPSS version 25.

Results: A total of 71 participants were studied, with the median (range) age of 61 (8 – 86) years. Majority of the participants 36 (50.7%) were > 60 years, 40 (56.3%) were males, 37 (52.1%) were residing in urban areas, 42 (59.2%) were not employed, 28 (39.4%) had secondary education, 41 (57.8%) were not smoking, 55 (77.5%) were taking alcohol. On the other hand, 69 (97.2%) had history of back pain, 65 (91.5%) had lower limb weakness, 13 (18.3%) had loss of sensation, 36 (50.7%) had loss of bowel and bladder function, 45 (63.4%) had undergone biopsy, 59 (83.1%) had surgery and chemotherapy as treatment option. Regarding the histological pattern, 58 (81.7%) had secondary spinal tumors, 60 (84.5%) had malignant spinal tumors and 62 (87.3%) had extradural spinal tumors, however large proportion of the spinal tumors, 23 (32.4%) were metastasis from prostate, 13 (18.3%) were multiple myeloma and 11 (15.5%) were metastasis from breast. Also There was significant relation between age and originality (p=0.002), age and metastasis (p=0.017) and anatomical location (p<0.001). In regard to the tumor originality, most of those with primary tumors, 4 (30.8%) were meningiomas and 4 (30.8%) plasmocytoma. Among those with secondary tumors, 23 (39.7%) were metastasis from prostate and 13 (22.4%) had multiple myeloma. Regarding nature of the tumor, most of those benign were meningiomas 4 (57.1%). Among those malignant 23 (35.9%) metastasis from prostate, Multiple Myeloma accounted 16(25%) and 11 (18.9%) were metastasis from breast. Based on anatomical location, intramedullary 2 (100.0%) were epindymomas, intradural 4(57.1%) were meningiomas, extradural 16 (25.8%) were metastasis from prostate and 13 (20.9%) were multiple myeloma. In regard to the anatomical location in the spinal column, the most common location of the spinal tumors was lumbar 32 (45.1%), followed by thoracic 20 (28.2%). In the cervicothoracic region, meningiomas was 1(33.3%), osteoblastoma 1(33.3%) and epithelia sarcoma 1 (33.3%). Most of the thoracic tumors 4(20.0%) were multiple myeloma and 4(20.0%) were metastasis from breast. Among those in thoracolumbar region 2(66.7%) were metastasis from prostate, and in lumbar region 9(28.1%) were metastasis from prostate, lumbosacral region, 2(28.6%) were metastasis from prostate,2(28.6%) were multiple myeloma and 2(28.6%) were metastasis from the breast. Lastly, in the thoracic-lumbar-sacral region 3(50.0%) were multiple myeloma. Regarding assessment of tumor related instability by SINS score among the study participants, 21(29.6%) were stable, 39(54.9%) were potentially unstable and 11(15.5%) had instability by the SINS. Factors such as loss of sensation (p=0.021) and anatomical location (p=0.013) were associated with spinal instability. Most of the stable participants 14(66.7%) had biopsy only. Most of those with potential instability, 27(69.2%) had biopsy only while those with instability, 5(45.4%) had biopsy and stabilization also there is no association between histological pattern subtypes and spinal instability p-value 0.178.

Conclusion: This study found that, secondary spinal tumors were predominant, most of them being malignant, affecting the adult population, a large number being metastases from the prostate in males and breast in females. Also primary spinal tumors were few, most of them being benign affecting the young age group. Meningiomas were observed to be the most common histological subtypes. On the other hand, the most affected anatomical site was observed to be the lumbar region and most of the spinal tumors were extradural in origin. Most patients fell in the category of potentially unstable by SINS and it was observed that majority had a history of surgery where biopsy only was done, few biopsy and decompression laminectomy and a smaller number biopsy, laminectomy and stabilization was done.

Introduction

A spinal tumor is an abnormal mass within a spine tissue or surrounding of the spinal cord including the spinal column. ST are commonly encountered in neurosurgical practice, 5% of bone tumors involves the spine [1,2]. Spinal tumors are from two common origins, they can be originating primarily from the spine and its surroundings and others usually originates from elsewhere, hence the term secondary spine tumors, usually they affect age groups ranging from pediatrics to geriatrics (6–84 years) [3,4]. Hemangiomas are the most common primary tumors of the spine and the common secondary spinal tumors are metastatic diseases originating from the lung, breast, prostate, MM, lymphoma, melanoma, sarcomas, GIT cancers, kidneys and thyroid tumors. Lung cancer is the most common cancer to metastasize to the bone in men, and breast cancer is the most common in women [5]. Route of spread to the spine and its surrounding tissues are through hematogenous and lymphatic system. The spine is generally susceptible to metastasis because of good its good blood supply, hence well vascularization and close relationship with regional lymphatic and venous drainage systems (especially Batson's venous plexus) [6]. Primary spine tumors are little encountered compared with secondary spine malignancies, 10% of all spinal tumors are primary spine tumors [7]. Secondary malignancies mostly occur in the spine. 90,000 new cases of spinal metastases occur in the United States annually. Unlike primary tumors of the spine which are relatively rare, with an overall prevalence of 2.5 to 8.5 cases per 100,000 persons per year [8]. The cause of primary spinal tumors is idiopathic, but exposure to cancer-causing agents can be a risk factor for primary spinal tumors. People with low immune system are more likely to develop Spinal cord lymphomas, which are affect lymphocytes. Genetic component has been also associated to be a risk factor since higher incidence of spinal tumors has been observed in particular families. Location and nature of the spine lesion are related to clinical presentation. Usually the symptoms are very slow but may progress rapidly if at all the lesion is malignant [9]. The foremost symptom appearing in spinal tumors is Non-mechanical middle or low back pain. Other symptoms include the following: hypoesthesia, paresis, neck or back stiffness, Pain and/or tingling sensation, paralysis, difficulty walking, which may cause falls, incontinence and spinal deformity such as scoliosis, kyphosis resulting from a large and/or destructive tumor. For precisely location of spinal tumor, radiographic image is used (such as plain radiography, CT-scan and MRI) [10,11]. It is important to screen all parts of the spine and pelvic region, plain radiographs being the cheapest and first line in imaging of spinal tumors; usually it can show the following in a metastatic lesion; osteoblastic, osteolytic or mixed changes. A "winking owl sign" usually indicate metastasis, lytic lesions, moth-eaten lesions and permeative destruction indicates the spinal tumor grows faster, and collapse of the vertebral body, indicating pathological fracture. Computed Tomography (CT) is superior to plain radiographs and is the most advantageous method in examination of bone tissues. It can also be an important and useful investigation in diagnosing spinal tumors,

regardless of its poor affinity and efficacy in lesions in the soft tissues. Apart from CT-scan and plain radiography another means is by using (MRI) which is superior to all diagnostic procedures in spine tumors, as it can show also lesions in the soft tissues including bone marrow and spinal canal, relationship of the tumor with neurovascular structures and tumor vascularity. In the diagnosis process of spinal tumors, the most important, confirmatory and top diagnostic process is Biopsy, which can be performed percutaneously as fine needle aspiration and tru-cut biopsy, incisional or excisional biopsy [12]. A multidisciplinary approach is employed in the treatment of spinal tumors; this is focused on surgery, radiation therapy, and chemotherapy. Because of the delicate structures, surgery is always a challenge [13,14]. But because of the well surgical modalities and techniques, minimum invasive surgery hand in with spinal stabilization, and tumor excision methods, the evolution of radiotherapy technology has led to foundation of conventionally fractionated radiotherapy (conventional External Beam Radiation [cEBRT]) to Stereotactic Radio-Surgery (SRS) [15,16]. If spinal tumors are left untreated they may lead to complication such as spinal instability, paraplegia or incontinence, resulting in significant morbidity and poor quality of life [17,18]. In patients with poor neurological status, there is significant morbidity [19,20]. In spinal tumors presenting with a complication of spinal instability, SINS can be employed to well categorize this tumor related spinal instability. This tool can well be used to categorize patients with instability and forms a basis to formulate an appropriate management of patients with spinal tumors related instability. As it was observed that among radiation oncologists, the SINS binary scale provides a reliable tool for rating tumor related spinal instability. SINS score can be categorized and used for surgical referral status: 'stable' (0-6 points) or 'current or possible instability' (7-18 points). Surgical consultation is usually required for those patients with a score of ≥7 [21]. It is very important to prevent or restore spinal stability in patient with spinal tumors and should be the major focus point in treatment of metastatic disease. There were no accepted guidelines classifying tumor related spinal instability. This was a gap and a challenge among oncologists, radiologists, and other health care providers who manage these patients without proper classifying guideline. Patients are at risk of having neurologic deficities, severe pain, and progressive deformity, if are poorly managed [22]. After SINS being introduced, it was seen that there were decrease in mean and median SINS in both the surgical and radiotherapy groups, lastly a significant difference in overall mean, median and categorical SINS between the surgical and radiotherapy cohort was observed. This mean decrease in SINS revealed an increased awareness of neoplastic-related spinal instability and earlier and more appropriate referral to the spine surgeon. Hence this was the first study to determine the influence of the SINS in a clinical setting [23]. In patient with spinal tumors it was observed that pain was relieved after radiotherapy, but it was not clearly defined as to why some patient's pain is relieved after radiotherapy while others still complains of pain. Hence this study had a hypothesis that pain was due to spinal instability and not the local tumor itself. And then SINS was employed in this study and revealed that higher scores increase failure of radiotherapy in patients with spinal metastases. So most of the patients receiving radiotherapy usually complain of pain due to tumor related spinal instability [24]. As we can see that in SSA there is scarce information on patients with spinal tumors, dearth information about the clinical and radiologic features and outcome of surgery for these lesions in this part of the world [25].

Methodology

Study Design

This was a hospital based analytical cross-sectional study.

Study Duration

From January 2018 to august 2021.

Study Area

This study was carried out in KCMC hospital which is situated in northern Tanzania at the foot of mountain Kilimanjaro. KCMC Hospital is one of the referral Hospitals located in Moshi-Rural District. Moshi Rural District is one of the six districts in Kilimanjaro region. Kilimanjaro Region is one of Tanzania's 31 administrative regions with a postcode number 25000. The regional capital is the municipality of Moshi. According to the 2012 national census, the region had a population of 1,640,087 the district has the population density of 124 people/km². The municipality has an estimated population of 201,150 and a population density of 3,409 persons per km^2. In the last official census of 2012, the municipality had a population of 184,292 and is administratively divided into 21 wards and then subdivided into 60 hamlets. KCMC is the only referral hospital in northern Tanzania, which serves a population of about eleven million people. Patients comes from Kilimanjaro region and it's neighboring regions which form Northern zone and other parts of United Republic of Tanzania and sometimes serves peoples from neighboring Kenya.

Study Population

All patients with spinal tumors attended at KCMC from Jan 2018 through Aug 2021.

Eligibility Criteria

Inclusion criteria: All patients with spinal tumors attended at KCMC from Jan 2018 to Aug 2022.

Exclusion criteria: Patients with no histological verification on spinal tumors, Patients with incomplete or missing information on files or hospital electronic system.

Sample Size and Sampling Technique

Sample size: The minimum sample size was calculated according to the following formula:

Prevalence was estimated to be 5% [26].

This was a retrospective paper done from 2004 to 2013

n = Z2 P (1 –P)

(SE) 2

Where- by;

Z =standard deviation = 1.96

P= proportion.

SE= is the standard tolerable error (0.05).

n =is minimum required sample size

From the calculation the minimum sample size was approximately 70 patients.

Study variables: Age, Sex, Residence, Education status, Occupation, Incidence date, Tumor location, Clinical presentation, Histological diagnosis, Spinal instability and Spinal tumor.

Data Collection Tools, Methods and Procedures

Data collection tools: Data was collected using structured checklist and SINS. The checklist comprised of socio-demographic information, clinical presentation, radiological findings, site biopsy, tumor location and treatment modalities. Spinal instability was assessed using SINS.

Data collection methods and procedure: Data was extracted from Orthopedics theatre biopsy book registry and pathology/Cancer registry retrospectively. Patients' information on their clinical presentation and radiology findings was traced from files and hospital electronic system. The structured checklist and SINS was employed to extract the data following the listed variables that are important for the study. The extracted data was exported into excel and then transferred into a secured hard drive for the study utility.

Data Management and Analysis

The data from the registry was reviewed and checked for validity before transferred to statistical package for analysis purposes. Data was coded and entered into the computer using SPSS program version 25. Mean and Standard Deviation (SD) was used to summarize the numerical data such as age of the patients in years; whereas frequency and proportions was employed to summarize categorical variables using tables and figures. Relationship between variables was tested using fisher's exact test. Cross tabulation was done to estimate proportion of spinal tumors.

Ethical Consideration

Approval was obtained from Kilimanjaro Christian Medical University College Research Ethics committee prior data collection with certificate number PG 04/2021. Permission was sought from the department of Orthopedics and Pathology departments at KCMC Hospital. No informed consent was used from clients as this is a check list review and no names of clients used in the analysis and reporting of research findings. Access to this information was only for the research purposes. Privacy and confidentiality was ensured using encrypted password.

Dissemination of results

The results of this study will be presented to the academic forum of Kilimanjaro Christian Medical University College. Copies of the dissertation will be available in the KCMUCo library, Orthopedics and Pathology/Oncology Department. Efforts will be made to publish the results in appropriate internationals for oncology or orthopedics.

Results

Characteristics of the Study Participants

Demographic characteristics of the study participants: This study included a total of 71 study participants. The median (range) age of the study participants was 61 (8 – 86) years. Majority of the study participants; 36 (50.7%) were aged > 60 years, 40 (56.3%) were males, 37 (52.1%) were residing in urban areas, 42 (59.2%) were not employed, 28 (39.4%) had secondary education, 41 (57.8%) were not smoking, 55 (77.5%) were taking alcohol. This is shown on **Table 1.**

Table 1: Demographic characteristics of the study participants (n=71).

Characteristics	n (%)
Age (years)	
< 30	8 (11.3)
30 – 60	27 (38.0)
> 60	36 (50.7)
Sex	
Male	40 (56.3)
Female	31 (43.7)
Residence	
Rural	34 (47.9)
Urban	37 (52.1)
Occupation	
Employed	24 (33.8)
Unemployed	42 (59.2)
Student	5 (7.0)
Education	
None	11 (15.5)
Primary	24 (33.8)
Secondary	28 (39.4)
University	8 (11.3)
Smoking	
No	41 (57.8)
Yes	30 (42.3)
Alcohol use	
No	16 (22.5)
Yes	55 (77.5)

Clinical characteristics of the study participants: On the other hand, 69 (97.2%) had history of back pain, 65 (91.5%) had lower limb weakness, 13 (18.3%) had loss of sensation, 36 (50.7%) had loss of bowel and bladder function, 45 (63.4%) had undergone biopsy, 59 (83.1%) had surgery and chemotherapy as treatment option. This is shown on **Table 2.**

Table 2: Clinical characteristics of the study participants (n=71).

Characteristics	n (%)
History of back pain	
No	2 (2.8)
Yes	69 (97.2)

Lower limb weakness	
No	6 (8.5)
Yes	65 (91.5)
Loss of sensation	
No	58 (81.7)
Yes	13 (18.3)
Loss of bladder and bowel functions	
No	35 (49.3)
Yes	36 (50.7)
History of surgery	
Biopsy	45 (63.4)
Biopsy and laminectomy	15 (21.1)
Biopsy and stabilization	11 (15.5)
Treatment option	
Surgery	12 (16.9)
Surgery and chemotherapy	59 (83.1)

Histological pattern of ST among patients attended at KCMC

Regarding the histological pattern, 58 (81.7%) had secondary ST, 60 (84.5%) had malignant and 62 (87.3%) had extradural spinal tumors. This is shown on **Figure 1.**
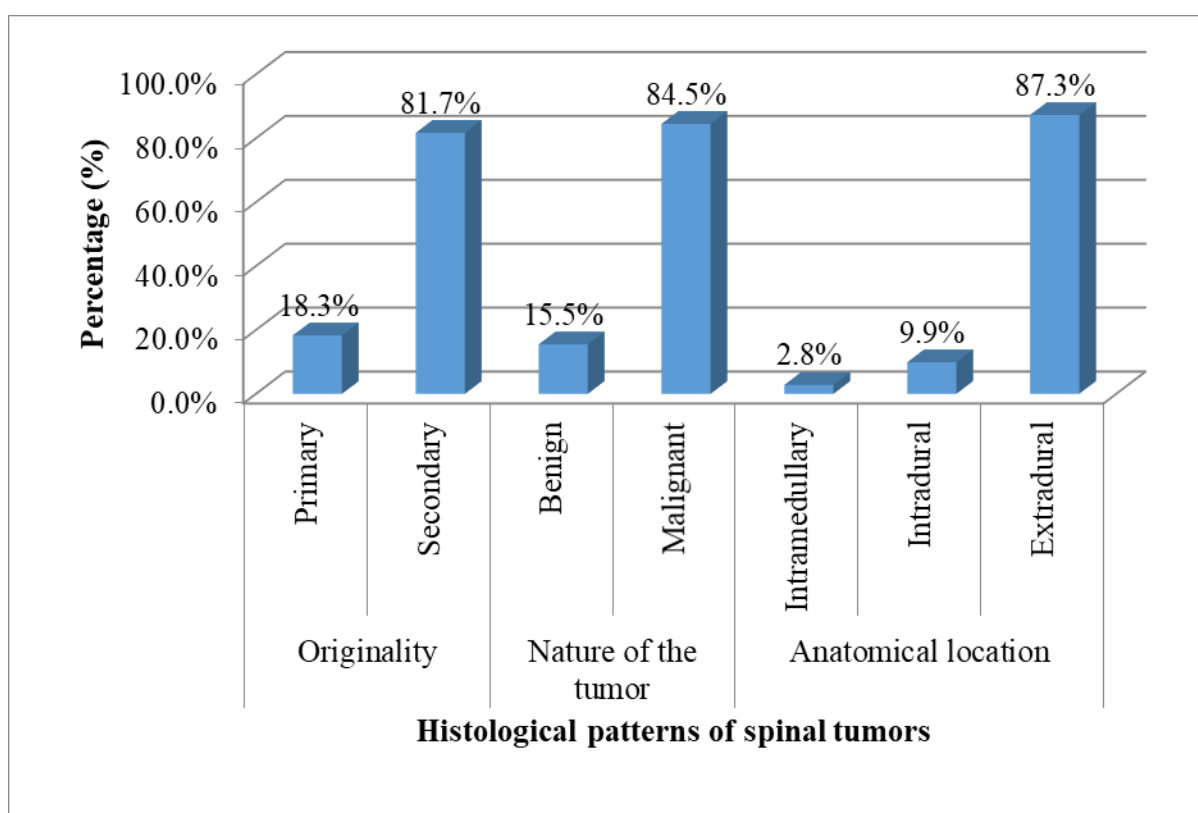

Figure 1: Histological pattern of spinal tumors at KCMC (n=71).

4.2.1 Histological pattern of spinal tumors subtypes: However large proportion of the spinal tumors, 23 (32.4%) were metastasis from prostate, 13 (18.3%) were multiple myeloma and 11 (15.5%) were metastasis from breast. This is shown on **Table 3.**

Table 3: Histological pattern of spinal tumors subtypes (n=71).

Name of tumor	n (%)
Adenocarcinoma of the prostate	23 (32.4)
Multiple myeloma	13 (18.3)
Invasive ductal carcinoma(breast)	11 (15.5)
Meningioma	4 (5.6)
Plasmocytoma	4 (5.6)
High grade serous carcinoma(ovary)	3 (4.2)
Neurofibroma	2 (2.8)
Adenocarcinoma of the colon	2 (2.8)
Spinal cord lymphoma	2 (2.8)
Epindymoma	2 (2.8)
Renal cell carcinoma(kidney)	1 (1.4)
Myoepithelial carcinoma	1 (1.4)
Osteoblastoma	1 (1.4)
Hepato cellular carcinoma(liver)	1 (1.4)
Epithelioid sarcoma	1 (1.4)

Histological patterns by age (n=71): There is strong association between age and ST originality (p- value 0.002), nature of the tumor (p- value 0.017) and anatomical location (p- value 0.001). Primary ST seen in age group < 30yrs 6(46.2%), secondary ST are seen in >60yrs 33(56.9%), benign ST <30yrs 4(36.4%), malignant ST >60yrs 33(55.0%), intramedullary ST <30yrs 2(100%), intradural ST <30yrs 4(57.1%) and extradural ST 35(56.5%) seen in age group >60yrs. This is shown in **Table 4.**

Table 4: Histological patterns by age (n=71).

	Originality				Nature of the tumor				Anatomical location				
	Primary	Secondary			Benign	Malignant			Intramedullary	Intradural	Extradural		
	n (%)	n (%)	Total		n (%)	n (%)	Total		n (%)	n (%)	n (%)	Total	
	13 (18.3)	58 (81.7)	n (%)	p-value	11 (15.5)	60 (84.5)	n (%)	p-value	2 (2.8)	7 (9.9)	62 (87.3)	n (%)	p-value
Age (years)													
< 30	6 (46.2)	2 (3.4)	8 (11.3)		4 (36.4)	4 (6.7)	8 (11.3)		2 (100.0)	4 (57.1)	2 (3.2)	8 (11.3)	
30 - 60	4 (30.8)	23 (39.7)	27 (38.0)		4 (36.4)	23 (38.3)	27 (38.0)		0 (0.0)	2 (28.6)	25 (40.3)	27 (38.0)	
>60	3 (23.0)	33 (56.9)	36 (50.7)	0.002	3 (27.3)	33 (55.0)	36 (50.7)	0.017	0 (0.0)	1 (14.3)	35 (56.5)	36 (50.7)	<0.001

Histological pattern of spinal tumors by originality: Regarding tumor originality, most of those primary ST, 4 (30.8%) were meningiomas and 4 (30.8%) was plasmocytoma. Among those secondary ST, 23 (39.7%) were metastasis from prostate and 13 (22.4%) had multiple myeloma. This is shown on **Table 5.**

Table 5: Histological pattern of spinal tumors by Originality (n=71).

	Primary	Secondary	
	n (%)	n (%)	Total
Name of the tumor	13 (18.3)	58 (61.9)	n (%)
Adenocarcinoma of the prostate	0 (0.0)	23 (39.7)	23 (32.4)
Multiple myeloma	0 (0.0)	13 (22.4)	13 (18.3)
Invasive ductal carcinoma(breast)	0 (0.0)	11 (18.9)	11 (15.5)
Meningioma	4 (30.8)	0 (0.0)	4 (5.6)
Plasmocytoma	4 (30.8)	0 (0.0)	4 (5.6)
High grade serous carcinoma(ovary)	0 (0.0)	3 (5.2)	3 (4.2)
Neurofibroma	2 (15.4)	0 (0.0)	2 (2.8)
Adenocarcinoma of the colon	0 (0.0)	2 (3.4)	2 (2.8)
Spinal cord lymphoma	0 (0.0)	2 (3.4)	2 (2.8)
Epindymoma	2 (15.4)	0 (0.0)	2 (2.8)
Renal cell carcinoma(kidney)	0 (0.0)	1 (1.7)	1 (1.4)
Myoepithelial carcinoma	0 (0.0)	1.(1.7)	1 (1.4)
Osteoblastoma	1 (7.7)	0 (0.0)	1 (1.4)
Hepato cellular carcinoma(liver)	0 (0.0)	1 (1.7)	1 (1.4)
Epithelioid sarcoma	0 (0.0)	1 (1.7)	1 (1.4)

Histological pattern of spinal tumors by nature of the tumor: Regarding metastasis, most of benign ST, 4 (57.1%) were meningiomas. Among those malignant 23 (35.9%) were metastasis from prostate and 11 (17.2%) were metastasis from breast. This is shown on **Table 6.**

Table 6: Histological pattern of spinal tumors by nature of the tumor (n=71).

	Benign	Malignant	
	n (%)	n (%)	Total
Name of tumor	7 (15.5)	64 (84.5)	n (%)
Adenocarcinoma of the prostate	0 (0.0)	23 (35.9)	23 (32.4)
Multiple myeloma	0 (0.0)	16 (25.0)	16 (22.5)
invasive ductal carcinoma(breast)	0 (0.0)	11 (17.2)	11 (15.5)
Meningioma	4 (57.1)	0 (0.0)	4 (5.6)
Plasmocytoma	0 (0.0)	4 (6.3)	4 (5.6)
High grade serous carcinoma(ovary)	0 (0.0)	3 (4.7)	3 (4.2)
Neurofibroma	2 (28.6)	0 (0.0)	2 (3.3)

Adenocarcinoma of the colon	0 (0.0)	1 (1.7)	1 (1.4)
Spinal cord lymphoma	0 (0.0)	1 (1.6)	1 (1.4)
Epindymoma	0 (0.0)	1 (1.6)	1 (1.4)
Renal cell carcinoma(kidney)	0 (0.0)	1 (1.6)	1 (1.4)
Myoepithelial carcinoma	0 (0.0)	1 (1.6)	1 (1.4)
Osteoblastoma	1 (14.3)	0 (0.0)	1 (1.4)
Hepato cellular carcinoma(liver)	0 (0.0)	1 (1.6)	1 (1.4)
Epithelioid sarcoma	0 (0.0)	1 (1.6)	1 (1.4)

Histological pattern of spinal tumors by anatomical location: All of those intramedullary, 2(100.0%) were epindymomas. Those intradural 4 (57.1%) were meningiomas. Those extradural 23(25.8%) were metastasis from prostate and 13 (20.9%) were multiple myeloma. This is shown on **Table 7.**

Table 7: Histological pattern of spinal tumors by anatomical location (n=71).

	Intramedullary	intradural	Extradural	
	n (%)	n (%)	n (%)	Total
Name of tumor	2 (2.8)	7 (9.9)	62 (87.3)	n (%)
Adenocarcinoma of the prostate	0 (0.0)	0 (0.0)	23 (25.8)	23 (32.4)
Multiple myeloma	0 (0.0)	0 (0.0)	13(20.9)	13 (18.3)
invasive ductal carcinoma(breast)	0 (0.0)	0 (0.0)	11 (16.1)	11 (15.5)
Meningioma	0 (0.0)	4 (57.1)	0 (0.0)	4 (5.6)
plasmocytoma	0 (0.0)	0 (0.0)	4 (6.5)	4 (5.6)
High grade serous carcinoma(ovary)	0 (0.0)	0 (0.0)	3 (4.8)	3 (4.2)
Neurofibroma	0 (0.0)	2 (28.6)	0 (0.0)	2 (2.8)
Adenocarcinoma of the colon	0 (0.0)	0 (0.0)	2 (1.6)	2 (2.8)
Spinal cord lymphoma	0 (0.0)	1 (14.3)	1 (1.6)	2 (2.8)
Epindymoma	2 (100.0)	0 (0.0)	0 (0.0)	2 (2.8
Renal cell carcinoma(kidney)	0 (0.0)	0 (0.0)	1 (1.6)	1 (2.8)
Myoepithelial carcinoma	0 (0.0)	0 (0.0)	1 (1.6)	1 (1.4)
Osteoblastoma	0 (0.0)	0 (0.0)	1 (1.6)	1(1.4)
Hepato cellular carcinoma(liver)	0 (0.0)	0 (0.0)	1 (1.6)	1(1.4)
Epithelioid sarcoma	0 (0.0)	0 (0.0)	1 (1.6)	1(1.4)

The common anatomical location of Spinal Tumors in the spinal column of patients attended at KCMC

The most common location of the spinal tumors was lumbar 32 (45.1%) followed by thoracic 20 (28.2%). This is shown on **Figure 2.**
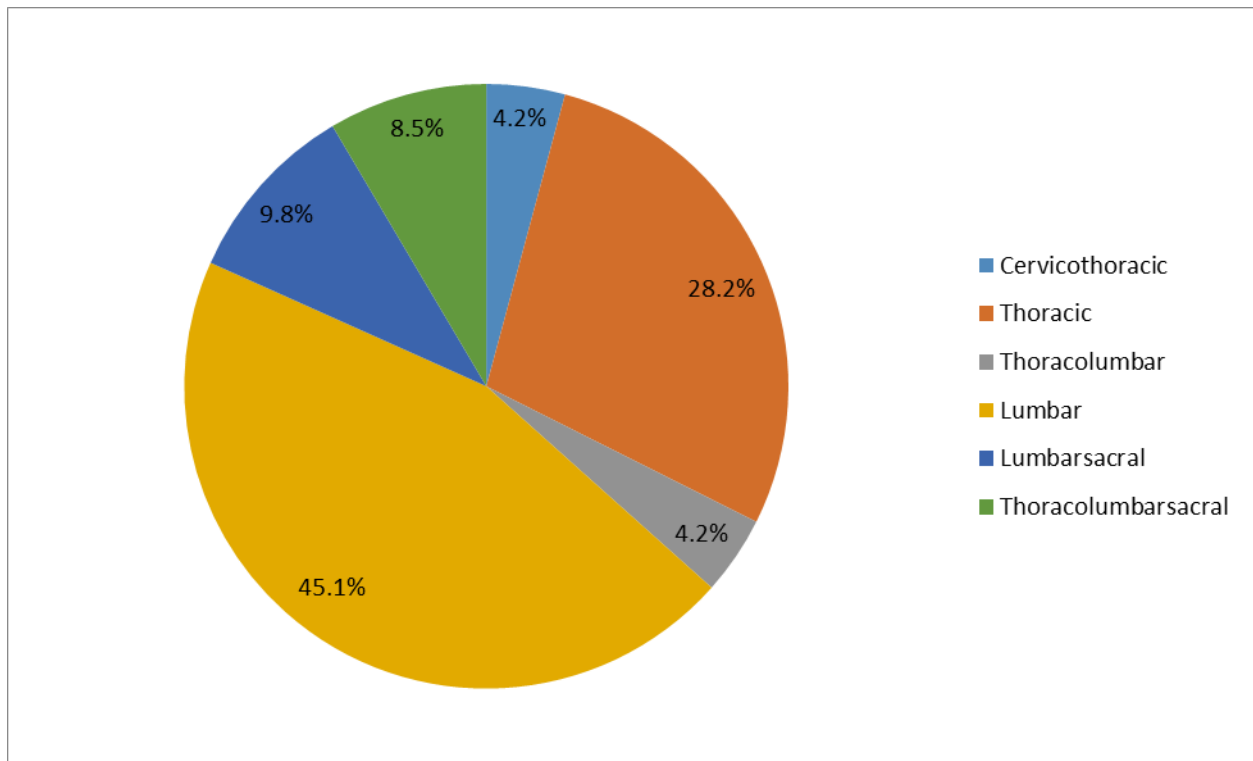
Figure 2: The most common anatomical location of ST in the spinal column of patients attended at KCMC (n=71).

Spinal tumors by tumor location

In cervicothoracic- meningiomas, osteoblastoma and epithelioid sarcoma 1(33.3%) each, thoracic, thoraco-lumbar and lumbar region- metastasis from the prostate, 5(10%), 2(66.7%) and 9(28.1%) respectively lumbosacral- metastasis from the prostate, breast and multiple myeloma 2(28.6%) each, disseminated in the thoracic- lumbar and sacral- multiple myeloma 3(50.0%), this is shown in **Table 8.**

Table 8: Spinal tumors by tumor location.

	Cervicothoracic	Thoracic	Thoracolumbar	Lumbar	Lumbosacral	Thoracic-lumbar-sacral	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	Total
Name of tumor	3 (4.2)	20 (28.2)	3 (4.2)	32 (45.1)	7 (9.9)	6 (8.5)	n (%)
Adenocarcinoma of prostate	0 (0.0)	5 (10.0)	2 (66.7)	9 (28.1)	2 (28.6)	1 (16.7)	16 (22.5)
Multiple myeloma	0 (0.0)	4 (20.0)	0 (0.0)	4 (12.5)	2 (28.6)	3 (50.0)	13 (18.3)
Invasive ductal carcinoma(breast)	0 (0.0)	5 (20.0)	0 (0.0)	4 (12.5)	2 (28.6)	0 (0.0)	11 (14.1)
Meningioma	1 (33.3)	2 (10.0)	0 (0.0)	1 (3.1)	0 (0.0)	0 (0.0)	4 (5.6)
Plasmocytoma	0 (0.0)	0 (0.0)	0 (0.0)	4 (12.5)	0 (0.0)	0 (0.0)	4 (5.6)

High grade serous carcinoma(ovary)	0 (0.0)	1 (5.0)	0 (0.0)	1 (3.1)	0 (0.0)	1 (16.7)	3 (4.2)
Neurofibroma	0 (0.0)	0 (0.0)	0 (0.0)	2 (6.3)	0 (0.0)	0 (0.0)	2 (2.8)
Adenocarcinoma of the colon	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.1)	0 (0.0)	0 (0.0)	1 (1.4)
Spinal cord lymphoma	0 (0.0)	1 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)
Epindymoma	0 (0.0)	1 (5.0)	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)
Renal cell carcinoma(kidney)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.1)	0 (0.0)	0 (0.0)	1 (1.4)
Myoepithelial carcinoma	0 (0.0)	1 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)
Osteoblastoma	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)
Hepato cellular carcinoma(liver)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (14.3)	0 (0.0)	1 (1.4)
Epithelioid sarcoma	1 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.4)

The spinal instability using SINS in patients with ST attended at KCMC

Among the study participants, 39 (54.9%) had potentially unstable SINS. Factors such as loss of sensation (p=0.021) and anatomical location (p=0.013) were associated with spinal instability. This is show on **Table 9 and 10**.

Table 9: Demographic characteristics of the study participants by SINS score (=71).

	SINS score				
	Stable	Potentially unstable	Unstable		
	n (%)	n (%)	n (58)	Total	
Characteristics	21 (29.6)	39 (54.9)	11 (15.5)	n (%)	p-value
Age (years)	61 (8 - 86)				
< 30	4 (19.1)	4 (10.3)	0 (0,0)	8 (11.3)	
30 – 60	8 (38.1)	12 (30.8)	7 (63.6)	27 (38.0)	
> 60	9 (42.9)	23 (58.9)	4 (36.4)	36 (50.7)	
Sex					
Male	13 (61.9)	23 (58.9)	4 (36.4)	40 (56.3)	
Female	8 (38.1)	16 (41.1)	7 (63.6)	31 (43.7)	0.387
Residence					
Rural	10 (47.6)	19 (48.7)	5 (45.5)	34 (47.9)	
Urban	11 (52.4)	20 (51.3)	6 (54.5)	37 (52.1)	0.999
Occupation					
Employed	9 (42.9)	10 (25.6)	5 (45.5)	24 (33.8)	

Unemployed	9 (42.9)	27 (69.2)	6 (54.5)	42 (59.2)	
Student	3 (14.2)	2 (5.1)	0 (0.0)	5 (7.0)	0.346
Education					
None	2 (9.5)	8 (20.5)	1 (9.1)	11 (15.5)	
Primary	8 (38.1)	12 (30.8)	4 (36.4)	24 (33.8)	
Secondary	9 (42.9)	15 (38.5)	4 (36.4)	28 (39.4)	
University	2 (9.5)	4 (10.2)	2 (18.2)	8 (11.3)	0.916
Smoking					
No	10 (47.6)	22 (56.4)	9 (81.8)	41 (57.8)	
Yes	11 (52.4)	17 (43.6)	2 (18.2)	30 (42.2)	0.171
Alcohol use					
No	5 (23.8)	9 (23.1)	2 (18.2)	16 (22.5)	
Yes	16 (76.2)	30 (76.9)	9 (81.8)	55 (77.5)	0.999

Table 10: Clinical characteristics of the study participants by SINS score (=71).

	SINS score				
	Stable	Potentially unstable	Unstable		
	n (%)	n (%)	n (58)	Total	
Characteristics	21 (29.6)	39 (54.9)	11 (15.5)	n (%)	p-value
• History of back pain					
No	1 (4.8)	1 (2.6)	0 (0.0)	2 (2.8)	
Yes	20 (95.2)	38 (97.4)	11 (100.0)	69 (97.2)	0.999
• lower limb paralysis					
No	2 (9.5)	4 (10.3)	0 (0.0)	6 (8.5)	
Yes	19 (90.5)	35 (89.7)	11 (100.0)	65 (91.5)	0.721
• Loss of sensation					
No	20 (95.2)	32 (82.1)	6 (54.6)	58 (81.7)	
Yes	1 (4.8)	7 (17.9)	5 (45.4)	13 (18.3)	0.021
• Loss of bowel and bladder functions					
No	10 (47.6)	19 (48.7)	6 (54.5)	35 (49.3)	
Yes	11 (52.4)	20 (51.3)	5 (45.5)	36 (50.7)	0.999
• Tumor location (spine location)					
Cervicothoracic	1 (4.8)	2 (5.1)	0 (0.0)	3 (4.2)	
Thoracic	9 (42.9)	8 (20.5)	3 (27.3)	20 (28.2)	
Thoracolumbar	2 (9.5)	1 (2.6)	0 (0.0)	3 (4.2)	
Lumbar	7 (33.3)	19 (48.7)	6 (54.6)	32 (45.1)	
Lumbosacral	2 (9.5)	5 (12.8)	0 (0.0)	7 (9.9)	
Thoracic lumbar & sacral	0 (0.0)	4 (10.3)	2 (18.2)	6 (8.5)	0.388

• Origin of the tumor					
Primary	6 (28.6)	5 (12.8)	2 (18.2)	13 (18.3)	
Secondary	15(71.4)	34 87.2)	9 (81.8)	58 (81.7)	
• Nature of the Tumor					
Benign	4 (19.1)	5 (12.8)	2 (18.2)	11 (15.5)	
Malignant	17 (80.9)	34 (87.2)	9 (81.8)	60 (84.5)	0.735
• Anatomical location					
Intramedullary	2 (9.5)	0 (0.0)	0 (0.0)	2 (2.8)	
Intradural	5 (23.8)	2 (5.1)	0 (0.0)	7 (9.9)	
Extradural	14 (66.7)	37 (94.8)	11 (100.0)	62 (87.3)	0.013
• History of surgery					
Biopsy	14 (66.7)	27 (69.2)	4 (36.4)	45 (63.4)	
Biopsy and laminectomy	5 (23.8)	8 (20.5)	2 (18.2)	15 (21.1)	
Biopsy and stabilization	2 (9.5)	4 (10.3)	5 (45.4)	11 (15.5)	0.101
• Treatment option					
Surgery	5 (23.8)	6 (15.4)	1 (9.1)	12 (16.9)	
Surgery and chemotherapy	16 (76.2)	33 (84.6)	10 (90.9)	59 (83.1)	0.679

Instability by SINS Score: Most of those with stable SINS, 14 (66.7%) had biopsy only. Most of those with potential instability, 27 (69.2%) had biopsy only while those with instability, 5 (45.4%) had biopsy and stabilization. This is shown on **Figure 3.**
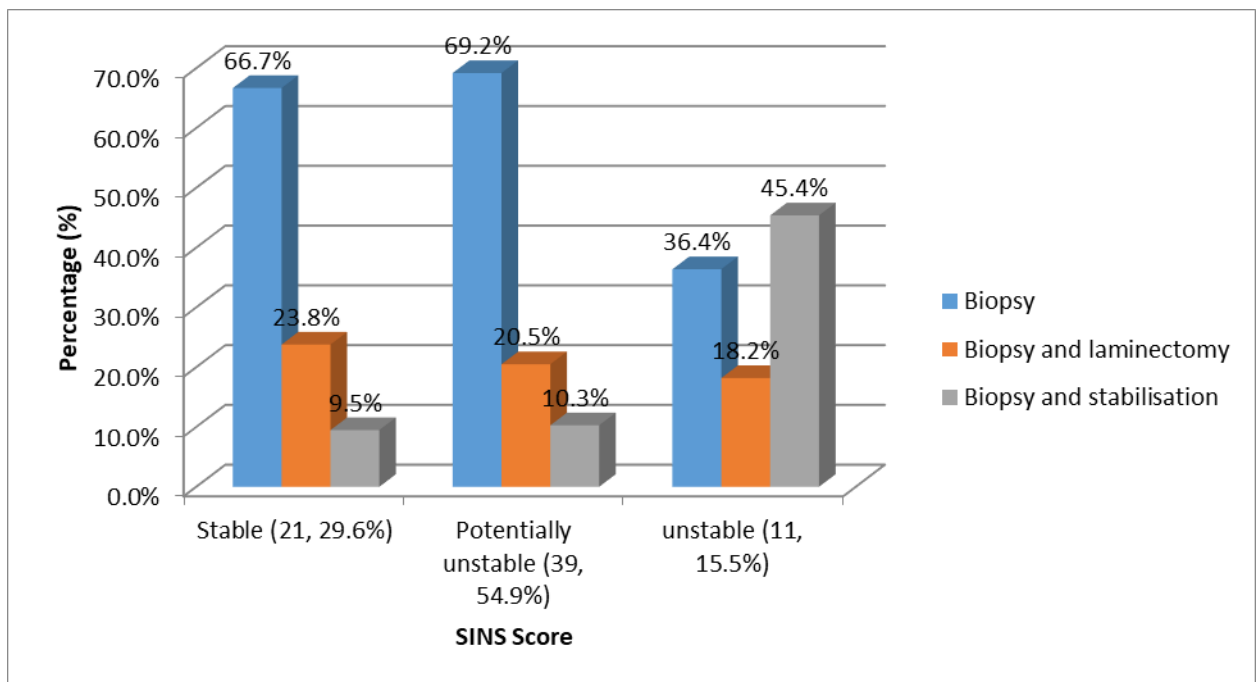
Figure 3: SINS score by surgery (n=71).

Histological pattern by SINS score (n=71): There is no association between histological pattern subtypes and spinal instability p-value 0.178

Table 11: Histological pattern by SINS score (n=71).

	SINS score				
	Stable	Potentially unstable	Unstable		
	n (%)	n (%)	n (%)	Total	
Tumor name	21 (29.6)	39 (54.9)	11 (15.5)	n (%)	p-value
Adenocarcinoma of the prostate	9 (42.9)	12 (30.8)	2 (18.2)	23 (32.4)	
Multiple myeloma	2 (9.5)	9 (23.1)	2 (18.2)	13 (18.3)	
invasive ductal carcinoma(breast)	3 (14.3)	6 (13.9)	2 (18.2)	11 (15.5)	
Meningioma	4 (19.0)	0 (0.0)	0 (0.0)	4 (5.6)	
Plasmocytoma	0 (0.0)	2 (5.1)	2 (5.015)	4 (5.6)	
High grade serous carcinoma(ovary)	1 (4.8)	2 (5.1)	0 (0.0)	3 (4.2)	
Neurofibroma	0 (0.0)	2 (5.1)	0 (0.0)	2 (2.8)	
Metastatic carcinoma of the colon	0 (0.0)	0 (0.0)	2 (18.2)	2 (2.8)	
Spinal cord lymphoma	0 (0.0)	2 (5.1)	0 (0.0)	2 (2.8)	
Epindymoma	2 (9.5)	0 (0.0)	0 (0.0)	2 (2.8)	
Renal cell carcinoma(kidney)	0 (0.0)	1 (2.5)	0 (0.0)	1 (1.4)	
Myoepithelial carcinoma	0 (0.0)	0 (0.0)	1 (9.1)	1 (1.4)	
Osteoblastoma	0 (0.0)	1 (2.5)	0 (0.0)	1 (1.4)	
Hepato cellular Carcinoma(liver)	0 (0.0)	1 (2.5)	0 (0.0)	1 (1.4)	
Epithelioid sarcoma	0 (0.0)	1 (2.5)	0 (0.0)	1 (1.4)	0.178

Discussion

Socio-demographic and clinical characteristic of the participants

This study was carried to determine the histological pattern, anatomical location and spinal instability of patients with spinal tumors attended at Kilimanjaro Christian Medical Centre from Jan 2018 to Aug 2021. A total of 71 participants were reviewed retrospectively among those the median (range) age of the study participants was 61 (8 – 86) years, this was also observed in South E. Nigeria [1]. Majority of the study participants; 36 (50.7%) were aged > 60 years, 40 (56.3%) were males, 37 (52.1%) were residing in urban areas, 42 (59.2%) were not employed, 28 (39.4%) had secondary education, 41 (57.8%) were not smoking, also a study done in USA [2] found that most of the patients were smoking compared to this study because in those studies majority were males. 55 (77.5%) were taking alcohol. Similar presentation was observed in studies done in Turkey, S.E. Nigeria and Nigeria [3-5]. Also this study on the other hand, found that 69 (97.2%) had history of back pain, 65 (91.5%) had lower limb weakness, 58 (81.7%) had loss of sensation, 36 (50.7%) had loss of bowel and bladder function, 45 (63.4%) had undergone biopsy, 59 (83.1%) had surgery and chemotherapy as treatment option, similar findings were observed in studies done in Nigeria, S.E Nigeria, India, Korea, China, Turkey and USA

[6-14]. This was very true because patients with spinal tumors ussually presents with compressive symptoms such as incontinance, paresis, paralysis, hyposthnesia and biopsy is a gold strandard diagnostic means to identify spinal tumors.

Histological pattern of spinal tumors

Regarding histological pattern this study found that, 58 (81.7%) had secondary, 60 (84.5%) were malignant and 62 (87.3%) had extradural spinal tumors. It was also similarly observed in studies done in Nigeria, S.E. Nigeria, Turkey, China and USA [15-20]. Large proportion of the spinal tumors, 23 (32.4%) were metastasis from prostate, 13 (18.3%) were multiple myeloma and 11 (15.5%) were metastasis from breast, same observations were seen in studies done in Australia, USA [20-22]. Different observations were seen in a study done in USA [23,24], where metastases from the Lungs 17.3% was predominantly and this was because most of the participants were males and had a history of smoking. Also this study depicted that there is strong association between age and Spinal Tumor originality (p- value 0.002), nature of the tumor (p- value 0.017) and anatomical location (p- value 0.001) and primary ST seen in age group < 30yrs 6(46.2%), secondary ST are seen in >60yrs 33(56.9%), benign ST <30yrs 4(36.4%), malignant ST >60yrs 33(55.0%), intramedullary ST <30yrs 2(100%), intradural ST <30yrs 4(57.1%) and extradural ST 35(56.5%) seen in age group >60yrs. Similar observations were seen in studies done in Australia, USA primary ST in younger and secondary ST in older age [25-27] also malignant ST and extradural in origin were observed in older age in studies done in Nigeria, Korea, Turkey and USA [29-34], this is very true because most of the malignancies do occurs as we age and most of the primary spinal tumors are rare hence when they are diagnosed usually it is very late. Regarding tumor originality, most of those primary ST, 4 (30.8%) were meningiomas and 4 (30.8%) was plasmocytoma. Among those secondary ST, 23 (39.7%) were metastasis from prostate and 13 (22.4%) had multiple myeloma. This was seen in studies done in Nigeria, Korea, Turkey and USA [35], where meningioma predominantly, contrary to this study, studies done in USA and Turkey found that Hemangioma primary ST was predominantly, this is because in those studies a large sample size was used. Index study also found out most of benign ST, 4 (57.1%) were meningiomas. Among those malignant 23 (35.9%) were metastasis from prostate and 11 (17.2%) were metastasis from breast. This was also observed in several studies done in Nigeria, Turkey, Australia, Singapore, German and USA, Benign ST- meningioma were the most common and Malignant ST were observed to be metastases from other parts of the body. Different observations were seen in a study done in USA, and observed that the most common benign ST was aneurysm bone cyst; this was because most of the patients were in a young age group and small sample size was used.

Common anatomical location

All intramedullary ST, 2(100.0%) were epindymomas. Intradural STs 4 (57.1%) were meningiomas. Those extradural ST 23(25.8%) were metastasis from prostate and 13 (20.9%) were multiple myeloma, other similar studies with the same findings were observed in studies done in S.E. Nigeria, Turkey, Australia, Singapore and German, where most common Intramedullary ST was epindymomas, intradural ST was meningioma and extradural ST were metastases from other sites. Contrary to these findings different results were seen in a study done in Nigeria, and found that in intramedullary STs, astrocytomas were predominant. Again regarding the most common location of the spinal tumors was lumbar 32 (45.1%) followed by thoracic 20 (28.2%). This was also similar in studies done in Turkey, where Lumbar region was also predominantly, but different findings were seen in studies done in Nigeria, Turkey, India and USA, where it was observed the thoracic region being

predominantly, this was due to either use of small or large sample size, female ratio was high hence breast metastases were high, and also primary ST tumors only were analyses. Also in cervicothoracic region meningiomas, osteoblastoma and epithelioid sarcoma 1(33.3%) each, thoracic, thoraco-lumbar and lumbar region metastasis from the prostate, 5(10%), 2(66.7%) and 9(28.1%) respectively lumbosacral region metastasis from the prostate, breast and multiple myeloma 2(28.6%) each and disseminated in the thoracic- lumbar and sacral- multiple myeloma 3(50.0%). This was observed in studies done in Nigeria, Turkey, Eastern China and USA.

Spinal instability by SINS

Index study found that, there is no association between histological pattern subtypes and spinal instability p-value 0.178, which is very true as in there is no any tumor subtypes that can predict the risk of getting tumor related spinal instability. Regarding SINS among the study participants, 39 (54.9%) had potentially unstable SINS. Same observations were seen in studies done in Singapore, Netherlands and Canada, where potentially unstable SINS predominantly. Factors such as loss of sensation (p=0.021) and anatomical location (p=0.013) were associated with spinal instability, this was also observed in study done in USA by Hussain, I. *et al.* (2018). Also most of those with stable SINS, 14 (66.7%) had biopsy only. Most of those with potential instability, 27 (69.2%) had biopsy only while those with instability, 5 (45.4%) had biopsy and stabilization. Similar studies done in Singapore, Netherlands and Canada, observed that most of the participants' in unstable SINS category stabilization surgery was done, but contrary to this study different studies done in Australia and USA, found that, most patients had potentially unstable SINS and stabilization was done, this was because SINS was employed as a means to decide whether patients needed stabilization surgery or not, but in our study these patients with potentially instability biopsy and decompression laminectomy was done regardless of a risk of instability this was because of no effective means of assessing instability, socio-economical factors and late presentation to the hospital hence biopsy only and palliation.

Limitation and strength of the study

• **Strength**

1.   Both primary and secondary ST was included.

2.   All age groups were involved.

• **Limitations**

1.   Missing of some patient's histological and radiological findings.

2.   Improper documentation in both orthopedics theatre book biopsy registry and pathology registry.

Conclusion

• This study found that, secondary spinal tumors were predominant, most of them being malignant, affecting the adult population, a large number being metastases from the prostate in males and breast in females.

• Also primary spinal tumors were few, most of them being benign affecting the young age group. Meningiomas were observed to be the most common histological subtypes.

• On the other hand, the most affected anatomical site was observed to be the lumbar region and most of the spinal tumors were extradural in origin.

- Most patients fell in the category of potentially unstable by SINS and it was observed that majority had a history of surgery where biopsy only was done, few biopsy and decompression laminectomy and a smaller number biopsy, laminectomy and stabilization was done.

Recommendation

- Screening of adult population for metastatic spinal tumours; prostate cancer for males and breast cancer for females, of which, both, the prostate and breast cancer were found be predominant in this study.
- Early and accurate diagnosis and classification of primary spinal tumours and therefore proper management despite of their low occurrence and most of them affecting young population and are benign.
- Use of SINS (Spinal Instability Neoplastic Score) in categorizing patients with tumour related instability with the score of 7-12 (potentially unstable) and above for stabilization to prevent or treat instability.

Author Contribution

PMM was involved in the conception, study design, acquisition and interpretation of data, and drafting of the manuscript. HHM supervised and reviewed the whole research work, AJP, FNM, HRM, EGM and RJT reviewed the research work. AM and FJS helped in the acquisition of histological results, MSN was involved in the acquisition of clinical data at the hospital. All the authors read and approved the final manuscript.

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