ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2017; 3(5): 387-395
www.allresearchjournal.com
Received: 25-03-2017
Accepted: 27-04-2017

Dr. Sweta Meena
MD Pathology, Presently Working as Consultant Pathologist at Curewell Diagnostic Centre, Alwar, Rajasthan, India

Dr. Sandhya Bordia
Professor at RNT Medical College, Udaipur, Rajasthan, India

Correspondence
Dr. Sweta Meena
MD Pathology, Presently Working as Consultant Pathologist at Curewell Diagnostic Centre, Alwar, Rajasthan, India

Efficacy of fine needle aspiration cytology in the diagnosis of bone lesions with two year prospective study

Dr. Sweta Meena and Dr. Sandhya Bordia

Abstract
Lesions of the skeleton develop in all age groups, affect any bone in the body and can be benign or malignant. Bony lesions have a broad spectrum of findings and are infrequently encountered in routine surgical pathology. Traditionally, at most institutions diagnostic tissue from bone tumors have been obtained from open and incisional biopsies which provide enough morphologic architecture to analyze, even though the process is time consuming and is associated with intraoperative and postoperative complications. This can be replaced by fine needle aspiration cytology, which is a simple and economical technique, performed as an outpatient procedure.A prospective study to evaluate the efficacy of fine needle aspiration cytology in the diagnosis of bone lesions was undertaken in the Department of Pathology, RNT Medical College Udaipur. Patients were clinically and radiologically suspected of bone tumour of orthopaedic department of MB Hospital Udaipur Rajasthan.
41 Aspiration of the bone lesions were done during the period of two year. In our study adequate material obtained in 40 cases out of 41 cases for analysis of cytological examination (97.56%).Histopathological correlation was possible in 22 patients. In two patient of myeloma, cytology was correlated with serum electrophoresis. Present study showed 87.50% specificity, 93.75% sensitivity and efficacy of 91.66% for detecting malignant bone tumours. These statistical values indicate the clinical utility of fine needle aspiration cytology in detecting the malignant bone tumours.

Keywords: Fine needle aspiration cytology - bone tumors and tumor-like lesions - diagnostic sensitivity

1. Introduction
Bone lesions were amongst the first pathologic abnormalities to be histologically diagnosed by percutaneous biopsy [1]. In 1931 Coley *et al*, reported 35 cases of bone tumours diagnosed by means of needle aspiration biopsy with a successful rate of 70-90%. 3 years later Martin and Ellis reported a series of 1405 cases, diagnosed with aspiration biopsy, of which 140 were bone tumours [2]. Lesions of the skeleton develop in all age groups, affect any bone in the body and can be benign or malignant. Bony lesions have a broad spectrum of findings and are infrequently encountered in routine surgical pathology. The key to their accurate recognition is the utilization of an integrated approach that assesses and correlates the clinical, radiographic, morphologic and biologic behaviour [3]. open and incision biopsies replaced by fine needle aspiration cytology, which is a simple and economical technique, performed as an outpatient procedure [5]. Contrary to the apprehension that bone is a hard tissue, impenetrable to fine needle, most of the bony lesions are associated with variable cortical destruction and soft tissue extension, hence can be reached [6]. Imaging technique like computed tomography and USG guided FNA can enhance the cellular yield by localizing the lesion [7]. Spinal lesions with life threatening cord compression are a medical emergency and fine needle aspiration biopsy can rapidly resolve the differential diagnosis between osteomyelitis, metastases, malignancy and lymphoproliferative lesions.
Although large lesions can be easily aspirated without image guidance, many lesions may benefit from image guidance to improve the accuracy of targeting lesion and improve the diagnostic yield from subsequent microscopic examination. FNAC was used in this study to examine its role in a detailed cytodiagnosis of bone lesions, its utility in preoperative diagnosis and its impact on therapeutic decisions.

Material & methods

Patients were clinically and radiologically assessed taking a brief history and informed consent. Inflammatory bone lesions and lesions with compact bone around them were excluded from the study as the needle cannot penetrate the thick sclerotic bony lesion. Some patients with a deep-seated bony lesion were referred for image guided aspiration.

Material

Fine needle aspiration sampling: It is a simple procedure and requires:-

1. Spirit swabs
2. Glass slides and cover slips
3. Disposable 10 millilitres syringes with 20-22 gauze needles
4. 95 percent ethanol for fixation
5. May - Grunwald - Giemsa stain
6. Microscope

Aspiration Sampling

Cleaning the skin overlying the lesion with spirit swab. A syringe with needle (21 or 22 gauze) and plunger in resting position was used for aspiration. The needle was then inserted into the swelling without any negative pressure in the syringe. When the needle tip had entered in the target area, the plunger was retracted, thus creating a low vacuum in the syringe and needle lumen. While the vacuum was maintained, the needle was moved back and forth at varied angles in order to obtain adequate cellular samples. The plunger was then released to eliminate the vacuum in order to reach pressure equilibrium in the system. The needle was withdrawn from the lesion and it was detached from the syringe. The plunger was slightly retracted to allow air inside the syringe. The needle contents were blown out on the glass slides by pushing the plunger, with the needle tip in touch with the glass slide. The aspirate was smeared with another slide by exerting slight pressure.

Five or six smears were prepared. The smears were then air dried. These air dried smears were stained by May-Grunwald-Giemsa stain.

May-Grunwald - Giemsa staining (Zajicek and Eneroth, 1970)

Result: Nuclei- BlueCytoplasm- Pink to red Whenever the biopsy was received in the department, it was routinely processed to obtain paraffin sections which were stained by H & E. Histopathologic study was done independently. The findings were recorded in a proforma. Results of cytological and histopathologic studies were later correlated to evaluate the efficacy of fine needle aspiration cytology.

FNAC results were classified in to the following categories; true negative (absence of malignancy correctly diagnosed); true positive (presence of malignancy correctly diagnosed); false negative (the cytological specimen failed to diagnosed a malignancy); and false positive (the cytological specimen was incorrectly considered or suspect of malignancy).

Study design included a comparison between results of FNAC with final histopathological diagnosis. Data analysis was based on galen and gambino method which calculates sensitivity and specificity of FNAC in differentiating between benign and malignant lesion.

TP - True positive FP - False positive

TN – True negative FN - False negative

1. False positive error ratio = $\frac{FP}{Total\ No.\ Of\ cases} \times 100$
2. False negative error ratio = $\frac{FN}{Total\ No.\ Of\ cases} \times 100$
3. Sensitivity = $\frac{TP}{TP + FN} \times 100$
4. Specificity = $\frac{TN}{TN + FP} \times 100$
5. Positive predictive value = $\frac{TP}{TP + FP} \times 100$
6. Negative predictive value = $\frac{TN}{TN + FN} \times 100$
7. Efficacy = $\frac{TP + TN}{TP + FP + FN + TN} \times 100$

These statistical values indicate the accuracy of the procedure.

Results

A prospective study to evaluate the efficacy of fine needle aspiration cytology in the diagnosis of bone lesions was undertaken during the period of 18th September 2012 to 20th September 2014.

Main features observed in the present study were – 41 Aspiration of the bone lesions were done during the period of two year. Age of the patients having bone tumours varied from 10 years to 75 years and 41.46% patients belonged to the age group of 10-29 years. Male to female ratio of bone tumours was 1.4:1.

80.49% cases had solitary lesion and 19.51% cases had multiple lesions. Most common site affected was iliac bone, after then upper end of tibia. There were no complications following the aspiration technique.

Table 1: Showing the Distribution of Lesions

Multiple Lesions	No. of Patients	Percentage
I. Multiple lesions	8	19.51%
II. Solitary lesions	33	80.49%
U.E. femur	3	7.32%
L.E. femur	3	7.32%
U.E. Tibia	4	9.76%
L.E. tibia	2	4.88%
U.E. Humerus	2	4.88%
Shaft humerus	1	2.44%
LE radius	1	2.44%
Scalp	2	4.88%
Mandible	1	2.44%
Maxilla	1	2.44%
Temporal bone	1	2.44%
Clavicle	2	4.88%
Scapula	1	2.44%
Sternum	1	2.44%
Iliac bone	6	14.63%
Sacrum	2	4.88%
Total	41	100%

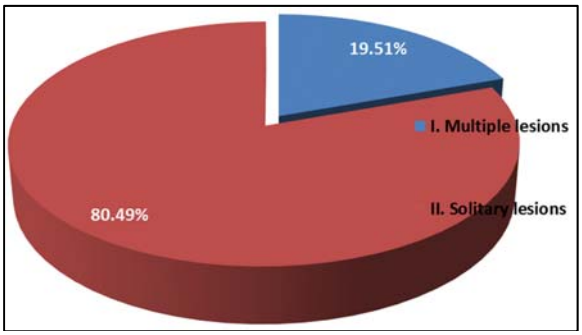


Fig 1: graphical representation:- Showing Incidence of multiple and solitary lesion.

Among 41 patients aspirated, cytology revealed malignant bone tumours in 24 patients (58.54%), benign bone tumour in 10 patients (24.39%) and tumour like lesions in 1 patient (2.44%). While in 1 patient (2.44%) diagnosis was inconclusive, in 3 patient (7.32%) diagnosis were infective. Two patients (4.88%) were categorized as other lesions which were organized hematoma and mucocele.

Table 2: Showing Incidence of Benign, Malignant and Other Lesions

		No. of Case	Percentage
	Benign Lesions	10	28.57%
1.	Chondrogenic tumour enchondroma	1	10%
2.	Osteogenic tumours Osteoid osteoma Osteoblastoma	2 1 (50%) 1 (50%)	20%
3.	Giant cell tumour - Giant cell tumour	5	50%
4.	Odontogenic tumour - ameloblastoma	1	10%
5.	Benign fibrohistiocytic tumour	1	10%
	Malignant lesions	24	68.57%
1.	Osteogenic tumours - osteosarcoma	1	4.17%
2.	Chondrogenic tumour Chondrosarcoma	1	4.17%
3.	Ewing's sarcoma / pnet –	3	12.50%
4.	Round cell tumour	4	16.67%
5.	Hematopoietic tumours - myeloma	3	12.50%
6.	Metastatic malignancy	12	50.00%
	Tumour like Lesions	1	2.86%
1.	Fibrous dysplasia	1	100%

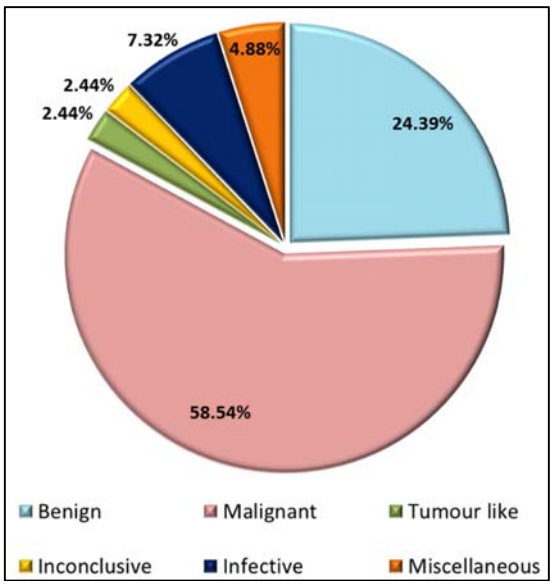


Fig 2: graphical representation:- Showing Incidence of Benign, Malignant and Other Lesions

Commonest type of bone tumours encountered were matastetic tumours (34.28%) followed by giant cell tumours (14.28%) and round cell tumours (11.42%). Among benign cartilaginous lesions one case of enchondroma was diagnosed. In benign osteogenic tumours one case of osteoid osteoma and one case of osteoblastoma was diagnosed. Biopsy was done in one case of osteoid osteoma and diagnosis was given respectively. Benign Fibrohistiocytic tumour was encountered in one patient cytologically. Giant cell tumours were encountered in 5 patients. Biopsy was possible in 4 cases and was consistent with the cytological diagnosis. Among the 24 cases of malignant tumours 1 case was diagnosed as osteogenic osteosarcoma, 1 case was diagnosed as chondrosarcoma. 3 patients of Ewing's sarcoma were cytologically diagnosed of which only one was biopsied and showed histopathologic, and IHC confermation. Among hematopoietic tumours, 2 patients were cytologically dignosed as myeloma.1 patients was diagnosed as solitary plasmacytoma, correlating with clinical, radiological, histological and electrophoresis findings. Round cell tumour was diagnosed in 4 (11.42%) cases cytologically. Ameloblastoma diagnosed in one

patient, cytologically. Fibrous dysplasia diagnosed in one patient cytologycally. Metastatic malignancy was encountered in 12 patients which included 4 patients of adenocarcinoma and 2 patient of squamous-cell carcinoma.

Table 3: Showing the FNAC Procedure

Aspiration	No. of Patients	Percentage
Guided	10	24.39%
USG	7 (70%)	
CT	3 (30%)	
Non Guided	31	75.61%
Total	41	100%

In our study adequate material obtained in 40 cases out of 41 cases for analysis of cytological examination (97.56%). Histopathological correlation was possible in 22 patients. In two patient of myeloma, cytology was correlated with serum electrophoresis. Of the 24 cases proved by histopathology and serum electrophoresis, cytological diagnosis was confirmed in 22 cases giving an accuracy of 91.67%.

Discussion

Among 41 patients aspirated, cytology revealed malignant bone tumours in 24 patients (58.54%), benign bone tumour in 10 patients (24.39%) and tumour like lesions in 1 patient (2.44%). Enchondroma is a benign hyaline cartilage neoplasm of medullary bone, accounting for 10-25% of all benign tumours. Most tumours are solitary [8]. In our study one case was diagnosed as enchondroma which is constituted 10% of all the benign tumour. Enchondromas of the hands and feet are typically palpable and sometimes painful tumours. Our case was 32 year old male having a lesion at lower end of femur. Cytologically smear was moderately celluler and cells were small and uniform, few cells were seen in lacune in the background of chondromyxoid material. Osteid osteoma and osteoblastoma are benign osteoblastic tumours with overlapping radiographic and histological features [9]. Osteid osteoma has distinctive clinical features and is almost never referred for fine needle aspiration cytology. Due to the reactive, sclerotic bone surrounding the osteoma nidus this lesion is anyhow not suitable for FNAC. Osteoblastoma is a rare benign tumour (<1% of bone Tumours) [9]. Most patients are between 10 and 30 years of age and predilection sites are the spine and sacrum (up to 50% of cases), of other sites, the proximal and distal femur and proximal tibia are the most frequent. The vast majority of osteoblastomas are intra-osseous tumours. In our study one case diagnosed as osteoid osteoma and one case was diagnosed as osteoblastoma which constitute 20% of all benign tumours. Another case of osteoid osteoma in our study was non diagnostic due to lesion was very sclerotic. Later it was diagnosed by histological examination. In our study one case was diagnosed as benign fibrohistiocytic tumour. On microscopy, cellularity was moderate with presence of isolated and clumps of fibroblastic cells with clumps of histiocytic cells. Other fibrohistiocytic and fibroblastic tumours of bone, including malignant fibrous histiocytoma, giant cell tumour, fibrosarcoma, and desmoplastic fibroma can be differentiated on radiological and histological features, and hyperparathyroidism may need to be excluded by biochemical investigations.

Giant cell tumour represents approximately 20% of benign primary bone tumours. In our study it constituted 14.28% of all the bone tumour aspirated, and 50% of the benign primary bone tumour. Majority of cases microscopically showed bimodal population of cell dispersed singly. Mononuclear cells were oval to spindle shaped with vesicular chromatin and scanty to moderate cytoplasm. Osteoclastic giant cells were attached to cell clusters forming a checkerboard pattern, which is characteristic of giant cell tumour and helps to exclude other giant cell containing lesions [10]. Classically the nuclei of mononuclear cells resembled the nuclei of osteoclastic giant cells. Mild atypia and mitoses can be seen as was seen in one of our cases.

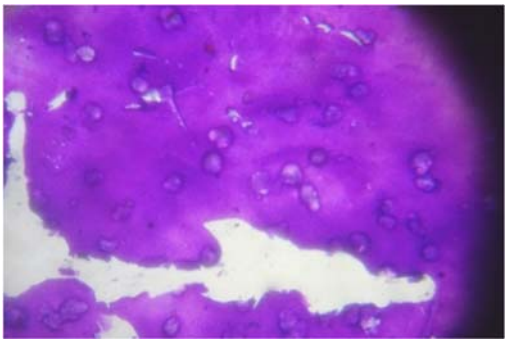
The diagnostic accuracy of fine needle aspiration cytology of giant cell tumour of bone has been described in literature to be 88-100%. Our study revealed 100% diagnostic accuracy of FNA diagnosis of giant cell tumour, (Table – 1).

Table 1: Showing Diagnostic Accuracy in Giant Cell Tumour

Study	No. of Aspirates	Biopsy	True +Ive	Accuracy
Pai *et al* [6]	21	15	15	100%
Jorda *et al* [5]	14	14	13	93%
Agarwal *et al* [11]	50	45	40	88%
Our study	5	5	5	100%

Enchondroma

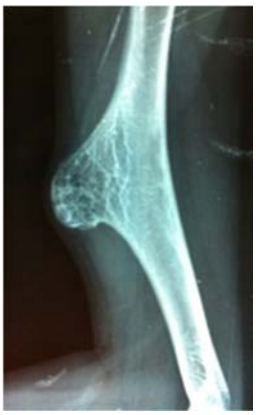
Cytology smear showing, uniform small cells in the background of chondromyxoid material. Few cells are seen in lacunae. (MGG, 400X).



Osteoblastoma

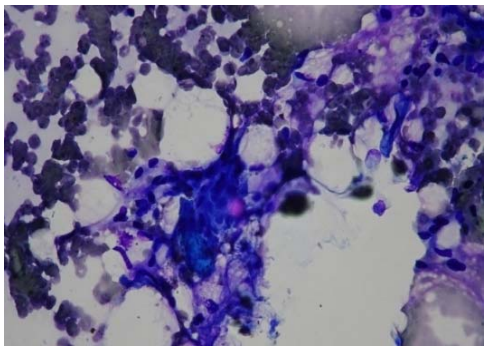
Radiograph: 10 yr old female child revealed well circumscribed expended, mixed type lesion with thinning of cortex of diaphysis of Humerus bone

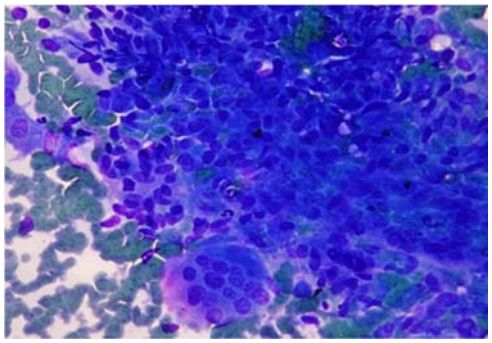
Cytology smear: moderate cellularity, osteoblast like cells are seen alone as well as in small clusters in the background having RBCs and calcification (MGG, 400X)

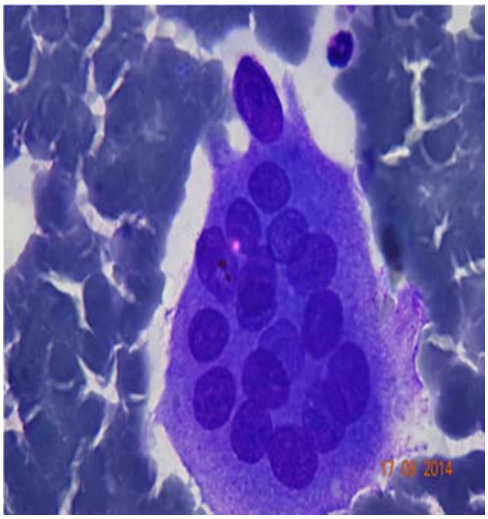


Gaint cell tumour

Cytology smear: highly cellular smear, bimodel population of cells comprising of spindle cells and mononuclear round cells with many osteoclastic gaint cells. (MGG, 400X). A osteoclastic gaint cell (MGG, 1000X).







Chondrosarcomas are a heterogeneous group of cartilaginous malignant tumours. They are the second most common of the primary bone sarcomas, up to 27% of primary bone sarcomas are chondrosarcomas in the published series. Primary chondrosarcoma is rare before the age of 45, and most appear in patients between 50 and 80 years of age. The most common sites are the pelvic bones and the extremities. Rare sites include spine, craniofascial bones and the small bones of the hands and feet. In our study one case was diagnosed as chondrosarcoma in 66 year old male, site was metaphysis of upper end of femur. Cytologically Grade 1 and 2 tumours shows Fragments of hyaline cartilage of variable size appear and have variable cellularity. There is a myxoid background matrix. Single cells are infrequent Mono- and binucleated rounded cells with well defined cytoplasm are seen, often in lacunae. Threre is slight to moderate cellular atypia and rarely mitoses. Grade 3 tumours (high-grade) shows abundant myxoid background matrix and relatively few fragments of hyaline cartilage, which are often highly cellular. Many dispersed tumour cells are seen. There is marked cellular and nuclear pleomorphism with prominent nucleoli and occasional mitosis. The most important diagnostic features common to all published series are the presence of hyaline cartilaginous fragments together with a myxoid background matrix. Cartilaginous fragments and matrix stain strongly red/blue and violet in MGG.

Osteosarcoma is the most common primary malignant tumour of bone. But In our study it constituted 2.85% of all bone tumours and 4.16% of all primary malignant neoplasm. Cytologically smear has Heterogenous population of cells consisting of ovoid, spindle and round cells having hyperchromatic nuclei with moderate anisonucleosis were seen in the background rich of osteoid matrix. On cytomorphology, osteosarcoma have been categorized as pleomorphic (malignant fibrous histiocytoma like), epithelioid, small cell, chondroblastic and mixed types [12]. However, in the present study only one case was diagnosed as osteosarcoma which was osteogenic variant of osteosarcoma made.

The presence of osteoid in FNAC smears has been variously reported to be between 35% to 40% [13]. Tumour osteoid was present in our cases (Table-2). alkaline phosphatase activity and presence of osteoid increases the accuracy of diagnosis [14].

Table 2: Showing Cytological Presence of Osteoid in Osteosarcoma

	No. of Positive cases	Osteoid in No. of Cases	Percentage
White *et al* [12]	45	16	3 5.55%
Bhatia *et al* [14]	59	12	34%
Our case	1	1	100%

Sometimes it is difficult to differentiate osteoid and chondroid matrix especially in wet fixed smears where both appear as hyaline pale violet material, however in MGG stained smears osteoid appears as clumps of amorphous bright pink intercellular material whereas chondroid matrix appears as a fine fibrillary intensely red purple matrix in the background [15].

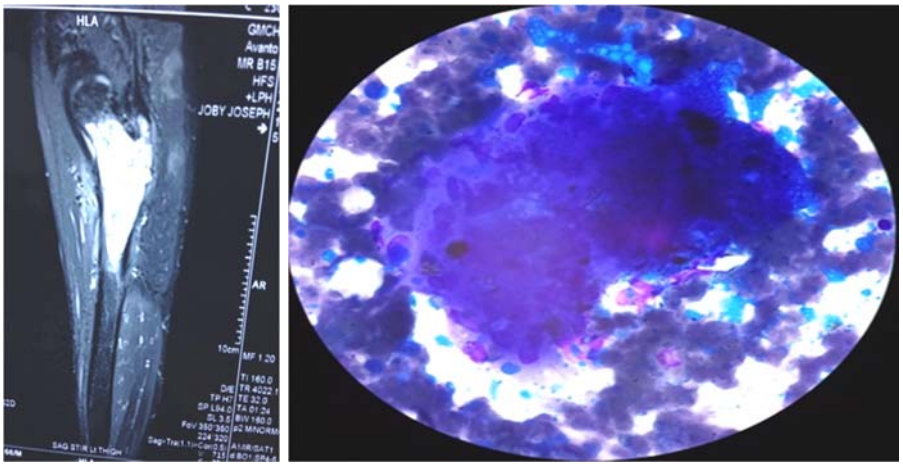
Table 3: Showing Diagnostic Accuracy in Osteosarcoma

	No. of Patients	Biopsy	True +ve	Percentage
Pai *et al* [6]	15	13	11	84.6%
Agarwal *et al* [11]	19	17	15	88.25%
Our study	1	1	1	100%

Chondrosarcoma

Radiograph: 66 yr old male revealed heterogeneous enhancing mass, extend metaphysis to medullary cavity in upper end of femur.

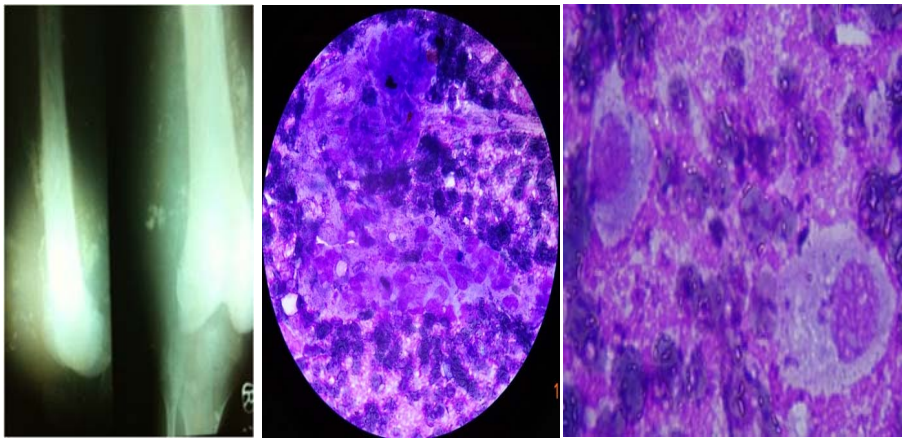
Cytology smear: moderate cellularity, hyaline cartilaginous fragment with uniform cells in lacunae having atypical nuclei. (MGG, 400X).



Osteosarcoma

Radiograph: 15 yr old female revealed large destructive lesion, periosteal reaction with sun ray appearance of lower end of femur.

Cytology smear: moderate cellularity, pleomorphic cells are arrange singly and in loosely cohesive clusters (MGG, 400X). Tumour cells having rounded nuclei and variable amount of cytoplasm. Background having abundant osteoid matrix. (MGG, 1000X).



Ewing's sarcoma is a malignant round cell tumour of bone, usually found in persons in the second decade of life. Cytologic smear in Ewing's sarcoma as a rule reveals better cytologic detaile than routinely processed histopathological sections[6]. Smears were moderately to highly cellular composed of monotonous population of round cells arranged in loosely cohesive clusters and forming perivascular pallisades at places, as reported in literature[16]. The cell borders were indistinct and the cytoplasm was scant. A dark and light cell effect was seen with occasional nuclear moulding. However nuclear grooving, indentation and folding were not seen which is present in atypical variants [16].

Rosette formations were seen in the all 3 case of our study which constitutes 12.50% of malignant tumours. It is not possible to distinguish Ewing's sarcoma from PNET on cytology; however a tumour showing extensive rosette formation is likely to be PNET, [13]. Background was fibrillary due to cytoplasmic fragility. It suggests the tendency of cells to remain cohesive and probably reflects the presence of immature or rudimentary intercellular junction as seen with electron microscopy [16].

Classically lymphoma, embryonal rhabdomyosarcoma, neuroblastoma, oat cell carcinoma and small cell osteosarcoma have to be considered in differential diagnosis One patient of Ewing's sarcoma was confirmed by histopathology and immunohistochemistry. The diagnostic accuracy in our case was 100% as with other studies (Table-4).

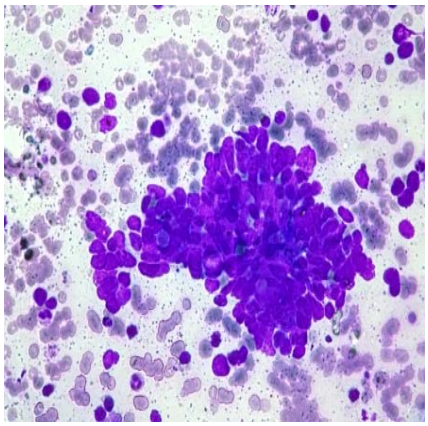
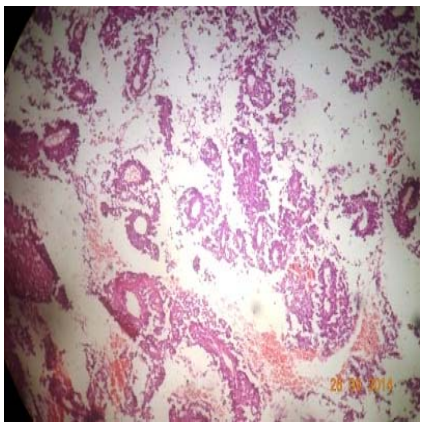
Table 4: Showing Diagnostic Accuracy in Ewing's Sarcoma/PNET

Study	Diagnostic Accuracy
Pai *et al* [6]	100%
Agarwal *et al* [11]	96.9%
Our study	100%

Ewing's sarcoma

Cytology smear: Dual population of cells forming rosette. Small Cells having hyperchromatic nucei, scanty cytoplasm, inconspicuous nucleoli. Large cells having pale staining and moderate cytoplasm. (MGG, 400X).

Histology: slide showing the small round cells, forming rosettes. (H&E, 100X)

Malignant small round cell tumours are characterised by small, round, relatively undifferentiated cells. These are also called small round blue cell tumours as the cells are blue, in the sense that they have single hyper chromatic nucleus having finely granular, evenly distributed chromatin. Nucleoli can be unapparent, small, or quite prominent. The cytoplasm is generally scanty, resulting in a very high nuclear to cytoplasmic ratio. In our study 4 cases were diagnosed as small round cell tumour which constitutes 16.67% of all malignant tumours. In all cases cytological smear were highly cellular giving accuracy 100%. Multiple myeloma is a neoplastic proliferation of plasma cells primarily occurring in bone marrow. The disease is slightly more frequent in males than females. In the present study 2 patient of multiple myeloma and 1 patients of solitary plasmacytoma were encountered.

The patients of multiple myeloma, fulfilled the criterion laid down by WHO like plasmacytoma on biopsy, marrow plasmacytosis >10%, presence of M-band and osteolytic bony lesions in the skull and pelvic bones. The other 1 patient being solitary plasmacytoma later diagnosed by histopathological examination. Plasmacytoma and multiple myeloma are usually recognized by aspiration cytology. It is reported that they often bleed heavily and yield scant cellularity [17]. But none of our patients bleed and the aspirate smears were moderate to highly cellular, composed of homogenous population of mature and immature plasma cells having eccentrically placed vesicular nuclei with spoke wheel chromatin. Occasional hyper chromatic nuclei were present. A clear cytoplasmic zone, around the nucleus was seen in all patients. Binucleated and trinucleated plasma cells were frequent. Multiinucleated plasma cells were present in one patient. Anisonucleosis was mild to moderate. Solitary plasmacytoma occurs in 3-5% of patients with plasma cell neoplasms. Our patient was 60 year old male present with solitary swelling of outer end of clavicle of 4 month duration. Showed anaplastic plasma cells with binucleate and multinucleated plasma cells.

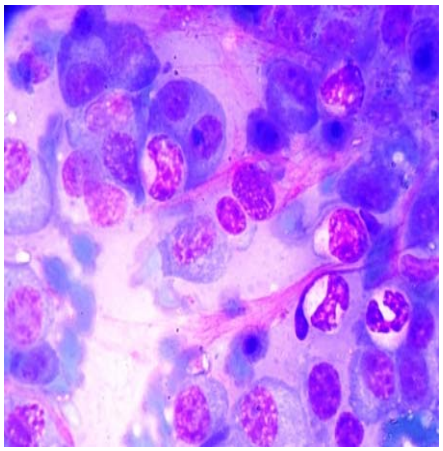
Cytological features were classical in all 3 patients in our study. The diagnosis of one patient was confirmed by histopathology and in two patients by serum electrophoresis, giving an accuracy of 100% (Table - 5).

Table 5: Showing Diagnostic Accuracy in Myeloma

Study	Percentage
Jorda *et al* [5]	89%
Agarwal *et al* [11]	100%
Our study	100%

Multiple myloma

Cytology smear: Highly celluler smear revealed plasmacytoid cells having eccentrically placed nuclei, coarse chromatin pattern, paranuclear hof. Few binucleate plasma cells also seen. (MGG 400X).



Metastatic carcinoma was the commonest malignant tumours encountered in our study accounting for 50% of all malignant tumours, of the 12 patients, the primary tumour was suspected in 5 patients (41.67%) In the remaining 7 patients the primary was occult. Metastatic deposits were suspected from prostate in 1 patient, which showed prostate enlargement on USG and mild increased PSA levels. Microscopy showed predominantly glandular formation with round and columnar cells. Mild pleomorphism and hyper chromasia were present. Secondaries were suspected to be from lung carcinoma in 3 cases as seen on X-ray chest and CT findings. Microscopy showed the presence of glandular clusters of atypical columnar cells. The remaining one case had suspected metastases from the thyroid. Microscopically there were round and polygonal anaplastic and hyper chromatic cells with abundant cytoplasm. Giant cells were also seen. Metastatic adenocarcinoma was the commonest type seen in 4 patients and metastatic squamous carcinoma in two patients.

The diagnosis of metastatic tumour is not difficult if the primary carcinoma is known. It is not always possible to suggest the site of a primary in bone metastases. For patients with suspected skeletal metastases a search for the primary tumour may preferably start with FNAC [13]. Distinct cytologic features can be of help in disclosing the primary site. Histopathology was done in seven patients which proved the cytologic diagnosis. The diagnostic accuracy of

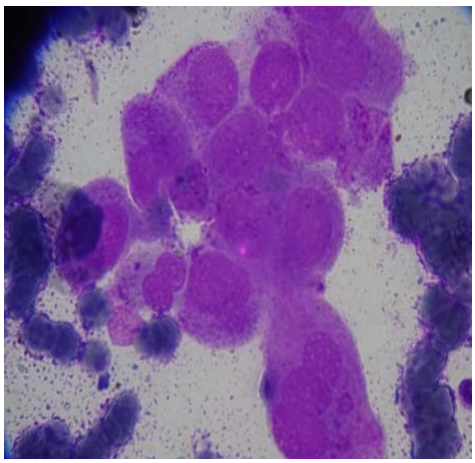
metastatic carcinoma is reported between 80-100%. (Table-6)

Table 6: Showing Diagnostic Accuracy in Metastatic Carcinoma

Study	Percentage
Pai *et al* [6]	93.3%
Agarwal *et al* [11]	88.9%
Our study	100%

Metastatic adenocarcinoma from lung

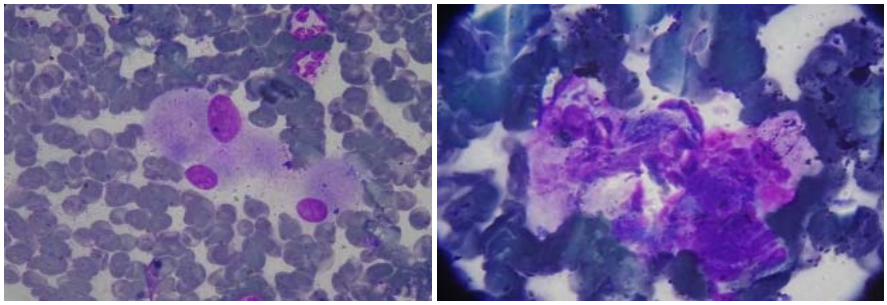
Cytology smear: Showing highly pleomorphic cells, arranged in glandular pattern. (MGG 400X).



Fibrous dysplasia is a non-neoplastic disorder of bone usually presenting in a monostotic form that occurs in children and young adults. In our study, smears from site of pathological fracture showed very scant cellularity, composed of cellular fibrous fragments, 'C' shape bent like structure, occasional giant cell and many scattered osteoblastic like cells. Histopathology confirmed the diagnosis. The differential diagnosis includes non ossifying fibroma, aggressive fibromatous and osteofibrous dysplasia [18]. Ameloblastomas constitute 1% of jaw lesions forming the commonest odontogenic tumour type [6]. These tumours arise from remnants of the dental lamina or from the basal layer of the oral mucosa. In the present study, a smear from 1 patient was moderately cellular and revealed basaloid, polygonal and spindle cell. The basaloid cells were arranged in clusters showing peripheral palisading. The cytoplasm was scant in basaloid cells and was abundant in polygonal cells. Mild nuclear pleomorphism is present. Histologic diagnosis of ameloblastoma was made, however pearls and eosinophilic bodies were not appreciable on cytology [19]. It needs to be differentiated from other cystic odontogenic lesions, epulis and granular cell myoblastoma.

Fibrous dysplasia, fibrous dysplasia

Cytology smear: scanty cellularity, composed of scattered osteoblast like cells and fibrous fragment including C' shape fibrous band. (MGG, 400X).



Our study suggests that fine-needle aspiration biopsy is a valid option in the diagnosis of bone tumours. It is a simple outpatient procedure which offers sufficient tissue material for the correct diagnosis in 91.66% of bone tumours, which is higher than the study of Kreicbergs *et al*. 1996 (80%) [20]. but comparable to study of Bommer *et al*. 1997 (97.1%) [21] and Wahane *et al*. 2007 (90.5%) [22]. FNAC was found to have a high sensitivity (93.75%) and specificity (87.50%) as a diagnostic procedure for malignant bone tumours in the present study.

In the study by Nnodu *et al*. 2006, sensitivity and specificity of diagnosing malignancy by FNAC were 95% and 94% respectively [23].

Conclusion

We emphasize that FNAC should be considered as a diagnostic tool in the initial workup of skeletal tumours and related lesions as the procedure is simple, economic, and reliable. The results are obtained quickly and if necessary repeated aspirations can be performed. FNAC of bony masses have a high diagnostic accuracy especially when sampling is adequate. If radiologic information is not compatible or diagnostic material is insufficient, a definitive pathologic opinion should never be delivered. Cytological technique that has been applied in this study can detect both primary and metastatic tumours as well as many benign tumour and tumour like conditions of bone. Contrary to the general belief, fine needle aspiration cytology can be used in the preliminary diagnosis of bone tumours. Despite, the limitation of inadequate aspirate material from bony lesions, concrete multidisciplinary approach is of great help in the early diagnosis of bone tumours. FNAC also alleviates the need for open biopsy in a substantial number of cases and helps in initiating appropriate therapy faster. Specific diagnosis and sub typing of bone tumours can be enhanced by simultaneous application of core needle biopsy in selected cases and making use of ancillary diagnostic techniques such as immunocytochemistry, electron microscopy, and DNA ploidy analysis, chromosomal and molecular genetic analysis.

References

1. Ashokraj G, Bhatia A. Fine needle aspiration cytology in the Diagnosis of bone tumours. Indian J Cancer. 1989; 26:260.

2. Layfield LJ, Glasgow BJ, Anders KH, Mirra JM. Fine needle aspiration cytology of primary bone lesions. Acta Cytol, 1987; 3, 1(2):177-84.
3. Nielsen GP, Layfield LJ, Rosenberg AE. Neopalstic and tumour like lesions of bone. Chapt 14, In: Silverberg SG, Delellis Ra, Frable WJ, Livolsi VA, Wick MR, editors. Silverberg's Principles and Practice of Surgical Pathology and Cytopathology.4th ed. Philadelphia: Churchill Livingstone. 2006; 1:701-87.
4. Kilpatrick SE, Renner JB, Creager A. editors. Diagnostic musculoskeletal surgical pathology.1st ed. Philadlephia: Saunders. 2004, 1-345.
5. Jorda M, Rey L, Hanly A, Azar PG. Fine needle aspiration cytology of bone. J Cancer Cytopathol, 2000; 90:47-54.
6. Pai MR, Vasudev R, Naik R, Lugade M. Role of fine needle aspiration cytology in the diagnosis of bone tumours. J Cytol. 2002; 19(1):33-9.
7. Maheshwari V, Khan L, Mehdi G, Sherwani KA, Prasad S. Cytomorphological diagnosis of bone tumours. J Cytol. 2005; 22(2):69-72.
8. Lucas DR, Bridge JA. Enchondromas: Enchondroma, periosteal chondroma and enchondromatosis. In: Fletcher CDM, Unii KK, Mertens F, editors. Pathology and genetics of tumours of soft tissue and bone.1st ed. Lyon: IARC Press. 2002, 237-40.
9. Rosenberg AE. Bones, joints, and soft tissue tumours. Chapt 26, In: Kumar V, Abbas AK, Fausto N. Robbins and Cotran pathologic basis of Disease.7th ed. Philadelphia: Saunders. 2004; 1:273-1324.
10. Vetrani A, Fulciniti F, Boschi R, Marino G, Zeppa P, Troncone G *et al*. Fine needle aspiration biopsy diagnosis of giant cell tumour of bone. Acta Cytol. 1990; 34(6):863-7.
11. Agarwal PK, Goel MM, Chandra T, Agarwal S. Predictive value of fine needle aspiration cytology of bone lesions. Acta Cytol. 1997; 41(3):659-65.
12. White VA, Fanning CV, Ayala AG, Raymond AK, Carrasco CH, Murray JA. Osteosarcoma and the role of fine needle aspiration. Cancer. 1988; 62:1238-46.
13. Jambhekar NA, Moonim HT, Khatib Y. Bone FNAC expectations and limitations. J Cytol. 2001; 18(2):57-72.
14. Bhatia A, Ashokraj G. Cytological diversity of osteosarcoma. Indian J Cancer. 1992, 56-60.
15. Das DK, Bhambhani S, Chachra KL, Murthy NS, Tripathi RP. Small round cell tumors of the abdomen and thorax: Role of fine needle aspiration cytologic feature in the diagnosis and differential diagnosis. Acta Cytol. 1997; 41:1035-47.
16. Kontozoglou T, Krakauer K, Qizilbash AH. Ewing's sarcoma. Acta Cytol. 1986; 30(5):513-8.
17. Kabukcuoglu F, Kabukcuoglu Y, Kuzgun U, Evsen I. Fine needle aspiration of malignant bone lesions. Acta Cytol. 1998; 42(4):875-82.
18. Logrono R, Kurtyzez DF, Wojtowycz M, Inhorn SL. Fine needle aspiration cytology of fibrous dysplasia. Acta Cytol. 1998; 42(5):1172-6.
19. Ramzy I, Aufdemorte TB, Duncan DL. Diagnosis of radioloucent lesiosn of the jaw by fine needle aspiration biopsy. Acta Cytol. 1985; 29(3):419-25.
20. Kreicbergs A, Bauer HCF, Brosjo O, Lindholm J, Skoog, Soderlund V. Cytological diagnosis of bone tumours. J Bone Joint Surg (Br). 1996; 78-B:25 8-63.
21. Bommer KK, Ramzy I, Mody D. Fine-needle aspiration biopsy in the diagnosis and management of bone lesions: a study of 450 cases. Cancer. 1997; 81:148-56.
22. Wahane RN, Lele VR, Bobhate SK. Fine needle aspiration cytology of bone tumors. Acta Cytol, 2007; 51:711-20.
23. Nnodu OE, Giwa SO, Eyesan SU, Abdulkareem FB. Fine needle aspiration cytology of bone tumours--the experience from the national orthopaedic and lagos university teaching hospitals, Lagos, Nigeria. Cytojournal. 2006; 3:16.