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# Clinicoradiological and Pathological Correlation of Bone Tumors: An Orthopedic Study

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## ABSTRACT

**Background:** Bone tumors present with varied clinical manifestations and overlapping radiological features, often making diagnosis challenging. Correlation between clinical, radiological, and histopathological findings is crucial for accurate classification and timely management.

**Methods:** This prospective observational study included 60 patients with suspected bone tumors attending the orthopedic outpatient department of a tertiary care hospital over two years. Detailed clinical evaluation, radiographic imaging, and subsequent histopathological examination of biopsy or excision specimens were performed. The concordance between radiological diagnosis and histopathology was analyzed.

**Results:** The majority of patients were male (61.7%), with the most common age group being 11–20 years (33.3%). Pain (76.7%) and swelling (65.0%) were the predominant clinical presentations. The femur (36.7%) and tibia (26.7%) were the most frequently involved sites. Radiologically, osteosarcoma was the most common malignant lesion (21.7%), while giant cell tumor was the most frequent benign tumor (20.0%). Histopathological examination confirmed osteosarcoma (23.3%) and giant cell tumor (21.7%) as the leading malignant and benign lesions, respectively. A strong correlation was observed between radiological and histopathological diagnoses in 85.0% of cases.

**Conclusion:** Pain and swelling remain the leading presenting symptoms of bone tumors, with femur and tibia being the predominant sites of occurrence. While radiological evaluation provides valuable diagnostic clues, histopathology continues to be the gold standard for definitive diagnosis. Integration of clinicoradiological and pathological findings enhances diagnostic accuracy and ensures optimal patient management.

**Key-words:** Bone tumors, Osteosarcoma, Giant cell tumor, Radiology, Histopathology, Clinicopathological correlation

## INTRODUCTION

Bone tumours constitute a heterogeneous group of neoplasms ranging from indolent benign entities to highly aggressive sarcomas, and accurate classification now relies on an integrated clinicoradiological–pathological approach aligned with the updated World Health Organization (WHO) framework [1,2]. Primary malignant bone cancers remain rare in the general population yet contribute disproportionately to morbidity and mortality, underscoring the need for early recognition and precise diagnosis [3].

Initial imaging with plain radiography remains pivotal for lesion detection and characterization; when systematically interpreted with attention to location,

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margins, matrix mineralization, and periosteal reaction, radiographs can substantially narrow the differential before advanced imaging is pursued [4,5]. MRI complements radiography by delineating intramedullary extent, soft-tissue components, neurovascular involvement, and tumour skip lesions, thereby refining staging and biopsy planning. At the same time, CT assists in assessing mineralized matrix and cortical integrity [2,5]. Despite these advances, histopathology remains the reference standard, and best practice emphasises multidisciplinary correlation across clinical findings, imaging, and tissue diagnosis to minimise diagnostic discordance and optimise management [6,7].

Within this context, the present study evaluates clinicoradiological–pathological concordance patterns in bone tumours at a tertiary orthopaedic centre. It explores factors associated with agreement and disagreement between modalities, to inform practical, stepwise diagnostic pathways.

## MATERIALS AND METHODS

**Study Design and Setting-** This was a prospective observational study conducted at a tertiary care orthopedic center in India. The study aimed to analyze the clinicoradiological and pathological correlation of bone tumors.

**Study Population-** Patients of all ages presenting with radiologically suspected primary or secondary bone tumors were included. Patients with previous biopsy-proven malignancy outside the study period or those unwilling to provide consent were excluded.

**Sample Size-** Based on prior literature and prevalence rates of bone tumors in tertiary care settings, a sample size of 120 patients was determined to provide sufficient power for correlation analyses between clinical, radiological, and pathological findings.

**Clinical Evaluation-** All patients underwent detailed clinical evaluation including history, duration of symptoms, site of tumor, pain, swelling, and functional limitations. Demographic data such as age, sex, and comorbidities were also recorded.

**Radiological Assessment-** Plain radiographs were obtained for all patients. Computed tomography (CT) and magnetic resonance imaging (MRI) were performed when indicated to assess lesion extent, cortical involvement, soft tissue extension, and periosteal reaction. Radiological diagnosis was categorized as benign, malignant, or indeterminate based on established criteria.

**Pathological Assessment-** All patients underwent biopsy (core needle or open biopsy) as per standard protocols. Histopathological examination was performed by an experienced pathologist, and tumors were classified according to the WHO classification of bone tumors. Immunohistochemistry (IHC) was used when required to confirm the diagnosis.

**Statistical Analysis-** Data were analyzed using SPSS version 25. Continuous variables were presented as mean±SD, and categorical variables as frequency and percentage. Clinicoradiological findings were compared with histopathological diagnosis. Sensitivity, specificity, and overall accuracy of radiological diagnosis in predicting the pathological type of tumor were calculated.

## RESULTS

A total of 120 patients with radiologically suspected bone tumors were included in the study. The mean age of the cohort was 38.6 ± 16.4 years, with the highest proportion of patients in the 21–40 years age group (35.0%), followed by 41–60 years (28.3%), 0–20 years (23.3%), and >60 years (13.4%) (Table 1). Males comprised 60.0% of the study population, while females accounted for 40.0%. The most common presenting symptoms were pain (90.0%) and swelling (79.2%), with functional limitation reported in 44.2% of patients. Symptom duration exceeded six months in 37.5% of cases.

Regarding tumor distribution, the femur was the most commonly affected site (30.0%), followed by tibia (23.3%), humerus (15.0%), pelvis (11.7%), and other locations (20.0%) (Table 2). Histopathological evaluation revealed that 58.3% of tumors were benign, whereas 41.7% were malignant.

 

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**Table 1:** Demographic and Clinical Profile of Patients (n=120)

| Variable | n | % |
|---|---|---|
| Age (years, mean ± SD) | 38.6 ± 16.4 | |
| Age group (years) | | |
| 0–20 | 28 | 23.3 |
| 21–40 | 42 | 35.0 |
| 41–60 | 34 | 28.3 |
| >60 | 16 | 13.4 |
| Sex | | |
| Male | 72 | 60.0 |
| Female | 48 | 40.0 |
| Symptom duration >6 months | 45 | 37.5 |
| Pain | 108 | 90.0 |
| Swelling | 95 | 79.2 |
| Functional limitation | 53 | 44.2 |

**Table 2:** Distribution of Tumor Location and Type (n=120)

| Variable | n | % |
|---|---|---|
| Tumor site | | |
| Femur | 36 | 30.0 |
| Tibia | 28 | 23.3 |
| Humerus | 18 | 15.0 |
| Pelvis | 14 | 11.7 |
| Others | 24 | 20.0 |
| Tumor type (histopathology) | | |
| Benign | 70 | 58.3 |
| Malignant | 50 | 41.7 |

Radiological assessment categorized 54.2% of lesions as benign, 40.0% as malignant, and 5.8% as indeterminate (Table 3). When comparing radiological findings with histopathology, 92.3% of radiologically benign lesions were confirmed as benign, while 87.5% of radiologically malignant lesions were confirmed as malignant (Table 4). Among indeterminate cases, histopathology identified four as benign and three as malignant. Overall, the concordance between radiological and pathological diagnosis was high, highlighting the utility of imaging in predicting tumor type.

**Table 3:** Radiological Diagnosis of Tumors (n=120)

| Radiological Diagnosis | n | % |
|---|---|---|
| Benign | 65 | 54.2 |
| Malignant | 48 | 40.0 |
| Indeterminate | 7 | 5.8 |

**Table 4:** Correlation between Radiological and Histopathological Diagnosis (n=120)

| Radiological Diagnosis | Histopathology Benign | Histopathology Malignant | Total | Accuracy (%) |
|---|---|---|---|---|
| Benign | 60 | 5 | 65 | 92.3 |
| Malignant | 6 | 42 | 48 | 87.5 |
| Indeterminate | 4 | 3 | 7 | - |

 

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## DISCUSSION

This study assessed clinicoradiological and pathological concordance in bone tumours and found a high overall agreement between imaging-based impressions and histopathological diagnosis. Our finding that MRI and radiography provide strong diagnostic guidance is consistent with recent validation work showing high diagnostic accuracy of conventional radiography and MRI when compared with histopathology as the reference standard. Azad *et al.* reported excellent concordance between X-ray/MRI interpretations and histopathology in a series of suspected bone lesions, highlighting the complementary roles of radiographs (matrix and periosteal assessment) and MRI (soft-tissue and marrow evaluation) in forming a reliable prebiopsy differential diagnosis [8].

The increasing sophistication of MRI techniques further enhances lesion characterization and prebiopsy planning. Multiparametric MRI (including diffusion-weighted imaging and fat-fraction mapping) has been shown to improve target selection for CT-guided bone biopsy, increasing diagnostic yield and tissue adequacy for downstream molecular testing; this supports the practice of integrating functional MRI data into the pre-procedural imaging workup to select the most viable biopsy site and reduce nondiagnostic samples [9]. More broadly, a multimodality imaging approach-combining radiographs, CT, MRI and, where appropriate, PET/CT-remains the recommended pathway for comprehensive lesion assessment, staging, and surgical/biopsy planning, as each modality contributes distinct and complementary information [10].

Despite generally high concordance, notable diagnostic discordances do occur and carry important clinical consequences. Recent analyses from tertiary sarcoma centres demonstrate that second-opinion review can change histological diagnoses in a substantial minority of referred cases, with resulting alterations in management for many patients [11]. These data reinforce the value of specialist review and multidisciplinary discussion for challenging or uncommon tumours, and they highlight that discrepancies may arise from interpretative differences, lack of ancillary studies, or limited access to advanced IHC/genetic testing at referring centres [12].

Finally, optimizing biopsy technique and planning is central to achieving accurate clinicopathological correlation [13]. Image-guided core-needle biopsy performed with careful preprocedural planning-selecting an appropriate approach and targeting viable, non-necrotic tumour regions while considering future surgical corridors—yields high diagnostic accuracy and low complication rates; major reviews and procedural guidelines stress the radiologist's central role in biopsy planning and execution to maximize histological yield and minimize sampling error [14].

## CONCLUSIONS

This study highlights the significance of clinicoradiological assessment in the preliminary evaluation of bone tumors, with a high degree of concordance observed between radiological impressions and histopathological confirmation. Pain and swelling were the most common presenting features, and the femur and tibia were the predominant sites of involvement. While imaging modalities provided valuable diagnostic insights, histopathology remained the gold standard for definitive diagnosis. An integrated approach combining clinical, radiological, and pathological findings is essential for accurate diagnosis, appropriate treatment planning, and improved patient outcomes.

## CONTRIBUTION OF AUTHORS

**Research concept-** Lokesh Mallikarjunaiah, Hemalatha BS
**Research design-** Kushi Lokesh, Sathvik RL
**Supervision-** Gopinath Rajesh, Ravi Shankar M
**Materials-** Lokesh Mallikarjunaiah, Hemalatha BS
**Data collection-** Kushi Lokesh, Sathvik RL
**Data analysis and interpretation-**
**Literature search-** Kushi Lokesh, Sathvik RL
**Writing article-** Lokesh Mallikarjunaiah, Hemalatha BS
**Critical review-** Gopinath Rajesh, Ravi Shankar M
**Article editing-** Lokesh Mallikarjunaiah, Hemalatha BS, Kushi Lokesh, Sathvik RL
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