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Original Research Article

# Fine Needle Aspiration Cytology (FNAC): A Valuable Tool for Diagnosing Soft Tissue Tumors and Tumor-Like Lesions: A Retrospective Study

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**Abstract:**

**Background:** Fine needle aspiration cytology (FNAC) is a common diagnostic method for soft tissue tumors; however, its accuracy and safety are currently being studied. This retrospective study assessed the efficacy of FNAC in soft tissue tumor diagnosis and its drawbacks. The main objective of this research was to assess how well FNAC works for soft tissue tumor diagnosis.

**Methods:** This retrospective investigation comprised 80 FNAC cases from a "February 2023 to December 2023" that were histologically validated. Out of these cases, 26 were benign and 54 were malignant. Pre-FNAC histology was available for only seven of the 14 recurrence cases. These eight examples were excluded from the analysis. In the 46 remaining patients, FNAC was the major cancer diagnosis method. The specificity, sensitivity, and positive predictive value of FNAC for soft tissue tumor diagnosis were assessed.

**Results:** The study found that FNAC had 91.5% specificity, 90.5% sensitivity, and 94.5% PPV for soft tissue cancer detection. Tumor classification was difficult; only 45.8% of patients were classified. Notably, three false-negative and two false-positive cases occurred. Both schwannoma and fibromatosis were misclassified as sarcomas. One fibrosarcoma, one malignant nerve sheath tumor, and one hemangiopericytoma were false negatives.

**Conclusion:** With its excellent sensitivity and specificity, FNAC becomes a useful method for differentiating benign from malignant soft tissue tumors. However, the precision with which FNAC can classify tumors is still limited, as a significant number of patients necessitate additional histological evaluation in order to confirm the exact diagnosis.

**Recommendation:** The findings suggest that FNAC should be used to diagnose soft tissue tumors initially. However, clinicians should avoid errors, especially in tumor categorization. If diagnostic doubt remains, histological confirmation should be considered for proper diagnosis and therapy. Pathologists and doctors can improve FNAC's soft tissue tumor diagnosis utility through study and collaboration.

**Keywords:** Cytology, Soft Tissue Tumor, Sarcoma, Fine Needle Aspiration Cytology.



## Introduction

The accurate diagnosis of bone and soft tissue tumors is paramount for developing effective treatment strategies. Obtaining a morphological diagnosis is a fundamental step in this process. Fine Needle Aspiration Cytology (FNAC) has emerged as a valuable tool in the diagnostic toolkit, particularly for assessing a varied range of neoplastic and non-neoplastic lesions in these tissues. It offers several advantages and is often considered as an replacement to excision biopsy for soft tissue tumors [1].

However, it's important to acknowledge that FNAC does have its limitations. One of the primary challenges lies in the fact that FNAC does not provide information about tissue architecture. Unlike excision biopsy, which provides a comprehensive view of the tissue's structure, FNAC relies solely on cellular material extracted from the lesion. This limitation can make it difficult to precisely categorize soft tissue tumors [1, 2].

Soft tissue tumors are inherently heterogeneous in nature. They often comprise a mix of neoplastic cells and cells from the surrounding host tissue. This cellular diversity within the tumor can pose a significant challenge during FNAC interpretation. Distinguishing between neoplastic and non-neoplastic cells in the absence of clear tissue architecture can be tricky and may lead to diagnostic errors [3].

Furthermore, soft tissue lesions can exhibit reactive and reparative growth within connective tissues. These processes can result in the formation of non-neoplastic lesions that closely mimic the characteristics of neoplastic conditions. This further complicates the interpretation of FNAC samples, as the cellular changes associated with reactive and reparative growth can resemble those seen in malignant tumors [3].

To overcome these challenges and ensure high diagnostic accuracy in soft tissue tumors, a pathologist or clinician performing FNAC must possess a deep understanding of the various histological variations that can occur in these lesions. Experience in interpreting cytology smears with different cell types is crucial, as it allows for a more nuanced assessment of the cellular material obtained through FNAC. Additionally, awareness of FNAC's limitations is essential for clinicians to exercise caution and consider additional diagnostic methods when essential to confirm the diagnosis and guide appropriate treatment decisions [3].

While FNAC plays a valuable role in the diagnosis of bone and soft tissue tumors, it should be utilized with a clear understanding of its strengths and limitations. Achieving a precise diagnosis relies on the expertise of the healthcare professionals involved and their ability to navigate the complexities of soft tissue lesions, ultimately ensuring the best possible patient care and treatment outcomes.

In this research, the aim was to assess the utility of FNAC in analyzing soft tissue tumors while also outlining the potential challenges associated with FNAC in the context of soft tissue lesions.

## Methodology

**Study Design:** Retrospective study

**Study Setting:** Cases of soft tissue tumors with FNAC proof that were diagnosed at the "Patna Medical College and Hospital Patna" over a ‘time period of 11 months’ were studied in this study.

**Study Size:** A total of 264 cases were subject to FNAC throughout "February 2023 to December 2023." FNAC identified 155 instances as soft tissue tumors in total. Of these 155 instances, 11 cases were classified as malignant and 64 cases as benign. Only 80 of these instances have access to histopathology.

**Participants:** A total of 80 cases were included in the study.

**Methodology:** The FNAC protocol adhered to Zajicek's [4] methodology. At the time of FNAC, clinical data was documented, including lesion size, site, and consistency. There were at least 6 smears produced from every case; four were air-dried and two were fixed in 95% ethanol. Hematoxylin and eosin or Papanicolaou staining were used on the alcohol-fixed smears, while the May-Grunwald-Giemsa (MGG) procedure was used on the air-dried smears. Expert cytologists evaluated the smears on their own, looking closely for certain cytological traits. A comparison was done between the histology slides and the FNAC smears.

**Bias:** When the study first began, there was a potential for bias, but it was prevented by providing all participants with the same material and concealing the group assignment from the nurses who took the data.

**Statistical Analysis:** Statistical analyses were conducted using SPSS version 21. The sensitivity, specificity, and positive predictive value were also analyzed.

## Results

The study included 80 cases in total for this research. After histological analysis, 26 instances were found to be benign and 54 cases to be malignant. Only seven of the 14 individuals that experienced recurrences had previous histology available prior to FNAC. Therefore, in 46 cases, FNAC largely identified cancers. False positives: Two cases that FNAC mistakenly classified as cancer were in fact benign. Three of the 46 instances with histopathological proven cancers were misdiagnosed as benign by FNAC. As a result, FNAC's sensitivity, specificity, and positive predictive value for identifying soft tissue tumors were, respectively, 90.5%, 91.5%, and 94.5%.

**Table 1: Histological correlations between benign tumors and tumorlike disorders identified by aspiration cytology**

| Diagnosis | Cytological diagnosis | | | |
|---|---|---|---|---|
| | Total (26) | Exactly categorized | Diagnosed benign but not exactly categorized | Diagnosed as malignant |
| Lipoma | 8 | 8 | 0 | 0 |
| Fibromatosis | 5 | 1 | 2 | 1 |
| Fibrous histiocytoma | 1 | 1 | 0 | 0 |
| Neurofibroma | 5 | 1 | 4 | 0 |
| Schwannoma | 7 | 1 | 5 | 1 |
| Total | | 12 | 11 | 2 |

**Benign Tumors:**

Table 1 displays the histological and cytological connection for benign tumors. One of the fibromatosis cases was incorrectly identified as a spindle cell tumor, which could have been a low-grade malignant tumor. In this instance, clusters of cells with an oval to spindle form with minor nuclear pleomorphism were visible in the cytology smear. Two of the cases were mislabeled benign spindle cell tumors and only one instance of fibromatosis was diagnosed accurately. The one and only instance of fibrous histiocytoma was correctly identified. Only one of the four instances of neurofibroma was accurately recognized; the other two cases were reported as benign spindle cell tumor, fibrous histiocytoma, and lipoma in the literature. Only one of the six schwannoma patients received a precise FNAC diagnosis; the other five cases were classified as benign spindle cell tumors or as something else entirely. On FNAC, one instance was incorrectly identified as low-grade spindle cell sarcoma; however, upon histological investigation, the diagnosis was changed to schwannoma.

**Table 2: Cytological association of tumors that are histopathological malignant**

| Histopathology diagnosis | Exact categorization on FNAC | Not exact categorized on FNAC but correctly diagnosed as malignancy | False negatives on FNAC | Total |
|---|---|---|---|---|
| Liposarcoma well-differentiated | 1 | 0 | 0 | 1 |
| Pleomorphic liposarcoma | 0 | 3 | 0 | 3 |
| Fibrosarcoma | 2 | 2 | 1 | 5 |
| Malignant fibrous histiocytoma | 8 | 1 | 0 | 9 |
| Dermatofibrosarcoma protuberans | 0 | 1 | 0 | 1 |
| Malignant nerve sheath tumor | 2 | 2 | 1 | 5 |
| Synovial sarcoma | 5 | 1 | 0 | 6 |
| Leiomyosarcoma | 0 | 3 | 0 | 3 |
| Pleomorphic rhabdomyosarcoma | 0 | 1 | 0 | 1 |
| Embryonal rhabdomyosarcoma | 0 | 0 | 0 | 0 |
| Hemangiopericytoma | 0 | 1 | 1 | 2 |
| Extraskeletal Ewing's sarcoma | 1 | 3 | 0 | 4 |
| Clear cell sarcoma | 2 | 2 | 0 | 4 |
| Total | 21 | 20 | 3 | 44 |

**Malignant Tumors:**

The cytological vs histological correlation for the 54 malignant soft tissue tumor cases that were identified by FNAC is shown in Table 2. Of the 44 cases of histopathologically verified sarcomas, 21 were classified as such exactly on FNAC, and the remaining 20 were identified as sarcomas but not classified as such. Three cases that FNAC misdiagnosed as benign were eventually found to be haemangiopericytoma, malignant nerve sheath tumor, and fibrosarcoma. FNAC was initially used to diagnose these patients as schwannoma.

The research demonstrated the high sensitivity and specificity of FNAC in the diagnosis of soft tissue tumors. Nonetheless, certain difficulties and incorrect diagnoses were noted, especially when identifying particular tumor subtypes, as demonstrated by the correlations between cytology and histology in cases that were both benign and malignant.

**Discussion**

The results of this investigation, which showed that FNAC had excellent sensitivity (90%) and specificity (91%) in the analysis of soft tissue tumours, are in line with earlier studies that found that specificity ranged from 80% to 94% and sensitivity from 86.5% to 94% [2,5, 6]. There aren't many large-scale studies that support the value of FNAC in the identification of soft tissue tumors [1, 7, 8].

This study found two false-positive cases, one with fibromatosis and the other misinterpreted as cancer because of degenerate atypical cells [9]. These findings are comparable with those of Hood et al. Three false-negative cases with reduced cellularity and mild pleomorphism were identified when FNAC misidentified schwannoma. In these situations, a clinical history and several aspirations from various places may be helpful. In 14 cases of recurrent sarcoma, FNAC proved useful in identifying malignancy and may have prevented the need for further excision biopsy.

Although FNAC demonstrated a high degree of sensitivity and specificity in differentiating between benign and malignant tumours, its ability to accurately classify different tumour types was not as strong. When repeat instances are taken out of the analysis, only 21 out of 46 cases (45.8%)

were correctly classified. This is consistent with earlier studies that noted investigative overlaps between different histologic subtypes of soft tissue sarcomas because of their development [2, 5]. Accompanying investigative methods like electron microscopy and immunocytochemistry can help with accurate sarcoma classification on FNAC. Tumors can be categorized as round cell sarcomas, spindle cell sarcomas, or pleomorphic sarcomas (fibrosarcoma, malignant nerve sheath tumor, leiomyosarcoma, etc.) if precise classification is not attainable. Five out of five cases of synovial cell sarcomas were accurately diagnosed based on typical traits, but both cases of clear cell sarcomas were appropriately classified based on unique cytomorphological features. Three tumors could not be diagnosed even after extensive inspection, which is in line with results from related datasets [3, 10].

The study showed that FNAC, which has a high sensitivity and specificity, can be a useful diagnostic tool for soft tissue tumors. It did, however, also draw attention to the difficulties in accurately classifying tumor types with FNAC alone, particularly when the tumors have overlapping histological markers. Accurate categorization may be improved by auxiliary methods like electron microscopy and immunocytochemistry. Additionally, in situations where FNAC results are not conclusive, the clinical history and numerous aspirations from other sites can be helpful.

The results of this investigation are consistent with earlier studies [2,3,5,6,9,10]. Analogous research has also documented the efficacy of FNAC in the identification of soft tissue neoplasms, highlighting its constraints in classifying certain tumor types because of the diverse character of these neoplasms. In situations where FNAC is insufficient to improve categorization accuracy, ancillary approaches and cautious clinical evaluation have been suggested as viable remedies.

## Conclusion

FNAC emerges as a valuable tool for classifying benign from malignant soft tissue tumors, demonstrating high sensitivity and specificity. Nevertheless, FNAC's accuracy in categorizing tumors accurately remains limited, with a substantial proportion of cases requiring further histopathological assessment to confirm the precise diagnosis.

**Limitations:** The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

**Recommendation:** Based on the findings, it is recommended that FNAC continues to be employed as an initial diagnostic tool for soft tissue tumors. However, clinicians should remain cautious of potential pitfalls, particularly in the exact categorization of tumors. In cases where diagnostic uncertainty persists, obtaining histopathological confirmation should be considered to ensure accurate diagnosis and appropriate management. Further research and collaboration between pathologists and clinicians can help refine the utility of FNAC in soft tissue tumor diagnosis.

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**List of abbreviations:**

FNAC- Fine needle aspiration cytology
MGG- May-Grunwald-Giemsa

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