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Original Research Article

Comparative Analysis of Core Needle Biopsy and Excision Biopsy in Breast Lesions: Diagnostic Accuracy and Concordance of Molecular Markers

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Abstract:

Background: Precise tissue-based diagnosis and dependable evaluation of biomolecular indicators are fundamental to appropriate clinical management of breast pathology. Minimally invasive tissue sampling is commonly employed as a first-line diagnostic approach, whereas surgical removal of the lesion continues to serve as the definitive benchmark. Assessing the level of diagnostic agreement and consistency of biomolecular findings between these approaches is essential for informed clinical decision-making.

Objectives: The present investigation sought to evaluate tissue samples obtained through minimally invasive sampling and surgical removal of breast lesions, focusing on diagnostic performance and consistency of selected biomolecular indicators.

Materials and Methods: This facility-based comparative investigation was carried out over a two-year duration at Hi-Tech Medical College, Bhubaneswar. A total of 180 individuals with breast lesions who underwent both minimally invasive sampling and subsequent surgical tissue removal were included. Histopathological findings from the initial sampling technique were evaluated against those obtained from surgically excised specimens. In malignant cases, immunohistochemical assessment of estrogen receptor, progesterone receptor, human epidermal growth factor receptor 2, and Ki-67 labeling index was undertaken to determine agreement between the two specimen types.

Results: The minimally invasive sampling approach demonstrated strong diagnostic performance when evaluated against surgically obtained specimens, with substantial concordance observed in both non-malignant and malignant lesions. Hormone receptor status showed a high level of consistency between the two sampling methods. Slightly reduced agreement was noted for human epidermal growth factor receptor 2 and Ki-67, primarily attributable to intratumoral variability and tissue sampling constraints. Overall discordance was limited to a small proportion of cases.

Conclusion: Minimally invasive tissue sampling represents a dependable and efficient approach for initial evaluation of breast lesions and assessment of key biomolecular indicators. While surgical tissue removal remains indispensable in select discordant scenarios, the minimally invasive method provides reliable diagnostic and prognostic information for the majority of individuals.

Keywords: Minimally Invasive Biopsy; Surgical Excision; Breast Pathology; Diagnostic Performance; Biomolecular Indicators; Immunohistochemistry.

Introduction

Malignancies of the breast represent the most frequently identified cancer among women globally and continue to be a major contributor to cancer-related mortality. Timely and precise identification of breast lesions plays a critical role in determining appropriate therapeutic strategies and predicting clinical outcomes. Improvements in screening and imaging have enabled earlier detection of suspicious lesions, creating a need for dependable tissue-based diagnostic techniques. Microscopic evaluation of tissue samples remains the cornerstone of definitive diagnosis, with two principal approaches commonly utilized for obtaining representative specimens [1].

In contemporary clinical practice, minimally invasive sampling techniques are often favored because they are associated with lower procedural morbidity, reduced expense, and shorter turnaround time. As a result, this approach has become the preferred initial diagnostic method for evaluating breast lesions, while surgical tissue removal is

typically reserved for definitive confirmation, therapeutic purposes, or situations involving discordant findings. Despite widespread adoption of minimally invasive sampling, questions remain regarding its diagnostic reliability and its capacity to accurately assess prognostic and predictive biomolecular features when compared with surgically obtained specimens [2].

Tissue Sampling Approaches in Breast Lesions: Minimally invasive tissue sampling involves removal of small cores of tissue using a hollow instrument, usually performed with radiologic guidance. The collected material is adequate for microscopic examination and ancillary testing. This technique has largely replaced earlier cytology-based methods due to improved sensitivity and specificity, particularly in differentiating in situ lesions from invasive disease [3]. In contrast, surgical tissue removal entails excision of the lesion or a substantial portion of it and is regarded as the definitive diagnostic reference. This approach allows comprehensive evaluation of tumor type, grade, margin status, and intralesional variability. However, it is more invasive, requires operative facilities, and may delay definitive treatment planning if used as the initial diagnostic step [4].

Although multiple investigations have reported strong diagnostic performance of minimally invasive sampling for breast lesions, instances of mismatch between minimally invasive and surgically obtained findings have been documented. Such discrepancies may arise from sampling limitations, intratumoral diversity, or technical factors affecting tissue handling. These concerns highlight the importance of systematically evaluating the degree of agreement between the two approaches, particularly with respect to final microscopic interpretation [5].

Biomolecular Indicators and Clinical Relevance: Management strategies for breast malignancies have evolved substantially with the incorporation of biomolecular indicators that inform prognosis and guide targeted therapy. Markers such as estrogen receptor, progesterone receptor, human epidermal growth factor receptor 2, and the Ki-67 proliferation index are routinely evaluated to categorize tumors, estimate biological behavior, and inform treatment decisions [6]. Minimally invasive tissue samples are increasingly utilized for immunohistochemical assessment of these indicators prior to definitive surgery, enabling early initiation of tailored therapy and more individualized patient management.

However, variability in expression of biomolecular indicators across different tumor regions, along with technical factors related to fixation and limited tissue volume, may influence assessment accuracy. Differences in marker status between minimally invasive samples and surgically removed specimens have been reported, with potential implications for treatment selection and prognosis [7]. These considerations underscore the need for systematic evaluation of concordance between sampling methods in the assessment of key biomolecular features.

Rationale and Objectives of the Study: Accurate evaluation of tissue-based diagnostic techniques is essential for optimizing the assessment and management of breast lesions. Comparing minimally invasive sampling with surgically obtained tissue is particularly important to ensure dependable diagnosis and consistent evaluation of biomolecular features that guide treatment planning. A tertiary-level institution with a high case load of breast lesions offers an appropriate setting to systematically examine agreement between these approaches under routine clinical conditions.

Accordingly, the present work was designed to conduct a comparative assessment of minimally invasive tissue sampling and surgically removed specimens over a two-year duration. The investigation focused on determining diagnostic performance, agreement in microscopic interpretation, and consistency of biomolecular indicator evaluation between the two specimen types. The outcomes of this analysis are intended to strengthen existing evidence regarding the dependability of minimally invasive sampling and to support clinical decision-making in the evaluation and treatment of breast pathology.

Methodology

This investigation aimed to compare tissue samples obtained through minimally invasive techniques and surgical removal of breast lesions, with emphasis on diagnostic performance and agreement in biomolecular indicator assessment. The methodological framework emphasized standardized specimen handling, consistent microscopic evaluation, and structured data interpretation.

Study Design and Case Selection: A facility-based comparative observational approach was implemented over a two-year period at Hi-Tech Medical College, Bhubaneswar. The study included 180 individuals presenting with breast lesions suspected on clinical examination and imaging. All participants underwent minimally invasive tissue sampling followed by surgical removal of the same lesion, allowing direct comparison between specimen types.

Eligibility was limited to individuals in whom both specimen types were available for evaluation. Participants of all adult age categories and both sexes were included. Cases were excluded if either specimen was inadequate for definitive microscopic interpretation or biomolecular evaluation.

Individuals who had received prior therapeutic intervention to the lesion, such as chemotherapy or radiotherapy, were also excluded to avoid treatment-related alterations in tissue characteristics. Clinical information collected for each participant included demographic details, clinical findings, imaging impressions, and provisional diagnoses. All procedures were carried out following documented consent and in compliance with institutional ethical standards.

Microscopic Evaluation and Biomolecular Indicator Assessment: Minimally invasive tissue sampling was performed using automated biopsy instruments with imaging guidance, selected according to lesion characteristics. Multiple tissue cores were obtained to ensure adequate representation. Surgically removed specimens were processed following excision using standard laboratory protocols.

All tissue samples were preserved in buffered fixative, processed routinely, and embedded in paraffin blocks. Sections were prepared and stained with hematoxylin and eosin for microscopic examination. Interpretation of minimally invasive and surgically obtained samples was performed independently by experienced pathologists who were unaware of the corresponding findings from the alternate specimen, thereby reducing observer-related bias. Lesions were categorized into benign, malignant, or borderline groups. In malignant cases, tumor type, grade, and presence of invasive components were documented. Agreement between specimen types was evaluated by comparing final microscopic diagnoses.

Evaluation of biomolecular indicators was carried out on both specimen types in cases diagnosed as malignant. Markers assessed included estrogen receptor, progesterone receptor, human epidermal growth factor receptor 2, and the Ki-67 proliferation index. Immunohistochemical staining followed standardized laboratory protocols, with appropriate internal controls included for each run. Interpretation of staining results was performed according to established scoring systems.

Data Collection and Statistical Analysis: Microscopic and biomolecular findings were systematically recorded using a predefined data collection format. Diagnostic performance of minimally invasive sampling was assessed by comparing results with those obtained from surgically removed specimens, which served as the reference standard. Agreement in biomolecular indicator status and proliferative index between the two specimen types was also evaluated.

Data analysis was carried out using suitable statistical software. Qualitative variables were summarized as counts and proportions, while numerical variables were expressed using measures of central tendency and dispersion. Agreement between specimen types was assessed using concordance measures and appropriate statistical tests. Findings meeting the predefined threshold were interpreted as statistically meaningful. The analysis focused on determining the reliability of minimally invasive tissue sampling for diagnosis and biomolecular evaluation, as well as identifying potential sources of discordance between sampling approaches.

Results

A total of 180 individuals with breast lesions underwent both minimally invasive tissue sampling followed by surgical tissue removal and were included in the analysis. In every case, the material obtained was sufficient for microscopic examination and immunohistochemical evaluation, enabling a detailed comparison between the two specimen types.

Clinicopathological Distribution of Cases: The study cohort consisted predominantly of women, spanning a broad age range from early adulthood to advanced age. Most participants presented with a clinically detectable breast lump, while a smaller subset was identified through radiological assessment alone. Lesions were most commonly located in the upper outer region of the breast. The distribution of age and sex within the cohort is depicted in Figure 1.

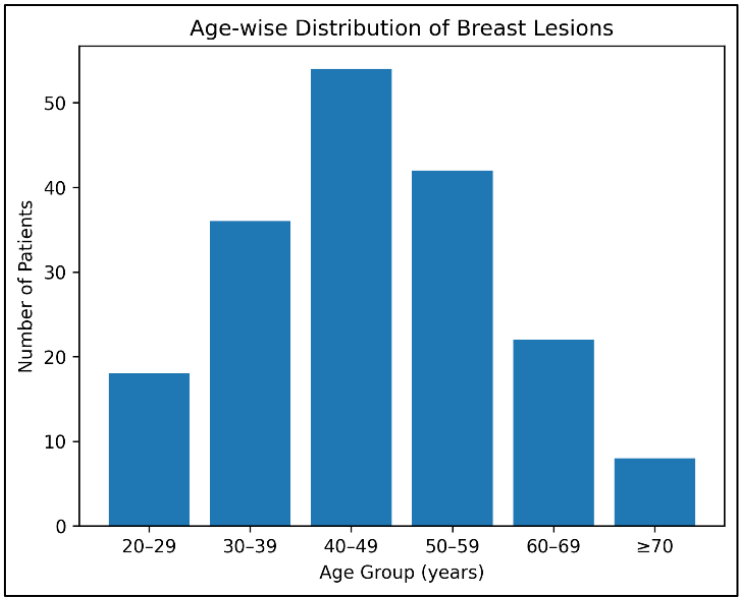

Figure 1. Age-wise distribution of patients with breast lesions (n = 180)

On histopathological evaluation of excision biopsy specimens, malignant lesions constituted the majority of cases, followed by benign lesions and a small proportion of borderline or high-risk lesions. Invasive ductal carcinoma was the most common malignant diagnosis, while fibroadenoma was the most frequently encountered benign lesion.

Diagnostic Accuracy of Core Needle Biopsy: Core needle biopsy demonstrated a high level of diagnostic accuracy when compared with excision biopsy findings. The majority of malignant lesions diagnosed on excision biopsy were correctly identified as malignant on core needle biopsy. Benign lesions also showed a high rate of concordance between the two methods. A small number of cases showed diagnostic discrepancy. These included cases where core needle biopsy reported benign or atypical features, while excision biopsy revealed malignancy. Such discrepancies were mainly attributed to sampling error, tumor heterogeneity, or limited representation of invasive components in the core samples. Overall diagnostic concordance between core needle biopsy and excision biopsy is depicted in Figure 2.

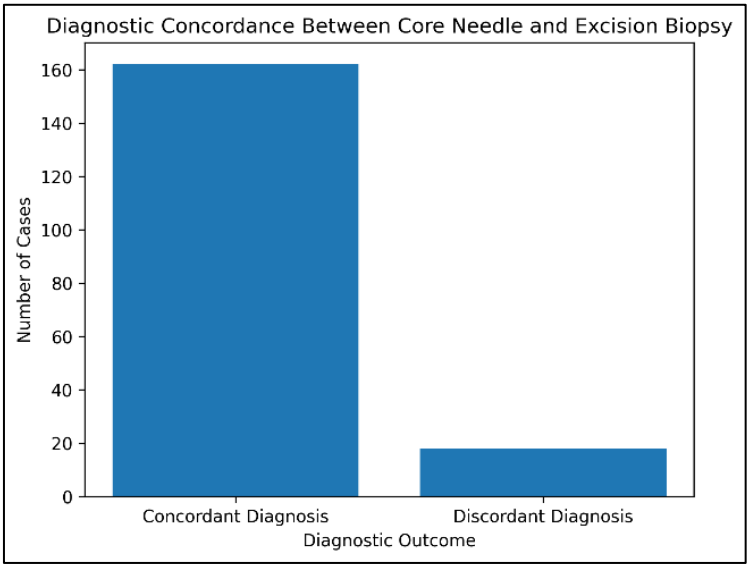

Figure 2. Diagnostic concordance between core needle biopsy and excision biopsy in breast lesions (n = 180)

Agreement of Biomolecular Indicators: Assessment of biomolecular indicators was performed in all malignant lesions. Hormone receptor evaluation demonstrated a high level of consistency between minimally invasive samples and surgically removed specimens. The majority of lesions showing receptor positivity on surgically obtained tissue were similarly identified on minimally invasive sampling. Evaluation of human epidermal growth factor receptor 2 demonstrated

comparatively lower consistency, with a limited number of cases exhibiting either equivalent or differing results between specimen types. Assessment of the proliferative index showed moderate variability, with some lesions displaying differences in labeling values between the two sampling approaches.

Despite these variations, overall consistency of biomolecular indicator assessment between the two specimen types remained high. Instances of disagreement were more frequently encountered in lesions exhibiting marked morphological variability and higher histological grade. These findings suggest that while minimally invasive sampling is dependable for initial biomolecular evaluation, surgically obtained tissue continues to play an important role in selected situations requiring comprehensive assessment. Overall, the findings indicate that minimally invasive sampling serves as an effective diagnostic approach for breast lesions, demonstrating strong agreement with surgically removed specimens in both microscopic interpretation and biomolecular evaluation. The observed distribution patterns and agreement measures, illustrated in Figure 1 and Figure 2, further support the applicability of this technique in routine clinical practice.

Discussion

Precise microscopic evaluation of breast lesions plays a central role in guiding clinical care, prognostic assessment, and therapeutic planning. With the growing use of less invasive diagnostic techniques, minimally invasive tissue sampling has emerged as the preferred initial approach for obtaining material for lesion evaluation. The present investigation examined its diagnostic performance in comparison with surgically obtained specimens and explored the level of agreement in biomolecular marker assessment between the two methods. The findings offer practical insight into the dependability of minimally invasive sampling in routine clinical use.

In the current analysis, minimally invasive tissue sampling demonstrated a high degree of agreement with surgically removed specimens, with most lesions identified on surgical material also correctly characterized using the less invasive approach. These observations are in line with earlier reports describing strong diagnostic performance of this technique, particularly in differentiating benign from malignant pathology [8]. The level of accuracy observed reinforces its suitability as a first-line diagnostic method in the evaluation of breast lesions.

Although overall agreement was substantial, a limited number of cases showed differences between minimally invasive and surgically obtained findings. Such variations were primarily attributed to tissue representation constraints and intralesional variability. Because minimally invasive sampling captures only a small portion of the lesion, areas containing atypical features or higher-grade components may be underrepresented. Comparable findings have been documented in earlier investigations, where discrepancies were noted in lesions initially categorized as benign or atypical on limited tissue sampling but later identified as malignant following surgical removal [9]. These observations underscore the importance of correlating pathological findings with clinical and imaging information and exercising careful judgment in cases with equivocal or suspicious initial results.

The evaluation of molecular markers has become an integral part of breast cancer diagnosis and management. Estrogen receptor, progesterone receptor, human epidermal growth factor receptor 2, and Ki-67 proliferation index provide critical information that guides systemic therapy decisions. In the present study, high concordance was observed for estrogen receptor and progesterone receptor status between core needle biopsy and excision biopsy specimens. This finding aligns with previously published literature indicating that hormone receptor status can be reliably assessed on core biopsy samples [10].

Human epidermal growth factor receptor 2 showed slightly lower concordance compared to hormone receptors. Discordance in HER2 status between core needle biopsy and excision biopsy has been reported in several studies and is often attributed to intratumoral heterogeneity, fixation variables, and interpretation challenges in equivocal cases [11]. Given the significant therapeutic implications of HER2 status, such discordance underscores the need for confirmatory testing on excision biopsy specimens in selected cases, particularly when core biopsy results are equivocal or discordant with clinical and radiological findings.

Ki-67 proliferation index demonstrated moderate variability between core needle biopsy and excision biopsy in the present study. Ki-67 assessment is inherently subject to interobserver variability and regional heterogeneity within tumors. Previous studies have similarly reported lower concordance rates for Ki-67 compared to other molecular markers, reflecting differences in tumor sampling and methodological factors [12]. While Ki-67 evaluation on core biopsy provides useful preliminary information, caution is warranted when using it as the sole determinant for treatment decisions. The clinical implications of these findings are significant. Core needle biopsy offers several advantages, including minimal invasiveness, reduced patient morbidity, lower cost, and shorter diagnostic turnaround time. Its high diagnostic

accuracy and acceptable molecular marker concordance make it a reliable tool for initial diagnosis and treatment planning. However, the limitations observed in certain cases reinforce the continued role of excision biopsy as the definitive diagnostic modality, particularly in cases with discordant findings or when precise tumor characterization is required [13].

Another important aspect highlighted by this study is the role of multidisciplinary collaboration. Optimal interpretation of core needle biopsy findings requires integration of clinical, radiological, and pathological data. Multidisciplinary tumor boards play a crucial role in identifying cases that require further tissue sampling or excision biopsy, thereby minimizing diagnostic errors and ensuring appropriate patient management [14]. The results of this study are particularly relevant in resource-limited settings, where access to advanced diagnostic tools may be constrained. Core needle biopsy, when performed and interpreted correctly, provides a reliable and cost-effective diagnostic approach. Ensuring standardized biopsy techniques, adequate tissue sampling, and adherence to immunohistochemical protocols can further enhance diagnostic accuracy and molecular marker concordance [15].

The present study has certain limitations. Being a single-center study, the findings may not be universally generalizable. Interobserver variability in histopathological and immunohistochemical interpretation was not formally assessed. Additionally, molecular marker evaluation was limited to routinely performed immunohistochemical markers, and advanced molecular assays were not included. Despite these limitations, the study provides valuable real-world data on the performance of core needle biopsy in breast lesion diagnosis [16]. Overall, the findings of this study support the use of core needle biopsy as an effective and reliable diagnostic modality for breast lesions while emphasizing the importance of excision biopsy in resolving diagnostic uncertainty and confirming molecular marker status in selected cases.

Conclusion

The findings of this investigation indicate that minimally invasive tissue sampling is a dependable and efficient approach for evaluating breast lesions, demonstrating strong agreement with surgically obtained specimens for microscopic interpretation and satisfactory consistency for essential biomolecular indicators. The high level of diagnostic performance observed supports the use of this technique as a first-line diagnostic option, given its advantages of reduced procedural burden, quicker turnaround, and economic feasibility. Agreement in hormone receptor assessment was particularly strong, reinforcing the usefulness of early tissue sampling for guiding treatment planning, including decisions related to neoadjuvant and adjuvant therapies. Evaluation of human epidermal growth factor receptor 2 and proliferative activity showed acceptable consistency overall, with discrepancies limited to a small number of cases, largely attributable to tissue sampling constraints, intralesional variability, and interpretative challenges associated with limited specimen volume. These observations highlight the importance of correlating pathological findings with clinical and imaging features and underscore the continued relevance of surgically obtained tissue in situations involving equivocal or discordant results. Overall, the study supports incorporation of minimally invasive sampling as an integral component of the diagnostic workflow for breast lesions, while recognizing surgical excision as essential for comprehensive characterization when required. Implementation of uniform processing protocols, consistent handling procedures, and rigorous quality control can further enhance diagnostic reliability and contribute to informed, evidence-based clinical decision-making in breast lesion management.

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