



## Comparative Diagnostic Accuracy of Fine-Needle Aspiration Cytology and Histopathology in Palpable Breast Lumps in Benue State University Teaching Hospital, Makurdi.

OnyewuchiAJ<sup>1</sup>, Ekeh BA<sup>2</sup>, Ojo BA<sup>3</sup>, Misauno<sup>4</sup>, Gbaa LZ<sup>2</sup>, Bamidele IO<sup>2</sup>, Inienger RD<sup>2</sup>.

<sup>1.</sup> Department of Surgery, Federal University of Health Sciences, Otuipo, Nigeria.

<sup>2.</sup> Department of Surgery, Benue State University, Makurdi, Nigeria.

<sup>3.</sup> Department of Anatomical Pathology, Benue State University, Makurdi, Nigeria.

<sup>4.</sup> Department of Surgery, University of Jos, Jos, Nigeria.

Corresponding author: Dr. Amina

### Abstract:

#### Background:

Fine-needle aspiration cytology (FNAC) is a minimally invasive, cost-effective diagnostic tool for evaluating palpable breast lumps, especially in resource-limited settings. However, its diagnostic concordance with histopathology—considered the gold standard—varies and necessitates contextual evaluation.

#### Objective:

To determine the diagnostic accuracy of FNAC in comparison with histopathological findings in patients with palpable breast lumps at Benue State University Teaching Hospital (BSUTH), Makurdi.

#### Methods:

This retrospective cross-sectional study evaluated 100 patients with palpable breast lumps who underwent both FNAC and subsequent open surgical biopsy between January 2020 and December 2023. Cytological diagnoses were classified using the UK NHS Breast Screening Programme (C1–C5) and correlated with histopathological outcomes. Diagnostic indices—sensitivity, specificity, accuracy, PPV, and NPV—were calculated.

#### Results:

The mean age of patients was  $41.8 \pm 15.3$  years. FNAC yielded 5% C1 (inadequate), 43% C2 (benign), 13% C3 (probably benign), 13% C4 (probably malignant), and 26% C5 (malignant). Histopathology revealed 53% benign and 47% malignant cases. FNAC demonstrated a sensitivity of 96.3%, specificity of 91.5%, diagnostic accuracy of 97.2%, PPV of 96.3%, and NPV of 97.7%. False positive and false negative rates were both 3.7%.

#### Conclusion:

FNAC showed high diagnostic accuracy and strong correlation with histopathology, affirming its reliability for initial evaluation and triaging of breast lumps. It remains an essential component of the triple diagnostic approach, especially in low-resource settings like North-Central Nigeria.

**Keywords:** Breast lumps, cytology, Diagnostic accuracy, Fine-needle aspiration, Histopathology, North-Central Nigeria, Palpable breast mass, Sensitivity, Specificity.

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### I. Introduction

Breast lumps are among the most common clinical presentations in women across all age groups and represent a significant proportion of surgical outpatient consultations globally and in sub-Saharan Africa (SSA)<sup>1,2</sup>. While most breast lumps are benign, the potential for malignancy necessitates prompt and accurate diagnostic evaluation to guide clinical management<sup>3</sup>. The standard diagnostic approach traditionally integrates the triple assessment which includes; clinical examination, imaging, and pathological evaluation to achieve high

diagnostic accuracy<sup>4</sup>. Among the pathological modalities, fine-needle aspiration cytology (FNAC) and core needle biopsy with histopathological examination are widely utilised.

FNAC is a minimally invasive, cost-effective, and rapid diagnostic tool that plays a pivotal role in the preoperative assessment of palpable breast lesions, especially in low- and middle-income countries (LMICs), where access to advanced imaging and histopathological services is limited<sup>5,6</sup>. It allows early diagnosis, helps stratify patients for surgery, and reduces unnecessary excisional biopsies<sup>7</sup>. FNAC has shown sensitivity and specificity rates ranging between 80–98% and 85–100%, respectively, in high-resource settings<sup>8</sup>. In Nigeria and across SSA, FNAC remains widely used due to its affordability, availability, and ease of use in resource-constrained environments<sup>9,10</sup>.

However, FNAC is not without limitations. It is operator-dependent, lacks architectural context, and may yield indeterminate or inadequate samples, particularly in cystic, sclerotic, or small lesions<sup>11,12</sup>. False negatives can delay diagnosis and treatment, especially in low-resource settings where confirmatory core biopsy or histopathology may be delayed or unavailable<sup>13</sup>. In contrast, histopathological examination of biopsy or excised tissue remains the gold standard for definitive diagnosis due to its superior ability to evaluate tissue architecture and determine tumour grade and receptor status<sup>14</sup>.

Despite its widespread use, the concordance between FNAC and histopathological diagnosis in palpable breast lumps remains variable across studies. Some Nigerian and SSA studies have reported high diagnostic accuracy of FNAC<sup>15-17</sup>, while others have highlighted significant discrepancies that raise concerns about sole reliance on cytology<sup>18-20</sup>. Given this context, it is important to locally evaluate FNAC performance against histopathology, particularly in tertiary centres serving large populations with limited diagnostic infrastructure.

This study aims to compare the diagnostic accuracy of FNAC with histopathological examination in the evaluation of palpable breast lumps at Benue State University Teaching Hospital (BSUTH), Makurdi, North-Central Nigeria. The findings will contribute to local data, validate FNAC's reliability, and guide best practices in breast lump assessment within similar healthcare settings.

## **II. Materials and Methods**

This was a retrospective descriptive study conducted at the Department of General Surgery in collaboration with the Pathology department, Benue State University Teaching Hospital (BSUTH), Makurdi, Nigeria, over 3 years from January 2020 to December 2023.

All patients who underwent fine-needle aspiration cytology (FNAC) for palpable breast lumps, followed by histopathological examination of corresponding biopsy or excision specimens, within the study period, were included. Cases were excluded if they had incomplete records, or if histology was not performed or unavailable.

FNAC was performed using a 23–25-gauge needle attached to a 10 mL syringe without local anaesthesia. Aspirated material was smeared onto clean glass slides, air-dried or alcohol-fixed, and stained using Giemsa and Papanicolaou stains.

Subsequently, core needle biopsies or excisional biopsies were obtained from the same lesion and processed for routine haematoxylin and eosin (H&E) staining for histopathological evaluation.

Cytological findings were classified based on standard reporting categories (benign, suspicious, malignant, or inadequate). Histopathological diagnoses served as the gold standard. All cytological and histopathological slides underwent independent evaluation by at least two consultant pathologists to improve diagnostic reliability and ensure inter-observer consistency.

Data were entered and analysed using SPSS version 25.0 (IBM Corp, Armonk, NY, USA). FNAC results were compared with histopathology to determine: Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), and overall diagnostic accuracy. Results were presented in frequency tables and cross-tabulations, and diagnostic indices were calculated using standard 2×2 contingency tables.

## **III. Results:**

The study included 100 patients presenting with palpable breast lumps. The mean age was 41.8 years ( $\pm 15.3$ ), with a broad range of 20 to 80 years. The 20–29-year age group was the most frequently affected, suggesting a predominance of benign breast conditions in younger women, although the overall age distribution reflects the possibility of both benign and malignant pathologies across age groups.

Fine-needle aspiration cytology (FNAC) achieved a high diagnostic yield, with only 5% of cases categorised as inadequate (C1). The largest category was benign lesions (C2), accounting for 43% of cases, followed by malignant diagnoses (C5) at 26%. Equivocal categories, C3 (probably benign) and C4 (probably malignant), each contributed 13% of cases, highlighting the inherent challenge in categorising borderline lesions cytologically. The distribution reflects an effective triage of patients using FNAC, although it underscores the importance of further tissue diagnosis in indeterminate cases.

Histology confirmed 53% of the cases as benign and 47% as malignant. Among the benign lesions, fibroadenoma was predominant, while invasive ductal carcinoma was the most common malignancy. This diagnostic spectrum is consistent with patterns typically seen in symptomatic breast presentations. The histopathologic classification provided definitive confirmation and essential prognostic information, particularly for malignant lesions requiring further oncologic management.

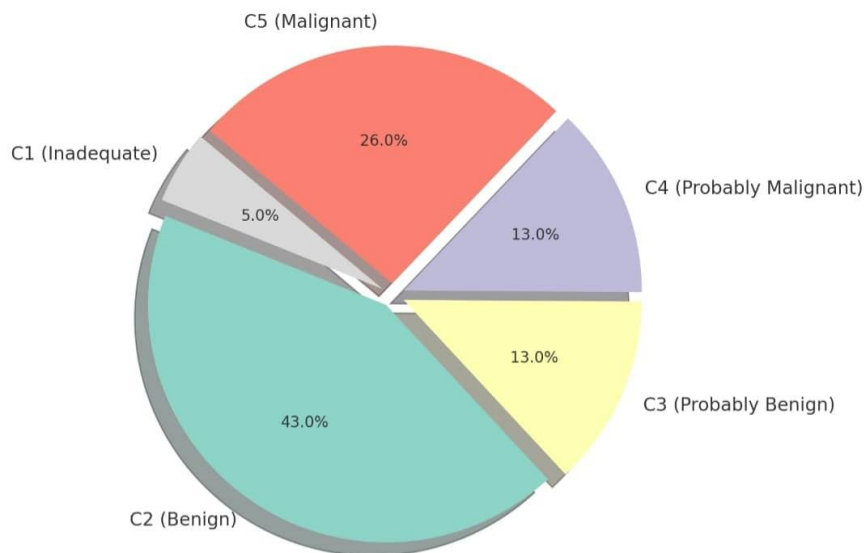
There was strong concordance between FNAC and histopathological outcomes. Among the 26 FNAC-diagnosed malignant cases (C5), 25 were confirmed malignant on histology, with one false positive. Conversely, among 43 benign FNAC cases (C2), only one was false negative. C3 and C4 categories showed mixed outcomes, with a near-equal distribution between benign and malignant histology, reinforcing the need for further biopsy in cases classified as indeterminate or suspicious.

The performance metrics of FNAC in this study are notably high:

- **Sensitivity:** 96.3%
- **Specificity:** 91.5%
- **Positive Predictive Value (PPV):** 96.3%
- **Negative Predictive Value (NPV):** 97.7%
- **Diagnostic Accuracy:** 97.2%
- **False Positive Rate:** 3.7%
- **False Negative Rate:** 3.7%

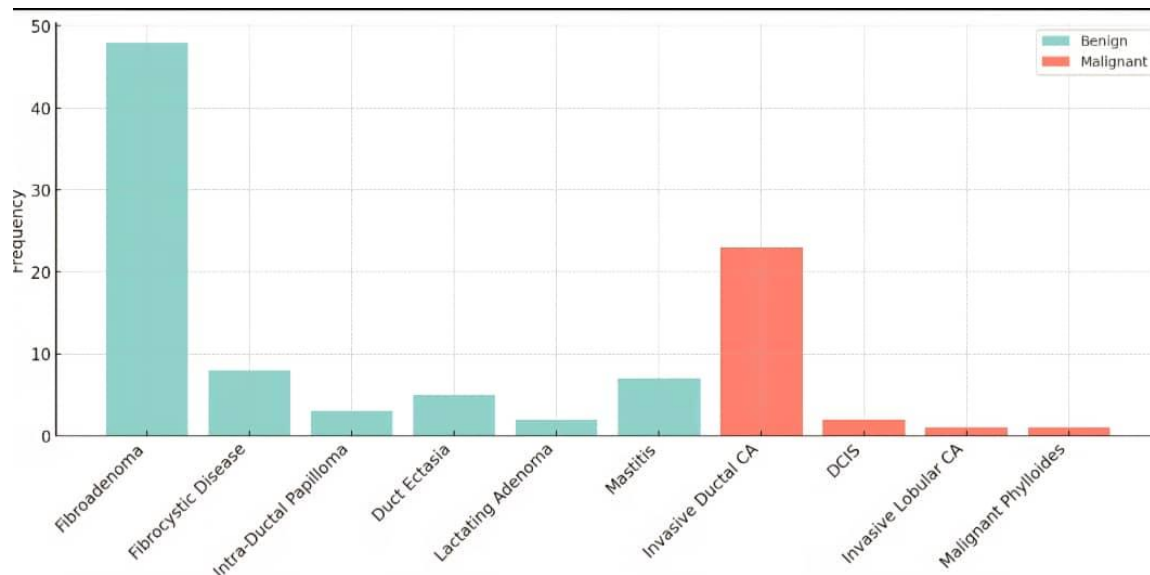
These results demonstrate that FNAC is a highly reliable tool for diagnosing palpable breast lesions, with a strong ability to rule in and rule out disease. The low false-negative and false-positive rates indicate robust quality control and skilled cytologic interpretation. The high NPV is particularly significant in clinical settings where minimising unnecessary surgery for benign disease is a priority.

**Figure 1: Distribution of FNAC Cytological Categories in Palpable Breast Lumps**



Diagnosis by Open Surgical Specimen (n=100)

**Figure 2: Histopathological Diagnosis of Palpable Breast Lumps**



**Table 1: Correlation of FNAC Results with Histopathological Diagnosis in Palpable Breast Lumps**

FNAC	Open Surgical specimen		Total Number of Patients
	Benign (n=53)	Malignant (n=47)	
C1-Unsatisfactory	3	2	5(5%)
C2-Benign	42	1 (FN)	43 (TN)(43%)
C3- Atypical Probably Benign	6	7	13 (13%)
C4- Suspicious, Probably Malignant	0	13	13 (13%)
C5- Malignant	1 (FP)	25	26 (TP)
	53(53%)	47(47%)	100 (100%)

Specificity, sensitivity, diagnostic accuracy, positive predictive value, and negative predictive value were calculated by using the following formulas.

**Specificity**

Measures the test’s ability to correctly identify those without the disease (true negatives).

**Formula:**

Specificity= $TN / (TN + FP) \times 100$

- **TN** = True Negatives (FNAC correctly identifies a benign case)
- **FP** = False Positives (FNAC incorrectly reports a benign case as malignant)

**Sensitivity:**

$26 / (26 + 1) \times 100 = 26 / 27 \times 100 \approx 96.3\%$

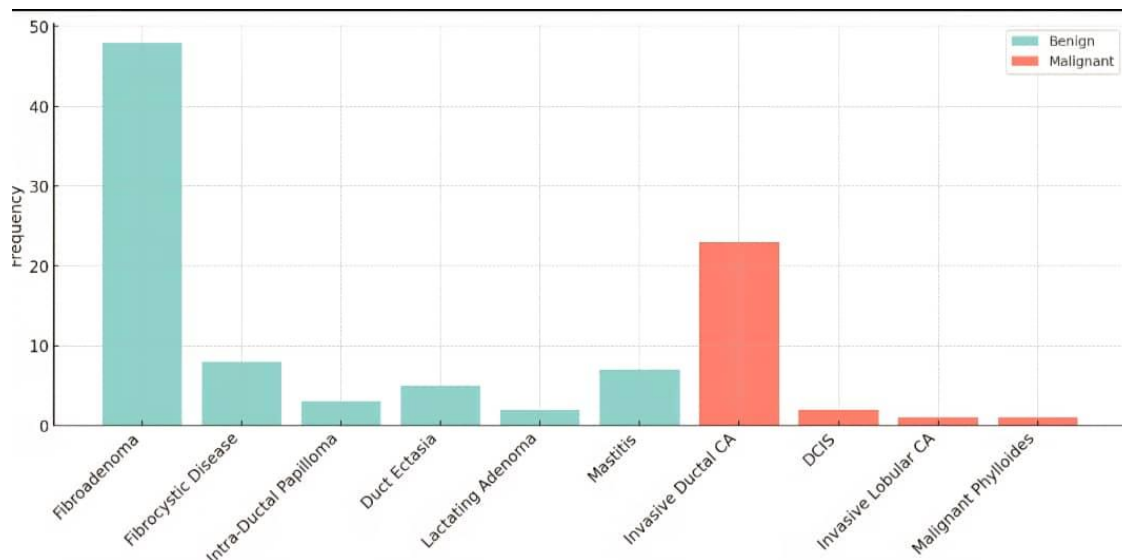
**Specificity:**

$43 / (43 + 1) \times 100 = 43 / 44 \times 100 \approx 97.7\%$

**Table 2: Comparative Analysis of Diagnostic Accuracy and Error Rates of FNAC in Breast Lesions Across Studies**

FNAC studies done	Diagnostic Accuracy	False Positive Rate	False Negative Rate
Present study	97.2%	3.7%	3.7%
Khattak MS et al 2020	98.78%	0.00%	1.53%
David Ibikunle et al, 2017	99.3%	0.00%	0.63%
Prachi Garg et al 2017	94%	0.4%	0.8%
Mulka J. et al 2017	96.6%	4.0%	15.0%
Mahajan et al 2013	98.11%	1.0%	1.0%
Phui-Ly Liew et al, 2010	92.4%	0.00%	11.5%

**Figure 3: Comparative Analysis of Diagnostic Accuracy and Error Rates of FNAC in Breast Lesions Across Studies**



Here is the **grouped vertical bar chart** comparing the diagnostic accuracy, false positive rate, and false negative rate across various FNAC studies. Each group of bars represents one study, allowing a clear visual comparison of diagnostic performance metrics.

#### IV. Discussion

This study reinforces the diagnostic reliability of fine-needle aspiration cytology (FNAC) in the evaluation of palpable breast lumps, a conclusion that aligns with a growing body of literature globally and within sub-Saharan Africa. With a diagnostic accuracy of 97.2%, sensitivity of 96.3%, and specificity of 91.5%, the performance of FNAC in this cohort mirrors or exceeds findings from comparable tertiary hospital-based studies across Nigeria and other low- and middle-income countries (LMICs)<sup>21-24</sup>.

The demographic distribution observed, with a mean age of 41.8 years and peak incidence in the 20–29-year age group, aligns with trends seen across Nigeria and West Africa, where breast diseases, particularly benign fibroadenomas are common in young women<sup>25-28</sup>. However, the proportion of malignant lesions (47%) in this study is notable and reflective of late presentation and poor screening uptake, which are persistent challenges in Nigeria and sub-Saharan Africa,<sup>29-31</sup>. This contrasts with high-income countries, where malignant lesions typically occur at later ages and are often detected earlier due to widespread mammographic screening<sup>32</sup>.

The high concordance observed between FNAC and histopathology, particularly in the C2 (benign) and C5 (malignant) categories, underscores FNAC's diagnostic power when interpreted by experienced cytopathologists<sup>33-35</sup>. Similarly, high levels of diagnostic agreement have been reported in studies from Ibadan<sup>36</sup>, Ilorin<sup>37</sup>, Jos<sup>38</sup>, and Benin City<sup>39</sup>. FNAC demonstrated a low false negative rate (3.7%), comparable to findings by Akinkuolie et al.<sup>40</sup> in Osogbo and Adebamowo et al.<sup>41</sup> in Ibadan, where meticulous technique and multi-pathologist review minimised interpretive errors.

The intermediate cytological categories C3 and C4, remained diagnostically ambiguous in this study, with nearly equal benign and malignant outcomes. This ambiguity has been echoed in studies from Enugu<sup>42</sup>, Makurdi<sup>43</sup>, and Kano<sup>44</sup>, and emphasises the limitation of FNAC in these equivocal cases. Such findings reinforce the recommendation that all C3 and C4 lesions should undergo core needle biopsy or excisional biopsy for definitive histological evaluation<sup>45,46</sup>.

Globally, the role of FNAC remains integral in initial breast lump assessment, particularly in LMICs where access to radiologic-guided core biopsy is limited. Studies in India<sup>47</sup>, Egypt<sup>48</sup>, and Malaysia<sup>49</sup> have reported diagnostic accuracies ranging from 92% to 99%, validating its clinical utility across diverse settings. A comparative evaluation with studies by Khattak et al.<sup>50</sup>, Garg et al.<sup>51</sup>, and Liew et al.<sup>52</sup> supports the reliability of FNAC when performed under standardised protocols.

In the Nigerian context, FNAC remains the frontline diagnostic tool for breast masses due to its cost-effectiveness, safety, and accessibility. Institutions in North Central Nigeria—including Jos<sup>53</sup>, Lokoja<sup>54</sup>, and Ilorin<sup>55</sup> have published similar findings, affirming FNAC's relevance in regional diagnostic algorithms.

However, the method remains dependent on operator skill and cytological expertise, and misclassification risks persist, particularly in cystic, necrotic, or poorly cellular lesions<sup>56</sup>.

The histopathological spectrum in this study, where fibroadenoma was the most common benign lesion and invasive ductal carcinoma (IDC) the leading malignancy, is consistent with established literature from Nigeria<sup>57-59</sup>, Ghana<sup>60</sup>, Kenya<sup>61</sup>, and Rwanda<sup>62</sup>. IDC's dominance among malignancies also underscores the urgent need for early detection strategies, as most patients in LMICs still present at advanced stages<sup>63,64</sup>.

Importantly, this study adds to the limited data from Benue State and the surrounding North Central regions by providing updated, institution-based performance metrics of FNAC. With robust diagnostic accuracy comparable to larger tertiary centres, the findings underscore the potential of scaling FNAC services in secondary and rural facilities to bridge diagnostic gaps<sup>65,66,67</sup>.

While FNAC cannot fully replace histology, particularly for tumor subtyping or hormone receptor analysis, its role in triaging palpable breast lumps remains undisputed. It should remain a core part of the triple assessment approach, especially in settings where histopathology turnaround times are prolonged, resources are limited, and timely clinical decision-making is critical for optimal patient outcomes.

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We received no funding for this study.

#### **Conflict of Interest:**

None

#### **Ethical Considerations:**

Approval for the study was obtained from the Health Research and Ethics Committee of the Benue State University Teaching Hospital, Makurdi. Patient confidentiality was maintained by anonymising all data during collection and analysis.

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