International Journal of Clinical Trials
Sinha K et al. Int J Clin Trials. 2026 May;13(2):161-167
http://www.ijclinicaltrials.com
pISSN 2349-3240 | eISSN 2349-3259
DOI: https://dx.doi.org/10.18203/2349-3259.ijct20261380

Original Research Article

Robinson cytological grading in breast carcinoma and its correlation with histopathological grading: a five-year retrospective study

Khushboo Sinha*, Sudha Iyengar, Reema Bhushan

Gajra Raja Medical College, Gwalior, Madhya Pradesh, India

Received: 09 December 2025
Revised: 09 February 2026
Accepted: 16 February 2026

***Correspondence:**
Dr. Khushboo Sinha,
E-mail: khushboossinha93@gmail.com

ABSTRACT

Background: Tumor grading is essential for prognosis and treatment planning in breast cancer due to the tumors strong biological heterogeneity. Although histopathological grading is still considered the best method, cytological grading with fine needle aspiration cytology (FNAC) provides a short and non-invasive substitute.
Methods: There were 120 instances of breast cancer identified by FNAC with accessible matched histology in this five-year retrospective research. Modified Bloom-Richardson (Nottingham) (MBR) approach was used to evaluate histopathological grading, whereas Robinson's six-parameter scoring system was used for cytological grading.
Results: The majority of cytologically graded tumors (51.7%) were grade II, followed by grade III (33.3%) and grade I (15.0%). A similar pattern was seen in histopathological grading, with grade II (48.3%) predominating. There was a 72.5% overall cyto-histological concordance, with grade III tumors showing the best agreement (82.5%). As cytological grade increased, lymph node positivity rose from 16.7% in grade I to 75.0% in grade III. A delayed diagnosis was indicated by the majority of tumors (59.2%) measuring between 2 and 5 cm upon presentation.
Conclusions: Robinson's cytological grading method is a straightforward, repeatable, and useful preoperative prognostic tool that has a good connection with lymph node metastases and histological grading.

Keywords: Breast carcinoma, FNAC, Robinson cytological grading, Histopathological grading, Cyto-histo concordance, Lymph node metastasis, Tumor aggressiveness

INTRODUCTION

Background and significance

Breast carcinoma is among the commonest type of malignancy that afflict women in the global population and is also a significant health issue of societal concern because of the rising incidence, morbidity, and mortality rate.[1] The breast cancer has remained one of the major causes of cancer related deaths among women in the world although there have been outstanding achievements in the diagnostic and treatment modalities.[2] The world health organization (WHO) suggests that breast cancer is almost 2.3 million cases per year, as well as about 11.7 percent of cancer cases. Breast cancer is the leading malignancy in women in India where it has overtaken cervical cancer and a high rate is observed among both the urban and rural population.[3]

Biological behavior of breast carcinoma is very heterogenous. Having similar histological appearances, tumors can have dramatically different clinical outcomes, responses to therapy and prognosis.[4] Consequently, it is essential to find a precise and trustworthy way of evaluating the level of aggressiveness and grade of the tumor prior to having ultimate surgery.[5] Grading systems are important in the determination of the tumor differentiation, clinical behavior prediction and in making therapeutic decisions. Histopathological grading based on biopsy or surgical specimens is traditionally considered to be the gold standard of measuring tumor grade.[6] The Nottingham modification of the Bloom Richardson system is the most utilized system of histopathological

grading system, in which three morphological parameters that were assessed include tubule formation, nuclear pleomorphism, and mitotic count.[7]

On the contrary, FNAC has been introduced as a simple, minimally aggressive, fast, and less expensive method of diagnosing breast lesions.[8] FNAC is a method of diagnosis that is commonly used as pre-test since it takes a short duration to complete minimal pain to the patient, and it can be used to differentiate between benign and malignant lesions.[9] Cytological grading of breast carcinoma has received significant interest over the past years, as it may both give important prognostic information prior to surgery and assist in the neoadjuvant management planning.[10] The idea behind cytological grading is to replicate the histopathological grading, therefore, allowing clinicians to know in advance what the tumor is going to do prior to removing it.

Need for cytological grading

FNAC has been a regular method of diagnosing carcinoma of the breast, but the possibility of giving prognostic information by grade was not investigated initially.[11] Cytological grading is used to fill the gap between diagnosis and preoperative prognostication. It provides a chance to assess the aggressiveness of the tumor, potential histologic grade, and potential response to the treatment, by assessing nuclear and cytoplasmic characteristics of malignant cells.[12] Given the number of cytological grading systems that have been proposed over the years, including Fisher, Hunt, Black and Mouriquand, the cytological grading system (introduced in 1994) proposed by Robinson has gained widespread acceptance because it is simple, reproducible, and highly correlates with histopathological grading.[13]

Robinson cytological grading system

Robinson et al developed a six-parameter (morphological) cytological grading technique using six morphometric parameters: Cell dissociation, cell size, cell uniformity, nucleoli, nuclear margins, and chromatin pattern.[14]

The parameters are rated on a scale of 1 to 3 and the summation of the answers establishes the cytological grade as grade I (3 -11 points), grade II (12-14 points), and grade III (15-18 points).[15] The system is beneficial in that it is based entirely on cytological features, it does not need any special staining or complex instruments, and it can be readily reproducible among cytopathologists. It provides a fast and effective analysis of tumor grade in small FNAC samples.[16]

The Robinson system has been confirmed by several studies that reveal good correlation with histopathological grading proving the prognostic importance of the system.[17] Close agreement between cytological and histological grades assists clinicians to decide on whether to apply aggressive management, chemotherapy, or radiotherapy before the surgical excision.[18] Besides, cytological grading assists in the counseling of patients and planning the treatment, particularly in the environment where the histopathological examination might not be provided immediately.[19]

Histopathological grading and its correlation

Histopathological grading is still the only ultimate process of evaluating tumor aggressiveness and prognosis. The resulting histopathological grading standard, the MBR system, is a system of scoring three features at 1 to 3, including tubule formation, nuclear pleomorphism and mitotic count.[20] The overall score is used to classify based on grade I (well-differentiated), grade II (moderately differentiated), and grade III (poorly differentiated). The histological grade is related to prognosis of the patient, recurrence rate, and survival. Consequently, any cytological grading method that is to be applied to clinical practice must exhibit a strong relationship with the histopathological grading to guarantee its reliability and prognostic validity.[21]

Rationale of the study

Accurate grading is crucial for prognosis and treatment planning due to the substantial heterogeneity of breast cancer. The gold standard, histopathological grading, is intrusive and not usually accessible, but it is reliable. A straightforward, quick, and non-invasive approach is Robinson's cytological grading using FNAC. In order to confirm its usefulness as a preoperative prognostic tool, this study was conducted to evaluate its efficacy and connection with histopathological grading.

METHODS

The current research is diagnostic consistency and reliability, this five-year retrospective study compared Robinson's cytological grading with MBR histopathological grading in breast carcinoma using patient records, histopathology reports, and archived cytology slides.

Study area

This research patients diagnosed January between 2020 and 2024 were included for retrospective cytology-histology correlation in the study, which took place at the department of pathology of a tertiary care teaching hospital that serve both urban and rural populations.

Study population

The population of the study was identified as the female patients that were diagnosed with breast carcinoma using the method of FNAC and received the surgical or biopsy of the breast lesion in the same institution, enabling the access to both cytological and histopathological data.

Inclusion criteria

All female patients with a positive cytological diagnosis of malignant breast lesion (C5 category according to IAC guidelines). Both corresponding FNAC and histopathological slides/reports are available. Full patient demographic and clinical information can be accessibly obtained in institutional records. Sufficient cytology specimen to grade, according to Robinson were included in the study.

Exclusion criteria

Cases with benign (C2) or suspicious (C3/C4) diagnosis in cytology and patients who did not have similar histopathological data were excluded.

Duration of the study

The study period encompassed five years (January 2020-December 2024). The period of data collection and analysis was January to June 2025.

Sampling technique

The research method technique is in every instance of breast cancer identified by FNAC that fulfilled the inclusion criteria during the research period was included using a purposive sample method. Patient IDs to track down corresponding histology reports, and we only included instances with comprehensive and consistent data in our final study.

Study variables

Primary variables

Finding by Robinson system of grading cytology, histopathological grading is based on the MBR (Nottingham) grading system.

Secondary variables

Age of the patient, lesion laterality (right/left breast), tumor size (in cm) of a patient and status of lymph node (records, where available).

Histopathological grading system

Grading was done histologically using the MBR system (Nottingham modification) which examines three characteristics: Tubule formation, nuclear pleomorphism and mitotic count.

The parameters have a score ranging between 1 and 3 each, and a combination of scores determine the histologic grade: Grade I (Well differentiated): 3-5, grade II (Moderately differentiated): 6-7 and grade III (Poor differentiation): 8-9.

RESULTS

Distribution of breast carcinoma cases

A total of 120 confirmed breast carcinoma cases with both FNAC and histopathology correlation were included in the study (January 2020-December 2024).

Table 1: Age-wise distribution of cases, (n=120).

Age group (in years)	N (%)
21-30	6 (5.0)
31-40	22 (18.3)
41-50	48 (40.0)
51-60	32 (26.7)
>60	12 (10.0)
Total	120 (100)

Table 1 shows that the age distribution of 120 instances of breast cancer is shown in the table. The age group of 41-50 years old had the highest number of instances (40.0%), followed by the group of 51-60 years old (26.7%). 18.3% of instances involved patients between the ages of 31 and 40.

Women over 60 accounted for a lower percentage of instances (10.0%), while those between the ages of 21 and 30 accounted for the fewest cases (5.0%).

Cytological grading by Robinson's system

All 120 FNAC smears were graded using Robinson's 6-parameter scoring.

Table 2: Distribution of cytological and histopathological grading of breast carcinoma case, (n=120).

Grading method	Grade	N	Percentage (%)
Cytological grading	Grade I	18	15.0
	Grade II	62	51.7
	Grade III	40	33.3
Histopathological grading	Grade I	20	16.7
	Grade II	58	48.3
	Grade III	42	35.0
Total		120	100

The Table 2 shows that the cytological grading of the breast cancer patients revealed that grade II accounted for 51.7%, grade III for 33.3%, and the grade I for the 15.0%.

The histopathological grading followed a similar trend, with Grade II tumors being the most common (48.1%), followed by grade III (35.0%), and grade I (16.7%), suggesting that the majority of the tumors in the study group were intermediate-grade.

Cyto-histological concordance

A direct correlation between Robinson cytologic grade and histopathological grade was assessed.

Table 3: Correlation between cytological and histological grades, (n=120).

Cytological grade	N	Concordance
Grade I ↔ grade I	14	77.8%
Grade II ↔ grade II	40	64.5%
Grade III ↔ grade III	33	82.5%
Total concordant	87	72.5%

Table 3 demonstrates that the histological and cytological classifications of breast cancer are in good agreement. A 72.5% overall concordance was noted. Grade III cancers had the best concordance (82.5%), followed by grade I tumors (77.8%), suggesting that cytology can reliably identify low- and high-grade lesions. The varied character of intermediate-grade cancers was reflected in the somewhat lower concordance (64.5%) of grade II tumors.

Lymph node status in relation to cytological grade

Lymph node involvement was evaluated where records were available.

Table 4: Lymph node involvement according to cytological grade, (n=120).

Cytological grade	Node positive	Node negative	Node positive (%)
Grade I	3	15	16.7
Grade II	18	44	29.0
Grade III	30	10	75.0
Total	51	69	-

Table 4 grade I cancers had the lowest lymph node positive rate (16.7%), grade II tumors had an intermediate rate (29.0%), and grade III tumors had the greatest rate (75.0%).

Laterality and tumor in breast carcinoma cases

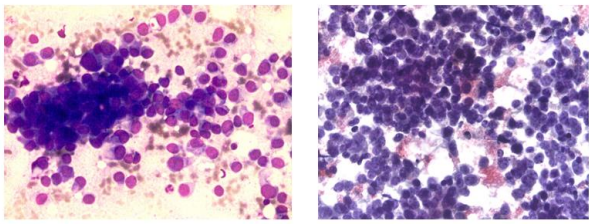
Table 5 shoes that the distribution of breast lesions revealed that the right breast was somewhat more affected than the left (53.3% vs. 46.7%). Tumor size was a key factor in patient presentation; 59.2% of cases had tumors measuring 2-5 cm, 22.5% had tumors greater than 5 cm, and 18.3% had tumors less than 2 cm. This suggests that most patients had tumors of intermediate size.

Cytological parameter scoring patterns (Robinson's system)

The majority of the cytological parameters had a score of 2, which indicates moderate atypia. On the other hand, a large number of instances had nucleoli and chromatin patterns with a score of 3, which indicates obvious high-grade nuclear characteristics.

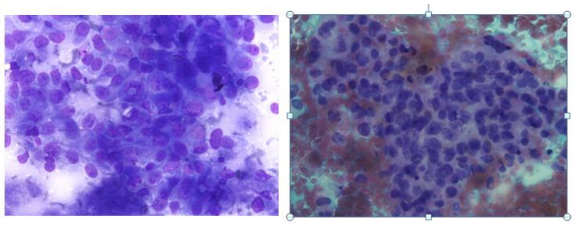
Table 5: Distribution of breast lesions according to laterality and tumor size.

Variables	Category	N	Percentage (%)
Laterality of breast lesions	Right breast	64	53.3
	Left breast	56	46.7
Tumor size distribution	<2 cm	22	18.3
	2-5 cm	71	59.2
	>5 cm	27	22.5
Total		120	100



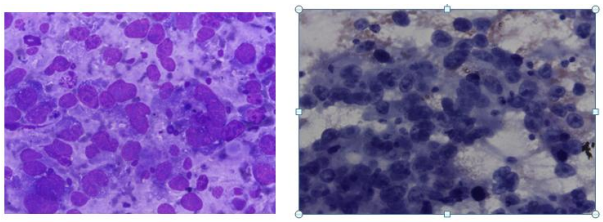
(a) Cytology examination (b) Histology examination

Figure 1: Invasive ductal carcinoma, Robinson's grade I (a) MGG stain, (b) PAP stain, 40×.
Microscopic image of 56-year female which was reported as grade II carcinoma breast in cytology as well as histology examination.



(a) Cytology examination (b) Histology examination

Figure 2: Invasive ductal carcinoma, Robinson's grade II. (a) MGG stain, (b) PAP stain, 40×.
A 70 year old women which was reported as grade III both in cytology and histology examination.



(a) Cytology examination (b) Histology examination

Figure 3 (a and b): Invasive ductal carcinoma NOS, Robinson's grade III (a) MGG stain, (b) PAP stain, 40×.

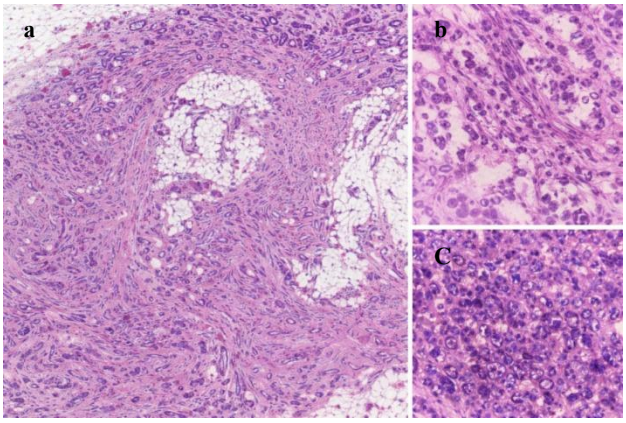


Figure 4 (a and b): The merged photomicrograph shows invasive ductal carcinoma, NOS on H and E stain.

At 10×, infiltrating tumor with gland and tubule formation is seen. At 40×, irregular tubules with nuclear pleomorphism and areas showing solid nests of tumor cells without tubule formation, marked nuclear atypia, and prominent nucleoli are evident.

A 57 year old women which was reported as grade I breast carcinoma both in cytology and histology examination.

Table 6: Cytological parameter scoring trend, (n=120).

Cytological parameter	Most frequent score	Observation frequency
Cell dissociation	Score 2	48.0%
Cell size	Score 2	52.5%
Cell uniformity	Score 2	49.0%
Nucleoli	Score 3	41.0%
Nuclear margins	Score 2	46.0%
Chromatin pattern	Score 3	38.5%

DISCUSSION

The present research offers the necessary information regarding the cytomorphology, grade distribution, and aggressive behavior of breast carcinoma in a tertiary-care hospital in North India. The results indicate that there are more intermediate and high-grade tumors, high cyto-histological concordance and high correlations among cytological grade, lymph node metastasis, and tumor size based on 120 paired FNAC and histopathology in proper cases.

The pattern of cytological grading showed that Grade II tumors comprised over half of all tumors (51.7%), then grade III tumors (33.3%). Such results are like other Indian reports who report higher proportions of grade I tumors detected early (Rakha et al).[6] because of the care outreach, awareness, and infrastructure systemic differences. The low rate of grade I (15 percent) in the current study indicates the lack of early diagnosis and is like epidemiological trends on a national level.

Grade II tumors (48.3%), grade III tumors (35) predominantly occurred histopathologically, which reflected the cytological distribution picture, and emphasized the real picture of the biological profile of breast carcinoma in this population. Its equivalence with cytology in our results is observed in previously conducted Indian studies to assess the Nottingham grading system (Srivastava et al).[14] The high compatibility of our results with cytology supports the diagnostic value of a FNAC where histopathology is either lagged or unavailable.

The study's most significant finding was the overall cyto-histological concordance rate of 72.5%, with Grade III tumors showing the best agreement at 82.5%. Because of the morphological superimposition and heterogeneity of intermediate-grade lesions, the Robinson cytological grading system is frequently regarded by cytopathologists as one of the simplest and most repeatable methods for identifying breast carcinoma. These high concords have been consistently noted in both international and Indian literature (Sinha and Gill).[24] Additionally, grade II tumors had a moderate concordance (64.5%), which is intrinsic to the grade I tumors' strong concordance (77.8%).

One of the strengths of this study was the correlation of cytological grade and metastasis in the lymph node. The rate of node positivity was increasing dramatically as grade I tumors had a rate of 16.7% to grade II having a rate of 29% and worst of all grade III tumors having a rate of 75%. Such high steepness is reflective of evidence in the world where nuclear atypia and chromatin aberrancy, as well as cell heterogeneity, are associated with metastatic potential and worse cancer biology (Kalhan et al).[23] just as the virulence characteristics of MRSA infections are protected by clinical severity. The implications of these findings on public health are also high: when a person is found to be positive at the time of diagnosis, it indicates a weakness in the screening, early referral, and community awareness.

The distribution of tumors size is another evidence of delayed diagnosis. The proportion of tumors with a diameter smaller than 2 cm was only 18.3 and the proportion of tumors with a diameter of 2-5, and tumors more than 5 cm was 59.2 and 22.5, respectively. These results are similar to national data that show that a significant number of Indian women continue to be diagnosed only when tumors are palpable or show signs (Anusha).[20] The bigger the tumor size, the higher the histological grades and the number of lymph nodes involved, which complicates the disease progression and the process of treatment.

The trends of cytology parameter scoring in this work, particularly, the presence of score-3 nucleoli (41%), coarse chromatin (38.5%), etc., indicate the presence of

aggressive nuclear features. These phenomena are in line with the nuclear morphometric findings that have attributed such characteristics to the high-grade histology and poor prognosis (Kaur et al).[25] Moderate atypia in cell size, margins, and dissociation was associated with the prevalence of grade II tumors and reflect the anticipated morphological spectrum in the group.

Limitations

The study's limitations include its reliance on archive data quality, the lack of molecular or immunohistochemical association, the diversity in FNAC smear interpretation, and the study's limited generalizability beyond the institution. On the other hand, the retrospective design does have practical and ethical advantages. Despite these caveats, the study adds to our understanding of how reliable and practical Robinson's cytological grading is in low-resource situations.

CONCLUSION

The current five year retrospective study proves that Robinson cytological grading is a valid and useful clinical tool in the evaluation of breast carcinoma with an overall cyto-histological concordance rate of 72.5% with the MBR system with a high rate of grade III tumors (82.5%), which also exhibits the highest rate of lymph node positivity (75%), reflecting aggressive biological behavior. Grade II and III predominant and observation that more than 80 percent of the lesions at diagnosis occupied more than 2 cm point out to late presentation and poor early detection in the study group. Cytological alterations like prominent nucleoli and coarse chromatin were highly associated with high-grade malignancy proving effective scoring parameters set by Robinson.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sinha K, Iyengar S, Bhushan R. Robinson cytological grading in breast carcinoma and its correlation with histopathological grading: a five-year retrospective study. Int J Clin Trials 2026;13(2):161-7.