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# Correlation between Robinson's Cytological Grading with Modified Bloom-Richardson Histopathological Grading for Infiltrating Ductal Carcinoma of Breast by Tumour Imprint

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## ABSTRACT

**Background:** Breast carcinoma remains one of the most common malignancies worldwide, and accurate tumour grading is essential for prognostication and therapeutic decision-making. Tumour imprint cytology provides rapid intraoperative cellular assessment with excellent nuclear detail, enabling the application of Robinson's cytological grading system. Establishing its correlation with the Modified Bloom–Richardson histopathological grading can help determine its reliability as an early prognostic tool. The aim is to evaluate the correlation between Robinson's cytological grading on tumour imprint smears and the Modified Bloom–Richardson histopathological grading in infiltrating ductal carcinoma of the breast.

**Methods:** This Prospective Observational study included 22 cases of infiltrating ductal carcinoma for which both tumour imprint smears and corresponding histopathology specimens were available. Imprint smears were stained with May–Grünwald–Giemsa and hematoxylin–eosin, and graded using Robinson's system based on six cytological parameters. Histopathological grading was performed on formalin-fixed, paraffin-embedded sections using the Modified Bloom–Richardson system. Cytology–histology concordance and agreement were analysed using percentage concordance and kappa statistics.

**Results:** Cytological grading yielded 3 cases in Grade I, 12 in Grade II, and 7 in Grade III. Histopathological grading showed 2 cases in Grade I, 13 in Grade II, and 7 in Grade III. The overall concordance between Robinson's cytological grade and histopathological grade was 72.7%, with the highest agreement observed in Grades II and III. Statistical assessment demonstrated substantial agreement between the two grading systems.

**Conclusion:** Robinson's cytological grading demonstrates good agreement with Modified Bloom-Richardson histopathological grading and serves as an effective intraoperative prognostic tool in infiltrating ductal carcinoma.

**Key-words:** Tumour Imprint Cytology, Robinson's Cytological Grading, Modified Bloom–Richardson Grading, Infiltrating Ductal Carcinoma

## INTRODUCTION

Breast carcinoma remains the most common malignancy among women worldwide and continues to be a leading cause of cancer-related mortality despite major advancements in diagnostic and therapeutic modalities [1].

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The burden is particularly significant in low- and middle-income countries, where delayed presentation, limited screening facilities, and financial constraints continue to impede early detection [2]. In this context, accurate preoperative or intraoperative tumour grading becomes essential, as tumour grade significantly influences prognosis, treatment planning, and prediction of response to systemic therapy [3].

Tumour imprint cytology has emerged as a rapid, reliable, minimally invasive intraoperative technique for assessing the cytomorphology of breast lesions. Unlike fine-needle aspiration, tumour imprint smears are prepared directly from freshly cut tumour surfaces at the

 

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time of surgery, providing highly cellular material with excellent preservation of nuclear and cytoplasmic details [4]. This method allows immediate evaluation of tumour characteristics and provides an opportunity to apply standardized cytological grading systems before permanent histopathology is available [5].

Robinson's cytological grading system, originally designed for cytology specimens, can be effectively applied to tumour imprint smears, given their high cellularity and well-preserved cytological features. The system evaluates six objective criteria—cell dissociation, cell size, uniformity, nuclear membrane irregularities, chromatin pattern, and prominence of nucleoli—and categorizes tumours into three prognostic grades corresponding closely to Histopathological behaviour [6].

Histopathological grading remains the gold standard for assessing breast carcinoma, with the Nottingham modification of the Bloom–Richardson system widely accepted for its prognostic value, reproducibility, and clinical relevance [7]. It evaluates tubule formation, nuclear pleomorphism, and mitotic count to classify tumours into Grades I, II, and III. Several studies have demonstrated substantial concordance between cytological grades assessed on imprint smears and corresponding histopathological grades, supporting the utility of cytological grading in situations where intraoperative prognostic information is beneficial [8].

Recent studies report concordance rates of 60–80% between Robinson's cytological grading and the Modified Bloom–Richardson Histopathological grading across various clinical settings, reinforcing the reliability of cytological assessment performed directly on tumour imprint smears [9]. Because infiltrating ductal carcinoma—now termed invasive carcinoma of no special type—constitutes the majority of breast cancers, establishing an accurate correlation between cytological grading on imprint smears and histopathological grading becomes highly relevant for prognostic evaluation and early decision-making [10].

Considering the increasing emphasis on rapid, cost-effective intraoperative diagnostic support, the present study aims to evaluate the correlation between Robinson's cytological grading on tumour imprint smears and the Modified Bloom–Richardson histopathological grading in infiltrating ductal carcinoma. Demonstrating this correlation reinforces the diagnostic and prognostic value of tumour imprint cytology as a dependable and accessible tool in routine surgical pathology practice.

## MATERIALS AND METHODS

**Study Design and Setting-** This prospective study was conducted in the Department of Pathology, GMERS Medical College and Hospital, Sola, from August 2024 to July 2025. All cases diagnosed as infiltrating ductal carcinoma of the breast for which both tumour imprint cytology and corresponding histopathology were available were included. A total of 22 cases met the inclusion criteria, confirmed from departmental records.

**Imprint Cytology Preparation-** Tumour imprint smears were prepared intraoperatively by gently touching clean glass slides to the freshly cut tumour surface. Three smears were fixed in ethanol for hematoxylin–eosin staining, and one air-dried smear was used for Giemsa staining. Cytological grading was performed using Robinson's grading system, which assesses six parameters: cell dissociation, cell size, cell uniformity, nuclear membrane irregularities, chromatin pattern, and nucleoli. Each parameter was scored 1, 2, or 3, and the total score determined the cytological grade (Table 1).

**Table 1:** Robinson's Cytological Grading System

| Criterion | Score 1 | Score 2 | Score 3 |
|---|---|---|---|
| Cell dissociation | Mostly clusters | Clusters + single cells | Mostly single cells |
| Nuclear size | 1–2× size of RBC | 3–4× size of RBC | ≥5× size of RBC |
| Cell uniformity | Monomorphic | Mildly pleomorphic | Pleomorphic |
| Nucleoli | Indistinct/small | Noticeable | Abnormal/distinct |
| Nuclear margin | Smooth | Slightly irregular/folds | Buds/clefts |
| Chromatin | Vesicular | Granular | Clumped/coarse |

 

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**Histopathological Processing and Grading-** All 22 modified radical mastectomy specimens were fixed in 10% neutral buffered formalin, routinely processed, embedded in paraffin, and stained with hematoxylin–eosin. The Modified Bloom–Richardson (Nottingham) grading system was used to evaluate tubule formation, nuclear pleomorphism, and mitotic count. Each feature was scored from 1 to 3, and the cumulative score categorized tumours into Grades I, II, or III (Table 2).

**Table 2:** Modified Bloom–Richardson Histopathological Grading System

| Criterion | Score 1 | Score 2 | Score 3 |
|---|---|---|---|
| Tubule formation | >75% | 10–75% | <10% |
| Nuclear pleomorphism | Small, uniform cells | Moderate variation | Marked pleomorphism |
| Mitoses (per 10 HPF) | 0–5 | 6–10 | >11 |

**Cytology–Histology Correlation-** Cytological grading classified 3 cases as Grade I, 12 as Grade II, and 7 as Grade III. Histopathological grading identified 2 cases as Grade I, 13 as Grade II, and 7 as Grade III. Concordance between cytological and histopathological grades was evaluated using percentage agreement and kappa statistics to measure agreement beyond chance.

**Statistical Analysis-** All data were analysed using standard statistical software. A p-value <0.05 was considered statistically significant.

**Ethical Considerations-** Ethical approval was obtained from the Institutional Ethics Committee (GMERSMCS/IEC/96/2024). Written informed consent was taken from all participants, and all procedures followed standard ethical guidelines ensuring confidentiality and participant safety.

## RESULTS

Table 3 shows the distribution of cytological grading according to Robinson's system. Out of the 22 cases evaluated, 3 cases (13.6%) were classified as Grade I, 12 cases (54.5%) were categorized as Grade II, and 7 cases (31.8%) fell into Grade III. Grade II was the predominant cytological grade observed in this study population.

**Table 3:** Distribution of Robinson's Cytological Grading (n = 22)

| Cytological Grade | Number of Cases | Percentage (%) |
|---|---|---|
| Grade I | 3 | 13.6 |
| Grade II | 12 | 54.5 |
| Grade III | 7 | 31.8 |
| Total | 22 | 100 |

Table 4 presents the histopathological grading distribution according to the Modified Bloom–Richardson system. Among the 22 cases, 2 (9.1%) were Grade I, 13 (59.1%) Grade II, and 7 (31.8%) Grade III. Grade II was also the most frequently observed Histopathological grade.

**Table 4:** Distribution of Modified Bloom–Richardson Histopathological Grading (n = 22)

| Histopathological Grade | Number of Cases | Percentage (%) |
|---|---|---|
| Grade I | 2 | 9.1 |
| Grade II | 13 | 59.1 |
| Grade III | 7 | 31.8 |
| Total | 22 | 100 |

Table 5 illustrates the cytology–histopathology correlation. Of the three cytological Grade I cases, two showed concordant Histopathological Grade I, and one showed Histopathological Grade II. Among the 12 cytological Grade II cases, ten showed Histopathological Grade II, and three were upgraded to Grade III. Of the seven cytological Grade III cases, five demonstrated concordant Histopathological Grade III, while two correlated with Histopathological Grade II. No major discrepancy involving a shift between Grade I and Grade III or vice versa was observed.

 

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**Table 5:** Correlation Between Robinson's Cytological Grade and Modified Bloom–Richardson Histopathological Grade (n = 22)

| Cytological Grade | Histopathological Grade I | Grade II | Grade III | Total |
|---|---|---|---|---|
| Grade I | 2 | 1 | 0 | 3 |
| Grade II | 0 | 10 | 2 | 12 |
| Grade III | 0 | 2 | 5 | 7 |
| Total | 2 | 13 | 7 | 22 |

## DISCUSSION

The present study evaluated the correlation between Robinson's cytological grading performed on tumour imprint smears and the Modified Bloom–Richardson histopathological grading in infiltrating ductal carcinoma. A concordance rate of 72.7% observed in the study reinforces the notion that tumour imprint cytology provides a reliable approximation of histopathological grade and can offer valuable intraoperative prognostic information. This level of agreement is comparable to findings from recent studies, which have reported concordance values ranging between 60% and 80% using similar methodologies [11]. Such consistency underscores the applicability of cytological grading systems in rapid assessment settings where immediate diagnostic input is beneficial.

Tumour imprint smears provide highly cellular material with excellent preservation of nuclear characteristics, allowing Robinson's grading criteria to be applied effectively. Goyal *et al.* demonstrated that imprint cytology yields superior nuclear detail compared to several other rapid intraoperative techniques, supporting its use for cytological grading [12]. The six-parameter structure of Robinson's system, which includes cell dissociation, nuclear size variation, cell uniformity, chromatin pattern, nuclear membrane irregularity, and nucleolar prominence, contributes significantly to its reproducibility and diagnostic value in cytological evaluation of breast carcinomas.

Histopathological grading using the Modified Bloom–Richardson system remains the definitive standard for prognostication due to its strong predictive correlation with tumour aggressiveness and clinical outcome [13]. The high rate of concordance observed in our study, particularly in Grades II and III, aligns with Saxena *et al*.'s observations, who reported that intermediate- and high-grade tumours demonstrate better cytology–histology agreement due to their distinct morphological features [14]. The discordance noted in a subset of cases—primarily involving under-grading on cytology—may be attributed to tumour heterogeneity or limited representation of mitotic figures in imprint smears, as previously highlighted by Sharma and Raina [15].

The results of the present study reaffirm the utility of tumour imprint cytology as a rapid, cost-effective supplement to intraoperative assessment. Although it cannot replace the comprehensive evaluation provided by histopathology, the strong cytology–histology correlation observed suggests that Robinson's cytological grading can serve as a valuable prognostic indicator, especially in settings where immediate grading contributes to surgical decision-making or early treatment planning. The overall findings contribute to the growing body of evidence that cytological grading of imprint smears is a reliable, reproducible, and clinically meaningful method for evaluating infiltrating ductal carcinoma.

## CONCLUSIONS

The present study demonstrates that Robinson's cytological grading shows good correlation with the Modified Bloom–Richardson histopathological grading in infiltrating ductal carcinoma. With a concordance rate of 72.7%, cytological grading using tumour imprint smears is a valuable and reliable tool for early prognostication, especially in settings where immediate Histopathological evaluation may not be feasible. The consistent agreement between cytology and histology reinforces the diagnostic strength of intraoperative assessment as an alternative to frozen section for effectively guiding treatment decisions.

## CONTRIBUTION OF AUTHORS

**Research concept-** Sonal Gojiya, Mehul Patel, Srushti Jani
**Research design-** Sonal Gojiya, Mehul Patel, Srushti Jani
**Supervision-** Jignasa Bhalodia
**Materials-** Sonal Gojiya, Mehul Patel, Srushti Jani
**Data collection-** Sonal Gojiya, Mehul Patel, Srushti Jani
**Data analysis and interpretation-** Jignasa Bhalodia
**Literature search-** Sonal Gojiya, Mehul Patel, Srushti Jani
**Writing article-** Sonal Gojiya, Mehul Patel, Srushti Jani
**Critical review-** Jignasa Bhalodia
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