

Utility of Scrape Cytology in The Diagnosis of Neoplastic Lesions

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Abstract

Background: Scrape cytology is a rapid, simple, and cost-effective cytodagnostic technique used for the preliminary evaluation of surgically resected lesions. It provides good cellular yield from the freshly cut surface of specimens and may help in early differentiation between benign and malignant tumours, particularly in centres where frozen section facilities are limited. The aim is to evaluate the utility of scrape cytology in the diagnosis of surgically resected neoplastic lesions. **Material and Methods:** This cross-sectional study was conducted in the Department of Pathology, S. V. Medical College, Tirupati, over a period of 6 months after Institutional Ethics Committee approval. A total of 141 surgically resected specimens with clinically suspected neoplasia were included. Scrape smears were prepared from the freshly cut surface of the lesions, stained with rapid haematoxylin and eosin and May-Grünwald-Giemsa stains, and examined microscopically. The scrape cytology diagnosis was compared with the final histopathological diagnosis, which was considered the gold standard. Diagnostic accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were calculated. **Results:** Out of 141 cases, 134 cases were diagnosed on scrape cytology, while 7 cases were undiagnosed due to inadequate or non-representative cytological material. Among the diagnosed cases, 96 were categorized as benign and 38 as malignant on scrape cytology. On histopathological correlation, scrape cytology showed an overall diagnostic accuracy of 86%, sensitivity of 71%, specificity of 93%, positive predictive value of 83%, and negative predictive value of 87%. Discordance was observed in 18 cases, mainly involving thyroid, breast, parotid gland, and testicular lesions. **Conclusion:** Scrape cytology is a useful, rapid, inexpensive, and reliable adjunctive diagnostic technique for the evaluation of surgically resected neoplastic lesions. It is particularly valuable for early differentiation of benign and malignant tumours in routine pathology practice. However, due to limitations in assessing tissue architecture, invasion, margins, and tumour typing, scrape cytology cannot replace histopathology. Final histopathological examination remains essential for definitive diagnosis.

Keywords: Scrape cytology; neoplastic lesions; histopathology; intraoperative diagnosis; cytodagnosis; benign; malignant.

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INTRODUCTION

Neoplastic lesions represent a major diagnostic category in surgical pathology, and their timely identification is essential for appropriate clinical management. The distinction between benign and malignant lesions influences surgical planning, the extent of excision, intraoperative decision-making, and subsequent therapeutic strategies. Although routine histopathological examination remains the definitive method for diagnosis, it requires tissue fixation, processing, embedding, sectioning, and staining, which may delay reporting when an immediate diagnostic impression is needed.^[1]

Cytological techniques are widely used as rapid diagnostic tools because they are simple, economical, and capable of demonstrating important cellular details. Among these techniques, scrape cytology is a useful method in which cellular material is obtained by scraping the freshly cut surface of a surgically excised specimen or biopsy tissue. The smears prepared from this material can be rapidly stained and examined microscopically. This technique provides adequate cellularity and allows assessment of cellular arrangement, nuclear morphology, chromatin pattern, nucleoli, pleomorphism, mitotic activity, necrosis, and background features.^[2,3]

Scrape cytology has particular value in the evaluation of neoplastic lesions because malignant tumours usually exfoliate cells more readily than normal or fibrotic tissue. The method can help in differentiating benign from malignant lesions and may also suggest the probable tumour type in many cases. It has been applied to lesions of the breast, thyroid, ovary, lymph node, gastrointestinal tract, soft tissue, and other organs with encouraging diagnostic accuracy.^[4,5] In comparison with touch imprint cytology, scrape cytology often yields more cellular smears because the lesion surface is actively sampled rather than merely touched.^[6]

Frozen section is considered an established method for intraoperative diagnosis; however, it requires specialized equipment, trained personnel, and proper tissue freezing

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facilities. Scrape cytology, in contrast, is technically simpler, less expensive, and faster. It can therefore serve as a valuable adjunct to frozen section, especially in institutions where frozen section facilities are limited or unavailable.^[7] Previous studies have reported good correlation between scrape cytology and final histopathological diagnosis, supporting its role as a rapid intraoperative and preliminary diagnostic technique.^[5,7,8]

Despite these advantages, scrape cytology has certain limitations. It does not provide complete architectural details and cannot reliably assess capsular invasion, vascular invasion, depth of infiltration, surgical margins, or stromal response. Diagnostic errors may occur due to inadequate sampling, necrosis, haemorrhage, poor smear preparation, drying artefact, or overlapping cytological features between reactive and malignant lesions.^[3,7] Therefore, scrape cytology should not be considered a replacement for histopathology but rather as a complementary diagnostic method.

The present study, Utility of Scrape Cytology in the Diagnosis of Neoplastic Lesions, was undertaken to evaluate the role of scrape cytology as a rapid diagnostic technique in neoplastic lesions and to compare its findings with final histopathological diagnosis. The study aims to assess its diagnostic accuracy, usefulness, and limitations in distinguishing benign and malignant lesions in routine pathology practice.

Aim and Objectives: The present study aimed to evaluate the utility of scrape cytology in the diagnosis of surgically resected tumours. The objectives of the study were to determine the efficacy of scrape cytology in diagnosing pathological lesions and to compare the scrape cytology diagnosis with the final histopathological diagnosis, considering histopathology as the gold standard.

MATERIALS AND METHODS

Study Design and Setting: This was a cross-sectional study conducted in the Department of Pathology, Sri Venkateswara Ramnarayan Ruia Government General Hospital, S. V. Medical College, Tirupati. Surgically resected specimens received in the Department of Pathology were included in the study.

Study Duration: The study was carried out over a period of 6 months from the date of approval by the Institutional Ethics Committee.

Sample Size Calculation: The sample size was calculated based on a previous study by Sharma et al., in which the sensitivity of scrape cytology was reported as 91%. This value was considered as the expected proportion. The confidence interval was taken as 95%, and the allowable margin of error was considered as 5%.

The sample size was calculated using the following formula:

$$n = Z^2 \times P (100 - P) / E^2$$

Where:

n = Required sample size; Z = Z value at 95% confidence interval = 1.96; P = Expected proportion/sensitivity from previous study = 91; E = Allowable margin of error = 5

Substituting the values:

$$n = (1.96)^2 \times 91(100 - 91) / 5^2$$

$$n = 3.8416 \times 91 \times 9 / 25; n = 125.85$$

Thus, the minimum required sample size was approximately 126 cases. After considering possible undiagnosed or inadequate cases, the final sample size may be rounded to approximately 138 to 141 cases, depending on institutional and statistical requirements.

Inclusion Criteria

Surgically resected specimens with clinically suspected neoplasia were included in the study.

Exclusion Criteria

The following specimens were excluded from the study:

1. Cut-open specimens received after fixation in 10% formalin.
2. Small biopsy specimens received in 10% formalin.
3. Specimens that were unsuitable for immediate scrape cytology due to inadequate fresh tumour surface.

Study Procedure: All surgically resected specimens were examined grossly, and the relevant gross findings were recorded. Each specimen was sectioned into two halves using a sharp knife. The freshly cut surface of the tumour was immediately scraped using the edge of a clean glass slide or a surgical blade.

The semi-fluid material obtained by scraping was spread evenly over clean glass slides. Two to three smears were prepared by gently smearing the material with the help of another glass slide. One to two smears were immediately fixed in absolute alcohol and stained with rapid haematoxylin and eosin stain. One smear was air-dried and stained with May-Grünwald-Giemsa stain. Additional stains, including special stains, were performed wherever required.

The scrape cytology smears were examined microscopically, and the lesions were categorized based on cytomorphological features. After smear preparation, the specimens were subjected to routine histopathological processing. Histopathological sections were examined microscopically, and the final diagnosis was recorded.

The scrape cytology diagnosis was then compared with the final histopathological diagnosis, which was considered the gold standard.

Data Analysis: The collected data were analyzed to determine the diagnostic performance of scrape cytology. The parameters assessed included diagnostic accuracy, sensitivity, specificity, positive predictive value, and negative predictive value.

All statistical analyses were performed using R programming language for statistical computing and data visualization, stable release version 4.4.2 (2024), for Windows.

RESULTS

A total of 141 surgically resected tumour specimens were included in the study and evaluated by scrape cytology. Out of these, 134 cases were diagnosed by scrape cytology, while 7 cases remained undiagnosed due to inadequate or non-representative cytological material. Thus, scrape cytology provided a diagnosis in 95.0% of cases.

Table 1: Distribution of diagnosed and undiagnosed cases based on scrape cytology

| Scrape Cytology Category | Number of Cases | Percentage (%) |
|--------------------------|-----------------|----------------|
| Diagnosed | 134 | 95.0 |
| Undiagnosed | 7 | 5.0 |
| Total | 141 | 100.0 |

Among the 134 diagnosed cases, the thyroid constituted the most common site, accounting for 44 cases, followed by the female genital tract with 26 cases. Breast and soft tissue

lesions contributed 22 cases each. Based on scrape cytology diagnosis, 96 cases were categorized as benign and 38 cases as malignant.

Table 2: System-wise distribution of cases based on scrape cytology diagnosis

| Location of Lesion | Benign | Malignant | Total Cases |
|------------------------|--------|-----------|-------------|
| Breast | 12 | 10 | 22 |
| Thyroid | 40 | 4 | 44 |
| Female genital tract | 24 | 2 | 26 |
| Soft tissue | 12 | 10 | 22 |
| Head and neck | 4 | 2 | 6 |
| Gastrointestinal tract | 2 | 6 | 8 |
| Male genital tract | 2 | 0 | 2 |
| Lymph node | 0 | 2 | 2 |
| Total | 96 | 38 | 134 |

Correlation of scrape cytology diagnosis with final histopathological diagnosis was performed in the 134 diagnosed cases. On histopathology, 92 cases were benign

and 42 cases were malignant. Scrape cytology correctly identified 86 benign cases and 30 malignant cases. There were 6 false-positive cases and 12 false-negative cases.

Table 3: Correlation of scrape cytology diagnosis with histopathological diagnosis

| Scrape Cytology Diagnosis | Histopathology Benign | Histopathology Malignant | Total Cases |
|---------------------------|-----------------------|--------------------------|-------------|
| Benign | 86 | 12 | 98 |
| Malignant | 6 | 30 | 36 |
| Total | 92 | 42 | 134 |

The diagnostic performance of scrape cytology was calculated by considering histopathology as the gold standard. The overall diagnostic accuracy of scrape cytology

was 86.57%. The sensitivity and specificity were 71.43% and 93.48%, respectively. The positive predictive value was 83.33%, while the negative predictive value was 87.76%.

Table 4: Diagnostic performance of scrape cytology

| Diagnostic Parameter | Formula | Calculation | Result |
|------------------------|-----------------------------------|------------------------------|--------|
| Accuracy | $(TP+TN)/Total\ cases \times 100$ | $(30 + 86) / 134 \times 100$ | 86.57% |
| Sensitivity | $TP / (TP + FN) \times 100$ | $30 / (30 + 12) \times 100$ | 71.43% |
| Specificity | $TN / (TN + FP) \times 100$ | $86 / (86 + 6) \times 100$ | 93.48% |
| (+ve) predictive value | $TP / (TP + FP) \times 100$ | $30 / (30 + 6) \times 100$ | 83.33% |
| (-ve) predictive value | $TN / (TN + FN) \times 100$ | $86 / (86 + 12) \times 100$ | 87.76% |

Overall, scrape cytology showed good diagnostic accuracy and high specificity in the evaluation of surgically resected neoplastic lesions. It was useful in rapidly categorizing lesions as benign or malignant and showed good correlation with final histopathological diagnosis.

Case-wise Explanation with Cytology–Histopathology Correlation

Case 1: Thyroid Lesion

[Figure 1] shows scrape cytology smears from a thyroid lesion. The cytosmear shows cellular clusters suggestive of a thyroid epithelial neoplasm. Cytological features were interpreted in favour of papillary thyroid carcinoma on scrape cytology. The smear shows epithelial cell groups with nuclear atypia, suggesting a malignant thyroid lesion.

[Figure 2] shows the corresponding histopathological section of the same case. Histopathology revealed features of hyperplastic solitary nodular goitre, with variably sized thyroid follicles filled with colloid. Thus, this case represents a discordant diagnosis, where scrape cytology suggested

papillary thyroid carcinoma, but final histopathology confirmed a benign hyperplastic thyroid lesion.

This case highlights one of the limitations of scrape cytology in thyroid lesions, where hyperplastic epithelial changes may sometimes mimic malignant nuclear features. Final histopathological examination remains essential for confirmation.

Case 2: Testis

[Figure 3] shows scrape smears prepared from an orchidectomy specimen. The cytosmear shows inflammatory cellular material composed predominantly of lymphocytic infiltrate, along with spindle-shaped cells and areas of necrosis. These features suggested an inflammatory lesion rather than a primary testicular tumour.

[Figure 4] shows histopathological features of the same case, confirming granulomatous orchitis. The section shows dense inflammatory infiltrate with granulomatous reaction and necrotic areas.

This case demonstrates that scrape cytology is useful not only in

neoplastic lesions but also in identifying non-neoplastic inflammatory conditions that clinically or grossly may simulate malignancy. The scrape cytology findings correlated well with histopathology in suggesting an inflammatory pathology.

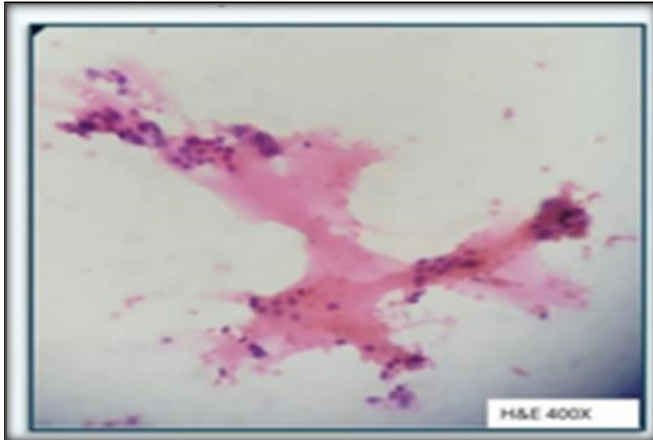


Figure 1: Scrape cytology smears showing features of papillary thyroid carcinoma [H&E, 400×]

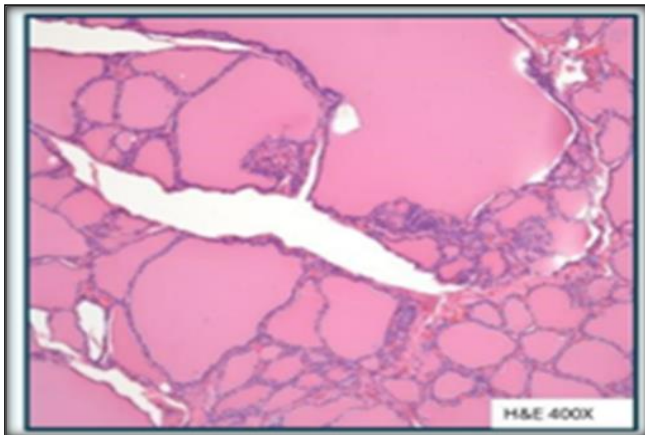


Figure 2: Histopathology of the same case showing hyperplastic solitary nodular goitre [H&E, 400×].

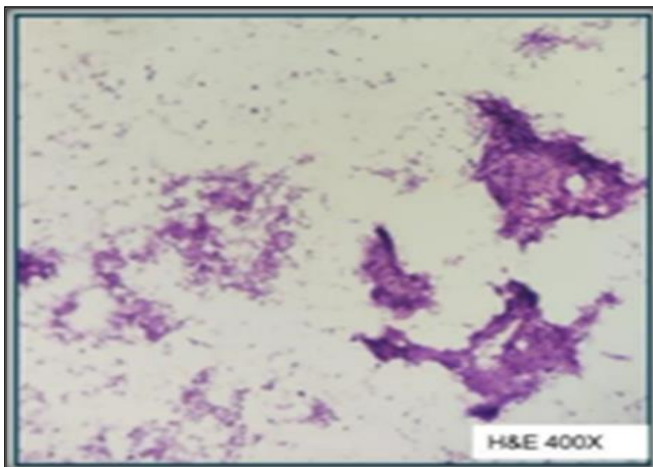


Figure 3: Scrape smears from an orchidectomy specimen showing lymphocytic inflammation, spindle cells, and necrosis [H&E, 400×]

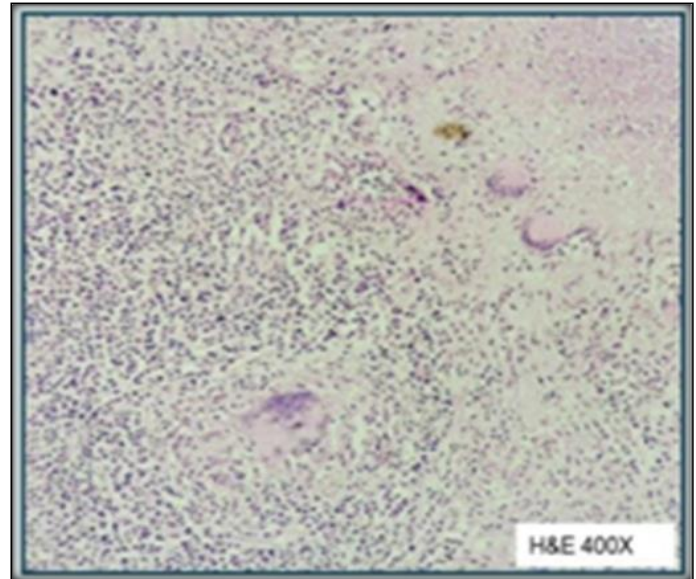


Figure 4: Histopathology of the same case showing features of granulomatous orchitis [H&E, 400×].

Case 3: Parotid Gland

[Figure 5] shows scrape cytology smears from a parotidectomy specimen. The smear shows a spindle cell neoplasm with cellular fragments composed of elongated spindle-shaped cells. Based on the cytomorphological appearance, scrape cytology suggested a spindle cell neoplasm.

[Figure 6] shows the histopathological section of the same lesion. The tissue section revealed features suggestive of salivary duct carcinoma, characterized by malignant epithelial proliferation arranged in duct-like and cribriform patterns.

This case shows partial diagnostic correlation. Scrape cytology identified the lesion as neoplastic and suggested spindle cell morphology, but the exact histological subtype was established only on histopathology. This emphasizes that scrape cytology can rapidly indicate malignancy; however, architectural evaluation on histopathology is necessary for precise tumour typing in salivary gland lesions.

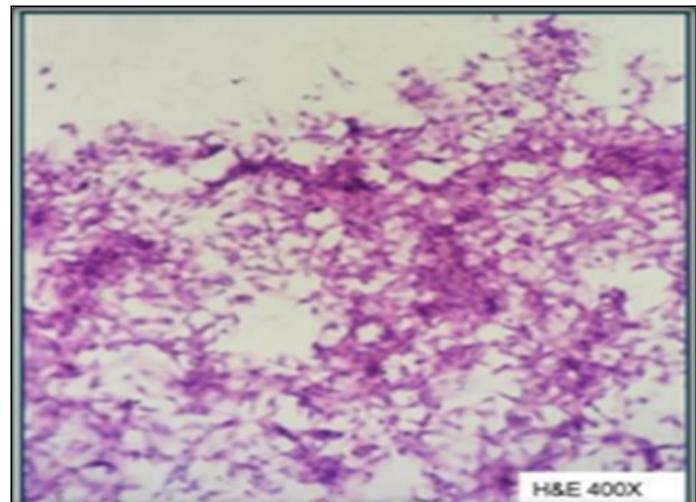


Figure 5: Scrape smears from a parotidectomy specimen showing a spindle-cell neoplasm [H&E, 400×]

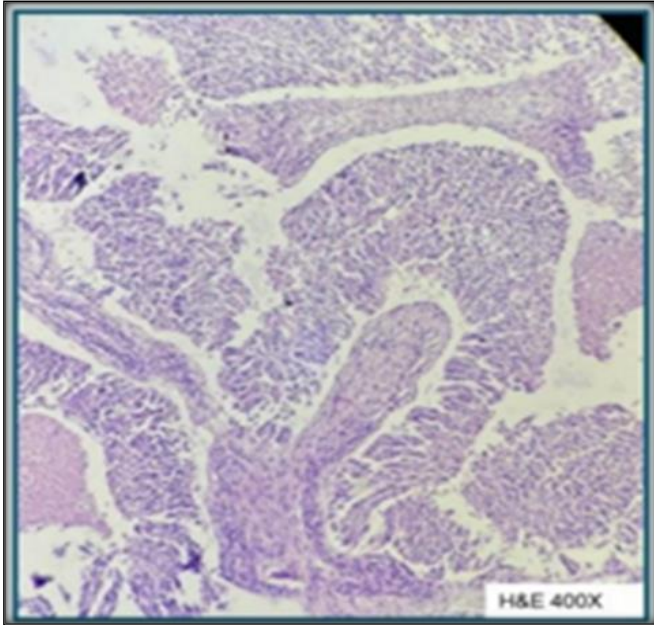


Figure 6: Histopathological section of the same case showing features suggestive of salivary duct carcinoma [H&E, 400×].

Case 4: Breast Lesion

[Figure 7] shows scrape cytospreads from a breast lesion stained with PAP stain. The smears show ductal epithelial cells with atypia admixed with occasional myoepithelial cells. The presence of epithelial atypia raised suspicion for a proliferative or possibly malignant breast lesion on cytology. Figure 8 shows the corresponding histopathological section. Histopathology demonstrated epithelial proliferation with focal apocrine change, rimmed by myoepithelial cells, favouring fibroadenoma.

This case represents another example of cytology–histopathology discrepancy. The scrape smear showed ductal epithelial atypia, but histopathology confirmed a benign fibroepithelial lesion. The presence of myoepithelial cells and preserved architecture on histopathology helped establish the benign nature of the lesion.

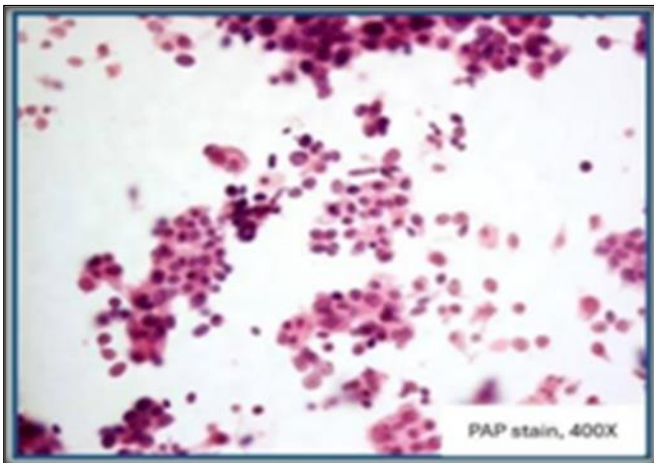


Figure 7: Scrape cytology smears showing atypical ductal epithelial cells admixed with occasional myoepithelial cells [Papanicolaou stain, 400×]

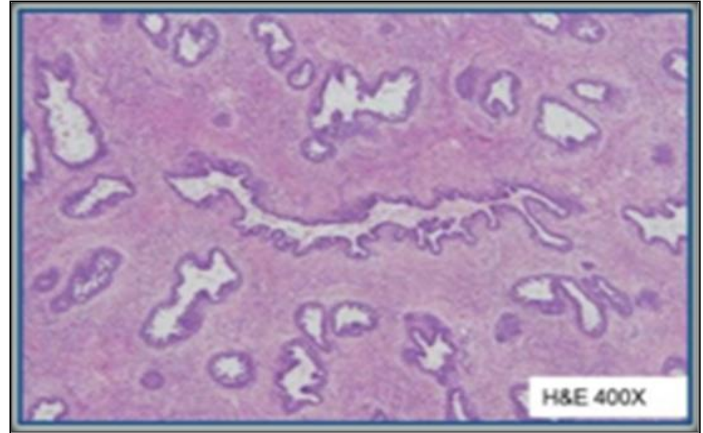


Figure 8: Histopathological section showing epithelial proliferation with focal apocrine change, rimmed by myoepithelial cells, favouring fibroadenoma [H&E, 400×].

DISCUSSION

Histopathological examination remains the gold standard for the definitive diagnosis of surgically resected specimens. It provides detailed information regarding tissue architecture, tumour pattern, invasion, margins, and other prognostic features. However, in many clinical situations, a rapid preliminary diagnosis is required to guide intraoperative decision-making. Intraoperative fine-needle aspiration cytology, imprint cytology, scrape cytology, and frozen section are useful rapid diagnostic techniques for the evaluation of tumours. Among these methods, scrape cytology is simple, inexpensive, rapid, and technically less demanding. It provides adequate cellular material from the freshly cut surface of lesions and can help in the early categorization of tumours as benign or malignant.

The present study evaluated the diagnostic utility of scrape cytology in surgically resected neoplastic lesions. A total of 141 surgically removed specimens were included from different organ systems, including breast, thyroid, soft tissue, female genital tract, gastrointestinal tract, salivary gland, male genital tract, lymph node, and head and neck region. Of these, 134 cases were diagnosed by scrape cytology, whereas 7 cases remained undiagnosed due to inadequate or non-representative cytological material. This indicates that scrape cytology provided a diagnostic opinion in the majority of cases and can be used as an effective adjunctive diagnostic method in routine pathology practice.

In the present study, scrape cytology showed an overall diagnostic accuracy of 86%, with a sensitivity of 71% and specificity of 93%. The positive predictive value was 83%, and the negative predictive value was 87%. These findings suggest that scrape cytology is useful for rapid differentiation between benign and malignant lesions. The high specificity observed in the present study indicates that cases diagnosed as malignant on scrape cytology showed good correlation with final histopathological diagnosis. However, the comparatively lower sensitivity suggests that some malignant lesions may be missed or underdiagnosed on scrape cytology due to sampling limitations or overlapping cytomorphological features.

Sharma et al. reported a diagnostic accuracy of 96%, sensitivity of 90.9%, and specificity of 97.4% in the evaluation of neoplastic

lesions by scrape cytology.^[9] Kolte and Satarkar studied 75 surgically resected specimens and reported a diagnostic accuracy of 97.3%, with sensitivity and specificity of 94% and 90%, respectively.^[10] Mahore et al. observed an accuracy of 91.5%, sensitivity of 96.4%, and specificity of 90.7% in rapid intraoperative diagnosis of tumours by scrape cytology.^[11] Khuroo et al. reported an accuracy of 89%, sensitivity of 83%, and specificity of 100% in thyroid lesions.^[14] Compared with these studies, the present study showed slightly lower overall accuracy and sensitivity, while specificity remained high.

The variation in diagnostic performance between the present study and previous studies may be due to differences in sample size, type of lesions studied, organ systems included, tumour cellularity, adequacy of smear preparation, sampling technique, and observer interpretation. Scrape cytology depends largely on obtaining representative material from the freshly cut surface of the lesion. Therefore, inadequate scraping, acellular smears, excessive haemorrhage, necrosis, cystic degeneration, fibrotic tumours, and poorly cellular lesions can reduce diagnostic yield. In addition, some benign and malignant lesions show overlapping cytological features, which may lead to diagnostic difficulty.

In the present study, thyroid lesions formed a major proportion of cases. Khuroo et al. evaluated the role of scrape cytology as an adjunct to fine-needle aspiration cytology in thyroid lesions and reported an accuracy of 89%.^[14] In the present study, the accuracy of scrape cytology in thyroid lesions was 80%. The relatively lower accuracy may be attributed to overlapping cytological features between hyperplastic nodules, nodular goitre, follicular adenoma, and papillary thyroid carcinoma. In thyroid lesions, architectural pattern, capsular invasion, and vascular invasion are important for final diagnosis, particularly in follicular-patterned lesions. These features cannot be reliably assessed on cytology alone, which explains some of the discordant cases observed in the present study.

The present study included 26 cases from the female genital tract and 4 cases from the gastrointestinal tract. All these cases were correctly diagnosed by scrape cytology in correlation with histopathology, showing an accuracy of 100% in these groups. Similar observations have been reported in studies on ovarian and female genital tract lesions, where scrape cytology was found to be useful for rapid intraoperative assessment and categorization of neoplasms.^[12,15] The good correlation in these cases may be due to adequate cellularity, representative sampling, and distinct cytomorphological features of the lesions.

Among soft tissue lesions, 22 cases were studied, of which 18 cases were correctly diagnosed by scrape cytology. Two cases yielded acellular smears, while one case diagnosed as squamous cell carcinoma on scrape cytology was later confirmed as neurofibroma on histopathology. Soft tissue lesions can be diagnostically challenging on cytology because of variable cellularity, spindle cell morphology, stromal fragments, and overlapping features between benign, malignant, and reactive lesions. In such cases, histopathological architecture and ancillary techniques such as immunohistochemistry may be required for accurate

tumour typing.

Discordance between scrape cytology and histopathology was observed in 18 cases. In thyroid lesions, 4 cases diagnosed as papillary thyroid carcinoma on scrape cytology were reported as hyperplastic nodules on histopathology, while 5 cases diagnosed as nodular goitre on scrape cytology were confirmed as follicular adenoma. These discrepancies may be explained by cytological atypia in hyperplastic nodules and the inability of scrape cytology to assess capsular or vascular invasion in follicular lesions. Paessler et al. also emphasized that scrape preparations may be useful as an adjunct in thyroid lesions, but final interpretation requires histopathological correlation.^[16]

In breast lesions, 4 cases diagnosed as atypical ductal hyperplasia on scrape cytology were reported as fibroadenoma with degenerative changes on histopathology, whereas 2 cases diagnosed as atypical ductal hyperplasia were confirmed as ductal carcinoma. These findings indicate that epithelial atypia in breast lesions may be difficult to interpret on cytology alone, especially in the presence of degenerative changes, proliferative epithelial patterns, or limited representation of myoepithelial cells. Chaitra and Geetha reported that scrape cytology is useful in the intraoperative diagnosis of breast lumps, although histopathological confirmation remains essential for final diagnosis.^[13]

One parotid gland lesion diagnosed as spindle cell neoplasm on scrape cytology was later confirmed as salivary duct carcinoma on histopathology. Similarly, 2 testicular lesions diagnosed as spindle cell neoplasm on scrape cytology were finally reported as granulomatous orchitis. These cases demonstrate that inflammatory, reactive, and malignant lesions may sometimes show overlapping cytological features. Granulomatous inflammation, necrosis, stromal reaction, invasion, and tumour architecture are better appreciated on histopathological sections than on scrape smears.

Overall, the present study supports the role of scrape cytology as a rapid and useful adjunctive diagnostic technique in the evaluation of surgically resected neoplastic lesions. It provides adequate cellular material with well-preserved cytomorphological details and helps in early differentiation between benign and malignant tumours. Its simplicity, speed, and cost-effectiveness make it particularly valuable in centres where frozen section facilities are limited or unavailable.

However, scrape cytology has certain limitations. It cannot replace routine histopathology because it does not provide complete architectural details or reliable assessment of invasion, surgical margins, capsular involvement, vascular invasion, and stromal response. Therefore, scrape cytology should be used as a complementary diagnostic tool, while final histopathological examination should remain mandatory for definitive diagnosis, tumour typing, grading, and further clinical management.

CONCLUSION

Scrape cytology is a rapid, simple, inexpensive, and useful adjunctive cytodagnostic technique for the evaluation of surgically resected neoplastic lesions. In the present study, it showed good overall diagnostic accuracy and high specificity in differentiating benign and malignant tumours. The technique provided adequate cellular yield with well-preserved

cytomorphological details, allowing early diagnostic categorization in most cases.

Although scrape cytology showed good correlation with final histopathological diagnosis, discordance was observed in some cases due to inadequate cellularity, sampling error, degenerative changes, and overlapping cytological features between benign, reactive, and malignant lesions. Since scrape cytology does not provide complete architectural details or reliable assessment of invasion, margins, capsular involvement, vascular invasion, and stromal response, it cannot replace routine histopathology.

Therefore, scrape cytology should be considered a valuable supportive tool for rapid preliminary diagnosis, especially in centres with limited resources or where frozen section facilities are unavailable. Final histopathological examination remains mandatory for confirmation, tumour classification, grading, and further clinical management.

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Conflicts of interest

There are no conflicts of interest.

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