Original Article

Correlation Between BI-RADS Categories and Yokohama Reporting System of Breast Cytology at a Tertiary Care Teaching Hospital

Heli Bharatbhai Presswala[1], Sanjay Vinayak Dhotre[1,*], Bhavesh Faldu[1], Hitendra Pravinkumar Barot[1], Arzoo Mansukhbhai Marvaniya[1], Bharat Pateliya[1]

[1]Department of Pathology, B. J. Medical College, Ahmedabad, Gujarat, India.

***Correspondence:** sanjayvdhotre@gmail.com

DOI
10.21276/apalm.3624

Article History
Received: 24-06-2025
Revised: 27-08-2025
Accepted: 08-09-2025
Published: 29-10-2025

How to cite this article
Presswala H, Dhotre SV, Faldu B, Barot HP, Marvaniya AM, Pateliya B. Correlation Between BI-RADS Categories and Yokohama Reporting System of Breast Cytology at a Tertiary Care Teaching Hospital. Ann Pathol Lab Med. 2025;12(10):A343-A349.

Abstract

Background: The highest level of preoperative diagnostic accuracy of breast lesions can be achieved using the triple approach of clinical examination, breast imaging reporting and data system (BI-RADS) grading by mammography and fine needle aspiration cytology (FNAC). Correlation between BI-RADS categories & cytological findings are useful approach to establish an important and accurate preoperative diagnosis as well as for planning therapeutic protocol in carcinoma of breast considering histopathology as gold standard.

Methods: A retrospective study of 100 female patients with palpable breast lump was conducted at B.J. Medical College, Ahmedabad. Patients underwent breast imaging and were categorized according to BI-RADS. FNAC was performed and smears were stained using standard cytological stains. The cytological diagnoses were reported according to the IAC Yokohama system. The correlation between BI-RADS categories and FNAC findings was analyzed.

Results: Out of 100 cases, 59 benign, 25 malignant, 13 atypical and suspicious for malignancy and 3 cases were unsatisfactory on FNAC. The most common benign lesion was fibroadenoma (34%), while infiltrating ductal carcinoma (24%) was the predominant malignant lesion. A maximum number of cases were reported in the 31–40 years age group. Concordance between BI-RADS and FNAC was observed in 85% of cases.

Conclusion: There is a high correlation between BI-RADS and cytological diagnosis in the assessment of breast lesions. We recommend that both BI-RADS and FNAC are vital investigation in the initial evaluation of patients with breast disease.

Keywords: Cytology; Breast imaging reporting and data system (BI-RADS); Fine needle aspiration cytology; Mammography.

Introduction

The most common clinical presentation encountered in breast clinics is a breast lump. Given that breast cancer ranks as the most commonly diagnosed malignancy and the leading cause of cancer-related death among women globally, meticulous evaluation and precise diagnosis of breast lumps are critical for effective management. [1]

A triple assessment approach is advocated in many countries for assessing a breast mass, combining clinical, radiological, and cytopathological information, thereby ensuring an accurate diagnosis and patient management. [2]

Fine needle aspiration cytology (FNAC) is a simple, rapid, and cost-effective procedure that serves as an essential tool in the early diagnosis and classification of breast lumps into benign or malignant categories. Despite its diagnostic utility, histopathology remains the gold standard. Correlating cytological findings with histopathological results enhances diagnostic precision and reinforces clinical decision-making. [3]

BI-RADS (Breast Imaging Reporting and Data System) is a structured reporting system developed by the American College of Radiology, first proposed in 1986 and formally released in 1993 to standardize breast imaging terminology and interpretation. Its introduction was prompted by the exponential rise in the use of mammography during the 1980s, particularly with the implementation of annual screening programs. This surge revealed significant variability in radiology reporting, highlighting the need for a uniform system to improve clarity, consistency, and communication in breast imaging reports. [4]

Breast imaging studies are assigned one of seven assessment categories: [5]

- **BI-RADS 0: incomplete**
  Additional imaging evaluation may be required, including supplementary mammographic views or ultrasound. In the case of mammography, obtaining prior images that were unavailable at the time of initial interpretation is also essential for accurate assessment.
- **BI-RADS 1: negative**
  symmetrical and no masses, architectural distortion, or suspicious calcifications
- **BI-RADS 2: benign**
  0% probability of malignancy
- **BI-RADS 3: probably benign**
  $< 2\%$ probability of malignancy
  short interval follow-up suggested
- **BI-RADS 4: suspicious for malignancy**
  2–95% probability of malignancy
  for mammography and ultrasound, these can be further divided:
  - BI-RADS 4A: low suspicion for malignancy (2–9%)
  - BI-RADS 4B: moderate suspicion for malignancy (10–49%)
  - BI-RADS 4C: high suspicion for malignancy (50–94%)

  biopsy should be considered
- **BI-RADS 5: highly suggestive of malignancy**
  $\geq 95\%$ probability of malignancy
  appropriate action should be taken
- **BI-RADS 6: known biopsy-proven malignancy**

The IAC Yokohama Breast FNAC Reporting system has been developed by a group of expert cytopathologists with assistance from surgeons, oncologists, and radiologists. It was developed to establish a standardized reporting system aimed at improving the interpretation of breast cytology. Additionally, it seeks to enhance communication between the cytopathologist and the clinician by linking the reporting categories with corresponding management recommendations. [6]

The Yokohama System classifies breast FNAC results into five diagnostic categories, each with defined cytological criteria and corresponding management recommendations based on the risk of malignancy (ROM). [7]

- **Insufficient/Inadequate** :This category includes smears that are sparsely cellular or poorly prepared, making definitive cytomorphological interpretation impossible. To reduce the frequency of inadequate samples, proper technique, operator training, the use of ultrasound guidance, and rapid on-site evaluation (ROSE) are recommended.
- **Benign** :Smears in this category demonstrate unequivocally benign cytological features. Common diagnoses in this category include fibroadenoma, fibrocystic changes, and normal breast tissue. Management typically involves clinical and radiologic correlation, with follow-up if the findings are concordant with benign disease.
- **Atypical** :This category includes aspirates with features that are indeterminate—neither clearly benign nor overtly malignant. These cases often necessitate additional investigation, such as a repeat FNAC or core needle biopsy (CNB), to reach a definitive diagnosis.
- **Suspicious for Malignancy** :Smears classified as suspicious show cytological features suggestive of malignancy but lack definitive criteria. These cases warrant further histopathological evaluation, usually with a core needle biopsy, to confirm malignancy and guide treatment planning.

- **Malignant** :This category is assigned when smears show definitive cytological features of malignancy. Management involves a multidisciplinary review of clinical, radiologic, and cytologic findings, typically followed by core needle biopsy to confirm the diagnosis and plan appropriate treatment.

The combined Yokohama–BI-RADS scoring system represents a significant advancement, as it merges the standardized imaging-based risk stratification of BI-RADS with the cytology-based categorization of the IAC Yokohama system. By incorporating complementary strengths from both modalities, this approach enhances diagnostic precision, facilitates more reliable lesion triage, and provides foundation for multidisciplinary communication. Ultimately, the combined system holds the potential to optimize clinical decision-making and contribute to improved outcomes in breast cancer management. [8]

Materials and Methods

The present study is a retrospective study of 100 cases done in cytopathology section of department of pathology at B. J. Medical college, Ahmedabad.

The detailed history of patient including age, site, mobility, pain and duration of palpable breast lump with any other significant findings like nipple discharge, nipple retraction, redness over swelling, associated axillary swelling etc. were noted. The BI-RADS categorization of mammography and ultrasound findings was included in the analysis.

Written informed consent, including the patient's signature was obtained prior to performing FNAC. The skin overlying the mass was prepared with 70 percent alcohol, a 22-23 gauge needle was introduced into the mass in all patients, and subsequently suction was applied with a 10mL plastic syringe. The needle was later detached, and smears were prepared from the drops at the tip of the needle on frosted slides. The procedure was then repeated twice with new needles. The cytological specimens were stained using Papanicolaou (Pap), Hematoxylin and Eosin (H&E), and May-Grünwald-Giemsa (MGG) stains. All slides were categorized in accordance with the IAC guidelines (Yokohama Reporting System) as follows: C1: insufficient material, C2: benign, C3: atypical, C4: suspicious and C5: malignant.

Inclusion Criteria: Female who give consent for fine needle aspiration. Female patients of all ages presenting with breast lump. Patients who have underwent breast imaging and reported as mass lesion.

Exclusion Criteria: Female with non-palpable breast lesions. Female not consenting for fine needle aspiration. Male patients.

Results

We examined a total of 100 cases of breast lesion in department of pathology at B. J. Medical college, Ahmedabad. Out of these, 59 were benign, 25 were malignant lesions, 13 were atypical and suspicious for malignancy and 3 were unsatisfactory.

The youngest patient was 20 years of age and the oldest was 84 years of age. The maximum number of cases (36 cases) was observed in the 31–40 years age group.

There was slight preponderance in right breast involvement with 53 cases followed by left breast involvement in 47 cases. Breast lumps were commonly seen in upper outer quadrant in 43 cases followed by lower inner quadrant 35 cases.

In the present study, the most common BI-RADS category was BI-RADS 4 (34%), followed by category 2 (25%) and category 3 (24%), while categories 0, 1, and 6 had no cases.

Out of the total 100 cases, 59 were diagnosed as benign on FNAC, of which 48 showed concordance with their BI-RADS categories. Fibroadenoma constituted the majority followed by fibrocystic changes, with most cases falling into BI-RADS II and III; a small proportion showed discordance. 13 cases were reported as atypical and suspicious for malignancy and 12 of these correlated well with BI-RADS, predominantly clustered in categories III, IV, and V reflecting their indeterminate but suspicious nature. All 25 malignant cases, including predominantly infiltrating ductal carcinoma and one mucinous carcinoma, demonstrated 100% concordance, with most lesions assigned to BI-RADS IV and V. Conversely, three smears were unsatisfactory on FNAC and showed no correlation, emphasizing the limitation of cytology in such instances and the need for repeat aspiration or biopsy in indeterminate cases.

Out of 100 cases, 48 benign, 25 malignant cases and 12 atypical and suspicious for malignancy cases (a total of 85) showed concordance with the diagnosis based on mammography. This corresponds to 81.35% concordance for benign cases, 100% for malignant cases and 92.3% for atypical and suspicious for malignancy. FNAC was unsatisfactory in 3 cases as shown in Table 2.

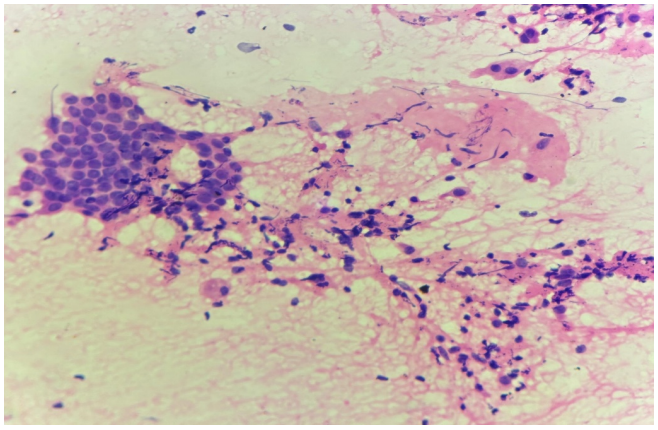

Figure 1: Fibroadenoma showing bimodal pattern containing epithelial and stromal fragments (H & E, 200x from the 20x objective lens)

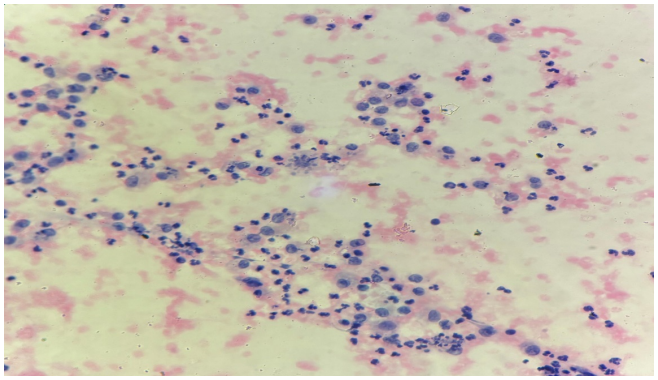

Figure 2: Acute mastitis showing inflammatory cells and necrotic debris (H & E, 200x from the 20x objective lens)

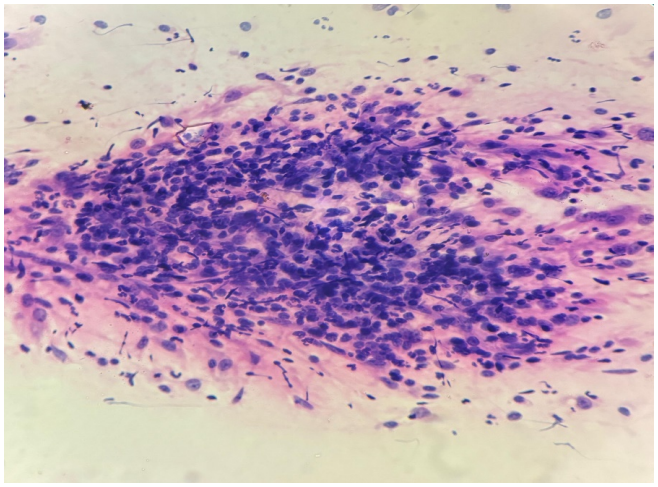

Figure 3: Granulomatous mastitis showing granuloma with epithelioid cells (H&E, 200x from the 20x objective lens)

Table 1: Correlation Between BI-RADS Categories and FNAC Findings

	BI-RADS Category								
FNAC Findings	**I**	**II**	**III**	**IVa**	**IVb**	**IVc**	**V**	**VI**	**Total**	**Correlated Cases**
Unsatisfactory				2		1			3	0
Benign lesion – specific										
Fibroadenoma		14	16	2	1	1			34	30
Fibrocystic changes		4	5	2	1				12	9
Acute mastitis		3	1						4	4
Granulomatous mastitis				1					1	0
Benign phyllodes tumor				1					1	0
Intraductal papilloma					1				1	0

Table 1 – continued from previous page

FNAC Findings	BI-RADS Category							Total	Correlated Cases
	I	II	III	IVa	IVb	IVc	V	VI		
Benign lesion- non specific										
Benign cystic lesion		4	1				1		6	5
Total (Benign)		**25**	**23**	**6**	**3**	**1**	**1**		**59**	**48**
Atypical and Suspicious for malignancy										
Atypical			1	1	4	2	1		9	8
Suspicious for malignancy				2	1		1		4	4
Total (Atypical+ Suspicious)			**1**	**3**	**5**	**2**	**2**		**13**	**12**
Malignant lesion										
Infiltrating ductal carcinoma				2	1	7	14		24	24
Mucinous carcinoma						1			1	1
Total (Malignant)				**2**	**1**	**8**	**14**		**25**	**25**

Table 2: Correlation of FNAC findings with mammography

FNAC	Mammography		Total (n=100)
	Benign	Malignant	
Benign	48	11	59
Atypical+Suspicious for malignancy	1	12	13
Malignant	0	25	25
Unsatisfactory	0	3	3
Total	**49**	**51**	**100**

Table 3: Comparison with other study

BI-RADS vs FNAC	In Present Study	Pandia et al. [9]	Bariya et al. [14]	Das S et al. [1]
Concordant benign (Benign Vs Benign)	48%	51%	44%	58.3%
Disconcordant benign (benign Vs malignant)	1%	4.34%	8%	6.66%
Concordant malignant (malignant Vs malignant)	37%	33.69%	40%	25%
Disconcordant malignant (malignant Vs benign)	11%	10.86%	8%	10%

Discussion

Kappa Coefficient (Cohen's Kappa) Used to measure agreement between BI-RADS and FNAC categories beyond chance. Interpretation of Kappa: < 0, Poor, 0.01–0.20, Slight, 0.21–0.40, Fair, 0.41–0.60, Moderate, 0.61–0.80, Substantial, 0.81–1.00, Almost perfect.

In present study, Cohen's kappa $\kappa \approx 0.70$, indicating substantial agreement between BI-RADS and FNAC.

In our study, Out of 100 cases, maximum number of cases (36%) were between 31 to 40 years of age group which was correlated with other study: by Pandia et al. [9] maximum number of cases (39%) were between 31-40 years of age group.

In our study, there was slight preponderance in right side breast involvement (53%) followed by left breast involvement (47%). This was comparable with other studies: by Sharma et al. [10] showed right side involvement more common than left side involvement.

In our study of 100 FNAC-confirmed cases, 59% were benign, while 25% were malignant. This is comparable to the findings by Waghmare et al. [11] approximately 56.25% and 31.5% of their cases were benign and malignant, respectively, on FNAC. Further, Pandia et al. [9] reported 55.43% and 38% as benign and malignant cases, respectively.

In our study, 85% cases were concordant with the diagnosis according to the mammography which was correlated with Das S et al. [1] 83% cases were concordant with mammography.

In our study, the 15% discordant cases emphasize the importance of correlating imaging with cytology and adopting a multidisciplinary approach. In such situations, relying on a single modality may be misleading and additional diagnostic

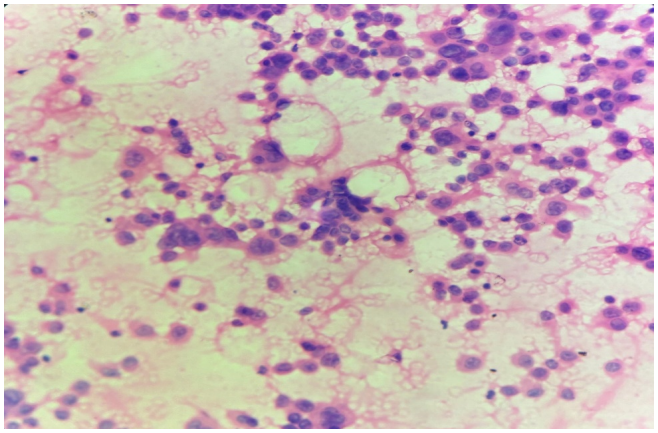

Figure 4: Infiltrating ductal carcinoma of breast showing epithelial cells with nuclear enlargement, pleomorphism and irregular nuclear membrane with loss of cell cohesion (H&E, 200x from the 20x objective lens)

procedures such as core biopsy, excision or advanced imaging are warranted to ensure accurate diagnosis and optimal patient management.

The following general cyto-morphological characteristics were used to distinguish benign from malignant [12]. Cell yield, Cell cohesiveness, Variation in size and shape of cells, Nuclear features- size, shape, chromatin and nucleoli, Mitoses, Bare bipolar nuclei in background.

Main cytomorphological Feature of common breast lesions are as following:

Fibroadenoma [13]

Smears showed a bimodal cellular pattern comprising epithelial and stromal components. Large, branching sheets of bland epithelial cells, Numerous single, bare bipolar/oval nuclei, Fragments of fibromyxoid stroma.

Fibrocystic Disease [13]

Epithelial fragments of usual epithelial cells, Scattered single bare bipolar/oval nuclei, The background revealed variable amounts of cyst fluid, macrophages, and apocrine metaplastic cells.

Inflammatory Lesion

Acute Mastitis Background of acute inflammation and necrotic debris.

Granulomatous Mastitis Epithelioid histiocytes, multinucleated giant cells, granulomas.

Benign Phyllodes Lesion Fibromyxoid stromal clumps, Reduced epithelial stromal ratio compared with fibroadenomas. Greater degrees of nuclear atypia and cellularity were characteristic of higher-grade phyllodes tumors. Large wavy and folded epithelial clusters. Usually exhibits benign cytomorphology Occasionally, hyperplastic changes with enlarged and vesicular nuclei and small visible nucleoli may be seen. Fibroblastic pavements.

Infitrating Ductal Carcinoma of Breast [13]

Moderately to highly cellular smears, Single population of epithelial cells; no myoepithelial cells, no single bare bipolar nuclei, A variable loss of cell cohesion was noted, with the presence of irregular clusters and scattered single cells, Single epithelial cells with intact cytoplasm, Moderate to severe nuclear atypia: enlargement, pleomorphism, irregular nuclear membrane and chromatin, Fibroblasts and fragments of collagen (stromal desoplasia) associated with the atypical cells,

Mucinous Carcinoma Cohesive groups of small to intermediate-sized epithelial cells with low-grade nuclei were seen floating within pools of extracellular mucin. Discohesive clusters composed of plasmacytoid cells exhibiting low-grade nuclei were observed.

This study has certain limitations. The sample size was limited to 100 cases from a single tertiary care center, which may affect the generalizability of the results. Additionally, histopathological confirmation was not available for all cases. Inter-observer variability in both imaging interpretation and cytological reporting was not assessed in this study.

Conclusion

We conclude that the 31–40 years age group was the most commonly affected in our study. Benign breast lesions (predominantly Fibroadenoma) were more common than malignant breast lesions (predominantly Infiltrating ductal carcinoma). The

correlation between BI-RADS categories and Fine Needle Aspiration Cytology was 85%. The cytology cases which were not correlated with BI-RADS categories, further follow up and biopsy were advised. Careful imaging-pathologic correlation is an integral part of the multidisciplinary approach and is essential for accurate diagnosis and appropriate management. Studies incorporating ancillary techniques such as immunocytochemistry, molecular testing, and digital pathology tools may further refine cytological categorization and bridge the gaps in atypical and suspicious cases. Additionally, exploring artificial intelligence–assisted image analysis in both radiology and cytology could pave the way for greater standardization and predictive accuracy in breast lesion assessment.

Acknowledgements: I hereby acknowledge to my guide Dr. Sanjay Dhotre sir, contributing as associate professor at B. J. Medical college, Ahmedabad for providing me with an opportunity and guidance. Also, I would like to thank and acknowledge all senior faculties and my colleague who have extended their help in completing my study.

Funding: None

Competing Interests: None declared.

References

1. Das, S., Raju, K., Tunuguntla, A., Sakalecha, A., & Nadipanna, S. (2022). Association of the International Academy of Cytology category with the Breast Imaging Reporting and Data System score in relation to the diagnostic accuracy for breast lumps. *Biomedical Research and Therapy*, *9*(10), 5332-5340. https://doi.org/10.15419/bmrat.v9i10.771
2. Yadav A, Singh A, Madaan S, Pujani M, Raychaudhuri S, Agarwal C, Chauhan V, Sidam D, Rajpoot J, Dhull G, Bansal C. International Academy of Cytology Yokohama System for Reporting Breast Cytology and the ACR Breast Imaging Reporting and Data System (BIRADS): Are they Concordant? *Iran J Pathol*. 2024 Fall;19(4):400-407. doi: 10.30699/ijp.2024.2028955.3300. Epub 2024 Oct 2. PMID: 40034927; PMCID: PMC11872029.
3. Hindle WH, Payne PA. The use of fine needle aspiration in the evaluation of persistent palpable dominant breast masses. *Am J Obstet Gynecol*. 1993;168:1814–8. doi: 10.1016/0002-9378(93)90695-f.
4. Magny SJ, Shikhman R, Keppke AL. Breast Imaging Reporting and Data System. [Updated 2023 Aug 28]. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459169/
5. Weerakkody Y, Manning T, Lemos P, et al. Breast imaging-reporting and data system (BI-RADS). *Radiopaedia.org* [Internet]. [cited 2025 Jun 2]. Available from: https://doi.org/10.53347/rID-10003
6. Ahuja S, Malviya A. Categorization of Breast Fine Needle Aspirates Using the International Academy of Cytology Yokohama System Along with Assessment of Risk of Malignancy and Diagnostic Accuracy in a Tertiary Care Centre. *J Cytol*. 2021 Jul-Sep;38(3):158-163. doi: 10.4103/JOC.JOC_31_21. Epub 2021 Aug 27. PMID: 34703093; PMCID: PMC8489693.
7. Yu W, Gan Q, Gong Y. The Yokohama System for Reporting Breast Cytopathology. *J Clin Transl Pathol*. 2023;3(2):99-105. doi: 10.14218/JCTP.2023.00006.
8. Ahuja S, Bhayana A, Zaheer S. Maximizing diagnostic precision: Evaluating the combined Yokohama and BI-RADS scoring system for breast lesions. *Rev Esp Patol*. 2025;58(1):100793. doi:10.1016/j.patol.2024.100793.
9. Pandia A., Samantaray S., Mohapatara J.S., Dash S., A comparative analysis of mammography breast imaging reporting and data system score and fine needle aspiration cytology in the evaluation of palpable breast lump. *International Journal of Research in Medical Sciences*. 2019; 7 (7) : 2644 .
10. Sharma, S.K., Singh, S., & Kumar, S. (2024). Role of clinical examination in the evaluation of patients with breast lumps: A cytopathological study. *World Academy of Sciences Journal*, *6*, 33. https://doi.org/10.3892/wasj.2024.248
11. Ramesh S. Waghmare, Shubhangi D. Sakore, S. B. Rathod; Fine needle aspiration cytology of breast lesions and correlation with histopathology; *International Journal of Research in Medical Sciences*, 2016; 4(10):4416-4421.
12. Anto J Richie, Melonie P. Radiological and Cytological Correlation of Breast Lesions with Histopathological Findings in a Tertiary Care Hospital in Costal Karnataka; *International Journal of Contemporary Medical Research*; February. 2019; 2:B1-4
13. Orell SR, Sterrett GF, Walters MN-I, Whitaker D. *Orell and Sterrett's Fine Needle Aspiration Cytology*. 5th ed. Philadelphia: Churchill Livingstone Elsevier; 2012. p. 156–209.
14. Bariya T.,Raval N. A Study of Comparison of BIRADS Score with FNAC Findings in Patients with Breast Lumps. *International Journal of Current Pharmaceutical Review and Research* 2024; 16(9); 60-65