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SONOELASTOGRAPHY AND HISTOPATHOLOGICAL CORRELATION OF BREAST LESIONS

Radio-Diagnosis

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ABSTRACT

Aim: The objective is to classify breast lesions into benign and malignant using ultrasound and elastography with a correlation to histopathological examination thereby assessing the significance of elastography. **Background:** Currently, histopathological examination remains the standard procedure for distinguishing breast masses. Due to the limitations of sonography and mammography, there is a substantial reliance on invasive biopsy emphasizing the need for exploring a more economically viable, non-invasive and reliable tool like elastography. **Materials And Methods:** Prospective observational study conducted in the Radiodiagnosis department at Kempe Gowda Institute of Medical Sciences, using Philips Affinity 70 G, high-frequency linear probe (L12-15), sample size (50), study span (6months) including OPD patients referred with breast lesions. **Results:** In our study, the majority of benign cases (48%) fell into BIRADS II, predominantly fibroadenomas. Malignant cases (20%) were predominant in BIRADS IV, most being ILC. HPE identified 35/50 (70%) cases as benign and 15/50 (30%) cases as malignant. Combining USG & elastography exhibited good specificity (82.85%) and accuracy (80%). A cutoff value of >2 for elastography score and strain ratio >3 yielded a high sensitivity and specificity ($p < 0.0001$). **Conclusion:** Elastography holds the potential to enhance the specificity of breast sonography in distinguishing benign from malignant masses.

KEYWORDS

Breast elastography, Breast USG, Breast strain ratio, Breast malignancy

INTRODUCTION:

Breast cancer stands as the most prevalent malignancy in women and the leading cause of cancer-related fatalities[1]. India, alongside China and the United States, contributes a significant share, constituting one-third of the global burden of breast cancer. Unfortunately, a considerable number of patients present at an advanced stage, posing challenges for effective treatment. Locally aggressive lesions and distant metastases are primary contributors to breast cancer-related deaths[2]. Recent advances in imaging techniques and screening programs have significantly enhanced the sensitivity of breast cancer detection and diagnosis, leading to a 40% reduction in the risk of mortality[3]. Mammography and sonography are the most sensitive non-invasive modalities employed for breast cancer detection.

Histopathologic examination currently serves as the standard investigation to distinguish between benign and malignant breast masses. Despite its invasive nature, this procedure yields a benign diagnosis in over 75% of cases, complicating the implementation of effective cancer screening programs[4].Ultrasound is commonly utilized as the primary workup tool in young females, yet certain scenarios exhibit substantial overlap in differentiating features between benign and malignant lesions[5]. The recent addition of elastography as a modality has demonstrated increased ultrasound specificity in diagnosing benign versus malignant lesions, facilitating early detection[6].Elastography has proven highly successful in imaging the breast, currently standing as the most widely and successfully imaged organ with this technique[4].

The fundamental principle behind elastography mirrors clinical palpation, where breast cancers typically exhibit greater hardness than normal breast tissue. This technique quantifies the hardness of a lesion in comparison to the surrounding tissue, revealing that malignant tumors deform less[6]. Strain elastography calculates the relative stiffness of tissue in response to manually applied force[7]. However, elastography data analysis remains qualitative rather than quantitative, with strain ratio measurements being the only viable option, comparing the strain of the target lesion with the surrounding fatty tissue in the breast[8].

Need For Study:

Given the limitations of sonography and mammography in the early stages of the disease, there is a substantial reliance on invasive biopsy, with only 10%-30% of results proving malignant[9]. This underscores the necessity for a more economically viable and safe tool to complement conventional ultrasound and avoid unnecessary interventions. Therefore, the study aims to evaluate the role of elastography in differentiating between benign and malignant lesions and correlate its findings with histopathology.

MATERIALS AND METHODS-

This study was conducted in the Department of Radiodiagnosis at Kempegowda Institute of Medical Sciences, Bangalore using ultrasound and elastography modalities of Philips affinity 70 G machine with high frequency linear probe L12 -15. This is a prospective observational study conducted with sample size of 50 in a timeframe of 6 months with the patient's presenting to the OPD with breast lesions, painless lump, nipple discharge and known / operated case of breast carcinoma with chance of recurrence.

The exclusion criteria included patients with acute inflammatory conditions of breast, past history of radiotherapy or chemotherapy, pregnant females and lactating woman, breast implants and those who presented with lesions with previous history of breast biopsy.The expected outcomes were to compare and correlate results of ultrasound, elastography with respect to the HPE diagnosis and to calculate the cut off value of elasticity score and strain ratio in order to differentiate benign from malignant lesions.

Procedure-

Sono-mammogram was performed and lesions were scored according to BIRADS US Lexicon criteria. Following sono-mammogram, elastography was performed and its score along with strain ratio were obtained according to Ueno elasticity five-score system and fat lesion ratio. The findings were then correlated with histopathological diagnosis. The additive role of elastography and its accuracy over sono-mammogram were assessed in differentiating benign from malignant breast lesions.

Two techniques are now available for clinical use: strain (compression based) and shear wave elastography. The type of elastography used in this study will be strain elastography. Strain is computed as the rate of change in axial tissue displacement as a function of depth. Strain images are produced when the relative differences in tissue motion at each location in the breast are calculated and displayed. Harder areas of

the breast (i.e., areas with less tissue displacement during compression) appear darker on strain images and softer areas of the breast (i.e., areas with more tissue displacement during compression) appear brighter.

Colour coding based on elastography-
Red-Tissues with greatest strain(softest component).
Blue-Tissues with no strain(hardest component).
Green-Tissues with average strain.
Elastography Score are assigned to each lesion according to index of suspicion for malignancy, as follows;
Score 1: Normal
Score 2 and 3: Benign
Score 4 and 5: Malignant
BGR Pattern: Cystic lesions.
For strain ratio cut off value is 3.0.
< 3 = benign
>3 = malignant

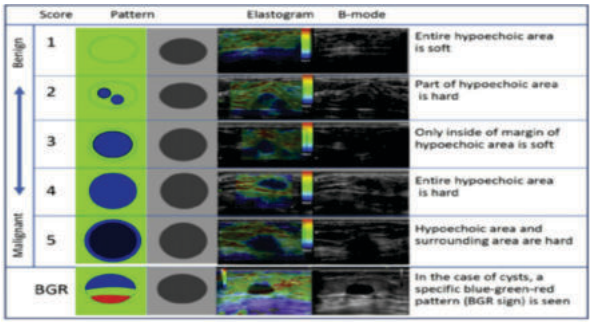

Figure 1: Tsukuba score/Ueno scale[10]

RESULTS-
A prospective study of 50 patients was conducted who clinically presented with breast lesions and subjected to ultrasonography and sono-elastography to establish the imaging diagnosis. These findings were later confirmed with histopathological diagnosis considered to be a gold standard.

Table 1: Distribution according to BIRADS score

BIRADS	NO. OF CASES	PERCENTAGE
GRADE II	24	48
GRADE III	13	26
GRADE IV	10	20
GRADE V	03	6
TOTAL	50	100

In our study out of 50 cases , it was found that maximum number of 24 cases (48%) belong to BIRADS II followed by 13 cases (26%) belonging to BIRADS III. Out of the total 30 benign cases (60%) maximum were found in BIRADS II accounting to 24 cases (48%). Out of the total 20 malignant lesions(40%) maximum were found in BIRADS IV accounting to 10 cases (20%)

Table 2: Distribution according to nature of lesion on USG.

BENIGN	MALIGNANT	TOTAL
30 (60%)	20 (40%)	50 (100%)

Based on USG findings, 30 cases (60%) were found to be benign and 20 cases(40%) were malignant.

Table 3: Distribution according to Elastography score

ELASTOGRAPHY SCORE	CASES	TOTAL/ PERCENTAGE
2	26	52
3	11	22
4	3	6
5	5	10
1(BGR PATTERN)	5	10
TOTAL	50	100

In our study, it was seen that the maximum number of cases had score 2 accounting for 26 cases (52%) followed by score 3 with 11 cases (22%). Out of the 36 benign cases (72%), maximum number of cases had score 2 corresponding to 26 cases (52%). Out of the 14 malignant cases (28%), maximum number of cases had score 5 corresponding to 5 cases (10%).

Table 4: Distribution of nature of lesion according to Elastography score

BENIGN</=3	MALIGNANT>3	TOTAL
36(72%)	14 (28%)	50 (100%)

Based on elastography findings, 36 cases (72%) were found to be benign and 14 cases(28%) were malignant.

Table 5: Distribution of benign breast lesions based on Histopathological examination.

BENIGN LESION	NO OF PATIENTS	PERCENTAGE
FIBROADENOMA	21	60
PHYLLODES TUMOUR	7	20
COMPLICATED CYST	2	5.7
ABSCESS	1	2.85
SIMPLE CYST	3	8.6
LIPOMA	1	2.85
TOTAL	35	100

In our analysis, out of total 35 benign breast lesions the most common lesion was Fibroadenoma (21 cases) followed by phyllodes tumour (7 cases) and simple cyst (3 cases).

Table 6: Distribution of malignant breast lesions based on Histopathological Examination

MALIGNANT LESIONS	NO OF PATIENTS	PERCENTAGE
DUCTAL CARCINOMA IN SITU	3	20
LOBULAR CARCINOMA IN SITU	2	13.3
INFILTRATING LOBULAR CARCINOMA	4	26.7
NON HODGKINS'S LYMPHOMA	1	6.7
PAGET'S DISEASE	1	6.7
MEDULLARY CARCINOMA	2	13.3
INFILTRATING DUCTAL CARCINOMA	2	13.3
TOTAL	15	100

Out of total 15 malignant breast lesions the most common lesion was ILC found in 4 cases followed by 3 cases of ductal carcinoma in situ.

Table 7: Comparison of Ultrasound and final Histopathological diagnosis

USG DIAGNOSIS	HISTOPATHOLOGICAL DIAGNOSIS	
MALIGNANT	MALIGNANT	BENIGN
	13	7
BENIGN	2	28

SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
86.6%	80%	65%	93.3%	82%

In present study, 28 cases with benign breast pathology were accurately diagnosed on USG. 13 cases with malignant breast pathology were accurately diagnosed on USG . 2 cases were falsely diagnosed as benign lesions. 7 cases highly suggestive of malignancy on imaging diagnosis turned out to be benign on final histopathology.

SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
60%	85.71%	64.29%	83.3%	78%

The overall sensitivity of USG for diagnosis of benign and malignant breast lesions was 86.6%, specificity was 80%, PPV with moderate PPV OF 65% and NPV OF 93.3%. The overall accuracy of USG was 82%.

Table 8: Comparison of Elastography and final Histopathological diagnosis

ELASTOGRAPHY	HISTOPATHOLOGICAL DIAGNOSIS	
MALIGNANT	MALIGNANT	BENIGN
	9	5
BENIGN	6	30

In present study, 30 cases with benign breast pathology were accurately diagnosed with elastography and 9 cases with malignant breast pathologies were accurately diagnosed with elastography. 6 malignant cases were falsely diagnosed as benign on elastography. 5 benign cases were falsely diagnosed as malignant on elastography.

The overall sensitivity of elastography was moderate 60%, specificity was 85.7% , PPV of 64.3% and NPV of 83.3% with an accuracy of 78%.

Table 9: Comparison of Elastography and USG findings

ELASTOGRAPHY	ULTRASOUND DIAGNOSIS	
MALIGNANT	MALIGNANT	BENIGN
	13	4
BENIGN	3	30

In present study, 30 cases with benign breast pathology were accurately diagnosed with USG and sonoelastography. 13 cases with malignant breast pathologies were accurately diagnosed with USG and sonoelastography. 3 cases found to be malignant on USG were benign on elastography. 4 cases seen as benign on USG were found be malignant on elastography.

With respect to USG, elastography had a good sensitivity of 81.5%, specificity of 88.1%, PPV of 76.4%, NPV of 90% and accuracy of 72% USG and elastography combined had a sensitivity of 73.3%, specificity of 82.85%, PPV of 64.65%, NPV of 88.3% and accuracy of 80%.

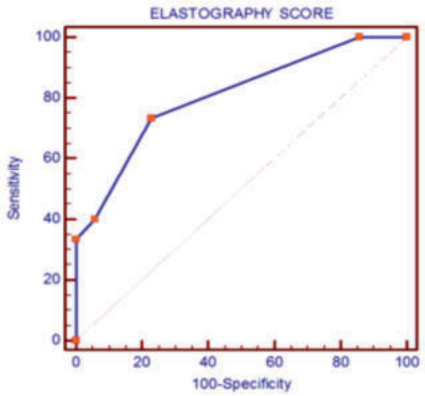

Figure 2: Sensitivity and Specificity values on ROC analysis for Elastography score

Table 10: Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.806
Standard Errora	0.0652
95% Confidence intervalb	0.669 to 0.904
z statistic	4.692
Significance level P (Area=0.5)	<0.0001

[a] DeLong et al., 1988
[b] Binomial exact

SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
81.5%	88.1%	76.4%	90%	72%

Youden index

Youden index J	0.5048
Associated criterion	>2

The cut off elastography score was 2.

The area under the receiver operating characteristic curve (AUC) was 0.806 with a sensitivity of 98.31% and specificity of 82.93% and cut off point of >2.

Table 11: Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.688
Standard Errora	0.0991
95% Confidence intervalb	0.541 to 0.811
z statistic	1.894
Significance level P (Area=0.5)	0.0582

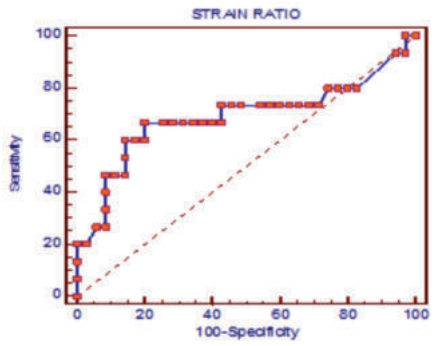

Figure 3: Sensitivity and Specificity values on ROC analysis for Strain ratio.

[a] DeLong et al., 1988
[b] Binomial exact

Youden index

Youden index J	0.4667
Associated criterion	>2.99

The area under the receiver operating characteristic curve (AUC) was 0.688 with a sensitivity of 96.61% and specificity of 80.49% The cut off value for strain ratio to differentiate benign vs malignant lesions was 2.99

DISCUSSION-

Among the total of 30 benign cases (60%), the majority were identified in BIRADS II, comprising 24 cases (48%), followed by 13 cases (26%) falling under BIRADS III. In contrast, 20 malignant lesions (40%) were predominantly observed in BIRADS IV, accounting for 10 cases (20%). The distribution in our study revealed 24 cases (48%) in BIRADS II, followed by 13 cases (26%) in BIRADS III.

Sakalecha AK et al's study indicated a prevalence of breast masses primarily categorized as BIRADS IV (n = 36), constituting 35.64% of cases [4]. Yilmaz E et al. similarly reported BIRADS IV lesions as the majority, making up approximately 43.09% of total cases[11] . Özel and Özel's study demonstrated a high incidence of benign lesions (71%), with benign solid lesions comprising 47.8% and benign cystic lesions forming 23.3% of overall cases[12] . Xiao et al. found that cystic lesions constituted about 39% of cases, with solid benign lesions accounting for about 25.3%. Their study reported an overall higher incidence of benign lesions (64.2%) [13].These variations could be attributed to geographic differences in the study locations, conducted in Poland [9] and China [4] respectively.

Analyzing our data, out of a total of 35 benign breast lesions, Fibroadenoma was the most common (21 cases), followed by phyllodes tumor (7 cases) and simple cyst (3 cases). Among the 15 malignant breast lesions, Invasive Lobular Carcinoma (ILC) was the most common, identified in 4 cases, followed by 3 cases of ductal carcinoma in situ. This aligns with a study by Ranjikesh et al., where fibroadenoma (19.4%) and fibrocystic disease (53.2%) accounted for the majority of benign lesions, and ductal carcinoma (75.5%) was the predominant malignant lesion [14] .Sinha D et al. reported a high incidence of fibroadenoma cases (79.5%) among benign cases and Invasive Ductal Carcinoma (IDC) (67.5%) as the most prevalent malignant lesion, followed by DCIS (10%) [15].

In our study, six cystic benign lesions were encountered, and one solid lesion (Phyllodes tumor) displayed cystic changes. All cystic lesions in the study exhibited the BGR artifact. Cho et al, in their study of 13 cystic lesions, also identified the BGR artifact using strain elastography, proposing that this pattern aids in distinguishing cystic lesions from solid masses [16].

In our study, based on USG findings, 30 cases (60%) were identified as benign, and 20 cases (40%) were malignant. Elastography findings categorized 36 cases (72%) as benign and 14 cases (28%) as malignant. Histopathology (HPE) findings indicated 34 cases (68%) as benign and 16 cases (32%) as malignant. In a similar study by Sakalecha AK et al, 53 masses (52.47%) were benign, and 48 masses (47.53%) were malignant [4].

Regarding accuracy, in our study, 28 cases with benign breast pathology were accurately diagnosed on USG, along with 13 cases of malignant breast pathology. Two cases were falsely diagnosed as benign lesions, and seven cases highly suggestive of malignancy on imaging were later determined to be benign on final histopathology. The overall sensitivity of USG for diagnosing benign and malignant breast lesions was 86.6%, with specificity at 80%, a moderate PPV of 65%, and NPV of 93.3%. The overall accuracy of USG was 82%.

Noteworthy misdiagnoses included a Phyllodes tumor, which, despite its benign appearance and 3cm size, turned out to be malignant in HPE. This can be attributed to reported imaging characteristic overlaps between benign and malignant phyllodes tumors, with a tumor diameter of 3 cm or greater indicating a higher likelihood of malignancy [17].Another misdiagnosed case was a DCIS lesion mistaken for Intraductal Papilloma due to its early stage.

Out of the seven cases initially deemed malignant but later proven benign, most were fibroadenoma and phyllodes. One case was chronic granulomatous mastitis, mimicking a tumor with spiculated margins. Another lesion was Paget's disease without atypia, appearing as an irregular mass with skin thickening, simulating carcinoma.

In a parallel investigation by Sakalecha et al, sonography exhibited a sensitivity of 89.8%, specificity of 96.15%, positive predictive value (PPV), and negative predictive value (NPV) of 95.65% and 90.91%, respectively, with an overall diagnostic accuracy of 93.07% [4]. A modified color score, inspired by Tsukuba scoring, was implemented in Sakalecha et al 's study. In another study by Chang et al, a proposal to modify the Tsukuba score into three categories—negative (score 0), borderline (score 1), encompassing Tsukuba scores 1, 2, 3, and malignant (score 2), covering Tsukuba scores 4, 5 was suggested [18],[4].The Korean Breast Elastography Study Group also recommended a similar modification [10].

In our investigation, it was evident that the majority of cases had an elastography color score of 2, accounting for 26 cases (52%), followed by score 3 with 11 cases (22%). Among the 36 benign cases (72%), the predominant score was 2, observed in 26 cases (52%). In contrast, among the 14 malignant cases (28%), the majority exhibited a score of 5, with 5 cases (10%). A total of 42 out of 50 lesions belonged to the modified score 1, and 8 lesions were categorized as modified score 2. The overall sensitivity of elastography was moderate at 60%, with specificity at 85.7%, a PPV of 64.3%, and NPV of 83.3%, resulting in an accuracy of 78%. The identified cut-off elastography score was 2, yielding an area under the receiver operating characteristic curve (AUC) of 0.806. The sensitivity was 98.31%, specificity 82.93%, with a cut-off point of >2.

In a study conducted by Sakalecha AK et al, the reported sensitivity was 97.8%, specificity 87.0%, PPV 86.79%, NPV 87.08%, and diagnostic accuracy 92.08% for benign lesions. The risk of missing a malignant case with the dual color score was 2.1% [4].Yilmaz E et al. suggested that the elastography score is a highly useful predictor of benignity in breast lesions [11].A similar conclusion was reached by Shamla et al, reporting a sensitivity of 85.3%, specificity of 87.8%, PPV of 92.7%, NPV of 76.5%, and an overall diagnostic accuracy of 86.2% [19].

In our study, elastography accurately diagnosed 30 cases with benign breast pathology and 9 cases with malignant breast pathologies, while misdiagnosing 6 malignant cases as benign and 5 benign cases as malignant. The falsely diagnosed malignant cases included lesions with solid and cystic/necrotic components, lymphoid tissue, and early malignant lesions like medullary carcinoma, DCIS, phyllodes, NHL, and Pagets with atypia. The erroneously diagnosed benign cases comprised lesions with increased tissue density such as scar/fibrotic tissue and granulomatous tissue—fibroadenoma, phyllodes, and chronic mastitis.

In the present investigation, both USG and sonoelastography accurately diagnosed 30 cases with benign breast pathology and 13 cases with malignant breast pathologies, while misdiagnosing 3 malignant cases as benign and 4 benign cases as malignant. The combined usage of USG and elastography demonstrated a sensitivity of 73.3%, specificity of 82.85%, PPV of 64.65%, NPV of 88.3%, and an accuracy of 80%.

Kumm et al. proposed that an NPV approaching 0.98 is necessary to confidently classify a breast lesion as benign, a threshold not met in our study [20]. Georgieva M et al's study demonstrated favorable sensitivity, with ultrasound combined with strain elastography and additional B-Mode ultrasound reaching 97%, compared to 92% for conventional B-mode alone. The corresponding specificities were 82% and 73%, respectively [21]. Au FW et al.'s investigation revealed significant improvements when combining ultrasound and elasticity ratio, showing specificity enhancement from 35.44% to 87.34%, positive predictive value from 45.74% to 80.77%, and accuracy from 57.72% to 90.24% ($p < 0.0001$). The AUC of combined ultrasound and elasticity ratio (0.914) outperformed other combined parameters[22].

In our study, the area under the receiver operating characteristic curve (AUC) was 0.688. The cut-off value for strain ratio to distinguish between benign and malignant lesions was 2.99, exhibiting a sensitivity of 96.61% and specificity of 80.49%. Sakalecha et al.'s study indicated an excellent prediction rate for the strain ratio cutoff in diagnosing both benign and malignant breast masses. With a strain ratio cutoff of 3.2, all 48 malignant breast masses were accurately diagnosed, and 52 out of 53 benign breast masses (98.11%) were correctly correlated with the pathologic diagnosis. The mean strain ratio demonstrated sensitivity of 100%, specificity of 98.11%, PPV and NPV of 97.96% and 100%, respectively, and diagnostic accuracy of 99.01% [4].

In Sakalecha et al.'s study, a mean strain ratio of 3.2 served as a cutoff to differentiate between benign and malignant breast masses. However, one case of benign granulomatous mastitis exhibited a higher mean strain ratio (7.8) and was misclassified under the malignant category. This emphasizes the importance of avoiding unnecessary breast biopsy, particularly for patients with a strain ratio of <3.2. Moreover, the strain elastography ratio can potentially serve as an independent indicator for distinguishing between benign and malignant lesions, obviating the need for an ultrasound BIRADS category or modified color scoring system [4].

Bojanic K et al. asserted that malignant breast lesions exhibit large aggregates of elastin fibers, a process known as elastosis. The stromal and malignant cells are believed to cause elastotic material aggregation in breast tissue, leading to increased stiffness in malignant lesions [23]. Özel and Özel obtained a strain elastography ratio cutoff of 3.1 for differentiating between benign and malignant lesions, consistent with our study [12]. Bojanic et al. obtained a higher strain elastography ratio cutoff of 3.8, demonstrating sensitivity and specificity of 90.5% and 93.2%, respectively [23]. Several studies by Gheonea et al[24] ,Mousa A E et al [25], and Balçık et al[26] suggested that a strain ratio exceeding 3.0 is indicative of a malignant breast mass.

In Sakalecha et al.'s study, elastography and ultrasonography incorrectly diagnosed granulomatous mastitis[4].Mutala et al. also reported a higher mean strain ratio for granulomatous mastitis in their study, suggesting that the presence of granulomatous tissue may increase stiffness and explain the elevated mean strain ratio[27].This finding contrasts with data from Yağcı et al. and Durur-Karakaya A et al., who reported lower strain ratios for granulomatous mastitis, ranging from 1.5 ± 0.8 (range 0.2–4) and 1.10 ± 0.79 (range 0.29–4), respectively[28],[29].

Sakalecha et al. demonstrated that the strain ratio cutoff exhibited an excellent prediction rate compared to modified color in diagnosing both benign and malignant breast masses. The strain ratio serves as a semi-quantitative parameter for measuring stiffness in a lesion. However, opinions among researchers on the accuracy of the strain ratio vary. According to Yoon SK et al's study, SR is a more effective and objective parameter for characterizing breast lesions than ES[30]. Variations in the cutoff value across studies may be attributed to technical factors in acquiring elastography data. Barr et al[31] identified pre-compression as a major limiting factor in obtaining accurate results with both strain and shear wave elastography. They found that pre-compression could increase the overall stiffness of the examined part, particularly affecting background fat, leading to reduced strain ratio and false-negative results. For accurate strain ratio measurement, minimum pre-compression should be applied.

The second contributing factor might be the inconsistent placement of the Region of Interest (ROI). The selection of uniformly sized ROIs and their placement at the same depth in both the lesion and adjacent fat

is crucial for the accuracy of readings. A third aspect involves maintaining the optimal level of external compression during the acquisition of elastography data, a critical factor for result accuracy. Given its reliance on the operator, this process can yield varying Strain Ratio (SR) values, potentially causing interobserver differences[32].

The diagnostic efficacy of elastography is also influenced by lesion size, as suggested by certain studies. However, we did not assess the performance of elastography concerning lesion size in our analysis. Lastly, the quality of the elastography map relies on overall breast density and architecture, a factor not examined in our study. We propose that these aspects be investigated in more extensive studies to enhance the quantitative and reproducible nature of strain elastography[32].

In our investigation, among the 13 BIRADS III cases, 8 were downgraded to BIRADS II based on strain ratio and score, while 5 were upgraded to BIRADS IV. Sadigh G et al.'s study showcased improved elastography outcomes for category 3 and 4 lesions. By combining ultrasound features and elastography parameters, they accurately predicted benignity in at least 22 out of 32 BIRADS IV category lesions, suggesting that unnecessary biopsies were conducted in these cases. Furthermore, they correctly upgraded five 4A category lesions to 4B or 4C based on elastography analysis, enhancing diagnostic confidence. These findings highlight the potential of ultrasound elastography to enhance the diagnostic accuracy of ultrasound. They concluded that in low-risk groups, elastography should be performed with positive ultrasonographic results to avoid unnecessary biopsies. Other studies also support these results and draw similar conclusions[33].

Wojcinski et al. analyzed BIRADS III lesions with sono-elastography, proposing that these lesions can be classified into low-risk and high-risk groups based on the elastography score. Within BIRADS category III lesions, we accurately predicted benignity in 47 out of 51 lesions due to their elasticity. Additionally, two well-circumscribed malignant lesions, misclassified as BIRADS III based on conventional ultrasonography features, were correctly characterized on elastography due to a high elasticity score and strain ratio, leading to their upgrade to category 4[34].

Limitations Of The Study:

This study had certain constraints, such as a relatively small sample size, limiting the provision of more meaningful data on rare conditions like phyllodes tumor, mastitis, and other carcinoma variants.

Elastography is inherently operator-dependent. In some lesions, Fine Needle Aspiration Cytology (FNAC) was initially performed, yielding inconclusive results in many cases. These cases ultimately underwent core biopsy or surgical excision for a definitive pathologic diagnosis. Notably, the study did not evaluate inter- or intra-observer variability, as it was not initially designed for such an assessment.

CONCLUSION:

Elastography exhibits the potential to enhance the specificity of breast sonography, aiding in the differentiation of benign and malignant masses, consequently diminishing the number of benign biopsies, especially in cystic lesions. The clinical significance lies in the accurate diagnosis of breast lesions, steering clear of unnecessary biopsies.

The integration of elastography, incorporating strain ratio and color score with ultrasound (USG), proves beneficial in distinguishing between benign and malignant breast masses, showcasing superior specificity and accuracy. Furthermore, early cancerous lesions are often better identified through elastography compared to traditional ultrasound, prompting potential upgrades of lesions for biopsy rather than routine follow-ups.

The collaborative utilization of strain elastography and conventional ultrasound allows for the reevaluation of a significant number of BIRADS III and IV lesions. This strategic approach helps in preventing unwarranted biopsies and provides reassurance to physicians for interval follow-ups.The elastography score emerges as the most valuable predictor of benignity in breast lesions. This study advocates the utilization of the previously employed color score of 2 and a mean strain ratio of 3 as effective parameters for distinguishing between benign and malignant breast masses.

Representative Cases:

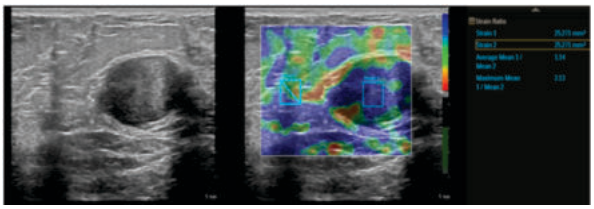

Figure 4: On USG -Well defined oval hypoechoic lesion is noted at the 4'o clock position of the left breast (BIRADS II). On Elastography it shows SR ratio of 2.13. Final Histopathology diagnosis was fibroadenoma .

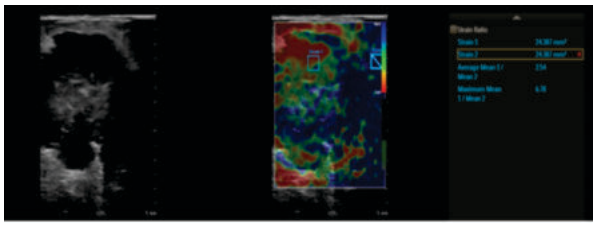

Figure 5: On USG- Fairly well defined taller than wider hypoechoic lesion with focal irregular spiculated margins noted in 3'o clock position of left breast with septations and microcalcifications within (BIRADS V).On Elastography it shows SR ratio of 6.7.Final Histopathology diagnosis was medullary carcinoma.

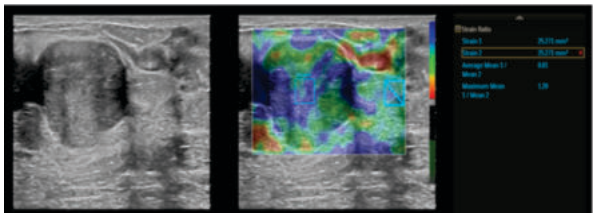

Figure 6: On USG- Well defined heteroechoic solid lesion noted in 6'o clock position of left (BIRADS IVA).On Elastography it shows SR ratio of 1.2.Final Histopathology diagnosis was Non Hodgkins Lymphoma.

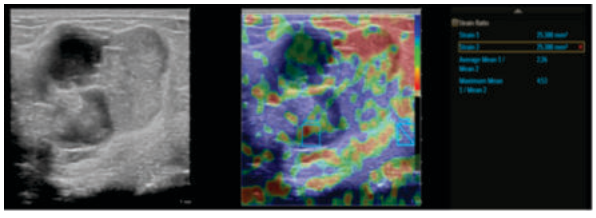

Figure 7: On USG- Well defined heteroechoic lobulated solid lesion is noted at the 11 'o clock position of the right breast with few cystic spaces within(BIRADS III). On Elastography it shows SR ratio of 4.53.Final Histopathology diagnosis was phyllodes tumor.

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