

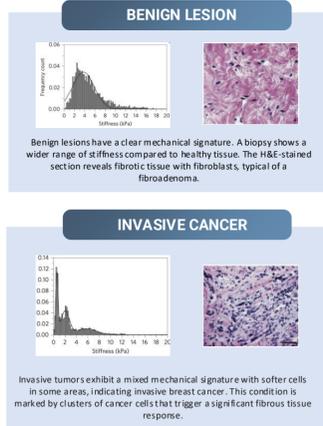
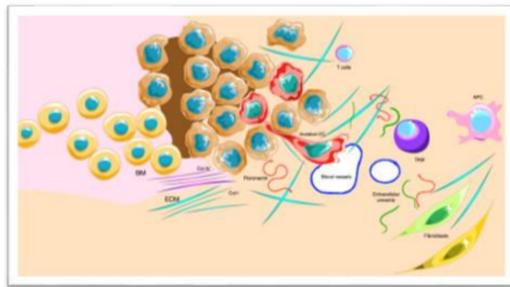
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Cancer exhibits spatial mechanical heterogeneity at the cellular, molecular, and nanoscale levels.

Plodinec M., et al. The nanomechanical signature of breast cancer. Nat Nanotechnol. 2012 Nov;7(11):757-65.

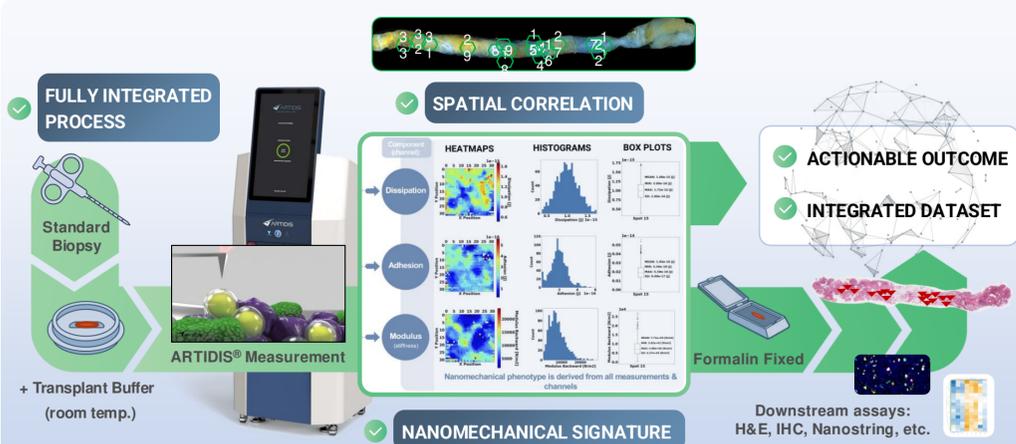


The biomechanical diversity of breast tumors underscores the need to correlate nanomechanical and microenvironmental properties across cancer progression stages. Plodinec et al. previously demonstrated the association between nanomechanical signatures and histopathological markers in healthy, benign, and malignant breast tissues.

Invasive lobular carcinoma (ILC) development is linked to E-cadherin loss, altering cell nanomechanics and remodeling the tumor microenvironment. While E-cadherin aids diagnosis, 15–35% of ILC cases show aberrant expression, with immunoreactivity reported in 0–23.5%, causing potential misclassification. E-cadherin loss also occurs in some poorly differentiated NST and high-grade ductal carcinomas, complicating ILC diagnosis. Variants like pleomorphic, alveolar, trabecular, and solid subtypes underscore the need for improved morphologic criteria to reduce diagnostic discrepancies.

ARTIDIS® Nanomechanical Signature Measurement is seamlessly integrated into routine clinical workflows.

Fresh clinical biopsy samples, either core needle or vacuum-assisted, were measured using the ART-1 nanomechanical phenotype device, the first of its kind to assess clinically actionable tissue nanomechanical signatures.



1. Northcott, J. M., et al. (2018). Feeling Stress: The Mechanics of Cancer Progression and Aggression. *Frontiers in Cell and Developmental Biology*.
2. Rianna, C., et al. (2020). Direct Evidence That Tumor Cells Soften When Navigating Confined Spaces. *Molecular Biology of the Cell*.
3. Yu, W., et al. (2021). Cancer Cell Mechanobiology: A New Frontier for Cancer Research. *Journal of the National Cancer Center*.

Nanomechanical Signatures Distinguishing Invasive Lobular Carcinoma from Ductal Carcinoma: Insights into Tumor Mechanobiology and Diagnostic Accuracy

587 Breast biopsies

112 IDC

13 ILC

From 2016 To 2019

	Ductal	Lobular
Median age	62.8	75.9
Estrogen receptor (%)		
Negative (<1%)	20 17.9%	1 7.7%
Positive (>1%)	92 82.1%	12 92.3%
Progesterone receptor (%)		
Negative (<1%)	33 29.5%	2 15.4%
Positive (>1%)	79 70.5%	11 84.6%
Ki-67 (%)		
<10	30 26.8%	7 53.8%
>10% <20%	33 29.5%	2 15.4%
>30%	49 43.8%	4 30.8%
Grading		
1	26 23.2%	2 15.4%
2	49 43.8%	9 69.2%
3	36 32.1%	2 15.4%
Not available	1 0.9%	0.0%
Count of T Classification		
1a	3 2.7%	
1b	15 13.4%	1 7.7%
1c	37 33.0%	4 30.8%
2	45 40.2%	6 46.2%
2a	1 0.9%	0.0%
3	7 6.3%	1 7.7%
4	2 1.8%	1 7.7%
4b	2 1.8%	
N classification		
Negative	68 60.7%	11 84.6%
Positive	42 37.5%	2 15.4%
Unknown	2 1.8%	
M classification		
0	103 92.0%	12 92.3%
1	9 8.0%	1 7.7%
Oncotype DX classification		
High risk	5 4.5%	
Intermediate risk	5 4.5%	
Low risk	11 9.8%	2 15.4%
Not applicable	91 81.3%	11 84.6%
	112 100.0%	13 100.0%

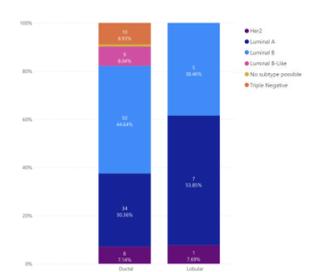


Figure 1. Breast cancer subtypes according to IDC and ILC.

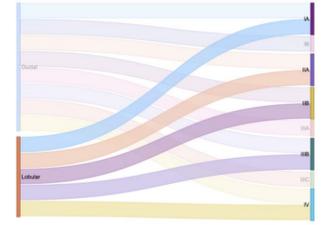


Figure 2. Breast cancer subtypes, including IDC and ILC, are categorized into different stages.

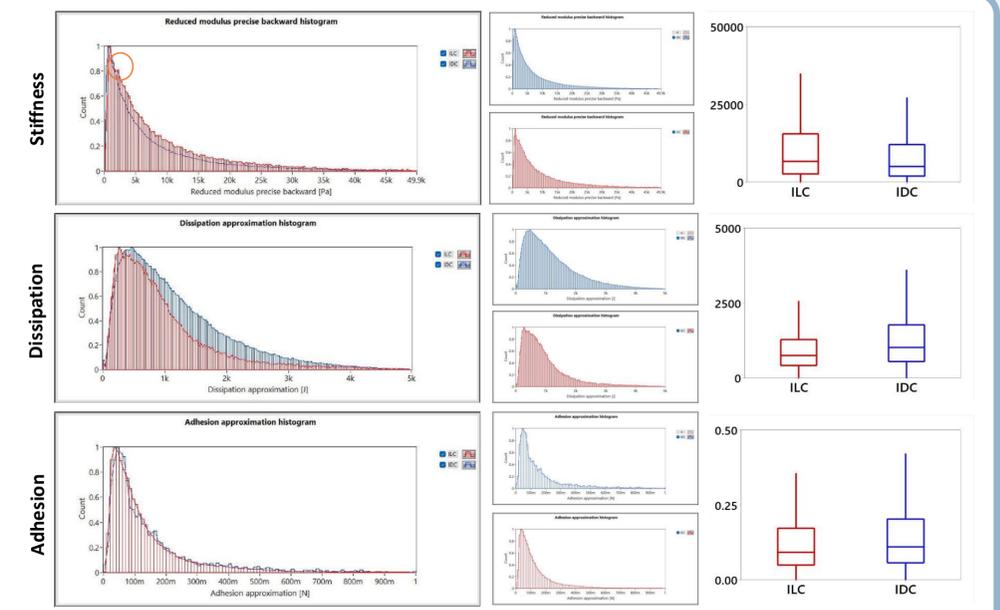


Figure 3. AFM Curves Depicting Stiffness, Dissipation, and Adhesion of IDC (Blue) and ILC (Red)

In the AFM stiffness curves, ILC shows a second peak, indicating greater heterogeneity in nanomechanical properties, possibly due to variations in tumor cell populations or microenvironment stiffness. In contrast, IDC has more uniform stiffness profiles.

ILC shows lower dissipation and increased stiffness compared to IDC. This reduced dissipation may indicate a more rigid tumor microenvironment, reflecting differences in tissue structure or extracellular matrix composition.

Nanomechanical Signature Distinguishes Diffuse and Aggregated Growth Patterns in Lobular Carcinomas

Table 2. Tumor Characteristics of ILC subtypes

	Classical type	Pleomorphic type
Estrogen receptor		
negative	1 20.0%	4 80.0%
positive	8 100.0%	4 80.0%
Progesterone receptor		
negative	2 40.0%	2 40.0%
positive	8 100.0%	3 60.0%
Grading		
1	2 25.0%	
2	5 62.5%	4 80.0%
3	1 12.5%	1 20.0%
Her2/neu		
negative	8 100.0%	4 80.0%
positive	1 20.0%	
Ki-67 (%)		
<10	6 75.0%	1 20.0%
>10% <20%	2 25.0%	2 40.0%
>30%	2 25.0%	2 40.0%
	8 100.0%	5 100.0%

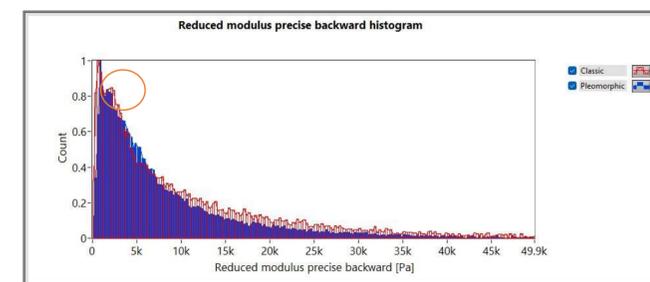


Figure 4. ILC Subtypes According to Breast Cancer Classification and Stage

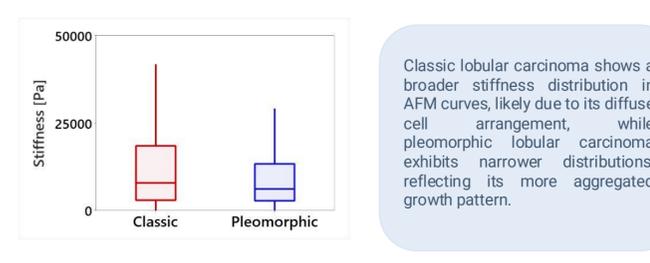


Figure 5. AFM Curves of Classic ILC (Red) and Pleomorphic ILC (Blue)

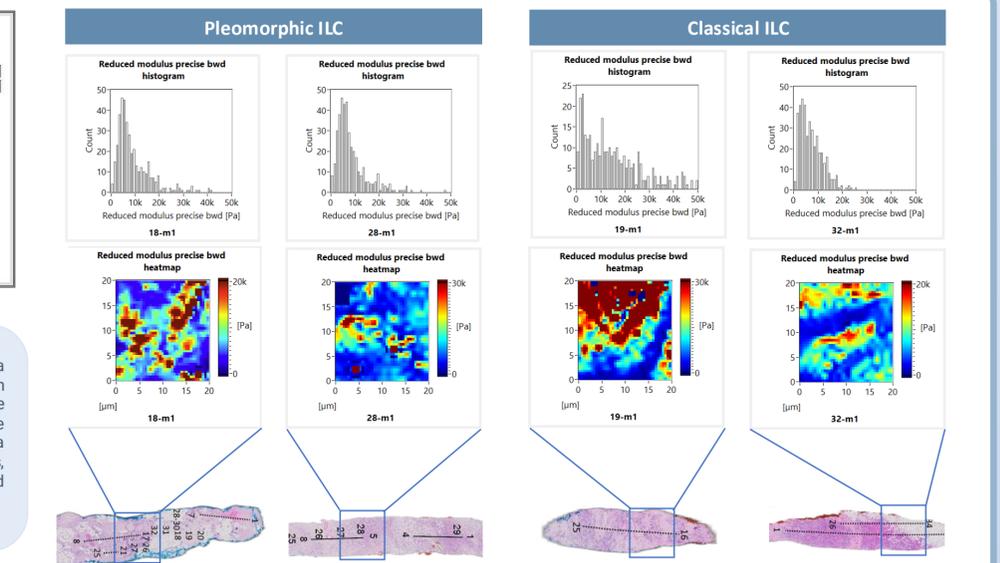


Figure 6. AFM Histogram and Heat Map of Specific Spot Measurements from Classic ILC and Pleomorphic ILC Samples

Classic lobular carcinoma shows a broader stiffness distribution in AFM curves, likely due to its diffuse cell arrangement, while pleomorphic lobular carcinoma exhibits narrower distributions, reflecting its more aggregated growth pattern.