Strain Imaging in the Breast

eSie Touch™ elasticity imaging | Virtual Touch™ imaging | Virtual Touch™ quantification | Virtual Touch™ IQ
**Basics for Successful Breast Imaging**

**Need**

1. Extraordinary B mode imaging
2. Pioneering technologies like Custom Tissue Imaging
3. Wide range of transducer selection for all breast sizes and imaging needs
   - All ACUSON S2000™ ultrasound system linear transducers perform eSie Touch™ elasticity imaging
   - All transducers feature Siemens pioneering MP Connectors for unmatched SNR with 612 connectors

Strain imaging is a suite of applications that provides additional information in breast ultrasound.
Clear depiction of small calcifications with custom speed of sound

1540 m/s  Optimized Speed
18L6 HD
Extraordinary detail resolution for the dedicated breast imaging center with Ergonomic grip.
Siemens pioneering technology – Hanafy lens for superb slice thinness throughout the field of view.
14L5, 12L4, and 9L4 Transducers

14L5
High resolution with added flexibility and additional exam benefits for enhanced exam range

12L4
High resolution with expanded footprint for greater breast coverage. Provides a combination of excellent depth penetration for larger breasts, coupled with excellent Image quality

9L4
A versatile transducer that additionally provides access to all Strain Technologies
A core transducer with added exam benefits of Cadence Contrast Pulse Sequencing* and Virtual Touch applications to supplement Elasticity – both Siemens Pioneering technologies

Includes all four Siemens Strain Technologies (eSie Touch™ elasticity imaging, Virtual Touch™ imaging, Virtual Touch quantification and our 4th generation of Strain, Virtual Touch IQ)

* At the time of publication, the U.S. Food and Drug Administration has cleared ultrasound contrast agents only for use in LVO. Check current regulations for the country in which you are using this system for contrast agent clearance.
eSieTouch™ Elasticity Imaging
For qualitative tissue strain analysis in small parts
Elastograms with eSie Touch™ Elasticity Imaging

Sophisticated algorithm allows viewing of both grayscale and color maps

Suite of analysis and workflow tools:
Strain ratio – allows value to be obtained for relative stiffness of two areas in breast

Automated measurements of lesions with syngo® eSieCalcs™ native tracing software

‘Shadow’ measurements for fast assessment of B mode and elastogram relative lesion size
Benefits for Clinicians and Patients

Ease of use – immediate feedback on elastogram quality, frame-by-frame, from acquired cine-loop with Quality Factor

• Single button press acquisition with any transducer
• Post processing for viewing of grayscale and several color maps for optimal demonstration of all lesion types
• Measurements, and ratio assessments available quickly and easily
Benefits for Clinicians and Patients

Elasticity Images are obtained with the probe and lesion perpendicular to gravity

No uncomfortable pressure or repetitive movement needed as with some systems

• Motion is provided by the patient’s breathing and heart beat
• If insufficient, slow minimal compression with the probe is applied
Elasticity Imaging Solution from Siemens

Creates an elastogram by detecting tissue stiffness or hardness with minimal transducer compression

Proprietary imaging technology detects compression changes from normal respiration and cardiac rebound

Dramatic increase in both imaging sensitivity and patient comfort
eSieTouch™ Elasticity Imaging
E/B Size Ratio

<0.1 % Strain detectability with eSieTouch Elasticity Imaging!

Biopsy Proven Breast Cancer

Image Courtesy of Richard Barr, M.D., Ph.D., Radiology Consultants, Youngstown, OH
“Bulls-Eye” appearance of cyst
### Evaluation of Breast Lesions Using Ultrasound Elasticity Imaging: A Multi-centered Trial


<table>
<thead>
<tr>
<th>Site</th>
<th>Total Lesion</th>
<th>Malignant Lesions</th>
<th>EI/B-mode Ratio ≥ 1</th>
<th>Sensitivity</th>
<th>Benign Lesions</th>
<th>EI/B-mode Ratio &lt; 1</th>
<th>Specificity</th>
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<td>361</td>
<td>87.4%</td>
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High sensitivity for lesion detection, but difficulty defining the lesion size in isoelastic benign lesions reduces specificity
Suspicious breast lesions appear measurably larger with Elastography vs. B-mode\(^1\)

- Hypothesized to be via detection of tentacle formation and/or desmoplasia

\(^1\) Ultrasound Elasticity of the Breast: Initial Results of a Real-Time System, Richard G. Barr MD, PhD
eSie Touch Elasticity Imaging

eSie Touch™ elasticity imaging Biopsy Proven Breast Carcinoma (14fps 4cm)
Clinical Examples

Fat Lobule

Note: Diagnosis based on biopsy findings
Clinical Examples

Simple Cyst

Note: Based on B-mode imaging
FNA <5mm cysts confirmed
Clinical Examples

Fibroadenoma showing characteristics of a suspicious lesion in B-mode,

Note: Diagnosis based on B-mode imaging
Invasive Ductal Carcinoma

Note: Physician diagnosis based on B-mode imaging
Invasive Ductal Carcinoma

Another view of same lesion.

Dark tail of lesion seen clearly in Elasticity: suspected to be arm of tumor invading duct or surrounding tissue

Note: Physician diagnosis based on B-mode imaging
Ductal Carcinoma – Grade 2

Note: Physician diagnosis based on B-mode imaging
Ductal Carcinoma – Grade 3

Note: Physician diagnosis based on B-mode imaging
Does B-mode give you the answer?
This is Shadowing Artifact
Suspicious Area in B-Mode Image Clearly Depicts Cyst Pattern When Seen on Elastogram

FNA performed for confirmation

Clear ‘bullseye’ cyst pattern on Elastogram
Lesions Have Unique Internal Characteristics

Note: Diagnosis based on Biopsy findings

- Large Cyst with debris
- Fibroadenoma
- Ductal Carcinoma
Lesions Have Unique Internal Characteristics

Note: Diagnosis based on Biopsy findings
Lesion referred for biopsy of solid lesion

Elastogram identifies the “solid” appearing lesion on B-mode as a cyst. FNA confirmed lesion is complicated cyst. Lesion completed aspirated.
Sonographically Depicted Breast Clustered Microcysts: Is Follow-Up Appropriate?¹

Conclusion - "Breast clustered microcysts are relatively common, seen in 5.8% of breast sonograms. In our series of 79 lesions with follow-up, none proved malignant: Follow-up on an annual basis appears reasonable for most such lesions"
Acoustic Radiation Force Impulse (ARFI) imaging utilizes shear waves that are normally generated during ultrasound imaging.

Shear waves are propagated laterally (do not return to the transducer) and so were not previously detectable. Siemens was the first manufacturer to provide a commercially available method to detect and quantify these shear waves.
Virtual Touch™ imaging

For qualitative tissue strain analysis in abdominal and small parts
ARFI Push Pulse to Create an Elastogram
Virtual Touch™ Imaging (VTi)
Breast lesion stiffness assessment

E/B Area Ratio of 2.02
proven breast cancer

Biopsy

Lesion heterogeneity more easily seen on these VTi images than on conventional B-mode

Soft region
(arrow)
Virtual Touch™ Imaging (VTi)
Stiffness assessment in focal liver lesions
Virtual Touch™ quantification

For quantitative tissue strain analysis in abdominal (including liver) and small parts
“Elastography continues to improve:
• Reproducibility
• Ease of use
• Clinical confidence

New developments allow a new way of analysis
• Reduction in operator variability
• More accurate and valuable quantitative information

VTi HD on the 9L4 seems to improve detection in very subtle lesions

VTq on the 9L4 has the potential to improve clinical confidence in differentiating benign and malignant lesions”

Dr. Corinne Balleyguier, IGR, Villejuif, France
14 mm IDC

Speed increased in the lesion vs. normal tissue

Lesion: 2.07 m/s
Normal tissue: 1.25 m/s
Subtle 6 mm malignant lesion

Low internal contrast

High velocity detected in the lesion with ARFI vs. normal tissue
6 mm subtle breast nodule

Low contrast

VTi easily showed the suspicious lesion

Suggests improvement of lesion visibility in some cases of difficult-to-visualize lesions
12 mm Bi-Rad ® 4 nodule

Speed measurement in the lesion < 2 cm/s

Dg: Grade 1 phylloid tumour

Benign lesions seem to show lower speed than malignant with ARFI. Further studies needed.
Bifocal IDC

Nice depiction of the lesion with VTi
Virtual Touch™ IQ

For visual and quantitative tissue strain analysis in small parts (breast, etc.)
Multiple Push Pulses to Quantify and Visualize

Region of interest

Push pulse

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Case Study, B-mode Ultrasound

Advanced SieClear™ spatial compounding
Large Breast Fibroadenoma 3.5 cm
Case Study, Virtual Touch™ IQ

Virtual Touch™ IQ
Velocity Mode – Large Breast Fibroadenoma 3.5 cm
Case Study, Virtual Touch™ IQ Quality Map

Virtual Touch™ IQ
Quality Mode – Large Breast Fibroadenoma 3.5 cm
“Adding VTIQ to BIRADS® assessment improves the specificity.”

Virtual Touch™ IQ
BI-RADS 4c Intraductal Carcinoma (IDC)

Uniform high SW Velocity in lesion SW Quality display indicates good SW velocity estimate throughout lesion
Virtual Touch™ IQ
Two Dimensional Shear Wave Imaging Improves Specificity

‘Qualitative’ Compression Strain Imaging

Quantitative Shear Wave Velocity Imaging

Benign

Malignant
Virtual Touch™ IQ
BI-RADS 5 Intraductal Carcinoma (IDC)

Unique to Siemens:
The SW Quality display differentiates where the SW velocity estimate is accurate and where the SW velocity estimate is poor, aiding interpretation.
eSieTouch™ Elasticity Imaging Compared to Virtual Touch™ IQ
Thyroid Nodule

Nodule Appears Uniformly Stiff
Improved Visualization of Elastic Heterogeneity