SIEMENS

eSie Touch Elasticity Imaging

Reference Guide

www.siemens.com/ultrasound

Contents

Elasticity Imaging

Background – What we know:

- Historically, palpation has been widely used as a method for assessing stiffness and elasticity. Palpation has limitations at deeper depths, with smaller lesion sizes or with subtle differences in tissue composition, thus making lesion detection and diagnosis more difficult.
- Changes in tissue stiffness, or elasticity, are known to generally correlate with pathological changes.

What is Elasticity Imaging

Elasticity imaging is used to calculate and qualitatively display the elastic properties of tissue, in other words, how much tissue deformation occurs with tissue compression. Tissue that is more elastic will deform more than tissue that is stiffer or less elastic.

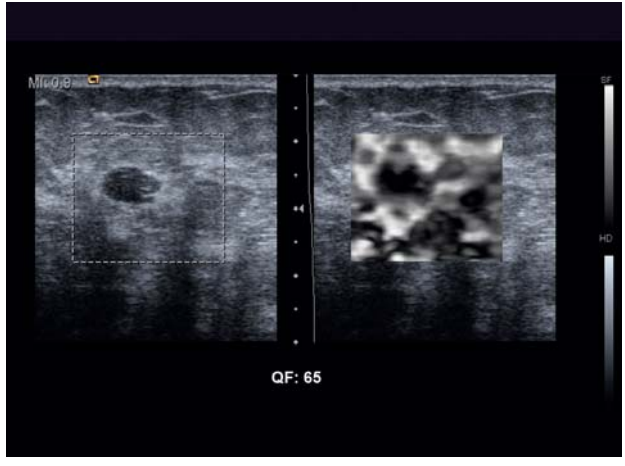
Based on tissue compression (identified as stress), the relative strain profile is computed in the axial dimension (identified as strain). The software calculates the relative difference in tissue movement, frame to frame, and then estimates the deformation of tissue.

$$E = -\frac{Stress}{Strain}$$

The strain profile is then converted to an elastogram and allows physicians to "see" the relative stiffness of a particular area that they may not be able to feel.

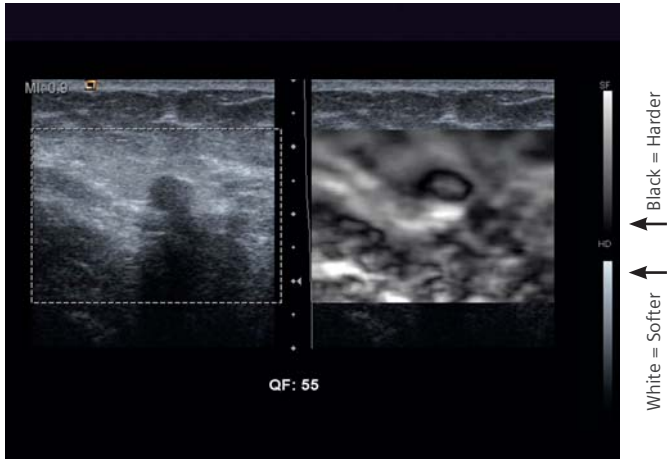
What is Siemens eSie Touch Elasticity Imaging?

- eSie Touch™ elasticity imaging is a unique qualitative imaging method utilizing proprietary algorithms to calculate and display the relative stiffness of tissue.
- eSie Touch elasticity imaging utilizes a real-time, dual imaging mode that simultaneously displays the standard B-mode image (composition of tissue) and the elastogram (relative stiffness) side-by-side.
- Quality tools aid in assessing each elastogram for accuracy.

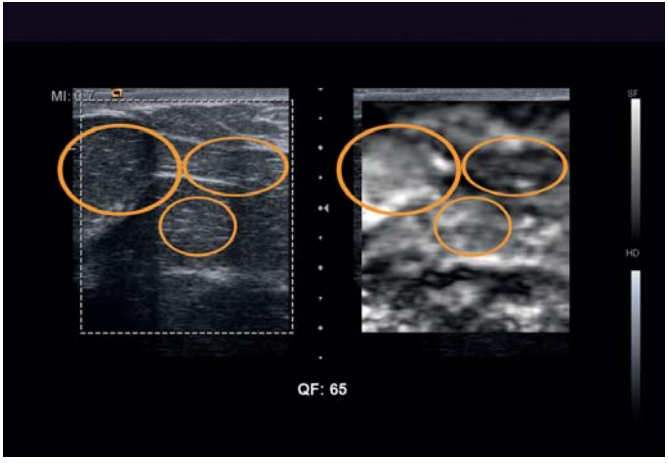


B-mode *Elastogram*

- It allows clinicians to see tissue information in a different way — by their mechanical properties.
- The elastogram provides a **qualitative** visualization of the stiffness of tissue — white indicates softer tissue and black indicates harder tissue.
- Color maps are also available which represent tissue stiffness in varying colors.
- Elasticity imaging provides additional information that can increase diagnostic findings and confidence.



Refer to the grayscale bar on the right of the screen to correlate the different areas of stiffness. Notice the representation of a complex cyst. This image uses the map index 0.

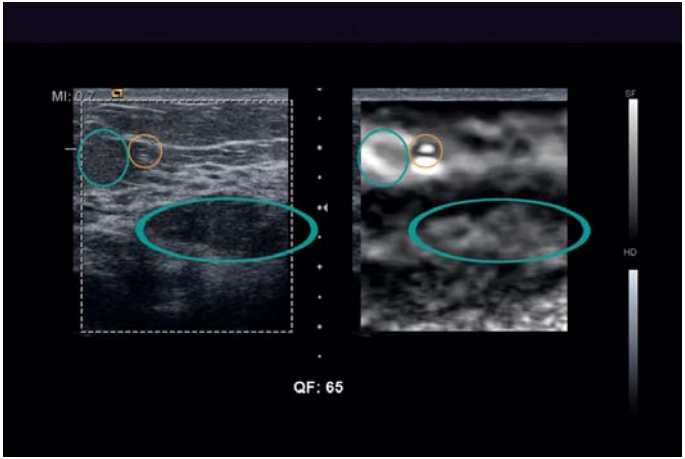


Ovals indicate area of fat in both images.

Relative Stiffness

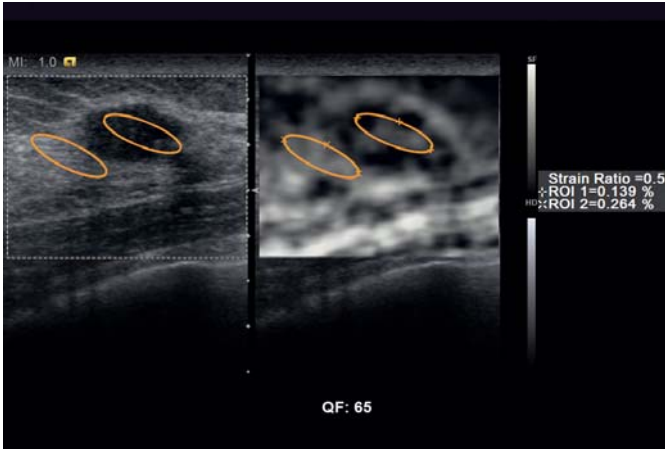
A critical point is that the elastogram displays the "softness" or "hardness" of an area **relative to the surrounding tissue.**

In this example showing a very fatty breast, the natural variations in the stiffness of fatty areas are apparent. The slightly stiffer fatty regions are correspondingly slightly darker.



Note the additional finding of a very small cystic structure, poorly visualized in the B-mode image.

In this second example, a fat lobule that lies deeper and posterior to, or within the dense fibrous layer, can often mimic the B-mode characteristics of a fibroadenoma. The elastogram, however, will show the softer mid-gray characteristics typical of fat as seen in the first image, and will be brighter than the dense or stiffer tissue surrounding it.



Relative strain in this fibroadenoma compared with the surrounding breast tissue.

eSie Touch Strain Ratio information

As part of Siemens' continuing investment in our products, an additional quantification tool, Strain Ratio is now available for the ACUSON S2000™ ultrasound system, release 2.0 and higher. A measure of the true strain (displacement %) of all pixels in each Region of Interest (ROI) is obtained and a numerical value for relative stiffness displayed.

The percentage displacement for each ROI is displayed and the Strain Ratio calculated. For example, the area shown in ROI 1 is approximately twice the stiffness of ROI 2. The lower the percentage value, the stiffer the lesion or area.

When performing Strain Ratio measurements, the two ROI should be of equivalent size and also positioned at approximately the same level (depth) within the image.

User Interface

Activate Elasticity Imaging by clicking on the EI button on the Imaging tab.

The **Map Index** on the thumbwheel has three options:

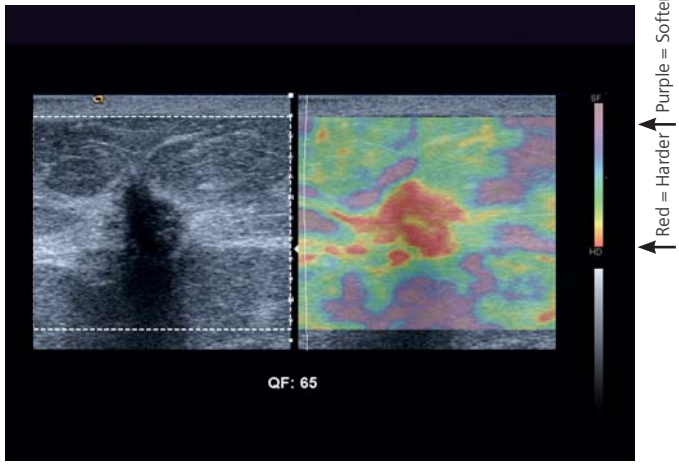
- Map 0 – Standard default map
- Map 1 – Balances the variation in pressure across the transducer face to improve contrast resolution
- Map 2 – Inverts black and white

The **Color Mapping** option is an On/Off control.

Use this to apply color mapping to the elastogram during live imaging, on a frozen image, or in cine.

As shown in the example to the right, it can provide additional useful information.

A second color map is now available with the ACUSON S2000 system, release 2.0 software which utilizes a blue/red configuration and allows color map inversion.



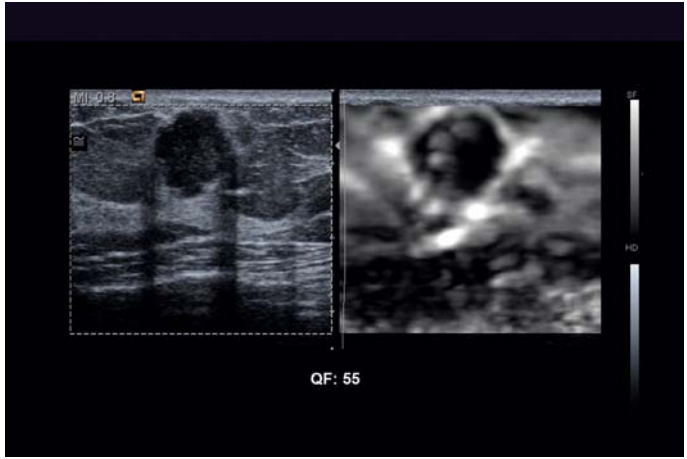
Note the color bar to the right. Red indicates harder and purple indicates softer tissue. Notice the additional clarity of the area in red.

Step-by-Step Workflow

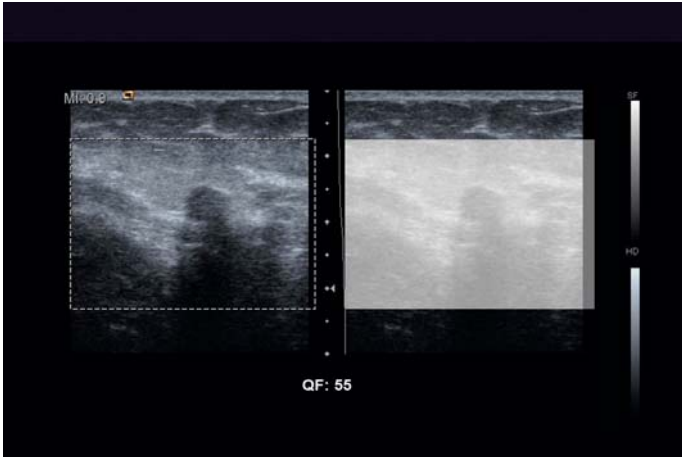
The following outlines an optimal workflow for acquisition and post-processing.

1. Position the transducer over an area of interest.
2. Optimize the B-mode image.
3. Activate EI using the button on the menu.
4. With the dual image onscreen, observe the elastogram while performing gentle cycles of compression.

Workflow continues on next page



The real-time images of this Invasive Ductal Carcinoma are simultaneously displayed side-by-side.



Use the Quality Feedback as a guide when acquiring the elastogram.

Tip: Continuous axial motion is key. However, in some instances, patient respiration or cardiac motion alone may provide enough information to produce a quality elastogram.

Tip: Relaxing pressure until the region under compression stops moving towards the transducer will help ensure reproducibility and consistent results.

If you see a white flash on the elastogram, it indicates one of the following conditions:

- Too much lateral movement or rocking motion;
- Too little pressure; or
- Too much pressure which causes the lesion to slip in and out of the plane.

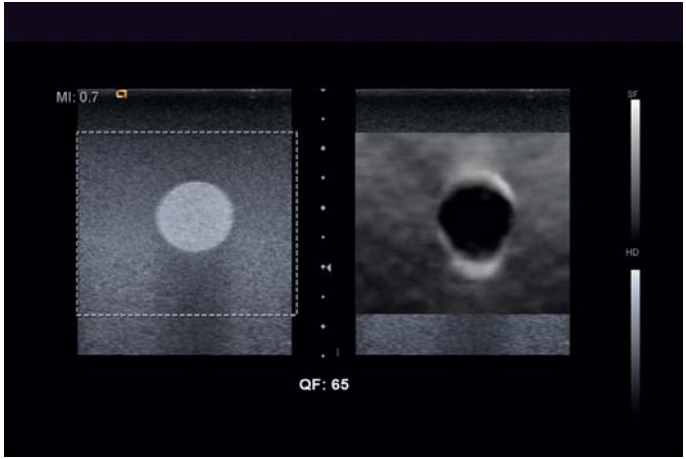
5. Continue scanning for approximately 10 seconds and then press the Freeze button.
6. Review the cine to obtain desired frames. (We recommend choosing a frame from a clip that contains a number of adjacent and consecutive frames with the same Quality Factor.)
7. The Quality Factor aids in the selection of an appropriate frame. Higher numbers generally equate to higher quality and for breast a QF of 55+ is common. Always be guided by the actual image appearance of the elastogram.

Acquisition Tips:

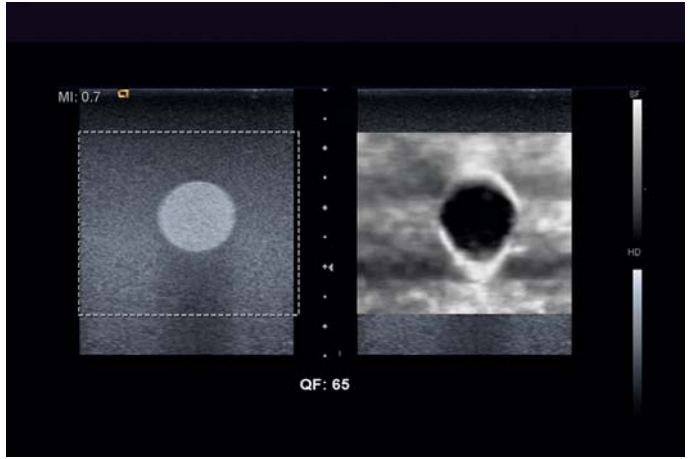
- Optimize the scan direction by positioning the patient to ensure as much of a perpendicular plane to the chest wall.
- If the lesion is in the upper or lower outer quadrant, turn the patient away from the side being examined to bring the scan axis more perpendicular to the tissue. This will facilitate good axial motion.
- Be aware of the amount of patient respiration and adjust your touch accordingly.

Acquisition Tips Continued:

- If there is a noisy background on the elastogram, increase the 2D gain in the far field.
- To ensure adequate information, make sure the region of interest is sufficiently large to include the area surrounding the lesion/area of interest. An image depth that allows the ROI to comprise around 50% of the total field of view is usually appropriate. Remember, the stiffness is calculated and displayed **relative** to the surrounding tissue.
- During cine review, try different Maps for selected frames to improve contrast resolution and/or view the elastogram with one of the color maps. Map 2 offers an inverted grayscale.



Map 0



Map 1

Post-processing

Once the images have been acquired, use the following post-processing steps.

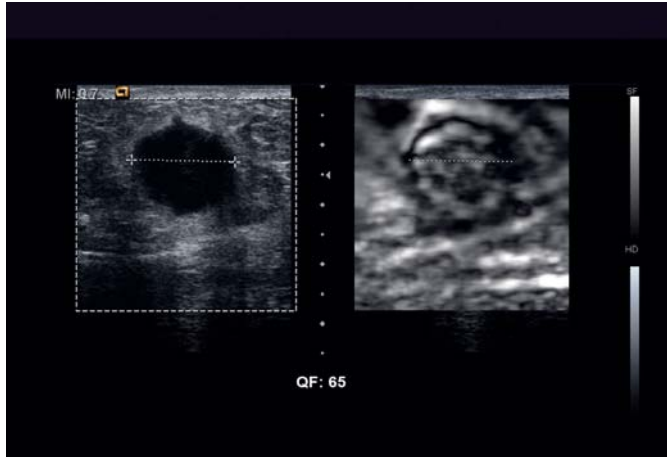
Note: All steps may not be required based on your preferences and/or workflow.

1. Create and save clips to archive information. For optimal workflow, create retrospective clips from the cine buffer.
2. If necessary, modify the size of the ROI (Region of Interest) to target and focus on the area of interest.
3. If desired, apply the color mapping to gather further information.

4. Perform distance, area or Strain Ratio measurements on the B-mode image and elastogram.

5. If desired, select the Shadow option for further understanding of the correlation between the B-mode image and the elastogram. It is generally easier to measure on the B-mode image.

   The Shadow option provides further understanding of the correlation between the B-mode image and elastrogram by shadowing one measurement on the opposite image.



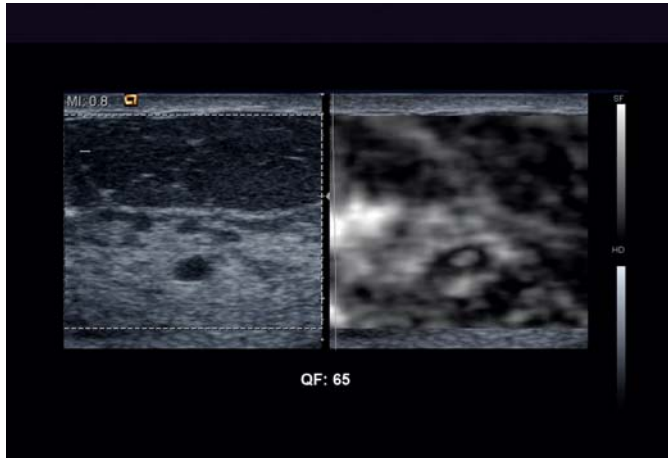
Notice the shadow option on the B-mode and elastogram. The stiffness in the area of this Invasive Ductal Carcinoma is displayed in the elastogram thus it will not necessarily match the exact shape of the area in the B-mode image.

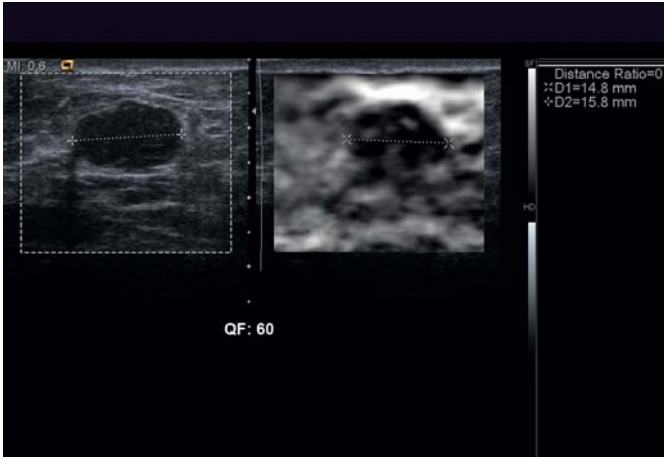
Images

Breast

Small cyst

Notice the small cyst. In the elastogram it is displayed as a bullseye with a white soft center surrounded by black and has posterior brightening. The typical bullseye appearance is more easily seen with Map 1, and is usually much more visible on grayscale than color maps.





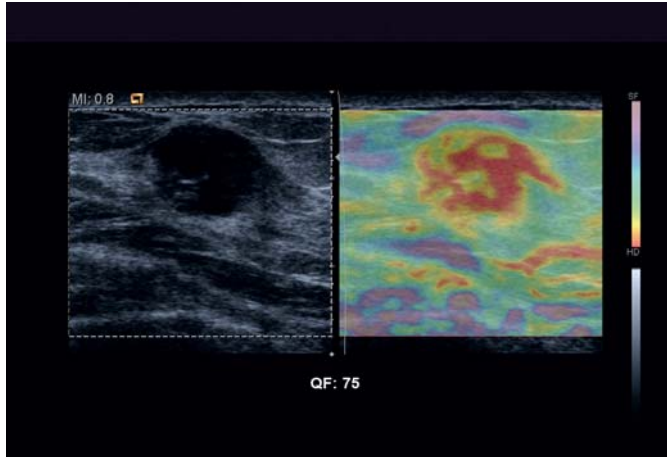
Biopsy–proven Fibroadenoma

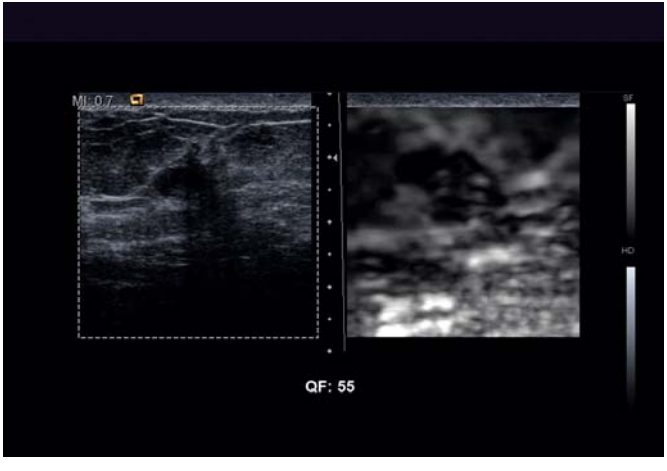
The Shadow option provides further understanding of the correlation between the B-mode image and elastogram by shadowing one measurement on the opposite image.

The stiffness of the area is displayed in the elastogram thus it will not necessarily match the exact shape of the area in the B-mode image.

Biopsy–proven Invasive Ductal Carcinoma

The color map provides additional information about the area of interest, where red indicates harder tissue and purple indicates softer tissue.



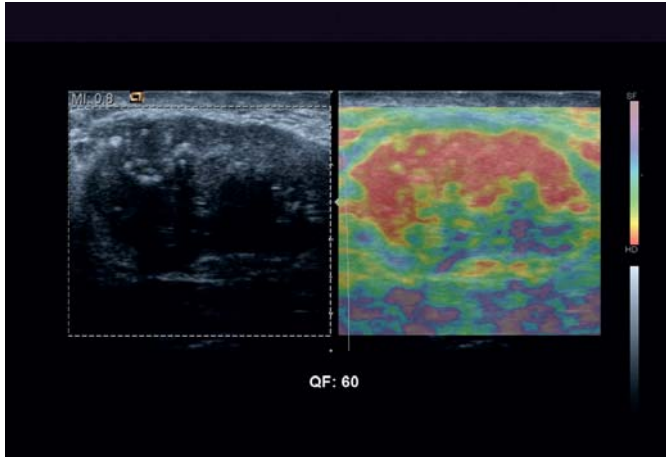


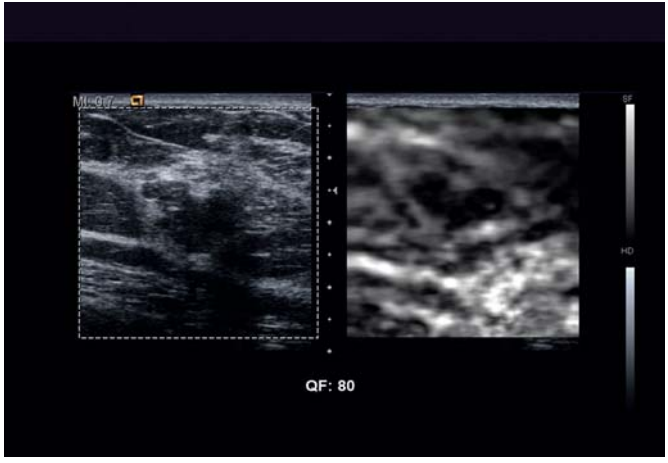
Biopsy–proven Invasive Ductal Carcinoma, High Grade

The visualized area of stiffness is much larger on the elastogram, probably due to the desmoplastic response of the surrounding connective tissue.

Biopsy–proven Fibroadenoma with Calcifications

The calcifications themselves do not deform, but probably contribute to the greater relative stiffness of the surrounding tissue as seen in this fibroadenoma.



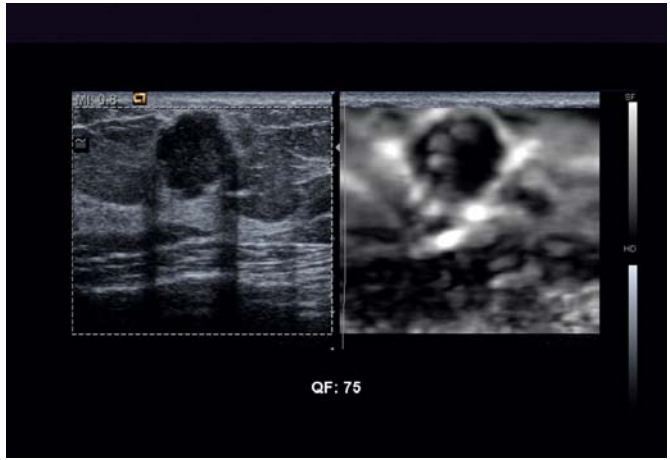


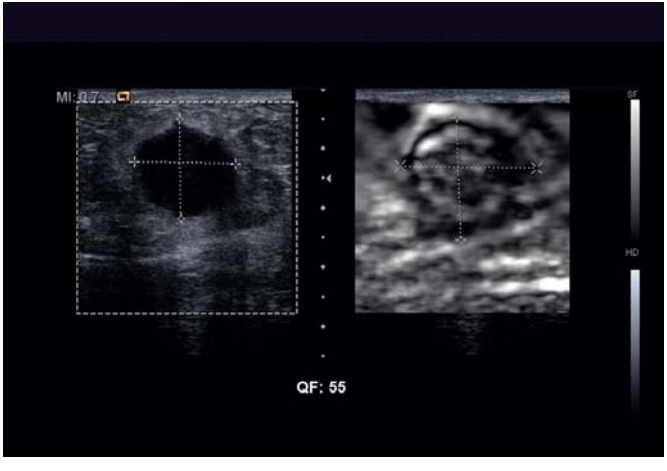
Biopsy–proven Fibroadenoma

The elastogram demonstrates various areas of both hard and soft tissue. Notice the mass is similar in size.

Biopsy–proven Invasive Ductal Carcinoma

Mixed areas of stiffness are noted on the elastogram. Notice how the area of stiffness appears larger.





Biopsy–proven Invasive Ductal Carcinoma

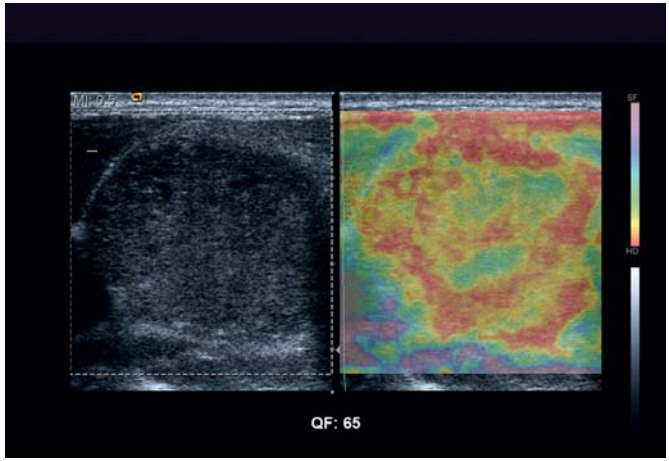
Highly aggressive invasive ductal carcinoma that is very soft and cystic looking on the B-mode image.

Soft areas within are clearly identified within the elastogram. Notice that the area of stiffness is larger than on B-mode.

Thyroid

Biopsy–proven Papillary Carcinoma

This thyroid cancer demonstrates mixed echogenicity on the B-mode image, which corresponds with the areas of soft and hard tissue indicated in the elastogram.

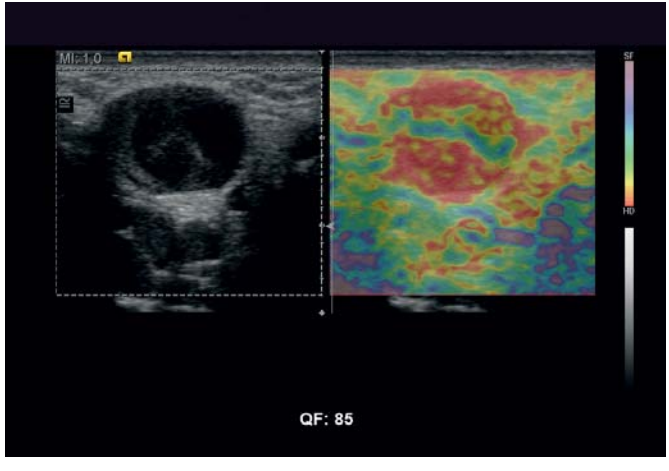


Red indicates harder and purple indicates softer tissue.

Salivary Glands

Parotid Mass

Parotid mass with mixed cystic and solid areas is well-mapped on the elastogram.

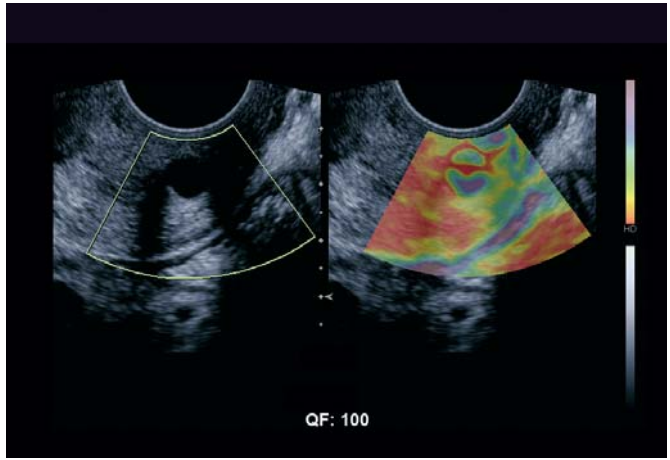


Parotid Mass.

Gynecology

Nabothian Cyst

Typical appearance of a cyst demonstrated in this color elasticity image.

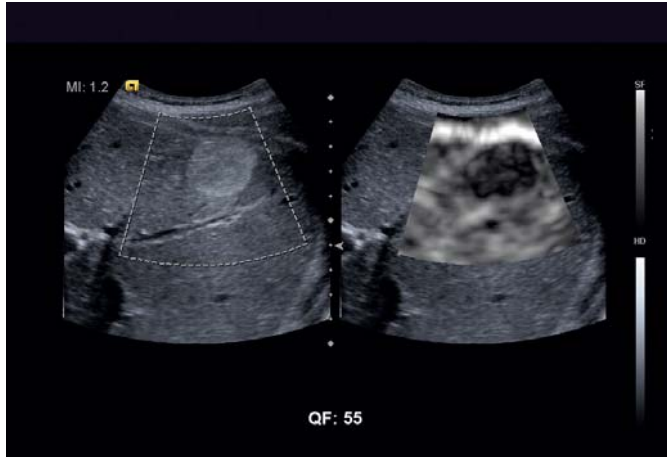


Nabothian Cyst.

Abdomen

Liver Hemangioma

Showing grayscale elastogram with clear definition of this hemangioma.



Liver Hemangioma.

Clinical images courtesy of:
Klinikum der Universität München-Grosshadern, Munich, Germany
Southwoods X-Ray and Open MRI, Youngstown, OH
Stanford University Medical Center, Stanford, CA
Wake Radiology Diagnostic Imaging Inc., Raleigh, NC

For more information on Siemens Ultrasound Solutions in breast care, please go to **www.siemens.com/elasticity**.

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