Strain Imaging in the Abdomen

eSie Touch elasticity imaging | Virtual Touch imaging | Virtual Touch quantification
Extending the Utility of Strain Applications

Conventional Elastography has gained widespread acceptance in breast imaging:

- Provides information on stiffness of tissue
- Aids in size assessment of lesions (malignancies tend to be larger than benign)
- Can help identify isoechoic lesions (stiffness variations)
- Can help guide interventional and biopsy procedures by identifying stiffest areas within a lesion

Extension of elasticity applications into abdominal exams provides many of the same benefits
Unique Advantages of Siemens

ACUSON S Family™ and ACUSON X700™ ultrasound systems offer extraordinary application and pioneering versatility for Strain Imaging in abdominal imaging

THREE options for Strain Imaging:

1. eSie Touch™ elasticity imaging
2. Virtual Touch™ imaging*
3. Virtual Touch™ quantification*

* ACUSON S2000 and ACUSON S3000 systems only
eSie Touch™ Elasticity Imaging

- **Transducer**
- **Region of Interest**
- **Stiff Lesion**
- **Soft Tissue**
- **Detection Pulse**
- **Elastogram**
Key Benefits for Clinicians and Patients

Comfort
- Often respiration and cardiac motion sufficient to provide elastogram
- No uncomfortable pressure/repetitive movement

Ease of use
- Immediate feedback - Quality Factor
- Single button press acquisition with any transducer

Post processing
- Viewing of grayscale and several color maps offering optimal visualization of all lesion types
- Measurements, and ratio assessments quickly and easily available

Increased surgical confidence
- Can provide increased visibility of lesion boundaries
eSié Touch Elasticity Imaging

Liver Hemangioma
Focal Fatty Sparing
Liver Metastasis
Benign vs. Malignant

Benign lesion

Malignant lesion

Images courtesy of Dr A Mateen, AIG, Hyderabad

© Siemens Medical Solutions USA, Inc., 2015.
Virtual Touch™ Imaging

- Displacement induced by **acoustic push pulse**
- **Detection pulses** track displacement **on axis** to the push pulse within the ROI
- The push/detect sequence is stepped across the ROI
- Relative displacement difference locations are mapped to the image
Inhomogeneous liver, suspicious for small lesion, in patient with previous Breast Ca.

Virtual Touch imaging shows lesion as stiffer than surrounding tissue, and allows a potentially more accurate biopsy (if required) by showing areas of greatest stiffness.
Clinical Images

Patient with known hydatid cyst

Layers clearly demarcated on Virtual Touch imaging with good differentiation between varying stiffnesses

Patient with known colorectal cancer
Virtual Touch™ Quantification

- **Shear waves** induced by a virtual extended shear wave source

- **Detection pulses** track displacement vs. time **off axis** to the **acoustic push pulse**

- Time to Peak (TTP) is measured along each detection beam and speed is computed

- The **speed** of shear wave propagation is related to tissue stiffness
Chronic Liver Disease – Conventional Approach

Liver changes associated with HBV, HCV, NASH and NAFLD are common among the ten major causes of death in the United States:

- Chronic hepatitis and cirrhosis progress over several decades
- Fibrosis staging is the key factor in determining liver health in these patients
- Biopsy is the ‘Gold standard’
Liver Biopsy

Staging is currently accomplished by a single core needle biopsy

- Not well tolerated
- Small sample size from a focal area
- Misdiagnosis of stage occurs in 20-40% of cases*
- Not viable in some patients

Chronic Liver Disease – Conventional Approach

Liver changes associated with HBV, HCV, NASH and NAFLD common

Ultrasound is simple and routinely used for assessing liver but can be inaccurate in staging liver fibrosis

“Fatty Liver” without Fibrosis

Clinical Cirrhosis

Cirrhosis masked by “Fatty Liver”
Positioning of the Region of Interest

- **Liver capsule**
- **ROI**
- **Gallbladder**
- **Kidney**
- **Shear-wave velocity**
- **Vs=1.47 m/s**
- **Depth: 3.3 cm**
- **Distance between skin and upper border of ROI**
Virtual Touch Quantification in Liver Fibrosis Staging

F0: $V_s = 1.14 \text{ m/s}$

F1: $V_s = 1.40 \text{ m/s}$

F2: $V_s = 1.4 \text{ m/s}$

F3: $V_s = 3.51 \text{ m/s}$

F4: $V_s = 3.51 \text{ m/s}$

© Siemens Medical Solutions USA, Inc., 2015.
Virtual Touch Quantification in Fibrosis
Technical Advantages

• Not affected by Ascites
• Independent of Fatty Liver Disease
• Works in high Body Mass Index patients
Additional Benefits of ACUSON S2000™ and ACUSON S3000™ Ultrasound systems

- Fully-featured ultrasound system
- Full range of exam types, including OB/GYN, cardiac, pediatric/neonatal, MSK and vascular
- Full transducer suite
- Siemens’ pioneering history and corporate research for continuing development and support
Case Study 1 – Pancreas
History and B-mode Findings

History:
- 63 year old male presenting with acute pain in abdomen.

B-mode:
- Pancreas shows increased size, and irregular contour, with altered echotexture
- Calculi and calcifications seen with significant peri-pancreatic edema
- Fluid collection anterior to distal body and tail with internal echoes

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 1 – Pancreas
eSie Touch™ Elasticity Imaging

eSie Touch elasticity imaging shows diffuse increase in stiffness throughout pancreas

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 1 – Pancreas
eSiemens Touch™ Elasticity Imaging

eSiemens Touch elasticity imaging shows diffuse increase in stiffness throughout pancreas

Images courtesy of Dr A Mateen, AIG, Hyderabad

© Siemens Medical Solutions USA, Inc., 2015.
Case Study 1 – Pancreas
Virtual Touch™ Quantification Findings

Virtual Touch quantification shows high velocities (above 3.5 m/s) consistent with increased tissue stiffness

Conclusion:
Acute on chronic calcific pancreatitis with significant peri-pancreatic edema and pseudocyst anterior to distal body and tail

Images courtesy of Dr A Mateen, AIG, Hyderabad
Virtual Touch™ Quantification Findings

Virtual Touch quantification shows high velocities (above 3.5 m/s) consistent with increased tissue stiffness

**Conclusion:**
Acute on chronic calcific pancreatitis with significant peri-pancreatic edema and pseudocyst anterior to distal body and tail

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 2 – Liver
History and B-mode Findings

History:
- 36 year old male referred for evaluation of altered liver echotexture and mild irregular liver contour. Query: Alcoholic liver disease

B-Mode:
- Small liver with altered echotexture and mildly irregular contour
- No ascites or effusion

Images courtesy of Dr A Mateen, AIG, Hyderabad

© Siemens Medical Solutions USA, Inc., 2015.
Case Study 2 – Liver
Virtual Touch™ Quantification Findings

Despite B-mode findings, Virtual Touch quantification was within normal range – 1.16 – 1.39 m/s

Subsequent blood work confirmed, being within normal range
Case Study 3 – Liver History and B-Mode

History:
- 39 year old female referred for routine follow up 3 months post bilateral oophorectomy

B-Mode:
- Liver normal in size, contour and echotexture
- Cystic lesion (35 x 18mm) noted in right lobe, with 2 mural nodules

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 3 – Liver
eSie Touch™ Elasticity Imaging and Virtual Touch™ Imaging Findings

Color coded elastograms demonstrate stiff lesion and delineate cystic area

Virtual Touch imaging confirms hard lesion and shows contrasting fluid as soft, denoting easy movement from push pulse (bright area)

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 3 – Liver
Virtual Touch™ Quantification

Virtual Touch quantification shows actual degree of stiffness in lesion – 3.22 m/s

High stiffness of lesion confirms suspicion of metastatic lesion secondary to Ca ovary

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 4 – Pancreas
History and B-mode Findings

History:
33 year old male with confirmed chronic pancreatitis presented with acute upper abdominal pain

B-mode:
Ill-defined hypoechoic area (21 x 21mm) in head of pancreas

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 4 – Pancreas
Strain imaging

eSie Touch™ elasticity imaging – lesion appears harder suggestive of focal inflammatory lesion on grayscale and color imaging

Images courtesy of Dr A Mateen, AIG, Hyderabad
Case Study 4 – Pancreas
Virtual Touch™ Quantification

Very high values were obtained from pancreatic head, with much lower in body and tail.

Follow-up measurements showed decreasing values suggestive of resolving pancreatitis.

Images courtesy of Dr A Mateen, AIG, Hyderabad