# Elastography – A Safe Modality to Differentiate Breast Lesions with Ultrasound?

A Thomas, T Fischer

*Fig. 1a: Hypoechoic mass with horizontal alignment and tender capsule*

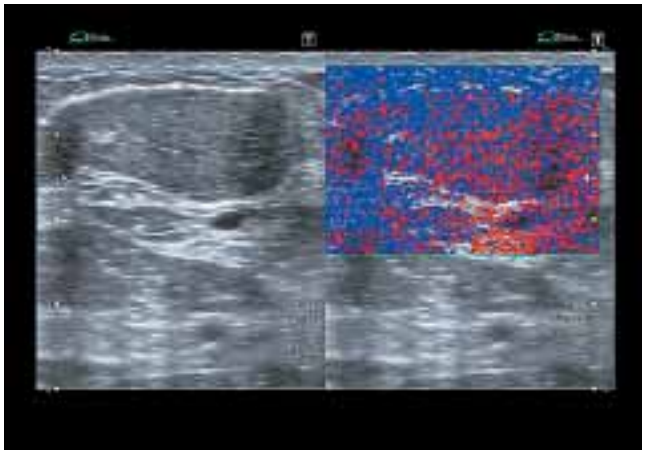

*Fig. 1b: On TDI, the mass is filled almost completely with color pixels. Hypoechoic visualization and sparing of the lesion with color pixels on TDI.*

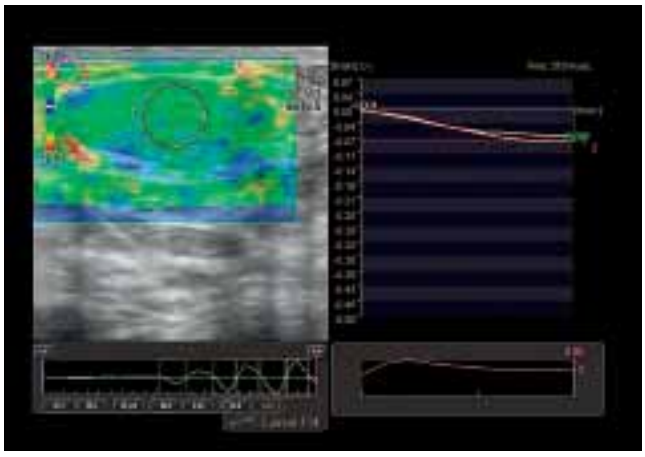

*Fig. 1c: Characteristic green color of fibroadenoma which appears elastic compared with the surrounding issue, as demonstrated by the low strain ratio.*

## Introduction

One important characteristic of tissue is its inherent elasticity which may be altered by pathophysiologic processes such as ageing, inflammation and malignant tumors. In this context elasticity is defined as the ratio of the tension (stress) needed to produce a relative change in length (strain) and describes how much pressure must be exerted on the tissue in order for it to undergo elastic deformation. In principle tissue elasticity can be derived from the stress and strain measured in the tissue structures. While strain can be computed easily based on the high frequency echo signals, stress cannot be determined directly from tissue measurements. Thus, compression must take place under standardized conditions.

In ultrasound examinations of breast tissue compressibility is one standard parameter to be considered in the differential diagnosis. Any non-compressible mass in B-mode studies is associated with an increased risk of malignancy. One new technical modality is the clinical application of sonographic elastography based on so-called strain imaging. Initial results of the assessment of the strain fields seem to indicate an improvement in specificity when elastography is employed in sonographic studies of the breast (Thomas A et al. Acad Radiol 2006 Dec; 13(12):1496-504).

The objective of the case study presented here was to evaluate two new methods for visualizing the elastic characteristics of breast masses. B-mode sonography was compared with Tissue Doppler Imaging (TDI) and with Strain Imaging (SI) (Thomas A et al. Acad Radiol 2007 May;14(5):522-9). This paper illustrates the subjective evaluation of the findings as well as quantitative assessment of the strain field of the mass compared with the surrounding tissue.

## Case report

Two women were referred to our multidisciplinary breast center for ultrasound-guided biopsy due to suspect findings on palpation.

First, a 47-year-old woman presented with a known mass seen on breast sonography which had been increasing in size. The family history was unremarkable. On palpation a smooth, well defined mass was felt which was easily displaced. Selective high-resolution sonography (Aplio XG, Fa. Toshiba, 9 MHz, THI, FC) revealed an isoechoic, smoothly defined mass in the right upper outer quadrant with a diameter of 29 mm and a delicate capsule. Tissue structure was intact and posterior enhancement was well defined (Fig. 1a). Without compression Tissue Doppler Imaging (TDI) can visualize tissue displacement only due to Doppler signals and with this modality the entire area of the mass, which appeared rather benign, was filled with color pixels (Fig. 1b). Strain imaging allowed analysis of the strain ratio and yielded the low value of 1.25 between the mass and the surrounding tissue (Fig. 1c). In addition to the low strain ratio the homogeneous green color of the tumor underlined the elastic nature of the finding. The overall classification of the mass was BIRADS category 3. The patient desired histopathologic workup and the core biopsy confirmed the diagnosis of fibroadenoma.

The second female was 80 years old and presented with a palpable mass in scar tissue. In the past she had been treated for breast cancer. On palpation a cherry-sized, coarse, immovable mass was felt. Sonography displayed a rather smooth hypoechoic lesion of vertical alignment with a hyperechoic halo (Fig. 2a). TDI demonstrated a mass with large sized sparing while on B-mode imaging the mass and on TDI the sparing with its color pixels were comparable (Fig. 2b). Analysis of the strain field yielded different values for the mass itself and the surrounding tissue, the resulting strain ratio of 15.61 being significantly increased (Fig. 2c). On a subjective level the coarse characteristic of the lesion could easily be ascertained by the blue color. Therefore, the mass was classified as BIRADS category 5. The histopathologic workup of the core biopsy confirmed the diagnosis of recurrent invasive ductal breast cancer and the patient underwent surgery.

*Fig. 2a: Irregularly defined lesion with hyperechoic halo*

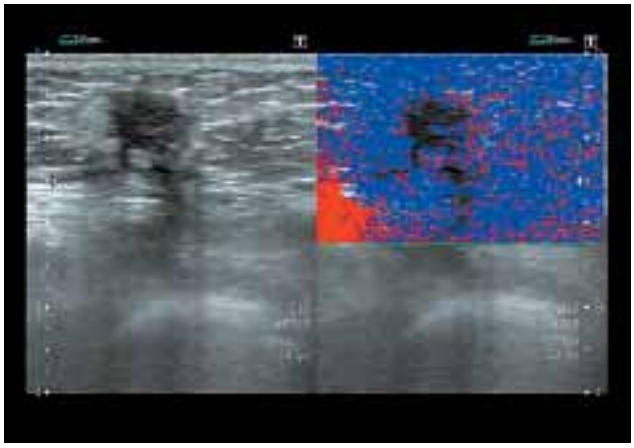

*Fig. 2b: The surrounding tissue demonstrates color pixels on TDI*

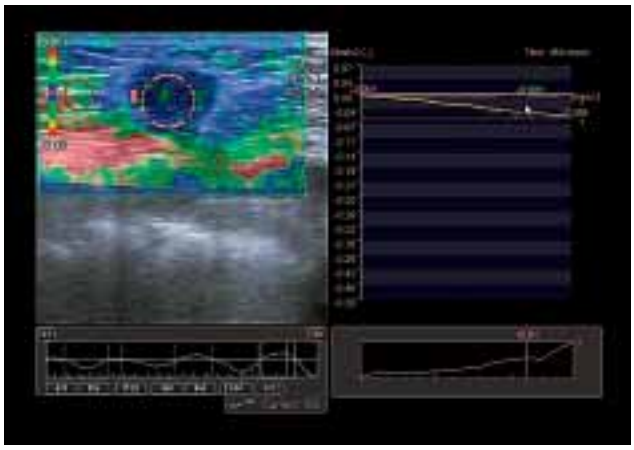

*Fig. 2c: The immovable coarse mass is colored blue. Compared with the surrounding tissue the lesion is characterized by a significantly higher strain ratio.*

## Discussion

To date, breast masses have been studied by various types of ultrasound elastography which, compared to B-mode ultrasound, yielded enhanced specificity. This means that determination of elasticity permitted reliable assessment of the benign or malignant nature of the mass. The ability to demonstrate tissue elasticity by real-time ultrasound or offline analysis of the strain field resulted in better typing of the lesions.

In the current workup of breast cancer elastography offers a promising approach for differentiating benign and malignant masses. The possibility to quantify the strain ratio between the lesion and its surrounding fatty tissue will result in better standardization of this modality. Using elastography for lesions of BIRADS category 3, which tend to be benign rather than malignant, could result in a reassessment to category 2. Since TDI is easy to use and does not require additional time, this simple pressure-independent Doppler technique should be evaluated in large studies.

## Practical conclusion

- Elastography permits typing of breast lesions
- Current study data on elastography demonstrate improved specificity compared with B-mode imaging
- Different techniques for quantifying the strain ratio will standardize the modality even further
- TDI is a simple, pressure-independent alternative to elastography

*Anke Thomas*
*Thomas Fischer*
*Ultrasound Research Laboratory*
*Department of Radiology*
*Charité – Campus Charité Mitte*
*Charitéplatz 1*
*10117 Berlin*
*Germany*