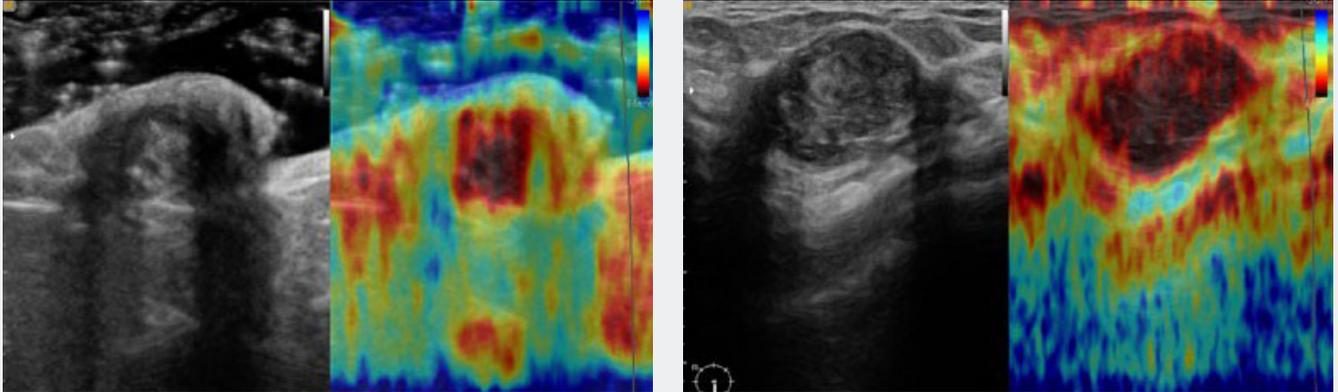


ElastoScan™ in breast diagnostics

: 10 Most Frequently Discussed Objectives

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"ElastoScan™ is excellently suited for obtaining information that can be compared with the results of palpation in breast cancer diagnostics"

Abstract

The first reports on examinations using sonoelastography were published over 20 years ago. However, this complementary method has only recently gained clinical relevance in breast sonography examinations. Direct correlation between the results of palpation of the breast with abnormalities in ultrasound images forms part of daily clinical routine. Increasing use of ultrasound for the early detection of breast cancer has led to the diagnosis of even the most challenging cases. In these cases, an elastography technique such as ElastoScan™ is excellently suited for obtaining information that can be compared with the results of palpation. The current paper aims to discuss the issues most commonly raised in breast sonoelastography and to illustrate them with case studies.

Introduction

Scientific research involving sonoelastography has been published since the beginning of the 1990s⁴. However, the method has only recently gained in clinical relevance^{6,8}. The results of palpation are still considered to be of great importance in breast diagnostics. Even today, imaging results are deemed more reliable when they are supported by palpation. The question therefore arises as to whether elastography might achieve the same importance in particular for the clarification of clinically challenging findings.

In the following, we would like to enter into ten points that are frequently discussed in the context of elastography. The examinations were performed using Accuvix A30 ultrasound system, the L5-13IS transducer and the elastography software, ElastoScan™ which is also available on RS80A, WS80A system(Samsung Medison Co. Ltd., Seoul, Korea).

1. Elastography and compression - Is the application of pressure indispensable for the generation of an elastography?

The terms, elastography and elasticity, are inevitably linked to a specific tactile perception. Compression and displacement have long been important in breast sonography. These two properties have regained importance through ElastoScan™. Elastography should, however, not be regarded as a replacement for, or extension of the results of palpation. Depending on the technique, the significance of the information provided by elastography can be actually increased with decreasing pressure applied with the transducer (Figure 1a, b).

ElastoScan™ allows elastography to function without any direct contact with the organ that is being examined. The advantage of this technology is that the conceivable factors, such as transducer weight, initial pressure exerted by the sonographer and counter-pressure due to the patient's breathing, have no effect on the results.

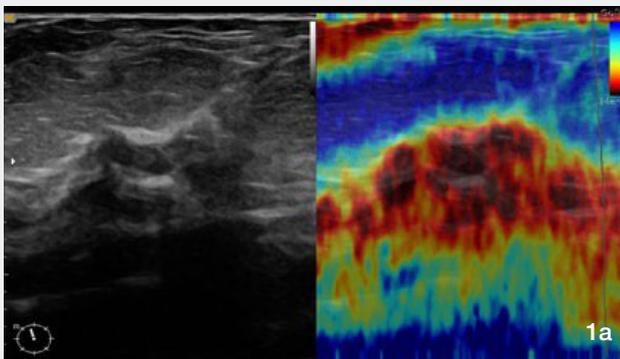


Figure 1a. Carcinoma under strong compression: delineation from surrounding tissue is difficult

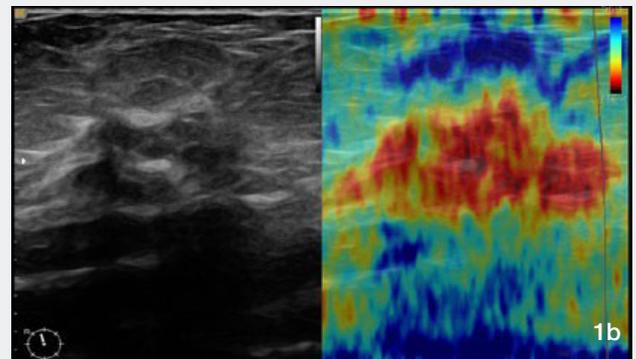


Figure 1b. Carcinoma under weak compression: behavior of the tumor core, its periphery and surrounding tissue are easier to differentiate

2. Does the depth of a lesion below the skin affect the visualization of the finding in elastography?

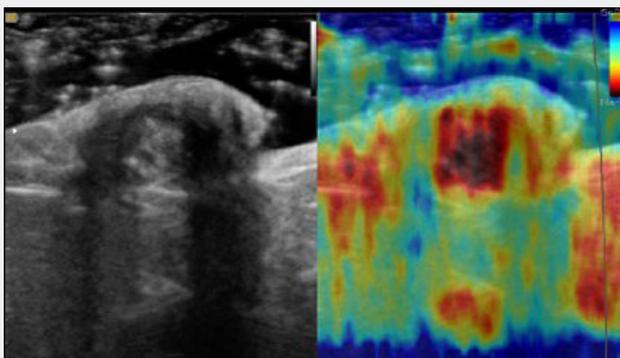


Figure 2. The transducer is placed in the gel without direct contact to the organ of interest: elastography clearly visualizes the small papilloma in the center of the mamilla

Lesions that are located very close to the surface of the skin can be easily assessed using elastography (Figure 2). But is the method also useful at greater depths? And, if yes, will it detect only rigid lesions or also soft lesions? Experience has shown that ElastoScan™ indeed detects deep-lying masses, for example carcinomas located close to fasciae are shown as indurated lesions while deep-lying cysts are visualized as elastic lesions (Figure 3a, b).

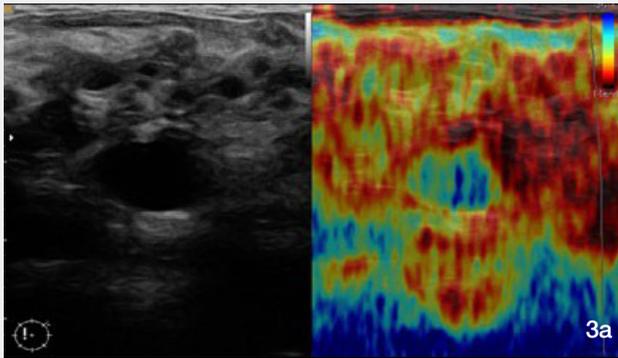


Figure 3a. Deep cyst under moderate compression: not very well visualized in the B-mode (left), much better delineation in the elastography (right)

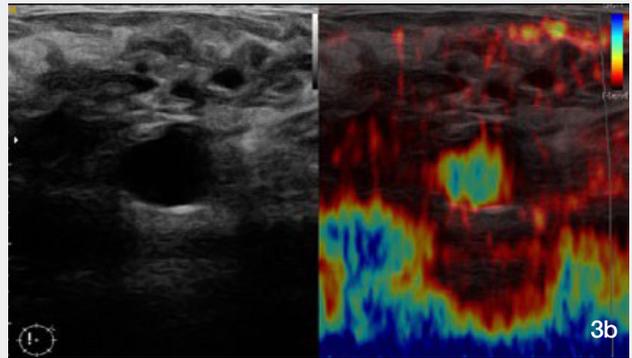


Figure 3b. Deep cyst under maximum compression: the cyst remains elastic

3. Color scales or deformability measurements: how meaningful are attempts at quantification?

Color scales in older publications on elastography usually code indurated lesions in blue and soft lesions in red. There is no plausible reason for this color allocation. Opposing color coding is often found in more recent publications, i.e., indurated lesions are red in these cases and softer lesions are blue. This may be due to the fact that red is considered a signal color that is more generally taken to indicate the indurated lesions that are classified as more unusual. State-of-the-art systems, however, do provide the option for the user to reverse this color allocation. When the user wishes to avoid this controversy entirely, there is the option of elastography with different gray-scale values or intensities of one individual color.

4. Is it possible to differentiate between "cystic" and "solid" in elastography?

One of the classic tasks of ultrasound has always been the differentiation between cystic and solid masses. However, in addition to the many types of lesions that can be unambiguously classified, there are numerous lesions that remain difficult to classify. The task here is to distinguish cysts producing scatter echoes or cysts with viscous secretions from a true solid mass. In this situation, ElastoScan™ is a helpful tool. The same holds true if, for example, after a punch biopsy, a carcinoma can no longer be clearly distinguished in the B-mode image from a hematoma that was created by the punch biopsy. Conversely, larger echoic cysts can also create considerable confusion in elastography (Figure 4).

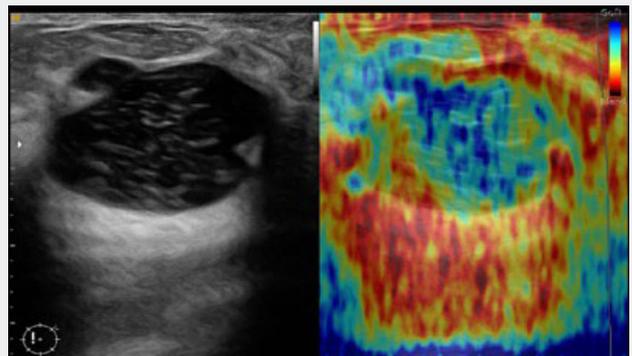


Figure 4. Larger hemorrhagic cyst

5. What role does elastography play in the evaluation of malignancy?

Elastography is certainly no replacement for the histological confirmation of findings and is also not a primary method for the detection of lesions, even if it is more sensitive than palpation and some studies have also revealed it to be more specific than pure B-mode sonography. It is therefore important not to create unrealistic expectations in this area.

6. Does the density of surrounding tissue affect the significance of elastography data?

The increasing use of sonography in breast cancer diagnostics has revealed ultrasound to be particularly well suited for the detection of lesions in dense tissue that is difficult to assess in mammography. Nevertheless, the potential of ultrasound in so-called breast involution is frequently underestimated. It is precisely the interaction of small malignomas with the surrounding fatty tissue which produces the contrasts allowing the detection and delineation of even small lesions in a systematic and thorough examination by applying varying pressure. These reactions, that are dependent on the environment, can also be used in elastography to visualize lesions, both in higher (Figure 5) and lower density environments (Figure 6). Independent of the echogenicity of the surrounding tissue, elastography sometimes allows us to obtain surprising insights into which structures are part of the tumor itself and which are not. This information can be extremely important when planning surgery.

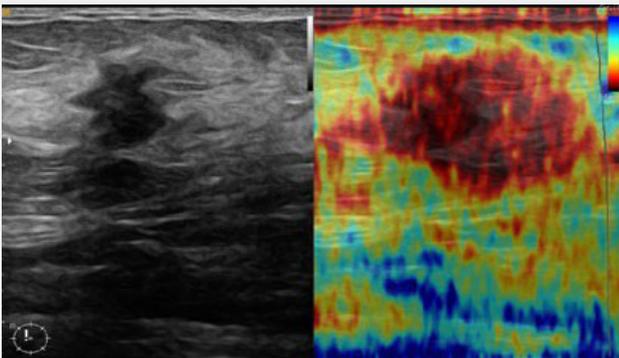


Figure 5. Carcinoma in echo-rich surroundings: ElastoScan™ shows a clear induration zone that is larger than the echo-poor part of the lesion

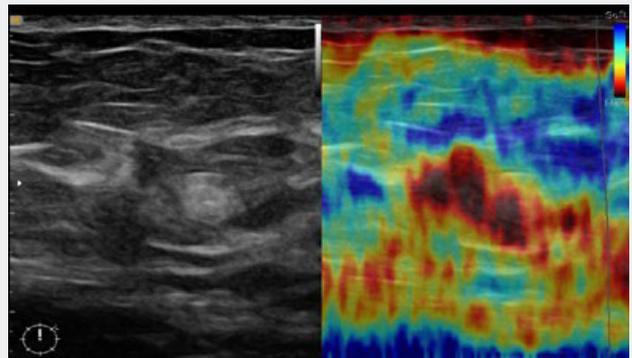
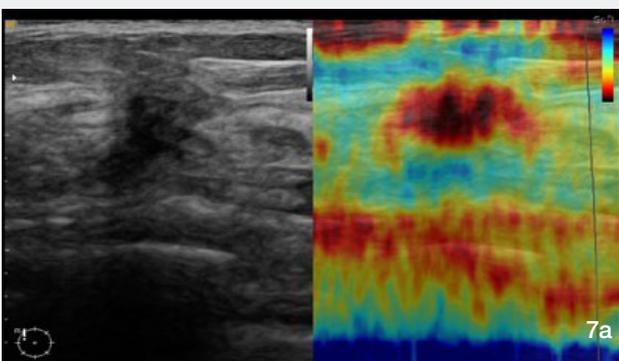


Figure 6. Carcinoma in surroundings mainly dominated by fatty tissue: only ElastoScan™ shows that the small, echo-poor lesion and the echo-rich part on the bottom right are components of the same structure.

7. Can ElastoScan™ improve the sonographic predictions of the dimensions of pathological findings?



The Ueno score, which is used by many sonographers, evaluates the correlation between the B-mode image and the elastogram³. The highest score, when malignancy is considered to be most likely, is obtained when the induration zone determined in elastography exceeds the dimensions of the lesion detected in the B-mode image.

However, the induration zone visualized using elastography is not necessarily identical to the tumor size that is confirmed subsequently with histology.

Elastography has a major advantage with reference to those lesions where the vertical tumor axis cannot be measured due to dorsal attenuation or extinction (Figures 7a ~ c).

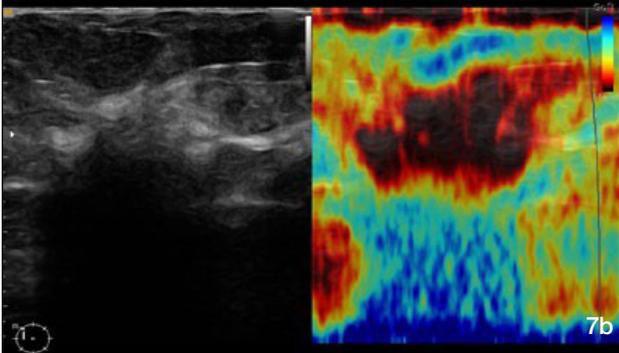


Figure 7b. Invasive lobular carcinoma with clear retrotumoral shadowing

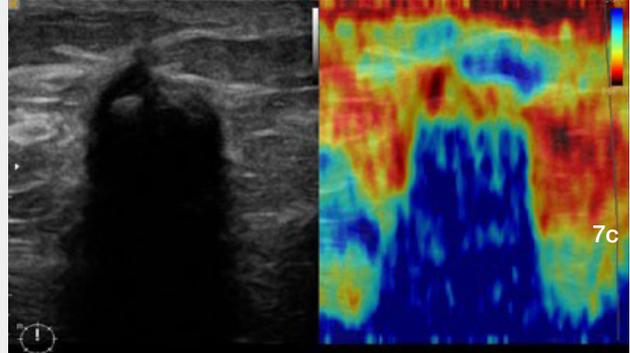


Figure 7c. Roughly calcified fibroadenoma with total retrotumoral extinction

8. Doppler ultrasound, 3D sonography and ElastoScan™ - What is the clinical relevance of these complementary methods?

The conventional 2D B-mode image will remain the main pillar of breast sonography. However, in cases where the findings are suspect, modern breast ultrasound can draw on a range of supplementary tools. 3D sonography allows comprehensive and reproducible documentation of a lesion, particularly in the coronary plane which cannot be documented using conventional methods. Doppler ultrasound provides information on vascularization. It thus uses a similar approach to MRI, albeit without the use of a contrast agent. This information can also be displayed three-dimensionally, complementing the information that has already been obtained. Finally, ElastoScan™ expands the diagnostic spectrum by adding a further level of perception that not only characterizes the lesion per se, but also its contact with the surrounding tissue (Figure 8). All these complementary techniques now rapidly provide valuable additional information, with little effort involved. In future, the question will therefore increasingly be posed as to why these techniques were not used to clarify suspect findings.

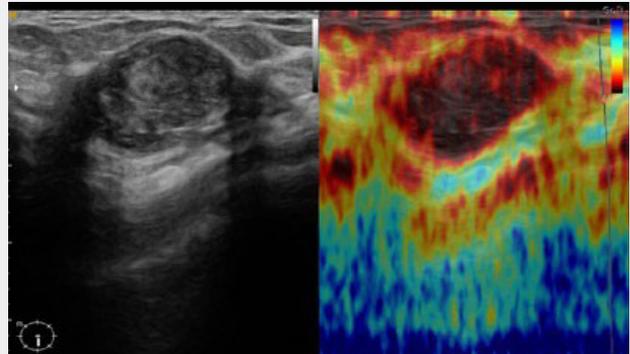


Figure 8. Rapid-growth breast tumor with smooth edges shown in elastography

9. Elastography as a complementary tool - What contribution can ElastoScan™ make towards second-look ultrasound?

An ultrasound scan occasionally does not lead immediately to the expected unambiguous diagnosis. In such cases, a so-called second-look ultrasound examination is performed after mammography or MRI results have been obtained, to correlate the results of sonography with the other images, for example, to support an intervention. In these circumstances, it is important to use all available complementary sonographic techniques, including elastography. The fact that this kind of approach is frequently successful and will certainly improve the performance of first-look sonography⁴.

10. Does ElastoScan™ contribute to reducing the number of unnecessary biopsies?

Comparable to the application of higher frequencies in breast sonography⁵, elastography can also decrease the number of unnecessary interventions and biopsies^{1,9}. In addition, punch biopsies and pre-surgery wire markings can be carried out in a more targeted fashion when supported by elastography images.

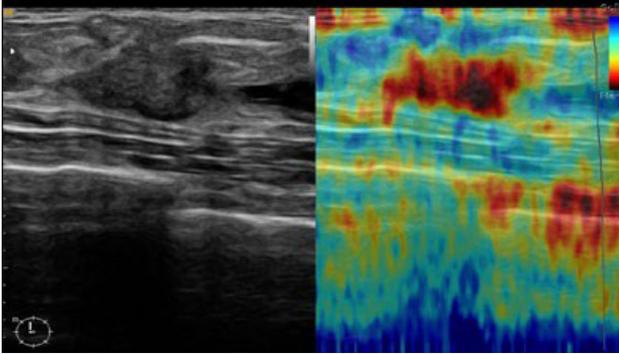


Figure 9. Mamma carcinoma with associated ductal structure. The difference between the hard tumor and the soft ductal structure was confirmed by pathohistology: well defined carcinoma without extensions or intraductal components.

Supported Systems

- RS80A with Prestige
- RS80A
- WS80A with Elite
- WS80A
- HS70A
- H60
- Accuvix A30

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