

**Role of Sonoelastography and MR-  
Elastography in Differentiation  
of Breast Lesions**

*ESSAY*

*Submitted in partial fulfillment for  
Master Degree in Radiodiagnosis*

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دور قياس المرونة بالموجات فوق الصوتية  
والرنين المغناطيسي في التفرقة بين إصابات  
الثدي

رسالة مقدمة توطئه للحصول علي درجه الماجستير  
في الاشعة التشخيصية

مقدمة من

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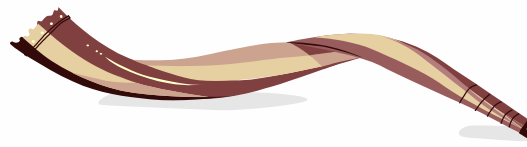
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*Ahmed Zaghlol  
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## *List of Abbreviations*

<b>ACR</b>	American College of Radiology
<b>AUC</b>	Areas Under Curve
<b>BIRADS</b>	Breast Imaging Reporting And Data System
<b>CAM</b>	Combined autocorrelation method
<b>CeMRI</b>	Contrast enhanced magnetic resonance imaging
<b>DCIS</b>	Ductal carcinoma in situ
<b>FN</b>	False negatives
<b>FOV</b>	Field Of View
<b>Gd</b>	Elasticity
<b>GI</b>	Viscosity
<b>GRE</b>	Gradient-recalled echo
<b>Hz</b>	Hertz
<b>IBC</b>	Inflammatory breast cancer
<b>IDC</b>	Invasive ductal carcinoma
<b>ILC</b>	Invasive lobular carcinoma
<b>kpa</b>	Kilopascals
<b>LCIS</b>	Lobular carcinoma in situ
<b><math>\mu</math></b>	The shear modulus (stiffness)
<b>MEG</b>	Motion Encoding Gradient
<b>MHz</b>	Mega Hertz
<b>MRE</b>	Magnetic Resonance Elastography

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<b>NPV</b>	Negative Predictive Value
<b>POD</b>	Probability of disease
<b>PPV</b>	Positive Predictive Value
<b>RF</b>	Radio-frequency
<b>ROC</b>	The receiver operating characteristic curve
<b>ROI</b>	Regions of interest
<b>SE</b>	Sonoelastography
<b>SENSE</b>	Sensitivity Encoding Sequence
<b>SP</b>	Specificity
<b>SR</b>	Strain Ratio
<b>TDLUs</b>	Terminal Ductal-Lobular Units
<b>TE</b>	Time of Echo
<b>TI</b>	Time of Inversion
<b>TR</b>	Time of Repetition
<b>T.S</b>	Tsukuba elasticity Score
<b>TP</b>	True positives
<b>US</b>	Ultrasonography

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## Introduction

Elastography is a newly developed method which was introduced in 1991 and started to be used in a clinical setting in 1997 (*Garra et al., 1997*).

Sonolastography is the technique of imaging the hardness of soft tissue. The resultant strain images show the behavior of tissue when subjected to mechanical stress (*Tan et al., 2008*).

With the use of sonoelastography, the difference in hardness between normal and diseased tissue of the breast can be estimated by measuring the tissue strain induced by probe compression. Several clinical studies have reported that sonoelastography has the potential to differentiate between breast lesions (*Regner et al., 2006*).

Sonoelastography of the breast allows an objective analysis of the viscoelastic properties of breast tissues and, therefore, corresponds to an improved and user-independent clinical breast examination that gives measurable physical quantities (*Tan et al., 2008*).

Sonoelastography represents a simple, fast, and non-invasive diagnostic method that may be a useful complement to US for less experienced radiologists in assessing solid non-

palpable breast lesions where specificity has proven higher (*Scaperrotta et al., 2008*).

Preliminary results suggest that real-time sonoelastography is a promising new approach for diagnosis of breast cancer with fair sensitivities and specificities (*Itoh et al., 2006*).

In a clinical trial, Sonoelastography is considered equal or superior to mammography in differentiation of breast lesions. A combination of elastography and sonography had the best results in detecting cancer and potentially could reduce unnecessary biopsy (*Zhi et al., 2007*).

MR elastography (MRE) of the breast represents a novel imaging technique that is based on the phase-contrast MRI technique and It can be used in combination with contrast enhanced breast MRI and allows imaging of the 3D propagation of low frequency acoustic waves within tissue (*Marippan et al., 2010*).

US elastography is typically restricted to the assessment of one-dimensional (1D) displacement data along the beam line. Thus, compared with full 3D techniques like MRE, it yields inherently more imprecise viscoelastic data (*Marripan et al., 2010*).