The Role of Elastography in Fibroadenoma of the Breast and differentiating it from its Mimics

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AMF	Anterior mammary fascia
BI-RADS	Breast Imaging-Reporting and Data System
FN	False negative
FP	False positive
MHz	Megahertz
MRI	Magnetic Resonance Imaging
NPV	Negative predictive value
PMCs	Pure mucinous carcinomas
PPV	Positive predictive value
ROC	Receiver operating characteristic curve
ROI	Region of interest
RMZ	Retromammary zone
SCZ	Subcutaneous zone
SE	Strain elastography
SR	Strain ratio
MZ	Mammary zone
TDLU	The terminal duct lobular units
TN	True negative
TP	True positive
US	Ultrasound

Introduction

Fibroadenomas are the most common benign tumors of the breast in young females with a peak incidence during the second and third decades of life **(Aoudia et al, 2018).**

Clinically, fibroadenomas usually occur in younger women, ages 20 to 30 years, but may also be seen in postmenopausal age groups. They are slow-growing tumors, with a size of less than 3 cm, except for rare giant fibroadenomas **(Yang et al, 2013).**

Fibroadenomas develop in the lobules at the ends of mammary gland ducts and are composed of epithelium and stroma. Histopathologic features of fibroadenomas include the concurrent proliferation of stromal and glandular elements **(Goel et al, 2005).**

At sonography, fibroadenomas give imaging features being well defined, lobulated, with smooth margins and heterogeneous internal echopattern **(Li et al, 2014).**

Fibroadenomas are generally classified as category 3 in the BI-RADS® lexicon and are the most commonly found lesions in breast biopsies **(Fleury et al, 2009).**

Breast lesions with similar sonographic features as fibroadenomas features are subdivided into benign fibrocystic

changes, lesions with low malignancy potential, and malignant lesions **(Fleury et al, 2009).**

Phyllodes tumor of the breast is a rare fibro-epithelial lesion that accounts for 0.3-1% of breast tumors. They can be classified as benign (most common), borderline and malignant lesions **(Abe et al, 2009).**

Ultrasonography, mammography and MRI are the diagnostic tools; however, the imaging features of fibroadenomas and phyllodes tumors show great resemblance making them hard to distinguish **(Adamietz et al, 2011).**

Pure mucinous carcinomas (PMCs) are rare tumors that account for 1–7% of all breast tumors. They are pathologically defined as carcinomas in which at least 90% of tumor cells are composed of extracellular mucin **(Ferré et al, 2016).**

Previous studies have found that less than 2% of lesions with the typical ultrasound features of a fibroadenoma, are found to be malignant on biopsy **(Lakshman and Vandersluis, 2018).**

Tissue biopsy by either fine needle aspiration or core biopsy is the most accurate for the diagnosis **(Houssami et al, 2001).**

Elastography combined with sonography is a relatively recent method for characterizing breast lesions according to their

elastic characteristics and improves the diagnostic accuracy of the conventional B-mode ultrasonography **(Adamietz et al, 2011).**

Newly introduced elastography methods may contribute to characterize breast lesions by measuring the stiffness of the mass. There are two main methods of assessing stiffness (elasticity) of a mass: strain elastography and shear wave elastography. In strain elastography, the stiffness of the mass can be viewed from the degree of strain (displacement) on manual compression **(Özel et al, 2018).**

The combination of elastography with the ultrasonography can be used to differentiate fibroadenomas from malignant mimics and upgrade their BIRADs score. Results will be correlated with histopathology.

Aim of work

To evaluate the diagnostic performance of combined ultrasonography and strain elastography and to compare the imaging characteristics of fibroadenomas with other benign and malignant mimics and assess the results by histopathological characteristics.

Anatomy of the breast

Gross Anatomy

The breasts are modified sweat glands and function as modified apocrine glands. Mature adult breasts occupy a prominent position on the anterior chest wall between the second and sixth ribs. The average breast measures 10 to 12 cm in diameter and is 5 to 7 cm in thickness. Across the chest wall, the breast extends from the margin of the sternum to the midaxillary line. A portion of breast tissue projects into the axilla which is known as the tail of Spence **(Figure 1) (Stahl et al, 2016).**

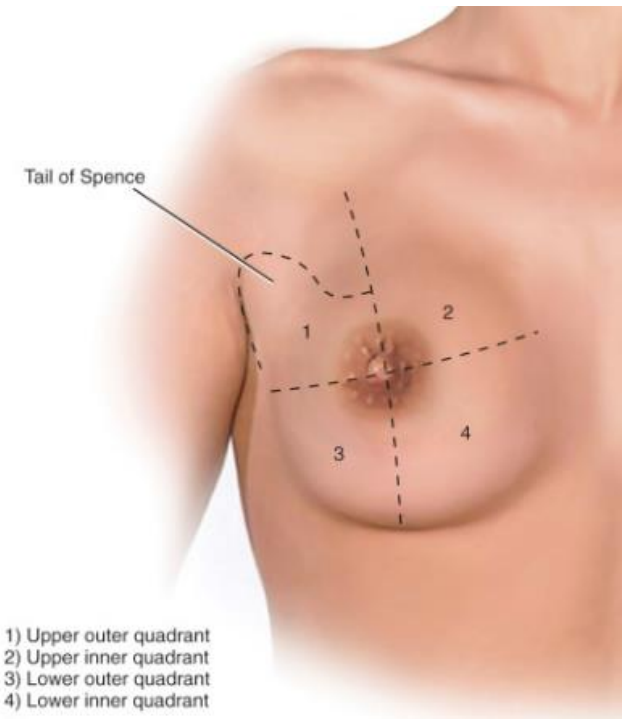

Figure 1 Position of the breast and its division **(Stahl et al, 2016)**.

Boundaries

The borders of the breast include the clavicle superiorly, the inframammary fold inferiorly, the sternum medially, and the anterior border of the latissimus dorsi laterally. The breast is primarily attached to the pectoralis major. It also has attachments with the serratus anterior, external oblique, and the superior portion of the rectus abdominis. **(Figure 2) (Larson et al, 2018).**

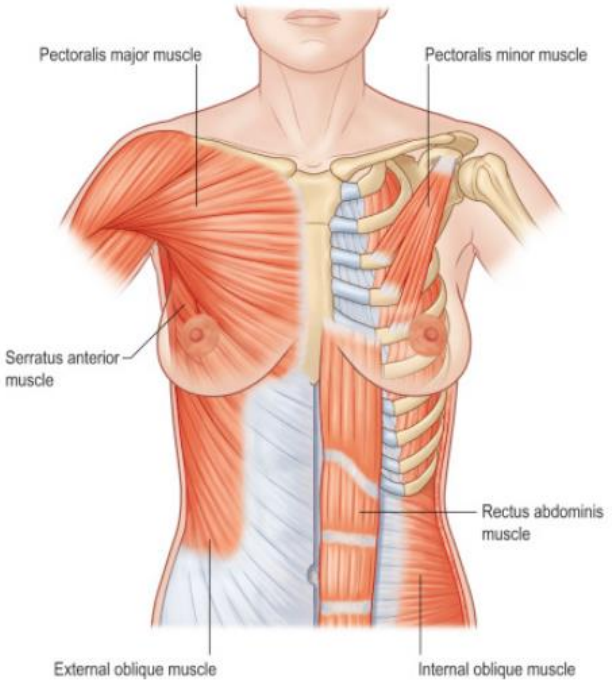

Figure 2 Muscle attachments to the breast **(Larson et al, 2018).**

Connective tissue

The breast lies on the chest wall on the deep pectoral fascia, with the superficial pectoral fascia enveloping the breast. Suspensory ligaments (Cooper's ligaments) connect the two layers, providing a degree of support to the breast and giving the breast its

shape. The tissues lying between the deep and superficial layers of the superficial pectoral fascia consist mainly of fat but additionally of breast parenchyma and connective tissue (stroma) **(Figure 3) (James and Evans, 2020).**

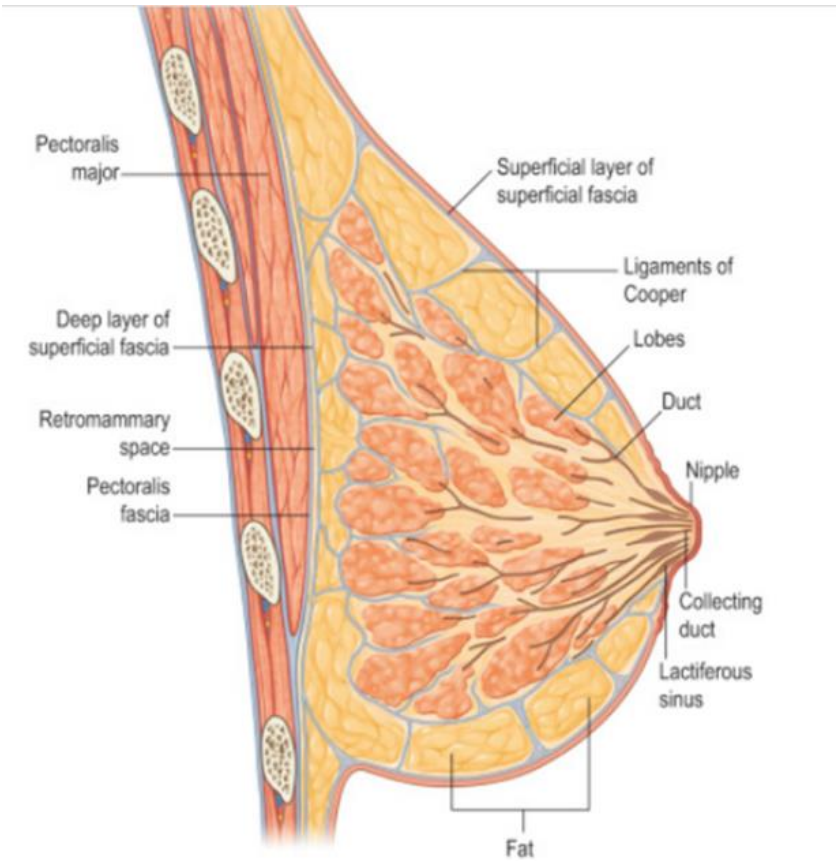

Figure 3 Gross anatomy of the breast **(Larson et al, 2018).**

Parenchyma

Deep to the nipple-areolar complex, the breast is divided into 15 to 25 lobes, each consisting of a branching duct system leading from the collecting ducts to the terminal duct lobular units (TDLU) **(Figure 4)**. The TDLU is formed by the lobule, which is made up