THE ROLE OF DIFFUSION WEIGHTED MRI IN THE DIAGNOSIS AND FOLLOW UP OF BREAST CANCER

Thesis

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List of Abbreviations

Abb.	Meaning
ACC	Adenoid cystic carcinoma.
ACR	American Cancer Society.
ADC	Apparent Diffusion Co-efficient.
BIRADS	Breast imaging reporting and data system.
BMI	Body mass index.
BRCA	Breast cancer antigen.
CAD	Computer aided detection.
CT	Computed Tomography.
DCE	Dynamic contrast enhancement.
DCIS	Ductal carcinoma in situ.
DES	Diethylstilbestrol.
DNA	DeoxyriboNucleic Acid.
DWI	Diffusion-weighted Imaging.
EPI	Echo planar Imaging.
FLASH	Fast low-angle shot pulse sequence.
FOV	Field of view.
FSPGR	Fast spoiled gradient recalled echo.
Gd	Gadolinium.
GFR	Glomular fitration rate
IDC	Invasive ductal carcinoma.
ILC	Invasive lobular carcinoma.
IV	Intra venous.
LCIS	Lobular carcinoma in situ.
Max	Maximum.
Min	Minimum.

List of Abbreviations (Cont…)

Abb.	Meaning
MIP	Maximum intensity projection.
MPR	Multi planar reconstruction images.
MRA	Magnetic Resonance angiography.
MR-CAD	Magnetic Resonance Computer Aided Detection.
MRI	Magnetic Resonance Imaging.
N.....	Number.
NCI	National cancer institute.
NPV	Negative predictive value.
NSF	Nephrogenic systemic sclerosis.
PPV	Positive productive value.
ROC	Receiver Operator Characteristics
ROI.....	Region of interest.
SD	Standard deviation.
SE.....	Spin-echo.
SPGR	Spoiled gradient recalled echo.
SPSS	Statistical Package for the Social Science.
STIR	Short T inversion recovery.
T.....	Tesla.
TDLU	Terminal ductal-lobular unit.
TE	Echo time.
TNM	Tumor, Nodes, Metastases.
TR.....	Relaxation time.
U.S	Ultrasonography.

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INTRODUCTION

Breast cancer is the commonest cancer in women worldwide with an estimated 1.4 million cases in 2008.The rates have been increasing steadily and there is every indication that they will continue to do so over the next few decades **(Cuzick, 2010)**.

When patients present for diagnostic evaluations, our goal is to establish the correct diagnosis, accurately and efficiently. For some women this may include mammographic images only or additional ultrasound; for other patients additional mammographic views, an ultrasound, MRI and a core biopsy are performed **(Gilda, 2007).**

Mammography is the main investigation for imaging of the breast cancer. Full field digital mammography is superior to standard mammography especially in the women with dense breasts but mammographic images are usually not enough to determine the existence of benign or malignant disease and the radiologist in some circumstances recommend further diagnostic studies**(Qaseem et al., 2007).**

Mammography is known to have high accuracy in detect breast cancer (sensitivity) but show high false positive rates (specificity) in the detection of breast malignancy (60-80%), resulting in unnecessary biopsies being performed **(Daniel, 2007).**

Magnetic resonance imaging (MRI) can discriminate benign from malignant lesions. Contrast enhanced MRI study of

the breast is based on the enhancement pattern of the lesions and morphologic changes, with these two criteria breast MRI has a sensitivity of about 75-89 % in detecting malignant breast lesions, however there is an overlap of these criteria with benign lesions which leads to a reported specificity of about 50 to 90 %**(Marini et al., 2007).**

Nowadays, there is increasing number of published studies which mentioned that the specificity of the breast MRI could be increased by using diffusion –weighted imaging (DWI) **(Wenkel et al., 2007)**.

Diffusion-weighted magnetic resonance imaging (DW-MRI) depends on the microscopic mobility of water. This mobility, classically called Brownian motion, is due to thermal agitation and is highly influenced by the cellular environment of water. Thus, findings on DW-MRI could be an early harbinger of biologic abnormality **(Padhani et al., 2009).**

By using the DWI sequence, one can calculate the apparent diffusion coefficient (ADC), a quantitative measure that is directly proportional to the water diffusion. High cell proliferation in malignant tumors increases cellular density, creating more barriers to the extracellular water diffusion, reducing the ADC, and resulting in signal loss. This sequence appears to be a useful tool for tumor detection and characterization, as well as for monitoring and predicting treatment response **(Pereiera et al., 2009)**.

AIM OF THE WORK

To highlight the role of diffusion weighted MRI in increasing the specificity of the MRI of the breast for detection of cancer breast in women with primary cancer or recurrent breast cancer.

ANATOMY OF THE BREAST

In young women, it is usually hemispherical and slightly pendulous, overlaps the 2nd to the 6th ribs and their costal cartilages, and extends from the lateral margin of the sternum to the mid axillary line. The greater part of the breast lies in the superficial fascia and can be moved freely in all directions. Its upper lateral edge (axillary tail) extends around the lower border of the pectoralis major and enters the axilla, where it comes into close relationship with the axillary vessels. In middle-aged multiparous women the breast may be large and pendulous, and in older women the breast may be smaller (Figure 1, 2) **(Snell, 2012).**

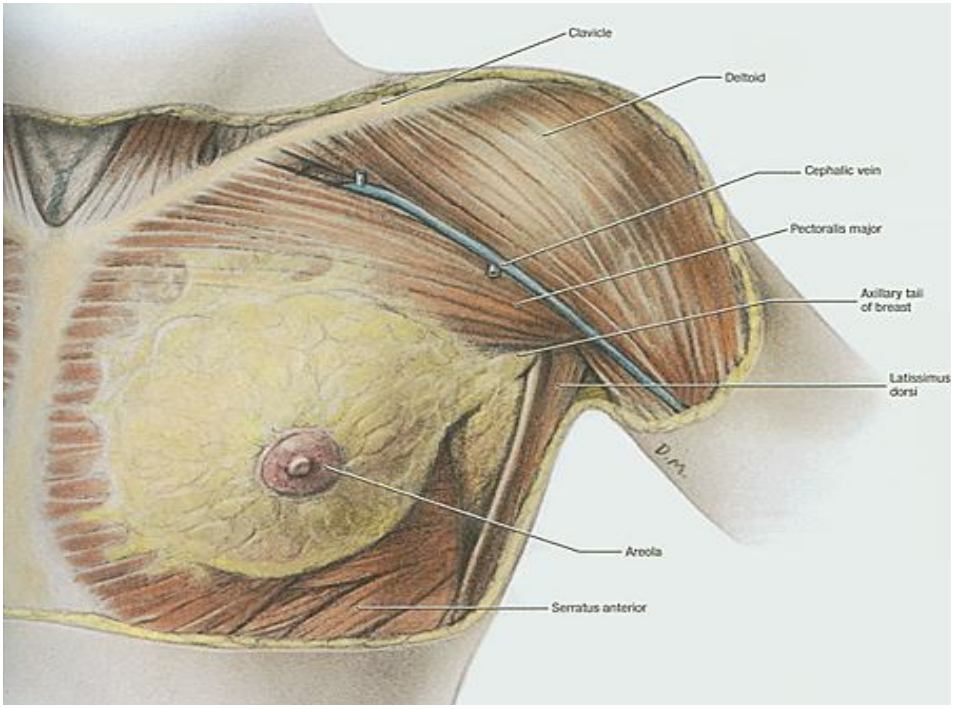

Figure (1): Axillary tail of breast **(Quoted from Dashner, 2010).**

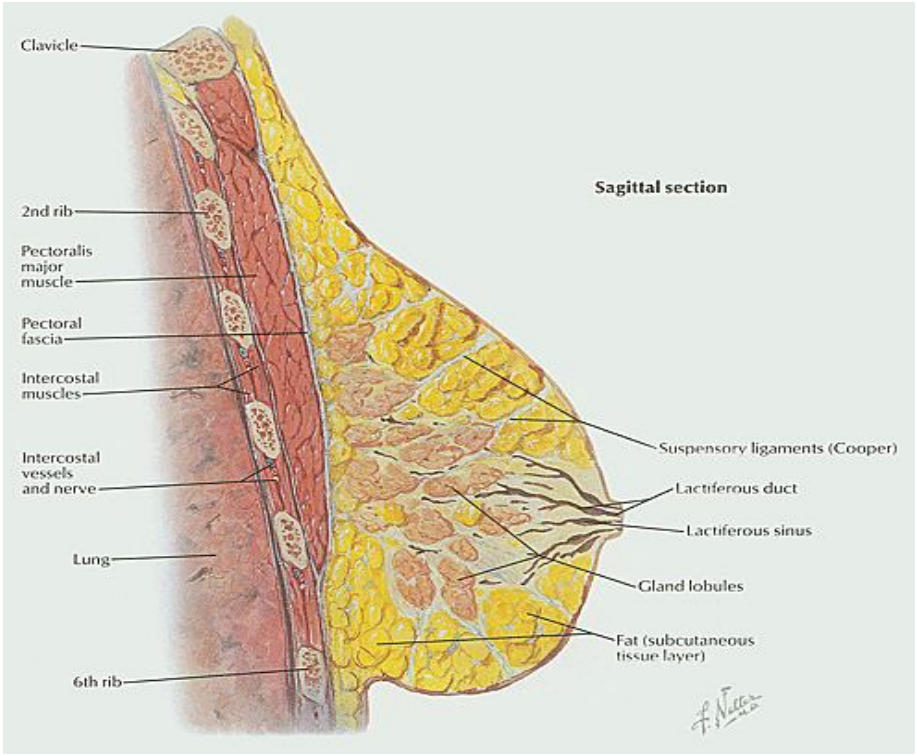

Figure (2): Anatomical structures of the breast and underlying chest wall **(Quoted from Agur, 2009)**.

The lobules group together into larger units called lobes. On average there are 15-20 lobes in each breast arranged roughly in a circular fashion. The distribution of the lobes is not even. However, there is a preponderance of glandular tissue in the upper outer portion of the breast. This is responsible for the tenderness in this region that many women experience prior to their menstrual cycle. It is also the site of half of all breast cancers. The lobes empty into the milk ducts which course through the breast towards the nipple/areolar area. There, they converge into 6-10 larger ducts called collecting ducts (lactiferous duct) just beneath the nipple-

areolar complex; each lactiferous duct opens into a lactiferous sinus, which then continues to drain into a separate opening on the apex of the nipple (Figure 3) **(Shiffman, 2009)**.

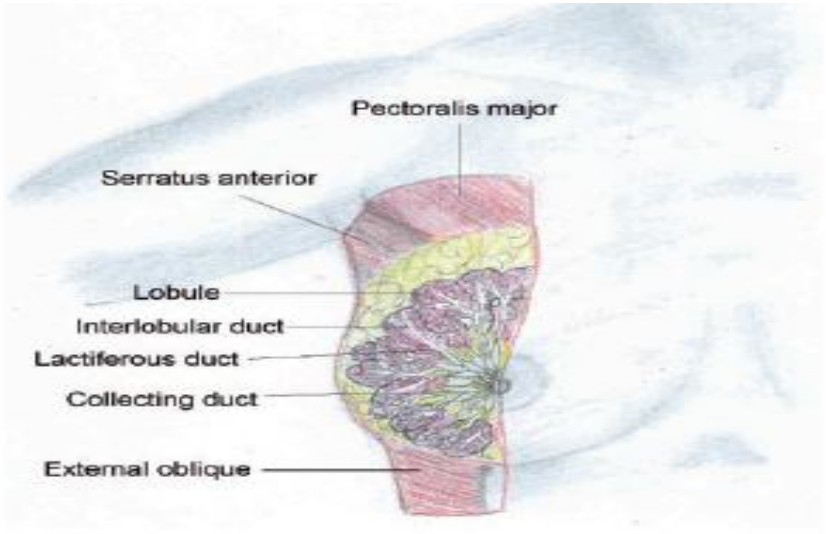

Figure (3): Glandular breast tissue **(Quoted from Davis, 2010).**

In addition the collecting duct has several branches, which end in a terminal ductal-lobular unit (TDLU), the basic functional and Histopathological unit of the breast. The TDLU is composed of a small segment of terminal duct and a cluster of ductules, which are the effective secretory units. A normal terminal ductal lobular unit ranges from 1 - 4 mm **(Canon, 2009).**

The breast is anchored to the pectoralis major fascia by the suspensory ligaments (Cooper's Ligaments) (Figure 4).These ligaments connect the two layers of the fascia

providing a degree of support to the breast and giving the breast its shape **(Jonathan, 2008)**.

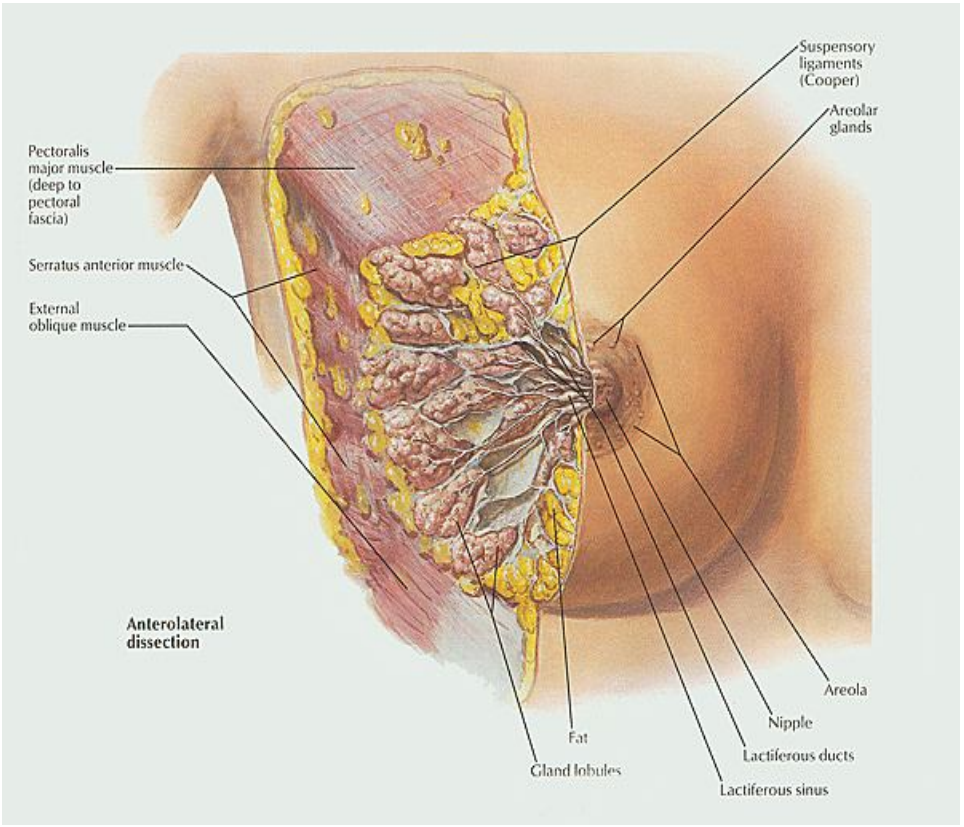

Figure (4): Pectoralis major fascia and suspensory ligament **(Quoted from Agur, 2009)**.