INTRODUCTION AND AIM OF WORK

Although numerous studies have outlined the benefits of contrast material enhanced MR imaging for detection of breast parenchymal findings, the assessment of lesions of the skin and superficial tissue at breast MR imaging has largely been overlooked, such lesions both benign and malignant are commonly encountered at breast MR imaging and their detection and diagnosis are often imperative, these lesions include superficial, local extensive, inflammatory, and recurrent breast cancer, iatrogenic changes, sebaceous cysts and less prevalent disease such as granulomatous mastitis and angiosarcomas. As MR imaging continuous to be used with increasing frequency in both the screening and diagnostic settings these will be encountered more often, consequently better understanding of which lesion may be ignored and which requires further evaluation will become increasingly important ***(Osborne et al . , 2009).***

MR imaging alone may not clearly indicate the cause of lesions of the breast skin and superficial tissue however radiologists should thoroughly assess such lesions taking in consideration the spectrum of possible causes. Mammography, ultrasonography, consultation with clinicians or dermatologists regarding, physical examination findings and when necessary correlation with pathologic findings in biopsy specimens may be used in conjunction with MR imaging to establish both the importance of these lesions and their definitive diagnosis ***(Radiographics., 2009).***

Breast MR imaging is being used with increasing frequency to aid in the detection and evaluation of breast malignancies, it is performed along with mammography in high risk women. In addition it is increasingly being used for evaluating the extent of disease in nearly diagnosed breast malignancies and as a tool for solving diagnostic dilemmas ***(Saslow et al . , 2007).***

Aim Of Work

The aim of this work is to review the normal anatomy and MR imaging appearance of breast skin, discuss and illustrate various causes of superficial abnormalities seen at breast imaging, including a wide spectrum of both common and uncommon benign and malignant entities and describe an algorithm for diagnosis of these superficial abnormalities.

Anatomy of Skin and Subcutaneous Fat of the Breast.

The breast is a modified cutaneous exocrine gland composed of skin, subcutaneous tissue, breast parenchyma, and breast stroma). Linking the upper chest wall, lower abdomen, and axilla ***(Morris ., 2005).***

Boundaries and extensions :

The breast is a modified skin gland enveloped in fibrous fascia . the superficial pectoral fascia is located just beneath the skin and in the retro-mammary space . The undersurface of the breast lies on the deep pectoral fascia although there are fascial layers between the breast proper and the pectoralis major muscle ,The breast is not completely separate from the pectoralis major muscle , As there are penetrating lymphatics and blood vessels ***(Morris ., 2005).***

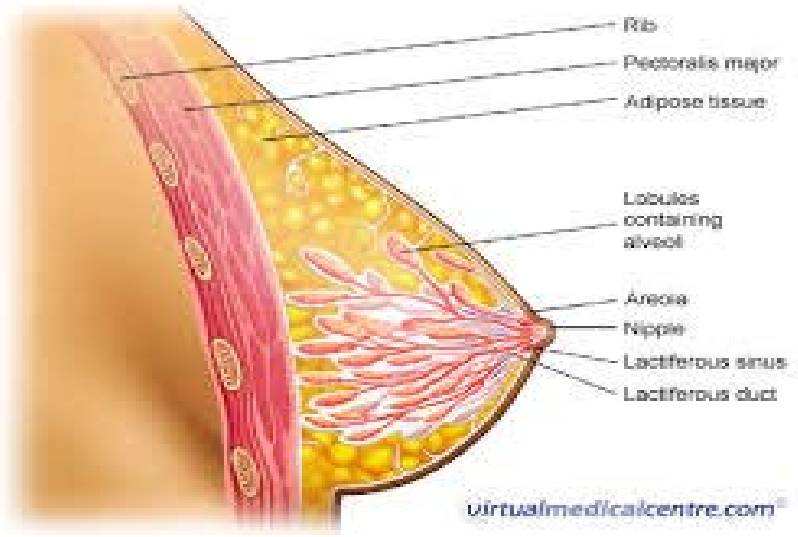

Figure (1) composition of female breast (Johnson et al , 2004).

Figure (1) Shows a simple picture of mature female breast sitting over the pectoralis major muscle . It extends vertically from the 2nd or 3rd rib to the abdominal wall at the 6th or 7th rib, and from the sternal edge medially almost to the mid axillary line laterally in the transverse plane. The superolateral quadrant is prolonged towards the axilla along the inferolateral edge of the pectoralis major , From which it project a little , and may extend through the deep fascia up to the apex of the axilla (axillary tail) ***(Johnson et al. , 2004).***

Breast composition

The breast is composed of three major structures : skin , subcutaneous tissue and breast tissue (parenchyma , functional elements and stroma). The parenchyma consists of glandular and ductal tissues while the stroma consists of connective tissues containg blood vessels , nerves , lymphatics and varying amount of adipose tissues ***(Saunders and Baum., 2000).***

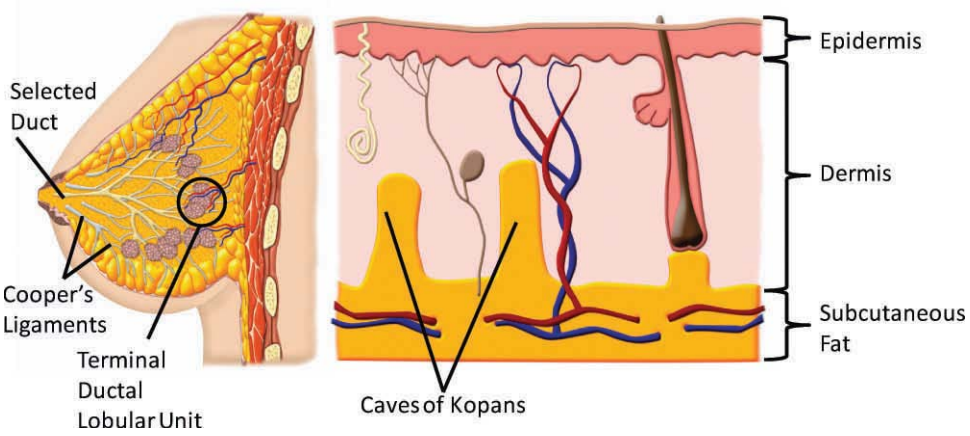

Figure (2) Drawings illustrate the normal anatomy of the breast (left) and breast skin (right) (Wang et al. , 2007).

The skin of the breast is composed of three layers: the epidermis, dermis, and hypodermis, or the subcutaneous fat layer as in figure (2). The thin epidermis is composed of several cell layers and contains no blood or lymphatic vessels and may not be distinguished from the dermis at imaging . However, within the dermis reside hair follicles, sebaceous glands, sweat glands, nerve endings, and blood and lymph

vessels. The hypodermis typically contains nerves, lymphatics, larger blood vessels , and fatty tissues ***(Whang et al. , 2007).***

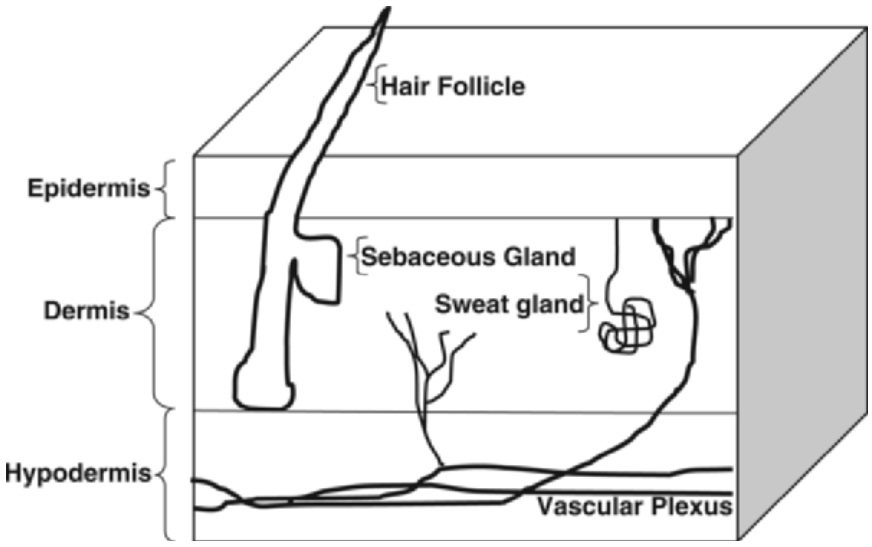

Figure (3) Diagram shows the anatomy of the skin layers, which include the epidermis, dermis, and hypodermis (Whang et al , 2007).

The skin overlying the breast is connected to the breast tissue by way of ligaments (known as Cooper ligaments), which provide structural support. The suspensory ligaments of the breast, or Cooper ligaments, traverse the breast tissue, incompletely compartmentalize it, and connect the anterior and posterior fascia ***(Stavros AT., 2004).***

The superficial extensions of Cooper ligaments, known as the retinacula cutis, extend through the subcutaneous fat and anchor the underlying breast parenchyma to the dermis. Terminal Ductule lobular units (TDLUs) (fig 5), which are

located in anterior or superficial breast tissue, may extend into the Cooper ligaments at the base of the hypodermis or become entrapped within the ligaments over time as the fibroglandular tissue atrophies ***(Kwak et al. , 2004).***

Hence, breast lesions that arise from Terminal Ductule lobular units may be located within subcutaneous fat. Such lesions include fibroadenomas, papillomas, adenosis, and breast cancer and should be part of the differential diagnosis for lesions located within the hypodermis. ***(Taira et al , 2007)***.

Together, the epidermis and dermis of the breast have a normal thickness of 0.5–2 mm, and the epidermis is indistinguishable as a separate layer from the dermis at imaging. At mammography, the combined epidermis and dermis are visible as a thin, smooth structure; at US, they appear as an echogenic layer; and at MR imaging, they appear as a symmetrically enhancing 0.5–2- mm structure. Cooper ligaments are commonly visible at all three modalities. Fig (3) ***(Bergmann-Koester et al., 2006).***

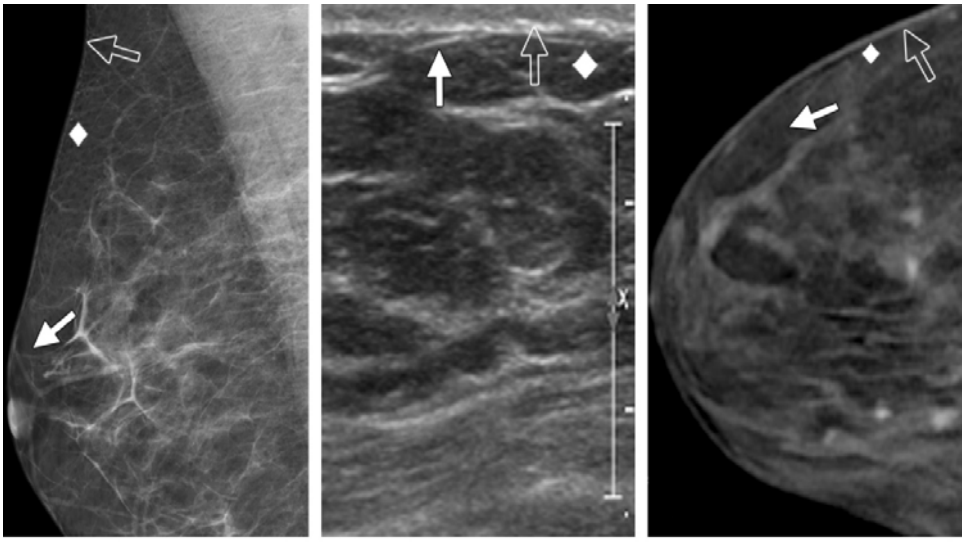

Figure (4). Normal superficial breast anatomy. Mammographic (a), US (b), and MR (c) images show Cooper ligaments (solid arrow), the dermis (open arrow), and subcutaneous fat, or the hypodermis (diamond) (Bergmann-Koester et al , 2006)

Nipple areolar complex is an intensely pigmented portion of specialized breast skin Located at the fourth intercostal space. The anatomy of the nipple-areolar complex is somewhat specialized. The skin of the nipple-areolar complex may normally be slightly thicker than 2 mm ***(Neuhaus et al., 2006).***

The nipple contains numerous sensory nerve endings and sebaceous glands, in addition however, it contains apocrine sweat glands, hair follicles, and accessory areolar glands of Montgomery.The tissue of the nipple-areolar complex is histologically contiguous with surrounding breast tissue, with

the subdermal smooth muscle of the nipple serving as an extension of the smooth muscle of the areolar dermis, and the stratified squamous epithelium of the skin of the nipple serving as an extension of the deep, double-cuboidal ductal epithelium of the breast ***(Frei et al.,2005)***

The parenchyma is divided into 15 to 20 lobes or segments that converge at the nipple in a radial arrangement. The ducts from the lobes converge into 6 to 10 major collecting ducts that have opening at the nipple and connects to outside. Each of these major ducts arborizes back from the nipple and forms a lobe or segment of glandular tissue. ***(Morris. , 2005)*** .

Beneath the nipple openings , the lactiferous sinus is visible . the lactiferous sinus is a slight dilatation of the ampullary portion of the major duct. The major ducts that converge below the nipple and drain each segment are 2mm in diameter . Each duct drains a lobe made up of 20 to 40 lobules. Each lobule contains 10 to 100 alveoli or acini . Each lobule also consists of branching ducts that divide into subsegmental structures and terminate in the terminal duct lobular unit. The terminal duct lobular unit consist of terminal duct and the acinus ***(Morris. , 2005).***

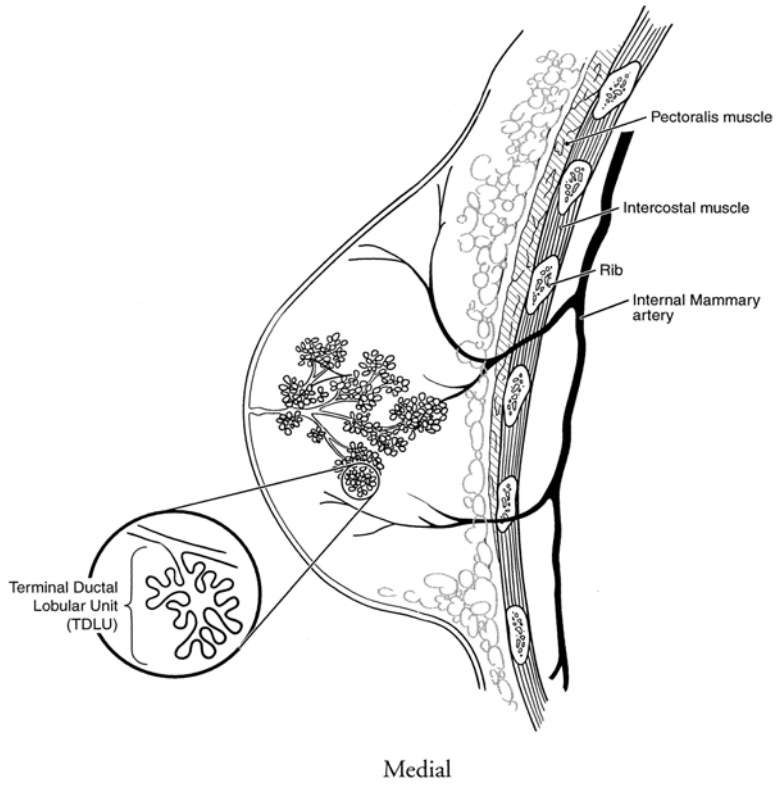

Figure (5) Normal anatomy of the breast, showing Terminal ductal lobular unit (TDLU) *(Morris. , 2005).*

The glandular tissue and ducts are surrounded by fat and supported by the cooper's ligaments, which are connective tissue elements that arise from the stromal tissue and attach to the pectoral fascia and dermis and support and suspend the breast tissue ***(Morris. , 2005).***

Musculature Related to the Breast

The breast lies over the musculature that encases the chest wall. The muscles involved include the pectoralis major, serratus anterior, external oblique, and rectus abdominis fascia. The blood supply that provides circulation to these muscles perforates through to the breast parenchyma, thus also supplying blood to the breast ***(Maxwell et al. , 2009)*** .

The pectoralis major muscle (fig 6) is a broad muscle that extends from its origin on the medial clavicle and lateral sternum to its insertion on the humerus. The thoracoacromial artery provides its major blood supply, while the intercostal perforators arising from the internal mammary artery provide a segmental blood supply. The medial and lateral anterior thoracic nerves provide innervation for the muscle, entering posteriorly and laterally. The action of the pectoralis major is to flex, adduct,and rotate the arm medially***(Maxwell et al., 2009).***

The pectoralis minor muscle, which lie behind the pectoralis major muscle it is not generally involved unless there is full thickness involvement of the pectoralis major muscle. (Morris . , 2005)

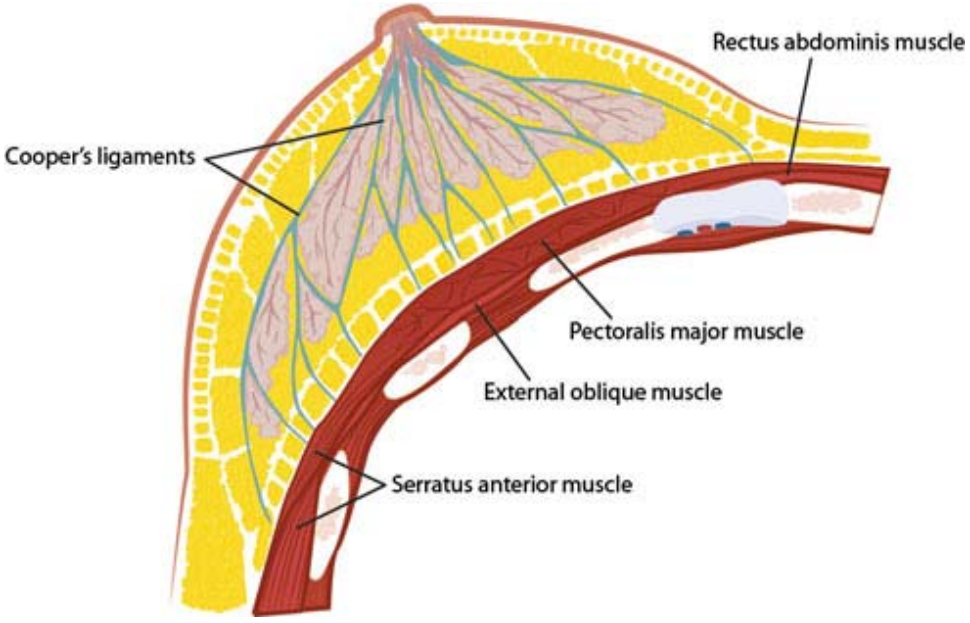

Figure (6) Musculature related to the breast (Maxwell et al , 2009)

The serratus anterior muscle is a broad muscle that runs along the anterolateral chest wall. Its origin is the outer surface of the upper borders of the first through eighth ribs, and its insertion is on the deep surface of the scapula. Its vascular supply is derived equally from the lateral thoracic artery and from branches of the thoracodorsal artery. The long thoracic nerve serves to innervate the serratus anterior, which acts to rotate the scapula, raising the point of the shoulder and drawing the scapula forward toward the body ***(Thorne et al ., 2007).***

The rectus abdominis muscle demarcates the inferior border of the breast. It is an elongated muscle that runs from its

origin at the crest of the pubis and interpubic ligament to its insertion at the xiphoid process and cartilages of the fifth through seventh ribs. It acts to compress the abdomen and flex the spine. The 7th through 12th intercostal nerves provide sensation to overlying skin and innervate the muscle. Vascularity of the muscle is maintained through a network between the superior and inferior deep epigastric arteries ***(Maxwell et al ., 2009).***

The external oblique muscle is a broad muscle that runs along the anterolateral abdomen and chest wall. Its origin is from the lower 8 ribs, and its insertion is along the anterior half of the iliac crest and the aponeurosis of the linea alba from the xiphoid to the pubis. It acts to compress the abdomen, flex and laterally rotate the spine, and depress the ribs. The 7th through 12th intercostal nerves serve to innervate the external oblique. A segmental blood supply is maintained through the inferior 8 posterior intercostal arteries ***(Maxwell et al. , 2009).***

Nerve Supply of the breast

The innervation of the breast comes from sensory and sympathetic nerves from the anterior and lateral cutaneous branches of the 4th , 5th and 6th intercostal nerves. The breast is considered highly innervated and thus is sensitive to various stimuli. Most nerve endings are at the apex of the nipple, where the rich sensory innervations benefit the suckling infant to initiate a chain of neural and neurohormonal events, resulting in the release of milk and maintenance of glandular differentiation essential for continues lactation ***(Morris . , 2005).***

Arterial supply of the breast (fig 7)

The breasts are supplied by branches of the axillary artery , the internal thoracic artery and some intercostal arteries. The axillary artery supplies blood from several branches, namely the superior thoracic, the pectoral branches of the thoraco-acromial artery, the lateral thoracic (via branches which curves around the lateral border of pectoralis major to supply lateral aspect of the breast) and the subscapular artery . The internal thoracic artery supplies perforating branches to the antero-medial part of the breast. The second to fourth anterior intercostal arteries supply perforating branches more laterally in the anterior thorax. The second perforating artery is usually the