
Abdominal Subcutaneous Adipose Tissue (DAT and SAT)

Since Vague's early work (Vague 1956) literature has consistently shown that adipose tissue distribution can be a more reliable predictor of chronic diseases than BMI or %BF (Aronne 2002b). In particular, abdominal adipose tissue which can be divided into subcutaneous and visceral depots can be an accurate predictor of coronary disease (Ohlson 1985), and type 2 diabetes (Chan et al 1994, Despres et al. 2001). The subcutaneous adipose depots can be further divided into superficial and deep compartments (see Figure 1) which are separated by subcutaneous fascia. The rationale for this division initially came from animal studies which indicate that lipids are depleted and deposited at a faster rate into the deep layer of the subcutaneous tissue than the superficial layer. This suggests that the superficial layer acts as a thermal insulation or storage layer whereas the deep layer functions as a metabolically active tissue (Carey 1997). These animal studies were confirmed by Monzon et al (2002) who reported that lipolytic activity was higher in adipocytes isolated from DAT compared with adipocytes isolated from SAT. Kelly and colleagues (2000) report that DAT, but NOT SAT is strongly related to insulin resistance in a cohort of lean and obese men and women.

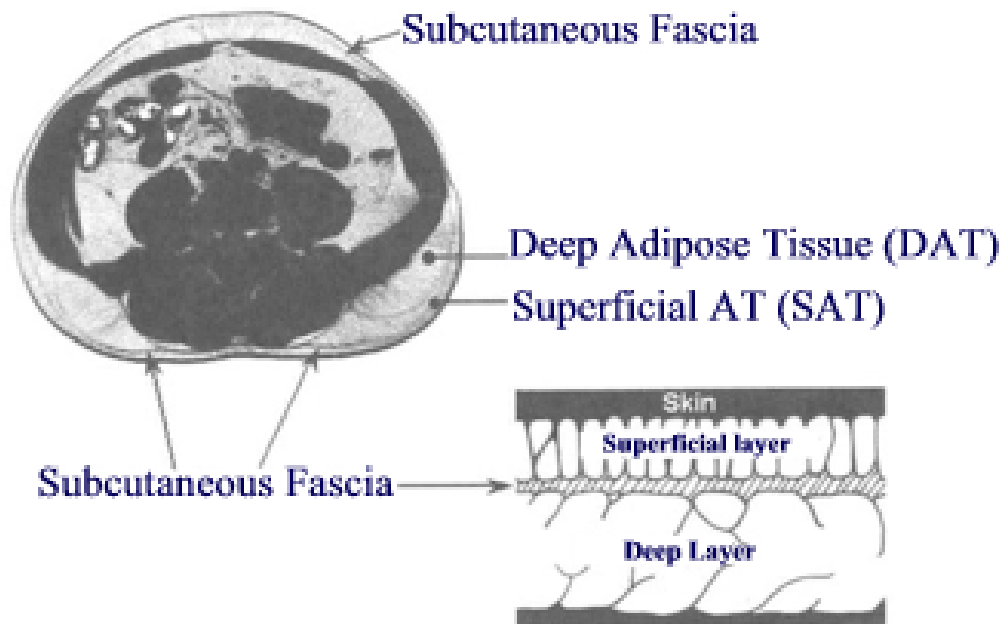


Figure 1 A CT image of the abdominal area of a male showing the key types of adipose tissue and how subcutaneous fascia separates the adipose tissue.

X-ray computed tomography (CT) and magnetic resonance imaging (MRI) are now considered the gold standard for measuring superficial, deep, and visceral adipose tissue thickness and volume. Figure 1 shows an example of a CT image of the abdomen. The light (adipose) and dark (muscle, bone, and organs) are clearly identifiable. Analysis of a series of CT images taken along the human body can provide very accurate measurements of body composition. Unfortunately, the high cost and radiation dose associated with CT makes this technique impractical for routine or regular body composition measurements. Although MRI imaging is safe it still remains a costly procedure and unlikely to become a routine screening tool for body composition. Another radiographic technique that is being used for body composition is dual energy x-ray absorption (DEXA). DEXA produces a two-dimensional image of the body which can be analyzed to calculate muscle,

bone and adipose tissue weight and volume with accuracies approaching CT and MRI imaging. DEXA however, can not directly identify SAT and DAT.

Ultrasound technology has been evaluated in the past (Black 1988, Ribeiro-Filho 2003, Saito 2003) and offers an attractive alternative to X-ray and MRI techniques. Ultrasound imaging is now routinely used in a variety of clinical settings, including obstetrics and gynecology, cardiology, urology and cancer detection. The BodyMetrix system offers the ability to accurately measure %BF by making multiple site measurements of fat thickness. More importantly the BodyMetrix Ultrasound System can be used in scan mode to identify the SAT and DAT layers. Figure 2 belows shows an example of a cross-sectional scan taken from within 3 cm of the belly button to within 6 cm of the hip bone. The scan clearly shows the SAT layer, the subcutaneous fascia and the DAT. It's interesting to note that the SAT appears to have very little structure as indicated by the comparatively low ultrasound signal (dark). By contrast the DAT layer shows significant structure as indicated by the higher degree of ultrasound signal within the fat layer. This is most likely connective tissue, or arteries/capillaries within the fat layer.

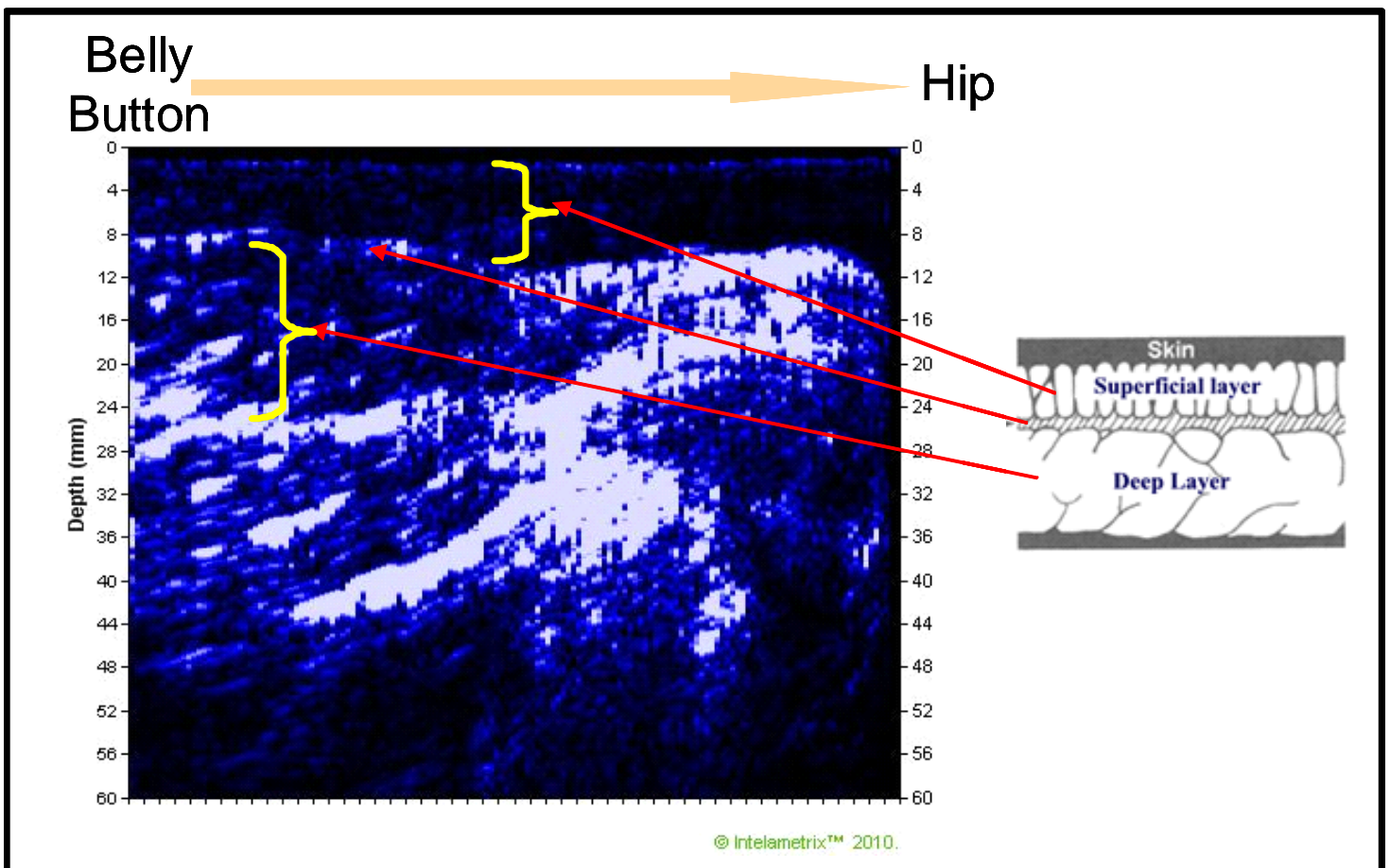


Figure 2 BodyMetrix ultrasound scan from within 3 cm of the belly button to within 6 cm of hip bone. The SAT and DAT layers are clearly visible.

The BodyMetrix System offers a low cost ultrasound system that can be used to accurately measure body composition and more uniquely abdominal subcutaneous tissue structure.

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