Introduction

A lean body is considered to reflect good self-control, and is regarded as attractive, healthy and socially acceptable. Obesity is a stigmatizing disorder, especially among women, which may explain why women predominate in seeking treatment as they usually disrespect their body shape ***(Chandawarkar, 2006).***

It is a chronic disease consisting of excessive fat accumulation in adipose tissue and presents a growing incidence not only in the industrial nations but also in developing nations. And the most serious forms of obesity, morbid obesity (BMI ≥40 kg/m2), is increasing at a faster rate than other categories of obesity or BMI over 35 in combination with comorbidities ***(Wolf and Kuhlmann, 2007).***

In 2014, more than 1.9 billion adults, 18 years and older, were overweight. Of these over 600 million were obese ***(WHO, 2015)***

Nonsurgical treatment has been inadequate in providing sustained weight loss. Currently, surgery offers the only viable treatment option with long term weight loss and maintenance for the morbidly obese. Surgeries for weight loss are called bariatric surgeries. There is no one operation that is effective for all patients. Because there are inherent complications from surgeries, bariatric surgeries should be performed in multidisciplinary settings. The success rate usually defined as >50% excess weight loss that is maintained for at least five years from bariatric surgery ranges from 40% in the simple to >70% in the complex operations. The weight loss from surgical treatment results in significant improvements and, in some cases, complete resolution of comorbid conditions associated with obesity. Patients undergoing surgery for obesity need lifelong nutritional supplements and medical monitoring ***(Fobi, 2004).***

However, for the morbidly obese patient, the massive weight loss that follows successful bariatric surgery is only the first step in the process. After massive weight loss, patients are left “deflated”. The excess skin that hangs from the torso, abdomen and extremities is not only extremely unsightly, but can be painful and susceptible to recurrent intertriginous infections.

In order for these patients to complete their transformation to a formerly morbidly obese patient, a plastic surgeon must address the deformities resulting from the massive weight loss. This type of extreme body contouring has grown concomitantly with the popularity of bariatric surgery. In 2013, abdominoplasty was the most common body contouring procedure performed after MWL, with 16,602 cases in the USA according to American Society of Plastic Surgeons statistics ***(American Society of Plastic Surgeons, 2013)***.

More than just excising excess skin and subcutaneous tissue, post-bariatric body contouring requires unique insights into the nature of the post-bariatric deformities. In addition, there must be an appreciation of the fact that massive weight loss patients are often relatively malnourished or anemic, and must be carefully evaluated pre-operatively ***(Spector, 2006).***

Abdominoplasty is the most popular operation desired by patients post bariatric surgery. There are different types of procedures, Traditional belt lipectomy procedures, extended abdominoplasty & Fleur-de-lis type ***(Wallach, 2005).***

Aim of the Work

Aim of the work is to study recent trends in post bariatric abdominoplasty, but with understanding in depth obesity, its mechanisms, its co-morbidities, the approach to treat and maintain this weight loss; in addition to the surgical treatment to reach the weight loss desired and then preparing this unique massive weight loss patient for body contouring procedures (if required) and discussing the most important of them which is abdominoplasty and its types.

Chapter 1

ANATOMY OF HUMAN SKIN

Components of normal human skin

Skin is the largest organ in the body. The skin weighs over 5 kg and covers a surface area approaching 2 m^2 in a 70 kg individual. It consists of a stratified, cellular epidermis and an underneath dermis of connective tissue **as shown in Fig. 1.** Beneath the dermis, there is a layer of subcutaneous fat, which is separated from the rest of the body by a layer of striated muscle ***(Loomis, 2001).***

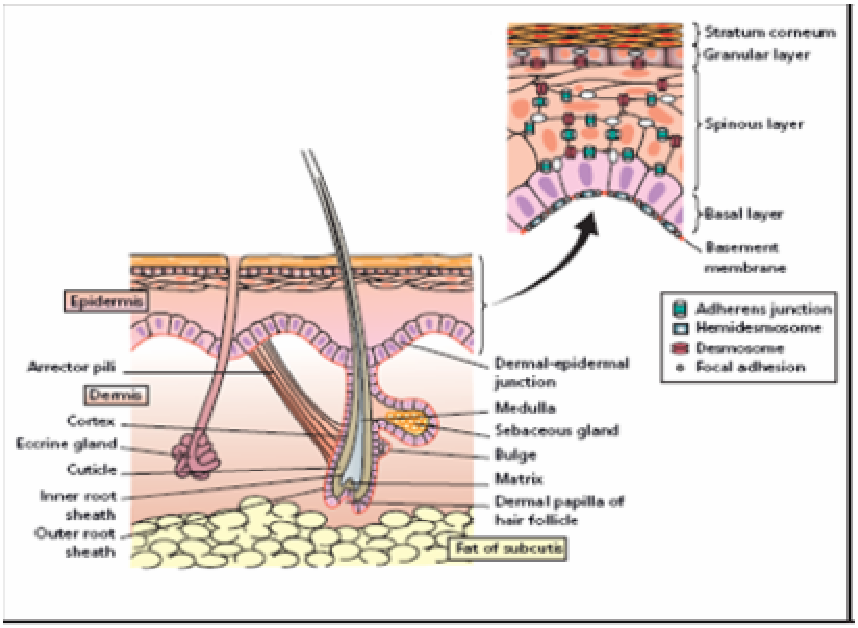

Figure (1): The skin and its appendages ***(McGrath & Uitto, 2010).***

The **epidermis** is mainly composed of keratinocytes. It is 0.05–0.1 mm in thickness. It is formed by division of cells in the basal layer which give rise to the spinous layer. The basal layer contains cells that move outwards and progressively differentiate, forming the granular layer and the stratum corneum layer. The cellular progression from the basal layer to the skin surface is about 30 days. The keratinocytes is formed by a cytoskeleton that is made of keratin intermediate filaments. The keratinocytes become flattened, as the epidermis differntiates. This process involves the filament aggregating protein, filaggrin, a protein component of keratohyalin granules. Certainly, keratin and filaggrin comprise 80–90% of the mass of the epidermis ***(Houben et al., 2007)***.

Stratum corneum, which is the outermost layer of the epidermis, where corneocytes have lost nuclei and cytoplasmic organelles. The corneocyte has a cornified envelope within the plasma membrane which is highly insoluble. Other cells in the epidermis are the Langerhans' cells, melanocytes, and Merkel cells ***(Houben et al., 2007)***.

The Langerhans' cells are dendritic in nature. They are of mesenchymal origin originating from bone marrow. They act as antigen presenting cells and process antigens detected by the skin to local lymph nodes and hence have a main role in adaptive immune responses in the skin. Merkel cells are derived from keratinocytes. They have a role as mechanosensory receptors that respond to touch ***(McGrath & Uitto, 2010).***

Melanocytes are also dendritic cells that distribute packages of melanin pigment in melanosomes to surrounding keratinocytes which gives the skin its colour. The number of melanocytes does not differ much between fair and dark skin. Instead, it is the nature of the melanin and melanosomes' size that account for the different appearances ***(McGrath & Uitto, 2010).***

Human skin also contains pilosebaceous follicles and sweat glands. The hair follicles enclose pockets of epithelium that are continuous with the superficial epidermis but which also envelop a small papilla of dermis at their base. A bundle of smooth muscle, the erector pili, extends at an angle between the surface of the dermis and a point in the follicle wall. Holocrine sebaceous glands lie just above the insertion, which open into the pilary canal. In some sites, such as the axillae, the follicles may be associated with apocrine glands. The eccrine sweat glands are also derived from the epidermis and opening directly to the skin surface ***(Schlake, 2007).***

The epidermis is attached to the dermis through a complex network of proteins and glycoproteins that extend from inside basal keratinocytes into the superficial dermis. The dermal–epidermal junction components contributes to adhesion as well as cell migration (as during wound healing). Over 30 different macromolecules including collagens, laminins & integrins interact within a basement membrane zone that is less than 200µm across ***(Ghohestani et al., 2001).***

The **dermis** is a supporting matrix or ground substance in which polysaccharides and proteins are connected to produce macromolecules that have a great capacity for retaining water. The dermis` thickness differs from being less than 0.5 mm to more than 5 mm. There are two major types of protein fiber collagen and elastic tissue. Collagen is the major extracellular matrix protein which comprimise 80–85% of the dry weight of the dermis. 29 different collagens have been recognized and depicted by Roman numerals in the order of their discovery, from I to XXIX, of which at least 12 are expressed in skin. The main interstitial dermal collagens are types I and III while type IV collagen is the principal basement membrane collagen, found at the dermal–epidermal junction and around dermal blood vessels, nerves and appendages. Collagen fibres are extremely tough and they are responsible for tensile strength of the skin ***(Frederick et al., 2001).***

Elastic fibres account for 2–4% of the extracellular matrix in the dermis and consist of two components, elastin and elastin-associated microfibrils, in which both are responsible for skin`s elasticity and resilience. Elastic microfibrils are composed of several proteins, as fibrillin, which surround the elastin and that extend throughout the dermis in a web-like configuration to the dermo-epidermal junction ***(Kielty, 2006).***

The dermis also contains a number of non-collagenous glycoproteins as fibronectins, fibulins and integrins. These extracellular matrix components responsible for cell adhesion and cell motility. There is a ground substance made up of glycosaminoglycan/ proteoglycan macromolecules between the dermal collagen and elastic tissue. These contribute only 0.1–0.3% of the total dry weight of the dermis, thus providing a key role by maintaining hydration, mostly due to the high water binding capacity of hyaluronic acid. Water resembles about 60% of the total weight of the dermis ***(McGrath & Uitto, 2010).***

The dermis is very rich in blood supply, although vessels don't pass through the dermal–epidermal junction. There is a superficial and a deep vascular plexus. The motor innervation of the skin is autonomic, which includes a cholinergic and adrenergic components. The sensory nerve endings are of several types; some are free, some terminate in hair follicles and others have expanded tips ***(Braverman & Yen, 1977).***

Functions of skin

The main role of the skin is providing a mechanical barrier against the external environment. The cornified cell envelope and the stratum corneum prevent water loss from the skin,in addition to keratinocyte derived endogenous antibiotics (defensins and cathelicidins) provide an innate immune defense against micro-organisms. The epidermis also contains a network Langerhans' cells, these cells initiate an immune response as well. Melanin provides some protection against DNA damage from ultraviolet radiation ***(McGrath & Uitto, 2010).***

The other important function of skin is thermoregulation, by vasodilatation or vasoconstriction of the blood vessels which helps regulate heat loss. Eccrine sweat glands are found at all skin sites; they also play a role in heat control and produce about 1 litre of sweat per hour during moderate exercise. Secretions from apocrine sweat glands responsible for body odour known as pheromones. Sebum secreted from sebaceous glands provide skin lubrication and water proofing ***(McGrath & Uitto, 2010).***

Subcutaneous fat act as a cushion during trauma and it also provides insulation. In non-obese people, subcutaneous tissue contains about 80% of total body fat. Fat also has an endocrine function, releasing leptin, which is a hormone that acts on the hypothalamus to regulate hunger and energy metabolism ***(McGrath & Uitto, 2010).***

Anatomy of the Anterior Abdominal Wall

Skin

The skin of the anterolateral abdominal wall is loosely attached to the superficial fascia and fat underneath. In individuals with normal body mass indices, collagen and elastin fibers in the dermis allow smooth and even draping of the skin over the contours of the abdomen. Langer's lines (Figure 2) are present as visible cleavage lines that run parallel to the horizontally and antero-inferiorly arranged collagen fibers in the skin. Incisions in the anterolateral abdominal wall should be made parallel to these lines to ensure optimum approximation of wound edges and also avoid retraction and gaping of the incision. Transverse or antero-inferior incisions also respect the course of the nerves and vessels of the abdominal wall, which run parallel to the cleavage lines ***(Snell, 2008)***.

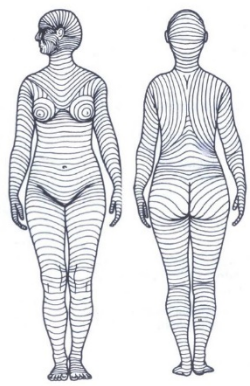

Figure (2): Langer's lines.

Fascia

Superficial Fascia

The subcutaneous tissue of the upper and lower abdominal wall is occupied by a fatty layer of superficial fascia known as Camper's fascia (Fig. 3). This layer varies in thickness depending on body habitus and is liable to reduction or partial excision during abdominoplasty. In the upper abdomen, Camper’s fascia is more fibrous compared to the lower, softer fat of the lower abdomen. A second, deeper layer of superficial fascia exists in the lower abdominal wall as Scarpa’s fascia. This layer is thin, membranous and is loosely adherent to the underlying deep fascia just above the muscles, except in the midline where it firmly attaches to the linea alba. It becomes thinner and is continuous with the superficial fascia of the thorax and back superiorly and laterally. Scarpa’s fascia forms a sheath for the penis or clitoris that is continuous with the deep fascia of the genitalia, inferiorly.Camper’s fascia continues toward the scrotum in males to become the dartos muscle, containing smooth muscle fibers. In the perineum, Scarpa’s fascia is a tough fibrous layer that inserts into the pubic arch as Colle’s fascia. Below the inguinal ligament, it is continuous with the fascia lata of the upper and lateral thigh ***(Snell, 2008).***

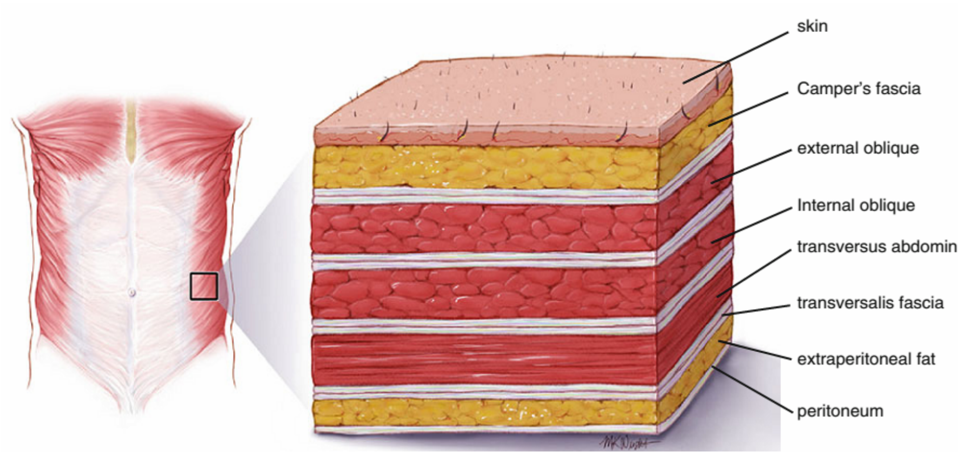

Figure (3): Layers of the anterolateral abdominal wall. Camper’s fascia lies superficially and contains variable amounts of subcutaneous fat. In the lower abdomen, Scarpas’s fascia exists as a second deeper layer that is adherent to the fascia overlying the muscle ***(McGrath & Uitto, 2010)***.

Deep Fascia

Deep to Scarpa's fascia, a thin layer of deep fascia lies closely adherent to the flat muscles of the abdominal wall and their aponeuroses. This layer is continuous inferiorly with the suspensory ligament of the penis and the deep fascia of the genitalia.

Transversalis Fascia

This is a thin connective tissue layer that lies between the inner most muscle of the abdominal wall and the extra peritoneal fatty layer. It continues superiorly with the connective tissue lining of the diaphragm and inferiorly with the iliac and pelvic fascia ***(Arslan, 2005)***.

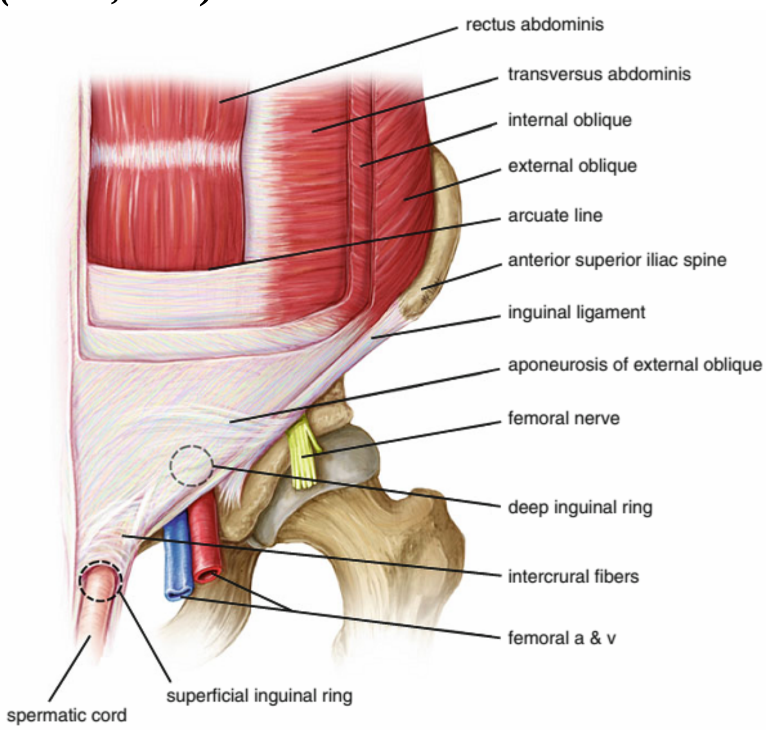

Figure (4): Inguinal region and muscles of the lower abdominal wall ***(McGrath & Uitto, 2010)***.

Muscles

"The muscles and their aponeuroses form a strong, flexible structure that protect the abdominal viscera, facilitate movement of the trunk, and work synergistically with the diaphragm during respiration, micturition, and defecation (Fig. 4). When the fatty superficial fascial layer above the muscles is thin and the muscles are toned, they also play a key role in the aesthetics of the abdomen, as their borders and prominences are visible. Attenuation and laxity in the abdominal wall muscles lead to protrusion of the abdomen" ***(Brauman, 2008)***.

"The three flat abdominal muscles that lie in the lateral abdominal wall become aponeurotic anteriorly at the mid clavicular line. Between the mid clavicular line and the midline, Rectus sheath is formed by the aponeuroses of the three flat muscles which is a tough fibrous envelope that encloses the vertical rectus abdominis muscles. Above the umbilicus, and to a point just below it, the anterior wall of the rectus sheath is formed by the aponeurosis of external oblique and the anterior lamina of the internal oblique aponeurosis, while the posterior wall of the rectus sheath (deep to rectus abdominis) consist of the posterior lamina of internal oblique aponeurosis and the aponeurosis of transversus abdominis. The exception is over the costal cartilages where rectus abdominis lies directly on the chest wall and the transversus abdominis is continuous with the thoracic muscles under the ribs. At the arcuate line of Douglas below the level of the umbilicus, the posterior wall of the rectus sheath becomes deficient where the aponeuroses of the flat muscles comprising it course anteriorly to cover the anterior surface of rectus abdominis (Fig. 5). The arcuate line lies in the upper half of a line from the pubic symphysis to the umbilicus and is consistently found to be at the level of the most distal horizontal tendinous intersection or rectus abdominis" ***(Mwachaka et al., 2010).***

"Fibers from the flat muscles from each side decussate in the midline to form the linea alba with additional interweaving of superficial and deep fibers. The rectus sheath is occupied primarily by the large vertical paired rectus abdominis and also by the smaller pyramidalis muscle in the lower abdomen" ***(Moore et al., 2010)***.

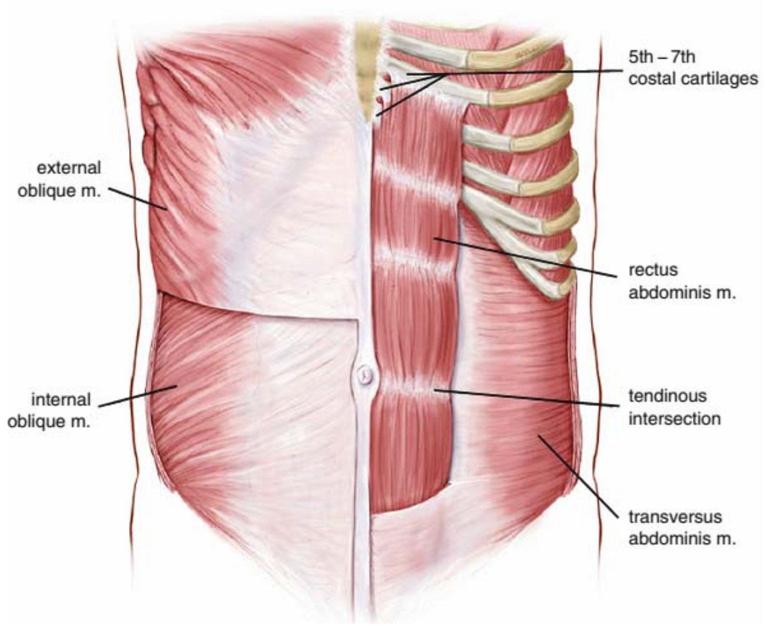

Figure (5): Muscles of the anterolateral abdominal wall
(McGrath & Uitto, 2010).