INTRODUCTION

Cutaneous deformities engendered by massive weight loss are constant reminders to the patient of physical and psychological difficulties. Therefore, abdominoplasty is the most recommended treatment for abdominal skin laxity ***(Von Soest et al., 2006).***

Abdominoplasty is an important and common operation in aesthetic surgery. Since its original recorded description, several technical improvements have been made. Fundamentally, however, there has been no change in the essential concept of extensive undermining almost to the costal margin, followed by appropriate resection and closure. The operation is still associated with a significant complication rate, morbidity and prolonged convalescence ***(Van Uchelen et al., 2001).***

During the past decade, many combinations of operative techniques for abdominoplasty have evolved to suit the individual requirements of the patient. Body-contouring techniques were developed over the past few decades, before liposuction came on the scene. Classic abdominoplasty has become more common. It appears to be technically easy but nevertheless it is a source of potentially serious complications that can clearly affect the aesthetic results and the satisfaction rate of the patients ***(Momeni et al., 2008).***

The type of incision is usually determined by the patient's body habitus or by the patient's choice of clothing, ie, bathing apparel or shorts. Most incisions are low on the abdomen, allowing the patient to wear fairly brief apparel. Most abdominoplasty

incisions are variations of the Regnault, Grazer, or the bicycle-handlebar techniques described by Baroudi ***(Grazer, 1990).***

The most devastating complication of an abdominoplasty is pulmonary embolus, which is described to be a risk factor at 0.8%.This complication is thought to be directly related to the severity of plication of the rectus fascia, which can cause intra-abdominal hypertension (i.e., >20 mmHg).The increased pressure has deleterious effects on the venous circulation by causing stasis and decreasing the return, therefore predisposing the patient to deep venous thrombosis (DVT) ***(Schein et al., 1995).***

Communication with the anesthesiologist at this point can help address this problem by early detection of any changes in the peak inspiratory pressure. Cases of pulmonary compromise and gastroesophageal reflux following rectus plication have been reported due to intraabdominal hypertension; some cases required release for resolution of symptoms ***(Jansen et al., 1999).***

Other complications include skin loss (major or minor), loss of umbilicus, elevation of the pubic escutcheon, and painful neuromas. From 1975, Regnault reports hematomas and/or seromas in 3% of patients, skin necrosis in 0.5%, hypertrophic scars in 3%, and scar revisions in 4% ***(Regnault, 1975).***

As with all body contouring procedures, complications can occur. The most common complications were wound dehiscence, seroma formation, infection, hypertrophic scarring, residual deformity, and wide umbilical scars. The incidence of complications dropped dramatically with experience ***(Pitanguy, 2000).***

AIM OF THE WORK

To evaluate different techniques of abdominoplasty discussing the steps for each procedure, indication, contraindication and considerable complications.

ANATOMY OF THE ANTERIOR ABDOMINAL WALL

Knowledge of the abdominal wall anatomy and its deformities provides a clear view of which aspects should be addressed during abdominoplasty. All patients are different, their deformities vary and, therefore, there is not a one-size-fits-all abdominoplasty ***(*Joseph and Remus, *2009).***

There are some anatomical landmarks that might serve as the main guideline providing orientation for obtain a good cosmetic result. The anterolateral abdomen is divided into nine regions by four imaginary planes: two verticals (midclavicular / midinguinal) and two horizontal transpyloric/intertubercular) planes (Fig.1) ***(Arslan, 2005).***

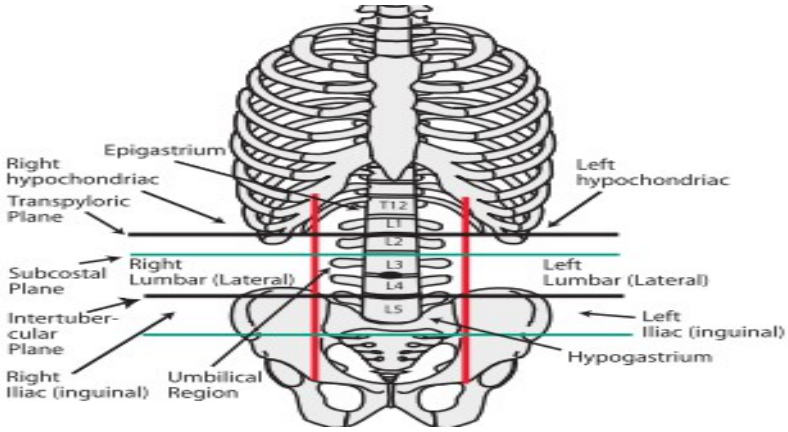

Figure (1): Various regions of the anterior abdominal wall ***(Taken from Shiffman and Mirrafati; Aesthetic Surgery of the Abdominal Wall; 1st Ed, 2005).***

The anterolateral abdominal wall consists, from the outside in, of the skin, superficial fascia, deep fascia, external and internal abdominal oblique, transverse abdominis and associated aponeuroses, rectus abdominis and pyramidalis, as well as the transversalis fascia ***(Arslan, 2005)***.

The skin is of average thickness, and loosely attaches to the underlying tissue. It exhibits certain surface markings such as the umbilicus, linea alba, linea semilunaris and epigastric fossa The linea alba (white line) is formed by the midline fusion of the aponeuroses of flat abdominal muscles and may be visible through the skin of muscular individuals ***(Arslan, 2005).***

The linea semilunaris (Spigelian line) (Fig.2) marks the lateral border of the rectus abdominis, extending from the costal arch near the ninth costal cartilage to the pubic tubercle.This line marks the sites of entry of motor nerves to the rectus abdominis, rendering it a surgically undesirable site for incisions. The small depression below the infrasternal angle is termed the epigastric fossa ***(Yngve, 1997).***

The horizontal directions of the connective tissue fibers beneath the epidermis form the visible Langer's cleavage lines (Fig.3). An incision made perpendicular to the direction of Langer's lines is most likely to gape and result in prominent scarring ***(Arslan, 2005)***.

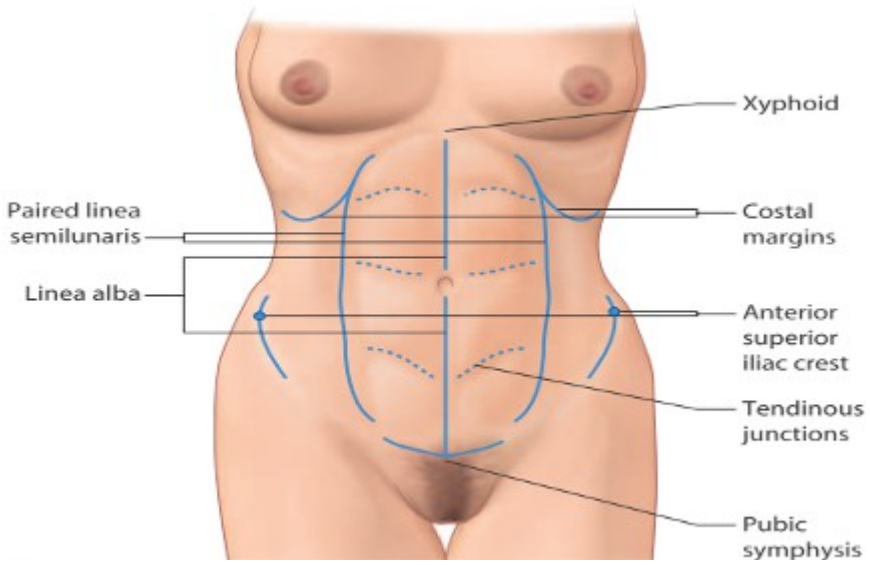

Figure (2): The soft-tissue landmarks include the linea alba, the paired linea semilunares, and the tendinous junctions or insertions of the rectus abdominis muscles ***(Taken from Hunstad and Repta; Atlas of Abdominoplasty. 1st Ed, 2009).***

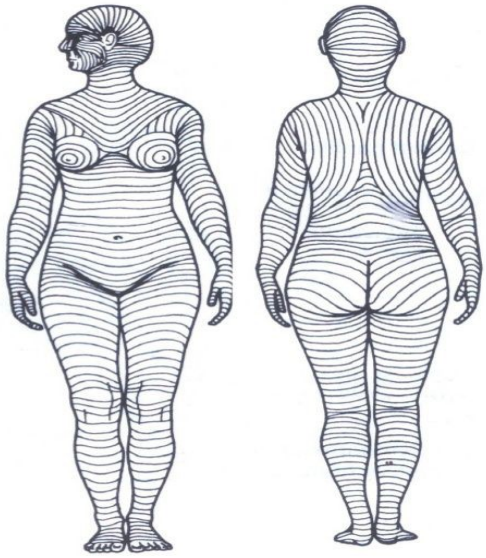

Figure (3): The horizontal directions of the connective tissue fibers beneath the epidermis form the visible Langer's cleavage lines.

The dermis of the skin of the anterolateral abdomen is resilient, permits some degree of stretch, and is able to counteract the prolonged tearing pressure. However, stretch exerted by the pregnant uterus can disrupt the connective tissue fibers of the dermis and produce striae perpendicular to the Langer's lines, commonly known as 'stretch marks' ***(Arslan, 2005)***.

The superficial fascia (Fig. 4) is a soft and movable layer, which comprises, to a great extent, a single variably fatty superficial layer known as Camper's fascia. The amount of fat in Camper's fascia varies depending on the nutritional status of the individual ***(Del Valle et al., 1992)***.

In the male, it continues inferiorly with the dartos layer of the scrotum and outer layer of the penis and spermatic cord, where it becomes thinner, lacking adipose tissue. In the female, it continues with the superficial fascia covering the labia majora. Approximation of Camper's fascia at closure of the abdominal incision during cesarean delivery appears to prevent postoperative superficial wound disruption ***(Del Valle et al., 1992).***

In the lower wall of the anterior abdomen, a deeper membranous layer known as Scarpa's fascia becomes visible. This layer remains connected, though loosely, to the deep fascia that covers the aponeurosis of the external abdominal oblique muscle ***(Del Valle et al., 1992)***.

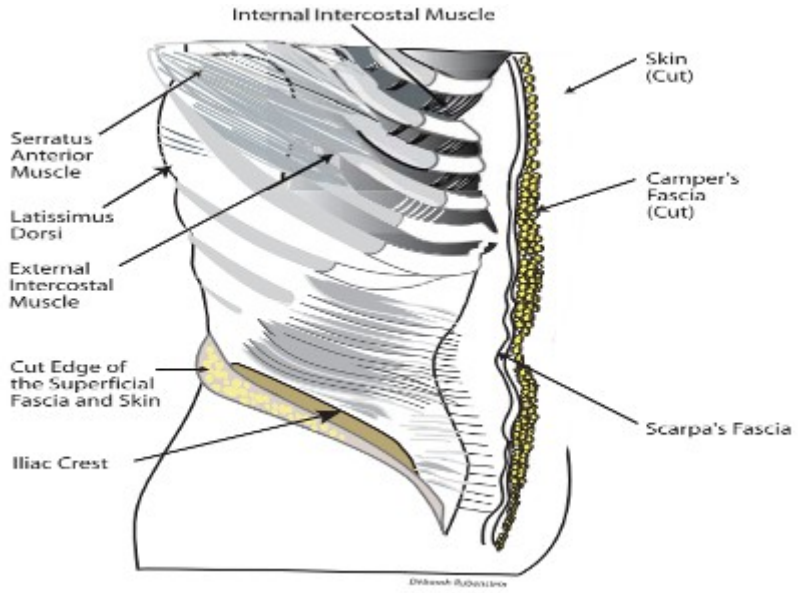

Figure (4): The two layers of the superficial fascia of the abdominal wall ***(Taken from Shiffman and Mirrafati; Aesthetic Surgery of the Abdominal Wall; 1st Ed, 2005).***

Blood supply of anterior abdominal wall

The abdominal wall receives blood supply through branches of the femoral, external iliac, subclavian and intercostal arteries as well as the abdominal aorta (Fig.5, 6). These branches include the superficial epigastric, superficial circumflex iliac, superficial external pudendal, deep circumflex iliac, superior and inferior epigastric, posterior intercostal, subcostal, musculo-phrenic, and lumbar arteries ***(Hester et al., 1984).***

The superficial epigastric artery is a branch of the femoral artery distal to the inguinal ligament that ascends in the superficial fascia of the abdomen toward the umbilicus. This vessel provides the blood supply to the superficial fascia and skin of the abdomen, anastomosing with the inferior epigastric artery ***(Hester et al., 1984)***.

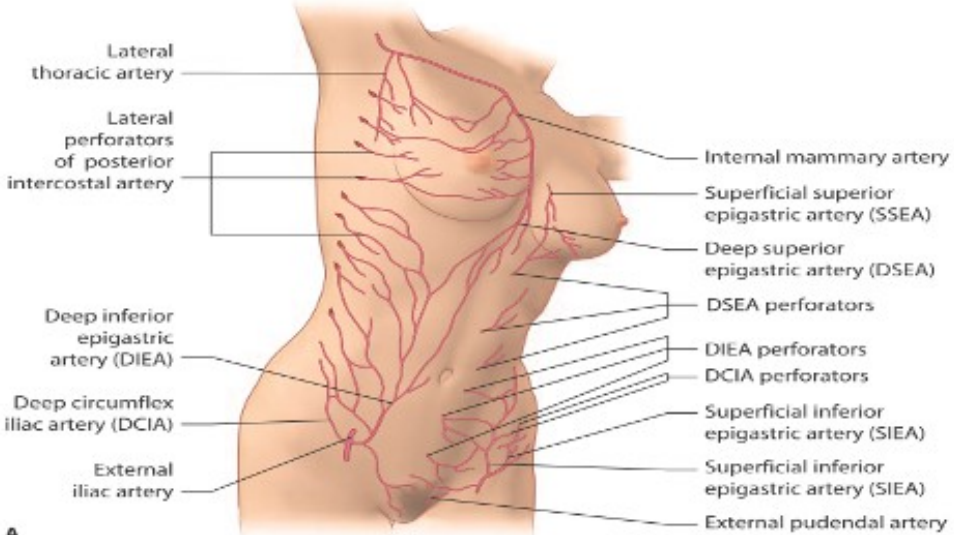

Figure (5): Blood supply of anterior abdominal wall ***(Taken from Hunstad and Repta; Atlas of Abdominoplasty. 1st Ed, 2009).***

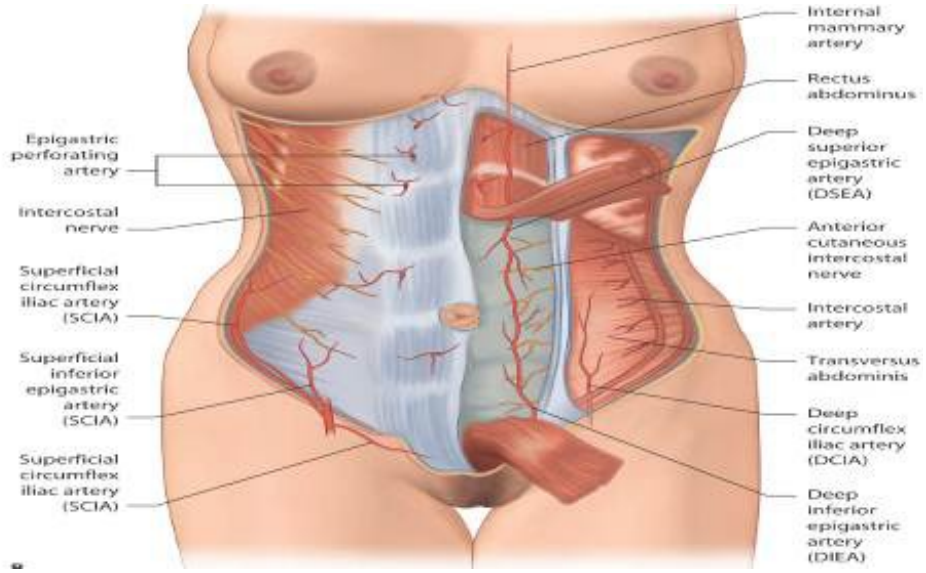

Figure (6): Blood supply of anterior abdominal wall ***(Taken from Hunstad and Repta; Atlas of Abdominoplasty. 1st Ed, 2009).***

The superficial circumflex iliac artery arises from the femoral artery near the origin of the superficial epigastric artery. It pierces the deep fascia of the thigh lateral to the saphenous opening and courses laterally toward the anterior superior iliac spine to supply the superficial fascia and skin .The superficial external pudendal artery branches off the femoral artery and runs medially deep to the great saphenous vein. It travels across the spermatic cord (round ligament) to supply the lower anterior wall of the abdomen ***(Reimann and Fritz, 1975)***.

The deep circumflex iliac artery originates from the external iliac artery lateral to the point of origin of the inferior epigastric artery and advances laterally posterior to the inguinal ligament in a sheath formed by the transversalis and iliac fascia. After it pierces the transverse abdominis and enters the area between this muscle and the internal oblique muscle, it anastomoses with the iliolumbar, superior gluteal, lumbar, and inferior epigastric arteries ***(Hester et al., 1984)***.

The superior epigastric artery (Fig.6), one of the terminal branches of the internal thoracic artery, arises at the level of the sixth costal cartilage, descends anterior to the transversus thoracis, and continues into the sternocostal triangle of Morgagni ***(Onishi and Maruyama, 1986)***.

The inferior epigastric artery (Fig.6) is a branch of the external iliac artery that ascends obliquely along the medial margin of the deep inguinal ring, posterior to the spermatic or round ligament. It may arise from the femoral artery, or, very

rarely from the obturator artery. It pierces the transversalis fascia to enter into the posterior wall of the rectus abdominis at the level of the arcuate line ***(Onishi and Maruyama, 1986)***.

This vessel penetrates the posterior sheath near the middle of the lower abdomen and the anterior sheath in an area ranging from the upper third of the lower abdomen to the umbilicus .After giving rise to the pubic, cremasteric and cutaneous branches, the inferior epigastric artery ascends under the parietal peritoneum as the lateral (epigastric) umbilical fold ***(Onishi and Maruyama, 1986)***.

The subcostal artery courses inferior to the last rib and anterior to the 12th thoracic vertebra. It lies posterior to the sympathetic trunk, thoracic duct, pleura and diaphragm. Then, it descends into the posterior abdominal wall posterior to the lateral arcuate ligament accompanied by the corresponding vein and nerve ***(Hester et al., 1984)***.

The musculophrenic artery, a terminal branch of the internal thoracic artery, runs inferiorly and laterally posterior to the seventh to ninth costal cartilages and gives rise to the lower two anterior intercostal arteries to the corresponding intercostal spaces. It supplies the pericardium and anterior abdominal muscles, anastomosing with the deep circumflex iliac and the lower two posterior intercostal arteries ***(Hester et al., 1984)***.

Venous Drainage of the Anterolateral Abdominal Wall:

The venous drainage of the abdominal wall is divided into superficial system formed by a network of veins that radiate out from the umbilicus. The network is drained into axillary vein via the lateral thoracic vein, above and below into the femoral vein via the superficial epigastric vein (fig. 7) ***(Snell, 2008).***

Deep system is formed of superior and inferior epigastric and deep circumflex iliac veins which follows the arteries of the same name and drain into the internal thoracic and external iliac veins. The posterior intercostals veins drain into the azygos vein and the lumbar veins drain into the inferior vena cava ***(Gray and Henry, 1918).***

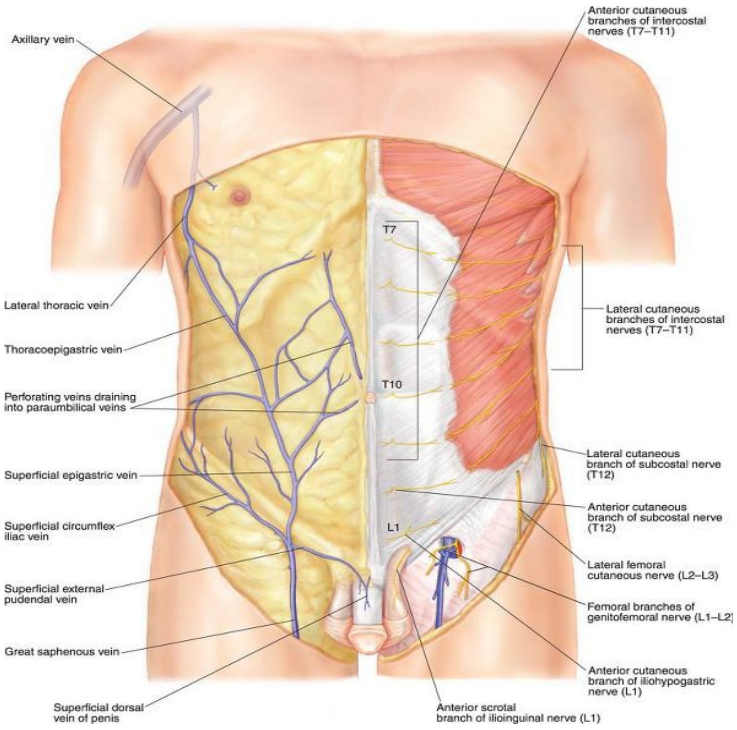

Figure (7): Superficial Veins and Cutaneous Nerves of the Anterior Abdominal wall ***(Tank et al., 2009).***

Lymphatic drainage of the Anterolateral Abdominal Wall:

The lymphatic vessels of the anterior abdominal wall lie both superficial and deep to the deep fascia.

- **Superficial vessels:**

The superficial lymphatic vessels accompany the subcutaneous blood vessels. Vessels from the lumbar and gluteal regions run with the superficial circumflex iliac vessels. Those from the infra-umbilical skin run with the superficial epigastric vessels. Both drain into the superficial inguinal nodes. The supra-umbilical region is drained by vessels running obliquely up to the pectoral and subscapular axillary nodes, and there is some drainage to the parasternal nodes ***(Borley, 2008)***.

- **Deep vessels:**

The deep lymphatic vessels accompany the deep arteries. The vessels from the posterior portion of the abdominal wall pass with the lumbar arteries to drain into the lateral aortic and retro-aortic nodes. Vessels from the upper anterior abdominal wall run with the superior epigastric vessels to the parasternal nodes. Vessels of the lower abdominal wall drain into the circumflex iliac, inferior epigastric and external iliac nodes ***(Borley, 2008).***

Nerve supply anterior abdominal wall:

The cutaneous innervation of the abdomen includes dermatomes T4–L1 (Fig.8). The lateral and anterior cutaneous branches of the intercostal and subcostal nerves supply much of the innervation to the abdominal soft tissue (Fig.8). The anterior branches of the intercostal and subcostal nerves travel between the internal oblique and the transverse abdominis muscles ***(Moore and Dalley, 2006).***

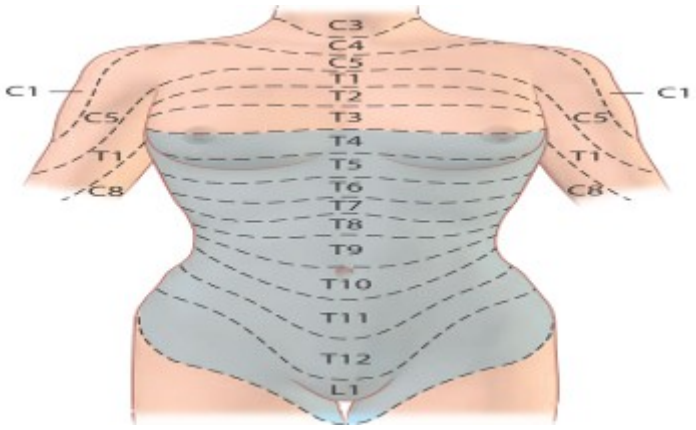

Figure (8): The abdominal skin and soft tissue receives its innervation from the continuation of intercostal and subcostal nerves, T4–L1 ***(Taken from Hunstad and Repta; Atlas of Abdominoplasty. 1st Ed, 2009).***

The cutaneous portions of these nerves travel through the rectus abdominis muscles to emerge from the anterior rectus sheath and supply sensation to the midline abdomen. The cutaneous distribution of the anterior branches of the intercostals and subcostals mirrors the vascular supply of the deep epigastric arcade ***(Moore and Dalley, 2006).***

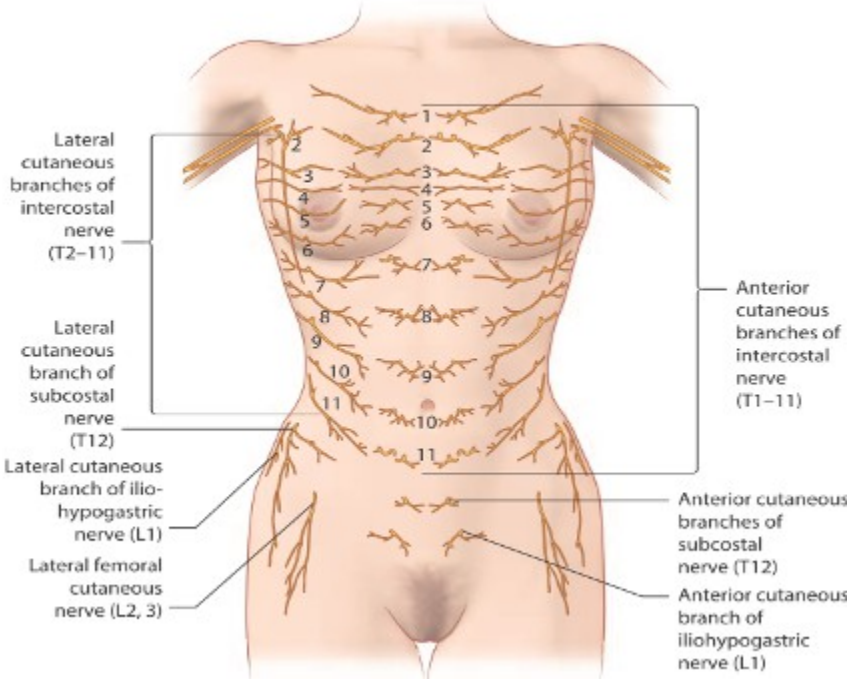

Figure (9): The anterior branches of the intercostal and subcostal nerves ***(Taken from Hunstad and Repta; Atlas of Abdominoplasty. 1st Ed, 2009).***

The lateral branches of the intercostal and subcostal nerves emerge through the oblique muscles laterally near the midaxillary line and travel superficial to the external oblique (Fig.9)**.** The most inferior abdominal skin is innervated by the ilioinguinal nerve, which courses superiorly through the mons ***(Moore and Dalley, 2006).***

In the female it follows a similar course and distributes sensory fibers to the skin of the major labium. The femoral branch passes posterior to the inguinal ligament to provide sensory fibers to the upper middle part of the femoral triangle ***(Akita et al., 1999).***