This presentation will discuss the anatomy of the anterior abdominal wall as it pertains to gynaecological and obstetric surgery.
The border of the anterior abdominal wall is defined superiorly by the xiphoid process of the manubrium sterni and the inferior aspects of the lower ribs that make up the subcostal margins.

Caudally, the border is defined by the upper edge of the pubic symphysis, inguinal ligaments and the iliac crests.
In addition to the structures that define the upper and lower borders of the anterior abdominal wall, important surface markings need to be noted. These include the umbilicus and the linea alba in the midline, the linea semilunaris – which defines the lateral edges of the recti muscles – the anterior superior iliac spine, and the superficial vessels, which may be visible in some thin women.
A cross section of the anterior abdominal wall will reveal, from outwards–inwards: the skin, the subcutaneous layer, which is made up of fatty tissue called the Camper's fascia and membranous tissue called the Scarpa's fascia, the pyramidalis muscle, which may be absent in up to 20% of humans, and the rectus muscle encased within the rectus sheath along with the pyramidalis if this is present.
Beneath the rectus muscle is the external oblique muscle and its aponeurosis, the internal oblique muscle and its aponeurosis, the transversus abdominis muscle and its aponeurosis, the transversalis fascia, extraperitoneal fat and, finally, the parietal peritoneum.

It should be noted that the skin is loosely attached to the underlying structures with the exception of the umbilicus where it is firmly tethered to underlying tissue.

Natural skin creases, called lines of Langer’s, run mostly in a horizontal direction across the trunk. They are associated with the distribution of collagen and elastic fibres in the skin.

Transverse incisions made parallel to Langer’s lines heal with narrower scars compared with vertical incisions as there is less tension on the scar.
The important fascia of the anterior abdominal wall is comprised of the rectus sheath, the transversalis fascia and the midline linea alba.

The formation of the rectus sheath will be discussed in the next slide.

The transversalis fascia is a weak fibrous layer that covers the inner surface of the transversus abdominis muscles and is separated from the peritoneum by a layer of fat commonly known as the extraperitoneal or preperitoneal fat layer.

The linea alba stretches from the xiphoid process to the pubic symphysis. It is defined as the fusion of the aponeurosis of the external oblique, internal oblique and transversus abdominis muscles. It maintains the abdominal musculature at a certain proximity to each other.
Now, back to the formation of the rectus sheath.

The rectus sheath is composed of the broad sheath-like aponeurosis of the three flank muscles and encloses the rectus abdominis and pyramidalis muscles if present.

Lateral to the rectus abdominis, the aponeurosis can be separate but they fuse as they reach the midline.

Different configurations exist above and below the arcuate line and this will be explained in the following two slides.
The internal oblique muscle is sandwiched between the external oblique and transversus abdominis muscles. The aponeurosis of the internal oblique muscle is bilaminar.

Now, above the arcuate line, the anterior bifurcation of the bilaminar aponeurosis of the internal oblique muscle joins the aponeurosis of the external oblique muscle to form the anterior rectus sheath while the posterior bifurcation of the same aponeurosis of the internal oblique muscle joins the aponeurosis of the transversus abdominis muscle to form the posterior rectus sheath.
Below the arcuate line, the aponeuroses of all three muscles form the anterior rectus sheath. The posterior sheath is therefore deficient, and the rectus muscle lies directly on the transversalis fascia.

The arcuate line is where the inferior epigastric vessels enter the rectus sheath, travel superiorly and converge with the superior epigastric vessels. The arcuate line might be absent in up to 30% of individuals.
The parietal peritoneal surface, which is the last layer of the anterior abdominal wall, is best seen during a laparoscopy as this gives an excellent view of the inner landmarks.

The upper limit of the collapsed empty bladder can be seen in the image.

This aids safety during incision of a suprapubic port during laparoscopy as it prevents injury to the bladder.

The next two slides will highlight the other important structures of note that can be visualised on the inner aspect of the anterior abdominal wall.
Superior to the umbilicus, a median fold known as the falciform ligament contains the ligamentum teres which is the remnant of the obliterated umbilical vein in its free inferior border.

It runs from the umbilicus towards the left lobe of the liver and, anatomically, divides the left lobe of the liver into medial and lateral sections.
Inferior to the umbilicus there are five vertical peritoneal folds that converge at the umbilicus.

The single median umbilical ligament is a remnant of the obliterated urachus which develops from the embryological allantois and attaches to the urinary bladder.

There are two medial umbilical ligaments which are remnants of the obliterated umbilical arteries. Last, there are two lateral umbilical ligaments associated with the inferior epigastric vessels.
The blood supply of the abdominal wall is comprised of superficial and deep vascular supplies.

The superficial vasculature is located in the subcutaneous tissues and supplies the tissues superficial to the external oblique aponeurosis and anterior rectus sheath.

The muscles and tissues below these layers are supplied by the deep vessels which are located in the musculofascial layers.

These vessels are at risk of injury especially during the placement of lateral ports during laparoscopy. The inferior epigastric arteries arise from the external iliac arteries and ascend upwards through the transversalis fascia and then between the rectus abdominis muscles and the posterior rectus sheath.

The superficial abdominal wall vessels, which are comprised of the superficial inferior epigastric artery and the superficial circumflex arteries arise from the femoral artery and may be visualised through transillumination in the majority of women at normal weight regardless of their skin colour, but this is of less value in overweight women.

However, the deep inferior epigastric vessels cannot be effectively located by transillumination as they run deep to the recti muscles. Therefore they need to be visualised on the undersurface of the peritoneal lining at laparoscopy.
The picture in this slide shows extensive bruising as a result of injury to an anterior abdominal wall vessel during placement of lateral laparoscopic ports.

In addition to transillumination of superficial vessels and direct visualisation of the deep inferior epigastric vessels, once a safe entry point is ascertained, one needs to ensure that the puncturing trocar remain perpendicular to the skin and myofascial planes during incision until the parietal peritoneum is tented so that there is no lateral sliding of the tip of the trocar as it traverses the layers of the anterior abdominal wall.
Iliohypogastric or ilioinguinal nerve injuries may be caused by suture entrapment at the lateral folds of the transverse fascial incisions, transection from incision, trocar placement during laparoscopic surgery, thermal injury from electrosurgical devices, or the formation of a neuroma during the normal healing process.

The ilioinguinal nerve seems to be at a greater risk, and the iliohypogastric nerve seems to be involved less often. Symptoms may be characterised by sharp, burning, lancinating pain radiating from the incision to the suprapubic area, labia, or thigh, paraesthesia over these areas and pain relief after infiltration with a local anaesthetic.

Techniques to reduce the risk of nerve injury during laparotomy include the use of midline longitudinal incision as, compared with a transverse incision, this is far less likely to disturb abdominal nerves.

However, the complications and risks associated with this kind of incision should be borne in mind. A short transverse incision placed within the borders of the recti muscles and 3 cm above the symphysis pubis results in minimal loss of neural function. If it is necessary to extend the incision, curving it cephalad rather than continuing in a straight line may help avoid injury of the iliohypogastric and ilioinguinal nerves.

Last, avoiding the use of cautery on the perforating branches of vessels helps avoid injury to the terminal sensory nerve fibres, which typically run alongside these vessels. Techniques used to reduce the risk of nerve injury during laparoscopy include the avoidance of port site incisions below the anterior superior iliac spine, preventing injury to the ilioinguinal and iliohypogastric nerves.
In these last two slides we will look briefly at the common anterior abdominal wall incisions made during laparotomy and laparoscopy.

At laparotomy, the midline incision is made along the linea alba, which is a watershed area, taking advantage of the fact that only terminal branches of the abdominal wall blood vessels and nerves are located at this point. The fibroelastic composition of its connective tissue as well as its low metabolic turnover does not require profuse vascularisation thereby limiting the potential for bleeding or nerve injury.

Consequently, incisions here do not cause troublesome bleeding. However, union is slow and therefore either non-absorbable or long-staying suture material is required when closing up. Otherwise, deficits will remain and these will be potential sites for incisional hernia.

The suprapubic transverse incision in the lower abdomen may encounter the inferior and superficial epigastric vessels. If these can be guarded against, the incision heals rapidly leaving only thin scars. Pfannenstiel’s, Cherney’s, and Maylard’s incisions actually refer to the technique of entry in the peritoneal cavity.
During laparoscopy, the umbilical port is usually the primary entry port.

The base of the umbilicus is the thinnest aspect of the anterior abdominal wall, as it is devoid of subcutaneous fat and the fascial layers are firmly adherent. These features enable a relatively safe entry.

When landmarks are not visible to guide placement, secondary lateral ports can be placed 5 cms superior to the mid-pubic symphysis and 8 cms lateral to the midline.

The Palmer’s point is an alternative primary entry port, which is located 3 cms below the left costal margin along the mid-clavicular line. This point is used mostly in women who have had previous abdominal surgery and where the frequency of bowel adhesions to the inner anterior abdominal wall is high or in women who have large pelvic masses such as uterine fibroids or ovarian cysts. It is also a port that may be used when there is a suspected umbilical hernia or urachal abnormalities are suspected just below the umbilicus.
You will now be shown a video demonstrating the opening and closing of a suprapubic abdominal incision.