Anatomy of abdominal incisions

Harold Ellis

Opening the abdomen is the essential preliminary to the performance of a laparotomy. A correctly performed abdominal exposure is based on sound anatomical knowledge, hence it is a common question in the Operative Surgery section of the MRCS examination.

Incisions

Essential features

The surgeon needs ready and direct access to the organ requiring investigation and treatment, so the incision must provide sufficient room for the procedure to be performed. The incision should (if possible):
- be capable of easy extension (to allow for any enlargement of the scope of the operation)
- interfere as little as possible with the strength and function of the abdominal wall.

Choice

The choice of the incision depends on:
- the type of surgery
- the organ to be exposed
- whether speed is an important factor (e.g. a fancy incision is inappropriate if the patient is bleeding to death from a intra-abdominal catastrophe)
- the build of the patient
- the presence of previous abdominal incisions (which may themselves be the site of an incisional hernia)
- the experience and preference of the surgeon.

A serious emergency (e.g. ruptured abdominal aortic aneurysm, closed abdominal injury) should be approached through a midline incision because it gives rapid access and can be enlarged to the whole length of the abdomen in a matter of seconds. A subcostal (Kocher) incision gives excellent access for open biliary surgery in the obese patient with a wide subcostal angle. However, this incision has no advantage over the quicker and easier to perform upper midline incision in the skinny patient with a narrow subcostal angle. Mark these two approaches on the abdominal wall of an asthenic subject and confirm this statement!

The Pfannenstiel incision is a beautiful cosmetic procedure for elective pelvic surgery (including open access to the prostate),

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but is time-consuming. A lower midline incision is needed for an emergency Caesarean section (where minutes may be crucial for baby and mother). The surgeon must also be sure of the pathology before performing this approach. Close the Pfannenstiel and start again with a lower midline if the 'pelvic mass' proves to be a carcinoma of the sigmoid colon!

There are more than one dozen abdominal incisions quoted in surgical textbooks, but the ones in common use today (and which the candidate must know in detail) are discussed below.

The midline incision (Figures 1–4)

The midline abdominal incision has many advantages because it:
- is very quick to perform
- is relatively easy to close
- is virtually bloodless (no muscles are cut or nerves divided).
- affords excellent access to the abdominal cavity and retroperitoneal structures
- can be extended from the xiphoid to the pubic symphysis.

If closure is performed using the mass closure technique, prospective randomized clinical trials have shown no difference in the incidence of wound dehiscence or incisional hernia compared with transverse or paramedian incisions.[1]

The upper midline incision is placed exactly in the midline and extends from the tip of the xiphoid to about 1 cm above the umbilicus. Skin, subcutaneous fat, linea alba, extraperitoneal fat and peritoneum are divided in turn. The extraperitoneal fat is abundant and vascular in the upper abdomen (especially in the obese) and small vessels must be coagulated with the diathermy. The falciform ligament with the ligamentum teres in its free edge lies in the midline, and is best avoided by opening the peritoneum to the left or right of the midline (Figure 5) deep to the belly of the rectus abdominis. The ligamentum teres should be double clamped, divided and ligated if it interferes with the exposure.

The lower midline incision is similar to the upper. Below the umbilicus, the linea alba is narrow and, not infrequently, the rectus sheath on one or other side is inadvertently opened, but this is unimportant.

In general, the peritoneum in the upper midline incision should be opened first at the lower end so that the exact position of the ligamentum teres and falciform ligament can be identified, allowing them to be dealt with as described above. In contrast, the peritoneum in the lower midline incision is opened first in its upper part to avoid the bladder. (Have a catheter in place in lower abdominal surgery to ensure that the bladder is empty.)

The upper and lower incisions can be extended the part or the whole extent of the abdominal wall. Most surgeons circumnavigate the umbilicus with the scalpel, but others take the incision directly through the umbilicus.

Right iliac fossa muscle split incision (Figures 1–3, 6, 7)

The right iliac fossa muscle split incision is the incision of choice for appendicectomy. The external oblique aponeurosis is divided along the line of its fibres, and the internal oblique and transversus abdominis muscles are split along their lengths. There

Anterior Abdominal Wall: Superficial Dissection

Pectoralis major muscle

Xiphoid process

Rectus sheath

Linea alba

Subcutaneous tissue (superficial fascia) of abdomen

Thoracoepigastric vein

Camper's (fatty) layer, Scarpa's (membranous) layer of subcutaneous tissue of abdomen (turned back)

Attachment of Scarpa's layer to fascia lata

Superficial circumflex iliac vessels

Superficial epigastric vessels

Superficial external pudendal vessels

Fundiform ligament

Superficial fascia of penis and scrotum (dartos) (cut)

Deep (Buck's) fascia of penis with deep dorsal vein of penis showing through

Serratus anterior muscle

Latissimus dorsi muscle

External oblique muscle — Muscular part / Aponeurotic part

Anterior superior iliac spine

Inguinal ligament (Poupart)

Intercrural fibers

Superficial inguinal ring

External spermatic fascia on spermatic cord

Cribriform fascia in saphenous opening

Fascia lata

Great saphenous vein

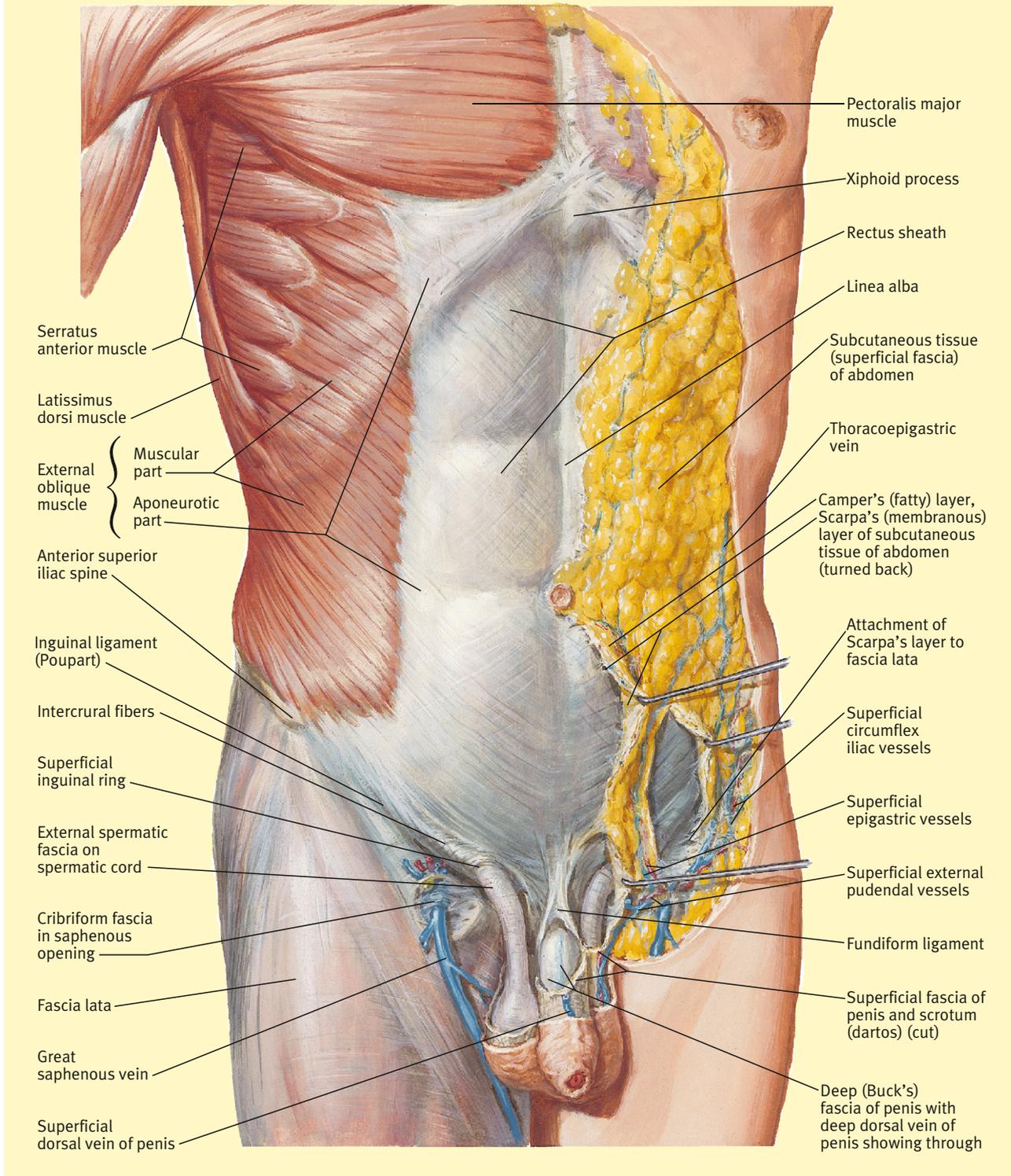Superficial dorsal vein of penis

Figure 1

is no postoperative weakening of the abdominal wall because no muscles are cut across. Wound dehiscence and incisional herniation are virtually unknown if this incision is performed correctly.

Classically, the skin incision is centred at McBurney's point, two-thirds of the distance along a line which joins the umbilicus to the anterior superior iliac spine, and is placed at right angles to this line (Figure 6). This places the incision along the line of the

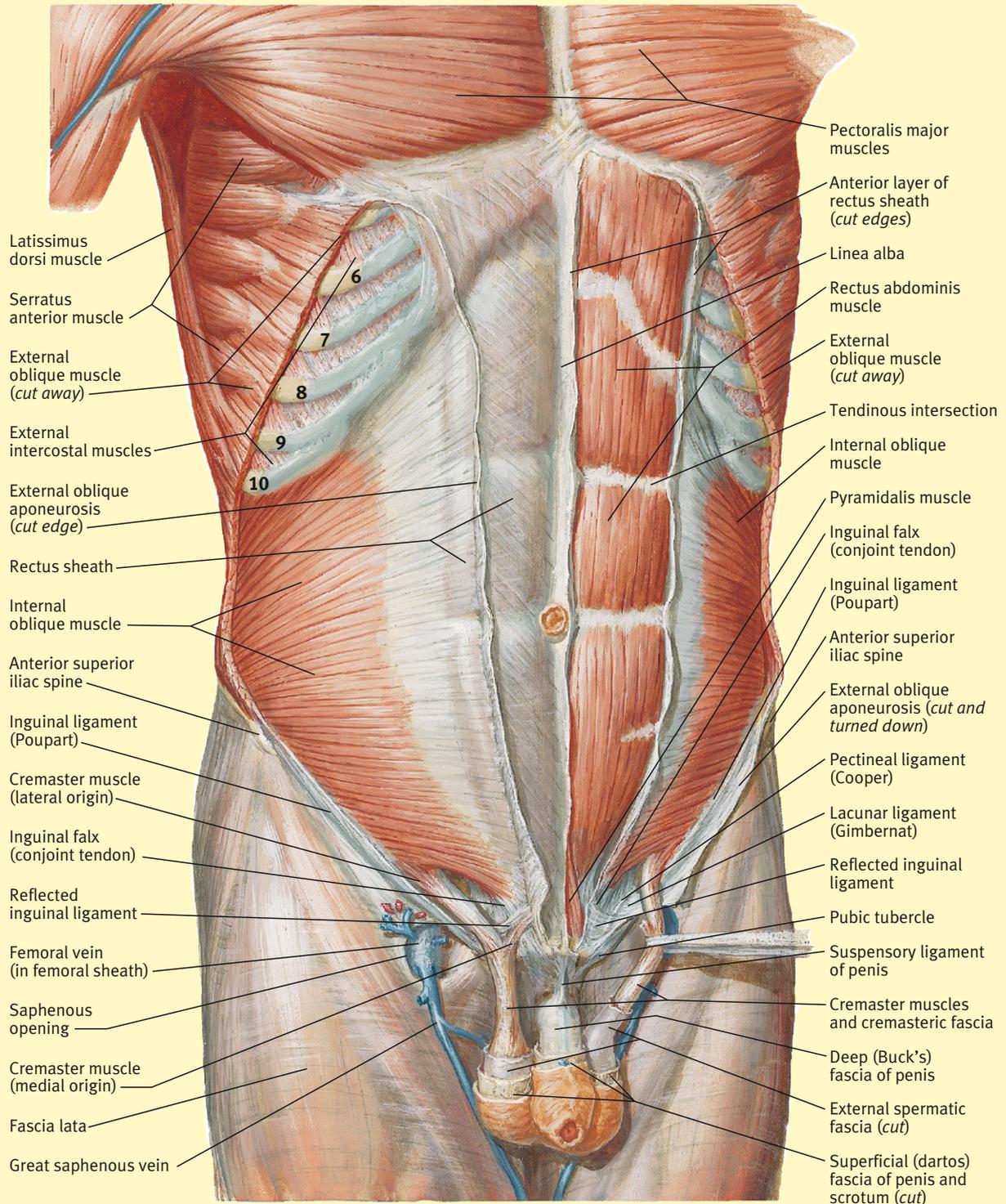## Anterior Abdominal Wall: Intermediate Dissection

Pectoralis major muscles

Anterior layer of rectus sheath (*cut edges*)

Linea alba

Rectus abdominis muscle

External oblique muscle (*cut away*)

Tendinous intersection

Internal oblique muscle

Pyramidalis muscle

Inguinal falx (conjoint tendon)

Inguinal ligament (Poupart)

Anterior superior iliac spine

External oblique aponeurosis (*cut and turned down*)

Pectineal ligament (Cooper)

Lacunar ligament (Gimbernat)

Reflected inguinal ligament

Pubic tubercle

Suspensory ligament of penis

Cremaster muscles and cremasteric fascia

Deep (Buck's) fascia of penis

External spermatic fascia (*cut*)

Superficial (dartos) fascia of penis and scrotum (*cut*)

Latissimus dorsi muscle

Serratus anterior muscle

External oblique muscle (*cut away*)

External intercostal muscles

External oblique aponeurosis (*cut edge*)

Rectus sheath

Internal oblique muscle

Anterior superior iliac spine

Inguinal ligament (Poupart)

Cremaster muscle (lateral origin)

Inguinal falx (conjoint tendon)

Reflected inguinal ligament

Femoral vein (in femoral sheath)

Saphenous opening

Cremaster muscle (medial origin)

Fascia lata

Great saphenous vein

Figure 2

fibres of the external oblique aponeurosis. This is a useful incision in the obese subject or if the incision must be extended, by:
- enlarging the skin incision
- extending the incision laterally by dividing the oblique muscles.

In most cases, a more aesthetic skin crease incision is used (Figure 6). However, a common mistake is to use McBurney's point as the centre of the incision: this will place it too medi-ally and the operator will find himself over the anterior rectus
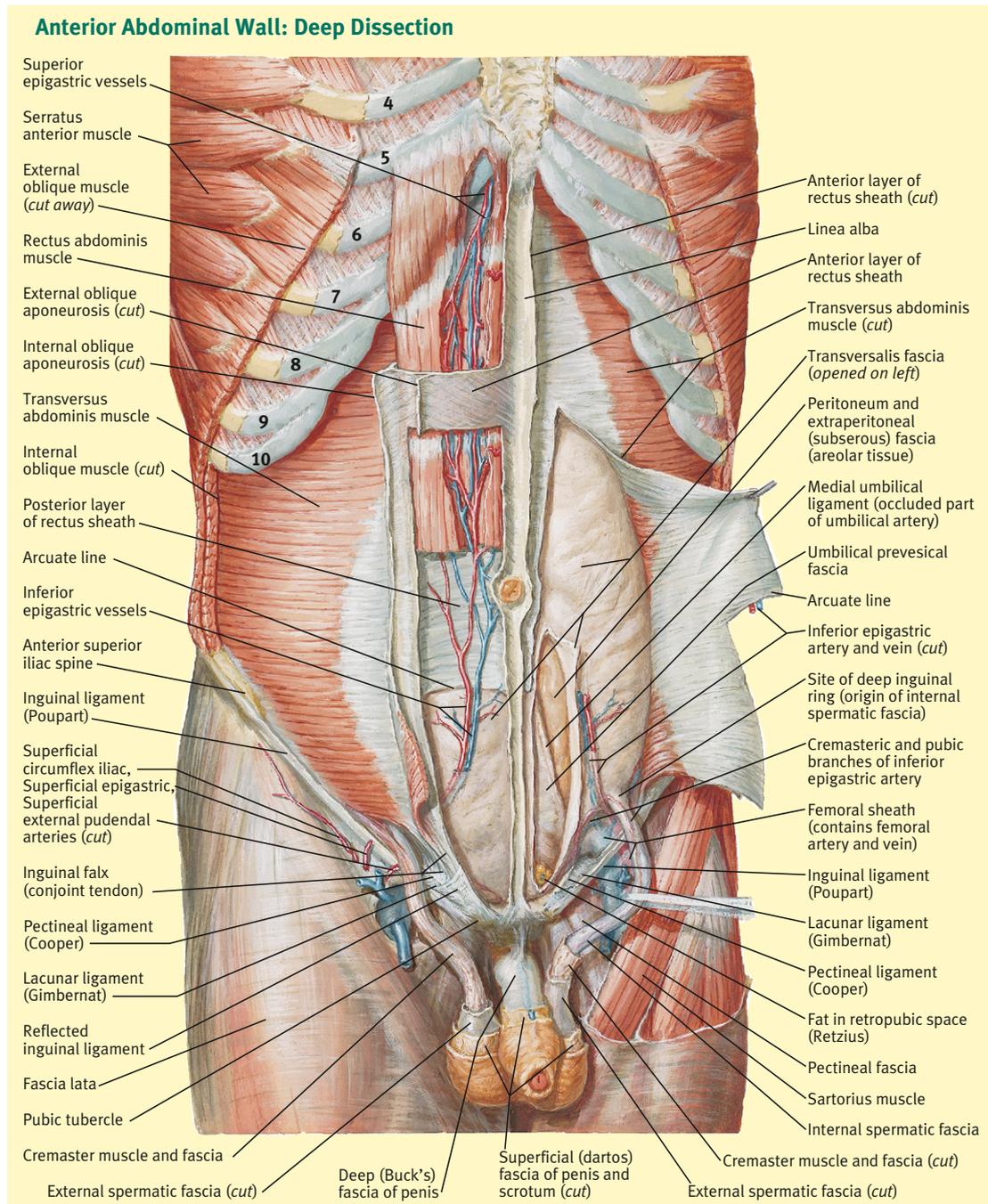
Anterior Abdominal Wall: Deep Dissection

Superior epigastric vessels

Serratus anterior muscle

External oblique muscle (*cut away*)

Rectus abdominis muscle

External oblique aponeurosis (*cut*)

Internal oblique aponeurosis (*cut*)

Transversus abdominis muscle

Internal oblique muscle (*cut*)

Posterior layer of rectus sheath

Arcuate line

Inferior epigastric vessels

Anterior superior iliac spine

Inguinal ligament (Poupart)

Superficial circumflex iliac, Superficial epigastric, Superficial external pudendal arteries (*cut*)

Inguinal falx (conjoint tendon)

Pectineal ligament (Cooper)

Lacunar ligament (Gimbernat)

Reflected inguinal ligament

Fascia lata

Pubic tubercle

Cremaster muscle and fascia

External spermatic fascia (*cut*)

Deep (Buck's) fascia of penis

Superficial (dartos) fascia of penis and scrotum (*cut*)

Anterior layer of rectus sheath (*cut*)

Linea alba

Anterior layer of rectus sheath

Transversus abdominis muscle (*cut*)

Transversalis fascia (*opened on left*)

Peritoneum and extraperitoneal (subserous) fascia (areolar tissue)

Medial umbilical ligament (occluded part of umbilical artery)

Umbilical prevesical fascia

Arcuate line

Inferior epigastric artery and vein (*cut*)

Site of deep inguinal ring (origin of internal spermatic fascia)

Cremasteric and pubic branches of inferior epigastric artery

Femoral sheath (contains femoral artery and vein)

Inguinal ligament (Poupart)

Lacunar ligament (Gimbernat)

Pectineal ligament (Cooper)

Fat in retropubic space (Retzius)

Pectineal fascia

Sartorius muscle

Internal spermatic fascia

Cremaster muscle and fascia (*cut*)

External spermatic fascia (*cut*)

Figure 3

sheath. Hence, in the patient of average build, the transverse skin crease incision should start 1–2 cm medial to the anterior superior iliac spine.

After dividing skin and subcutaneous fat (the superficial fascia), the external oblique aponeurosis is divided along the line of its fibres—not a drop of blood should be shed (Figure 7). The fibres are retracted to expose the underlying internal oblique muscle, which is opened with artery forceps or closed scissors at right angles to the fibres or external oblique, starting at the lateral edge of the rectus sheath (where this muscle is thinnest). The under-lying transversus abdominis muscle is closely applied to the internal oblique and will usually be found to be split open with it; the two muscles are then widely opened with the two index fingers and held apart with retractors. A fold of peritoneum is then picked up with forceps, carefully nicked open with the scalpel and the opening stretched with the two index fingers.

The retracted muscles slip back into place at the end of the operation. It was not my practice to put any sutures into them and merely to close the skin. However, many surgeons cannot resist putting a stitch or two into the external oblique aponeurosis.
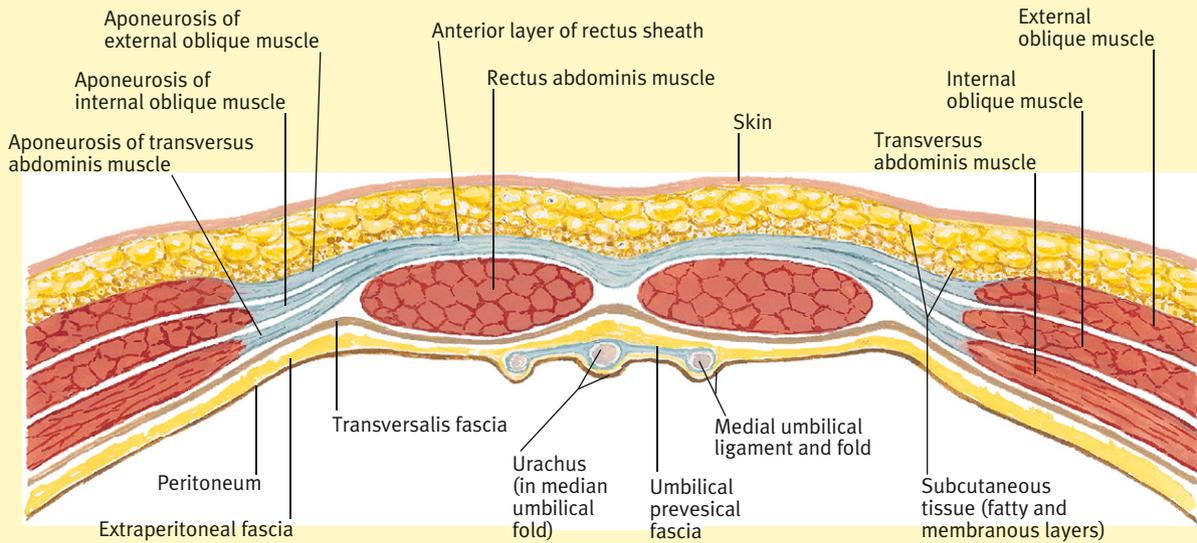
Rectus Sheath: Cross Sections

Section above arcuate line

Aponeurosis of
external oblique muscle

Aponeurosis of
internal oblique muscle

Aponeurosis of transversus
abdominis muscle

Anterior layer of rectus sheath

Rectus abdominis muscle

Linea alba

Skin

External
oblique muscle

Internal
oblique muscle

Transversus
abdominis muscle

Peritoneum

Extraperitoneal fascia

Transversalis fascia

Posterior layer
of rectus sheath

Falciform
ligament

Subcutaneous
tissue (fatty layer)

Aponeurosis of internal oblique muscle splits to form anterior and posterior layers of rectus sheath. Aponeurosis of external oblique muscle joins anterior layer of sheath; aponeurosis of transversus abdominis muscle joins posterior layer. Anterior and posterior layers of rectus sheath unite medially to form linea alba

Section below arcuate line

Aponeurosis of
external oblique muscle

Aponeurosis of
internal oblique muscle

Aponeurosis of transversus
abdominis muscle

Anterior layer of rectus sheath

Rectus abdominis muscle

Skin

External
oblique muscle

Internal
oblique muscle

Transversus
abdominis muscle

Transversalis fascia

Urachus
(in median
umbilical
fold)

Umbilical
prevesical
fascia

Medial umbilical
ligament and fold

Peritoneum

Extraperitoneal fascia

Subcutaneous
tissue (fatty and
membranous layers)

Aponeurosis of internal oblique muscle does not split at this level but passes completely anterior to rectus abdominis muscle and is fused there with both aponeurosis of external oblique muscle and that of transversus abdominis muscle. Thus, posterior wall of rectus sheath is absent below arcuate line and rectus abdominis muscle lies on transversalis fascia

Figure 4

The upper midline incision

A Surface markings.

B The linea alba and peritoneum are divided. The falciform ligament is avoided by opening the peritoneum to the left or right of the midline.
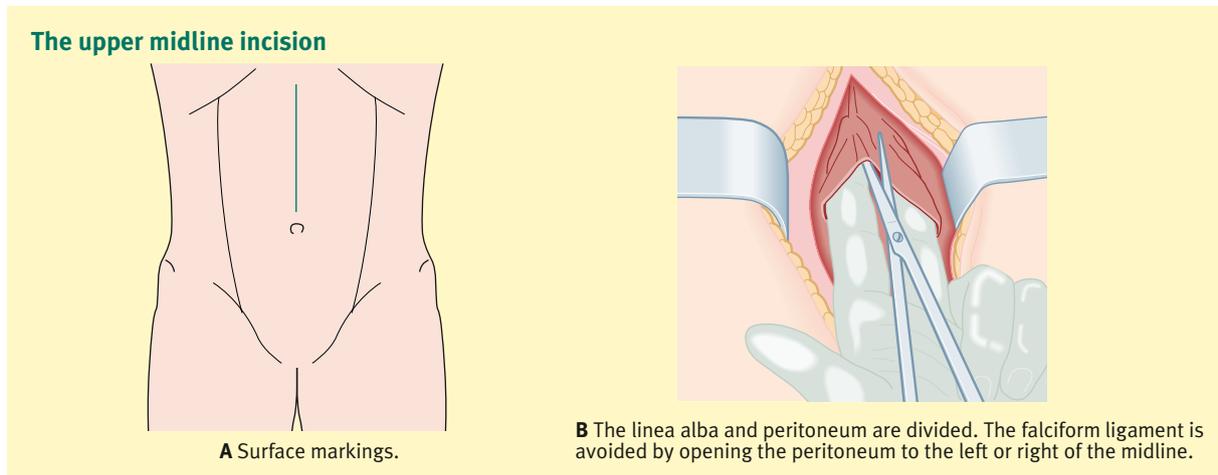
Figure 5

The subcostal (Kocher) incision

The Kocher incision is usually performed on the right side (e.g. biliary surgery), but may be performed on the left (e.g. elective splenectomy) or the two may be joined across the midline to give major access to the upper abdomen (e.g. hepatic surgery). The skin incision (Figure 8) starts in the midline 2.5–5 cm below the costal margin—some surgeons employ an almost transverse skin crease incision. The incision is about 12 cm long in the subject of average size and build. After dividing skin and subcutaneous fat, the anterior rectus sheath is divided along the line of the incision. The rectus muscle is divided using diathermy to control branches of the superior epigastric vessels. The lateral abdominal muscles are split in an outward direction to provide extra access. The small 8th intercostal nerve is sacrificed, but the larger 9th nerve (lying between the internal oblique and transverse muscles) should be identified and saved. The incision is deepened to open the posterior rectus sheath and underlying peritoneum.

Surface markings of the right iliac fossa incision

+ = McBurney's point

Anterior superior iliac spine

The classic McBurney incision is centred over McBurney's point and is at right angles to this. **A** Most surgeons now use the more transverse skin crease incision, which starts just medial to the anterior superior iliac spine **B**.

Figure 6

The rectus muscle, divided transversely, is not sutured in closing the incision. Provided the posterior and then anterior rectus sheaths are sutured, the divided rectus muscle will heal by scar tissue—in effect, this merely produces another fibrous intersection in the rectus muscle.

The Pfannenstiel incision

The Pfannenstiel incision is a useful incision for:
- elective open gynaecological surgery
- elective Caesarean section
- the retropubic approach to the prostate and the bladder neck (Figure 9).

The incision is placed in the curving interspinous skin crease, immediately inferior to the pubic hair line in the female. At this level, the superficial fascia is in the two layers, the:
- more superficial fatty layer (Camper's fascia)
- deeper fibrous layer (Scarpa's fascia).

The fatty layer contains three sets of vessels that must be divided and tied; these are, from medial to lateral, the:
- external pudendal
- superficial inferior epigastric
- superficial external iliac arteries, together with their veins.

The anterior rectus sheath is divided on both sides along the length of the wound. The cut edge of the sheath is lifted and dissected away from the adherent anterior aspect of the rectus muscle on each side by scissors or scalpel dissection. The rectus muscles are retracted laterally from each other to expose the underlying peritoneum (covered by a variable amount of extraperitoneal fat) and the peritoneum is then opened in the midline.

It is easy to damage the bladder in this procedure unless two vital precautions are taken:
- empty the bladder before the operation by means of a self-retaining catheter, which is left in situ
- start opening the peritoneum at the upper end of the wound.

The exposure given by this incision is somewhat limited and it should not be used when a procedure that is outside the limits
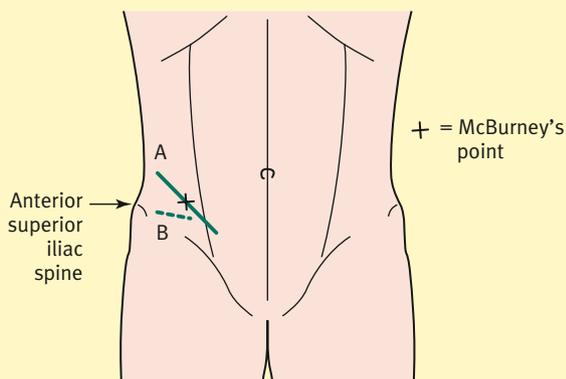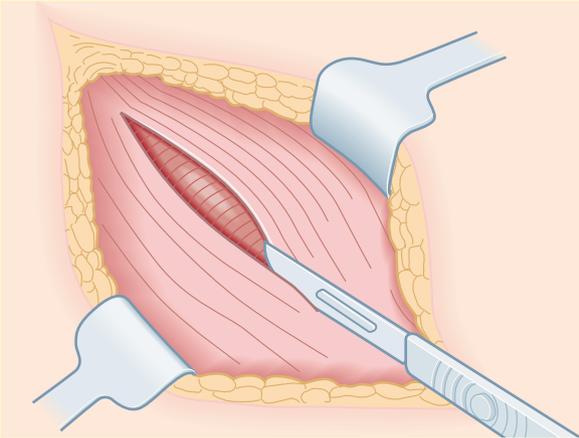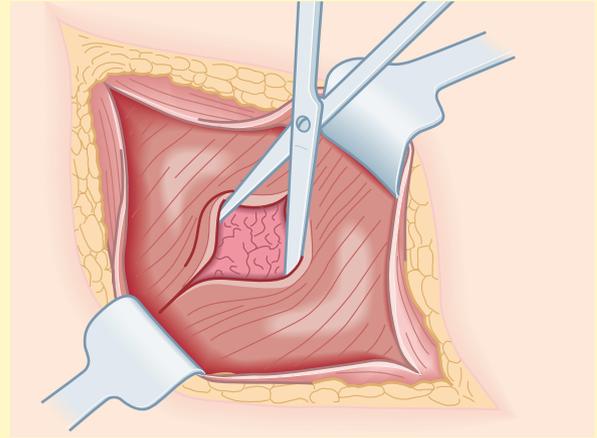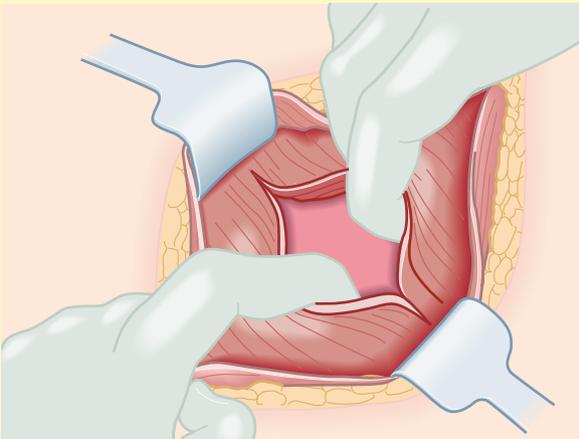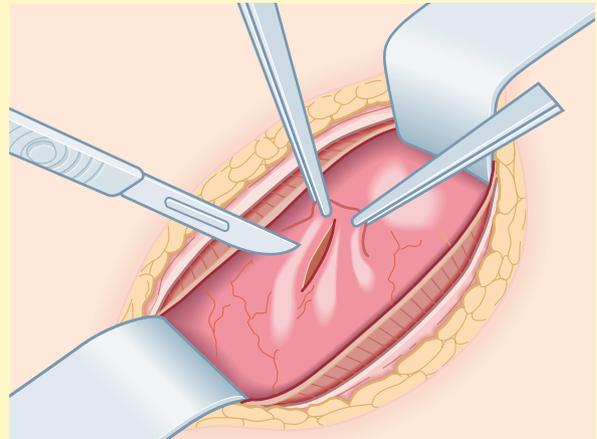
Muscle split incision

A The external oblique aponeurosis is divided.

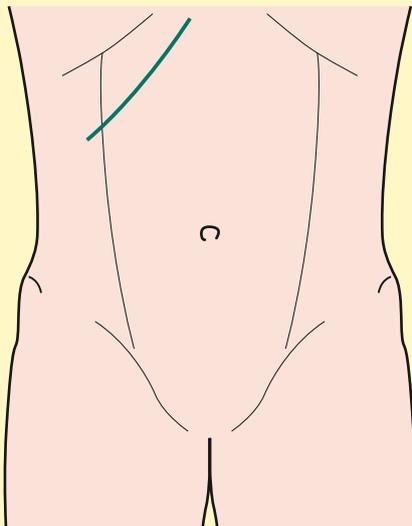**B** The internal oblique and transversus muscles are split.

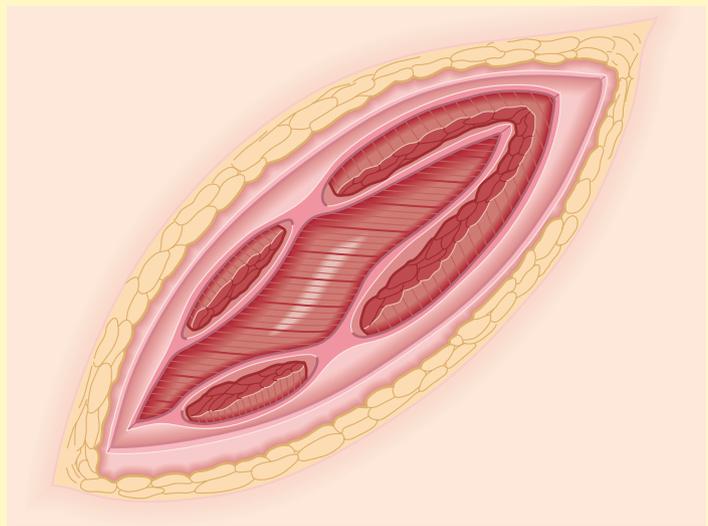**C** The index fingers of each hand enlarge the opening.

D The peritoneum is opened.
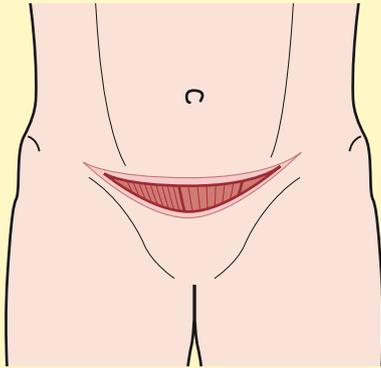
Figure 7

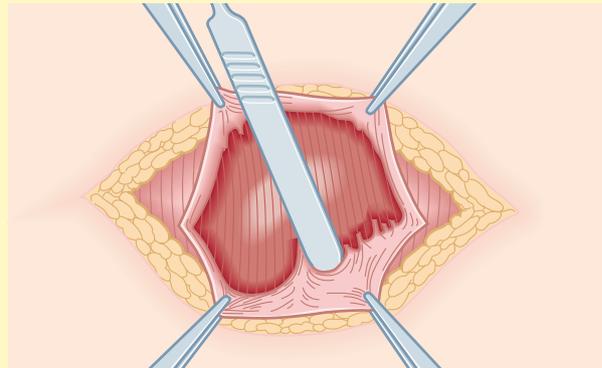## Kocher incision

A Surface markings.

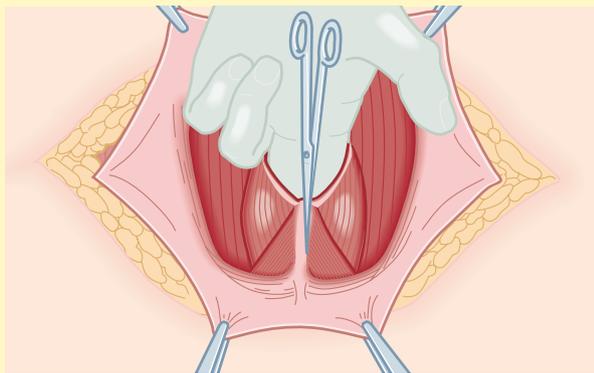**B** Division of the rectus sheath and the medial portions of the lateral muscles.

Figure 8

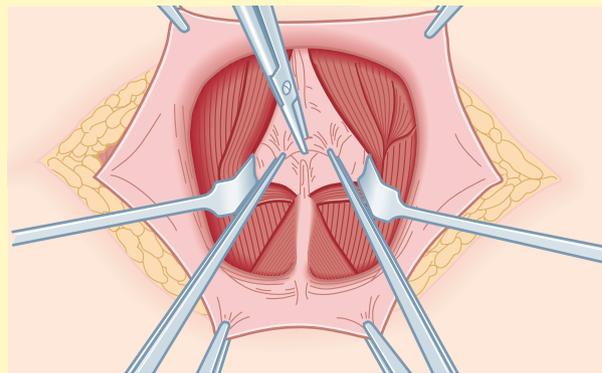## Pfannenstiel incision

A Initial incision.

B Transverse division of the anterior rectus sheath, which is then dissected free of the adherent muscle.

C The recti are retracted and the peritoneum opened, starting superiorly.

D The peritoneum is fully divided.

Figure 9

of the pelvic cavity is needed. The advantage is that it leaves an almost imperceptible scar because it lies in a skin crease and is obscured by pubic hair. ◆

REFERENCE

1 Ellis H, Coleridge-Smith PD, Joyce AD. Abdominal incisions—vertical or transverse? *Postgrad Med J* 1984; **60:** 407–10.