Surgical Anatomy of Hernial Rings

John E. Skandalakis, Stephen W. Gray, John T. Akin


"Where should I cut the ring of the incarcerated or strangulated hernia?"

A strangulated hernia at any site is a surgical emergency. Delay in treatment will usually result in gangrene and eventual perforation of the incarcerated viscus.

The surgeon must know the precise anatomy of the constricting ring in order to incise it without injury to nerves and vessels or to the incarcerated viscus, as well as to provide conditions favorable for subsequent repair. In some cases the required incision is obvious; in others, it is easily performed only if the anatomy is well understood; in a few, considerable skill as well as understanding may be necessary to avoid a surgical catastrophe. In no case should the incision be longer than necessary to release the herniated viscus. To "nick the neck" will usually be sufficient.

We have made no effort to add to the number of excellent books on hernias which describe in detail the anatomy, etiology, diagnosis, and repair of hernias. Here we are concerned only with reduction of those hernias, already incarcerated or strangulated, that require surgical release before repair can be attempted. The illustrations are diagrammatic and have been made to emphasize the structures forming the ring and any special hazards involved in cutting it. We hope to answer only the first question presented by these incarcerated hernias: "Where should I cut the ring?"

**Incarcerated Indirect Inguinal Hernia**

Incarceration may occur at either the external or the internal ring. In children, constriction is usually at the external ring.

The ring is a triangular opening of the aponeurosis of the external oblique muscle, the base being part of the pubic crest with the margins formed by the two crura. The superior crus is formed by the aponeurosis itself, and the inferior crus is formed by the inguinal ligament.

Enlargement of the ring is accomplished by incising the aponeurosis of the external oblique muscle upward and parallel to the fibers. The incision should be only long enough to permit reduction of the hernia.

The internal inguinal ring, a normal defect in the transversalis fascia, is V-shaped. The arms of the V, the anterior and posterior crura, are formed by special thickenings of the transversalis fascia, forming a sling. In making the incision, retract the internal oblique muscle medially. Continue the anterior incision of the sac upward, far enough to release the incarcerated viscus. Keep in mind the possibility of a sliding hernia when you attempt to open the sac.
Incarcerated Interparietal Hernias

The hernial sac enters the internal inguinal ring as in indirect inguinal hernia. The sac passes between any two layers of the abdominal wall (properitoneal, interstitial, or superficial hernia). The sac may be multilocular, often having an indirect hernial component which emerges through the external ring.

In some superficial hernias the sac may emerge from the external inguinal ring before entering the subdermal fascia between the external oblique muscle and the skin. The external inguinal ring may then be the site of constriction.

Incarcerated Femoral Hernia

The boundaries of the femoral ring are: anterior, the inguinal ligament; posterior, the pectinate ligament (of Cooper); medial, the lacunar ligament (of Gimbernat); lateral, the femoral vein.

The incision should divide the inguinal ligament anteriorly, or divide the lacunar ligament medially. The former incision is preferred since the lacunar ligament is only 0.5 to 1 cm in length and its division may not enlarge the ring sufficiently.

We prefer to divide the inguinal ligament because an aberrant obturator artery, arising from the inferior epigastric artery, may pass medial to the femoral ring in the edge of the lacunar ligament rather than lateral to the ring. Injury to this vessel will cause unnecessary complications.

If the approach is made from above the inguinal ligament, and thus through the floor of the inguinal canal, the aberrant obturator artery can be seen clearly so that the lacunar ligament can be cut with safety.

Incarcerated Obturator Hernia

The boundaries of the hernial ring are: superior and medial, the obturator groove of the superior ramus of the pubic bone; inferior, the pelvic fascia containing the edge of the obturator membrane, the internal and external obturator muscles; posterior and lateral, the obturator vessels and nerves. The vessels lie lateral to the sac in 50 per cent of patients and medial, anterior, or posterior in the remainder.

Since the relation of the sac to the vessels and nerves is variable, the incision should be made at the lower margin of the ring.

Incarcerated Sciatic Hernias

There are three sites through which sciatic hernia may occur: suprapyramidal, through the greater sciatic foramen; infrapyramidal, through the greater sciatic foramen; and subspinous, through the lesser sciatic foramen.
**Incarcerated Suprapyramidal Hernia.** The boundaries of the ring are: **superior,** the anterior sacroiliac ligament; **inferior,** the upper border of piriformis muscle; **lateral,** the ilium; **medial,** the upper part of sacrotuberous ligament and part of sacrum.

Transect the piriform muscle by a posterior and inferior incision, remembering that the following structures lie in, or pass through, the greater sciatic foramen which is the "Monemvassia," the only gate, of the gluteal area: piriformis muscle, superior gluteal nerve and vessels, inferior gluteal nerve and vessels, internal pudendal nerve and vessels, posterior femoral cutaneous nerve, nerves to internal obturator muscle, nerves to quadratus femoris muscle, and sciatic nerve.

**Incarcerated Infra pyramidal Hernia.** Its boundaries are: **superior,** the lower border of piriformis muscle; **inferior,** the sacrospinous ligament; **posterior,** the sacrotuberous ligament; **anterior,** the ilium. For the incision, transect the piriform muscle. Remember the proximity of the vessels and nerves passing through the greater sciatic foramen.

**Incarcerated Subspinous Hernia.** The ring is formed by the lesser sciatic foramen, the boundaries of which are: **anterior,** the ischial tuberosity; **superior,** the sacrospinous ligament and ischial spine; **posterior,** the sacrotuberous ligament. Decompression and reduction without incision is preferred. If reduction cannot be accomplished otherwise, incise the obturator internus muscle.

**Incarcerated Supravesical Hernias**

**External Supravesical Hernia.** Ring and incision as in inguinal hernia.

**Internal Supravesical Hernia.** There are several sites of herniation in the supravesical fossae. Through these, the hernial sac passes in front of, or to the side of the bladder. A single case of intravesical hernia is known. In retrovesical hernia, the sac passes behind the bladder.

Supravesical, prevesical, and paravesical hernial rings are similar. The boundaries may be described as follows: **superior,** the upward continuation of the vesical fascia and its fusion with the transversalis fascia and the peritoneum; **inferior,** fold of vesical fascia and peritoneum; **lateral,** the lateral umbilical ligament and peritoneum; **medial,** the medial umbilical ligament and peritoneum. Boundaries of the retrovesical hernia are: **superior** and **anterior,** the vesical fascia and peritoneum of the posterior bladder wall; **inferior** and **posterior,** the transverse vesical fold.

If enlargement of the ring is necessary, the posterior margins should be incised upward.

**Incarcerated Perineal Hernias**

A primary perineal hernia may occur anterior or posterior to the superficial transverse perineal muscle.
Anterior Perineal Hernia. The defect is located anterior to the superficial transverse perineal muscle through the urogenital diaphragm into a triangle formed by the bulbocavernous muscle medially, the ischiocavernous muscle laterally, and the transverse perineal muscle posteriorly. The sac passes between the ischiopubic bone and the vagina, producing a swelling in the posterior half of the labium majus.

An abdominal approach is advised, with division of the deep transverse perineal muscle, including both layers of the urogenital diaphragm if necessary.

Posterior Perineal Hernia. The defect is located posterior to the superficial transverse perineal muscle, through the levator ani muscle, or between the levator ani and the coccygeus muscles. Koontz states: "It usually emerges halfway between the rectum and the tuberosity of ischium." If the levator ani muscle is not attached to the obturator fascia, a gap, the hiatus of Schwalbe, is formed: "It is important because a process of pelvic peritoneum may be pushed through the hiatus into the suprategmental space, and in this way occurs a hernia into the ischiorectal fossa." Division of the levator ani muscle is sufficient to release the incarcerated viscus.

Incarcerated Lumbar Hernias

Hernia Through The Inferior Lumbar Triangle (Petit's Hernia). The boundaries of the inferior lumbar triangle are: anterior (abdominal), the posterior border of the external oblique muscle; posterior (lumbar), the anterior border of the latissimus dorsi muscle; base, the iliac crest.

The floor of the triangle is formed by the lumbodorsal fascia and the internal oblique muscle, with some participation of the transversus abdominis muscle. If the hernia is small, the ring is formed by fibers of the lumbodorsal fascia and the internal oblique muscles. If the hernia is large, the ring is formed by the boundaries of the inferior lumbar triangle. The ring may be enlarged by a medial or lateral incision of the lumbodorsal fascia.

Hernia Through The Superior Lumbar Triangle. The boundaries of the superior lumbar triangle are: anterior (abdominal), the posterior border of the internal oblique muscle; posterior (lumbar), the anterior border of the sacrospinalis muscle; base (costal), the serratus posterior inferior muscle and the 12th rib.

The floor of the triangle is formed by the transversus abdominis aponeurosis through which herniation may occur. Thus, if the hernia is small, the ring is formed by the aponeurosis only; if the hernia is large, the ring is formed by the boundaries of the superior lumbar triangle. The ring may be enlarged by a medial or lateral incision (or both) midway between the 12th rib and the iliac crest.
Incarcerated Umbilical Hernia

Herniation at the umbilicus is of four types:

1. Hernia of the intestines into the cord during development of the fetus. This normal herniation spontaneously reduces before birth. If reduction fails to take place, an omphalocele results.

2. Intussusception of the intestines through a congenital, abnormally patent vitelline duct.

3. Infantile umbilical hernia. Bulging of the abdomen between the recti at the umbilicus is not uncommon in infants. Incarceration is rare and the defect usually repairs itself without requiring surgery.

4. Acquired umbilical hernia in adults. It is this type with which we are concerned.

The ring is formed by the fusion of all abdominal layers of the defect. Herniation is through the linea alba, usually at the upper margin of the ring so that the sac protrudes above or to one side of the umbilicus (paraumbilical).

The incision should be circular or elliptical, around, never over, the hernial sac. The ring should be incised laterally and the incision extended into the aponeurosis of the rectus abdominis with retraction of the muscle if necessary.

Incarcerated Epigastric Hernia

This is also known as hernia of the linea alba or ventral hernia. The ring is composed entirely of fibers of the linea alba. It may lie anywhere between the xiphoid process and the umbilicus. The ring can be enlarged by incising the linea alba upward or downward, sufficiently to release the incarcerated tissue or viscus.

Incarcerated Lateral Ventral Hernia (Spigelian Hernia)

Spigelian hernia occurs along the linea semilunaris of Spieghel. There has been confusion in the literature of the linea semilunaris and the linea semicircularis (semilunar fold of Douglas). Hollinshead writes: "Lateral ventral hernias are called Spigelian hernias because they are said to occur along Spieghel's (Spigelius) line, which is generally regarded as synonymous with the semilunar line." We agree with Hollinshead and believe that the confusion arose because most Spigelian hernias occur on the linea semilunaris where it intersects the linea semicircularis.

The linea semilunaris is usually taken as the lateral border of the rectus sheath, although Spieghel intended it to be the line of transition between the muscular fibers and the aponeurosis of the transversus abdominis muscle. These two lines define a "semilunar zone" from 0.3 to 3.7 cm wide, within which a Spigelian hernia may take place, anywhere from above the level of the umbilicus to the symphysis pubis.
If the hernia lies at the intersection of the linea semilunaris (Spieghel) and the linea semicircularis (Douglas), the ring is formed by the aponeurosis of the internal oblique muscle and the aponeurosis of the transversus abdominis muscle. If the hernia is above the linea semicircularis, but below the umbilicus, the ring is almost the same. If the hernia is above the level of the umbilicus, the defect is formed by a tear in the transversus abdominis muscle and a defect of the aponeurosis of the internal oblique muscle. The neck of the hernia may be tough and rigid; the sac may be covered by properitoneal fat.

A transverse incision should be made just above the swelling, keeping in mind that the sac is under the aponeurosis of the external oblique muscle which should be carefully incised. An oblique incision of the aponeurosis following the direction of the fibers will be anatomically most sound. The procedures for umbilical herniorrhaphy should be followed.

**Incarcerated Gastrochisis**

This is a congenital defect of the body wall always to the right or left of the midline, the ring being formed by all layers of the abdominal wall. The defect occasionally needs to be enlarged by incising the lower edge of the ring if the opening is too small to permit reduction of the herniated intestinal loops. The capacity of the abdominal cavity rather than the diameter of a constricting ring, is the usual problem.

**Incarcerated Paraduodenal Hernias**

**Incarcerated Right Paraduodenal Hernia.** The mouth of the sac lies behind the superior mesenteric artery or the ileocolic artery at the base of the mesentery of the small intestine (mesentericoparietal fossa of Waldeyer). The mouth opens to the left. The sac is directed to the right and usually lies in the retroperitoneal space behind the right mesocolon or transverse mesocolon. The boundaries are: superior, the duodenum; anterior, the superior mesenteric artery or ileocolic artery; posterior, the lumbar vertebrae.

To avoid vascular injury the incision must be in the lower part of the mouth. If vascular damage appears inevitable, the surgeon should open the mesentery and decompress the proximal intestinal loop before attempting reduction.

**Incarcerated Left Paraduodenal Hernia.** The mouth of the sac usually lies behind the inferior mesenteric vein and the left colic artery, at the left of the 4th part of the duodenum, at the duodenojejunal flexure. The mouth opens to the right. The sac is directed to the left and usually lies in the retroperitoneal space behind the left mesocolon. The boundaries are: superior, the duodenojejunal flexure or the beginning of the jejunum, pancreas and renal vessels; anterior, the inferior mesenteric vein and left colic artery; right, the aorta; left, the left kidney.

The incision should be made in the lower part of the mouth. McNair advises division of the inferior mesenteric vein. A downward incision of the mouth will avoid this sacrifice.
**Incarcerated Transomental Hernia**

The ring is formed entirely by omentum. A vessel will usually lie in one edge of the defect. Incise the omentum after clamping.

**Incarcerated Transmesenteric Hernias**

The mesenteric defect may be located in: (a) the mesentery of the small intestine, (b) the transverse mesocolon, (c) the sigmoid mesocolon. At least one free edge of the ring is usually formed by a branch of the superior mesenteric or inferior mesenteric artery. Since there is no sac and the obstructed loop is visible, decompress the dilated loop only and do not incise the neck. Vascular injury ad portas must be avoided.

**Incarcerated Hernia Through The Epiploic Foramen Of Winslow**

The boundaries of the foramen are: superior, the caudate process of the liver and the inferior layer of the coronary ligament; anterior, the hepatoduodenal ligament containing the portal vein, the hepatic artery, and the common bile duct; the cystic duct is also present in the free edge of the lesser omentum; posterior, the inferior vena cava; inferior, the first part of the duodenum and the transverse part of the hepatic artery.

For the incision open the hepatogastric omentum after clamping, and decompress the proximal intestinal loop. Do not incise the neck; the authors do not advise ligation of the hepatic artery. (Remember that there is no excuse for dividing the neck of the sac.)

**Incarcerated Retroanastomotic Hernias**

Markowitz is the authority on these iatrogenic hernias: "Construction of each gastrojejunostomy, either as a procedure by itself or as a step in the performance of a partial gastrectomy, results in the formation of an internal hernia ring which may be the cause of severe difficulties in the immediate or distant postoperative period."

**Hernia Following Retrocolic Gastrojejunostomy.** The boundaries of the ring are: anterior, the gastrojejunostomy and the efferent or afferent jejunal loop, depending on whether the afferent loop is attached to the lesser or the greater curvature of the stomach; posterior, the posterior parietal peritoneum; superior, the transverse mesocolon and posterior wall of the gastric remnant; inferior, the ligament of Treitz and the duodenojejunal peritoneal fold.

No incision should be made. An enterostomy should be performed to facilitate reduction of the loop. Recurrence is prevented by closure of the ring.

**Hernia Following Antecolic Gastrojejunostomy.** With the afferent loop attached to the greater curvature of the stomach, the boundaries of the ring are: anterior, the gastrojejunostomy and the afferent jejunal loop; posterior, the omentum and mesocolon; superior, the transverse colon and mesocolon; inferior, the ligament of Treitz and the duodenojejunal peritoneal fold.
With the afferent loop attached to the lesser curvature of the stomach, the boundaries of the ring are: anterior, the afferent jejunal loop with its mesentery; posterior, the omentum, transverse colon, and mesocolon; superior, the gastrojejunostomy, ligament of Treitz, and the duodenojejunal peritoneal fold; inferior, the jejunum with its mesentery. No incision of the ring is required.

**Incarcerated Diaphragmatic Hernias**

**Incarcerated Posterolateral Hernia (Hernia Through the Foramen of Bochdalek).** This hernia may be congenital or traumatic and is more common on the left side. The congenital defect, and hence the ring, is located in the posterior portion of the diaphragm, usually where it is attached to the 10th and 11th ribs. In 90 per cent of cases there is no hernial sac.

The choice of approach to the diaphragm in any particular case is beyond the scope of this chapter. The surgeon should always be prepared to perform a thoracoabdominal incision should an abdominal approach prove inadequate.

The diaphragm should be incised laterally from the margin of the ring toward the periphery. The surgeon should be familiar with Merendino's description of incisions that will avoid severing branches of the phrenic nerve. Bear in mind that if a sac is present, it should be excised.

**Incarcerated Anterior Hernia of the Diaphragm (Parasternal Hernia, Hernia Through the Foramen of Morgagni).** The diaphragm attaches to the xiphoid process by two narrow slips on either side of the midline and to the seventh costal cartilage just lateral to the xiphoid process. This attachment leaves three gaps, one medial and two lateral. The superior epigastric vessels pass through the lateral gaps, anterior to the diaphragm, together with some lymphatic channels. The gaps themselves are the sternocostal triangles, the foramina of Morgagni, or the spaces of Larrey. The hernial ring is thus formed anteriorly by the costal cartilage and the xiphoid process, and laterally, posteriorly, and perhaps medially by the diaphragm. There may or may not be a peritoneal sac. The right lateral foramen is the usual site of herniation.

According to Nakayama and Yanagisawa, the approach should be abdominal in the newborn and in children. A thoracoabdominal approach is preferred in adults. The diaphragm should be incised laterally along the costal margin only far enough to release the incarcerated loop.

**Incarcerated Hiatal Hernia.** In about 50 per cent of patients, the esophageal hiatus is formed by the right and left limbs of the right crus of the diaphragm. In the remainder of patients, both the right and left crura participate in the formation of the hiatus.

In the patient with hiatal hernia, the fibrous attachments of the esophagus to the diaphragmatic ring are altered, and the relations in the newborn and in the adult differ. The details of these differences are highly controversial and are beyond the scope of this paper.
The ring must be considered to be muscular, although two inconstant ligaments should be mentioned: *anterior*, the transverse ligament of the central tendon, which is the point of union of the two limbs of the right crus; *posterior*, the median arcuate ligament joining the crura just above the celiac axis.

The left lateral incision must be toward the central tendon to avoid injury to the phrenic nerve. Remember that the left phrenic nerve supplies the left half of the right crus as well as the left leaf and left crus of the diaphragm, and that a hernial sac is always present.

**Incarcerated Aortohiatal Hernia.** In many patients the median arcuate ligament which forms the posterior boundary of the hiatal hernia ring is absent. As the transverse ligament of the central tendon of the diaphragm is strong, enlargement of the hiatus can take place only posteriorly, occasionally reaching the aortic hiatus. In such cases the aorta becomes the posterior boundary of the ring.

Incision should be made as in hiatal hernia.

**Summary**

An incarcerated hernia must be reduced before any attempt at repair can be made. We have described the surgical anatomy of the ring in most of the hernias of the abdomen, both internal and external. In addition we have described the incision or other procedure required for safe reduction of the hernia. We believe that this information about "where to cut," none of it new, has not been previously assembled.