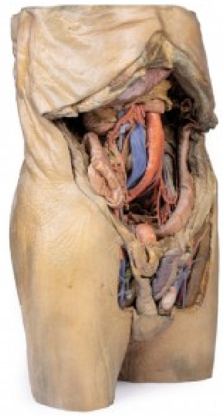
Abdomen with Bilateral Hernias

Price inquiry: +48 605999769, kontakt@openmedis.pl

Product code: AM02706



This 3D model represents one of the largest and most complex in the series, consisting of a partial torso from the diaphragm to the proximal thigh with a complete abdominal cavity preserving varying levels of dissection. This 3D model also records the rare, simultaneous occurrence of indirect and direct inguinal hernias allowing for a consideration of the anatomical underpinnings for both conditions. Given the scale of the dissection this 3D model description is divided into discrete parts based on views and regions.

The diaphragm: On the superior aspect of the model the diaphragm is preserved, and while slightly distorted due to removal of the thoracic ribs through dissection, both domes and costodiaphragmatic recesses can be appreciated. The fibrous pericardium is present on the superior surface of the central tendon, with the terminal part of the inferior vena cava visible in the caval foramen. Just lateral to caval foramen is the oesophagus within the oesophageal hiatus, and then the descending thoracic aorta approaching the aortic hiatus just ventral to the thoracic vertebrae.

The epigastric and hypochondriac regions: Within the abdomen, the anterior abdominal wall, greater omentum, and much of the gastrointestinal tract has been removed alongside the parietal peritoneum over the posterior abdominal wall to expose retroperitoneal organs and structures. In the superior abdomen, the terminal portion of the oesophagus has been retained and can be seen entering the cavity just lateral to the left lobe of the liver. The removal of the stomach has exposed the extent of the pancreas from the head (positioned within the arc of the duodenum) to the tail extending to the capsule of the spleen preserved in the left hypochondrium. Superior to the pancreas, the splenic artery and common hepatic arteries can just be observed spanning across the narrow space between the pancreas, diaphragm and liver. The splenic follows its archetypical ‘tortuous route’ towards the spleen, and strongly divides prior to reaching the hilum (and adjacent to the splenic vein). The common hepatic can be seen dividing into the gastroduodenal (visible again as a cut vessel just inferior to the duodenum) and giving off the right gastric artery; these vessels lie superficial relative to the hepatic portal vein. The superior mesenteric artery and vein can be seen passing anteriorly near the head of the pancreas and horizontal part of the duodenum, and the retained ileocolic artery can be traced to the caecum of the large intestine in the lower right quadrant of the abdomen. The inferior mesenteric vein can be, in part, appreciated arising from the retained superior rectal vein ascending from the undissected true pelvis and spanning across the superficial aspect of the descending thoracic aorta.

Inferior to the liver the gallbladder can be viewed just between the right and left anatomical lobes. On the left, the passage of the renal artery and vein can be seen just deep to the pancreas, and the ureters can be observed descending from the partially exposed kidney across the superficial surface of the exposed psoas major and minor muscles.

The umbilical and lumbar regions: Most of the organs occupying the umbilical and lumbar regions of the abdomen have been removed in order to expose structures in the posterior abdominal wall. In the midline, the descending abdominal aorta and inferior vena cava dominate the region, with the testicular arteries and veins isolated and traceable towards the inguinal regions. Two right lumbar arteries are visible arising from the aorta, and despite removal of the mesenteries and most of the colon the inferior mesenteric artery can be seen giving rise to the left colic, sigmoid and superior rectal arteries. On the right side of the specimen inferior to the kidney, the subcostal, iliohypogastric and ilioingual nerves are exposed alongside the circumflex iliac artery

The hypogastrium and iliac regions: In the midline, the bifurcation of the descending abdominal aorta into the common iliacs (and subsequent division into the internal and external iliacs) can be observed deep to some of the overlying structures (e.g., testicular vessels, ureters) noted previously. On the right side, the obturator artery can be seen traversing from its origin towards the anterior aspect of the pelvis. The mirrored merging of external, internal and common iliac veins into the inferior vena cava is also preserved. Within the confines of the true pelvis the peritoneum has been retained over the region, covering the urinary bladder adjacent to the pubic symphysis and obscuring the rectum as it descends from the sigmoid colon. In the right iliac region the very terminal part of the ileum and caecum with appendix fill the iliac fossa, with the appendix (and appendicular artery) visible just superficial to the testicular artery, vein and genital branch of the genitofemoral nerve descending towards the inguinal canal. In the left region, the sigmoid colon descends across the iliac fossa. As it approaches the anterior abdominal wall, an epiploic appendage contribution to the indirect hernia can be observed just lateral to the retained inferior epigastric artery.

The inguinal region and perineum: A distinctive and unique feature of this model is the dissection of simultaneous direct and indirect hernias preserved on the right and left sides, respectively. While most of the anterior abdominal wall has bee removed, the inferior epigastric arteries (and accompanying veins) have been retained to allow for interpretation of the herniations. On the right side, a distinct outpouching of the parietal peritoneum has formed medial relative to the inferior epigastric artery, representing an indirect herniation event. On the left side, the hernia sac extends laterally relative to the inferior epigastric artery and into the opened spermatic cord, with continuity of the epiploic appendage from the sigmoid colon into the sac.

The skin over the perineum has been removed in order to demonstrate both the structure of the penis (with both the corpus spongiosum and corpora cavernosa contrasted) and the position of the testes and spermatic cords relative to the anterior abdominal wall. On the right side, which in this individual is impacted by a direct hernia, the spermatic cord has been left undissected allowing for an appreciation of the external spermatic fascia from the inguinal region through to the testis. On the left side, the spermatic cord has been opened and is dominated by the enlarged and varicose testicular vein (reflecting the impact of the indirect hernia exposed within the cord) just superior to the epididymis and exposed tunica albuginea of the testis.

The thigh: Anterior dissections into the femoral triangle region have been undertaken to both thighs with varying preservation of contents. On the right side the femoral sheath has been removed to expose the femoral artery, vein and the deep inguinal lymph nodes. The femoral artery has been sectioned with a portion removed to expose the origin of the profunda femoris and to better appreciate the draining of the great saphenous vein into the femoral vein. Just lateral to these structures the very terminal component of the femoral nerve is visible. On the left side a slightly larger dissection window has been opened to expose more of the underlying anterior and medial thigh compartment muscles, from the sartorius and iliopsoas laterally to the pectineus and adductor longus medially. The femoral artery has been preserved, with a wellpreserved superficial circumflex iliac artery and the origin of the profunda femoris visible adjacent to the femoral nerve.

The model terminates at the level of the mid-thigh, and while not a primary focus of the model the spatial organisation of structures in the cross-section can be seen. This includes the anteriorly positioned femoral diaphysis with tightly-packed anterior compartment muscles and the passage of the femoral artery and vein in the subsartorial canal.

Abdomen with Inguinal Hernia

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Diaphragm and Xyphoid Process: The diaphragm has been secured to the superior border of the dissected specimen with sutures to ensure an unobstructed view of the abdomen. The xyphoid process is in the middle of this sutured border.

Liver and Gallbladder: The liver in the right hypochondrium has been pushed laterally to reveal the kidney posterior to it. The falciform ligament divides the right and left anatomical lobes of the liver and enveloping ligamentum teres, which is a remnant of the umbilical vein which is present during foetal development. Below ligamentum teres at the inferior border of the liver in this model, the gall bladder is sandwiched between the anatomical lobes of the liver.

Stomach and Splenic Vasculature: The deflated stomach has been deflected superiorly to reveal the splenic artery and vein. The tortuous course of the splenic artery and vein can be observed as it approaches the spleen, giving off numerous branches which enter the hilum of the spleen.

Spleen and Pancreas: The spleen is in the left hypochondrium of the specimen. Its gastric impression indicates where the greater curvature of the stomach would normally sit. Toward the inferior pole of the spleen, the tail of the pancreas is fused to the hilum of the spleen. Unlike the remainder of the organ, the tail of the pancreas is intraperitoneal.

Kidneys: The kidneys are primarily retroperitoneal, however in this specimen the peritoneum that usually covers these organs has been removed. Normally, the right kidney is displaced inferiorly by the liver relative to the than the left kidney. However, in this specimen the right kidney is both higher and smaller than the left. The left kidney is abnormally large and is supplied by two accessory renal arteries which arise directly from the abdominal aorta. These connect just superior to the hilum and also to the inferior pole of the kidney.

Adrenal Glands: The left adrenal gland is detached from its usual position on the superior pole of the kidney. The middle adrenal artery originates directly from the aorta, left of the coeliac trunk, whilst the inferior adrenal artery is derived from the left renal artery: both supply the adrenal gland. The superior adrenal artery has been obscured by connective tissue.

Rectum and Bladder: Although the majority of the peritoneum in the abdomen has been removed below the level of the sacral prominence (S1), a layer of peritoneum remains intact, which overlays the rectum and bladder. Notably this the first part of the rectum, which is intraperitoneal.

Gastrointestinal Tract: The final part of the ascending duodenum and the descending colon at the left colic flexure has been ligated with twine, with the intestine in between being removed in order to provide a better view of the abdomen.

Pelvic Region: In this specimen the sigmoid colon has indirectly herniated through the inguinal canal. On the right, the vas deferens emerges from the superficial inguinal ring and coursing towards the right of the scrotum to eventually attach to the right testicle. The remainder of the contents of the right spermatic cord have been removed from this specimen. The sutures observed inferior to the vas deferens are remnants from the embalming process. These indicate that the right femoral artery was used as the point of entry

Abdominal Vasculature: The coeliac trunk can be seen just inferior to the reflected stomach. Typically, the coeliac trunk has three main branches; left gastric, splenic and common hepatic, to supply the foregut. However, in this 3D model, the coeliac trunk gives off both right and left gastric branches, the splenic artery and a gastroduodenal branch that splits to become two superior pancreaticoduodenal arteries. The proper hepatic artery emerges directly from the abdominal aorta, independent of the aforementioned branches, and gives rise to the right inferior phrenic artery. The iliolumbar artery can be seen emerging deep to the right psoas, anastomosing with branches of the right deep circumflex iliac artery which courses along the iliac crest.

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Spleen and Pancreas

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This 3D model preserves the deep foregut organs: the descending, horizontal and ascending duodenum, the pancreas, and the spleen. A small window in the duodenum has been opened to allow for a view of the plicae circularis within this proximal part of the small intestine (and contrasts the strong rugae development seen in the stomach; see AW 42). The head of the pancreas is preserved in its normal position within the curvature of the duodenum, and a distinct uncus can be observed at the distal margin and adjacent to the exiting of the superior mesenteric artery (already divided into its numerous named branches). Along the superior margin of the body of the pancreas, the celiac trunk has been sectioned from the descending abdominal aorta. The complete splenic artery can be observed on its tortuous route from origin to the spleen, as well as the bases of the left gastric artery and common hepatic artery. Immediately adjacent to the celiac trunk is a small part of the splenic vein, which emerges from within the capsule of the pancreas, and is in part visible in along its route near the splenic artery. A small portion of the superior mesenteric vein adheres to the posterior aspect of the pancreas, representing the course of the vessel before it would normally join the splenic and form the hepatic portal vein. The tail of the pancreas is invested in the capsule of the spleen, and obscures any branching of the splenic artery prior to entering the organ (as seen on our other spleen models in A8 and AW 34, which provides further information on the anatomy and spatial associations of this organ).

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Abdomen Vasculature

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Coeliac Trunk: Supplying the embryological foregut, the celiac trunk arises from T12 spinal level. Branches that can be observed in this specimen include the Left gastric artery arising from the left portion of the celiac trunk; remains of the splenic artery arising from the celiac trunk and visible passing to the left hypochondrium; the Common hepatic artery, located to the right of the celiac trunk and giving off key branches; the Gastroduodenal artery, branching inferior to into the right gastric artery, and provide an anastomosis to the superior mesentery artery via the superior pancreaticoduodenal and the Proper hepatic artery, beginning after the gastroduodenal artery, branching to form the Left hepatic artery, the first branch of the proper hepatic artery, Right hepatic artery, located inferiorly, eventually giving rise to the Cystic artery, connecting to the gallbladder.

Superior Mesenteric Artery and Inferior Mesenteric Artery: Supplying the midgut and hindgut respectively, the superior mesenteric and inferior mesenteric artery arise at the L1 and L3 vertebral levels, respectively. While both have key branches, this specimen does not preserve them in their entirety. The Superior mesenteric artery can be seen in the model exiting below the pancreas, dividing out into many branches and the Inferior mesenteric artery can be observed descending on the left of the abdominal aorta. The left colic artery, moving laterally, can be seen leaving the IMA to give rise to the marginal arteries that supply to the colon.

Venous System of the Abdomen: The superior mesenteric vein can be seen posterior to the superior mesenteric artery, notably less tubular than its arterial counterpart. In the specimen, the left anatomical lobe of the liver has been removed, exposing portal vein branches.These will supply nutrients from the gastrointestinal system to the hepatocytes which will then connect back to the venous system through the hepatic veins. This will then meet the Inferior Vena Cava.

Hilum of the Kidney: The right kidney shows typical anatomy, as opposed to the left kidney which shows anatomical variation. Seen at the right kidney are the Right renal vein, most superior, merging directly into the IVC, the Right renal artery, most inferior, passing deep to the IVC from its origin from the abdominal aorta and the Right ureter, coursing superficial to the right renal artery to eventually travel inferiorly. The left kidney presents unique variation at the hilum with key structures as follows. The Left renal vein, most inferior (as opposed to the usual superior) and is highly subdivided. The Left renal artery, most superior (as opposed to the usual inferior) and the Left ureter, can be seen descending from the hilum and medial to the kidney.

Muscles, Nerves and Other Vasculature: The psoas major and iliacus muscle can be seen on both sides of the specimen and surrounding them, key branches of the lumbar plexus can be seen, particularly on the left side. The Iliohypogastric nerve, continuing laterally as the most superior of the nerves present and the Ilioinguinal nerve, inferior to the iliohypogastric, directed towards the inguinal canal. The Femoral nerve, originating deep to and entering view lateral to psoas major and the Genitofemoral nerve, coursing superficial to psoas major, dividing into the genital and femoral branches of innervation. Medial to the psoas major, the left testicular artery and left testicular vein can be seen (as this is a male specimen). While the artery will receive blood directly from the aorta, the left testicular vein will drain to the left renal vein. The right sided testicular vasculature can also be observed however the right testicular vein drains directly into the IVC. The branch of the iliolumbar artery that anastomoses with the iliac circumflex artery can be observed passing under the testicular artery and vein and under the ureter.

Gallbladder: Just inferior to the liver, the gallbladder can be observed with the cystic artery moving inferiorly to meet it. The cystic duct can also be seen moving from the gallbladder, meeting the common hepatic duct moving from the liver to form the common bile duct.

Liver with Vessels and Gall Bladder

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Product code: AM02726




The size and shape of this specimen varies somewhat from a typical liver. It is less wedge-shaped and longer in the superoinferior dimension (on the posterior view this would translate to a greater vertical height). Normally, a liver is less than 16cm in the midclavicular line.1 This specimen measures approximately 18cm in the midclavicular line, suggesting some degree of hepatomegaly. However, it is worth mentioning that some measurement distortion may have occurred based on the fixing and curation of the specimen – and it must be noted that the accuracy of estimating liver size using a single parameter is limited. Liver measurements diagnostic of hepatomegaly vary depending on normal anatomical variation in liver size and morphology, the method of measurement, and patient features such as sex and BMI.

An alternative explanation could be normal anatomical variation. However, this specimen does not fit the description of the most common anatomical variations confused with hepatomegaly – Riedel’s lobe (a downward projection of the right lobe), ‘beaver tail’ liver (an elongated left lobe), or a papillary process projecting from the caudate lobe.

Internal Abdominal wall

Internal Abdominal wall

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Product code: AM02727




This 3D model captures the internal surface of the anterior abdominal wall, a region oftentimes removed or damaged during dissection (and complimenting our A8 abdominal specimen where the anterior wall has been removed). The parietal peritoneum has been removed from the internal surface of the specimen in order to more clearly demonstrate the relationships of the anterior abdominal muscle fibres and connective tissue structures as they converge on the midline. On the margins of the specimen, particularly superiorly, the horizontally-oriented transversus abdominus muscle fibres can be seen converging towards their aponeurosis (tendon sheet). In the inferior 1/3 of the model, we can see the termination of the posterior aspect of the aponeurosis forming the arcuate line. This marks the location where the aponeurosis changes its orientation relative to the rectus abdominus muscle (visible on either side of the midline); above the arcuate line the aponeurosis of the transversus abdominus muscle is evenly divided around the rectus abdominus muscle, while below the arcuate line all aponeurotic fibres pass anterior relative to the rectus abdominus. At this point, we can observe the inferior epigastric arteries (and accompanying veins) passing superiorly from their origins from the external iliac arteries and veins to pass into the anterior abdominal wall tissues. On the right side of the model we can appreciate how the orientation of the inferior epigastric artery relative to the fibres of the rectus abdominus muscle define the apex of the inguinal (Hesselbach’s) triangle (missing only the base formed by the inguinal ligament, not present in this specimen). This region lateral to the inferior epigastric artery is a frequent site of direct hernias (which can be appreciated on the A8 abdomen model) given the relative weakness of the wall inferior to the arcuate line and lateral to the margin of the rectus abdominus muscle. In the midline, and dividing the two halves of the rectus abdominus muscle, is part of the median abdominal ligament – a draped fold of the parietal peritoneum that covers the urachus, a fibrous embryological remnant of the allantois, which extends from the bladder into the umbilical cord.

Stomach

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Product code: AM02724

   

This 3D model is an isolated stomach with two dissection windows to expose the rugae and pylorus. A small portion of the terminal oesophagus is preserved at the cardiac region, and a small portion of the proximal duodenum beyond the pyloric sphincter. The large window within the body of the stomach allows for a clear view into the fundus and the welldeveloped rugae on the posterior aspect of the wall of the organ. The smaller window, opened just at the pyloric region, allows for an appreciation of the thickening of the organ wall at the pyloric sphincter just proximal to the start of the duodenum.

Bowel - Portion of Ileum

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Product code: AM01250

   

This 3D printed specimen demonstrates a small loop of ileum and mesentery. A window into the mesentery has been dissected (removing fat and visceral peritoneum) to show arterial arcades in the mesentery (many short vasa rectae and more numerous arcades than in jejenum). There are several large lymph nodes surrounding the larger vessels near the root of the mesentery. A distinct feature of the fat in the mesentery extending up to (and indeed, beyond) the mesenteric border of the bowel. A small portion of the lumen has been opened to reveal the nature of the mucosal folding (fewer but larger folds than jejenum).

Vasculature of the Spleen

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Product code: AM02722




At the splenic hilum, the splenic artery and vein can be seen entering the spleen to supply and drain the organ. The opening of the splenic vein has been kept patent by the insertion of silicon tubing in the model. This model shows the most superior branch of the splenic vein has been sectioned from its normal passage into the spleen. The “tortuous” of twisted shape of the splenic artery can be appreciated as it branches at the hilum. This reflects the overall curled and twisted shape of the vessel across its course from the coeliac trunk to the spleen.

The splenic artery and vein give rise to short gastric vasculature as well as the left gastro-omental vasculature. In this specimen, the splenic artery and vein have been cut after these vessels have branched, and thus they cannot be seen in the model.

The splenorenal ligament connects the spleen to the left kidney and contains the splenic artery, splenic vein and tail of the pancreas. It is formed by the overlaying of peritoneum that was originally part of the dorsal mesentery during embryological development over this vascula-ture. The splenorenal ligament is not observable on the model as the peritoneum has been removed in order to expose the splenic vasculature.

The gastrosplenic ligament connects the stomach to the spleen and contain the short gastric arteries and part of the left gastro-omental artery at its origin as it branches off the splenic artery. Like the splenorenal, the gastrosplenic ligament is formed by the overlaying of peritoneum that was originally part of the dorsal mesentery during embryological development. The gastrosplenic ligament is not present as the splenic artery has been dissected after its formation.

The outside of the spleen consists of a thin fibrous capsule. Due to its delicate nature and the large quantity of blood usually contained in the spleen, the fibrous capsule is vulnerable to rupture.

Bowel - Portion of Jejunum

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Product code: AM01245

   

This 3D printed specimen presents a small loop of jejenum and mesentery. A window into the mesentery, fat and visceral peritoneum has been removed to illustrate the arterial arcades in the mesentery (many long straight vasa rectae and fewer vascular arcades than in ileum). Also note the presence of lymph nodes (grey-light green) which are a prominent feature of the mesentery, especially near its root close to larger vessels. Classically the fat in the mesentery in the jejenum does not extend to the mesenteric border of the jejenum and would normally allow the observer to view the long straight vessels (vasa recti). However in this example from an individual with a reasonably large amount of abdominal fat, this ‘window’ is not apparent as fat extends further towards the mesenteric border of the jejenum. A small segment of the lumen of the jejenum has been opened to reveal the nature of the mucosal folding (more folds and smaller folds than the ileum).

Bowel - Portion of Jejunum

Price inquiry: +48 605999769, kontakt@openmedis.pl

Product code: MA01103

This 3D printed specimen presents a small loop of jejenum and mesentery. A window into the mesentery, fat and visceral peritoneum has been removed to illustrate the arterial arcades in the mesentery (many long straight vasa rectae and fewer vascular arcades than in ileum). Also note the presence of lymph nodes (grey-light green) which are a prominent feature of the mesentery, especially near its root close to larger vessels. Classically the fat in the mesentery in the jejenum does not extend to the mesenteric border of the jejenum and would normally allow the observer to view the long straight vessels (vasa recti). However in this example from an individual with a reasonably large amount of abdominal fat, this 'window' is not apparent as fat extends further towards the mesenteric border of the jejenum. A small segment of the lumen of the jejenum has been opened to reveal the nature of the mucosal folding (more folds and smaller folds than the ileum).