Lumbar hernias of the posterolateral abdominal wall: anatomical and pathologic findings at 64-slice multidetector CT

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Learning objectives

1- To review the normal anatomy of the posterolateral abdominal wall.

2- To illustrate and discuss the 64-slice multidetector CT appearance of lumbar hernias of the posterolateral abdominal wall, and their classification according to location, contents and etiology.
Background

Normal anatomy and MDCT appearance of the lumbar region

Hernias of the lumbar region tend to occur in areas of relative weakness of the posterolateral abdominal wall. At the lumbar region, these predisposed areas have been termed the superior (Grynfeltt-Lesshaft) and inferior (Petit’s) lumbar triangles (Fig. 1 on page 8).

The lumbar region

The lumbar region, located at the posterolateral abdominal wall, is superiorly limited by the 12th rib, inferiorly by the iliac crest, medially by the erector spinae muscles, and laterally by the external oblique muscle (Fig. 2 on page 8). At the lumbar region, the abdominal wall consists, form superficial to deep, of skin, subcutaneous fat, superficial subcutaneous fascia (two fibrous layers with intermediate fat), thoracolumbar fascia, superficial muscle layer (latissimus dorsi and external oblique muscles), medial muscle layer (erector spinae muscles, internal oblique muscle and serratus posterior inferior muscle), deep muscle layer (quadratus lumborum muscle, psoas muscle and transverse abdominis muscle), transversalis fascia, properitoneal fat and peritoneum (Fig. 3 on page 9). Thoracolumbar fascia has three layers: anterior (deep to quadratus lumbar muscle), middle (between quadratus lumbar and erector spinae muscles) and posterior (superficial to erector spinae muscle). The three layers fuse lateral to these muscles and continue with transversus abdominis and internal oblique muscles.

b) The superior lumbar triangle

The superior lumbar triangle usually adopts the configuration of an inverted triangle. It is superiorly bound by the 12th rib and the serratus posterior inferior muscle; posteromedially by de erector spinae muscles and quadratus lumborum muscle; and anterolaterally by the internal oblique muscle (Fig. 4 on page 10). The floor is formed by the transversalis fascia. The roof is formed by the latissimus dorsi muscle. (Fig. 5 on page 11, Fig. 6 on page 12, Fig. 7 on page 13). Although usually described as an inverted triangle, the superior triangle may be quadrilateral as well. In the triangular configuration, the serratus posterior inferior muscle does not contribute to delimitate the space, while it does in the quadrilateral configuration.

The relative weakness of the superior lumbar triangle is influenced by a number of anatomical details. Just below the rib, the fascia transversalis is not covered by the
Anatomical variations at the boundaries of the superior triangle influence its size and configuration, and indirectly, determine the predisposition for lumbar hernia. The length and angulation of the 12th ribs influences the shape and size of the superior triangle. In a tall, thin person, angulated final ribs lead to narrower and smaller superior lumbar triangles (Fig. 9 on page 15). In patients with rudimentary 12th ribs, the upper limit of the superior lumbar triangle is formed by the 11th ribs (Fig. 10 on page 16). The size and form of the quadratus lumborum and serratus posterior inferior muscle are also determinant. The union of the posterior fibers of the latissimus dorsi and external oblique muscles, the variable insertion of the latissimus dorsi and external oblique on the last ribs, and the muscular or aponeurotic nature of the insertion of the internal oblique muscle at the 12th rib are also determinant.

The MDCT appearance of the superior lumbar triangle is influenced, not only by the complex anatomical features of the region, but also by the thickness and obliquity of acquired reformations. On axial images, a rapid cranio-caudal transition through the superior lumbar triangle is usually observed, reflecting the anatomical structure of the space (Fig. 11 on page 17). Mild asymmetry of the superior lumbar triangle in commonly observed on axial or coronal views (Fig. 12 on page 18). The configuration of the triangle significantly varies from a strict coronal reformation to an oblique coronal view, parallel to the lumbar spine (Fig. 13 on page 19). On sagittal views, a muscle slip from the latissimus dorsi or internal oblique muscles may occasionally be found inserting into the 12th rib (Fig. 14 on page 20).

c) The inferior lumbar triangle

The inferior lumbar triangle is smaller, more lateral, and more inconstant than the superior one, so hernias in this space are less common. The inferior lumbar triangle is an upright triangle bordered inferiorly by the iliac crest, anterolaterally by the external oblique muscle, and posteromedially by the latissimus dorsi muscle (Fig. 15 on page 21). The floor is formed by the thoracolumbar fascia, adjacent to the aponeurosis of the the internal oblique and transversalis abdominis muscles. The roof is formed by the superficial subcutaneous fascia and the skin (Fig. 16 on page 22, Fig. 17 on page 23, Fig. 18 on page 24, Fig. 19 on page 25). The inferior lumbar triangle is not penetrated by nerves or blood vessels.
A number of anatomical variations contribute to weaken the inferior lumbar triangle, acting as predisposing factors for lumbar hernia. The thinning of the internal oblique muscle may be a predisposing factor (Fig. 20 on page 26). Also, in women with wide hips an abnormal origin of the external oblique muscle or a medial origin of the latissimus dorsi muscle make the inferior lumbar triangle wider.

Because of these and other reasons, the MDCT appearance of the inferior lumbar triangle is highly variable. There is a wide spectrum of normal inferior lumbar triangles on axial MDCT images, ranging from no bulging and mild protrusion to frank herniation of retroperitoneal fat (Fig. 21 on page 27). On sagittal views, the normal contour of the retroperitoneal fat should keep a posterior straight border (Fig. 22 on page 28).

**Classification and etiopathogenesis of lumbar hernias**

Lumbar hernias have been traditionally classified according to location, contents or etiology. More recently, Moreno-Egea et al suggested a new comprehensive classification with a therapeutic orientation (Table 1):

<table>
<thead>
<tr>
<th>Location</th>
<th>Localized</th>
<th>Superior lumbar triangle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Inferior lumbar triangle</td>
</tr>
<tr>
<td>Diffuse</td>
<td></td>
<td>Incisional or postoperative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traumatic</td>
</tr>
<tr>
<td>Contents</td>
<td>Extraperitoneal</td>
<td>No peritoneal sac</td>
</tr>
<tr>
<td></td>
<td>Paraperitoneal</td>
<td>Peritoneum sliding and adhering to the viscera</td>
</tr>
<tr>
<td></td>
<td>Intraperitoneal</td>
<td>Complete peritoneal sac around viscera</td>
</tr>
<tr>
<td>Etiology</td>
<td>Congenital</td>
<td>Associated with other malformations</td>
</tr>
<tr>
<td></td>
<td>Acquired</td>
<td>Spontaneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Postoperative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traumatic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infectious</td>
</tr>
<tr>
<td>Therapeutic</td>
<td>A &lt;5 cm</td>
<td>Superior Fat Spontaneous No atrophy</td>
</tr>
<tr>
<td>(Moreno-Egea et al)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B &lt;5-15 cm</td>
<td>Inferior Visceral Incisional Mild atrophy</td>
</tr>
</tbody>
</table>
### Lumbar hernias

Lumbar hernias can be congenital and acquired. Congenital hernias are rare, appear during infancy, and associate with other malformations. Acquired lumbar hernias can be classified as spontaneous, posttraumatic or postoperative. Spontaneous lumbar hernias are about 55% of lumbar hernias, and are often discovered in asymptomatic individuals. Posttraumatic and postoperative lumbar hernias represent other 25% of cases.

Postoperative hernias are related to surgical incisions or iliac bone grafting. Those surgeries over lumbar or iliac regions may weak normal anatomy of the dorsolateral abdominal wall, thus predisposing to lumbar hernias. Incisional lumbar hernias complicate 7% of retroperitoneal approaches. Aortic and renal surgeries are the most commonly involved.

Traumatic lumbar hernias are usually caused by high energy trauma. They usually follow the sudden application of a blunt force to the abdomen, which produces increased intraabdominal pressure. The location of the lumbar hernia does not usually correspond to the site of impact.

### Clinical diagnosis of lumbar hernias

The clinical diagnosis of lumbar hernias is usually based on clinical history, careful inspection and lumbar palpation. Lumbar hernias predominate in men, between 50 and 70 years. They show predilection for left side. Lumbar hernias can produce no symptoms, and some of them are unexpectedly found during routine radiological exams. When lumbar hernias become symptomatic, they may cause pain or discomfort. They can also manifest with palpable lumbar lump. More rarely, bowel loops may protrude into a lumbar hernia, causing gastrointestinal symptoms. Episodes of urinary obstruction have also been described.

Postoperative lumbar hernias are occasionally suspected in patients in whom a lumbotomy was previously performed. The laxity of the transversalis abdominis and oblique muscles usually experiment a gradual improvement, but rarely a complete restoration, which predisposes for lumbar hernia. Not infrequently, it may be difficult to distinguish mild bulging of the abdominal wall from true postoperative lumbar hernia.
Traumatic lumbar hernias are frequently associated with flank hematomas and fractures. Traumatic lumbar hernias belong to the spectrum of lesions associated with the belt syndrome, which also include fracture-subluxation of the first lumbar vertebra, jejunal perforation and mesenteric laceration. The diagnosis of traumatic lumbar hernias is usually delayed, because other injuries are more urgently addressed. Physical examination may reveal a reducible mass associated with pain and bruising just superior to the iliac crest. Local tenderness and ecchymosis may also be found. However, initial physical examination may be normal. If not recognized, traumatic lumbar hernias will typically increase in size, resulting in long-term morbidity.

In summary, the clinical assessment of lumbar hernias remains challenging and may lead to diagnostic uncertainties. Thus, the clinician may require an imaging study to further confirm or exclude lumbar hernia. Although other imaging modalities may be used, we have found 64-slice MDCT particularly valuable in this clinical setting.

**Treatment of lumbar hernias**

Reconstruction usually includes extensive dissection from the 12th rib to the iliac crest, followed by mobilization of local flaps, plication of normal fascia and onlay mesh. Alternatively, an extensive retroperitoneal dissection with extraperitoneal placement of a large sheet of polypropylene mesh may be performed. Recently, the laparoscopic techniques have been applied.
**Fig. 1a, 1b.** Posterior coronal volume-rendered MDCT images show the boundaries of the lumbar region and its weak points, the superior (st) and inferior (it) lumbar triangles.

**Fig. 0**

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Fig. 2 Diagram shows the boundaries of the lumbar region, superimposed on a coronal volume-rendered MDCT image.

**Fig. 0**

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**Fig. 3a, 3b.** Axial diagram shows the crosssectional structure of the lumbar region
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Fig. 5a, 5b. Axial MDCT images are used to show the cross-sectional anatomy of the superior lumbar triangle.
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Fig. 8. Sagittal maximum-intensity-projection (MIP) in a 77-year-old man with aortic stenosis shows the point where the left subcostal artery courses at the superior lumbar triangle below the 12th rib, anterior to the quadratus lumborum muscle and behind the kidney (circle). At this point, the subcostal neurovascular pedicle pierces the posterior aponeurosis of the transversus abdominis muscle, and, passing forward between this muscle and the internal oblique muscle, anastomoses with the superior epigastric, lower intercostal and lumbar arteries.

Fig. 0

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Superior triangle
Length and orientation of 12th ribs

Fig. 9a-c. Posterior volume-rendered MDCT images in three different patients show the influence of the length and angulation of the 12th ribs on the size and configuration of the superior lumbar triangle.

Fig. 0

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**Fig. 10a, 10b.** Rudimentary 12th ribs. In patients with rudimentary 12th ribs (arrows), the upper limit of the superior lumbar triangle (yellow triangle) is formed by the 11th ribs (arrowheads).

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**Fig. 11a-d.** Normal appearance of the superior lumbar triangle on axial MDCT images projected on a coronal multiplanar reformation (a). At the base of the inverted triangle (b), the axial image displays the 12th rib, the serratus posterior inferior muscle, the latissimus dorsi muscle, and the transversalis fascia. At the middle third of the superior triangle (c), the rib and the serratus posterior inferior muscle are no longer seen, and the latissimus dorsi muscle becomes thinner. At the lower third of the superior lumbar triangle (d), the fascial plane is hardly seen. In this latter image the latissimus dorsi becomes aponeurotic, is hard to identify, superficial to the external oblique muscle.

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**Fig. 0**

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Fig. 12a, 12b. Mild asymmetry of the superior lumbar triangle on axial (a) and coronal reformatted (b) MDCT images is a common finding (arrows). In the presented example, the left superior lumbar triangle is slightly taller and wider than the right one.

Fig. 0

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**Fig. 13a, 13b.** Variable appearance of the superior lumbar triangle on orthogonal (a) and oblique (b) coronal reformatted MDCT images of the same patient (arrows). In the presented example, the oblique coronal plane depicts a longer and wider superior lumbar triangle than the orthogonal coronal plane, more closely reflecting their true dimensions.
Fig. 14. Variable appearance of the superior lumbar triangle on sagittal reformatted MDCT images in two different patients. On a sagittal view, the floor of the superior lumbar triangle is formed by the transversalis and thoracolumbar fascias, represented on MDCT images by a thin layer of tissue (arrowhead in 14a). However, this layer may be thick, representing a muscle slip from the internal oblique muscle (arrow in 14b).
Fig. 15. Diagram shows the boundaries of the inferior lumbar triangle, superimposed on a coronal volume-rendered MDCT image

- **eom**, external oblique m, **esm**, erector spinae m, **icm**, intercostal m, **ldm**, latissimus dorsi m, **iom**, internal oblique m, **lr**, lumbar region, **pm**, psoas m, **qlm**, quadratus lumborum m, **spim**, serratus posterior inferior m, **tam**, transversus abdominis m, **12th**, twelfth rib, **atlf**, anterior thoracolumbar fascia, **mtlf**, middle thoracolumbar fascia, **ptlf**, posterior thoracolumbar fascia, **ssf**, superficial subcutaneous fascia, **tf**, transversus fascia, **st**, superior triangle, **it**, inferior triangle

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Fig. 0

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**Fig. 16a, 16b.** Axial MDCT images show the cross-sectional anatomy of the inferior lumbar triangle (at the vertex of triangle).
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**Fig. 20a, 20b.** Axial MDCT images in two different patients. The width of the inferior lumbar triangle (arrowheads) depends on the size and configuration of the internal oblique muscle (arrows). The thinning of the muscle girdle of the internal oblique muscle weakens the inferior lumbar triangle.

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**Fig. 0**

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**Fig. 21a-d.** Axial MDCT images in four different patients show the variable appearance of the inferior lumbar triangle. There is a wide spectrum for the contour of the retroperitoneal fat within a normal inferior lumbar triangle, as seen on Figs. 21a-c (arrows). In Fig. 21d, a small inferior lumbar hemia is shown for comparison (arrowhead).

**Fig. 0**

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22a-d. Sagittal reformatted MDCT images show the variable appearance of the inferior lumbar triangle in four different patients. In Fig. 22a-c, the contour of the retroperitoneal fat is preserved (arrows). In Fig. 22d, a small inferior lumbar hernia is shown for comparison (arrowhead), showing a convex posterior contour.

Fig. 0

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Imaging findings OR Procedure details

64-slice MDCT features of lumbar hernias

The fast acquisition and multiplanar capabilities of 64-slice MDCT provide an optimal standpoint for systematic evaluation of the lumbar region and for precise characterization of lumbar hernias. MDCT allows an accurate assessment of the defect size, and identification of the disrupted fascial or muscle layers. In addition, readily provides identification of hernia contents and associated pathology.

Spontaneous hernias of the superior lumbar triangle are located below the 12th rib, and are usually contained by a normal or atrophic latissimus dorsi muscle. In order to achieve a correct finding, the key finding on MDCT images is the protrusion of fat or viscerae through the fascial plane (Fig. 1 on page 32, Fig. 2 on page 32). When severe atrophy of the dorsolateral abdominal wall muscles is found, it may be difficult to distinguish superior lumbar hernias from diffuse hernias (Fig. 3 on page 33). However, the diffuse hernias clearly extend into the area of both lumbar triangles, superiorly reaching the 12th rib and inferiorly abutting the iliac crest. Following surgical correction of spontaneous hernias, MDCT may be used to demonstrate anatomical restoration (Fig. 1c on page 32) or recurrent herniation (Fig. 4 on page 34).

Following lumbotomy, a superior (Fig. 5 on page 35) or diffuse (Fig. 6 on page 36) lumbar may develop. An inferior lumbar hernia may also arise in patients who underwent iliac crest harvesting (Fig. 7 on page 37). In our experience, MDCT is useful for detection of these postoperative complications, and for evaluating the results after hernia repair.

Traumatic lumbar hernias may involve the superior or inferior lumbar triangle (Fig. 8 on page 38), although violent trauma may also lead to diffuse lumbar hernias. Traumatic lumbar hernias typically associate with flank hematomas, and may complicate with internal abdominal damage, including mesenteric laceration (Fig. 9 on page 39) or jejunal perforation.

Differential diagnosis of lumbar hernias

In most patient who previously undewent lumbotomy there is variable bulging of the dorsolateral abdominal wall. In most cases, no true fascial defect exists, and no surgical correction is needed. In order to distinguish simple bulging of the atrophic dorsolateral
abdominal wall from true postoperative herniation MDCT studies may play a significant role (Fig. 10 on page 40).

The multiplanar capabilities of MDCT may also prove useful in detecting other potential mimickers of lumbar hernias, such as intercostal hernias (Fig. 11 on page 41), subcutaneous hematomas (Fig. 12 on page 42), long-standing degloving injuries (Fig. 13 on page 43), abscesses, and soft-tissue tumors (Fig. 14 on page 44) of the posterolateral abdominal wall.
Fig. 1a-c. Spontaneous hernia of the superior lumbar triangle in a 64-year-old man with long-standing painful lump of the lumbar region. Axial (a) and coronal reformatted (b) MDCT images show the hernia (arrowheads). Axial MDCT image (c) show excellent result after surgical repair.

Fig. 0

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Fig. 0

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Fig. 2a-c. Spontaneous hernia of the superior lumbar triangle in a 68-year-old man suffering miastenia gravis. Axial (a), coronal (b) and sagittal (c) reformatted MDCT images show herniation below the 12th rib (arrowheads) through the thoracolumbar fascia.
**Spontaneous hernia**

**Fig. 3a-c.** Spontaneous diffuse lumbar hernia in a 78-year-old woman with constitutional syndrome. Axial (a), coronal (b) and sagittal (c) reformatted MDCT images show a diffuse lumbar hernia (arrowheads).

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**Fig. 0**

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Fig. 4a, 4b. Recurrent diffuse lumbar hernia in a 66-year-old woman with previous left lumbar hernia repair. Axial CT images (a, b) show recurrent diffuse lumbar hernia, with descending colon protruding into the subcutaneous fatty tissues (arrowheads).
**Fig. 5a, 5b.** Postoperative hernia of the superior lumbar triangle in an asymptomatic 72-year-old woman who underwent left nephrectomy. Axial (a) and coronal reformatted (b) MDCT images show a postoperative superior lumbar hernia (arrowheads), contained by atrophic latissimus dorsi and external oblique muscles. The spleen and a small bowel loop are seen protruding into the hernia sac.
**Fig. 6a, 6b.** Postoperative diffuse lumbar hernia in an 80-year-old man in whom a right nephrectomy was performed. Axial MDCT image (a) shows a diffuse lumbar hernia containing bowel loops (arrowheads). Following hernia repair, the postoperative MDCT study (b) shows adequate correction of the hernia.
Fig. 7a, 7b. Postoperative inferior lumbar hernia in a 44-year-old woman who underwent iliac crest harvesting. Axial MDCT image (a) shows an inferior lumbar hernia (arrowheads), slightly medial to the inferior lumbar triangle. Coronal volume-rendered MDCT reconstruction (b) shows the postoperative iliac defect (arrow) which may have contributed to the lumbar hernia.
Fig. 8a, 8b. Traumatic inferior lumbar hernia in a 16-year-old man who sustained a traffic car accident. Axial CT (a) shows protrusion of extraperitoneal fat (arrowheads) through the inferior lumbar triangle. A small hematoma (star) is also seen (a). A follow-up study 4 days after (b) shows spontaneous reduction of the hernia (b).
Fig. 9a-c. Traumatic inferior lumbar hernia in a 31-year-old man who sustained a traffic car accident. Axial (a) and sagittal reformatted (b) MDCT images show an inferior lumbar hernia, with protrusion of extraperitoneal fat (arrowheads). Coronal reformatted MDCT image in the same patient (c) shows intra-abdominal active extravasation (arrow), reflecting mesenteric laceration.

Fig. 0

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Fig. 10a-d. Postoperative hernia in a 54-year-old woman who underwent right nephrectomy. Axial (a-b), coronal (c) and sagittal (d) reformatted MDCT images show a postoperative superior lumbar hernia, and atrophy of the right dorsolateral abdominal wall.

Fig. 0

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Fig. 11a-c. Intercostal hernia in a 67-year-old man. Axial (a), coronal (b) and sagittal (c) reformatted MDCT images show an abdominal intercostal hernia (arrowheads), which may clinically mimic a lumbar hernia.

Fig. 0

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Fig. 12a, 12b. Flank hematoma in a 57-year-old man. Axial (a) and coronal reformatted (b) MDCT images show a subcutaneous hematoma of the right flank (arrowheads).
Fig. 0

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**Differential diagnosis**

Lipoma

**Fig. 14a, 14b.** Intramuscular lipoma in a 66-year-old woman. Axial (a) and coronal reformatted (b) MDCT images show an intramuscular lipoma of the internal oblique muscle (arrowheads).

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Conclusion

Currently available 64-slice multidetector computed tomography (MDCT) provides an excellent opportunity for reviewing the normal anatomy of the superior and inferior lumbar triangles.

64-slice MDCT may be considered a useful modality for diagnosing lumbar hernias and their complications, thus aiding in surgical planning and postoperative follow-up.
References


