Lateral lumbar interbody fusion

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Since its inception in the year 2001 the minimally invasive trans-psoas Lateral Lumbar Interbody Fusion (LLIF) approach has gained significant favor among spine surgeons. It is now routinely utilized to treat an array of spinal pathologies including degenerative disc disease, low grade spondylolisthesis, and adult spinal deformity. The intent of this video is to provide a step by step account of the basic procedural details when performing the LLIF procedure for a single level broad based degenerated lumbar disc with herniation. The video can be found here: http://youtu.be/dZFMqmqC6Q8.

Key Words • lateral lumbar interbody fusion • spondylolisthesis • minimally invasive • video

Surgical Technique

Points of Note: Preoperative MRI should be carefully evaluated to examine for the position of the great vessels, the sympathetic and lumbar plexus and their relation to the psoas muscle, and the spinal curvature. The major anatomic landmarks to consider when preparing for LLIF include the ribs, lung, diaphragm, major vessels (aorta, vena cava, iliacs, and segmentals), visceral organs (bowel, kidneys, liver, spleen) and the spinal rotation and curvature. The diaphragm will be in the surgical access path when accessing the spine for the levels from T10–L1. The diaphragmatic tendinous attachments may be encountered down to the L-3 vertebra.

Position: After induction of general anesthesia, the patient is placed in the lateral decubitus position with the left side up. We prefer to use the left side to access the spine as the aorta and iliac arteries are sturdier than the vena cava and iliac veins, and are more likely to withstand surgical handling without being injured. In patients with scoliosis the aorta may lie on the lateral aspect of the vertebral bodies and thus would require access from the right side.

The patient is positioned on the table such that the table break lies at the midpoint of the iliac crest and the greater trochanter. Insure that all pressure points are padded, and the patient is secured to the table with tape at the following locations:

1. Over the iliac crest and around the table.
2. Over the iliac crest pulling it inferiorly and secured to the caudal table end.
3. Over the thoracic region above the surgical exposure and around the table.

The bed is flexed to expand the costo-pelvic interval. Once the patient is secured to the table, the table (not the C arm) is adjusted to obtain true anteroposterior (the spinous processes should be midline and the pedicles should be equidistant from the spinous processes) and lateral images (crisp endplates and pedicles should be visualized). We use a chlorhexidine wipe and Chloroprep to prepare the surgical site.

Access: A 3–4 cm transverse incision is made along the lateral flank at the level of the disc space. The main paired abdominal muscles include the external oblique muscles, internal oblique muscles, transversus abdominis muscles, and their respective aponeuroses, which provide core strength and protection to the abdominal wall viscera. The incision should be made parallel to the direction of the fibers of the external oblique to minimize the possibility of injury to the motor nerves supplying the abdominal musculature. Blunt dissection with anterior sweeping movements of the retroperitoneal contents is then performed to enable palpation of the psoas muscle and the transverse process of the index vertebra. The finger is then directed medially to gently palpate the psoas muscle and release any fibrous attachments and then posteriorly to palpate the tip of the transverse process. The first dilator is then passed through the oblique muscle layers with the lead edge on the surgeon’s fingertips as it is passed through these surgical layers and is docked on the psoas muscle in the center of the disc space.

Electrophysiological Monitoring: The lumbar sympathetic plexus tends to lie in the posterior one third of the psoas muscle. Electrophysiological monitoring, which we utilize in all our cases assists greatly in safe passage of the dilators and the retractor system without causing damage to the nerves. The system continuously searches for the stimulus threshold that elicits an EMG response and reports this threshold both audibly and visually. As the stimulus source (the dilators and the retractor system also act as electrodes and are insulated to minimize current shunting) moves closer to the nerve, less stimulus intensity is required to elicit a response, resulting in a lower threshold, which provides an indication of the relative proximity of the dilator to the nerves. We consider threshold values of 5 mA as a marker of a safe distance from the nerves.

Procedure: After advancement of the initial dilator through the psoas muscle and the index level is confirmed with fluoroscopy, a K-wire is then advanced approximately 3 cm into the disc space. The retractor system is then advanced over the dilators and gently expanded to reveal the disc space. An EMG blunt-tip probe is used to locate the laterally traversing nerve root (ideally behind the posterior retractor blade) to ensure that it lies outside the surgical corridor. Once correct position and safe passage is confirmed, a shim is advanced into the posterior aspect of the disc space to secure the retractor. An anterior retractor blade is then used to visualize the anterior longitudinal ligament following which it is placed in front of the disc space approximately 1 cm deep, protecting the visceral structures anterior to it as well as the ligament itself. The disc space is then opened sharply with a knife and a thorough discectomy performed. All cartilaginous material is removed from the endplates following which the contralateral annulus is released, enabling distraction across the disc space. Appropriate sized trials are then placed to determine height and width following which the interbody graft is placed.

Closure: AP and lateral fluoroscopy is performed to confirm ideal implant position. Copious irrigation is completed following which the retractor is removed under direct visualization to insure meticulous hemostasis. The transversalis fascia is approximated with absorbable sutures followed by a subcuticular skin closure. Patients are discharged from the hospital after an overnight stay.