Open anterior approaches for lumbar spine procedures

Andrew A. Gumbs, M.D.a, Norman D. Bloom, M.D.a, Fabian D. Bitan, M.D.b, Scott H. Hanan, M.D.a,*

aDepartment of Surgery, Lenox Hill Hospital, 100 East 77th Street, New York, NY 10021, USA
bDepartment of Orthopedic Surgery, Lenox Hill Hospital, 100 East 77th Street, New York, NY 10021, USA

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Abstract

With the advent of anterior lumbar interbody fusion (ALIF) and artificial discs as common procedures for the treatment of many spinal problems such as pseudoarthrosis, degenerative disc disease, and internal disc disruption from trauma, anterior exposure has become an increasingly popular procedure for the general, thoracic, urologic and vascular surgeon. Despite this, the body of literature describing this procedure is lacking. Dividing the approach for anterior spinal surgery into the thoracolumbar, mid-lumbar, and lumbosacral regions, we describe the basic techniques and anatomy needed to perform these open approaches, specifically, repairs of disc spaces T12–L2, L2–5, and L5–S1, respectively. The technique for the retroperitoneal approach will be discussed in detail; however, issues involved with indications for transperitoneal approach and technical “pearls” will also be discussed. © 2007 Excerpta Medica Inc. All rights reserved.

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With the advent of anterior lumbar interbody fusion (ALIF) as a common procedure for the treatment of many spinal problems such as pseudoarthrosis, degenerative disc disease, and internal disc disruption from trauma, anterior exposure has become an increasingly popular procedure for general, thoracic, urologic, and vascular surgeons. Despite this, the body of literature describing this procedure is lacking, especially in the general and vascular surgery literature. Dividing the approach for anterior spinal surgery into the thoracolumbar, mid-lumbar, and lumbosacral regions, we describe the basic techniques and anatomy needed to perform these open approaches, specifically, repairs of disc spaces T12–L2, L2–5, and L5–S1, respectively. The technique for the retroperitoneal approach will be discussed in detail, and issues involved with indications for transperitoneal approach will also be described. The techniques for thoracic and cervical approaches and laparoscopic procedures will not be addressed here.

Technique

Thoracolumbar region (T12–L2)

The patient is placed in the lateral decubitus position and secured using either a bean-bag or sand bags. Typically, the approach is via the left side; however, the right chest and retroperitoneum may be approached if need be. A thoracoabdominal incision is made, generally directly over the 10th or 11th rib depending on the patient’s anatomy and the levels to be exposed. The incision is oriented in an oblique fashion and is carried down onto the abdominal wall for a few centimeters. The subcutaneous tissues, the serratus anterior, and latissimus dorsi muscles, are divided to expose the intercostals muscles directly over the desired rib. The intercostals muscles are divided to expose the superior border of the intended rib. The rib is dissected free from its bed in a standard fashion, being careful to avoid the neurovascular border below. Anteriorly, the costal margin or the rib is identified and divided. At this point the abdominal wall musculature can be divided. The external and internal obliques are split for a variable distance. It is best to limit this to the bare minimum to prevent postoperative muscular dysfunction. Immediately below the split costal margin is the transversalis layer, which can now be divided.

Once this is complete, the peritoneum is dissected off of the overlying diaphragm and the psoas muscle, which opens the retroperitoneal space. The diaphragm can now be taken
down under direct visualization leaving a distal cuff for repair and staying clear of the more central region to avoid phrenic nerve injury. A self-retaining retractor is placed to obtain exposure within the thoracic and retroperitoneal space. The lung can be gently compressed cranially with a moist lap pad and a minimal decrease in tidal volume; single-lung ventilation is not necessary. The parietal pleura over the lower thoracic spine is now opened and the thoraco-lumbar juction exposed. The segmental vessels to the vertebral bodies are dissected and divided to gain anterior access to the disk spaces. Specific care must be paid to the segmental arteries because of the potential for serious hemorrhage. These arteries are paired at each vertebral level and supply extra-spinal and intra-spinal structures. These vessels need to be controlled and ligated on the side, which the exposure is undertaken. This should be done close to the aorta to ensure that the collateral blood supply to the spinal cord is preserved to protect against cord ischemia [2].

Because the artery of Adamkiewicz is fundamental in supplying blood flow to the anterior and posterior spinal arteries in the thoraco-lumbar area, selective angiography of the artery of Adamkiewicz has been advocated in the pre-operative work-up of patients to aid in choosing surgical approach in the hopes of minimizing risks for serious hemorrhage. Large segmentals can also be individually occluded temporarily with vascular clamps while spinal monitoring takes place. If no changes are identified, these vessels can be divided. This artery usually arises on the left between T8–10, but its origin can vary between T7 and L4; as a result, special care must be taken when dissecting out vertebral bodies at these levels [2]. At this region care should be taken to avoid injury to the retroperitoneal lymphatics (cisterna chyli/thoracic duct) as large lymphocele can develop. Should an injury occur, oversewing the lymphatic chain with a non-absorbable suture (2-0 silk) should remedy the situation.

If the diaphragm was incised, a large bore chest tube is placed and the diaphragm is repaired with a non-absorbable stitch after the orthopedic procedure is completed. The thoracic cavity is closed by first placing rib approximating sutures and then repairing the intercostals musculature. The serratus anterior and latissimus dorsi muscles are reapproximated with running non-absorbable stitches and the anterior abdominal wall is reconstructed layer by layer with this technique as well.

Mid-lumbar region (L2–L5)

A left paramedian incision is made to avoid the more prominent common iliac vein on the right and carried down through the subcutaneous tissue until the external oblique fascia is identified. This layer is incised at its medial extent, where it is still aponeurotic. At this point, the rectus sheath is opened and the rectus muscle is mobilized to identify the posterior rectus sheath and semilunar line. Mobilization of the rectus can be toward the midline or toward lateral; we prefer mobilization from medial to lateral to avoid disruption of the segmental innervation to the abdominal wall. At the level of the semilunar line, the retroperitoneal space can be developed by bluntly dissecting the peritoneum in a lateral to medial direction and off of the overlying posterior rectus sheath. This layer can then be divided in a vertical direction to allow for muscle sparing and to facilitate closure. The peritoneal sac is now bluntly dissected off of the psoas muscle, taking care to identify the ipsilateral ureter, until the left iliac artery and vein are identified. This incision can usually be used to expose L2–S1.

At this point the exposure is aided by the use of a self-retaining retractor. We use both the Balfour Retractor (Spectrum, Stow, OH) and the Omni-Retractor (Omni, St. Paul, MN). The multiple varied blades available in both of these systems assist in the actual dissection. Multiple repeated adjustments of these blades can complete the exposure. The left iliac artery and vein are retracted medially, and any segmental vessels are divided laterally. Care must again be taken at this stage to control any segmental branches that may affect the orthopedic surgeon’s exposure. At this region care must again be used to avoid injury to the retroperitoneal lymphatics and lumbar sympathetics. More important is the need to avoid injury to the vascular structures. The ileolumbar or ascending vein is generally a large branch overlying the L5 body. This vessel can tether the iliac vein and prevent adequate exposure of the L4/5 disk space. We generally dissect this vessel and divide it (Fig. 1). The L5 root, which often runs in close proximity to this branch, should be located. When the ascending branch is left intact, undue traction on the left iliac vein should be avoided, because minor tears can lead to major hemorrhaging.

At this point the orthopedic portion of the procedure is undertaken (Fig. 2). After vigorous hemostasis is confirmed, the blades are removed one by one to assure a dry field. The wound is irrigated and the abdominal wall is reconstructed in a layered fashion.

![Fig. 1. Division of ilio-lumbar vein for exposure of mid-lumbar and lumbo-sacral region.](image-url)
Lumbo-sacral region (L5–S1)

Access to the lumbo-sacral spine can be obtained via several incisions. Some prefer a right paramedian incision close to the midline to avoid injury to the nerves innervating the rectus, an oblique incision running from the iliac crest to a point between the umbilicus and pubis or a transverse incision with either a muscle-cutting or muscle-splitting approach [2]. A low transverse incision can be used as well, incising the anterior fascia transversely to expose the rectus muscles. These muscles can be cut, but we recommend mobilizing the midline to again enter the preperitoneal space and mobilize the peritoneal envelope from left lateral to medial. The ipsilateral ureter should be identified and swept with the peritoneum toward the midline. Dissection is carried down between the iliac vessels to expose the sacral promontory and L5/S1 disk. The middle sacral vessels are exposed and divided to complete this exposure (Fig. 3). Care should be taken at this level to avoid unnecessary use of electrocautery to prevent pelvic sympathetic disruption, which can result in retrograde ejaculation in a male patient.

Transperitoneal

When previous surgery makes the retroperitoneal approach impossible due to excessive scar tissue, the transperitoneal approach can be used. Once access to the peritoneal cavity is obtained via either a paramedian or transverse incision, the white line of Toldt can be mobilized for exposure of the lumbar discs (Fig. 4). The dissection is then carried out as above. For transperitoneal exposure of the lumbo-sacral region the colon does not need to be mobilized (Fig. 5), but the peritoneum needs to be excised to enter into the disc interspace (Fig. 6).

Comments

ALIF has become an increasingly popular procedure because of several advantages over the posterior approach: reduced incidence of nerve damage, the ability to perform a more complete disc excision, and the ability to place a larger interbody fusion device with what should be higher rates of fusion [1].

Because of the diaphragm at the thoraco-lumbar junction, this part of the spine is one of the most difficult regions for surgeons to access. Traditionally this junction is accessed below the 9th or 10th rib, requiring a chest tube at the
end of the case [2]. By entering the retroperitoneal space at the 11th rib, an extrapleural approach can obviate the need for chest tube placement. Although this procedure has a reputation for providing reduced exposure, a retrospective unmatched review of 26 consecutive patients by Kim et al from Toronto did not substantiate this. Nonetheless, they did report increased operative time due to the difficulty in preserving the integrity of the pleural cavity [3]. An additional advantage of this approach is the potential for decreased morbidity from pulmonary complications and hospital stay. Closure of this type of incision is usually more difficult and can be facilitated with mesh.

Potential complications of the anterior approach are numerous and range from lymphoceles, ureteral injuries, retroperitoneal fibrosis, rectus muscle hematoma, pancreatitis, femoral nerve palsy, pseudomeningoele, and latissimus dorsi rupture, to retrograde ejaculation and impotence [4–16]. As a result, we offer patients the option to bank sperm preoperatively [17].

Minimally invasive techniques for spine procedures have been described and include: lumbar corpectomy with anterior reconstruction and laparoscopic retroperitoneal exposures, and discectomies with anterior lumbar fusions. These are not performed by our group because of the increased complication rates [11–14]. A group out of the University of Wisconsin reported their experience with 50 consecutive patients that underwent either an open retroperitoneal approach or a laparoscopic transperitoneal one, finding a significantly higher incidence of complications in the laparoscopic group (4% vs 20%). They also noted a trend towards compromised fusions due to limited exposures, although operative time and hospital time were not significantly different [1]. When compared to the retroperitoneal approach, transperitoneal exposures have been found to have an increased risk of retrograde ejaculation for exposures of L4 through S1 [15].

Endoscopic techniques for retroperitoneal access to the lumbar spine for ALIF have been described since the late 1990s [16,18]. Known as lumboscopy, the retroperitoneal space is accessed similarly to total extraperitoneal (TEP) laparoscopic hernia repairs, using CO2 insufflation and a balloon spacer. Also referred to as a balloon-assisted endoscopic retroperitoneal gasless (BERG) approach, this technique not only has the advantage of being performed with minimally invasive techniques, but it does not require violation of the peritoneum [18]. A recent experience reported complications in 3 of 46 (7%) patients, requiring hardware removal in 1 (2%) patient [19].

In conclusion, because of advantages over posterior repairs, demand for anterior spinal approaches will only increase. Even though larger prospective randomized trials are still needed, minimally invasive techniques have not shown any advantage over the open approach. Open retroperitoneal exposures to the thoraco-lumbar, mid-lumbar, and lumbosacral vertebral bodies are safe procedures and should be in the repertoire of general and vascular surgeons. Even though experienced orthopedic spine surgeons can have comparable complication rates, a combined approach reduces complication rates in anterior spinal surgery by maximizing the various surgical skills of the orthopedic or neurosurgical spine surgeon and the general or vascular exposure surgeon [20,21].

References