1. Introduction:

In the pursuit of less invasive more effective surgical methods, surgeons devised a laparoscopic access technique to the abdominal cavity. Through this technique, general surgeons, vascular surgeons, urologists and gynecologists evolved from diagnostic procedures to therapeutic procedures. The laparoscopic approaches have now become mainstream in these specialties by virtue of the less invasive approach; faster post treatment recovery and rehabilitation, and less obvious skin scars (1) (Figure 1). In the mid 1990’s spinal surgeons in their attempt to capitalize on these benefits attempted to extend the laparoscopic approach to access the spine. Laparoscopic fusion of the lumbosacral spine was first reported by Mc Afee et al in 1995 (2). New tools and implants were designed and used with varying degrees of success. To date however, the laparoscopic access to the spine has not achieved the same level of acceptance as in other surgical specialties. This is due to the need for specialized expertise and potential for other direct and indirect spine related morbidity associated with the surgery, and further advances in other methods of achieving a more predictable lumbar fusion.

2. Indications:

The indications for laparoscopic anterior fusion are the same as those for traditional open anterior fusions:

a. Single or two level symptomatic degenerative disks, 
b. Segmental instability, 
c. Grade 1 spondylolisthesis, 
d. Pseudoarthrosis, 
e. Failed posterior lumbar surgery, 
f. Degenerative scoliotic deformity, 
g. Long fusions to the pelvis

3. Contraindications:

The contraindications for laparoscopic anterior fusions (perhaps more important) are:

a. Extensive peritoneal or retroperitoneal adhesions from previous surgery, radiation therapy or infection. 
b. Intra or retroperitoneal infectious or inflammatory conditions. 
c. Greater than Grade 2 spondylolisthesis. 
d. Overlying psychological conditions 
e. Positive Waddell’ sign, 
f. Habitual narcotics users.

4. Surgical Procedures:

4.a. Surgical Equipments:

The required surgical equipments for laparoscopic anterior lumbar fusion are:

a. Experience with laparoscopic surgery (experienced laparoscopic surgeon) 
b. Laparoscopic equipments (Camera, Monitor, Insufflator, Ports, Laparoscopic instruments, Laparoscopic retractors) (Figure 2a)
Laparoscopic Anterior Lumbar Fusion

4. Fluoroscopy (To determine the correct level(s) to be fused) (Figure 2b)

4.b. Patient Positioning:
With the patient in the supine position on a radiolucent operating table, first the bladder is decompressed by placement of a Foley catheter. The arms can be placed on the thorax of the patient or the patient may be elevated from the table with the use of gel pads or blankets to prevent interference of the arms with the fluoroscopic images. The patient is placed in trendelenburg position (laparoscopic procedures may require up to 30 degrees of trendelenburg position) to facilitate mobilization of the abdominal contents cephalad.

4.c. Surgical Technique:
Multiple portal configurations can be used depending on the instruments, implants and training of the surgeons. Typically at least 4 portals are used;

a) Periumbilical
b) Right lower quadrant portal
c) Left lower quadrant portal
d) Suprapubic spinal working portal (should be the last portal to be opened) (Figure 3a)

As in any surgical procedure “you can not do what you can not see”, thus an important aspect of any laparoscopic approach is to achieve and ensure satisfactory exposure of the desired surgical area. In addition in males, it is important to avoid excessive manipulation of the retroperitoneal contents or use

Figure 1:
Laparoscopic procedure is much superior in terms of cosmetic appearance when compared to the traditional open approaches.
excessive cautery in the deep pelvic region in order to prevent retrograde ejaculation. Once a good exposure is achieved, (Figure 3b, 3c, 3d) then the fusion procedure follows similar steps to any well done interbody fusion; evacuate the nucleus, debride the cartilaginous endplates to expose the bleeding subchondral bone, provide the osteoinductive, conductive and generic material to provide stability and fusion (Figure 4 a,b,c,d,e,f) Figure 5 a,b,c) (Figure 6 a,b,c).

5. Complications and Avoidance:

Laparoscopic surgery is a less invasive technique; however the risks and potential complications are still significant and essentially similar to any open spinal procedure. The unique complications associated with a laparoscopic approach originate from the unique instruments used in this type of surgery like the Veress needle and the trocars. The first trocar or needle is inserted blindly, and can easily cause bowel or vascular injury. In the general surgery literature where laparoscopic surgery is commonly used, vascular injuries including perforation of the aorta and iliac vessels were reported in up to 0.6% of the cases, 10% of them serious. Some fatalities were reported and trocar perforation of a blood vessel is the second most often reported cause of death after anesthesia. Unlike open procedure where vascular injury is immediately recognized, in laparoscopic surgery, vascular injury may not be recognized till the patient is in shock.

A second major life threatening complication associated with laparoscopy and vascular injury is

Figure 2a: Surgical equipment and tools.
gas embolization. The insufflation gas (CO₂) can enter the heart through a defect in the blood vessels. Gas embolism resulting in death and near death incidents was reported. Usually the presentation is immediate and dramatic but may also be noted 30 minutes later when gas enters the portal system. Other injuries such as bowel injuries, some fatal, were reported in 4/1000 cases. These included injuries to stomach, small bowel, colon and spleen. Misplacement of the Veress needle has been reported to cause pneumothorax and or a tension pneumothorax, hypoxemia and hypotension. Gas may also enter the pleural space after trocar injury to the diaphragm or the persistence of a congenital opening through the diaphragm. The reader must note that none of these dreaded complications occurs in the course of open laparotomy where Veress needle, trocars, and gas insufflation are not used.

During laparoscopic surgery, it is important to note that excessive cautery can cause injury to adjacent organs, and even distant organs. In addition, retrograde ejaculation is found to be higher after laparoscopic ALIF procedures.

In evaluating laparoscopic surgery complications one needs to recall that the technique replaces an open procedure with a published rate of complications between 2 and 4% for the exposure component of the fusion procedure. Laparoscopic surgery introduces new risks such as trocar injury, cardiovascular problems and damage to bowel and major vessels that are rarely if ever encountered in open fusion procedures.

Several comparative studies showed that at the L5-S1 disc level, there was no marked difference between laparoscopic anterior fusion (ALIF) and the open or mini-open ALIF in terms of short-term efficacy, i.e., operative time, blood loss, and length of hospital stay. With regard to the complication rate, however, there was a higher incidence of retrograde ejaculation in laparoscopic ALIF. At the L4-L5 and L4-L5/L5-S1 disc levels, the complication rate and conversion rate to open surgery was high in

Figure 2b:
It is important to place the fluoroscopy in a way which facilitates the operation of the device without compromising the surgeon’s field of operation. Also the screen should be placed in a place where it can easily be seen by both the surgeon and the assistant.
laparoscopic ALIF, and many authors were not impressed with this technique at these levels (3).

Many authors initially stated that laparoscopic procedure is associated with higher costs than open procedures (5, 6). Today however, due to the readily available use of the laparoscopic instruments the costs have stabilized to a more acceptable level. Despite that the trend to laparoscopic fusion procedures has not increased.

6. Postoperative Care:

The postoperative care is similar to any open lumbar fusion surgery. After an uncomplicated procedure, the patient can start a clear liquid diet starting from the postoperative 1st day. Patient can be discharged about 3-4 days after the procedure and the return to work is generally 2-3 months after the operation.

Figure 3
a) The operating room set is seen.

b, c, d) The exposure of the iliac arteries, abdominal aorta and vena cava inferior are seen.
Figure 4:

a,b) The AP and lateral X-rays of a patient with L5-S1 degenerative disc disease.

c,d,e,f) Sagittal and axial MRI images of a patient with L5-S1 degenerative disc disease.
Figure 5:
Intraoperative views showing:

a) marking of the disc space,

b) placement of the working cannula through which disc space debridement, endplate removal and placement of the interbody fusion materials is carried out,

c) final position of the implant.
Laparoscopic Anterior Lumbar Fusion

Figure 6:
Postoperative 1 year follow-up views of the same patient
a) AP X-ray  b) Lateral X-ray showing fusion mass both in front of and behind the interbody cage,
c) Sagittal CT image showing solid fusion of both endplates through the interbody cage.

7. References:


