Hypothesis: With the advent of anterior lumbar interbody fusion and artificial disk replacement as common procedures for the treatment of many spinal problems, anterior exposure has become an increasingly popular procedure for general, thoracic, urologic, and vascular surgeons. Despite this, the body of literature describing this procedure, especially the general and vascular surgery literature, is lacking.

Design: A retrospective review of medical records was performed for patients operated on from April 2002 to March 2004.

Setting: Tertiary care university hospital.

Patients: In total, 64 open retroperitoneal exposures for anterior spinal approaches were performed. Thirty-five (55%) were performed on men and 29 (45%) on women.

Interventions: Fifty patients (78%) required lumbosacral approaches, and 14 (22%) required access to purely lumbar disk spaces. Forty-three patients underwent single-disk approaches, and 21 required access to either 2 or 3 levels. Forty patients (63%) underwent anterior lumbar interbody fusion, and 22 (34%) had a Prodisc disk replacement.

Main Outcome Measures: We analyzed intraoperative and early postoperative complications.

Results: The average age was 43 years (range, 25-89 years), 42 and 44 years for men and women, respectively. Ninety-seven percent of all attempted retroperitoneal exposures were successful. Intraoperative complications occurred in 5 patients (8%) and included inability to mobilize the iliac veins, injury to the iliac vein, and ureteral tear. The postoperative course was complicated in 8 patients (14%) and included fever, urinary retention, spinal headache, *Clostridium difficile* colitis, and ileus.

Conclusion: Open retroperitoneal exposure to the lumbar and lumbosacral vertebral bodies can be performed safely with a multidisciplinary approach that maximizes the various surgical skills of the orthopedic and vascular or general surgeon, reducing complication rates in anterior spinal surgery.

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ANTERIOR LUMBAR INTERBODY FUSION AND DISK REPLACEMENT ARE BECOMING INCREASINGLY COMMON PROCEDURES FOR THE MANAGEMENT OF A NUMBER OF SPINAL PROBLEMS, SUCH AS PSEUDARTHROSIS, DEGENERATIVE JOINT DISEASE, AND INTERNAL DISK DISRUPTION FROM MALIGNANCY, INFECTION, OR TRAUMA. EXPOSURE OF THE ANTERIOR PORTION OF THE LUMBAR DISKS CAN BE OBTAINED THROUGH EITHER A TRANSPERITONEAL OR EXTRAPERITONEAL APPROACH, UTILIZING A VARIETY OF SKIN INCISIONS. THE RETROPERITONEAL APPROACH IS THE PREFERRED PROCEDURE BECAUSE IT CAN BE PERFORMED THROUGH SMALL SKIN INCISIONS AND OBVIATES THE NEED FOR BOWEL RETRACTION. SINCE MOBILIZATION OF VASCULAR STRUCTURES AND THE URETERS ARE GENERALLY NECESSARY, IT IS COMMON FOR VASCULAR, UROLOGIC, OR GENERAL SURGEONS TO ASSIST THE SPINE SURGEON WITH THE EXPOSURE OF THE LUMBAR DISKS.

The purpose of this study was to retrospectively review a single institution’s contemporary experience with this surgical procedure and to compare this data with previous reports in the literature. We confine our analysis to procedures on the lumbar disks and exclude operations on the cervical and thoracic disks.

METHODS

DATA ACQUISITION

The medical records of all patients at the Yale-New Haven Hospital, New Haven, Conn, who underwent anterior lumbar disk surgery between April 2002 and March 2004 were retrospectively reviewed. The type of operation, the indication, and the outcomes based on postop-
therapeutic outpatient evaluation were determined. Human investiga- tional committee approval was obtained prior to initiating this study.

TECHNIQUE

Using lateral and anteroposterior fluoroscopy, a skin mark was made over the disk spaces of interest. We usually employed a left paramedian incision for exposing L4-L5 and more cephalad disk spaces and a right paramedian exposure for L5-S1 centered on this skin marking, although a transverse skin incision was also acceptable for most single-level cases and some 2-level cases.

The external oblique fascia was identified and incised close to the midline. The rectus muscle was mobilized posteriorly to its lateral extent to reveal the posterior rectus sheath and the semi- lunar line of Douglas. This marked the transition of the separation of the aponeurosis of the transversus oblique and posterior internal oblique layer from the anterior internal oblique muscle fibers. At this level, the retroperitoneal space could be developed by sweeping the peritoneum in a lateral to medial direction and off the overlying posterior rectus sheath (Figure 1). This layer could then be incised in a vertical orientation to allow easy retraction of the peritoneal contents and to preserve the epigastric vessels. The peritoneum and ipsilateral ureter were then bluntly dissected free off of the psoas muscle, and the left iliac artery and vein were identified (Figure 2).

Exposure was aided by the use of a self-retaining retractor, the Syn-Frame (Synthes-Retractor System; Synthes, Paoli, Pa), which has multiple blades of varying length (Figure 3). The left iliac artery and vein were retracted medially and all lateral segmental vessels ligated and divided. Special attention should be paid to the ileolumbar or ascending vein, a large branch overlying the L5 body laterally (Figure 2). We generally dissected this vessel completely and divided it. The L5 root often runs in close proximity to this branch and should be identified. In cases where the ascending branch is left intact, one must be cognizant to avoid undue traction on the left iliac vein, as major hemorrhage can result from minor injuries. Use of the bipolar cautery may reduce the chance of inadvertent damage to nerve fibers. Retroperitoneal lymphatics must be ligated if crossed. When exposure of only the L5-S1 disk space was needed, we generally performed a right paramedian incision. This spared the left retroperitoneum for recurrent disease of the L5-S1 disk or subsequent disk involvement at higher lumbar levels. For exposure of the L5-S1 disk, it is usually easy to dissect between the iliac vessels, specifically the right common iliac vein (RIV) and left common iliac artery (LIA). Note the use of the Syn-Frame self-retaining retractor (Synthes-Retractor System; Synthes, Paoli, Pa).

RESULTS

From April 2002 to March 2004, 344 lumbar disk procedures were performed at Yale–New Haven Hospital; of these, 193 (56%) were performed by orthopedic surgeons and 151 (44%) by neurosurgeons. Two hundred eighty patients (81%) were approached posteriorly, 60 (17%) underwent anterior lumbar approaches, and 4 (2%) underwent both anterior and posterior approaches (Figure 4).
Of the open retroperitoneal approach for anterior spinal exposure, 35 (55%) were performed on men and 29 (45%) on women (Table 1). The average patient was 43 years of age (range, 25-89 years). Fifty patients (78%) required lumbosacral (L5-S1) approaches, and 14 (22%) required access to purely lumbar disk spaces (L1-L5). Forty-three patients underwent single-disk approaches, and 21 required access to either multiple levels (2-3 levels). Forty patients (63%) underwent anterior lumbar interbody fusion, and 22 (34%) had an artificial disk replacement (Prodisc; Synthes).

Ninety-seven percent of all attempted retroperitoneal exposures were successful. Two patients had the operation aborted because of the inability to safely mobilize the iliac veins off of the spine secondary to old scar tissue. One patient was a 33-year-old man with a history of previous L5-S1 diskectomy, and the other was a 42-year-old woman with a history of perforated appendicitis. Two iliac veins were torn intraoperatively but were repaired at the time of the initial surgery, with subsequent successful completion of the orthopedic procedure. Three ureteral stents (5%) were placed preoperatively because of previous pelvic surgery. One of these patients had 13 previous spinal surgeries, and although a ureteral stent was placed preoperatively, she suffered a ureteral tear, which was repaired by the urologist in a retroperitoneal manner.

There were no mortalities, but the postoperative course was complicated in 8 patients (14%) (Table 2). Four patients had a postoperative fever; 1 patient who was undergoing anterior lumbar interbody fusion secondary to a lytic lesion from metastatic lung cancer developed pneumonia, a second patient had urinary retention that resolved after several additional days of Foley catheter drainage. An additional 2 patients had spinal headaches that resolved with conservative management. One patient was treated with antibiotics for a Clostridium difficile infection, and 1 patient developed a postoperative ileus that resolved after several days of nasogastric decompression. The mean±SD length of stay was 4±2.2 days (range, 2-22 days).

### Table 1. Patient Demographics of Patients Who Underwent an Anterior Retroperitoneal Exposure

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Average (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>43 (25-89)</td>
</tr>
<tr>
<td>Men</td>
<td>44 (25-66)</td>
</tr>
<tr>
<td>Women</td>
<td>42 (27-89)</td>
</tr>
<tr>
<td>No. of disk spaces</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>43 (67)</td>
</tr>
<tr>
<td>Multiple</td>
<td>21 (33)</td>
</tr>
<tr>
<td>Location of exposure</td>
<td></td>
</tr>
<tr>
<td>L1-L2</td>
<td>6 (7)</td>
</tr>
<tr>
<td>L2-L3</td>
<td>9 (11)</td>
</tr>
<tr>
<td>L3-L4</td>
<td>6 (7)</td>
</tr>
<tr>
<td>L4-L5</td>
<td>21 (26)</td>
</tr>
<tr>
<td>L5-S1</td>
<td>39 (48)</td>
</tr>
</tbody>
</table>

### Table 2. Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>No (%) of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inability to complete procedure</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Intraoperative vascular injury</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Ureteral injury</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Postoperative fever</td>
<td>8 (14)</td>
</tr>
<tr>
<td>Spinal headaches</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Clostridium difficile infection</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

Anterior exposure of lumbar disks has become an increasingly popular approach to the treatment of disk disease. This strategy has several advantages over the posterior approach, including the reduced incidence of nerve damage, the avoidance of paraspinal muscle trauma, the ability to get a more complete disk excision and therefore placement of a larger interbody fusion device, and decreased hospital course.1

Potential complications of the anterior approach are numerous because of the anatomic structures. These include retrograde ejaculation, impotence, retroperitoneal fibrosis, rectus muscle hematoma, pancreatitis, femoral nerve palsy, pseudomeningoele, and latissimus dorsi rupture.2-14 Some authors offer patients the option to preoperatively bank sperm because of the increased potential for autonomic nerve compromise during the dissection.15 To date, we have not noted these complications in our patients and have only had the postoperative course complicated by fever, urinary retention, spinal headache, *C difficile* colitis, and ileus in our patients. One study reviewing 1310 consecutive cases for anterior exposures of L2-S1 revealed a 0.45% incidence of left iliac artery thrombosis. It also reported a 1.4% incidence of major vein lacerations, which is comparable to our incidence of 3%.16

Minimally invasive techniques for lumbar corpectomy and anterior reconstruction and laparoscopic retroperitoneal exposures and discectomies with anterior lumbar fusions have been described.15,17 Zdeblick and David1 reported their experience with 50 patients who
underwent either a laparoscopic transperitoneal approach or an open retroperitoneal one. They found a significantly higher incidence of complications in the laparoscopic group (4% vs 20%) and a tendency for decreased exposure resulting in limited fusions. Operative time and hospital time were not significantly different. Other groups have reported that the transperitoneal approach confers a 10-fold increased risk of retrograde ejaculation compared with the retroperitoneal approach for exposures of L4 through S1.

Balloon-assisted endoscopic retroperitoneal gasless techniques for anterior lumbar interbody fusion have also been described. The retroperitoneal space is accessed similarly to the technique of total extraperitoneal laparoscopic hernia repairs, via a balloon spacer and carbon dioxide insufflation. Also termed lumboscopic, this technique has the advantage of being performed with minimal invasively techniques and does not require violation of the peritoneum. A recent experience with 46 patients reported complications in 3 patients (7%), requiring hardware removal in 1 patient.

In summary, the open retroperitoneal exposure for anterior spine surgery is a technically challenging and rewarding technique. Because of the distinct advantages of accessing the entire disk as opposed to the posterior approach, as well as the emerging technique of spinal disk arthroplasty, demand for anterior lumbar procedures will only increase. To date, laparoscopy has not shown any advantage over the open technique; however, larger prospective randomized trials are still necessary. The lumboscopic approach is a promising new technique to gain access to the retroperitoneal space with complication rates similar to those of the open technique, and it has the theoretical advantage of decreased hospital stay and convalescent time, but experience is limited. Additionally, by approaching the spine from the right side, this approach theoretically maintains the aspect for repeat spinal access through the left side via a standard open retroperitoneal approach, should it be needed in the future. Open retroperitoneal exposure to the lumbar and lumbosacral vertebral bodies can be performed safely and should be in the repertoire of the orthopedic and vascular or general surgeon. Although some reports indicate that experienced orthopedic spine surgeons can have comparable complication rates, we believe a combined approach maximizes the various surgical skills of the orthopedic and vascular or general surgeon, reducing complication rates in anterior spinal surgery.

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Correspondence: Bauer Sumpio, MD, PhD, Department of Vascular Surgery, Yale University School of Medicine, 333 Cedar St, New Haven, CT 06504 (bauer.sumpio@yale.edu).
Previous Presentation: This study was presented at the annual meeting of the New England Surgical Society, October 1, 2004; Montreal, Quebec; and is published after peer review and revision. The discussions that follow this article are based on the originally submitted manuscript and not the revised manuscript.

REFERENCES


DISCUSSION

Benedict Cosimi, MD, Boston, Mass: Your approach to the retroperitoneal space is very similar to what we often use in kidney transplantation. Some of the long-term complications we see after that procedure can be impotence or genital femoral nerve injury. It was not clear to me how you followed your patients for these longer-term complications.

Dr Gumbs: We see our patients postoperatively and initially at 3, 6, and 12 months, and we follow them that way on an outpatient basis. We had a patient, I should mention, who did report transient retrograde ejaculation, which did resolve, but no one with impotence.

Joseph Meyer, MD, Concord, NH: We have been exposing the lumbar spine for about 17 years at our hospital and more recently we have used the lower midline approach for L5 disk space because we think it requires a smaller incision and also
reduces the risk of the innervation of the rectus muscle on the left side. We have had a couple of patients over the years who develop a bulge in the rectus muscle, not as a result of hernia but because of denervation in the muscle. I am wondering if you have experienced a problem if you have altered your technique at all.

Dr Gumbs: We have not experienced that. We actually make our incision lateral to the rectus sheath and then we are able to spare the muscle that way. We do this, I should mention, so that if we do need to do a reoperation, we still have the alternate side of the patient that has no scar tissue and is essentially virgin if a redo operation is needed.

William Cook, MD, North Andover, Mass: There is quite a long history of transthoracic spinal surgery. It goes back about 40-45 years and was first really popularized by a man named Hodgson in Hong Kong who was operating on a lot of patients with tuberculosis who had spinal collapse. One thing that I would say to you as a cautionary is that as you find that this works so well you may be tempted to go higher and higher in your exposures of the spine for various reasons, and I think it is worth remembering that there is a major arterial supply to the anterior spinal artery system at about T9-T10, and in patients in whom you operate on at that level, you should have some previous arteriography to know for sure that you are not going to interrupt something that is going to leave your patient with a paraplegia.

Dr Gumbs: Thank you.

James Hebert, MD, Burlington, Vt: Have you had any lymphoceles or lymphatic leaks, and if so, how have you managed those?

Dr Gumbs: We actually have not. I know it is common after transplant procedures, but we have not had it.

W. Hardy Hendren, MD, Boston: I would just comment that this is not a new concept. I can recall when Dr Joe Barr was the chief of orthopaedics at the Mass General, his asking me to provide this exposure for him and this was in about 1958, a long time ago. Also, I would comment that Dr John Hall, who has been the chief of orthopaedics at Children’s, where I have been for the last 20 years, has used retroperitoneal approach, even a thoracoabdominal one, and he does it himself with great skill and a very low complication rate as an orthopedic surgeon. He does not call for us to help him. He does not need it.

Dr Gumbs: I know some orthopedic surgeons have a vast amount of experience. I think the use of a vascular surgeon or general surgeon who has more experience in this area in case they do get into trouble is better overall for patient care.