

## Percutaneous Discectomy: An Anatomical Study

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Percutaneous discectomy is a viable alternative in the treatment of herniated intervertebral discs of the lumbar spine. Anatomical analysis of the retroperitoneal surgical path utilizing computed tomography suggests that the risk of vascular injury is negligible at the L-4, L-5 level, but substantial at the L-5, S-1 level. In addition, one-third of patients otherwise suitable for percutaneous discectomy have segments of bowel obstructing the surgical path. Obtaining an abdominal computed tomographic scan with the patient in the surgical position seems to be a valuable screening technique in the evaluation of candidates for this procedure. (*Neurosurgery* 16:141-147, 1985)

Key words: Back pain, Computed tomography, Intervertebral disc displacement, Lumbar disc surgery, Percutaneous discectomy, Retroperitoneal anatomy

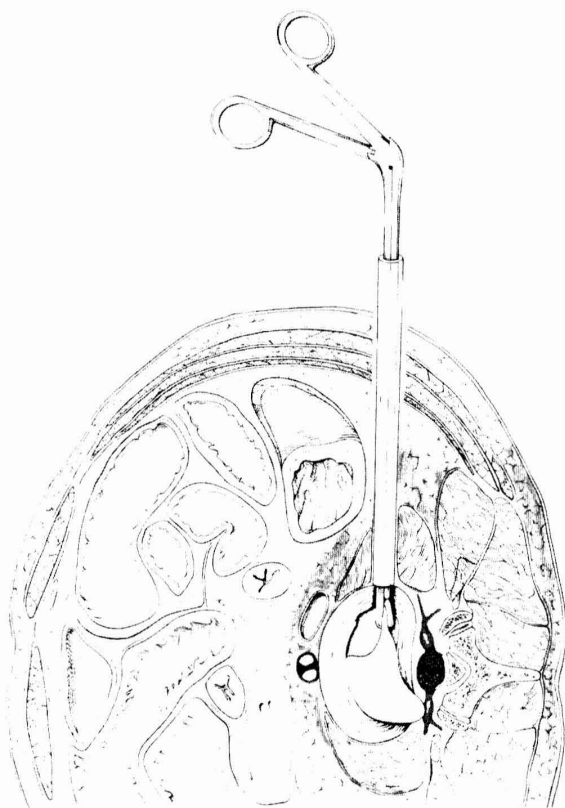


FIG. 1. Drawing of a cross section of the abdomen at the level of the L-4, L-5 interspace with a 40 French chest tube inserted just above the iliac crest and positioned at the lateral aspect of the disc space. Note the specially lengthened rongeur positioned to remove disc material in piecemeal fashion. The symptomatic side is down and the surgical approach is through the asymptomatic side. This is necessitated by the angle of the surgical instruments. (From Friedman WA: Percutaneous discectomy: An alternative to chemonucleolysis? *Neurosurgery* 13:542-547, 1983.)

### INTRODUCTION

Recently, less invasive alternatives for the treatment of herniated intervertebral discs of the lumbar spine have been widely publicized. The most well-known of these approaches is the intradiscal injection of a chemonucleolytic agent. At the University of Florida, another procedure has been used on selected patients for the treatment of lumbar herniated

discs. This procedure, called percutaneous discectomy (PD), involves an approach to the L-4, L-5 herniated nucleus pulposus via a 40 French chest tube inserted through the patient's side just above the iliac crest (Fig. 1). The tube is passed through the retroperitoneal soft tissues and the psoas muscle and is carefully positioned with fluoroscopic guidance at the lateral border of the intervertebral disc. Specially lengthened instruments are then inserted through the chest tube to re-



FIG. 2. Abdominal CT scan, immediately above the level of the iliac crest passing near the L-4, L-5 interspace, obtained with the patient in the supine position. The aorta and inferior vena cava (arrowheads) are ventral to the vertebral body. They present no obstruction to a lateral approach to the disc space through the psoas muscle (wide arrows). The aorta, as in this case, is frequently calcified.

move the disc in piecemeal fashion. The total surgical time is approximately 15 minutes. At the writing of this paper, 15 patients have undergone this procedure at the University of Florida. The details of the operative technique as well as selection of patients and postoperative results have been discussed by Friedman (1). The potential disadvantages of PD involve the possibility of damage to structures located in the retroperitoneal surgical path. Catastrophic complications could result from damage to the major vessels (aorta, inferior vena cava, iliac vessels) or the bowel. This study was undertaken to assess the potential incidence of these problems.

#### MATERIALS AND METHODS

Thirty-five abdominal computed tomographic (CT) scans at the level of the lumbar spine were analyzed. Twenty-five CT scans of supine patients with abdominal complaints were obtained using a Phillips Tomoscan 310 body scanner (Phillips Medical Systems, Inc., Shelton, Connecticut). All were officially interpreted as normal by a staff radiologist. Care was taken to exclude abdominal CT scans of patients who were under 18 years old or that revealed evidence of previous abdominal operation. The slice selected for analysis was at or immediately adjacent to the iliac crest, thus passing near the L-4, L-5 interspace (Fig. 2).

Five scans were obtained as above, but the slice selected for analysis was approximately at the level of the L-5, S-1 interspace (Fig. 3). Five scans were of patients who were selected

for PD according to criteria previously described (1). After the oral administration of meglumine diatrizoate (Gastrografin; E. R. Squibb & Sons, Princeton, New Jersey), these abdominal CT scans were obtained with the patient in the surgical position (i.e., in the lateral decubitus position). The slice selected for analysis was at the level of the L-4, L-5 intervertebral disc (Fig. 4).

All 35 scans were subjected to the following anatomical analysis. The midpoint of the intervertebral disc or vertebral body was approximated and used as the anatomical reference point (M). A straight line (H) was drawn through Point M dividing the slice into anterior and posterior segments. Next, a series of lines was drawn through Point M and tangent to the dorsal and ventral margins of each of the following abdominal structures: right psoas muscle, right vascular complex, left vascular complex, left psoas muscle. The right vascular complex consisted of either the inferior vena cava (at L-4, L-5) or the right common iliac vessels (at L-5, S-1) depending on the level of the CT slice. The left vascular complex consisted of either the aorta or the left common iliac vessels. The angle that each line made with Line H was recorded. Subsequently, the span (number of degrees between the lines tangent to the dorsal and ventral borders) of each structure (RPS, RVS, LVS, LPS) relative to the midpoint of the disc was calculated, and the overlap of muscular and vascular structures (RPVD, LPVD) was determined (Fig. 5 and Table 1).

In addition to the 35 scans studied as above, 8 abdominal CT scans obtained from prospective surgical candidates in



FIG. 3. Abdominal CT scan, approximately at the level of the L5, S-1 interspace, obtained with the patient in the supine position. The iliac vessels (*arrowheads*), partially calcified, course along the medial aspect of the psoas muscles (*wide arrows*) and present an obstruction to a lateral approach to the disc space.

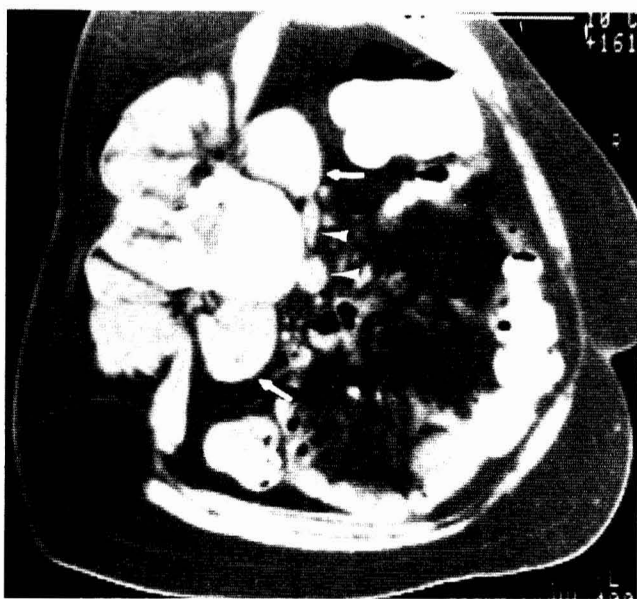


FIG. 4. Abdominal CT scan, at the level of the L-4, L-5 interspace, obtained after the oral administration of contrast medium with the patient in the surgical position for a right-sided approach to the intervertebral disc. Neither the major vessels (*arrowheads*) nor segments of bowel present an obstruction to the retroperitoneal surgical path on the right side. The psoas muscles are indicated by the *arrows*.

the surgical position were analyzed to define the relation of the bowel to the path of the size 40 French chest tube (Fig. 1). This was accomplished by drawing a line through Point M and tangent to the dorsal border of the most dorsally located segment of bowel. The angle that this line made with Line H was recorded.

## RESULTS

The data gathered from the 25 abdominal CT scans obtained near the L-4, L-5 level with the patient in the supine position (supine crest position) are presented in Figure 6. The right and left psoas spans were relatively constant among the 25 patients: mean spans were 60° on the right and 62° on the left. Although little overlap between the right psoas muscle and the right vascular complex was found, these structures were closely apposed. No overlap was noted between the left psoas muscle and the left vascular complex. The mean difference between the ventral border of the right psoas muscle and the dorsal border of the right vascular complex was 1°, whereas the comparable value on the left side was 18°.

The data gathered from the five abdominal CT scans obtained at the L-5, S-1 level with the patient in the supine position are presented in Figure 7. The right and left psoas spans were relatively constant among the patients: mean spans were 47° on the right and 51° on the left. Considerable overlap between the right psoas muscle and the right vascular complex was noted on every scan. Considerable overlap was also noted between the left muscular and vascular structures.

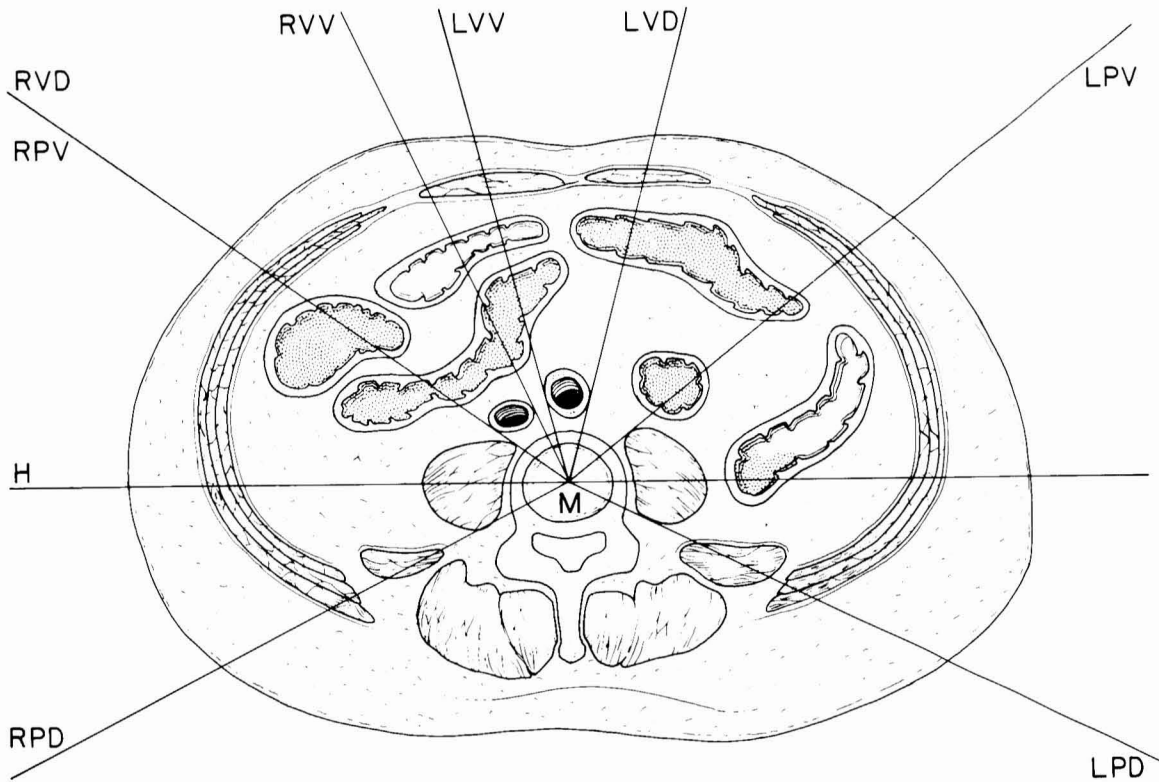


FIG. 5. Grid used for anatomical analysis superimposed on a drawing of a cross section of the abdomen at the level of the L-4, L-5 intervertebral space. The psoas muscles may be seen on either side of the vertebral body. The major vessels are immediately ventral to the vertebral body. Important anatomical landmarks are identified with the appropriate abbreviations (see Table 1).

TABLE 1  
Abbreviations Used in Anatomical Analysis for PD<sup>a</sup>

Abbreviation	Descriptive Name
M	Midpoint of vertebral body
H	Horizontal (line passing through point in the coronal plane)
RPD	Right psoas dorsal
RPV	Right psoas ventral
RVD	Right vascular dorsal
RVV	Right vascular ventral
LVV	Left vascular ventral
LVD	Left vascular dorsal
LPV	Left psoas ventral
LPD	Left psoas dorsal
RPS	Right psoas span
RVS	Right vascular span
LVS	Left vascular span
VS	Vascular span
LPS	Left psoas span
RPVD	Right psoas-vascular difference
LPVD	Left psoas-vascular difference
RCD	Right colon dorsal
LCD	Left colon dorsal

<sup>a</sup> See Figure 5.

The data gathered from the five abdominal CT scans obtained at the level of the L-4, L-5 intervertebral disc in the surgical (lateral decubitus) position are presented in Figure 8. The muscular-vascular relationships illustrated in these graphs are similar to those described above for the 25 scans near the

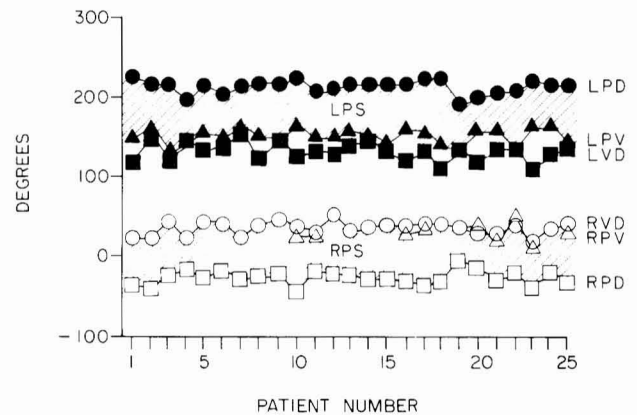


FIG. 6. Graphic relationship of retroperitoneal muscular and vascular structures near the level of the L-4, L-5 interspace with the patient in the supine position. The psoas span is shaded. Little or no overlap is present between the psoas muscle and the dorsal borders of the vascular structures (RVD, LVD) on either side. (See Table 1 for definition of labels.)

L-4, L-5 level in the supine position. An important feature of the scans obtained in the surgical position is the relationship of the bowel to the path of the 40 French chest tube. It is inconsequential to analyze the presence and relative location of bowel in the supine scans because the bowel may shift position when the patient is placed in the surgical position. It is of the utmost utility to perform this analysis on scans obtained in the surgical (lateral decubitus) position because

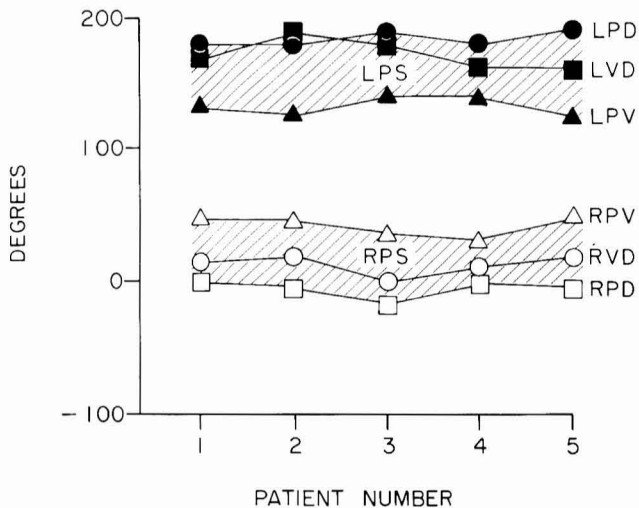


FIG. 7. Graphic relationship of retroperitoneal muscular and vascular structures near the level of the L-5, S-1 interspace with the patient in the supine position. The psoas span is shaded. Considerable overlap is present between the psoas muscle and the dorsal borders of the vascular structures (RVD, LVD) on both sides. (See Table 1 for definition of labels.)

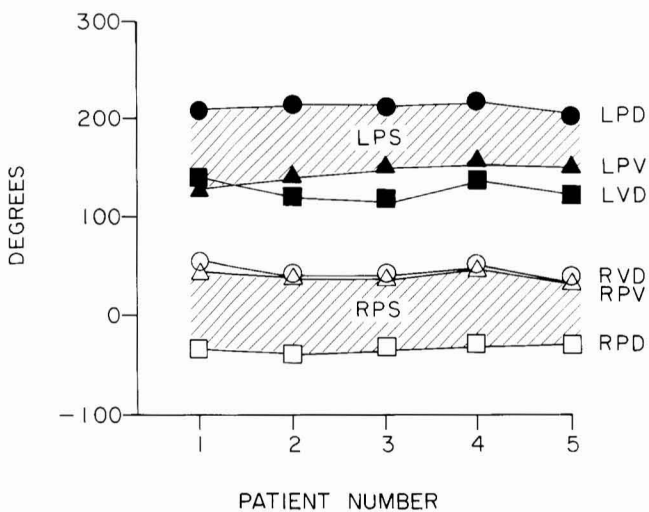


FIG. 8. Graphic relationship of retroperitoneal muscular and vascular structures near the L-4, L-5 interspace with the patient in the surgical position. (See Table 1 for definition of labels.)

the information will be vital in determining whether the surgical path is clear.

The data gathered from the eight abdominal CT scans obtained from prospective surgical candidates in the surgical position are presented in Table 2. Four patients were unacceptable candidates because a loop of bowel was too close to the path of the 40 French chest tube by subjective evaluation. Retrospectively, the angle between Line H and the dorsal border of the bowel was determined in these eight scans. A positive number indicates that the dorsal border of the bowel is ventral to Line H; a negative number indicates that the dorsal border of the bowel is dorsal to Line H. In accepted candidates, the angle was zero or positive (Fig. 9) and, in unacceptable candidates, the angle was negative (Fig. 10). Although individual values provided little useful information

TABLE 2  
Position of Most Dorsal Bowel Segment in Candidates for PD

Percutaneous Discectomy Performed	Symptomatic Side <sup>a</sup>	Angle between H and Dorsal Border of Bowel <sup>b</sup>	Free Psoas Path <sup>c</sup>
Yes	L	+5	35
Yes	L	+2	42
Yes	L	+0	34
Yes	*	+8	40
No	R	-21	12
No	R	-2	35
No	L	-14	21
No	L	-20	12

<sup>a</sup> Asterisk indicates central disc herniation with bilateral symptoms.

<sup>b</sup> Positive numbers indicate that the bowel lies ventral to H. Negative numbers indicate that a segment of bowel lies dorsal to H.

<sup>c</sup> Free psoas path was calculated as the absolute value of the difference between the dorsal border of the most dorsally located segment of bowel and the dorsal border of the psoas muscle.

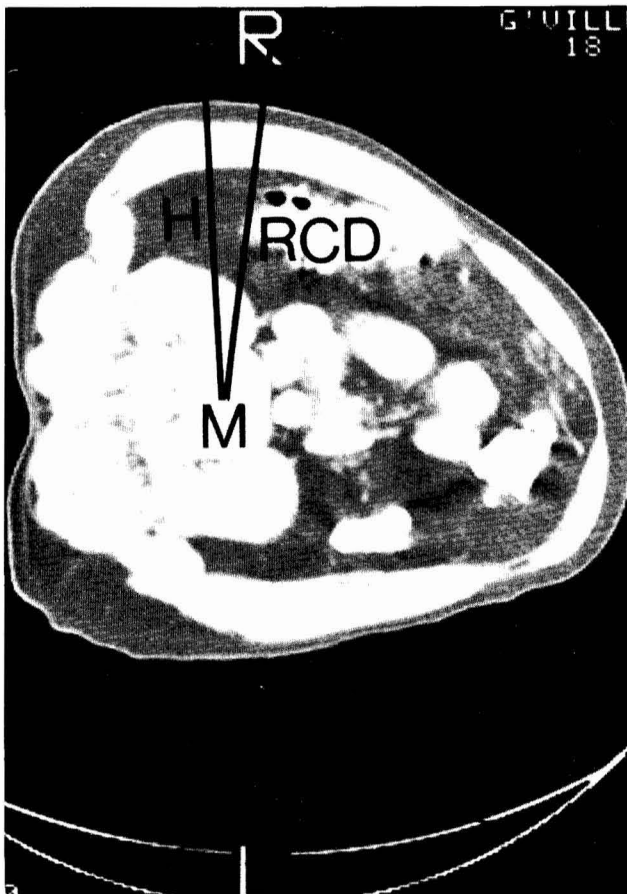


FIG. 9. Abdominal CT scan in the surgical position of a patient acceptable for PD. Note that the dorsal border of the bowel is ventral to Line H. (See Table 1 for definition of labels.)

the mean free psoas path (the absolute value of the difference between the dorsal border of the most dorsally located segment of bowel and the dorsal border of the psoas muscle) in accepted candidates was 38°; the same value in unacceptable candidates was 20° degrees.

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