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Depth-labeled lumbar disc forceps for safe lumbar disc surgery: Our experience with 405 patients

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Abstract

Injury of intraabdominal structures by rupturing the anterior longitudinal ligament is a known complication of discectomy. Despite its very low incidence, it has a high mortality. Although various minimally invasive methods are defined for discectomy, no significant reduction in this complication has been achieved. Positioning of the patient, aggressive discectomy, and deep-seated use of disc forceps are important risk factors. The aim of this study is to share our experience with modified instruments to minimize the risk of vascular and visceral injury during discectomy in surgically treated 405 patients with lumbar disc herniation. We routinely perform preoperative depth measurements at the level of lumbar disc herniations for the patients undergoing lumbar disc surgery and check the neighborhood with the prevertebral structures. During the operation, we perform discectomy with custom disc forceps that were labeled with centimeter measurements in accordance with these lengths. We performed discectomy on 405 patients using these forceps between January 2015 and May 2021. In this retrospective study, disc depth measurements differed according to disc levels and gender. Disc depth was longer in males at all lumbar disc levels. It is very important to avoid vascular and visceral injuries for spinal surgeons. For this reason, we believe that knowing the safe preoperative discectomy depth and area and using centimeter-labeled disc forceps is the best method to prevent such complications.

Keywords: vascular injury, bowel injury, ureter injury, safe discectomy, depth labeled disk forceps

1. Introduction

Posterior lumbar discectomy is the most common, best described and most experienced operation in spinal surgery (1, 2). Mortality and morbidity are low in lumbar discectomy, in which the most common complications are wound infection and CSF fistula (3). Although it is such a well-known surgical procedure, in the absence of intraoperative attention and care, retroperitoneal and intraabdominal organ injuries may occur, and it may become a nightmare for the surgeon. These are vascular injuries and hollow organ perforations such as bowel and ureter (4). Vascular complication rate during lumbar discectomy is 0.01% -0.06%. However, its mortality ranges between 40% -100% (5-9). The clinical presentation of vascular injuries may vary. For example, symptoms related to large artery injuries develop acutely due to excessive intraoperative blood loss, whereas arteriovenous fistulas and pseudoaneurysms may manifest themselves months and years later (10-13). Ureter and bowel injuries are less common and usually are not noticed intraoperatively. Postoperative abdomen and flank pain, hematuria and fever are observed in ureter injuries. Fever, abdominal pain, sepsis signs, air-fluid levels in the abdomen x-ray, wound infections, discitis and peritonitis symptoms suggest intestinal perforation (1, 2, 4, 14-17).

Defects in the anterior longitudinal ligament, adherence of organs to the anterior longitudinal ligament, surgery for recurrences, aggressive and deep discectomy, obesity, previous intraabdominal surgery, and prone surgical position which causes an increase in intraabdominal pressure are the factors that are blamed for these complications with high mortality during lumbar discectomy (4, 18, 19). Anterior longitudinal ligament defect may have occurred preoperatively or by instruments used during discectomy. To prevent intraoperative visceral organ injury from this defect and to perform a safer discectomy, the disc forceps were marked with centimeter measurements by the author. The aim of this retrospective study is to present the labeled disc forceps and to share our experience with the patients we operated with these forceps.

2. Materials and Methods

405 patients who underwent lumbar discectomy with depth-labeled disc forceps in our clinic between January 2015 and May 2021 were included in the study. The patients' gender, age, discectomy levels, posterior-anterior (1st length) and posterior-oblique (2nd length) disc depths were evaluated retrospectively from digital patient files and PACS system. (Fig. 1, Fig. 2). This study was approved by Amasya University Non-Interventional Clinical Research Ethics Committee (date/decision no: 03.06.2021/81).

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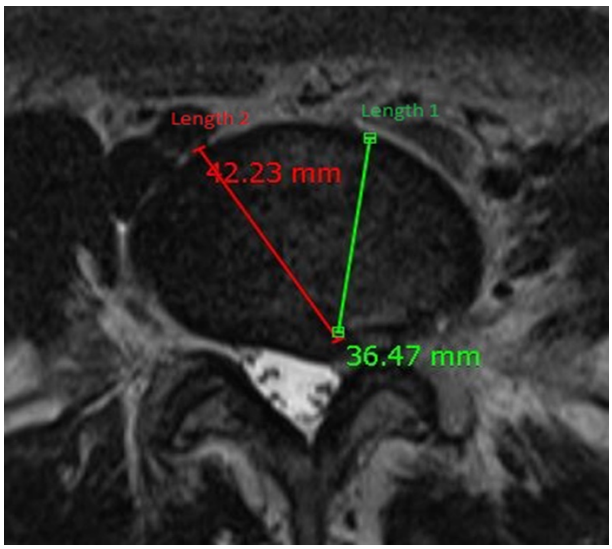

Fig. 1. Depth measurements on the left at L4-5 disc level

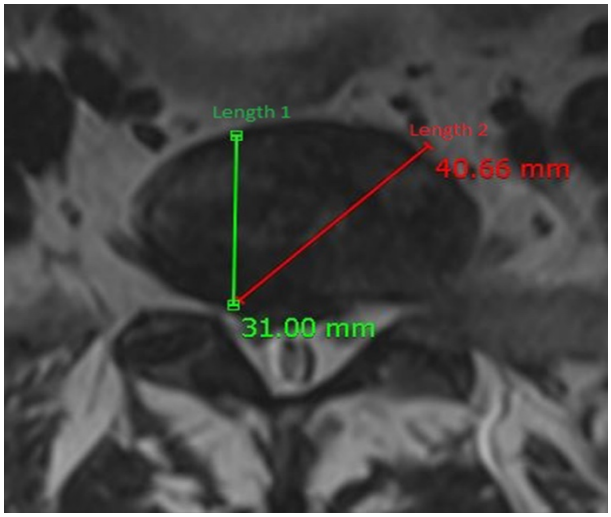

Fig. 2. Depth measurements on the right at L5-S1 disc level

2.1. Our preoperative evaluations

MRI examination was performed on all patients with lumbar disc herniation for which we decided to operate. T2 axial sections passing through the level with disc herniation were examined. Depth from the posterior longitudinal ligament where it will be opened for discectomy to anterior disc margins were measured vertically and obliquely. The relationships between anterior disc boundaries and visceral structures were evaluated (Fig. 1, Fig. 2).

2.2. How we do discectomy

When the patient is placed in the prone position on the operating table, silicone pads are placed slightly laterally to avoid an increase in intra-abdominal pressure. The lumbar disc forceps are marked with numbers and lines up to 5cm with laser engraving. Each line on the instruments corresponds to a centimeter, and the numbers correspond to half centimeters. In other words, the place where we see the number 4 points to 3.5 cm, and the line above the number 4 points to 4 cm. (Fig. 3). In addition, this marking encircles the instrument in 360 degrees; It can be easily seen from the right, left, bottom and top. In our operations, we used these disc forceps. We performed discectomy in accordance with the measurements we made in preopoperative axial MRI sections. (Fig. 4). We usually used disc forceps in 3-4mm less depth than these measurements. (Fig. 5). We did not expand our discectomy window in the posterior longutinal ligament towards the midline as much as possible. In this way, we created a safe discectomy area in the depth of the disc level and in the oblique direction towards the contralateral side.

Fig. 3. Depth-labeled disc forceps (measurements in centimeter)

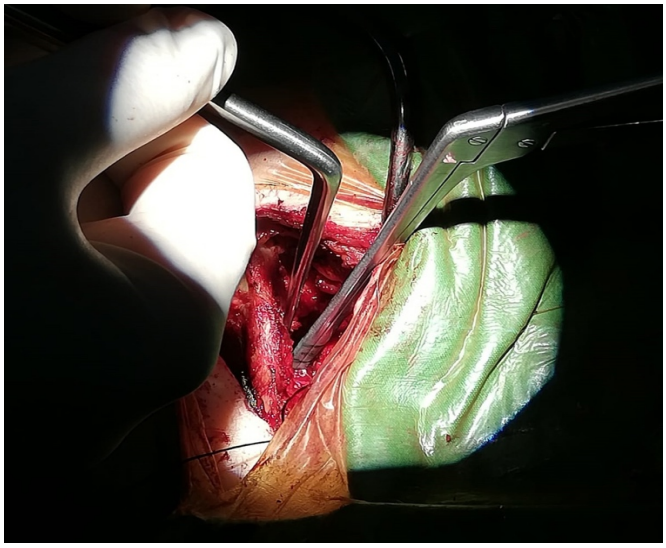

Fig. 4. Discectomy at 3.5 cm depth

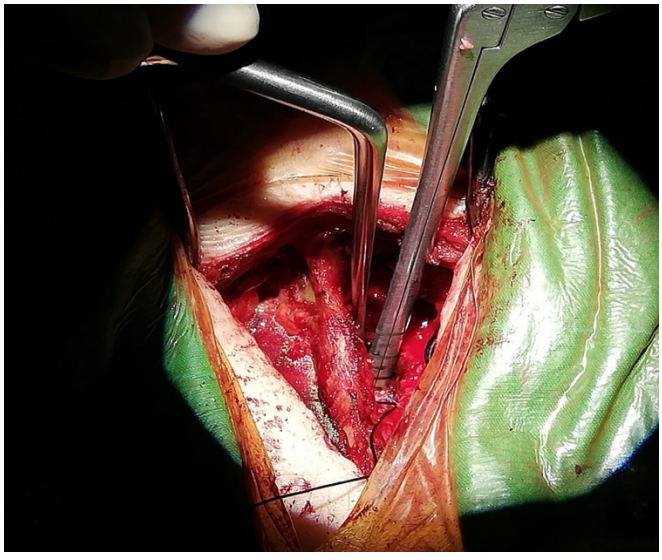

Fig. 5. Discectomy at 2.5 cm depth

3. Results

215 (53%) of the patients were female and 190 (47%) were male. The mean age was 50.6 (23-82) years, 49.67 years for women and 51.7 years for men. 4 patients were operated at

L2-3, 68 patients at L3-4, 163 patients at L4-5 and 170 patients at L5-S1 level. The patients were followed up for an average of 33.3 (65-0.3) months postoperatively. (Table 1). The detailed results of the 1st and 2nd lengths of the disc levels in male and female patients who underwent discectomy, are presented in Table 2. Disc depths were longer in males at all levels. Although the average lengths of each disc level were measured, there were significant differences between the longest and shortest measurements. For example, the 1st and 2nd longest measurements for women were 46.75 mm and 52.48 mm at L5-S1 level, respectively, and 51.37 mm and 56.51 mm at L4-5 level for men. The shortest measurements were 23.91 mm and 30.13 mm at the L5-S1 level for women, and 28.95 mm and 33.45 mm at the L5-S1 level for men. In the postoperative follow-up of the patients, no clinical complaints of vascular, ureter and intestinal injuries were detected.

Table 1. General characteristics of the patients

Discectomy level	Female (215/ 53%)	Male (190/47%)	Total (405)
L2-3	3	1	4
L3-4	38	30	68
L4-5	84	79	163
L5-S1	90	80	170
	215	190	405
	Average age (years)		Postoperative follow-up (month)
Female	Male	Overall	
49.6 (23-82)	51.7 (25-76)	50.6 (23-82)	33.3 (65-0.3)

Table 2. Measurements at herniated disc levels by gender

	Female		Male	
Herniated disc level	Length 1 (mm)	Length 2 (mm)	Length 1 (mm)	Length 2 (mm)
L2-3	31.73 (36.85-27.13)	39.52 (45.02-36.1)	36.04	40.19
L3-4	33.93 (42.70-26.50	39.34 (49.88-32.39)	38.33 (45.96-33.71)	42.88 (49.32-37.23)
L4-5	34.23 (43.13-26.86)	39.46 (49.1-30.15)	37.80 (51.37-31.11)	43.59 (56.51-33.48)
L5-S1	34.10 (46.75-23.91)	39.96 (52.48-30.13)	35.60 (44.47-28.95)	41.65 (55.11-33.45)

4. Discussion

Regardless of the technique performed, posterior lumbar discectomy is generally considered a reliable surgical procedure. Although prevertebral injuries during discectomy are very rare, they are well-defined complications (11). Suspicion, early diagnosis and timely interventions for these intraoperative and/or postoperative complications are lifesaving. Otherwise, mortality is high (18, 20, 21).

Prevertebral vascular injury as a complication of posterior lumbar discectomy was first reported in 1954 by Linton and White (22). Later, bowel and ureter injuries were presented in the literature, but they were less common (1, 2, 4, 17, 23, 24, 25, 26, 27, 28). It is interesting that although microscopic discectomy techniques are widely used today, there is no evidence that such complications have been reduced (29). Visceral organ and vascular injuries are mostly available as case reports in the literature.

Vascular injuries are most common at L4-5 and L5-S1 levels. The most commonly injures structure is the contralateral common iliac artery. This is followed by injuries in the external iliac artery, inferior vena cava and aorta, respectively (5, 18, 30, 31). Intestinal injuries are most associated with L5-S1 discectomies (4, 15, 23). The prone knee-chest position, which increases the anatomical convergence between the intestines and the vertebral column due to increased intraabdominal pressure, and previous abdominal surgery increases the risk of complications (4, 20, 21). Ureter injuries are most common in the contralaterally located ureter at the L4-5 level (25, 32). We act in accordance with the recommendations in the literature by minimizing the increase in intra-abdominal pressure positionally in our operations.

In prevertebral injuries during discectomy, crossing the anterior longitudinal ligament at the anterior or contralateral side following deep placement of the disc forceps is the most blamed cause (21, 33). In routine practice, the depth of intraoperative disc forceps is adjusted based on the surgeon's experience. However, for a surgeon who has performed more than 15,000 discectomies, 3 cases of vascular injury complication cannot be ignored (34). Surgical microscope and magnification loops, which are widely used today, may cause overestimation of the intervertebral disc depth (35). When the desire for aggressive discectomy is added, crossing the anterior longitudinal ligament and prevertebral injuries are inevitable (36). Thus, Nilsonne and Hakelius (37) radiologically demonstrated that the disc forceps were inserted too deep during discectomy to minimize the risk of recurrent disc herniation, resulting in vascular and visceral organ injury. Anda et al. (38) found that the sagittal diameter of the L3-4, L4-5 and L5-S1 intervertebral discs was between 33mm and 56mm and suggested that advancing the disc forceps less than 30mm (3cm) would prevent vascular and visceral organ injury. Schwartz and Brodkey (39), reported that the safe discectomy depth was 2.85 cm. Antar et al. (40) found different depths at each disc level for each person and proved that the disc depth was greater in men than in women. In our study, we found that disc depths were very different both between disc levels and between genders. Therefore, we did not insist on a fixed depth. In addition, disc depths were longer in males than females, consistent with the literature.

In very few anatomical and clinical studies in the

literature, authors recommended marking the disc forceps to prevent vascular and visceral organ injuries in the prevertebral region and adjusting the depth using patient-based measurements during discectomy (24, 38, 40, 41). However, this is only a suggestion, and there is no report about the routine use of depth-labeled disc forceps. In addition, there are no length-measuring disc forceps in the catalogs of companies that produce surgical instruments in our country. In this sense, the disc forceps in the laminectomy sets in our clinic were marked with cm measurements by the author, and their routine use in discectomy operations was ensured by preoperative disc depth measurements of all patients. No evidence of vascular, ureter and intestinal injury was found in 405 patients who underwent discectomy in this way and followed up for an average of 33.3 months postoperatively.

Vascular, bowel and ureter injuries during discectomy are complications that cause nightmare for spinal surgeons. To avoid this disastrous complication, we recommend routinely measuring the intervertebral disc depth preoperatively, marking the existing disc forceps with depth measurements, having the new ones to be manufactured in the same way, thus performing discectomy within the safe area.

Conflict of interest

None to declare.

Acknowledgments

None to declare.

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