



# How I do it: bilateral lumbar spinal canal microsurgical decompression via unilateral approach

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## Abstract

**Background** Bilateral lumbar spinal canal decompression via unilateral approach is a surgical way to treat degenerative spinal canal stenosis.

**Method** We report the treatment of degenerative lumbar spinal canal stenosis by removing overgrown ligaments, bone, and other compromising tissue on both sides of the spinal canal, using one side approach, avoiding surgical trauma of the counter side of the spine.

**Conclusion** This technique allows to achieve perfect results using common microsurgical instruments and Caspar distractor for one or multilevel surgery.

**Keywords** Microsurgical spinal canal decompression · Degenerative lumbar spine stenosis · Surgical technique

## Relevant surgical anatomy

Degenerative lumbar spine stenosis (LSS) involves overgrowth of facet joints (FJ) with formation of osteophytes and synovial cysts. They compromise spinal canal size and compress neural structures together with hypertrophy of yellow ligaments (YL) and epidural fat.

Concomitant canal narrowness or degenerative spondylolisthesis additionally diminishes the canal. These are the reason of central and lateral stenosis leading to claudication and back pain.

LSS can be evident and symptomatic due to one or multi-level changes.

The convenient anatomical and surgical division of the structures includes homo- and contralateral structures, central and lateral canal, and cranio-caudal divisions: disc level, cranial, and caudal to the disc (Fig.1).

## Description of the technique

The surgery is performed in the prone position of the patient. Initial marking is done with X-ray to find the correct level. This minimally invasive spine surgery is performed using surgical microscope or head magnification ( $\times 3.0$  magnification is sufficient).

The skin incision is made in the posterior midline 2.5–3 cm long centralized at the disc that provides perfect cosmetic results. In the case of multilevel surgery, the incision is prolonged.

The lumbar fascia and aponeurosis are cut in curved line. The flap is retracted to the opposite side.

Gentle dissection of muscles makes the tunnel for Caspar distractor. We never cut the muscles from the vertebrae. The remnant fibers of the m.multifidus at the bottom of the wound are removed and the interlaminar space is cleared. As much as possible the muscle fibers are spared and laterally distracted.

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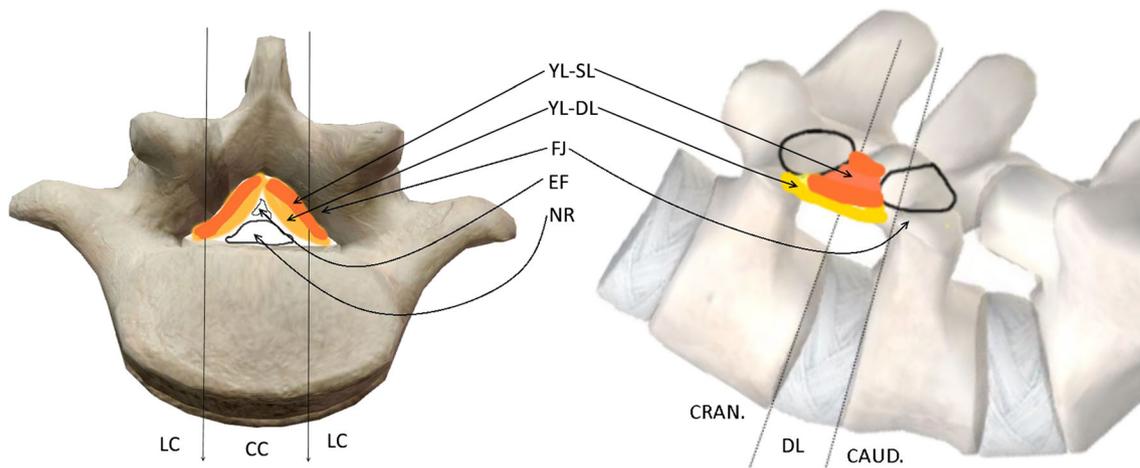
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**Fig. 1** Anatomical divisions and substrates of the stenosis. LC, lateral part of the canal; CC, central part of the canal; DL, disc level; CRAN, cranial level; CAUD, caudal level; YL-SL, yellow ligament superficial

layer; YL-DL, yellow ligament deep layer; FJ, facet joint; EF, epidural fat; NR, nerve roots

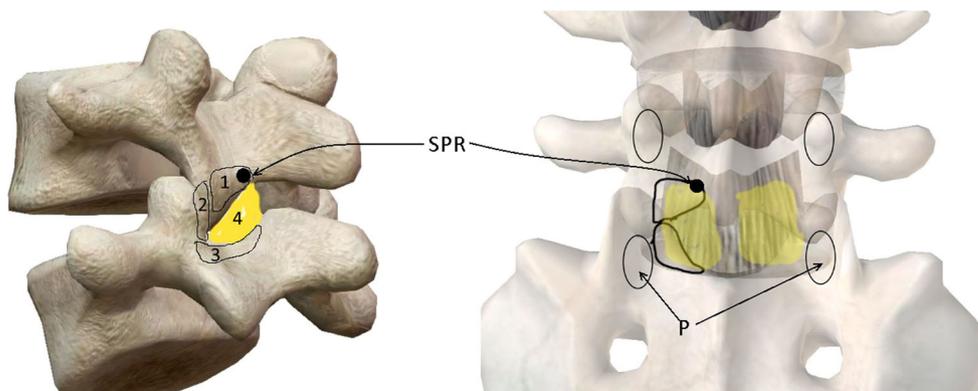
We start bone resection with diamond drill at the junction of the spinous process (SP) and cranial vertebra lamina. This point is the projection of the dorsal central spinal canal top and even in severe stenosis contains epidural fat and a little space. It helps avoid dural tear at the beginning of the resection, and this point is easy to find at the initial bone removal. The resection of the laminae extends cranially until the YL begins to free from the bone and the epidural space opens. The next step is the medial resection of the FJ. The key mark is the medial border of the caudal vertebra pedicle. If it is not achieved, the decompression of the lateral spinal canal is insufficient. Reaching the wall of the pedicle provides adequate decompression and protects from excessive FJ resection. Even in the case of hypertrophied both FJ and SP, the distance between them is more than 5–7 mm, which is sufficient for fine Kerrison punches and long shaft diamond burr not to affect or break the SP and perform decompression.

The caudal extension of the resection of the lower vertebra lamina reaches the middle of the pedicle. It provides the removal of overgrown joint and subarticular decompression (Fig. 2).

The bone resection goes up to the basis of the SP where the bone is resected over and through the outer layer of YL. The outer layers of the YL are detached after the bone resection and can be easily removed in big fragments with forceps, providing the clear view at the bottom. The dissection of the epidural space starts as well at the first point resection, giving safe detachment of deep layer of YL from the bone and underlying dura. In most cases, the YL are removed en bloc. The rest of the bone and YL are resected with Kerrison.

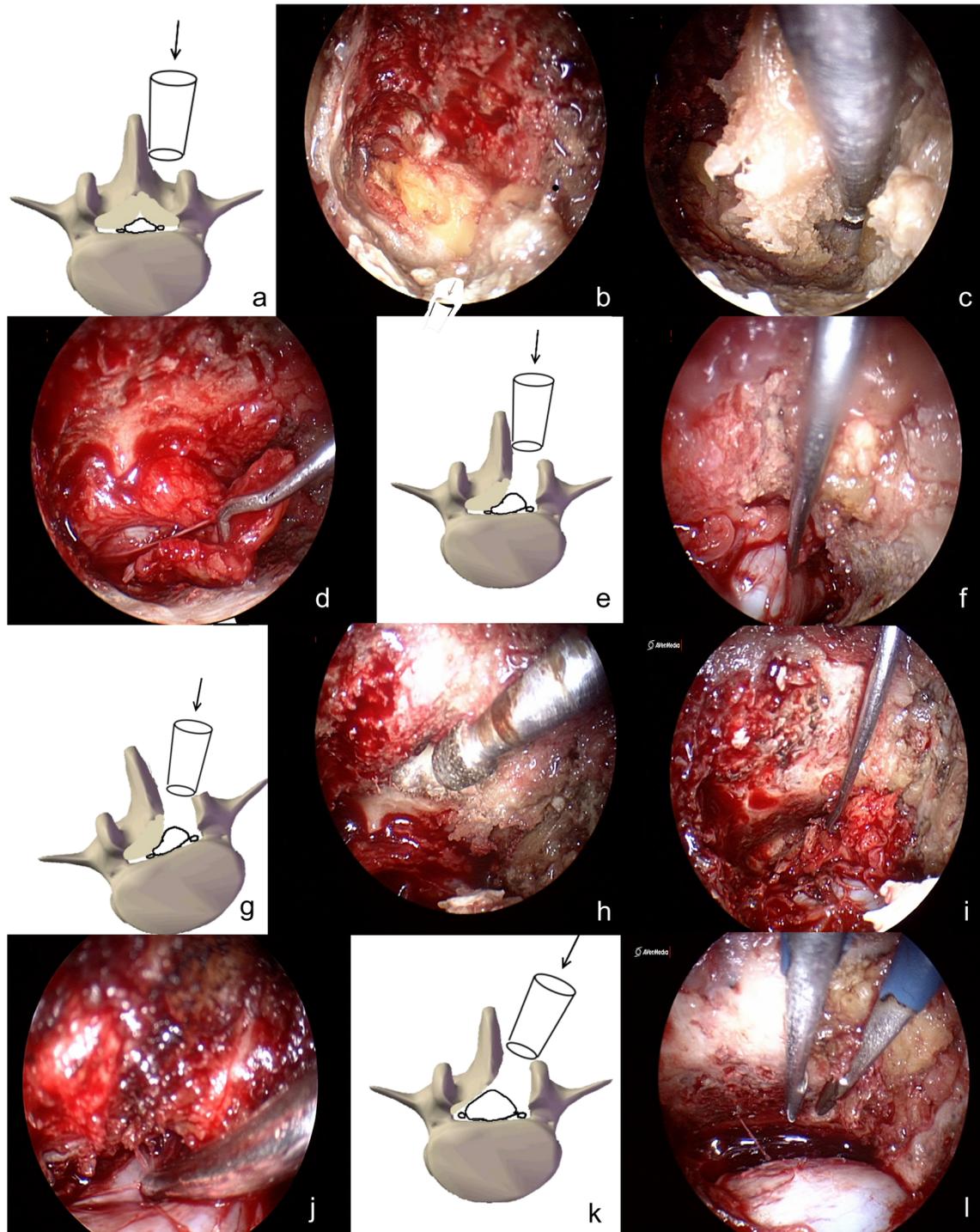
The contralateral bone resection is performed after patient rotation in the operator’s direction. This table rotation is up to 10–25 degrees and allows direct visualization of the contralateral part of the canal. We remove the bases of the SP and go over the top of the canal. The

**Fig. 2** Steps and borders of bone and ligament resection. SPR, start point of the resection; P, pedicles; 1,2,3,4, serial steps the resection



opposite YL protects the underlying dura when resecting bone. The medial resection of the opposite FJ reaches down the lateral canal. At this moment, the thinned basis of bone can be easily broken with rotation of dissector

and the bone is removed en bloc. After the bone resection, the opposite YL is also removed in one piece. The rest of the bone and the YL are resected with Kerrison punch. The free direct probing of the medial border of



**Fig. 3** Intraoperative steps. (a) Homolateral resection. (b) Resection of cranial lamina. (c) Resection of FJ and caudal lamina. (d) Resection of YL en bloc; (e), (f) Homolateral decompression. (g) Table rotation. (h)

Contralateral bone resection. (i) Resection of opposite YL en bloc. (j), (k) Contralateral decompression. (l) Synovial layer coagulation

the opposite pedicle is the key for adequate contralateral decompression (Fig.3).

In the case of two- or three-level surgery, the wound is packed with tough rolled napkin giving Caspar funnel the support at the adjacent level.

The wound is closed with active drainage.

## Indications

Traditional surgical treatments of LSS are laminectomy and bilateral FJ resection [2]. Bilateral iatrogenic surgical trauma to posterior structures (muscles, ligaments, and joints) seriously damages the biomechanics of the spine and leads to the progression of spine degeneration, instability, and postoperative pain [1]. Symptomatic LSS with claudication and radicular pain is the indication for

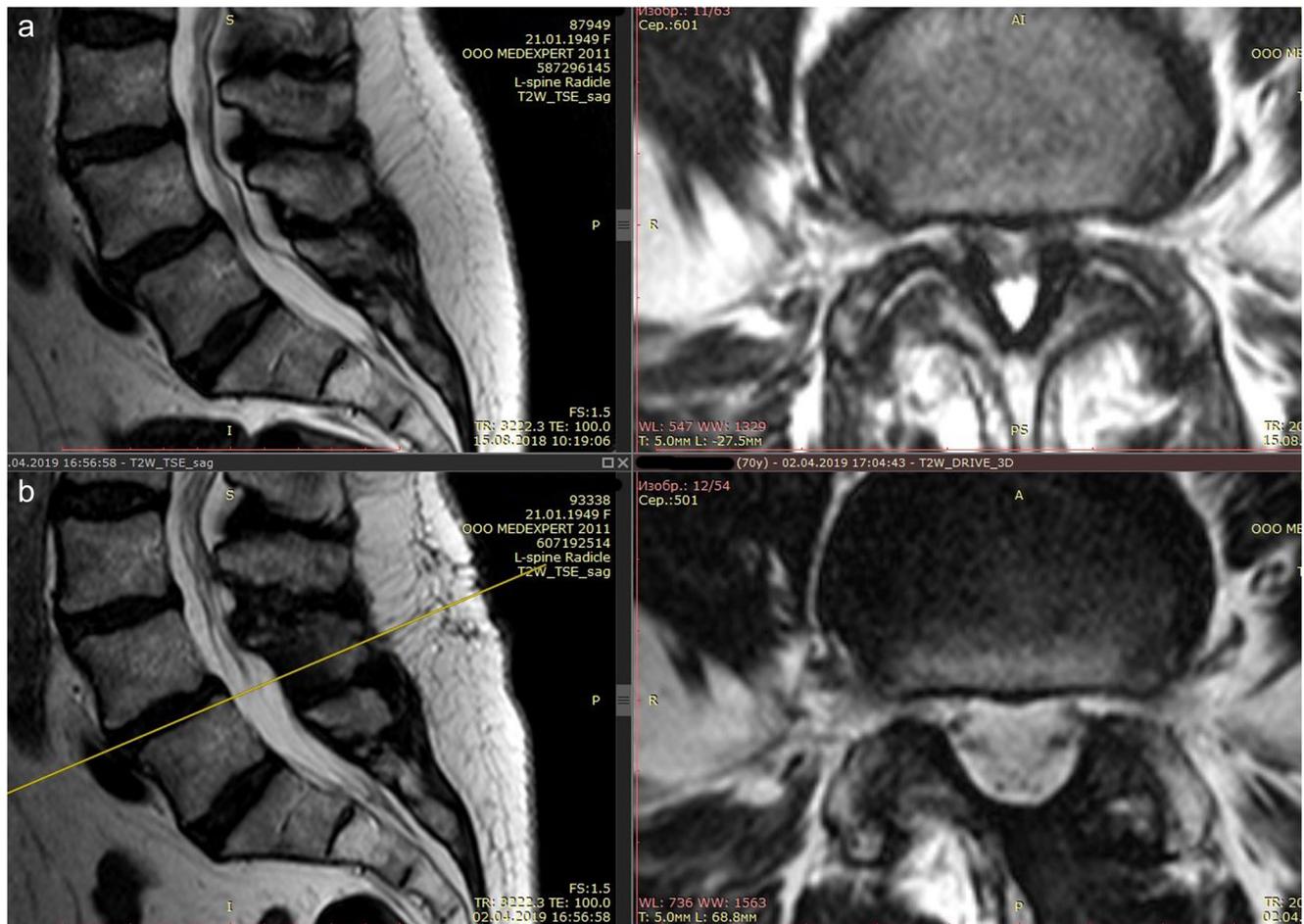
bilateral lumbar spinal canal decompression via unilateral approach [7] [9] [10].

The choice of number of levels to be operated in the case of multilevel stenosis depends on the preference of the surgeon and the patient, which is often elderly one. This technique allows easily simultaneous multilevel surgery.

The combination of LSS with low-grade spondylolisthesis is not the contraindication to this standalone bilateral decompression and is effectively treated without additional spinal instrumentation [5, 8] (Fig.4).

## Limitations

From the technical point of view, there are no real limitations to remove any bony or ligament tissue, causing LSS both on



**Fig. 4** MRI of degenerative multilevel lumbar spine stenosis with L4 spondylolisthesis, female, 69 years old. (a) Preoperative L4L5 level. (b) Postoperative L4L5 level

the side of the access, and on the opposite one in any case of severe stenosis. As well as it does not limit the number of levels for decompression.

## How to avoid complications

The most severe intraoperative complication is the dura tear and liquor leakage. This comes from a little space in the narrowed canal, that pushes the dura and it causes its interposition when resecting with Kerrison. The surgical trick is the special way of bone cutting: when bone resecting the jaws of the Kerrison punch should be closed in half way, and the rest of the bone is removed by breaking out with final rotation movement.

The second reason of dura damage is its adhesions with yellow ligament. It is often seen on the dorsal surface of the dura, mostly in the case of spondylolisthesis and previous instability. Anticipation of such possibility and meticulous preparation of dura and roots prevent the complication.

The late complication is the formation of synovial articular cysts causing root compression. The medial resection of FJ opens the articular cavity and promotes the synovial protrusion. The best way of prevention is obligatory electrocoagulation and shrinkage of synovial layer on both sides, especially on the contralateral one.

The special attention should be payed to the resection the midline portion of upper and lower laminae and attaching YL at this site in the case of central stenosis, especially in the case of spondylolisthesis that comprises the spinal canal by laminae.

## Specific perioperative considerations

In the case of multilevel stenosis, we prefer the decompression at all the levels where the lateral or/and central stenosis is convincing and undoubtedly relevant to the history and MRI. All the levels of decompression can be bilateral or some of them can be unilateral.

The side of access is determined by the prevailing side of symptoms and the most prominent LSS.

## Specific information to give about this surgery

LSS is most commonly due to degenerative changes in older individuals [4]. Microdecompression is a minimally invasive procedure and has low rate of complications. Aged patients should be persuaded not to refuse the surgery and improve their life quality [3, 6].

We advise the patient to use lumbar bandage within 1–2 months, but it is not obligatory and can be restricted to 2–3 weeks.

We educate the patients after surgery regarding the change of posture and modification of physical activity to avoid back pain.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of Ethical Committee of the Ministry of Health of the Russian Federation and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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**Key points** - Microsurgical decompression should be considered in any case of degenerated lumbar stenosis as an effective improvement of life quality.

- Bilateral decompression via unilateral approach is possible at all stenosis levels simultaneously and its combination with low-grade spondylolisthesis does not demand instrumentation.

- The important lateral landmark for complete decompression on the ipsilateral and contralateral side is the reach of pedicle surface.

- The important central landmark for complete decompression is the partial resection of the bone rim with attaching yellow ligament at the central part of cranial and caudal laminae.

- The important cranial landmark for complete decompression is self-detachment of yellow ligament and opening of the epidural space.

- The important caudal landmark for complete decompression is the reach of the middle of the pedicle.

- The most part of bone resection is safely done under the protection of yellow ligament before its complete removal.

- Thermocoagulation of the facet joint synovial layer is obligatory after finishing the decompression to prevent postoperative synovial cysts on both sides of the decompression.

- Dural damage can be prevented by starting the dissection at the most dorsal part of the canal, by avoiding hard dissection and tension of dura adhesions.

- Bone resection should be started by diamond drill and finished with Kerrison punches in partial cutting and rotating maneuver.

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