MINIMALLY INVASIVE ENDOSCOPIC TECHNIQUE FOR POSTERIOR LUMBAR INTERBODY FUSION*

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Minimally invasive posterior lumbar interbody fusion with endoscopic technique and special device for this procedure are presented. The technique allows reducing intraoperative injury of paravertebral tissues, primarily muscles, and can improve the treatment outcomes in patients with degenerative diseases of the spine.
Key Words: posterior lumbar interbody fusion, degenerative disease of the spine, endoscopic equipment.

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Posterior lumbar interbody fusion (PLIF) was first performed by R.B. Cloward in 1943 [2]: an iliac crest graft was placed into the interbody space after laminectomy and discectomy. According to Cloward, positive clinical results were obtained and the high rate of interbody fusions was attained in 85 % of cases. However, other surgeons failed to achieve as good results; hence, the interest in this surgery had faded for a long time [3]. It was only several decades later that posterior interbody fusion has attracted the attention of surgeons again and has become a commonly used procedure for managing patients with lumbar osteochondrosis. This method became recognized due to the fact that modern devices for spinal fusion have been successfully designed. In 1977, G. Bagby and S. Kuslich [1, 8] designed and used cages (the metal interbody fixation systems). A cage is shaped as a hollow cylinder with screw thread on its outer surface, which facilitates graft placement between vertebral bodies and prevents its spontaneous migration. The orifices in cylinder walls allow the spongy autobone placed into the cage to be fused with the bodies of the adjacent vertebrae, thus ensuring the formation of an interbody bone block. The metal cage prevents the autograft placed between the vertebral bodies against collapsing and maintains the required height of the intervertebral gap, thus ensuring stability of the operated segment [5, 14].

Fixation of spinal segments via posterior interbody fusion made it possible to broaden the volume of decompression with a low risk of instability development [10]. However, this surgery has also some drawbacks. The paravertebral tissue lesion may deteriorate the functional status of the spine, aggravate postoperative pain, and lengthen the recovery time. A number of researchers have reported the negative effects of extensive dissection and retraction of muscles when performing posterior interbody fusion. Kawaguchi et al. [6, 7] have found that an increase in the level of creatine phosphokinase, the indicator of muscular lesions, is directly related to the retractor pressure and duration of retraction of muscles. This shows good agreement with the data reported by Gejo et al. [4] who showed that the intensity of lesion of paravertebral muscles during a surgery and frequency of emergence of postoperative lumbar pain depends on the retraction duration. Styf and Willen [13] have ascertained that a retraction device can increase the intramuscular pressure to the ischemic level. Mayer et al. [9] have demonstrated that the reduction in force of paravertebral muscles after posterior fusion was pronounced stronger as compared to that after discectomy. Rantanen et al. [11] and Sihvonen et al. [12] revealed that patients with negative outcomes of lumbar spine surgery frequently have extensive organic changes in paravertebral muscles.

In order to minimize the surgical trauma of paravertebral muscles, we have elaborated a minimally invasive procedure of posterior lumbar interbody fusion using endoscopy equipment and a special device for performing this surgery (Patent Application No. 2,005,112,701 "Device for endoscopic posterior interbody fusion", April 26, 2005 priority date; patent decision November 23, 2006).

The device consists of an originally designed tube equipped with a blunt obturator (Fig. 1). The case is shaped as a shallow cylinder with the slanted distal end and a lateral cavity. Two channels for the endoscope symmetrically localize on the opposite sides of the tube at an acute angle to its axis. The top ends of the channels are equipped with collets that secure the endoscope in proper position. There is a holder to secure the device in the wound. The blunt obturator consists of a cylindrical body with the handle attached to it. A forward-viewing endoscope (0°) 4 mm in diameter and 180 mm long is used to perform the surgery.

Surgical procedure. The surgery is performed under local anesthesia. The patient is positioned in a knee-chest position. A 30–35 mm long skin incision is made along the line of spinous processes in the projection of the operated spinal segment. The lumbar aponeurosis is dissected on the left and right from the spinous processes; the paravertebral muscles are subsequently moved apart. The tube with the obturator is placed into the chan-

nel in such a manner that its lateral cavity localizes at the side of spinous processes (Fig. 2). This allows to position the tube closer to the medial line, thus ensuring a good view of the vertebral arches and the interarch space. The slanted shape of the distal end of the tube ensures closer abutment to the arches, which prevents overlapping of the lumen of the working channel by the paravertebral muscles. After the obturator is removed, an endoscope is placed into one of the lateral channels of the tube, while an aspirator is placed into the opposite one. Two symmetric lateral channels provided by the design allow one to change positions of the aspirator and the endoscope, thus ensuring a good view of the operating theater and broader opportunities for surgical manipulations.

The decompression and posterior interbody fusion is performed using surgical instruments that are typically employed for open decompression and stabilization surgeries though a posterior approach (Fig. 3). The key surgical stages (decompression, discectomy, placing grafts into the interbody space) are performed through the working channel of the tube located in its center under endoscopic control (Figs. 4, 5). In case of technical problems, the decompression of spinal cord rootlets can also be performed using the conventional open procedure, since the size of the surgical wound (~35 mm) does not impede this type of procedure.

Posterior lumbar interbody fusion using grafts made of porous titanium nickelide was performed in 6 patients according to the aforedescribed procedure. The presence of pain syndrome caused by intervertebral disc herniation or by monosegmental degenerative stenosis of the spinal cord with signs of segmental instability, which was resistant to conservative treatment, was an indication for the surgery. In all the cases, adequate decompression of the rootlets of the spinal cord (interlaminectomy, excision of a herniated disc, resection of arch margins and articular processes) and posterior interbody fusion were successfully performed. Neither intra- nor postoperative complications were observed. The low intensity of pain around the postoperative wound allowed one to stop using analgesic agents on day 2 or 3 after the surgery.

The proposed method for posterior lumbar interbody fusion using endoscopic technique allows one to reduce the paravertebral tissue trauma (of muscles in particular) and may improve the outcomes of surgical treatment of patients with degenerative lesions in the spine.

Fig. 1
Surgical tube with an obturator

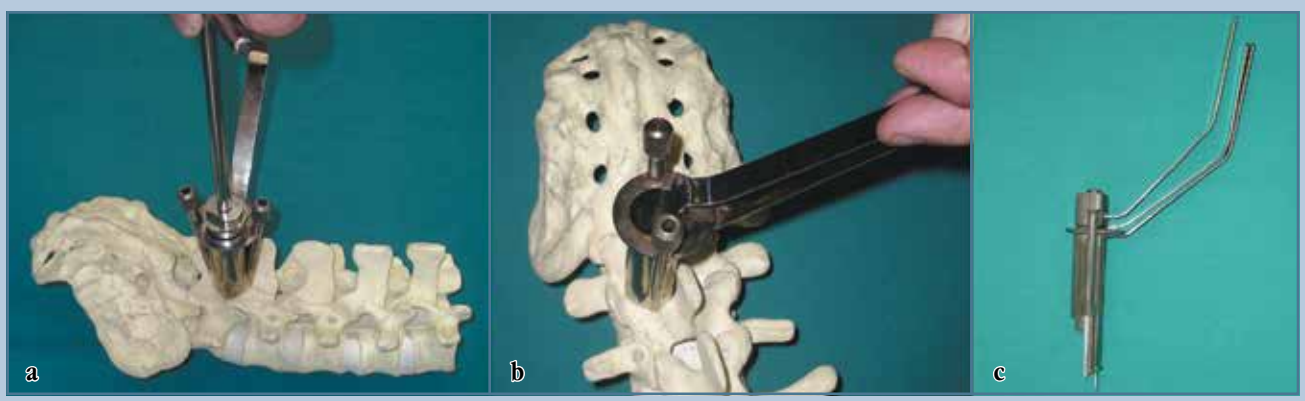

Fig. 2
Stages of placing a surgical tube: **a** – the tube is placed onto the vertebral arches; **b** – the obturator is removed; the rootlet retractor is placed; **c** – the tube with the rootlet retractor and a guiding tube (lateral view)

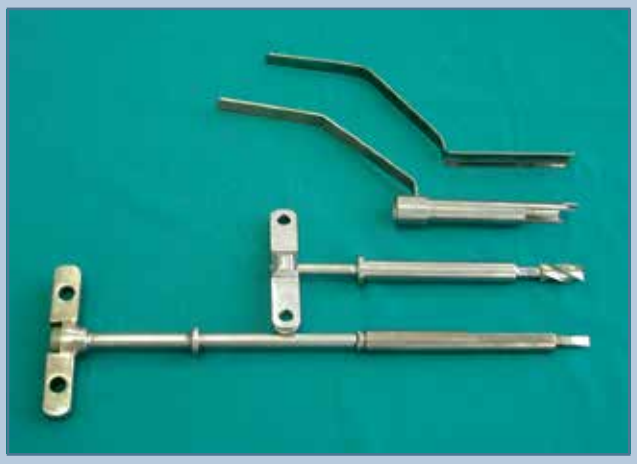

Fig. 3
A surgical instrument kit for performing posterior interbody fusion

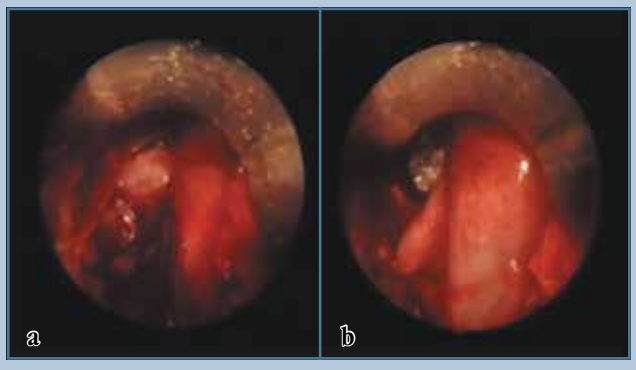

Fig. 4
Intraoperative endoscopic presentation: **a** – a medially displaced rootlet; subligamentous disc herniation is visualized; **b** – the rootlet straightened up after the disc herniation was removed, the posterior surface of the graft made of porous titanium nickelide can be seen

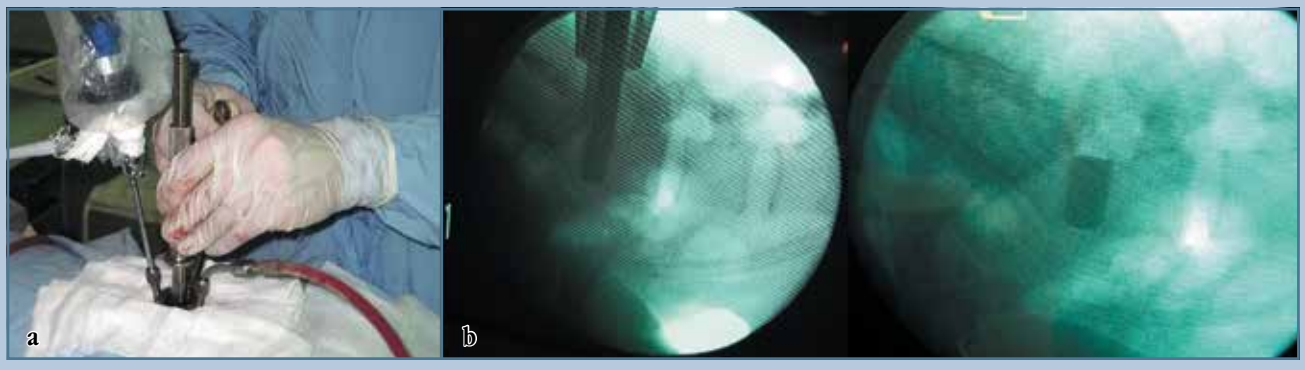

Fig. 5
Graft placement: **a** – general view; **b** – X-ray control during and after graft placement

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