COMPLICATIONS OF SURGICAL TREATMENT OF DEGENERATIVE LUMBAR STENOSIS

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Objective. To study the structure of complications after surgical treatment of degenerative lumbar stenosis and to analyze their influence on outcomes and indications for revision.
Material and Methods. A total of 513 patients with degenerative lumbar stenosis underwent decompression and stabilization of stenotic spinal motion segments including transpedicular fixation and fusion (TLIF or PLIF). All complications both during operations and in the early and late periods of follow-up were systematized.
Results. The total rate of complications was 26.51 %. The rate of early complications, including intraoperative ones was 12.67 %, and of late complications — 13.84 %.
Conclusion. Unsatisfactory outcome in the early postoperative period was associated with pulmonary embolism and suppuration of postoperative wound with generalization of the infection process. Unsatisfactory long-term results of treatment were most often caused by loosening of instrumentation and late suppuration
Key Words: lumbar stenosis, surgical treatment, complications.

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Degenerative lumbar stenosis is one of the most common causes of progressive functional maladjustment of the spine. According to the literature [1, 3], the incidence of lumbar stenosis among patients with chronic back pain is 6–15 %. Averaged data on the annual number of operations for lumbar stenosis in Western Europe amounts to 114–132 cases per 1,000,000 of population [7, 8].

There are various surgical approaches towards correction of degenerative spinal canal stenosis and the choice of methods is still a matter of debate [9]. Recently, dorsal root decompression combined with transpedicular fixation (TPF) and interbody fusion through posterior or posterolateral approach to the intervertebral disc (PLIF or TLIF) has become widespread. The effectiveness of surgical treatment of degenerative lumbar stenosis with limited number of affected discs is obvious. However, the rate of complications after such operations reaches 20 % [4, 5]. The early postoperative complications may include worsening of vertebrogenic neurologialc deficit, postoperative liquorrhea, and suppuration of postoperative wound. In the later period patients may experience insufficiency of support structures, late suppuration, and progression of degenerative processes in the adjacent spinal motion segments (SMS) [5, 6, 10].

In some cases, complications may be easily corrected and do not affect the treatment outcome. In other clinical situations, early or late complications will eventually require a revision surgery, and will have negative impact on the outcome, up to and including death.

The purpose of the research is to study the structure of complications after surgical treatment of degenerative lumbar stenosis and to analyze their influence on outcomes and indications for revision.

Material and Methods

A total of 513 patients (205 men and 308 women aged 23 to 74 years) underwent treatment for degenerative lumbar stenosis during 2009–2013.

All patients had long history of the disease. The main clinical manifestations at the time of hospital treatment were resistant compression-ischemic radiculopathy, chronic pain in the back and lower limbs, and difficulties in walking. Pain intensity was assessed by the VAS. At the time of admission it amounted to 55–90 points. Oswestry Low Back Pain Disability Questionnaire was used to objectively assess the functional maladjustment [2]. The diagnosis was confirmed by MRI and/or CT in all patients. In all cases the narrowing of the spinal, lateral and foraminal canals was due to combined morphological causes. Concomitant somatic pathology, which required pre-clinical preoperative treatment, was present in 95 (18.6 %) patients.

In order to systematize tactical and technical approaches to surgical treatment of degenerative spinal stenosis and to analyze the outcomes, all patients were divided into two groups based on

the number spinal motion segments (SMS) affected by degenerative changes. The first group included 403 patients with relatively limited scope of degenerative lumbar stenosis which affected one, two or three SMS, and the second group included 110 patients with more extensive degenerative processes with four or more affected SMS.

Well known technical approaches, TPF + PLIF (n = 102) and TPF + TLIF (n = 301), were used for surgical treatment of 403 patients with limited lumbar degenerative stenosis. The extensive stenoses were treated using three tactical options. Thirty nine cases involved decompression of all stenotic levels accompanied by required volume of fixation, in 61 cases the strategy included decompression and stabilization (TPF + TLIF or PLIF) of no more than three SMS with the most pronounced clinical manifestations. The third tactical option included two-stage treatment. It has been used in 10 most somatically severe elder patients. The first stage consisted of TPF and posterior decompression limited to laminectomy and foraminotomy on the stenotic SMS, and the second stage included anterior decompression with fusion.

Results

Short-term outcomes within 3 months after the treatment were studied in 100% of the patients. The clinical symptoms of radiculopathy and back pain were completely eliminated (VAS 0–5 points) in 280 (54.58 %) patients. Another 147 (28.65 %) patients reported the absence of manifestations of radicular syndrome accompanied by minor low back pain during exercise (VAS up to 20 points). A significant reduction in radicular pain and lumbar pain (VAS score 20–35) was achieved in 86 (16.77 %) patients. All these patients experiences significant improvement in the quality of life indicators, as measured by Oswestry Low Back Pain Disability Questionnaire.

We have examined complications after the surgical treatment. The complications were divided into groups based on the time of onset: early, including intraoperative complications, complications that developed in the hospital and postoperatively in the period up to 3 months, and late complications that developed 3 months to 6 years after the surgery. The total number of early complications was 65 (12.67 %). A total of 26 (5.1 %) patients experienced intraoperative complications: 24 (4.67 %) patients had intraoperative injury to the dura mater and liquorrhea and 2 (0.39 %) patients had pulmonary embolism (PE). In 10 (1.94 %) out of 24 patients the intraoperative liquorrhea was not fully eliminated, and both cases of pulmonary embolism resulted in the death of the patient.

To facilitate the analysis of the causes of intraoperative injuries to the dura mater we assumed that the total number of cases represent 100 % and found that in 11 (45.83 %) patients the damage to the dura mater during TLIF or PLIF occurred against the backdrop of epidural fibrosis, which we believed to be consequence of previous surgeries (6 cases) or long-term of vertebroradicular conflict (5 cases). In 7 (29.16 %) patients intraoperative injury to the dura mater could be explained by technical difficulties associated with decompression of critical volume of the combined degenerative stenosis; in the remaining 6 (25.00 %) cases no significant morphological reasons have been identified that could have led to the injury. Out of the 24 (100.00 %) cases of damage to the dura mater, in 14 (58.33 %) cases the traumatic defects occurred in the visually controlled area and were sutured. In 10 (41.67 %) patients the injury was outside the visually controlled area on the anterior surface of the dural sac, and two-component biopolymer “BioGlu” glue and “Surgicell” sponge were used for sealing. These 10 cases were the ones where no complete sealing was achieved, and the liquorrhea continued on drainage in the early postoperative period.

In these situations, the patients received antibiotic therapy. Drainage tubes remained in place for up to 4–5 days after the surgery, and after their removal the small holes through which they were inserted were tightly sutured. In 7 cases, it was possible to stop the liquorrhea. In three patients the cerebrospinal fluid seeped through the sutures into a bandage. These patients received lumbar cerebrospinal fluid drainage for a period of 4 to 6 days and the sutures were reapplied. Therefore, the liquorrhea was successfully treated in the early postoperative period in all 10 patients.

Intraoperative pulmonary embolism which resulted in the death of 2 (0.39 %) patients occurred during the execution of the final phase of TLIF along four SMS. It should be noted that the fatal intraoperative pulmonary embolism was recorded in patients without any high-risk factors, who underwent the standard preventive therapy.

In the early postoperative period the most frequent complication was acute radiculopathy, which was observed in 22 (4.28 %) patients. These 22 cases of postoperative radiculopathy were assumed to constitute 100%. In 19 (86.36 %) patients it was arrested by medication, while in 3 patients (13.60 %) the conservative measures were ineffective. CT and/or MRI examination was used to identify the cause of acute radicular syndrome: in 2 (9.00%) cases it was due to misplaced screws (Fig. 1) and in 1 (4.54 %) case it was caused by incomplete removal of an articular facet osteophyte. Revision decompressive surgeries were performed. The complications did not affect the outcomes.

Suppuration of the postoperative wound in the early postoperative period was reported in 14 (2.72 %) patients. The remedial surgery was performed including necrectomy, active drainage of the wound by vacuum dressings with staged replacement and subsequent imposition of secondary sutures. In 2 (0.38 %) patients, the suppuration of the wound in the early postoperative period, after TLIF along three and four SMS, caused sepsis, bilateral pneumonia and multiple organ failure. In 10 (71.42 %) out of 14 (100.00 %) cases the suppuration in the early postoperative period was successfully arrested and metal construction was preserved, 4 (28.58 %) patients required removal of the metal constructions and 2 (14.28 %) patients died as a result of gen-

eralized wound infection. Three patients (0.58 %) developed a hematoma in the operation zone, which required revision surgery.

The distribution of early complications is presented in Fig. 2.

Therefore, there were 4 (0.77 %) deaths in the intraoperative and early postoperative periods: two were due to intraoperative pulmonary embolism and two were due to sepsis and multiple organ failure. Unsatisfactory early treatment outcomes were observed in 8 (1.55 %) patients: death of 4 (0.77 %) patients and removal of the spinal systems due to suppuration in another 4 (0.77 %). None of the cases of liquorrhea, postoperative hematoma and acute radiculopathy had negative effect on the treatment outcomes.

Long-term outcomes of treatment with follow-up of at least 12 months were studied in 314 (61.2 %) patients. No complaints and full functional adaptation of the spine were considered to be good long-term outcomes of treatment and were achieved in 155 (49.36 %) patients. Indistinct symptoms of radiculopathy and/or localized pain in the back, which did not require drug therapy were also corresponded to be good long-term outcomes and were observed in 61 (19.42 %) patients. Incomplete functional adaptation accompanied by remitting symptoms of radiculopathy and lumbalgia and requiring periodic medical correction was perceived by the patients as a positive treatment outcome and therefore was considered to be satisfactory long-term outcome. It was achieved in 28 (8.91 %) cases. The analysis of the numerical indicators based on the Oswestry questionnaire, which describes the long-term outcomes, demonstrated significant reduction in the therapeutic effect in the first year of follow-up for patients operated on 4 or more SMS.

Poor long-term outcomes, requiring revision operations, were reported in 71 (13.84 %) cases. The reasons for revision surgery in the long-term follow-up period (whose total number was taken as 100 %) were as follows: destabilization of the caudal screws of the spinal system, 19 (26.76 %) cases (Fig. 3), destabilization of the cranial screws, 13 (18.3 %) cases, fractures of the cranial or caudal screws, 6 (8.45%) cases, unlocking of screw's connectors, 2 (2.81 %) cases, recurrent radiculopathy due to epidural cicatrical process, 11 (15.49 %) cases, progression of the degenerative processes from the cranial level to the operated SMS level, 6 (8.4%) cases (Fig. 4), development of interbody pseudarthrosis, 4 (5.63 %) cases, development of paravertebral CFS leakages, 2 (2.81 %) cases, late suppuration, 8 (11.26 %) cases, which in two cases were accompanied by partial destabilization of the transpedicular metal construction.

The distribution of the late follow-up period complications is presented in Fig. 5.

The range of revision surgeries in the late postoperative period is presented below with their total number taken as 100 %. Reinstalling unstable lower screws from S1 to the iliac bone, 9 (12.67 %) cases, replacement of unstable cranial screws with the extension of the system in the cranial direction with interbody stabilization of the cranial SMS, 8 (12.26 %), replacement of unstable cranial screws with the extension of the system in the cranial direction without interbody stabilization of cranial SMS using rods with a dynamic angle for cranial SMS, 6 (8.45 %), additional decompression, 11 (15.49 %) cases, replacement of broken screws without extending the system, 5 (7.04 %) cases, extension of the spinal system with cement implantation of cranial screws, 4 (5.63%) cases, and caudal screws, 3 (4.22 %) cases, extension of the system in both directions, 3 (4.22 %) cases, re-installment of the spinal system, 2 (2.81 %) cases, re-installment of the destabilized screws from the iliac bones, 2 (2.81 %) cases, shortening of pedicle system in the presence of interbody fusion at the level of the TLIF and destabilization of the screws in the cranial SMS, fixed only with posterior metal structure, 4 (5.63 %) cases, including 2 (2.81 %) cases accompanied by the use of rods with dynamic units for cranial SMS, sanitation of late suppuration, 8 (11.26 %) cases, including partial

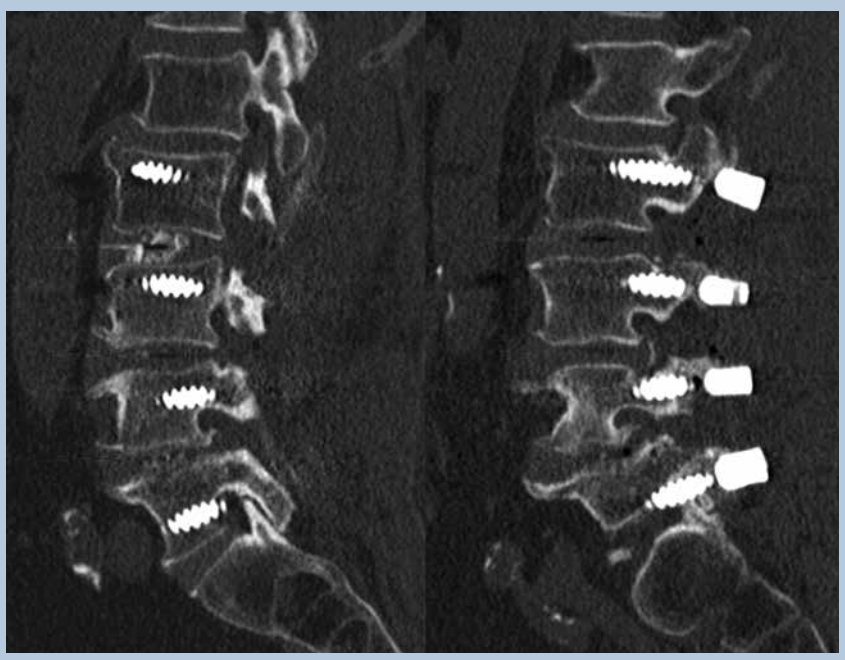

Fig. 1
CT scans of the patient M., misplacement of screws at L5: the screw was implanted transforaminally, triggering acute radiculopathy at L5

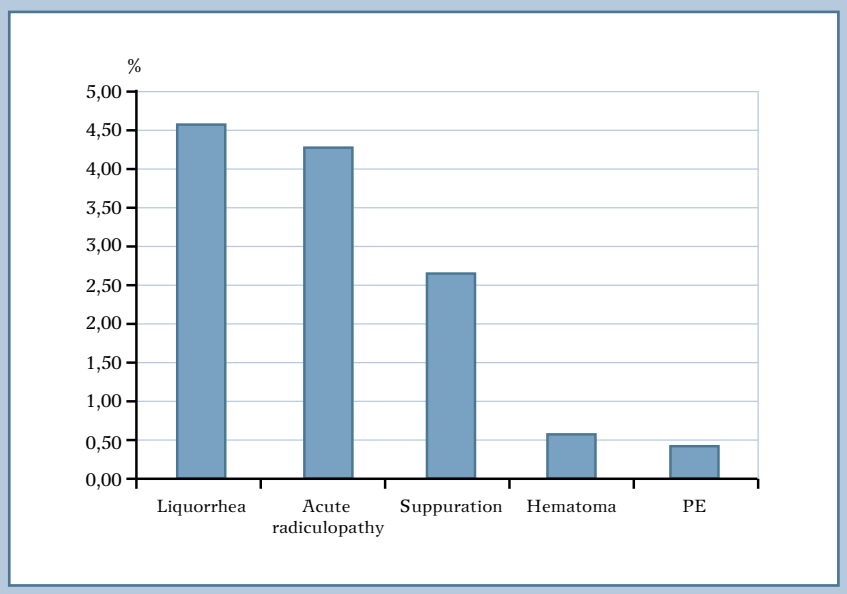

Fig. 2
Early complications

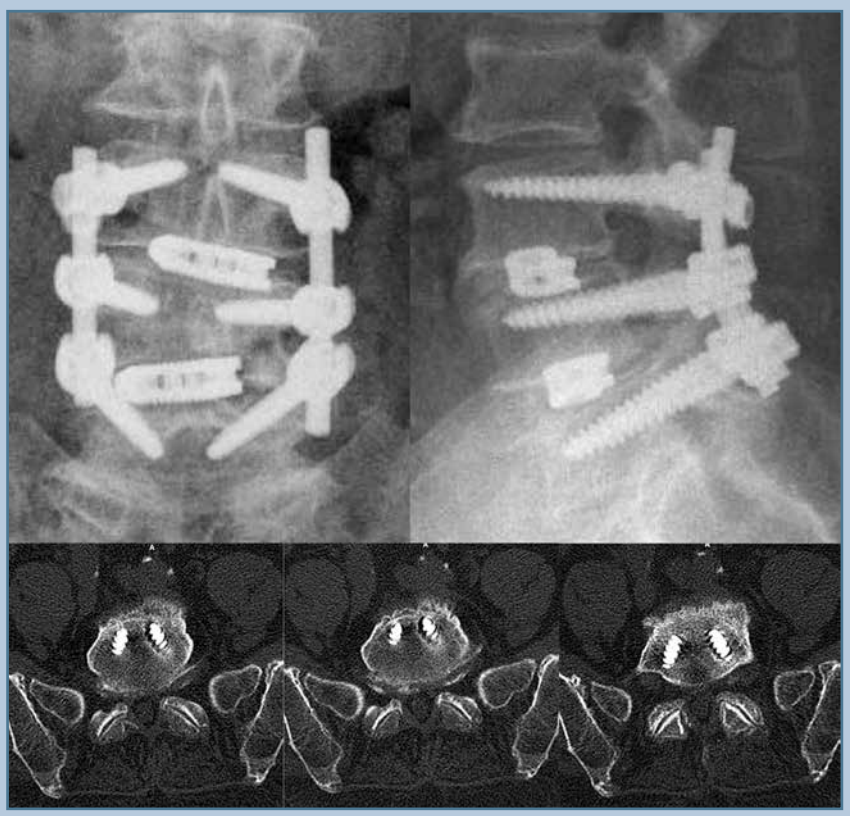

Fig. 3
Radiographs and CT scans of the patient S., which confirmed the destabilization of the caudal screw of spinal system at L5

resetting of transpedicular system elements, 2 (2.81 %) cases, opening of the cerebrospinal fluid leaks and sealing of the dura mater, 2 (2.81 %) cases, repeat fusion surgery in interbody pseudarthrosis, 4 (5.63 %) cases.

The most frequent revision surgery in the long term period was re-fixing (re-osteosynthesis) of the spine. A total of 48 surgical interventions of this type were performed due to partial destabilization of the spinal system.

Discussion

The most dangerous intraoperative complications and early postoperative period complications, resulting in fatal outcomes, were pulmonary embolism and wound suppuration with subsequent generalization, which caused septicemia. The list of the early postoperative period complications, leading to unsatisfactory treatment outcomes, included suppuration of postoperative wounds with early destabilization of metal fixators which required their removal. Other complications (liquorrhea, acute radiculopathy, postoperative hematomas, early suppuration without destabilization of the spinal systems) did not have adverse effect on treatment outcomes, although in some cases they were indicators for revision surgery.

Unsatisfactory treatment outcomes in the late postoperative period were often associated with destabilization of the metal structures and late suppuration. Clear correlation was established between the risk of destabilization of the pedicle spinal system in the long term follow-up period and the length of the spine fixation. We found that out of 218 patients operated on for lumbar stenosis of one SMS, 8 (3.66 %) patient required revision surgery in the late postoperative period; out of 134 patients with two affected SMS, 9 (6.71 %) patients required revision surgery; out of 52 patients operated on for stenosis of three SMS, 6 (11.53 %) patients required revision, out of 62 patients with extensive stenosis (across three the most clinically relevant levels), 9 (14.51 %) patients required revision, and out of 47 patients who under-

went surgery across four and more SMS, 39 (82.9 %) patients required revision.

Conclusions

1. The total number of complications in surgical treatment of degenerative lumbar stenosis was 26.51 %. In 17.73 % of cases the complications were indications for revision surgery and in 15.01% of cases they had negative effect on treatment outcomes.

2. In the early postoperative period, PE and suppuration and generalization of postoperative wound infection, which require the removal of metal constructions, led to unsatisfactory treatment outcomes.

3. Destabilization of the metal structures and late suppuration were the most common causes of unsatisfactory long-term treatment outcomes.

4. In the surgical treatment of degenerative lumbar stenosis, the increase in the length of the spine fixation above four or more SMS significantly increases the risk of destabilization of the metal structures in the later follow-up period and increases the likelihood of indications for revision surgery.

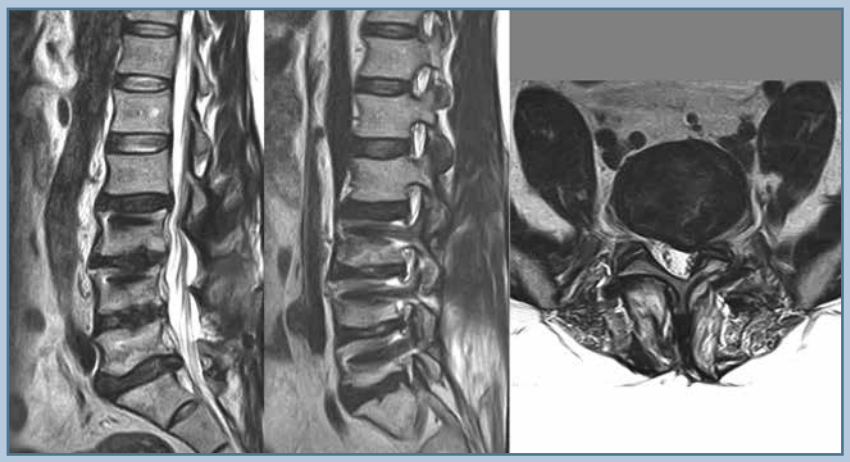

Fig. 4
MRI scans of the patient K., which confirmed the existence of adjacent-level syndrome, mainly in the caudal level of fixation of the spinal motion segment L5–S1, which has developed over 16 months after the surgery

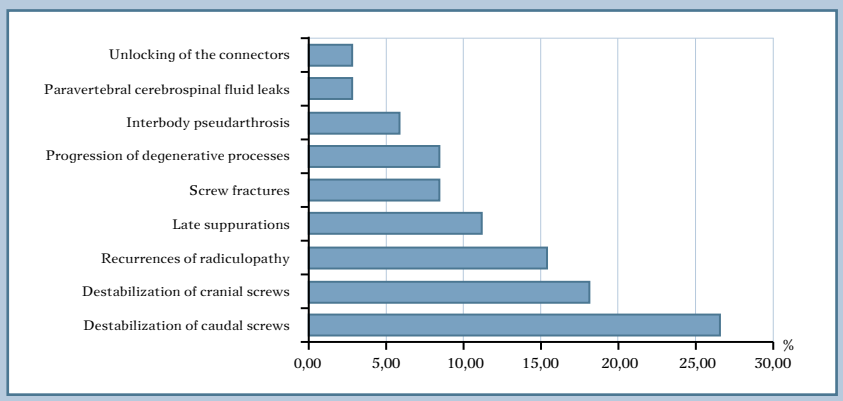

Fig. 5
Late complications, which were the reasons for revision surgery

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