RESULTS OF DIFFERENTIATED SURGICAL TREATMENT OF ELDERLY AND SENILE PATIENTS WITH LATERAL LUMBAR SPINAL CANAL STENOSIS

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Objective. To analyze the results of differentiated surgical treatment of elderly and senile patients with lateral stenosis of the lumbar spinal canal.

Material and Methods. A total of 95 patients with nerve root compression and back pain were operated on. The analysis and complex evaluation of treatment results were carried out in two groups: Group 1 included 79 (84.15 %) patients with nerve root compression associated with lateral spinal canal stenosis without instability of the spinal motion segment; Group 2 – 16 (15.85 %) patients with clinically significant lateral lumbar spinal canal stenosis with one root compression and severe back pain syndrome caused by the spinal motion segment instability. The clinical and neurological status of patients was evaluated using VAS, ODI, and SF-36 questionnaires. Changes in the angle and depth of the lateral radicular recess and the instability of the spinal motion segment were assessed using CT and functional radiographic findings.

Results. Lateral stenosis in elderly and senile patients is presented as a combination of compressing factors in 47.2 % of cases. The increase in the angle of the lateral radicular recess up to 30–40° and in its depth up to 5 mm resulted in reduction of the pain syndrome in the leg and back, and improvement of the quality of life.

Conclusion. The use of differentiated surgical treatment tactics based on identification of the dominant clinical neurological syndrome provides good and excellent results in patients of the older age group in 83 % of cases.

Key Words: lateral stenosis of the spinal canal, surgical treatment, elderly and senile patients.

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According to neuroimaging studies, signs of the spinal canal stenosis are present in 20 % of the population aged 65 years and in 80 % above 70 years [4, 19, 20]. Spinal canal stenosis is the most common cause of surgery on the spine in patients above 65 years old [1, 2, 5, 6, 13, 15, 18, 21, 28].

Lateral stenosis is caused by a range of factors and their combinations resulting in narrowing (less than 3 mm) between the medial margin of the superior articular process and the posterior vertebral margin [22]. Lateral stenosis presents as a unilateral monoradiculopathy.

No common views on the tactics of surgical treatment of the spinal canal stenosis in older individuals have been formulated at present.

Kalff et al. [19], Muntig et al. [25] observed the best outcomes of decompression and stabilization surgery. Forsth et al. [13] and Lee et al. [21] showed that the addition of stabilization to decompression was not associated with improved outcome versus decompression only. According to Deyo et al. [11], the decision on a particular type of operation is often arbitrary.

Material and Methods

The surgical outcomes for 95 patients operated on at the Spinal Neurosurgical Department, Federal Center of Neurosurgery (Novosibirsk) in 2013–2015 were analyzed.

The inclusion criteria were elderly and senile age (WHO, 1963), one root compression associated with degenerative lateral lumbar stenosis, and ineffective conservative treatment for 2 months.

Exclusion criteria were spinal surgeries, concomitant spinal pathology (spinal infections, tumors, scoliotic deformity of the spine greater than 10° according to Cobb [7]), and mental disease.

The mean postoperative follow-up was 11 ± 7 months (range, 3 to 24 months). The average age of patients was 66 years (60–83).

The clinical and neurological status was assessed. Manifestations of pain syndrome, quality of life, and physical activity were estimated using the standard scales and questionnaires: VAS [16], the Oswestry disability index (ODI) [12], and SF-36 [30].

The factors of nerve root compression and instability of the spinal motion segment were identified by using instrumental study methods:

– lumbar spine X-rays in two views with functional flexion-extention tests [31].

– MRI, CT, CT-myelography with 3D-reconstruction to measure the depth and angle of the lateral recess; a lateral recess angle ≤30° and lateral recess depth ≤3 mm were described as diagnostic criteria for lateral recess stenosis [22] (Fig. 1).

Analysis and complex evaluation of the treatment outcomes were performed in two groups: group 1 – 79 (84.15 %) patients with nerve root compression associated with lateral spinal stenosis without instability of the spinal motion segment (White – Panjabi criteria < 5 scores); group 2 – 16 (15.85 %) patients with clinically significant lateral stenosis of the lumbar spinal canal with one root compression and severe back pain syndrome caused by instability of the spinal motion segment (White – Panjabi criteria ≥5 scores).

Surgical outcomes were analyzed at 3–24 months after surgery. The clinical and neurological status of patients was evaluated using VAS, ODI, and SF-36 questionnaires. The changes in the lateral recess angle and depth, instability of the spinal motion segment were measured using CT and functional radiography.

Numeric data in the paper are represented as the mean/median (lower; upper quartile). A linear correlation between the continuous and scale variables was estimated using the Spearman's rank correlation coefficient (r). The Mann – Whitney test was used to compare differences between two independent groups and Wilcoxon test – for dependent variables. Multiple comparisons were performed using the Holm correction. Estimations were performed using the R software version 3.3.1 [29].

Results

Postoperatively, the patients experienced a statistically significant reduction of leg and back pain; functional disability (ODI), physical and mental SF-36 health scores improved (Table 1).

Postoperative CT of the lumbar spine showed a statistically significant changes in parameters of the lateral recess (p_{corr} < 10–5; Table 2).

Due to severe degenerative changes in the spine in elderly and senile patients, lateral stenosis most often presented as a combination of factors – in 45 (47.2 %) patients (Fig. 2a, b), rarer as disc herniation – in 27 (28.0 %; Fig. 2c, d), spondylosis in 15 (16.0 %; Fig. 3), hypertrophy of the superior articular process in 6 (6.4 %; Fig. 4a, b), and synovial cysts of the facet joints in 2 (2.4 %; Fig. 4c, d).

Based on SF-36 questionnaire, quality of life of patients substantially improved when lateral recess sizes increased to the threshold magnitudes: angle (30–40°) and depth (5 mm; Fig. 5). There was no further significant improvement in quality of life with increasing the lateral recess depth or angle.

Scores of leg and back pain, disability, and quality of life in both groups improved in 79 (83.15 %) patients; there was no clinical improvement in 13 (13.68 %), and the indicators deteriorated in 3 (3.15 %). According to the modified MacNab scale, good and excellent outcomes were observed in 78 (82.10 %) patients, satisfactory in 14 (14.73 %), and unsatisfactory in 3 (3.15 %).

In the first 12 months postoperatively, leg and back pain reduced, scores of disability and quality of life improved in patients of both groups, but deteriorated slightly in 24 months because of continued degeneration of the spinal motion segment (Fig. 6).

A comparison of outcomes after decompression alone (group 1) and decompression with fusion (group 2) showed slightly better scores for back and leg pain, quality of life in the decompression group (Table 3).

Reoperations were performed in 9 (9.47 %) patients: decompression in 6 (6.31 %) because of continued degeneration of the spinal motion segment; spinal cord stimulation for drug-resistant neuropathic pain was conducted in 2 (2.1 %), decompression with fusion for continued segment degeneration and segmental instability in 1 (1.05 %). Facet joint radiofrequency denervation at the lumbar spine for facet joint pain syndrome was performed in 5 (5.26 %) patients.

Postoperative residual symptoms in the legs (numbness, hypalgesia, paresis, pulling/dragging sensations of various intensity) were observed in 34 (36.27 %) patients.

Complications were recorded in 9 (9.47 %) cases (Table 4).

Discussion

In our study, in 20 % of cases when it was difficult to reveal nerve root compression using MRI, nerve root compression was verified by 3D-reconstruction of CT-myelography images. According to Bartynski et al. [3], the diagnostic accuracy of MRI is 71–72 %, CT-myelography – 62 %; radiographic myelography – 93–95 %; however, the authors did not analyze 3D-reconstruction of CT-myelography images. Morita et al. [24] reported that CT-myelography is more reliable and

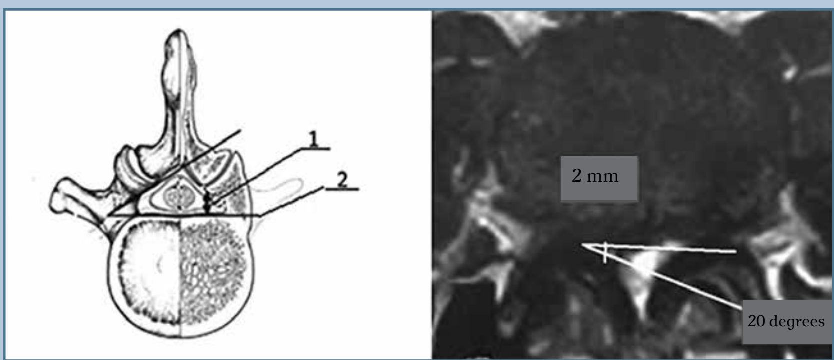

Fig. 1
Lateral recess and axial MRI slice through the lumbar spine according to Mamisch et al. [22]: 1 – depth of the lateral recess; 2 – angle of the lateral recess

Table 1

The results of patient evaluation using VAS, ODI, and SF-36 before and after surgery

Questionnaire	Period	Value; mean/median (lower; upper quartile)	Minimum and maximum value
VAS (leg), scores	Preoperative	6.4/7.0 (4; 8)	0; 10
	Postoperative	2.3/2.0 (1; 3)	0; 8
VAS (back), scores	Preoperative	5.8/6.0 (4; 8)	0; 10
	Postoperative	3.0/3.0 (2; 4)	0; 10
ODI	Preoperative	51/53 (40; 63)	16; 94
	Postoperative	31/29 (20; 38)	4; 73
SF-36 (physical component)	Preoperative	27/26 (23; 30)	16; 44
	Postoperative	40/40 (34; 47)	23; 56
SF-36 (mental component)	Preoperative	29/27 (22; 36)	12; 54
	Postoperative	41/41 (34; 49)	20; 58

$p < 10^{-10}$.

reproducible than MRI for assessment of nerve root compression.

Postoperative scores for back pain, radicular pain, and health parameters improved in our study ($p < 10^{-10}$; Table 1).

A comparison of two groups of patients revealed slightly greater mean preoperative intensity of leg pain on VAS scale in group 1 than in group 2. In 24 months, group 1 demonstrated the best scores of leg pain intensity (a decrease by 4.3 points) compared with group 2 (a decrease by 3 points). The difference in VAS scores for back pain: $p = 0.06$, leg pain: $p = 0.08$. The difference in quality of life on SF-36 (physical component): $p = 0.04$, SF-36 (mental component): $p = 0.04$ (Table 3).

Munting et al. [25] demonstrated statistically significant reduction of back and leg pain in patients after decompression alone and decompression with stabilization, herewith preoperative scores did not differ significantly. Statistically significant and the lowest postoperative back and leg pain scores as well as the difference between pre- and postoperative scores were observed in patients in the decompression and fusion group. Son et al. [28] compared the outcomes of decompression and decompression with stabilization: there was a statistically significant reduction of back and leg pain and improvement in physical activity according to ODI in both groups; however, despite the best VAS and ODI scores after decompression surgery, no statistically significant difference between these groups was revealed. Decompression surgery: preoperative VAS scores for back pain – 5.9 scores, postoperative – 3.1; decompression and stabilization surgery: preoperative VAS scores for back pain – 7.1, postoperative – 3.2; decompression surgery: preoperative VAS scores for leg pain – 7.4, postoperative – 2.9; decompression and stabilization surgery: preoperative VAS scores for leg pain – 7.5, postoperative – 3.1; decompression surgery: preoperative ODI – 63, postoperative – 32; decompression and stabilization: preoperative ODI – 68, postoperative – 45. These data indicate that instrumental fixation alone during operations for degenerative spinal canal stenosis does not improve surgical outcome and quality of life.

Our data show that depth and angle of lateral recess significantly increased in patients after surgical treatment. According to Colak et al. [8], the mean preoperative depth of the lateral recess was 2.7 mm, but the postoperative sizes were not presented.

In our study, MRI, CT-myelography with 3D-reconstruction documented that nerve root compression in the lateral recess in patients of elderly and senile age was most frequently caused by a combination of compressing factors – 47.2 % of the cases.

The analyzed literature does not assess the frequency of factors contributing to nerve root compression in the lateral recess.

We analyzed the influence of changes in lateral recess sizes on the quality of life using the SF-36 questionnaire. Upon reaching certain threshold values of the

Table 2

Characterization of the lateral recess before and after surgery

Lateral recess	Period	Value; mean/median (lower; upper quartile)	Minimum and maximum values
Depth, mm	Preoperative	3.7/3.9 (2.7; 4.6)	1.8; 5.3
	Postoperative	5.3/5.3 (4.9; 5.5)	4.1; 7.4
Angle, degrees	Preoperative	24.0/25.0 (18; 31)	12.0; 35.0
	Postoperative	42.0/42.0 (34; 47)	29.0; 59.0

$p < 10^{-5}$.

Fig. 2
An axial CT-myelography slice **(a)** and axial MRI slice **(b)** show a combination of factors of root compression in the lateral recess (white arrows) – hypertrophy of the superior articular process, ligamentum flavum, disc protrusion, spondylosis; sagittal and axial MRI slices **(c**, **d)** show disc herniation (white arrows) as a factor of nerve root compression in the lateral recess

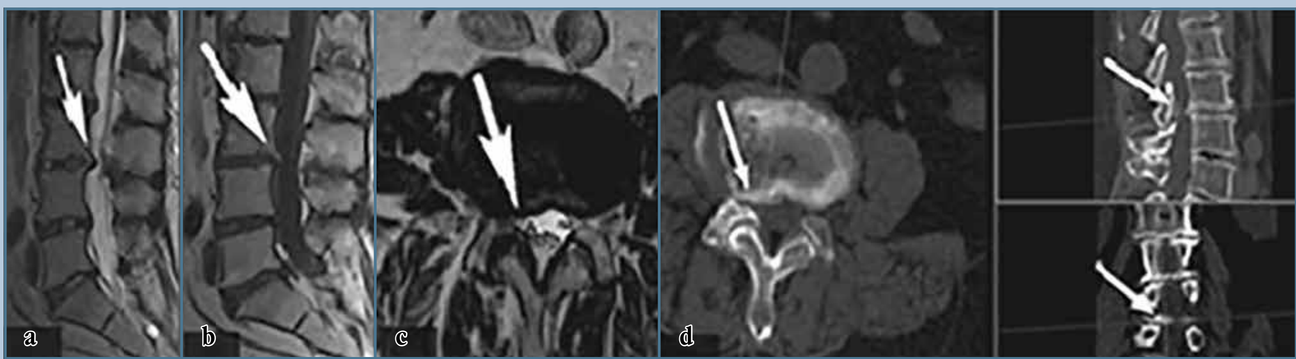

Fig. 3
Spondylosis as a factor of nerve root compression in the lateral recess (white arrows): **a, b** – sagittal MRI slice; **c** – axial MRI slice; **d** – HCT 3D-reconstruction of the lumbar spine

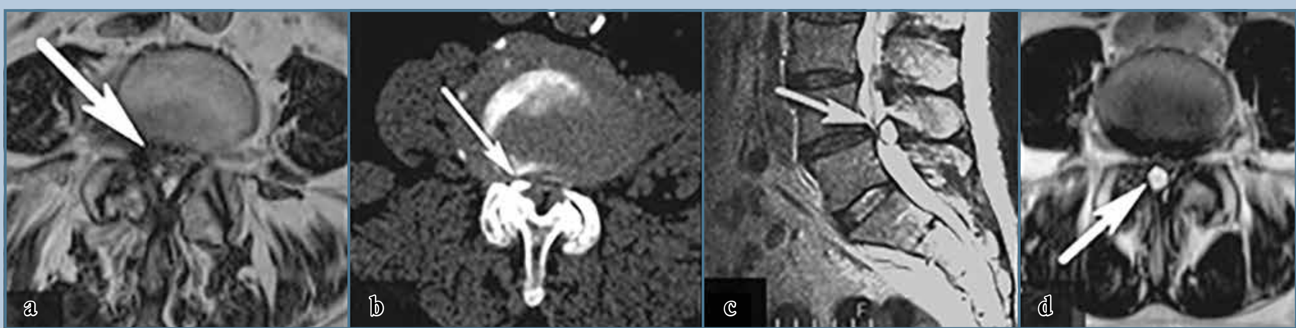

Fig. 4
An axial MRI slice **(a)** and axial CT slice **(b)** show hypertrophy of the superior articular process as a factor of nerve root compression in the lateral radicular recess (white arrows); sagittal and axial MRI slices **(c, d)** show synovial cysts of the facet joint as a factor of nerve root compression in the lateral recess (white arrows)

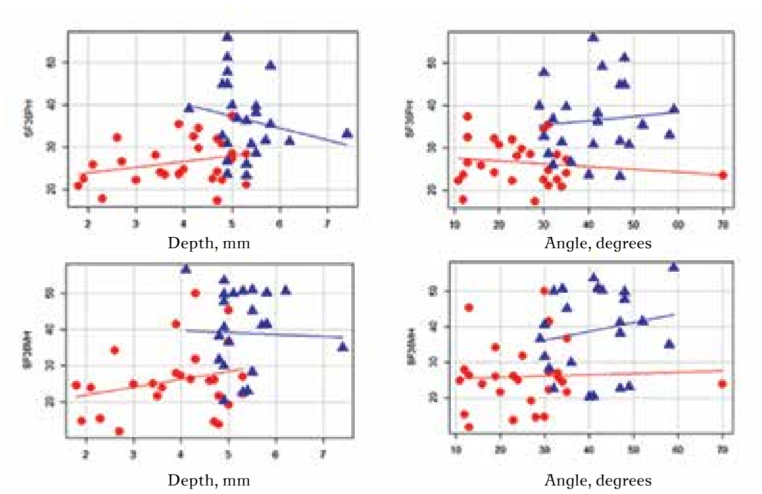

Fig. 5
Dependence of SF-36 scores (physical and mental components preoperatively (red symbols ●) and postoperatively (blue symbols ▲) on the lateral recess depth and angle, the line on the graph corresponds to regression lines

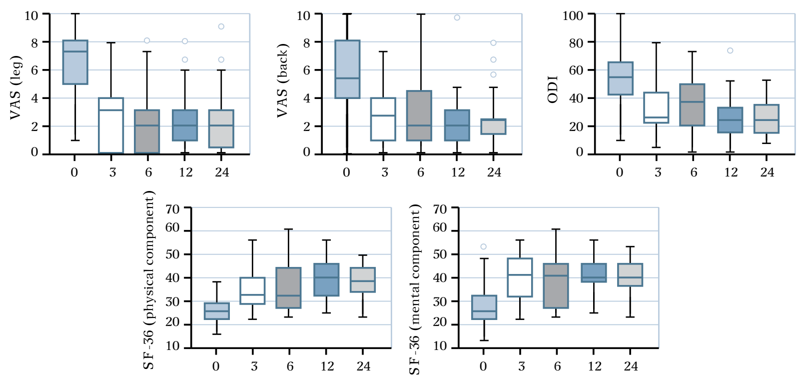

Fig. 6
Dynamics of questionnaire disability and quality of life scores according to VAS scale, ODI, and SF-36 in 3, 6, 12, 24 months postoperatively

angle and depth, the quality of life of patients can be considerably improved, but further increase in lateral recess sizes is not associated with a better quality of life. Thus, there is no need for excessive resection of bone structures and correction of spinal canal indices that is confirmed by a study by Cavusoglu et al. [5]. Resection of bone and soft tissue structures sufficient for nerve root decompression in the lateral recess improves quality of life and allows one to avoid destabilization of the spinal motion segment.

According to the modified MacNab scale, good and excellent outcomes were observed in 78 (82.1 %) patients. These data are similar to the results of other authors: Pao et al. [26] reported good and excellent outcomes in 2 years in 80 % of patients.

In 24 months, scores of disability and quality of life of patients in both groups slightly deteriorated because of continued degeneration of the spinal motion segment. It corresponds to the data reported by Morgalla et al. [23]: good and excellent outcomes comprised 90 % in the first year after surgery and the proportion of good and excellent results reduced to 85 % in 2 years. According to Slatis et al. [27], surgical outcomes for spinal canal stenosis at the lumbar spine in 8–10 years after surgery were comparable with the results of conservative treatment of these patients.

Jansson et al. [17] reported that the rate of reoperations was 5 % in 2 years, 8 % – in 5 years, and 11 % – in 10. Adogwa et al. in a study [1] showed a 10.3 % reoperation rate; Son et al. [28] demonstrated a higher rate of repeated surgery (10.3 %) in the decompression and instrumental fixation group than in decompression alone (6.5 %).

Foulongne et al. [14] noted residual events affecting the legs after decompression in 45 % of patients and attributed them to long-term root compression caused by severe degenerative changes of the spinal canal and the appearance of morphological alterations in the roots. In our study, residual events were observed in 36 % of cases.

The highest rate of complications in our study was observed in the group of decompression and stabilization (18.0 %), less – in the decompression group (7.5 %). Deyo et al. [9, 10], Morgalla et al. [23], and Son et al. [28] reported a higher complication rate in the decompression and stabilization group (Table 5).

According to our data, the rate of good and excellent outcomes was 83 %, which is comparable with the results of other authors (Table 6).

Conclusion

In elder and senile patients, nerve root compression in the lateral recess is

Table 3

Comparison of the outcomes after decompression alone and decompression and stabilization surgeries

Questionnaire	Period	Unilateral decompression	Decompression and stabilization	Comparison after surgery
VAS (leg), scores	Preoperative	6.5/7.0 (5; 8)	5.7/6.5 (3; 8)	–
	Postoperative	2.2/2.0 (0.5; 3)	2.7/3.0 (2; 3)	$p = 0.08$. $p_{corr} = 0.17$
VAS (back), scores	Preoperative	5.7/5.0 (4; 8)	6.0/6.5 (3.8; 8)	–
	Postoperative	2.8/3.0 (2; 4)	4.1/4.0 (2.8; 5)	$p = 0.06$. $p_{corr} = 0.17$
ODI	Preoperative	52/54 (41; 63)	50/52 (39; 63)	–
	Postoperative	30/29 (20; 38)	33/30 (25; 44)	$p = 0.44$. $p_{corr} = 0.41$
SF-36 (physical component)	Preoperative	27/26 (23; 30)	27/26 (23; 31)	–
	Postoperative	41/41 (36; 48)	37/36 (31; 40)	$p = 0.04$. $p_{corr} = 0.17$
SF-36 (mental component)	Preoperative	29/28 (22; 33)	26/25 (20; 36)	–
	Postoperative	41/41 (37; 50)	36/34 (30; 41)	$p = 0.04$. $p_{corr} = 0.17$

Table 4

Complications of surgical treatment for lateral stenosis of the lumbar spinal canal in elderly and senile patients, n (%)

Complications	Group 1 (n = 79)	Group 2 (n = 16)
Total	6 (7.50)	3 (18.75)
Intraoperative injury to the dura mater	4 (5.00)	1 (6.25)
Aggravation of neurological deficit in the early postoperative period	1 (1.25)	1 (6.25)
Clinically significant epidural hematoma	1 (1.25)	1 (6.25)

caused by a combination of compressive factors in 47.2 % of cases.

An increase in the lateral recess sizes to threshold values (angle 30°, depth 5 mm) after decompression significantly improves quality of life of patients, but excessive decompression and a further increase in lateral recess sizes has no effect on the improvement of quality of life.

The use of differentiated surgical algorithm of treatment based on the identification of the dominant clinical neurological syndrome provides good and excellent outcomes in 83 % of cases in elderly and senile patients.

Stabilization methods do not improve surgical outcomes and should only be used in cases of clinically significant instability of the spinal motion segment.

This study is not a sponsored project. The authors declare that they have no conflict of interest.

Table 5

Complications of surgical treatment for stenosis of the lumbar spinal canal in elderly and senile patients (according to literature data)

Authors	Type of complications		Number, %
Morgalla et al. [23], n = 108	Minimally invasive decompression surgery	Large complications	1.70
		Wound complications	3.00
		Mortality	0.60
	Decompression and stabilization	Large complications	4.60
		Wound complications	4.11
		Mortality	1.20
Deyo et al. [10], n = 12 154, Son et al. [28], n = 60	Decompression surgery		2.3–9.7
	Decompression and stabilization		5.6–27.6

Table 6

Surgical outcomes for spinal canal stenosis in elderly and senile patients (according to literature data)

Authors	Outcomes		Number, %
Cavusoglu et al. [5], n = 100	Immediate good surgical outcomes for lumbar spinal stenosis		86
Morgalla et al. [23], n = 108	Good outcomes of minimally invasive decompression surgeries for the central stenosis in the first year after surgery		90
	Good outcomes of minimally invasive decompression surgeries for the central stenosis in three years after surgery		85
Lee et al. [21], n = 25	Good outcomes of decompression surgeries with instability		43
	Good outcomes of decompression and stabilization		80
Foulongne et al. [14], n = 98	Residual events in the legs after surgery for lumbar spinal stenosis		45
Slătis et al. [27], n = 94	In 8–10 years surgical outcomes for spinal canal stenosis match the outcomes of conservative treatment		–
Son et al. [28], n = 60	Reoperations after decompression surgery		6,50
	Reoperations after decompression and stabilization		10,50
Adogwa et al. [1], n = 69	Adjacent segment disease	Patients before 50 years old	17
		Patients above 50 years old	36
	Formation of pseudoarthrosis		5–7
	Reoperations		10,30
Jansson et al. [17], n = 9 664	Reoperations	in 1 year	2
		in 2 years	5
		in 5 years	8
		in 10 years	11
Данная статья, n =95	Good outcomes of treating lateral stenosis in 2 years postoperatively		83
	Unsatisfactory outcomes of surgical treatment of spinal lumbar stenosis		3
	Residual events in the legs after surgery for lumbar spinal stenosis		36
	Reoperations		9

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