

Surgical strategies in degenerative lumbar spondylolisthesis

Estratégias operatórias da espondilolistese degenerativa lombar

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ABSTRACT

Objective: The goal of this study is to present surgical methods of nerve elements decompression in the vertebral canal and the techniques of internal spine stabilization in patients with degenerative lumbar spondylolisthesis. **Methods:** Clinical analysis included 36 patients (17 females and 19 males) managed surgically due to degenerative spondylolisthesis at our Departments, between 1997 and 2003. Intervertebral dislocation exceeding 20% was referred in ten patients where the vertebral column stabilization was achieved by transpedicular stabilization as well as intervertebral and posterolateral spinal fusion (group I). Spondylodesis in spondylolisthesis with the percentage of slippage of lesser than 20% (18 patients) was accomplished by intervertebral cages and posterolateral osseous grafts (group II). In the remaining eight cases, spondylolisthesis was smaller than 20% and with the denivelation of the intervertebral space (group III); nervous structures were liberated and spondylodesis was unnecessary. **Results:** Low back pain and sciatic neuralgia relieved in 29 (81%) and 31(86%) patients, respectively. Neurological deficits subsided completely in 25 (81%) cases. **Conclusions:** Strategy of surgery in patients with degenerative lumbar spondylolisthesis is established based in the evaluation of the following factors: vertebral displacement extent, height of intervertebral space and assessment of vertebral column stability.

KEYWORDS: Spondylolisthesis/surgery; Spinal diseases/surgery

RESUMO

Objetivo: o objetivo deste trabalho é apresentar os métodos cirúrgicos de descompressão dos nervos do canal vertebral e de estabilização vertebral em pacientes com espondilolistese lombar degenerativa. **Métodos:** análise clínica de 36 pacientes tratados cirurgicamente por espondilolistese lombar degenerativa entre 1997 e 2003. O escorregamento intervertebral maior do que 20% ocorreu em 10 pacientes nos quais a estabilização da coluna vertebral foi obtida com artrodese postero-lateral e estabilização transpedicular (Grupo I). O escorregamento vertebral menor do que 20% ocorreu em 18 pacientes e a estabilização foi obtida com enxerto ósseo postero-lateral e com o uso de cages intervertebrais (Grupo II). Nos outros oito pacientes em que o escorregamento também era menor do que 20% não foi necessária a artrodese, tendo sido apenas realizada a descompressão nervosa (radicular) (Grupo III). **Resultados:** a dor lombar (lombalgia) e a dor ciática foi aliviada em 29 (81% e 31 (86%) dos pacientes respectivamente. Os déficits neurológicos desapareceram totalmente em 25 (81%) dos pacientes. **Conclusão:** a indicação da tática operatória nos pacientes com espondilolistese lombar degenerativa é baseada nos seguintes fatores: extensão do escorregamento vertebral, altura do espaço intervertebral e avaliação da estabilidade mecânica vertebral.

DESCRITORES: Espondilolistese/cirurgia; Doenças da coluna vertebral/cirurgia

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Degenerative lumbar spondylolisthesis was first described by Junghanns, Macnab and Newman in the 30s and the 40s of the previous century (quoted from Balderstron and Vaccaro)¹. Degenerative lumbar spondylolisthesis takes place most frequently at the level of the L4-L5 level and is characterized by anterior displacement of L4 vertebra over L5 vertebra. X-ray examinations demonstrate an intact neural arch and pars intraarticularis. The cause of the displacement is the degenerative changes of intervertebral joints at the spondylolisthesis level. The value of the anterior displacement index varies between 5% and 30%. Intervertebral joints hypertrophy at the spondylolisthesis plane leads to nervous structures compression within the vertebral canal at the region of the lateral recess and at the level of inferior vertebral pedicle. In case of greater displacement, the compression of nerve roots leaving intervertebral foramina below superior vertebral pedicle can be found. Spinal stenosis and nervous structures compression may be also caused by posterior protrusion of the intervertebral disc, osteophytes and thickened yellow ligament¹⁻⁶. The goal of this study was to present surgical management of nerve elements decompression in vertebral canal and internal spine stabilization in patients suffering from degenerative lumbar spondylolisthesis.

TABLE 1 - Clinical characteristics

Patients (N=36)	
Sex	
Females	17
Males	19
Age	
Between 49 and 64	36
the mean age $56,39 \pm 7,12$ yrs	36
Signs	
Low back pain	36
Sciatic neuralgia	36
Neurological deficits	31
Neurogenic intermittent claudication	7
Diagnostic examinations	
X-ray (a-p and lateral)	36
Functional X-ray	36
MRI	34
CT	21
Densitometry	19
Electrophysiological tests	21
Level of spondylolisthesis	
L2-L3	2
L3-L4	7
L4-L5	24
L5-S1	3
The degree of spondylolisthesis	
From 8% to 29%	36
the mean value $17,62 \pm 7,84\%$	36

METHODS

The clinical and radiological analysis included 36 patients with degenerative spondylolisthesis in whom surgery was carried out between January 1997 and December 2003 (Table 1). There were 17 females and 19 males from 49 to 64 years (average 56 years). Conservative treatment prior to the surgery yields no improvement. The patients complained of pain in lumbosacral region radiating to the lower extremities.

Neurological examination demonstrated unilateral or bilateral sciatic neuralgia. Neurological symptoms were observed in 31 cases and neurogenic claudication was noted in seven patients.

Plain radiograms, extension and flexion films established proper diagnosis and choice of adequate method for surgery. Additional investigations were also necessary as follows: MRI – performed in 34 cases, CT- in 21 cases, densitometry of lumbosacral spine in 19 cases, electrophysiological examinations (electromyography and nerve conduction) in 21 cases.

The degenerative lumbar spondylolisthesis most often occurred at the level of L4-L5 (24 cases). It was found at the level of L3-L4 in seven cases, L2-L3 in two cases, L5-S1 level in three patients. The extent of anterior vertebral displacement was varied between 8% - 29% (mean $17,62 \pm 7,84\%$).

In relation to extent of displacement, the height of the intervertebral disc and degree of nervous elements compression determined the type of surgical strategy. One of three types of surgical strategies was applied (Table 2). Patients with spondylitic displacement greater than 20% (Figure 1) were qualified for the first type of operative treatment, those with displacement smaller than 20% (Figure 2) - for the second type of surgery and the patients with displacement smaller than 20% but with a completely eliminated height of intervertebral space underwent the third type of surgery.

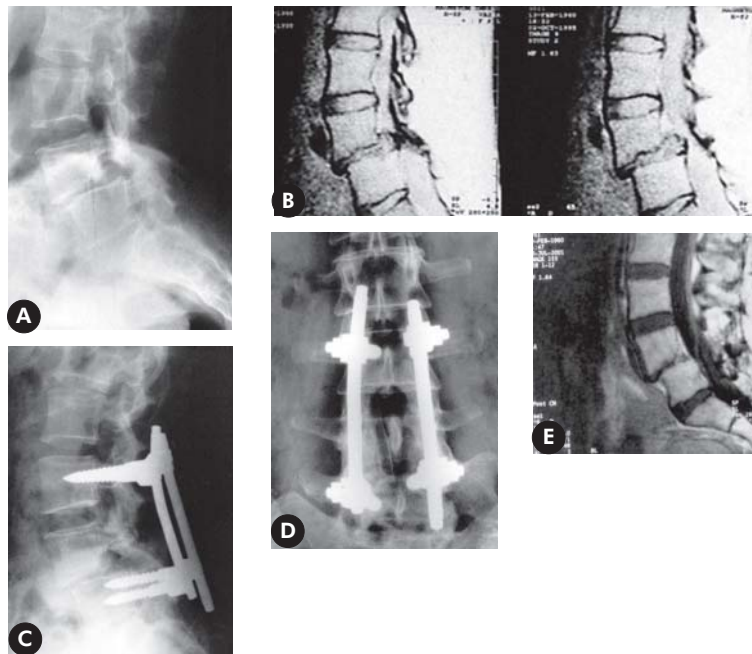
The first type of operation (ten cases) consisted of two - level laminectomy, bilateral removal of intervertebral joints and discectomy at spondylolisthesis level. The vertebral column stability was achieved by transpedicular stabilization as well as intervertebral and posterolateral spinal fusion with autogenic bony grafts.

The second type of operation (18 cases) included one - level laminectomy of upper vertebral arch, bilateral removal of intervertebral joints and discectomy at the level of spondylolisthesis. The vertebral column stabilization was obtained by intervertebral fusion with intervertebral titanic cages packed with bony grafts and additionally posterolateral spinal arthrodesis with autogenic bony grafts.

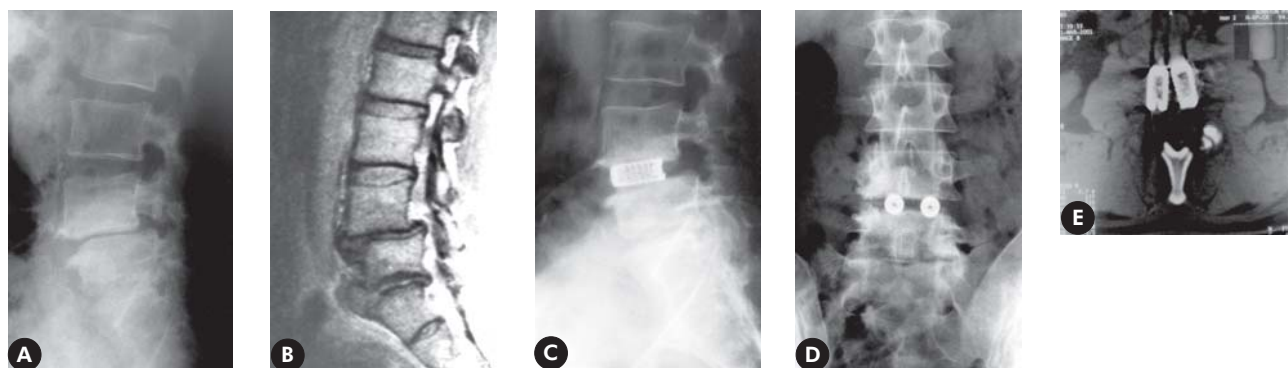
The third type of operative procedure (eight cases) included bilateral, one-level, oblique laminotomy and foraminotomy and removal of postero-superior edge of the inferior vertebra. In this type of surgery there was no indication for additional spinal arthrodesis since the vertebral column stabilization evaluated preoperatively (functional X-ray) and intraoperatively was found to be very sufficient.

TABLE 2 - Surgical treatment

Types of nervous structures decompression	N° of cases N = 36	Types of stabilization		
		Transpedicular	Intervertebral cages cages (PLIF)	Autogenic bone
1. Two level laminectomy, bilateral facetectomy and discectomy	10	10	-	10
2. One level laminectomy or laminotomy	18	-	18	18
3. Bilateral oblique laminotomy, foraminotomy and partial removal of posterior, upper edge of inferior vertebra	8	-	-	-

**Figure 1**

The patient, female, 52 yrs old with bilateral sciatic neuralgia and feet paresis. Preoperatively X-ray in lateral projection (A), MRI (B) discloses L4-L5 spondylolisthesis (anterior displacement - 22%) and hernia of intervertebral disc. The patient was managed surgically (the first type of operation) by laminectomy, facetectomy and discectomy. The vertebral column stabilization was achieved by transpedicular screws as well as intervertebral and posterolateral spinal arthrodesis with autogenic bony grafts. Postoperative X-ray in lateral (C) and a-p projections (D) show location of autogenic bony grafts and transpedicular stabilization. Pain and neurological deficits subsided. The control MRI (E) two years after removal of metallic implants disclosed right anatomy of lumbo-sacral segment and spondylodesis in intervertebral space L4-L5

**Figure 2**

The patient, male, 54 years old with the low back pain, left side sciatic neuralgia and left foot paresis. Preoperative X-ray in lateral projection (A) and MRI (B) discloses L4-L5 spondylolisthesis (anterior displacement -18%). The patient underwent surgery (the second type of operation). Bilateral laminotomy L4 and facetectomy L4-L5 as well as discectomy L4-L5 decompressed a nervous roots. The vertebral stabilization with intervertebral cages packed with autogenic bony tissue was achieved. Postoperative X-ray in lateral (C) and a-p projection (D) and CT examination (E) presented PLIF stabilization. Pain and neurological deficits subsided

RESULTS

The results of surgery are presented in Table 3. The low back pain relief was noted in 29 (81%) patients. The symptoms of the sciatic neuralgia subsided in 31 (86%) cases and neurological deficits were reduced completely in 25 (81%) cases. Five patients showed no improvement (one case after the first type of operation, two cases after the second type and two cases after the third type). At the follow up examination, these patients complained of lumbar back pain and the signs of neurogenic claudication. On neurological examination, sciatic neuralgia and neurological deficits were still present. Deterioration (intensification of low back pain and neurological deficits) was also noted in two patients (in one case after the second type of operation and in one case after the third type of operation). The patients were self-dependent and analgesic drugs relieved the pain. There were no intraoperative and postoperative complications.

DISCUSSION

The degenerative lumbar spondylolisthesis is often found to be asymptomatic. The most common clinical signs include lumbar back pain, femur neuralgia, sciatic neuralgia, neurological deficits and neurogenic claudication. It is essential to differentiate between the signs of degenerative lumbar spondylolisthesis and coxarthrosis, atheromathosis of the lower limbs, diabetic neuropathy, neoplasm of retroperitoneal space and lumbosacral plexus disease¹. Only 10-15% of the patients with degenerative lumbar spondylolisthesis require surgery. Elder age, coexisting diseases, the duration of neurological deficits increase the surgery risk⁷. The indications for surgery included low back pain, sciatic neuralgia and neurological deficits resistant to conservative treatment. The aim of the operation was to decompress the nervous structures and provide the internal stabilization of the vertebral column^{5, 8-10}.

On the basis of X-rays, CT and MRI, the preoperative evaluation of the level of vertebral displacement, the height of intervertebral space, the location and the range of vertebral canal stenosis as well as stability of the spinal motion segment were specified determining the type of surgery and method of internal vertebral stabilization. Different techniques of surgery were useful to decompress the nervous structures of vertebral canal properly and to establish the spinal

stabilization by spondylodesis. We observed in 29 (81%) cases very good results. Different techniques of surgery for degenerative lumbar spondylolisthesis were discussed in the literature^{8-9,11-15}.

In case of such as symptoms as instability and lumbar back pain only posterolateral spondylodesis is performed with autogenic bony grafts which are placed between the transverse processes of the vertebrae at the level of spondylolisthesis^{4,9-10}. Another type of surgical procedure is intervertebral osteosynthesis (in case of the slight slippage) with metallic plugs packed with bony tissue via posterior approach (PLIF – posterior lumbar interbody fusion) or anterior approach (ALIF – anterior lumbar interbody fusion). The aim of the osteosynthesis is to achieve internal spondylodesis^{5, 11, 16}.

Analysing the results of the surgical procedure of degenerative lumbar spondylolisthesis, Satomi et al⁷ observed the improvement of neurological condition in 77% of cases with anterior approach (ALIF) and in 56% of cases treated with posterior approach (PLIF).

Decompressive laminectomy without fusion was described by Laus et al. in patients with natural stability of the motion segment of the vertebral column due to narrowed intervertebral space and the presence of bony hypertrophy. The results demonstrated in our material were similar to Laus's et al. and also revealed improvement neurological conditions³.

Internal vertebral stabilization by transpedicular screws in patients with degenerative lumbar spondylolisthesis enhances spondylodesis and good functional outcome can be achieved. Surgical intervention for treatment of lumbar spondylolisthesis was recommended by Kim et al.¹⁷ and Zdeblic¹⁸. After follow-up periods of four¹⁷ and ten years¹⁸ since internal stabilization neurological condition was improved in nearly all patients.

CONCLUSION

Strategy of surgery in patients with degenerative lumbar spondylolisthesis is established on the basis of evaluation: vertebral displacement extent, height of intervertebral space and assessment of vertebral column stability.

TABLE 3 - Results of surgery

Clinical signs	Preoperative		Postoperative	
	Cases N = 36	Improvement N=29 (81%)	Non-improvement N=5 (13%)	Worsening N=2 (6%)
Low back pain	36	29 (81%)	5	2
Sciatic neuralgia	36	31 (86%)	4	1
Neurological deficits	31	25 (81%)	4	2
Neurogenic intermittent claudication	7	3 (43%)	3	1

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