

OPERATIVE TREATMENT OF DEGENERATIVE LUMBAR SPINE SPONDYLOLISTHESIS

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Abstract

Introduction: Management of degenerative lumbosacral spondylolisthesis with spinal stenosis is still controversial. Surgery is widely used, as well as non-surgical treatment.

Aim: To evaluate the clinical results and functional outcome after operative treatment in Grade II and III lumbar spine spondylolisthesis.

Material and methods: Twelve patients with symptoms and image-confirmed degenerative spondylolisthesis entered the study. Mean patient age was 57 years. Spondylolisthesis Grade II or III, segment L4-L5 or L5-S1 were evaluated. All patients underwent similar protocols. Operative treatment was decompressive laminectomy, posterior one segment fixation, and fusion with autologous bone grafting. Functional outcome measures were Visual Analog Scale (VAS, 10-point scale) and Oswestry Disability Index (ODI, 100-percent scale) after 6 and 12 months.

Results: Patient follow-up was 12 months. Preoperatively, 7 patients had severe disability according to ODI, 4 had moderate disability. VAS measured 6 and 7 points in 6 patients, lowest score of 4 points and the highest score of 9. After 6 months, ODI showed 5 patients had minimal and 7 had moderate disability; 2 patients had 0 points on the VAS, 2 had a score of 1, 4 had a score of 2, highest score of 4 points. Treatment outcome effects after 1 year were 9 patients with minimal disability, 3 with moderate; VAS – 2 patients with 0 points, 3 with 1 point, 4 with 2 points.

Conclusion: Patients with degenerative spondylolisthesis and spinal stenosis treated surgically showed substantially greater improvement in pain and functional outcome during a period of 1 year.

Key words: decompressive laminectomy, Oswestry Disability Index, spondylolisthesis, Visual Analog Scale.

Introduction

Degenerative spondylolisthesis is an anterior subluxation of the vertebra relative to the inferior vertebra. The cause of subluxation is degenerative changes in the vertebral disc and the posterior facet joints. Spondylolisthesis can be a cause for spine deformity and central spine stenosis, as well as foraminal stenosis [1, 2]. Spinal column instability in spondylolisthesis is a result of the loss of the anatomic stability of the spine as a whole due to the subluxation of the vertebra. In anterolisthesis, the upper

vertebral body is positioned abnormally compared to the vertebral body below it. To be more specifically, the upper vertebral body slips forward on the one below. In ventrolisthesis, the upper vertebral body slips backwards on the one below (occurring rarely).

Regarding localization, 80% of cases occur at L4-L5, 20% L3-L4 or L5-S1 level. In 95% of cases spondylolisthesis is bilateral. Most commonly occurs in patients over 40 years. It is more common in females (female to male ratio 4 : 1). The prevalence among patients is 5.8%

in male and 9.1% in female. The prevalence in osteoporotic female is 28.4%, with 12% occurring at the L3-L4 level, 73% at the L4-L5 level, and 28% at the L5-S1 level [3].

There is a genetic predisposition among a number of patients with a positive family history for the existence of spondylolisthesis or spinal column dysplasia. The etiology of spondylolisthesis is multifactorial. There may be a congenital component among certain types, and significant factors include body posture, gravitation, rotational forces and the occurrence of stress loads on the spine.

Spondylolisthesis can be graded according to the percentage of vertebral subluxation in the sagittal plain, using the system adapted from Meyerding [4]:

- Level 1: less than 25% of the vertebral diameter;
- Level 2: 26–50%;
- Level 3: 51–75%;
- Level 4: 76–100%;
- Level 5 (called spondyloptosis): more than 100%.

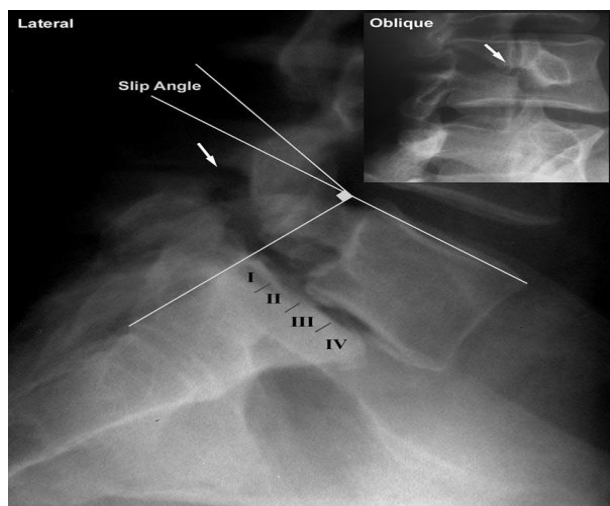


Figure 1 – The Meyerding grading system

Anatomy and Biomechanics

The most common location is at the junction of L5-S1. The compressive force is moving downwards on the spinal column through the L5-S1 segment conveying the strength on the pelvis, thus resulting in a huge pressure in the previously mentioned part of the spinal column. Facet joints in the L5-S1 segment have large compressive burdens and hence it is subjected to injuries. The *pars interarticularis* rep-

resents the weakest region in the posterior vertebral column, opposing to the occurrence of significant forces during normal movements in the spinal column. The *pars interarticularis* may be congenitally changed or may be subjected to repetitive stress under the influence of rotation and hyperflexion resulting in the occurrence of micro fractures. In having lumbar lordosis, gravity, body posture, high intensity activity (such as gymnastics), genetic factors, all play a role in the emergence of listhesis [5, 6]. If there is an appearance of a fibrous nonunion as a result of the previously mentioned factors, the *pars interarticularis* is elongated resulting in a progressive listhesis. In patients with spondylolysis, it is believed that in 30–50% that state will progress toward spondylolisthesis.

Classification

The most used and popular classification is the one Wiltze [7] proposed and described in 1976. This classification system describes 6 different types of spondylolisthesis:

- Type 1 – Dysplastic spondylolisthesis: congenital malformation of the sacrum or L5 neural arch;
- Type 2 – Isthmic spondylolisthesis: stress fracture, elongation, acute fracture of *pars interarticularis*;
- Type 3 – Degenerative spondylolisthesis: long lasting arthritis of the zygapophyseal joints;
- Type 4 – Traumatic spondylolisthesis: fracture of the neural arch (excluding the region of the *pars interarticularis*);
- Type 5 – Pathologic spondylolisthesis: bone diseases – Paget's disease, metastatic deposits, osteoporosis;
- Type 6 – Iatrogenic spondylolisthesis: as a consequence of surgery in the lumbosacral region (when more than 50% of both facets are resected);

Degenerative spondylolisthesis can be often asymptomatic for a long period of time. Most common symptoms of degenerative spondylolisthesis include: low back pain, neurogenic claudication, radicular pain (unilateral or bilateral radiculopathy) and leg muscle weakness. 62% of the patients reported low back pain as well as sciatica, 7% sciatica only, 31% reported low back pain only. Symptoms were similar in patients with spondylolisthesis and chronic low back pain. A positive straight leg raising test result

in 12% and an L5 sensory disturbance in 13% were the most common [8, 9].

Treatment options include: nonsurgical (Nonsteroidal anti-inflammatory medication, physical therapy, bracing) and surgical treatment (decompression, decompression and posterior fusion without spinal instrumentation, decompression and posterior fusion with posterior spinal instrumentation or decompression and posterior fusion and posterior instrumentation combined with facet or interbody fusion). Surgery is used when there is persistent or recurrent leg pain despite adequate non surgical treatment, progressive neurological deficit, significant reduction in quality of life and confirmatory imaging studies consistent with the diagnosis [10–16].

Aim

The aim of this study is to evaluate the clinical results and functional outcome after surgical treatment of grade II and III lumbar spine spondylolisthesis using decompression, posterior spinal fixation and facet fusion.

Material and methods

Twelve patients who have symptoms and image-confirmed (RTG, MRI) degenerative spondylolisthesis entered in a prospective study at the University Traumatology Clinic, Medical Faculty Skopje. Mean age of patients was 57 years. Spondylolisthesis grade II or III, segment L4-L5 or L5-S1 were evaluated. All the patients underwent similar preoperative, operative and postoperative protocol. The operative treatment was decompressive laminectomy, posterior one segment fixation and facet fusion with autologous bone grafting. The postoperative treatment outcome measures were the Visual Analog Scale (VAS, 10-point scale, higher scores indicating more severe symptoms) and

Oswestry Disability Index (ODI, 100-percent scale, with lower scores indicating less severe symptoms) after 6 and 12 months. Among the 12 patients (male 2, female 10) a total of 5 patients had an L5-S1 segment spondylolisthesis, 5 patients had an L4-L5 segment spondylolisthesis and 2 patients had an L3-L4 spondylolisthesis; 6 patients had a Grade II spondylolisthesis, 6 patients had a Grade III spondylolisthesis.

Results

All patients were followed for the period of 1 year. Preoperatively, 7 patients had severe disability according to ODI, 4 had moderate disability and 1 patient crippled disability (Table 1). VAS measured 6 and 7 points in 6 patients, lowest 4 points and the highest being 9 points (Table 2). After 6 months, ODI showed 5 patients had minimal disability and 7 had moderate (there was no patient with severe or crippling disability); 2 patients had 0 points on the Visual Analog Scale, 2 patients had a score of 1, 4 patients had a score of 2, the highest score being 4. The treatment outcome effects after 1 year were 9 patients with minimal disability, 3 with moderate, VAS – two patients with 0 points, three patients with 1 point and four patients with 2 points.

Table 1

Functional results – Oswestry Disability Index (ODI)

	Pre-op	6 months	12 months
Minimal disability	/	5 pt (41.66)	9 pt (75%)
Moderate disability	4 pt (33.33%)	7 pt (58.34%)	3 pt (25%)
Severe disability	7 pt (58.34%)	/	
Crippling disability	1 pt (8.33%)	/	

Table 2

Functional results – VAS

VAS (N = 12 pt) – preoperatively	VAS – at 6 months postoperatively	VAS – at 12 months postoperatively
4 points: 1 pt (8.33%)	0 points: 2 pt (16.67%)	0 points: 2 pt (16.67%)
5 points: 3 pt (25%)	1 points: 2 pt (16.67%)	1 points: 3 pt (25%)
6 points: 3 pt (25%)	2 points: 4 pt (33.33%)	2 points: 4 pt (33.33%)
7 points: 3 pt (25%)	3 points: 3 pt (25%)	3 points: 3 pt (25%)
8 points: 2 pt (16.67%)	4 points: 1 pt (8.33%)	



Figure 1 – Preoperative plain radiographs of a L5-S1 spondylolisthesis

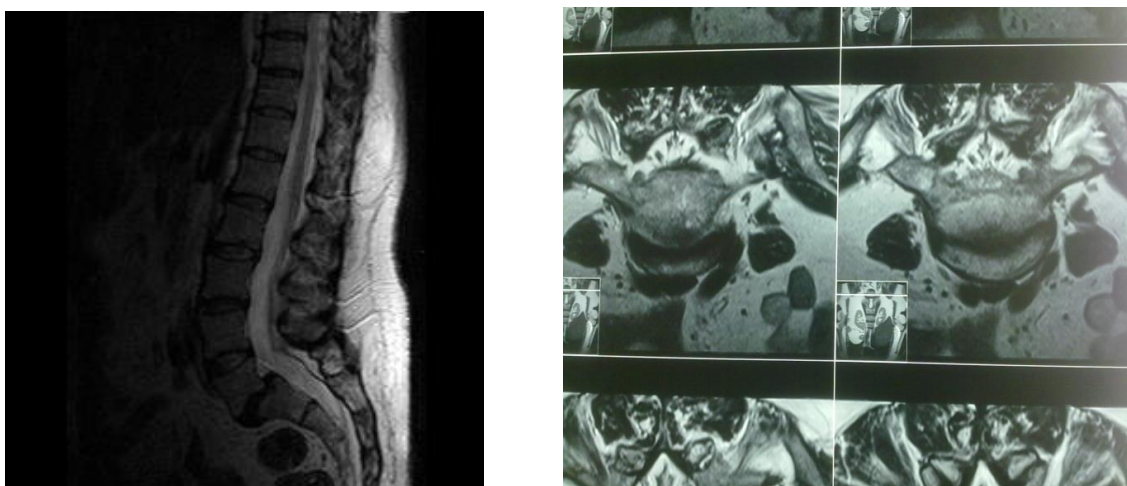


Figure 2 – Preoperative MRI of a L5-S1 spondylolisthesis



Figure 3 – Intraoperative findings L5-S1 (same patient)



Figure 4 – Intraoperative findings L5-S1 (same patient)

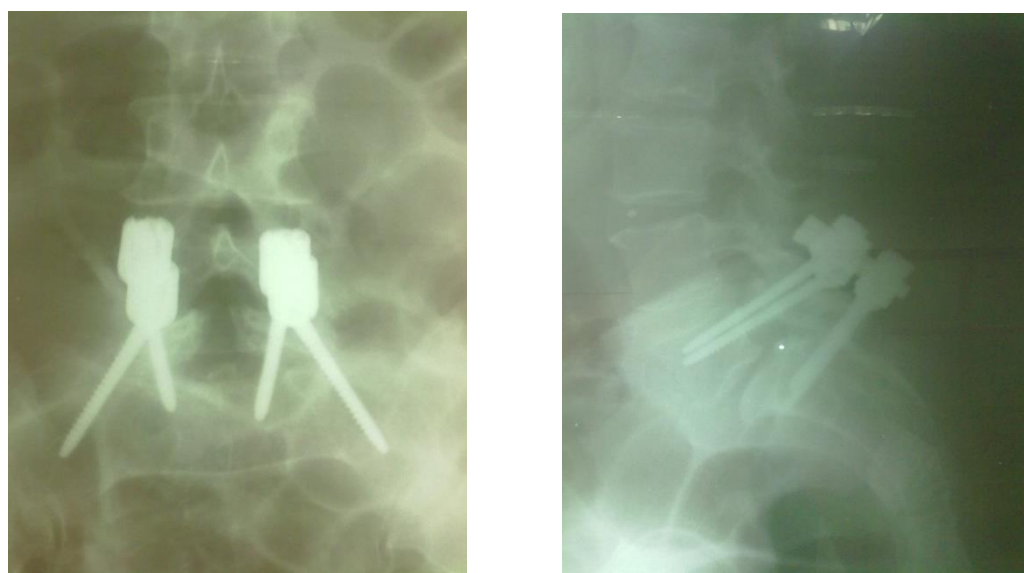


Figure 5 – Postoperative radiographs of a L5-S1 spondylolisthesis

Discussion

Although different operative techniques for reduction and fixation of spondylolisthesis were used, there is no existing consensus about the ideal surgical treatment. The main goal for surgery of degenerative lumbosacral spondylolisthesis is to solve the clinical symptoms, eventually to reduce or to preserve the degree of spondylolisthesis and to prevent the further slippage and neurological complications. Surgical treatment can lead to satisfactory results in 85–90% of patients with high degree of spondylolisthesis.

One examination, called the *Spine Patient Outcomes Research Trial (SPORT)*, analyzes the relation between surgical and conservative treatment in patients with spinal stenosis, degenerative spondylolisthesis and intervertebral disc herniation. This examination ana-

lyzes data comparing surgery with nonoperative care for degenerative spondylolisthesis over a period of 4 years. Comparative effectiveness evidence for clearly defined diagnostic groups shows good value for surgery compared with nonoperative care over 4 years. According to the obtained results, surgical therapy improved the health condition and give better results in the course of a four year period in relation to the nonoperative treatment [17].

Dean et al. examined 58 patients who were subjected to anterior cervical decompression and fusion, with an iliac crest graft, operated as a result of degenerative spondylolisthesis in the period from 1974 to 2003. Patients were evaluated for neurological improvement and osseal fusion. The study showed that the average neurological improvement equaled 1.5

Nurik degrees and the rate of fusion equaling 92% [18, 19].

In a study of Shaeren et al, decompression and dynamic stabilization gave excellent results after monitoring the patients for a period of four years; the study included older patients with spinal stenosis and degenerative spondylolisthesis [20]. According to Zdeblick et al, who conducted a prospective randomized study which confirmed that the addition of a rigid posterior instrumentation increases the rate of fusion and correlated with less pain and return to the work place [21, 22]. In a prospective study Herkowitz showed that fusion gives better clinical results compared with decompression [23].

The results obtained in patients with an istmic type of spondylolisthesis are the best. Most papers report a rate of 75–95%, results ranging from good to excellent. Patients subjected to surgery have an improved quality of life and reducing of their pain. Certain studies made on a longer follow-up period still recommend a conservative treatment among asymptomatic younger patients (children and adolescents) with spondylolisthesis type 1 or type 2. However, several authors decided to undertake a surgical treatment (mostly fusion) when the spondylolisthesis is symptomatic if it does not respond to conservative treatment or in cases of spondylolisthesis of a higher level. For the good outcome of the surgical treatment it is necessary to have a good selection of patients; there should be a clear indication for operative treatment in order to obtain the best results from the surgery.

Conclusion

Our study had several limitations, including a small number of patients, design of the study, patient's objectivity and a short follow up period. However, the preliminary results of this small group of patients shows that the surgical treatment of grade II and III lumbar spine spondylolisthesis using decompression, (segment laminaectomy) posterior segment fixation and facet fusion showed substantially greater improvement in pain, functional outcome and quality of life during a follow up period.

Conflict of interest

The authors declare that they have no conflict of interest in connection with this paper.

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Резиме

ОПЕРАТИВЕН ТРЕТМАН НА ЛУМБОСАКРАЛНА ДЕГЕНЕРАТИВНА СПОНДИЛОЛИСТЕЗА

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Третманот на лумбосакралната дегенеративна спондилолистеза со спинална стеноза сè уште е контроверзен. Многу често се користи

хирургија, а исто така и нехируршки третман. Целта на овој труд е да се оценат клиничките резултати и функционалниот исход по оперативниот третман на спондилолистеза степен II и III на лумбално-сакралниот 'рбет.

Во студијата беа вклучени дванаесет пациенти со симптоми и клиничка слика со потврдена дегенеративна спондилолистеза. Просечната возраст на пациентите изнесува 57 години. Сите пациенти имаа спондилолистеза со степен II или III, на сегмент L4-L5 или L5-S. Оперативниот третман се состои од декомпресивна ламинектомија, заден еден сегмент фиксација и фузија со автологен коскен графт. Функционалниот исход се евалуираше со помош на Визуелната аналогна скала (VAS) и Oswestry Disability Index (ODI) на 6 и 12 месеци.

Пациентите беа следени во период од 12 месеци. Предоперативно, седуммина пациенти имаа тешка попреченост според ОДИ, четворица имаа умерена попреченост. VAS имаше вредност од 6 и 7 поени кај шестмина пациенти, најниска оценка од 4 поени и највисока оценка 9. По шест месеци, ОДИ покажа дека петмина пациенти имале минимална попреченост и седуммина имале умерена попреченост; двајца пациенти имале 0 поени на VAS, двајца имале резултат од 1, четворица имале резултат од 2, највисок резултат од 4 поени. Функционалниот исход по една година биле: деветмина пациенти со минимална попреченост; тројца со умерена; VAS – двајца пациенти со 0 поени; тројца со 1 поен; четворица со 2 поена.

Според нашите испитувања и резултати, пациентите со дегенеративна спондилолистеза и спинална стеноза што се третираат хируршки покажаа значително поголемо подобрување во однос на болка и функционален исход во период од една година.

Клучни зборови: визуелна аналогна скала, декомпресивна ламинектомија, Oswestry Disability Index, спондилолистеза.