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Original Article

CLINICAL AND PARACLINICAL CHARACTERISTICS OF PATIENTS UNDERGOING FUSION SURGERY FOR GRADE II LUMBAR SPONDYLOLISTHESIS

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ABSTRACT: To describe the clinical and paraclinical characteristics of patients undergoing fusion surgery for grade II lumbar spondylolisthesis at Thong Nhat Hospital, Ho Chi Minh City. This retrospective study reviewed 29 patients with grade II lumbar spondylolisthesis who underwent transforaminal lumbar interbody fusion (TLIF) between May 2020 and December 2023 at Thong Nhat Hospital. Data were analyzed using SPSS 25.0. The mean age was 53.66 ± 9.76 years, and the female-to-male ratio was 4.8:1. All patients presented with low back pain, accompanied by unilateral radicular pain in 37.9% and bilateral radicular pain in 62.1%. The step-off sign was present in 86.2% of patients. A positive Lasègue test (< 70°) was observed in 68.9%. Slippage occurred at L4 in 58.6% (17 patients), L5 in 37.9% (11 patients), and L3 in 3.4% (1 patient). The causes were isthmic defects (62.1%) and degeneration (37.9%). Degenerative spondylolisthesis occurred predominantly at L4 (81.8%), whereas isthmic spondylolisthesis was more frequent at L5 (55.6%) ($p = 0.028$). The mean slip percentage on conventional X-ray was 31.29 ± 5.98%, with a mean slip distance of 12.04 ± 2.28 mm and a mean disc height of 6.72 ± 2.81 mm. There was a moderate inverse correlation between slip percentage and disc height ($r = -0.432$; $p = 0.019$). Spinal stenosis and foraminal stenosis on MRI were found in all patients (100%). Neuromuscular conduction abnormalities on electromyography were present in 55.2% of cases. Surgical patients with grade II lumbar spondylolisthesis predominantly present with features of spinal stenosis and foraminal stenosis, along with a high prevalence of the step-off sign. Vertebral slip percentage shows a moderate inverse correlation with disc space height.

Keywords: Spondylolisthesis, interbody fusion surgery, step-off sign, disc height.

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1. INTRODUCTION

Spondylolisthesis is twice as common in women as in men [1]. Its reported prevalence is about 5% to 6% in adults and about 12% in adolescents who take part in high-impact sports such as football, competitive athletics, or gymnastics, and in patients with Scheuermann disease [2]. Most patients with spondylolisthesis have no symptoms [3]. Symptoms usually arise from mechanical causes or spinal stenosis, and patients often complain of persistent neurogenic claudication, a consequence of spinal stenosis that presents as low back pain radiating to both lower limbs, with paresthesia and weakness when walking or standing [4]. Symptoms usually progress over months to years. According to the Meyerding classification, grade II spondylolisthesis is defined as a slip of 25% to 50% [5]. At this degree of slippage, the structural deformity combined with spinal canal stenosis and foraminal stenosis makes these clinical symptoms more pronounced, particularly when surgery is indicated. Although many studies have addressed lumbar spondylolisthesis in general, studies in Vietnam that describe in detail the clinical and paraclinical characteristics of patients with grade II spondylolisthesis who have an indication for surgery remain limited.

Knowledge of the clinical features (step-off sign, Lasègue test, claudication) and imaging parameters (slip distance, disc height, degree of spinal stenosis) in patients with grade II spondylolisthesis is decisive for diagnosis, for assessing the degree of instability, and for choosing an appropriate interbody fusion technique. We therefore conducted this study to describe the clinical and paraclinical characteristics of patients undergoing fusion surgery for grade II lumbar spondylolisthesis at Thong Nhat Hospital, Ho Chi Minh City.

2. SUBJECTS AND METHODS

This was a retrospective descriptive case series of patients diagnosed with grade II lumbar spondylolisthesis who underwent interbody fusion at the Department of Neurosurgery, Thong Nhat Hospital, Ho Chi Minh City, from 05/2020 to 12/2023.

2.1. Study population:

Inclusion criteria: (1) Patients older than 18 years. (2) A confirmed diagnosis of grade II lumbar spondylolisthesis according to the Meyerding classification, based on clinical examination combined with complete imaging (conventional radiography, dynamic radiography, and magnetic resonance imaging of the lumbar spine). (3) Transforaminal lumbar interbody fusion.

Exclusion criteria: (1) Previous posterolateral bone graft surgery. (2) Spondylolisthesis with other spinal disorders, such as conditions causing imbalance or multilevel changes in spinal anatomy, including scoliosis, spinal malformations, tumors, and spinal infections. (3) Concomitant infection, pregnancy, coagulation disorders, severe liver failure, severe renal failure, or respiratory failure.

2.2. Data collection and variable definitions:

Data were extracted from coded medical records. The study variables were as follows:

Clinical characteristics: age, sex, low back pain, radicular pain (unilateral/bilateral), neurogenic claudication distance, paraspinal muscle spasm, step-off sign, Lasègue test (positive when radicular pain appears at a leg-raise angle < 70 degrees), deep tendon reflexes, sensory disturbances, muscle strength (MRC scale, 0–5/5), and muscle atrophy.

Radiographic characteristics: Meyerding grade. Slip percentage (Taillard method) = (slip distance / width of the superior endplate of the lower vertebra) x 100%. Slip distance (mm) and disc space height (mm, measured at the center of the disc on the lateral view). Instability was assessed on dynamic flexion/extension radiographs (slip percentage increased by > 4% or angulation changed by > 10 degrees).

Magnetic resonance imaging (MRI) and electromyography (EMG): degree of spinal stenosis (mild, moderate, severe), foraminal stenosis, facet joint hypertrophy, and ligamentum flavum thickening. Neuromuscular conduction on EMG (normal, or reduced conduction/nerve root injury).

2.3. Data processing and statistical analysis:

Data were entered and analyzed using SPSS version 25.0.

Normally distributed continuous variables are presented as mean ± standard deviation (mean ± SD).

Categorical variables are presented as frequencies and percentages (n, %).

Proportions between categorical groups were compared using the chi-squared test or Fisher's exact test (when more than 20% of cells had an expected frequency < 5).

Normality was checked with the Kolmogorov-Smirnov test. The correlation between slip percentage and disc height was analyzed using Pearson's correlation coefficient (r).

Statistical significance was set at $p < 0.05$.

2.4. Research ethics:

The study complied with the principles of the Declaration of Helsinki. It was approved by the Biomedical Research Ethics Committee of Thong Nhat Hospital, Ho Chi Minh City (approval number: 85/2023/BVTN-HĐYĐ). All personal information of patients was coded and kept strictly confidential.

3. RESULTS

The study included 29 patients with grade II spondylolisthesis who underwent pedicle screw fixation combined with interbody fusion at the Department of Neurosurgery, Thong Nhat Hospital.

Table 1: General characteristics

VARIABLE	VALUE (n, % or mean ± SD)
Age	53.66 ± 9.76
Sex	
Male	5 (17%)
Female	24 (83%)
Slip level	
L3	1 (3.4%)
L4	17 (58.6%)
L5	11 (37.9%)
Cause	
Isthmic	18 (62.1%)
Degenerative	11 (37.9%)
Increased slip % on dynamic X-ray	
Yes	22 (75.9%)
No	7 (24.1%)

Comment: The female-to-male ratio was 4.8:1. The most common slip level was L4 (17 patients, 58.6%), followed by L5 (11 patients, 37.9%) and L3 (1 patient, 3.4%) (29 slip levels in 29 patients with single-level spondylolisthesis). The cause of spondylolisthesis was associated with the slip level: degenerative spondylolisthesis occurred mainly at L4 (81.8%), whereas isthmic

Table 2: Clinical characteristics

	VARIABLE		n(%)
Subjective symptoms	Low back pain		29(100%)
	Radicular leg pain	Unilateral	11(37.9%)
		Bilateral	18(62.1%)
	Neurogenic claudication	Under 100 m	13(44.8%)
		100 – 500 m	12(41.4%)
		Over 500 m	4(13.8%)
Physical signs	Step-off sign		25(86.2%)
	Paraspinal muscle spasm		19(65.5%)
	Lasègue	<30°	1(3.4%)
		30°-70°	19(65.5%)
		>70°	9(31.1%)
	Reduced lower-limb reflexes		9(31.1%)
	Sensory disturbance	Numbness, paresthesia	16(55.2%)
		Numbness + hypoesthesia	13(44.8%)
		None	0
	Motor deficit	Strength 3/5	1(3.4%)
		Strength 4/5	4(13.8%)
		Strength 5/5	24(82.8%)
	Muscle atrophy		5(17.2%)

spondylolisthesis occurred more often at L5 (55.6%) (p = 0.028, Fisher's exact test). Dynamic radiographs showed an increased slip percentage, indicating spinal instability, in 75.9% of patients.

Comment: The common symptoms of spondylolisthesis were low back pain with bilateral sciatica and neurogenic claudication. The step-off sign is a typical sign of spondylolisthesis. The Lasègue test was positive (< 70 degrees) in 20 patients (68.9%), while 9 patients (31.1%) had a negative Lasègue test (> 70 degrees).

Table 3: Radiographic characteristics

Characteristic	± SD
Slip (%) on conventional X-ray	31.29 ± 5.98
Slip (%) on dynamic X-ray	37.52 ± 6.56
Slip distance (mm)	12.04 ± 2.28
Disc height (mm)	6.72 ± 2.81

Comment: Dynamic radiographs assessing spinal instability showed an increased slip percentage in 75.9% of patients. In grade II spondylolisthesis, the mean slip distance was 12.04 mm and the mean disc height was 6.72 mm.

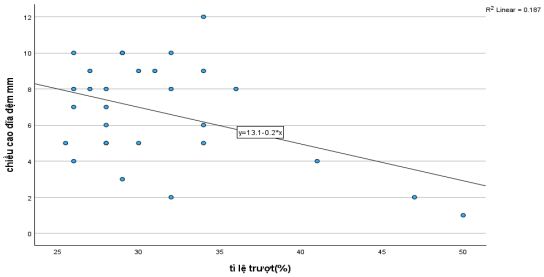


Chart 1: Correlation between vertebral slip percentage and disc height

Comment: The analysis showed a statistically significant inverse correlation of moderate strength between vertebral slip percentage and disc height (r = -0.432; p = 0.019 < 0.05). The higher the slip percentage, the lower the disc space height.

Table 4: MRI and electromyography characteristics

Characteristic			n (%)
Magnetic resonance imaging (MRI)	Spinal stenosis	Mild	6(20.7%)
		Moderate	17(58.6%)
		Severe	6(20.7%)
	Foraminal stenosis	29 (100%)	
	Ligamentum flavum thickening	Yes	20(69%)
		No	9(31%)
	Facet hypertrophy	25(86.2%)	
Electromyography	Reduced conduction	16 (55.2%)	
	Normal	13 (44.8%)	

Comment: All 29 patients had spinal stenosis and foraminal stenosis. Neuromuscular conduction was abnormal in 55.2% of patients and normal in 44.8%.

4. DISCUSSION

We found a female-to-male ratio of 4.8:1, consistent with the general observation of Vietnamese authors that degenerative and isthmic spondylolisthesis occur far more often in women than in men in the Vietnamese population. Regarding slip level, degenerative spondylolisthesis occurred mainly at L4 (81.8%), whereas isthmic spondylolisthesis was more common at L5 (55.6%); the difference was statistically significant (p = 0.028). These results are fully consistent with the reports of Pham Vo Ky [6], Koslosky [5], and Mesfin [7].

The step-off sign is a characteristic spinal deformity of high value in the clinical examination of spondylolisthesis. In this study, 86.2% of patients had a step-off sign, considerably higher than in the reports of Nguyen Vu (23.3%) [8], Pham Vo Ky (27.4%) [6], and Lai Huynh Thuan Thao (8%) [9]. This difference is due to our sample being limited to grade II spondylolisthesis (slip of 25%–50%), in which the bony step is large enough to be clearly palpable on clinical examination.

Regarding signs of nerve root irritation, a positive Lasègue test (< 70 degrees) was recorded in 68.9% of patients. This rate is lower than in some studies of patients with spondylolisthesis in general, such as Lai Huynh Thuan Thao (96%) [9] and Nguyen Vu (87.7%) [8]. The explanation is that in grade II spondylolisthesis, radicular pain is caused mainly by foraminal stenosis and spinal stenosis that are fixed during standing and walking (causing neurogenic claudication), whereas in the supine resting position used for the Lasègue test, nerve root tension decreases, so the rate of positive Lasègue tests is not high. Our results are similar to those of Borni et al. (55.9%) [10] and Mark S Greenberg (82%) [11]; Carla Vanti [12] reported a Lasègue test sensitivity of 71% in spondylolisthesis, with a confidence interval of 53%–87%, and Cook CJ et al. [13] noted that nerve root tension tests have low sensitivity in lumbar spinal stenosis syndrome.

On imaging, dynamic radiographs showed an increased slip percentage in 75.9% of cases, confirming the important role of dynamic films in assessing instability. We found a statistically significant moderate inverse correlation between slip percentage and disc height ($r = -0.432$; $p = 0.019$). By convention, r values of 0.3–0.5 indicate a moderate correlation. This reflects how degeneration-related disc collapse increases instability and promotes anterior slippage of the vertebral body. An analysis of NHANES-II data (Hipp JA et al. [14]) also confirmed that loss of disc height often accompanies the progression of lumbar spondylolisthesis.

On electromyography, the rate of neuromuscular conduction abnormalities was 55.2%. This is similar to the report of Min Cheol Chang [15], who explained that chronic nerve root injury caused by spinal stenosis in spondylolisthesis usually does not immediately reduce conduction amplitude to severely low levels; EMG therefore has moderate sensitivity (about 50%–60%) and is used mainly to support the differential diagnosis from other peripheral nerve disorders.

Study limitations:

This study has several limitations: (1) it was a single-center retrospective study with a relatively small sample (N = 29), because only patients with grade II spondylolisthesis who had an indication for surgery were selected; (2) the sample is subject to selection bias, because all patients had an indication for surgery, so the severity of clinical findings (step-off sign, spinal stenosis) was greater than in the general population with spondylolisthesis; (3) preoperative functional scores, such as the VAS pain score or the Oswestry Disability Index (ODI), were not assessed; and (4) long-term postoperative outcomes were not followed longitudinally.

5. CONCLUSION

Patients with grade II lumbar spondylolisthesis who underwent interbody fusion at Thong Nhat Hospital were predominantly women. Degenerative slips were concentrated at L4, whereas isthmic slips were concentrated at L5. The main clinical features were spinal stenosis syndrome, neurogenic claudication, and a very high rate of the step-off sign (86.2%). A positive Lasègue test and EMG abnormalities occurred at moderate rates. Vertebral slip percentage had a moderate inverse correlation with disc space height.

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