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Prognosis of disc herniated patients using back pain functional scale

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ABSTRACT

Objective: Describe the clinical and magnetic resonance characteristics in patients with lumbar disc herniation and investigate the correlation between Back pain functional scale and clinical and magnetic resonance characteristics.

Research subjects: 46 patients treated at Hue University of Medicine and Pharmacy Hospital from July 2023 to February 2024, with clinical symptoms suggestive of disc herniation and definitively diagnosed by magnetic resonance imaging lumbar spine.

Research method: Cross-sectional descriptive study. Patients were examined clinically and had an MRI scan of the lumbar spine, assessed by the 12-factor Back pain functional scale (BPFS).

Results: There is a difference between BPFS scores in patients with or without clinical symptoms. Finger-to-ground distance, Valleix sign, VAS score have a strong correlation with BPFS score. BPFS score has a strong correlation with the degree of spinal stenosis and there is a statistically significant difference in BPFS score between stenosis degrees ($|r| = 0.97$, $p<0.05$).

Conclusion: There is a clinical correlation between BPFS and the degree of spinal stenosis on MRI in patients with lumbar disc herniation.

Keywords: BPFS; disc herniation; low back pain; clinical; MRI.

I. INTRODUCTION

A herniated disc (also called bulged, slipped or ruptured) is a fragment of the disc nucleus that is pushed out of the annulus, into the spinal canal through a tear or rupture in the annulus. Discs that become herniated usually are in an early stage of degeneration. The spinal canal has limited space, which is inadequate for the spinal nerve and the displaced herniated disc fragment. Due to this displacement, the disc presses on spinal nerves, often producing pain, which may be severe. Herniated discs can occur in any part of the spine. Herniated discs are more common in the lower back

(lumbar spine) [1]. Spinal disc herniation is a common disease in the world and is the cause of about 72% of sciatica cases [Andrew J, 2006]. Lumbar disc herniation has a high incidence rate: from 1% to 3% in European and American countries [11]. The causes of disc herniation are complex and multifactorial, caused by processes including aging, abnormal mechanical loading, and accidental damage. Lumbar disc herniation is one of the leading causes of lost productivity, disability, and care costs and is considered a health problem worldwide [9,10]. Currently, there are many imaging methods to help diagnose lumbar disc herniation: contrast-enhanced discography, nerve root capsule imaging, and computed tomography. Magnetic resonance imaging has important value in diagnosis because of the safety of the technique and the ability to accurately assess the extent and location of disc herniation as well as the degree of spinal stenosis with a sensitivity of 92%. and specificity of 91% [2]. Around the world, lumbar spine pain and sciatica are often monitored and evaluated clinically based on the Oswestry, Quebec, SF-36, Roland - Morris scales,...[3]. Among them, the Oswestry score and a number of other scores are widely researched in the world. However, the BPFS back pain functional scale has not been widely researched and applied to clinical practice, although a few studies have shown low error and superior reliability of this scale based on correlation with other scales [3,4,5,7].

BPFS is designed based on the International Classification of Functioning (ICF) proposed by the World Health Organization. The advantage of BPFS is that it is simple and easy to understand but still ensures comprehensiveness, including 12 factors according to 5 Likert levels to monitor movement limitations and daily activities. BPFS is a quantitative scale based on points, so it increases accuracy and can monitor small differences. This scale has a minimum detectable change of 22.2% with standard error is 6.5% at the 95% confidence interval. Research around the world shows that the BPFS scale can be used in clinical settings to measure functional outcomes of low back pain patients by demonstrating good correlation between BPFS and other scales (Roland Morris, Oswestry, SF-36) [4,5]. Another advantage is that patients can easily use and monitor back pain using this scale. Based on that, doctors can make clinical assessments and adjust specific treatment methods for each patient [5]. Around the world, there have been many studies describing clinical and magnetic resonance characteristics as well as research on the relationship between clinical factors and magnetic resonance images in patients with lumbar disc herniation. However, the use and monitoring of patients with sciatica due to disc herniation using the functional score in general as well as the BPFS score in particular is not yet popular. Researching these scales is clinically meaningful. Therefore, we conducted this project with the goal of evaluating the correlation between BPFS score with clinical characteristics and magnetic resonance imaging.

II. RESEARCH SUBJECTS AND METHODS

1. Research subjects

Data were collected at the Department of Neurosurgery - Hue University of Medicine and Pharmacy Hospital, during the period July 2023 - February 2024.

1.1. Sample size

Convenience sample (46 patients)

1.2. Inclusion criteria

Patients with symptoms of sciatica suggestive of disc herniation and confirmed by magnetic resonance imaging of the lumbar spine.

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1.3 Exclusion criteria

Patients with history of lumbar spine surgery or signs of nerve root damage or disease affecting nerve conduction (diabetes mellitus, alcohol abuse, polyneuritis, amyotrophic lateral sclerosis,...).

2. Research methods

2.1. Study design

Cross-sectional descriptive study.

2.2. Procedure

46 patients with sciatica due to disc herniation were asked about their medical history and had a clinical examination. Record information: age, gender, medical history, surgical history; clinical factors include lumbar spine syndrome (spinal pain points, paraspinal muscle spasticity, reduced range of motion of the lumbar spine, finger-ground distance) and lumbar nerve root syndrome (paravertebral pain point, Valleix sign, Lasègue sign, "Bell" sign, decreased tendon reflexes, radicular movement disorder, radicular sensory disorder, muscle atrophy, urinary retention or incontinence). Assess the level of limitation of the patient's motor function and daily activities using the Back Pain Functional Scale (BPFS) scale including 12 factors according to 5 Likert levels, the lowest is 0 points - cannot perform any activities, the highest is 60 points - no difficulty in all activities. Patients had a lumbar spine MRI at least once, and the results were read by an imaging specialist. Record and group information: number of herniated levels, type of disc herniation, degree of spinal stenosis.

2.3. Analytical methods

Patient information, clinical and MRI characteristics were statistically described using frequencies and proportions for categorical variables, and medians and standard deviations for continuous variables. Use the algorithm to analyze the relationship between each independent variable (clinical characteristics, magnetic resonance) with the dependent variable (BPFS score levels) using t-test, ANOVA and linear regression. Choose a significance level of $p < 0.05$. Data were entered and processed for statistical analysis using IBM SPSS Statistics 20.0 software.

III. RESULTS

3.1 General characteristics

***Table 1**. Frequency distribution of general characteristics*

Characteristics		Number of patients	Percentage
Age	< 60	29	63.1%
	60-80	15	32.6%
	> 80	2	4.3%
Sex	Female	28	60.9%
	Male	18	39.1%

Age of study patients ranged from 31-84 years old. The average age of study patients is 56.93 ± 12,058. The working age group from 30-59 years old is the most infected (63.1%). Female patients account for the highest proportion (60.9%), the rest are male (39.1%).

3.2 Clinical and magnetic resonance imaging features

***Table 2**. Frequency distribution of clinical features*

Symptoms		Number of patients	Percentage
Lumbar spinal pain points	Positive	41	89.13%
	Negative	5	10.87%
Finger-ground distance (cm)	10-20	7	15.22%
	20-30	8	17.39%

Symptoms		Number of patients	Percentage
Finger-ground distance (cm)	30-40	22	47.83%
	40-50	6	13.04%
	>50	3	6.52%
Paraspinal muscle spasticity	Positive	32	69.6%
	Negative	14	30.43%
Reduced range of motion	Positive	46	100%
	Negative	0	0
Paravertebral pain point	Positive	29	63.04%
	Negative	17	36.96%
"Bell" sign	Positive	19	41.3%
	Negative	27	58.7%
Valleix sign	Positive	22	47.83%
	Negative	24	52.17%
Lasègue	Positive	40	86.96%
	Negative	6	13.04%
Radicular sensory disorder	Positive	30	65.22%
	Negative	16	34.78%
Radicular movement disorder	Positive	13	28.26%
	Negative	33	71.74%
Decreased tendon reflexes	Positive	14	30%
	Negative	32	70%
Muscle atrophy	Positive	0	0
	Negative	46	100
Urinary retention or incontinence	Positive	0	0
	Negative	46	100

***Table 3**. Frequency distribution of VAS score*

VAS score	Number of patients	Percentage
Moderate (3-6)	25	54.35%
Severe (7-10)	21	45.65%

Clinical characteristics of lumbosacral syndrome: Patients have 89.13% spinal pain points, 100% reduced spinal range of motion, finger-ground distance is about 30-40cm accounts for the highest rate (47.8%), paravertebral muscle spasticity (69.6%). Clinical characteristics of lumbosacral nerve root syndrome: Patients with paraspinal pain account for 63.04%; "Bell" sign 41.30%, Valleix sign 47.83%, patients with Lasègue sign account for a high proportion of 86.96%, patients with radicular movement disorder account for 28.26%; radicular sensory disorder (65.22%); 30% decreased tendon reflexes; 100% of patients did not have circular muscle disorders (urinary retention) or muscle atrophy. The VAS scale is level 3 or higher with the severe spectrum (7-10) accounting for approximately the same proportion as the severe spectrum (3-6). There is no VAS score below level 3.

***Table 4**. Frequency distribution of magnetic resonance imaging features*

MRI characteristics		Number of patients	Percentage
Number of herniated level	1 disc	32	70%
	>1 disc	14	30%
Type of disc hernation	Posterior central	31	67%
	Posterior paracentral	15	33%

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MRI characteristics		Number of patients	Percentage
Degree of spinal stenosis	Mild	21	46%
	Moderate	10	22%
	Severe	13	28%
	Extremely severe	2	4%

*Degree of spinal stenosis according to Modic M.T (1999)

Magnetic resonance imaging of the lumbar spine in most 1-level disc herniation accounts for 70%, the type of disc herniation is usually posterior central(67%), and the degree of spinal stenosis on MRI accounts for a high rate, especially grade 1 (46%). The average score of the BPFS scale is 30.46 ± 9.824, with no score below 10 and above 47.

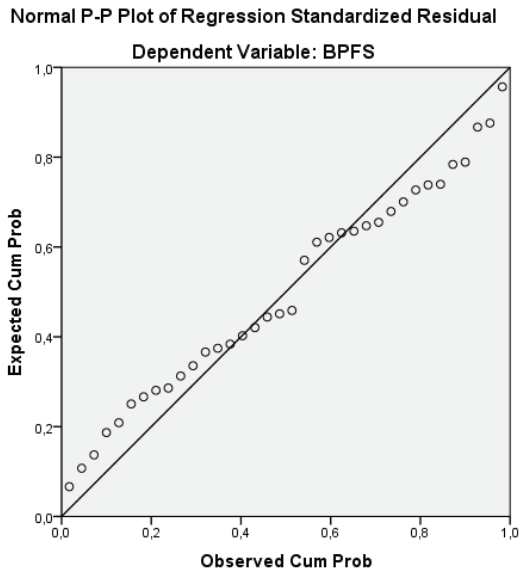

***Figure 1**. Regression standardized residual of BPFS*

***Table 1**. Average BPFS score of patients according to clinical symptoms of lumbar spine syndrome.*

Symptoms		Number of patients	X ± SD	Compare means	Correlation
Lumbar spinal pain points	Positive	41	29.29 ± 9.24	p=0.02	r = 0.002 p(r) = 0.02
	Negative	5	40.00 ± 10.22		
Finger-ground distance (centimeters)	10-20	7	40.14 ± 4.53	p=0.003	r = -0.608 p(r) < 0.001
	20-30	8	31.5 ± 5.16		
	30-40	22	29.91 ± 10.09		
	40-50	6	27 ± 9.88		
	> 50	3	16 ± 4.36		

Symptoms		Number of patients	X ± SD	Compare means	Correlation
Paraspinal muscle spasticity	Positive	32	29.28 ± 10.49	p=0.175	r=0.195 p(r)=0.128
	Negative	14	33.14 ± 7.77		
Reduced range of motion of the lumbar spine	Positive	46	-	-	-
	Negative	0	-		

A t-test showed average BPFS score in patients with lumbar spinal pain points and paraspinal muscle spasticity is higher than the group of patients without these symptoms. An ANOVA showed finger-ground distance is inversely proportional to the increase in BPFS score level. Linear regression informed there is a strong correlation between BPFS and finger-ground distance, with $|r| = 0.608$, $p < 0.05$. The difference between the average BPFS score between the group with and without signs of paraspinal muscle spasticity was not statistically significant with $p > 0.05$. The relationship between signs of reduced range of motion and BPFS score was not examined.

***Table 2**. Average BPFS score of patients according to clinical symptoms of lumbar nerve root syndrome*

Symptoms		Number of patients	X ± SD	Compare means	Correlation
Paravertebral pain point	Positive	29	28.41 ± 10.42	p=0.065	r= 0.36 p(r)=0.016
	Negative	17	33.94 ± 7.81		
"Bell" sign	Positive	19	26.89 ± 8.58	p=0.038	r=0.33 p(r)=0.024
	Negative	27	32.96 ± 10.01		
Valleix sign	Positive	22	23.55 ± 7.13	p<0.001	r= 0.7 p(r) < 0.001
	Negative	24	36.79 ± 7.41		
Lasègue sign	Positive	40	28.80 ± 9.33	p=0.002	r=0.46 p(r)=0.003
	Negative	6	41.50 ± 4.59		
Radicular movement disorder	Positive	13	25.46 ± 9.23	p=0.029	r=0.36 p(r)=0.015
	Negative	33	32.42 ± 9.47		
Radicular sensory disorder	Positive	30	28.10 ± 10.25	p=0.024	r=0.36 p(r)=0.016
	Negative	16	34.88 ± 7.38		

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Symptoms		Number of patients	X ± SD	Compare means	Correlation
Decreased tendon reflexes	Positive	14	25.21 ± 10.18	p=0.015	r=0.31 p(r)=0.034
	Negative	32	32.75 ± 8.88		
Muscle atrophy	Positive	0	–	–	–
	Negative	46	–		
Urinary retention or incontinence	Positive	0	–	–	–
	Negative	46	–		

A t-test showed average BPFS score in groups with clinical symptoms of lumbar nerve root syndrome: "Bell" sign, Valleix sign, Lasègue sign, radicular movement disorder, sensory disorder along the roots, decreased tendon reflexes were lower than in the group without this symptom, the difference was statistically significant with $p < 0.05$. In particular, BPFS score has a strong correlation with Valleix sign ($|r| = 0.7$, $p < 0.001$) and a moderate correlation with the remaining symptoms ($0.3 < |r| < 0.5$), especially the Lasègue sign (r=0.46). There was no difference in mean BPFS score between patients with or without paraspinal pain ($p > 0.05$). There were no patients with symptoms of radicular muscle atrophy and urinary retention/urinary retention, and the relationship between the BPFS scale and these two symptoms could not be evaluated.

***Table 3**. Correlation between VAS score and BPFS score*

VAS score	Number of patients	X ± SD	Compare means	Correlation
Moderate (3-6)	25	35.92 ± 7.91	< 0.001	r = 0.777 p(r) < 0.001
Severe (7-10)	21	23.95 ± 7.78		

The average BPFS score in the group of patients with severe VAS scores was lower than the group of patients with moderate VAS scores. This shows that the higher the VAS score, the lower the BPFS score, which is statistically significant with $p<0.05$. A Pearson showed BPFS score has a strong correlation with VAS score ($|r| = 0.777$, $p < 0.0001$).

***Table 4**. Correlation between BPFS score and MRI of the lumbar spine in patients with disc herniation*

MRI characteristics		Number of patients	X ± SD	Compare means	Correlation
Number of herniated levels	1 disc	32	31.91 ± 9.32	p=0.132	r= –0.28 p(r)=0.051
	>1 disc	14	27.14 ± 10.49		

MRI characteristics		Number of patients	X ± SD	Compare means	Correlation
Type of disc herniation	Posterior central	31	28.10 ± 9.79	p=0.017	r=0.4 p(r)=0.007
	Posterior paracentral	15	35.33 ± 8.18		
Degree of spinal stenosis	Mild	21	38.33 ± 6.49	p< 0.001	r= –0.97 p(r) < 0.001
	Moderate	10	30.30 ± 4.06		
	Severe	13	20.92 ± 2.43		
	Extremely severe	2	10.5 ± 0.71		

*Degree of spinal stenosis according to Modic M.T (1999)

The difference in average BPFS score between groups according to the number of herniated disc levels is not statistically significant with p > 0.05. The BPFS score gradually decreases with the degree of spinal stenosis. The average BPFS score in the mild spinal stenosis group is the highest, followed by the moderate spinal stenosis, then the severe spinal stenosis group and finally extremely severe spinal stenosis. This difference is statistically significant with p < 0.05. There is a strong correlation between BPFS and the degree of spinal stenosis with |r| = 0.97, p<0.001. Regarding the type of disc herniation in the study, it is usually distributed in two types: posterior central and posterior paracentral. The postcentral type has a lower BPFS score than the posterolateral type, representing a greater degree of movement limitation.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3966,574	17	233,328	49,812	,000[b]
	Residual	84,315	18	4,684		
	Total	4050,889	35			

a. Dependent Variable: BPFS

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,990[a]	,979	,960	2,164	2,371

***Figure 2**. The regression model of BPFS is appropriate and can be generalized and applied to the whole population (p < 0.05, R=0.96) (Hair et al., 2014)*

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IV. DISCUSSION

Research and evaluation of clinical scales in assessing function due to disc herniation have been widely carried out, including a number of scales such as Roland Morris, SF36, Oswestry, Quebec, McGill...[3] In this study, we chose the BPFS scale to evaluate the severity in patients with lumbar disc herniation. First published in 2000 by Stratford et al., the Back Pain Functional Scale (BPFS) was designed to assess the degree of limitation of motor function and daily activities caused by low back pain. In a study by Özgür Akşan in 2022, the BPFS scale was used in combination with the VAS scale to monitor the results of disc herniation treatment using caudal epidural injection under the guidance of fluoroscopy in a prospective study in 309 patients F. In addition to being designed for use in research, the usefulness of the BPFS score was also demonstrated for patient monitoring in clinical practice through the results of this study. This is also consistent with studies on the effectiveness of the BPFS scale based on comparisons with other scales by authors around the world. Shown by the good correlation between BPFS and other scales (Roland Morris, Oswestry, SF-36)[4,5]. Gokhan Maras and colleagues (2019) also specified the comparison using Pearson correlation ($p < 0.001$) between BPFS with Oswestry and Roland Morris ($|r| \geq 0.5$, $p < 0.05$)[7]. The BPFS scale has been shown to be superior to the Roland Morris scale with higher reliability and lower errors of 82% and ±10.5%, respectively; reliability is 88% and consistency is 93% according to Stratford[4]. Through conducting research, we found that the advantage of the scale is that the assessment is quick, simple, and easy to understand while still ensuring comprehensiveness, including 12 factors according to 5 Likert levels. However, the disadvantage of the scale is that it is based on the patient's subjective assessment.

In our study, the average score of the BPFS scale is 30.46 ± 9.82, with no score below 10 and above 47. Research results show that the patient has symptoms of lumbar spine syndrome and lumbar nerve root syndrome have lower mean BPFS scores than asymptomatic patients. The difference is statistically significant with $p < 0.05$ in most symptoms and has a moderate or higher correlation with BPFS score ($0.3 < |r|$, $p < 0.05$). Patients with paravertebral pain scores do not affect the results of the BPFS scale with $p>0.05$. In the research patient group, there were no patients with symptoms of radicular muscle atrophy and urinary retention. All patients had limited range of motion of the lumbar spine, so we could not evaluate the correlation between the measure BPFS and these symptoms. With the symptom of paravertebral muscle spasticity, according to the results, there is no relationship with the BPFS score. We think that this symptom is not highly accurate in clinical practice and relies heavily on subjective feelings, but most remaining clinical signs and BPFS score differences were all statistically significant with $p < 0.05$. This shows that it is possible to use the BPFS questionnaire to assess the degree of limitation of spinal movement and activities due to back pain and monitor the progression of the disease during treatment or for treatment purposes, prognosis and diagnosis. Therefore, there is a concordance between the patient's subjective level using the BPFS questionnaire and examination of clinical signs. Patients with moderate VAS scores had higher BPFS than the severe VAS group. This difference is statistically significant with $p < 0.001$. There is a strong correlation between BPFS score and VAS score ($|r| = 0.777$, $p < 0.0001$). Shows that the higher the VAS score, the lower the BPFS score and vice versa. This is different

from the average correlation between BPFS and VAS by Cheng Qi Jia et al. ($|r| = 0.484$)[8]. The VAS scale and BPFS scale are both based on the patient's subjective assessment. Compared to VAS, BPFS is more complex, providing more information to medical staff about the effects of back pain on patients' activities and work. Thereby giving the patient a prognosis and next treatment direction, which can be medicine, surgery, rehabilitation, traditional medicine to improve the patient's pain level as well as make it easier for the patient. in daily activities. And BPFS can be used to monitor the effectiveness of treatment on patients, thereby changing appropriate treatment strategies for patients or doing research. Thus, in clinical practice, the BPFS scale can be used alone or in combination with the VAS scale to evaluate the patient's clinical condition. Comparing the average BPFS score and the severity of spinal stenosis, the average BPFS score in the mild spinal stenosis group is the highest with 38.33 ± 6.49 points, followed by moderate, severe and extremely severe spinal stenosis.This difference is statistically significant with $p < 0.05$. BPFS strongly correlates with the degree of spinal stenosis ($|r| = 0.97$, $p<0.001$). This shows that spinal stenosis is related to clinical severity according to the BPFS scale. The BPFS score can be used to predict the severity of the patient's spinal stenosis.

Regarding the type of disc herniation in the study, it is usually distributed in two types: posterior central and posterior paracentral. The posterior central type has a lower BPFS score than the posterior paracentral type, representing a greater degree of movement limitation, $p < 0.05$. The correlation between BPFS and type of disc herniation is moderately correlated with $|r| = 0.4$, $p < 0.007$. However, because the study did not exploit other types (herniation anteriorly, inside/outside the foramina or into the vertebral body) due to the small sample size, the application of BPFS to predict the type of herniation is still unclear. Comparing the average BPFS score and the number of levels of disc herniation of the patient, the most common single-level herniation group has an average BPFS score of 31.91 ± 9.32 and the less common multi-level herniation group has an average BPFS of 27.14. ± 10.49. However, the correlation between BPFS score and number of herniated floors was not statistically significant, $p>0.05$. Therefore, the number of herniated levels of the patient does not affect the BPFS score or clinical manifestations. It can be explained that whether the hernia is 1 disc or multiple discs, if the MRI compresses the nerve root causing severe stenosis, the level of clinical manifestations will be severe and oppositely. Therefore, the number of herniated levels is not the deciding factor. Although BPFS according to the results compiled from the study can be considered a model for monitoring and predicting clinical outcomes, imaging resonance (severity of spinal stenosis), our study is limited by the small sample size.

V. CONCLUSIONS

The BPFS scale can evaluate the degree of limitation of spinal movement and activities in patients with back pain due to disc herniation. There is a difference in the average BPFS score between with and without clinical symptoms (the majority), there is no difference in the BPFS score with the number of herniated floors. Finger-ground distance, Valleix sign, VAS score, spinal stenosis degree on MRI have a strong correlation with BPFS score. Therefore, the BPFS scale can help support diagnosis and monitoring before or after treatment for patients with lumbar disc herniation, thereby providing appropriate treatment options for each specific patient.

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