

## Ultrasound Diagnosis of Lumbar Intervertebral Disc Herniation in Adolescents and Young People

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### Abstract

**Objective:** To evaluate the possibilities of ultrasonography in the diagnosis of lumbar disc herniation in adolescents and young adult.

**Materials and Methods:** The analysis of the results of ultrasonography (USG) of 31 patients in whom MRI diagnosed a herniated disc of the lumbar spine was carried out. The age of the subjects varied within the range of 17 - 21 years. The dimensions of the central spinal canal, the width of the spinal nerve canals were measured, and the structure of the nucleus pulposus and annulus fibrosus was studied. Ultrasonography (USG) was conducted on a Philips HD 11XE device using a convection transducer in the frequency range 2 - 5 MHz; MRI - General Electric, Signa HDI, 1.5T.

**Results:** In 14 (45,2 ± 8,9%) cases the hernia was median, in 12 (38,7 ± 8,7%) - paramedian and in 5 (16,1 ± 6,6%) - posterolateral types. The difference in the frequency of occurrence of the median and paramedian localization of the hernia in comparison with the posterolateral localization had a significant value ( $P < 0.01$  and  $P < 0.05$ ). The hernia in 2 (6,5 ± 4,4%) cases was localized at level of L3-L4, in 16 (51,6 ± 9,0%) - L4-L5 and in 13 (41,9 ± 8,9%) - L5-S1.

**Conclusion:** Ultrasonography, being a more economical method, can be used to find out the causes of back pain in adolescents. The sufficient quality of the image obtained with the help of USG allows it to be used to assess the nature of changes in the lumbar discs, to clarify the localization of the hernia, and to compare it with clinical symptoms.

**Keywords:** Lumbar Disc Hernia; Spinal Nerve Canal; Ultrasound Diagnostics; Adolescents and Young Adult

### Introduction

The completion of physical growth and development by adolescence is accompanied by the onset of degenerative changes in the lumbar intervertebral discs. A wide range of motion in the lumbar region increases the load on the intervertebral discs, intervertebral joints, ligaments in each segment of the spinal column, which leads to the development of degeneration [1]. By adolescence, dehydration of the nucleus pulposus of the intervertebral discs begins, and this reduces their amortizing function. Increasing pressure on such discs increases the tendency to cracks and tears [2]. Hammood E.Kh., *et al.* (2017) conducted a retrospective analysis of 1,045 cases of surgical placement for herniated lumbar intervertebral discs. They found that among the operated 13 (1.22%) were at the age of 13 - 21 years. Analysis of the medical records of these patients showed that 2/3 of them had injuries. Low back pain and sciatica were the main complaints in 77% of patients [3]. Karademir M., *et al.* (2017) conducted conservative treatment of 70 adolescents and boys aged 9 - 19 years. They found that the hernia in 54% of cases developed at the L4-L5 level, in 34% of cases at the L5-S1 level. If persistent radicular pain persisted for more than 6 weeks, patients were offered surgical placement [4]. Lin R-H., *et al.* (2021) obtained good results of percutaneous endoscopic lumbar discectomy in children in the treatment of herniated lumbar intervertebral discs [5].

The presence of osteochondrosis among older people is not a rare case, but it also occurs in young people. Many researchers suggest that a genetic predisposition to degeneration is a major factor in the early formation of disc herniation. Degenerative changes in adolescence are often the cause of pain in the lumbar region. During adolescence, the prevalence of back pain for various reasons ranges from 20% to 30%. During adolescence, the intensity of pain is usually correlated with a growth spurt. Among young weightlifters and wrestlers, increased stress often leads to pain in the lumbar region [6]. Lumbago and sciatica are the most common clinical manifestations of low back pain. According to the results of a study by O'Sullivan and Lin I (2014), 18% of cases of back pain in young adult are caused by sciatica or lumbar radiculopathy [7].

In the diagnosis of the causes of pain, the intensity and nature of the pains, the zone of their distribution, matter. Often, the degree of changes in the spinal motion segment and the intensity of back pain do not correspond. With a hernia, back pain is not permanent and may disappear during remission [8-13].

As know, radiography visualizes bone structures better and cannot distinguish between soft tissue structures, which include intervertebral discs. Since its introduction into clinical practice, magnetic resonance imaging (MRI) has become the main method for diagnosing pathologies of the intervertebral discs and spinal cord. In degenerative disc disease, the most common MRI findings are decreased signals from the nucleus pulposus, thinning of the annulus fibrosus, protrusion or herniated discs [14]. Modern ultrasound devices provide a high-quality image of the structures of the spinal motion segment, and the cost of the study is much lower than that of MRI. All this opens up new perspectives for the widespread use of the method, especially in adolescence [15,16]. The presented literature data indicate the need to study ultrasound signs of degenerative disc disease, in particular, the formation of a hernia.

### Objective of the Study

To determine the role of ultrasonography in the detection and localization of disc herniation of the lumbar spine in adolescents.

### Materials and Methods

The analysis of the results of ultrasonography (USG) of 31 patients in whom MRI diagnosed a herniated disc of the lumbar spine was carried out. The age of the subjects varied within the range of 17 - 21 years. The dimensions of the central spinal canal, the width of the spinal nerve canals were measured, and the structure of the nucleus pulposus and annulus fibrosus was studied.

All studies were carried out on a Philips HD 11 ultrasound scanner using a transducer with a frequency of 2 - 5 MHz.

31 patients were selected from among 143 patients aged 13 - 21 years who consulted a pediatric neurologist or orthopedist for back pain. After clinical and MRI examination, 31 of them at the age of 17 - 21 were found to have herniated lumbar discs. All of these patients underwent ultrasonography to compare the results of the two imaging modalities.

### Results

USG was performed in the sagittal and axial projections along the central line of the abdomen. In the sagittal projection, the position of the lumbar vertebrae, the presence of ante- or retrolistesis was assessed, the height of the discs was estimated. On axial echograms visualized intervertebral discs, central spinal canal, spinal nerve canals, determined epidural blood flow, the thickness of the yellow ligament. The easiest way to visualize the intervertebral disc of L3-L4 was the umbilicus, above - L2-L3 and L1-L2, below L4-L5 and L5-S1. Another guide to determine the position of the disks was the disk L5-S1, which is located in the suprapubic zone above the filled bladder.

Hernias were found only at the level of the lower lumbar discs. The hernia in 2 (6,5 ± 4,4%) cases was localized at level of L3-L4, in 16 (51,6 ± 9,0%) - L4-L5 and in 13 (41,9 ± 8,9%) - L5-S1 (Table 1). In 14 (45,2 ± 8,9%) cases the hernia was median, in 12 (38,7 ± 8,7%)

- paramedian and in 5 (16,1 ± 6,6%) - posterolateral types (Table 2). The difference in the frequency of occurrence of the median and paramedian localization of the hernia in comparison with the posterolateral localization had a significant value (P < 0.01 and P < 0.05).

The level of IVD		Hernia, n = 31
1	L1-L2	-
2	L2-L3	-
3	L3-L4	2 (6,5 ± 4,4%)
4	L4-L5	16 (51,6 ± 9,0%) P4-3 < 0,001
5	L5-S1	13 (41,9 ± 8,9%) P5-3 < 0,001

**Table 1:** The level of localization of the hernia in the lumbar spine.

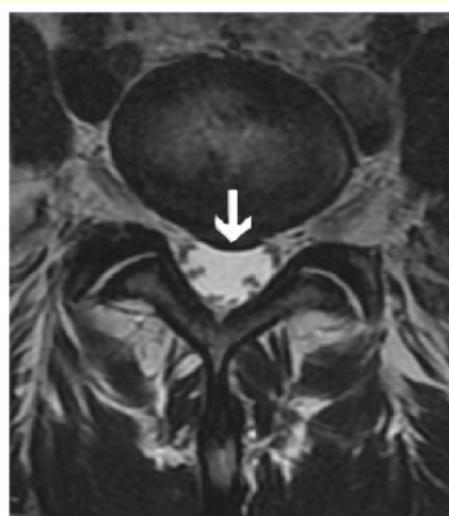
The type of hernia		Hernia, n = 31
1	Median	14 (45,2 ± 8,9%) P1-3 < 0,01
2	Paramedian	12 (38,7 ± 8,7%) P2-3 < 0,05
3	Posterolateral	5 (16,1 ± 6,6%)

**Table 2:** Types of localization of herniated lumbar discs inside the spinal canal.

Osteochondrosis was manifested itself with such clinical symptoms as lumbago, sciatica, or in combination (Table 3). Lumbago among patients with a median hernia was observed in all 14 (100.0 ± 2.7%) cases, with paramedian hernia - in 10 (83.4 ± 10.8%) cases and with posterolateral hernia - in 1 (20.0 ± 17.8%) case, respectively.

Clinical symptoms	Lumbar hernia (n = 31)		
	Median (n = 14)	Paramedian (n = 12)	Posterolateral (n = 5)
	1	2	3
Lumbago	14 (100,0 ± 2,7%)	10 (83,4 ± 10,8%)	1 (20,0 ± 17,8%)
Sciatica	-	1 (8,3 ± 8,0%)	4 (80,0 ± 17,8%) P 3-2 < 0,001
L+S	-	1 (8,3 ± 8,0%)	-

**Table 3:** Comparison of clinical symptoms and preferential localization of lumbar discs hernia in adolescents and young adult.

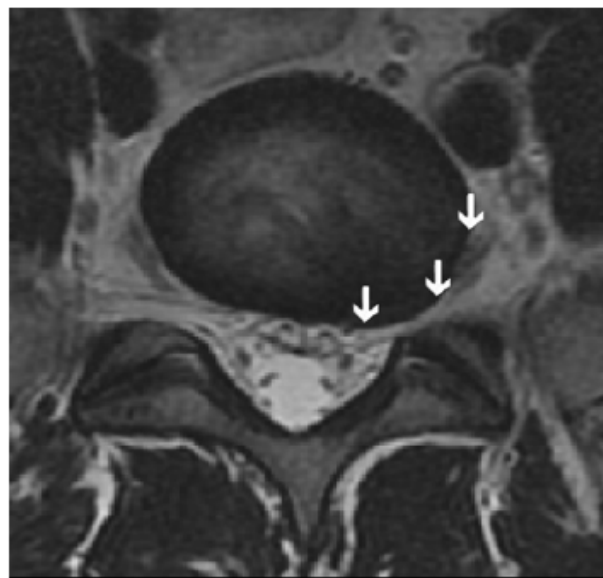


**Figure 1:** MRI visualization of the median hernia of L5-S1 (arrow) in a patient aged 21 year.

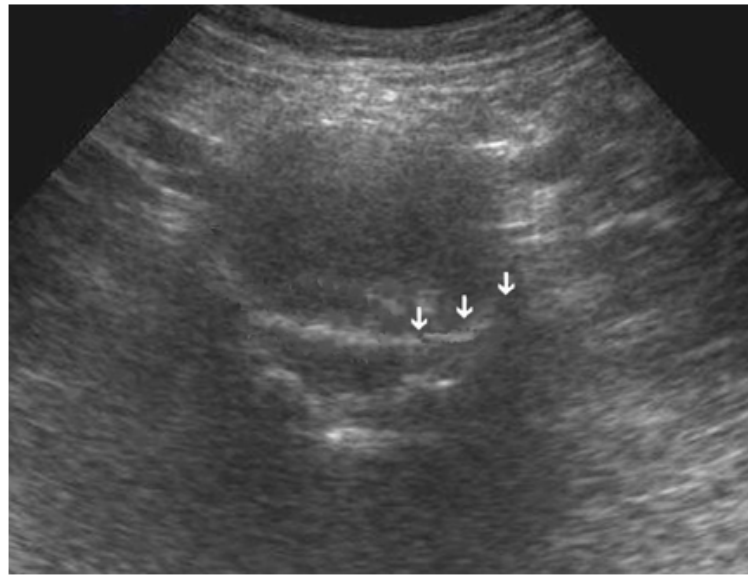


**Figure 2:** The same. US visualization of the median hernia of L5-S1 (arrow).

Sciatica in a patient with median localization of hernia was not observed. Among patients with paramedian hernia the sciatica was observed in 1 ( $8.3 \pm 8.0\%$ ) case, with posterolateral hernia - in 4 ( $80.0 \pm 17.8\%$ ) case, respectively (Figure 3 and 4).



**Figure 3:** MRI visualization of the left-sided large posterolateral hernia of L4-L5 (arrow).  
The narrowing of left spinal nerve canal. Patients have a left sided sciatica.



**Figure 4:** The same. US visualization of the left-sided large posterolateral hernia of L4-L5 (arrow). The narrowing of left spinal nerve canal. Patients have a left sided sciatica.

Only one patient with paramedian localization of hernia had a combination of lumbago + radiculitis. The difference in the frequency of occurrence of the median and paramedian localization of the hernia in comparison with the posterolateral localization had a significant value ( $P < 0.001$  and  $P < 0.01$ ). Sciatica in a patient with posterolateral localization of hernia was observed significantly more often than with paramedian and median hernia ( $P < 0.001$ ).

## Discussion

Literature data indicate that factors in the development of degenerative disc disease may include a genetic predisposition, repetitive microtrauma, connective tissue dysplasia, hypothermia.

Currently, the most common method for diagnosing osteochondrosis in various age groups is magnetic resonance imaging [14]. Modern transducers operating in a wide frequency range allow obtaining high-quality images of discs that are not inferior to MRI [15].

Since degenerative changes in cartilaginous structures begin in childhood, and ultrasonography has shown itself to be an informative method in diagnosing pathologies of the musculoskeletal system, it becomes necessary to study the features of herniated lumbar discs in adolescence. Our results indicate that most often herniated lumbar discs are localized at the L4-L5 and L5-S1 levels. Our data coincide with the data of other researchers [4]. Hernias of posterolateral localization are more often the cause of the development of the clinical symptom of sciatica, and median hernias are manifested by lumbago.

With ultrasound, patients do not receive radiation exposure. This indicates a great opportunity for echography, especially in pediatrics and use it as a screening study.

### Conclusion

Ultrasonography, being a more economical method, can be used to find out the causes of back pain in adolescents. The sufficient quality of the image obtained with the help of USG allows it to be used to assess the nature of changes in the lumbar discs, to clarify the localization of the hernia, and to compare it with clinical symptoms.

### Comments

Violation of the ecology, prolonged immobility of children in front of the monitor, acceleration of growth - all these contribute to the development of early degenerative changes in the intervertebral discs.

Ultrasonography is especially useful for screening intervertebral discs in schoolchildren and young athletes. In the presence of minimal changes in the nucleus pulposus, pain may be absent.

### Conflict of Interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

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