

DOI: <https://doi.org/10.34921/amj.2025.2.017>

GƏNC İNSANLARDA BEL OSTEONXONDROZUNUN ŞÜA DİAQNOSTİKASI

**Ro.R.Abdullayev¹, İ.A.Voronjev¹, R.Ya.Abdullayev¹, F.İ.Kulikova²,
A.G.Kiriçenko³, N.S.Lisenko¹, T.A.Dudnik⁴, A.V.Vlasenko¹, A.G.Sirko²,
N.V.Tomax³, O.V.Hubarik²**

¹Xarkov Milli Tibb Universiteti, Xarkov, Ukrayna;

²İ.İ.Meçnikov adına Dnepropetrovsk Regional Klinik Xəstəxana, Dnepr, Ukrayna;

³Ukrayna Səhiyyə Nazirliyinin Tibbi və Sosial Əlillik Problemləri üzrə
Ukrayna Dövlət Tədqiqat İnstitutu, Dnepr, Ukrayna;

⁴Poltava Dövlət Tibb Universiteti, Poltava, Ukrayna;

Xülasə. Məqalədə bel osteoxondrozunun klinik və nevroloji əlamətləri olan 85 xəstədə şüa diaqnostikası metodları ilə aparılmış tədqiqatın nəticələri haqqında məlumat verilir. Onlardan 31-i yeniyetmə (17-21 yaş) (I qrup), 54-ü gənc (22-44 yaş) yaşda (II qrup) olub. I qrupda disk protruziyası 18,1%, disk yırtığı 5,8% ($P<0,001$), II qrupda isə müvafiq olaraq 27,9% və 17,0% ($p<0,01$) müşahidə edilmişdir. Protruziya və yırtıq yeniyetməlik dövrünə nisbətən gənc yaşda əhəmiyyətli dərəcədə ($p^*<0,05$ və $p^*<0,001$) daha çox qeydə alınıb. Rentgenoloji olaraq fəqərəarası məsafənin azalması protruziya zamanı disklərin 77,5%-də, yırtıq zamanı disklərin 85,2%-də qeyd olunub; onların ultrasəsə birbaşa vizualizasiyası 96,1%-də və 96,3%-də qeyd olunmuşdur ($p<0,001$ və $p<0,05$). L5-S1 və L4-L5 səviyyələrində protruziya və yırtıqların geyd olunma tezliyi əhəmiyyətli dərəcədə fərqlənir. L3-L4 səviyyəsində protruziya 15,7%, yırtıq 5,6% hallarda müşahidə edilib ($p<0,05$). Bel diskləri yırtığının diaqnostikasında ultrasəsin həssaslığı 96,2%, spesifikliyi 100,0%, dəqiqliyi 96,3% təşkil etmişdir.

Bel osteoxondrozunun diaqnostikasında şüa müayinəsi üsullarının müqayisəsi göstərmişdir ki, ultrasəsə müayinə rentgenoqrafiyadan üstündür və MRT ilə eyni imkanlara malikdir. Yeniyetmələr arasında disklərdə protruziya və yırtığın aşkarlanması onlarda osteoxondrozun inkişafının diaqnostikadan çox əvvəl başladığını göstərir.

Açar sözlər: şüa diaqnostikası, bel osteoxondrozu, gənc şəxslər

Key words: radiological diagnosis, lumbar osteochondrosis, young people

Ключевые слова: лучевая диагностика, поясничный остеохондроз, молодые лица

RADIOLOGICAL DIAGNOSIS OF LUMBAR OSTEOCHONDROSIS IN YOUNG PEOPLE

**Ro.R.Abdullaiev¹, I.A.Voronzhev¹, R.Ya.Abdullaiev¹, F.I.Kulikova²,
A.G.Kyrychenko³, N.S.Lysenko¹, T.A.Dudnik⁴, A.V.Vlasenko¹,
A.G.Sirko², N.V.Tomakh³, O.V.Hubaryk²**

¹Kharkiv National Medical University, Kharkiv, Ukraine;

²I.I.Mechnikov Dnipropetrovsk Regional Clinical Hospital, Dnipro, Ukraine;

³Ukrainian State Research Institute of Medical and Social Disability Problems
of the Ministry of Health of Ukraine, Dnipro, Ukraine;

⁴Poltava State Medical University, Poltava, Ukraine

The article presents data on the results of radiological examination of 85 patients with clinical and neurological signs of lumbar osteochondrosis. Of these, 31 were adolescents (17-21 years old) (group I), 54 were young (22-44 years old) (group II). In group I, protrusion was diagnosed in 18.1% of discs, hernia - in 5.8% of discs ($P<0.001$), and in group II - in 27.9% and 17.0% of discs ($p<0.01$), respectively. Protrusion

and hernia were registered reliably ($p < 0.05$ and $p < 0.001$) more often in young age than in adolescence. The radiological symptom of decreased intervertebral space height was observed in 77.5% of protrusion cases and in 85.2% of hernia cases, when their direct visualization by ultrasound was observed in 96.1% and 96.3% of cases ($p < 0.001$ and $p < 0.05$). At the L5-S1 and L4-L5 levels, the frequency of protrusion and hernia did not differ significantly. At the L3-L4 level, protrusion was observed in 15.7%, hernia in 5.6% of cases ($p < 0.05$). The sensitivity of ultrasound in diagnosing hernia was 96.2%, specificity - 100.0%, accuracy - 96.3%.

Comparison of radiation methods of examination in diagnostics of lumbar osteochondrosis showed that ultrasound has an advantage over radiography and the same capabilities as MRI. Detection of disc protrusion and hernia among adolescents indicates the onset of osteochondrosis development long before their diagnosis.

The intervertebral disc (IVD) and ligamentous apparatus form the vertebral motor segment, which performs the main function of the spinal column. The intervertebral disc acts as a shock absorber, provides flexibility and reduces stress on the vertebral bodies. The disc consists of the end plates, the annulus fibrosus (AF), and the nucleus pulposus (NP). Histological studies show that degenerative changes in IVD begin in childhood [1].

Degenerative disc disease (DDD) in the lumbar spine is the most common cause of pain. A study by J. P. G. Urban et al. showed the role of biomechanical factors and gene phenotypes in the development of degenerative changes in IVD at a young age [2]. The link between low back pain and degenerative changes in the discs, the role of improper loading and trauma in their development is noted in many publications [3].

A wide range of movements in the lumbar region contributes to an increase in the load on the spinal motion segment, and this, in turn, accelerates the development of degeneration in the nucleus pulposus. Increasing pressure on the intervertebral discs increases the risk of cracking and rupture of the fibrous ring. In childhood, degenerative disc disease as the main cause of back pain is often not diagnosed [4].

In young people in the absence of secondary signs of degeneration in the MRI process, low signal intensity is registered in several IVD, which is an indirect sign of their dehydration [5]. Age and baseline changes in the disc, rather than genetic factors, influence the 5-year development of degeneration in patients with lumbar pain. The formation of an intervertebral hernia causes the development of spinal pain at rest [6]. Degenerative disc disease (DDD) progresses with age and involves meta-bolic

disorders and recovery of degenerative altered MHD tissue. The degenerative and inflammatory processes that occur during disc degeneration contribute to the growth of nerve fibers and blood vessels in the disc, which potentially explains the development of pain in such patients [7].

In a study by Mueller S. et al. also found no statistically significant differences in the incidence of back pain in boys and girls [8]. The results of the study by Lin I. et al. show that in 18 % of cases, pain in the lower back has the character of sciatica and is accompanied by radiculopathy [9]. According to Hammood E. Kh. et al among those operated on for herniated lumbar intervertebral discs, 1.22 % of patients were aged 13–21 years. Among all operated patients, 2/3 had a history of trauma [10].

The vertebral column consists of bone and soft tissue elements. To adequately assess the state of these structures, various imaging methods are used, which include conventional radiography, computed and magnetic resonance imaging (CT and MRI), as well as ultra-sound. X-ray and CT better visualize bone structures, while MRI and ultrasonography better visualize soft tissue structures, which include intervertebral discs, ligamentum flavum, spinal nerves, and spinal cord [11].

In some clinical disciplines, ultrasound has shown results comparable to gold standard methods such as MRI, demonstrating its potential utility in the field when MRI is not available. These features make ultrasound suitable for use in situations such as emergency trauma assessment, image-guided therapy [12]. Previous studies have shown the possibilities of ultrasonography in assessing the state of the cervical intervertebral discs [13]. Literature data indicate the prospects of studying the possibility

of ultrasonography in the diagnosis of degenerative disease of the lumbar intervertebral discs.

The purpose of the study is a comparative assessment of the capabilities of radiological methods investigation in the diagnosis of lumbar osteochondrosis in young people.

Material and methods. 84 patients aged 17-44 years were included in our study. Of these, 31 patients were young adults (17-21 years old), 53 patients were adults (22-44 years old). All patients complained of lower back pain. The results of the ultrasound investigation were compared with MRI dates. Ultrasonography was conducted on a Philips HD 11XE device using the frequency range 2-5 MHz; MRI - General Electric, Signa HDI, 1.5T.

Statistical analysis was performed using the nonparametric Mann-Whitney method. If the p value <0.05, the difference between the compared groups was considered statistically significant. The sensitivity, specificity and accuracy of ultrasonography in the diagnosis of disc hernia were determined.

Results and discussion. Visualization of the lumbar spinal motion segments was carried out in longitudinal and transverse projections along the midline of the abdomen. In the longitudinal projection, the height of the intervertebral discs, vertebral bodies, and their ratio were determined. On the axial projection, the internal structure of the discs, the central spinal canal, the canals of the spinal nerves, epidural blood flow, and the thickness of the yellow ligament were evaluated. To count the discs, we were guided by the navel, since the intervertebral disc L3-L4 is located at this level, above - L2-L3 and L1-L2, and below L4-L5 and L5-S1.

Since there are 5 lumbar intervertebral discs, a total of 155 discs were visualized in adolescents and 265 discs in young adults. Among adolescent patients, 28 (18.1±3.1%) protrusions and 9 (5.8±1.9%) hernias were detected, and among young patients, 74 (27.9±2.8%) protrusions and 45 (17.0±2.3%) hernias, respectively (Table 1). As can be seen from the table, among both groups, protrusion was registered reliably ($P<0.001$ and $P<0.01$) more often than hernia. In addition, among all patients with lumbar pain, protrusion and hernia were registered reliably ($p^*<0.05$ and $p^*<0.001$) more often in young age than in adolescence.

It is known that traditional radiography does not allow direct visualization of soft tissue structures, which include the intervertebral disc and ligamentous apparatus. Indirect X-ray signs of osteochondrosis are decrease of the intervertebral space, sclerosis of the end plates of the vertebrae and subchondral bone, as well as marginal osteophytes in the epiphyseal zones [14].

We compared the results of radiography, ultrasound and magnetic resonance imaging. The work included MRI data only for herniated discs. When comparing the results of radiation research methods, the fact of a decrease in the height of the intervertebral space during radiography was taken into account, since the method did not allow direct visualization of the discs (**Fig. 1, 2**). During radiography, an obvious decrease in the height of the intervertebral space in patients with disc protrusion was noted in 79

Table 1. Distribution of patients by age and type of lumbar osteochondrosis

Age	Number of patients	Number of discs	Protrusion	Hernia
17-21	31	155	28 18,1±3,1% $P<0,001$	9 5,8±1,9%
22-44	53	265	74 27,9±2,8% $P<0,01$ $P^*<0,05$	45 17,0±2,3% - $P^*<0,001$

Note: P – difference between the frequency of detection of protrusion and hernia within each age group;
P* – difference between age groups in the frequency of detection of protrusion and hernia.



Fig. 1. Spondylograms of the lumbosacral spine reveal the initial signs of dysplastic lumbosacral osteochondrosis. Left-sided lumbar scoliosis 1st degree.

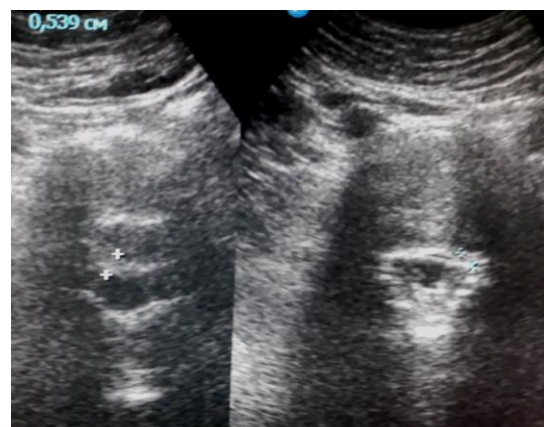


Fig. 2. The axial echogram L4-L5 (right part of the echogram) shows a median protrusion of the disc inside the spinal canal with the integrity of the fibrous ring preserved. Hyperechoic inclusions are visible in the nucleus pulposus. At the level of L3-L4 (left part of the echogram), the posterior contour of the disc is smooth, the nucleus pulposus is homogeneous.

(77.5±4.1%) cases, and in patients with disc herniation - in 46 (85.2±4.8%) cases, which is statistically significantly ($P<0.001$ and $P<0.05$) different from the results of ultrasound (96.1±3.7% and 96.3±2.6%, respectively), which directly visualized protrusion and hernia (Table 2).

Table 3 presents data on the level of localization of discs with protrusion and hernia. At the L1-L2 level, protrusion and hernia were absent. At the L2-L3 level, protrusion was registered in 5 (4.9 ±2.1%), and hernia was absent. At the L3-L4 level,

protrusion was recorded in 16 (15.7 ±3.6%) cases, hernia – in 3 (5.6 ±3.1%) cases ($P<0.05$), at the L4-L5 level – in 43 (42.1 ±4.9%), hernia – in 26 (48.1 ±6.8%) cases, at the L5-S1 level – in 38 (37.3 ±4.8%), hernia – in 25 (46.3 ±6.8%) cases, respectively. The table shows that at the L5-S1 and L4-L5 levels, hernia and protrusion were recorded statistically significantly ($P^{*5-3} <0.001$ and $P^{*5-3} <0.01$) more often than at the L3-L4 level, and at the L3-L4 level more often than at the L2-L3 level.

Table 2. Comparison of the results of radiation research methods in the diagnosis of osteochondrosis

Type of lumbar degenerative diseases	X-ray - decrease in the height of the IVS	Ultrasound	MRI	Total
Protrusion	79 (77,5±4,1%)	98 (96,1±3,7%) $P<0,001$	-	102
Hernia	46 (85,2±4,8%)	52 (96,3±2,6%) $P<0,05$	54 (100,0%)	54

Note: IVS – intervertebral space.

Table 3. Distribution of cases of degenerative changes in discs depending on its level

№	Segments of IVD	Type of osteochondrosis	
		Protrusion, n=102	Hernia, n=54
1	L1-L2	-	-
2	L2-L3	5 (4,9 ±2,1%)	-
3	L3-L4	16 (15,7 ±3,6%) P <0,05 P* 3-2 <0,05	3 (5,6 ±3,1%)
4	L4-L5	43 (42,1±4,9%) P*4-3 <0,001	26 (48,1±6,8%) P*4-3 <0,001
5	L5-S1	38 (37,3±4,8%) P* 5-3 <0,01	25 (46,3±6,8%) P* 5-3 <0,001

Note: P – difference between the frequency of detection of protrusion and hernia at the level of each disc;
P* – difference between different levels of discs in the frequency of detection of protrusion and hernia separately.

The localization of protrusion and hernia inside the spinal canal was assessed as median, paramedian and posterolateral. Table 4 presents data on the type of osteochondrosis and localization inside the spinal canal. Median protrusion was recorded in 57 (55.9±4.9%) cases, paramedian – in 41 (40.2±4.9%), posterolateral – in 4 (3.9±1.9%) cases, and hernia – in 21 (38.9±6.6%), 25

(46.3±6.8%) and 8 (14.8±4.8%) cases, respectively. As can be seen from the table, median and paramedian localization of hernia was diagnosed reliably (P<0.001) more often than posterolateral. Posterolateral hernia was registered significantly more often than protrusion, and median protrusion was registered significantly (P* <0.05) more often than hernia.

Table 4. Distribution of cases by localization and type of osteochondrosis

Type of osteochondrosis	Localization inside of spinal canal		
	Median	Paramedian	Posterolateral
Protrusion	57 (55,9±4,9%) P <0,001 P* <0,05	41 (40,2±4,9%) P <0,001	4 (3,9±1,9%)
Hernia	21 (38,9±6,6%) P <0,01	25 (46,3±6,8%) P <0,001	8 (14,8±4,8%) P* <0,05

Note: P – difference between the localizations of osteochondrosis inside of spinal canal;
P* – difference between protrusion and hernia inside of their localization inside of spinal canal.

Table 5. Results of USG in identifying of Hernia

Hernia identifying by MRT (n=54)			
Yes		No	
52		2	
TP	FN	TN	FP
50	2	2	0
Sensitivity		96,2%	
Specificity		100,0%	
Accuracy		96,3%	

Note: TP – true positive, FN – false negative, TN – true negative, FP – false positive.

Table 5 presents the results of USG in the diagnosis of hernia, which was detected by MRT. In 50 cases, the results of USG was true positive (TP), in 2 cases false negative (FN), in 2 case true negative (TN) and in 0 case false positive (FP). The sensitivity of USG was 96,2%, the specificity was 50,0% and the accuracy was 94,6%.

Discussion. The most common and accessible research method of spine is radiography performed in the anterior, lateral and oblique projections. It helps to assess the condition of the vertebral bodies, determine spondylotic changes, and the presence of instability. However, traditional radiography does not allow visualization of the intervertebral disk, the ligamentous apparatus of the spine. Computed tomography is the most sensitive method for studying the bone structures of the spine. It can visualize calcified disc herniation, reveal all changes in bone tissue. MRI is the most sensitive method for visualizing herniated discs, as it better demonstrates the structures of soft tissues and spinal nerves in the radicular canal [14].

According to the results of MRI studies of 301 young and middle-aged patients, O. B. Panta et al. (2015) found that protrusion of the L4–L5 discs is most common in older people, and herniated disc L5–S1 in young people. In young people, radiculopathy was more often observed due to the paramedian localization of a hernia or protrusion [15]. Over the past two decades, magnetic resonance imaging has

become the main method for diagnosing degenerative changes in the disks, in particular protrusion and hernia [1].

Literature data indicate that degenerative disc disease begins in childhood, and ultrasound has shown itself to be an informative method for diagnosing pathologies of the musculo-skeletal system, it becomes necessary to study the characteristics of lumbar disc herniation in young adult [15]. Hernias of posterolateral localization are more often the cause of the development of a clinical symptom of sciatica, and median hernias often manifest as a lumbago [13, 16].

Since traditional radiography does not allow direct visualization of intervertebral discs, indirect signs are used to diagnose osteochondrosis. One of them is a decrease in the height of the intervertebral space [14]. We studied the presence of this symptom in patients with an established diagnosis of disc protrusion and herniation. Radiographically determined decrease in the height of the intervertebral space in patients with disc protrusion was noted in $77.5 \pm 4.1\%$ of cases, and in patients with disc herniation - in $85.2 \pm 4.8\%$ of cases, which statistically reliably ($p < 0.001$ and $p < 0.05$) differed from the ultrasound results. In addition, we assessed the diagnostic value of ultrasound compared with MRI in determining disc herniation. The sensitivity of ultrasound was 96.2%, specificity 100.0%, accuracy 96.3%, respectively.

Conclusion

1. Comparison of radiation methods of

examination in diagnostics of lumbar osteochondrosis showed that ultrasound has an advantage over radiography and the same capabilities as MRI.

2. Detection of protrusion and hernia among young people indicates the onset of osteochond-

rosis development long before their diagnosis.

3. Ultrasonography is a reliable method for diagnosing herniated lumbar intervertebral discs, both in segments and inside the spinal canal.

Conflict of interest

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

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ЛУЧЕВАЯ ДИАГНОСТИКА ПОЯСНИЧНОГО ОСТЕОХОНДРОЗА У МОЛОДЫХ ЛИЦ

Ро.Р.Абдуллаев¹, И.А.Вороньжев¹, Р.Я.Абдуллаев¹, Ф.И.Куликова², А.Г.Кириченко³,
Н.С.Лисенко¹, Т.А.Дудник⁴, А.В. Власенко¹, А.Г.Сирко²,
Н.В.Томах⁴, О.В Губарик²

¹Харьковский национальный медицинский университет, Харьков, Украина;

²Днепропетровская областная клиническая больница им. И.И.Мечникова, Днепр, Украина;

³Украинский государственный научно-исследовательский институт медико-социальных проблем инвалидности Министерства здравоохранения Украины, Днепр, Украина;

⁴Полтавский государственный медицинский университет, Полтава, Украина

Резюме. В статье приведены сведения о результатах лучевых методов исследования у 85 пациентов с клиничко-неврологическими признаками поясничного остеохондроза. Из них 31 был в юношеском (17-21 год) возрасте (I группа), 54 в молодом (22-44 года) возрасте (II группа). В I группе протрузия диагностировалась в $18,1 \pm 3,1\%$ дисках, грыжа – в $5,8 \pm 1,9\%$ дисках ($p < 0,001$), а во II группе – в $27,9 \pm 2,8\%$ и $17,0 \pm 2,3\%$ дисках ($p < 0,01$), соответственно. Протрузия и грыжа в молодом возрасте регистрировалась достоверно ($p^* < 0,05$ и $p^* < 0,001$) чаще, чем в юношеском возрасте. Рентгенологический симптом снижение высоты межпозвонкового пространства отмечался в $77,5 \pm 4,1\%$ случаев протрузии и в $85,2 \pm 4,8\%$ случаев грыжи, когда их прямая визуализация при УЗИ отмечалась в $96,1 \pm 3,7\%$ и в $96,3 \pm 2,6\%$ случаев ($p < 0,001$ и $p < 0,05$). На уровне L₅-S₁ и L₄-L₅ частота протрузии и грыжи достоверно не отличалась. На уровне L3-L4 протрузия отмечалась в $15,7 \pm 3,6\%$, грыжа в $5,6 \pm 3,1\%$ случаев ($P < 0,05$). Чувствительность УЗИ в диагностике грыжи составила 96,2%, специфичность – 100,0%, точность – 96,3%.

Сравнение лучевых методов исследования в диагностике поясничного остеохондроза показало, что ультразвук имеет преимущество перед рентгенографией и одинаковые возможности с МРТ. Выявление протрузии и грыжи среди лиц юношеского возраста свидетельствует о начале развития остеохондроза еще за долго до их диагностики.

For correspondence:

Abdullaev Rizvan Yagubovich, Department of Ultrasound of Kharkiv National Medical University, Kharkiv, Ukraine

E-mail: ry.abdullaev@knmu.edu.u

Тəqdim edilmişdir: 17.01.2025

Qəbul edilmişdir: 25.04.2025