

## RADIOLOGICAL DIAGNOSTIC METHODS OF SOFT-TISSUE COMPONENTS IN THE SPINAL CANAL FORMING LUMBAR STENOSIS

The modern categorization defines the different forms of lumbar part spine stenosis, coming from anatomical and pathological of the principle. One of the varieties is a central lumbar stenosis. Compression of medulla spinalis occurs due to reduction of sizes of the spine central canal caused either by osseous structure or soft-tissue of the spine canal. All soft-tissue components of the spinal canal can form stenosis including defeat of intervertebral disk (the hernia of the disk). This work studies efficiency of X-ray (at 33 patients) and MRI (at 92 patients) methods in diagnostics of the hernia of the disk that participates in forming lumbar part spine stenosis.

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### Introduction

It is known that the lumbar stenosis is rather frequent disease among the general pathology of the spine. It is a consequence of various pathogenic causes, among which the lesion of the not bone components of the spinal canal occupies the leading place (Kurbanov et al, 2000; Wang et al., 2008). The degenerative lesion of the intervertebral disk that belongs to the structures of not bone component of the spinal segment should be related to one of the factors of spinal canal stenosis. In the proceedings of a number of the scientists (Prodan et al., 2008; Choi et al., 2007; Korovessis et al., 2004) it is stated, that in degenerative-dystrophic lesions of the intervertebral disk there is developed prolapsed of the cartilaginous elements into the spinal canal, forward and to the different directions. Invaginated cartilaginous masses in anterior and anterior-lateral invaginations separate and break anterior longitudinal ligament, induce formation of marked osteophytes. The posterior and posterior-lateral cartilaginous hernias result in clear changes as compressions of spinal cord, elements of equine tail, i.e. compress the contents of dural sac. At all variety of lumbar spine stenosis types, in the current clinical practice, as a rule, their diagnosis is carried out by radiological methods (Zubarev, 2003; Mikhaylov et al., 2000; Hiwatashi et al., 2004).

The purpose of the present work is to study comparative efficiency of X-ray and magnetic resonance imaging methods (MRI) in diagnosis of the lesions of intervertebral disk which participates in formation of lumbar stenosis.

### Material and methods

92 patients underwent magnetic-resonance imaging (MRI) investigation with signs of lesions of the intervertebral disk of lumbar part of the spine. X-ray examinations of the lumbar part of the spine were performed in 33 patients.

According to the literary data (Abdullaev et al., 2006; Modic et al., 2007) and own material, the X-ray investigations were carried out in those age groups of the patients, in which there are found predominantly degenerative changes in the lumbar spine, that is, at the age of 21-60 years.

X-ray in standard posterior-direct and lateral projections allows to study the form, contours and structure of lumbar vertebra, height and form of intervertebral disks, features of the spine statics, to reveal presence of a curvature of the spine, however X-ray

method unable to define degrees of the prolapse of articular elements of intervertebral disks into the spinal canal.

Using MRI potential it is possible in complete volume to estimate all elements of intervertebral disk (pulpal nucleus, fibrous ring, cartilaginous plate) and soft tissue component of the spinal canal (spinal cord, intracanal ligamentous apparatus, structures of epidural, subdural and subarachnoidal spaces).

MRI investigation was carried out on the tomography "Ovation" GE, power of the magnetic field was 0,35 Tesla. The superficial coil "Body-Spine" was used. In the algorithm of the technique for evaluation of the spinal canal lesions there were included sagittal projections, weighed T1W and T2W, transversal projections in the mode T1W. The investigation in the sagittal projection is the most informative allowing estimation of topographic-anatomic relations of bone, cord and ligamentous structures of the spinal segment. Transversal projection was used for specification of details of the pathological changes.

In norm on MRI in a mode T1W the intervertebral disk looks as homogeneous, iso-intensive structure. Prolapse of the intervertebral disk into spinal canal on the sagittal projections was visible rather well. But the outside part of fibrous ring, posterior longitudinal and yellow ligaments, dura mater gives low (hypointensive) signal on T1W, thereof they are difficult for differentiation from each other. For this purpose the mode T2W is used which gives good contrast between pulpal nucleus and fibrous ring and there is an opportunity of differentiation of break fibrous ring and disk protrusion without break of fibrous ring. The tissue of fibrous ring is preserved, but became thin and on T2W there are defined only external tissues giving low signal. Protrusion has the wide base, and can proceed up to intervertebral holes. During break of fibrous ring tissue the prolapse of pulpal nucleus occurs subligamentously or in the rupture of posterior longitudinal ligament into dural sac. In the most of cases there is defined locally expressed protrusion of the intervertebral disk tissue. The displacement and compression of the spinal cord were visible well both in the sagittal and transversal projections.

## Results and discussion

Justification of this X-ray investigation in 33 patients was identification of diagnostic criteria of intervertebral disk lesions in at acquired not-osseous stenosis of lumbar site of the spinal canal.

X-ray investigation at early stage of lesions of intervertebral disk failed to show changes. With development of pathological process in the intervertebral disk the lowering of disk height, sclerosis of lock plates of vertebral bodies, marginal osseous growing which were consequence of proliferation and ossification of the fibrous ring tissues are defined X-ray. On the roentgenograms they look like marginal osseous "thorns" directed to the perpendicularly longitudinal axis of spine, both forward and in the different directions, and back, into the lumen of the spinal cord. It should be noted, that the potential of X-ray investigations is limited for revealing changes in the intervertebral disk, such as condensation, breaking, fragmentation of the gelatinous nucleus, breaking of fibrous ring with subsequent protrusion of the destroyed disk into the spinal canal forming disk hernia.

Thus, the limited capacity of roentgen diagnosis for study intervertebral disk disorders requires application of other methods of high technology, such as MRI.

Magnetic resonance imaging has become one of the methods of high technology in noninvasive diagnosis for identification of intervertebral disk hernia. We used MRI method for examination of 92 patients with symptoms of intervertebral disk lesion at the level of lumbar spine. The lesions of intervertebral disks were mainly found at level L4-L5 (45.9%) and L5-S (32.1%) and only in 22% of the patients the levels of lesions were noted in the upper intervertebral disks of the lumbar spine, from them in some intervertebral disks they were met in 5.8% cases. There was not found significant

difference in the prevalence of the intervertebral disk damaged between men and women (48.9% and 51.1%, respectively).

The reduction of MRI signal from intervertebral disk due to dehydration of disk is considered as the earliest degenerative change of intervertebral disk. With development of pathological process the prolapse of gelatinous nucleus into the spinal canal (disk hernia) occurred which resulted in compression of the dural sac contents. Hernia protrusions are clearly visible on the sagittal slices in the mode T2W as zone with low signal at the background of bright signal of dural sac.

We conditionally determined the sizes of intervertebral disk protrusions into the spinal canal up to 6 mm, up to 9 mm, and up to 12 mm. The protrusions were marked the most frequently in variant up to 9 mm in 41.4% cases, then there were 6 mm - 39.1% and up to 12 mm 19.5% cases. The level of lesion as it was marked above, was met mainly in the intervertebral segments L4-L5 and L5-S1.

Table 1 shows the sizes of protrusion with lateralization of the intervertebral disk into the spinal canal in the patients with degenerative-dystrophic lesions in the lumbar part of the spinal cord. We registered median, paramedian (to the left, to the right) and posterior-lateral (to the left, to the right) variants of the intervertebral disk hernia. There are presented absolute and percentage quantity of the patients suffering in each variant with hernia lateralization of the intervertebral disk in relation to age. The hernia protrusion is met most of all in the paramedian variant (hernia lateralization to the left - 33 subjects (37.9%), to the right - 32 subjects (36.8%). The intervertebral disk hernia at young age (21-30 years) were observed more frequently in men, than in women (8 and 4 subjects, respectively). With age (41-60 years) increasing the women suffer more often, than man (28 and 16 subjects, respectively). The maximal disk lesion is noted at the mature age (31-50 years). There were only 5 subjects with posterior-lateral lateralization of disk hernia.

TABLE 1. PROLAPSE CHARACTERISTICS OF INTERVERTEBRAL DISK INTO THE SPINAL CANAL WITH LATERALIZATION IN RELATION TO PATIENT'S AGE

Age	To 6 mm (M±m=5.04±0.10)			7-9 mm (M ±m= 8.46 ± 0.12)			10-12 mm (M ± m = 11.26 ± 0.14)			Patients number				
	Median	Paramedian		Median	Paramedian		Median	Paramedian		Total				
		left	right		left	right		left	right	Abs.	%			
21-30 years	1	2	3	4	2	1	2	5	-	2	1	3	12	13.8
31-40 years	2	3	4	9	3	3	4	10	1	2	2	5	24	27.6
41-50 years	3	4	5	12	3	4	5	12	1	2	2	5	29	33.3
51-60 years	2	3	1	6	2	3	2	7	-	-	2	2	15	17.3
Over 60 years	-	2	1	3	1	1	-	2	1	1	-	2	7	8.0
Patients number	Abs.	8	14	12	34	11	12	13	36	3	7	7	17	87
	%	9.2	16.1	13.8	39.1	12.6	13.8	15.0	44.1	3.5	8.0	8.0	19.5	100.0

In our opinion, the disk hernia, according to the MRI data, develops in the following order: at the initial stage there is hyperhydration of the disk, characterized by the increase of brightness of MR-signal from pulpal nucleus on T2 - the weighed images, change of the form of a disk with increase of its vertical size. It can be evaluated as the initial stage of the pathological process. With progressing of the pathological process the dehydration of the disk occurs characterized by the decrease in intensity of a signal from pulpal nucleus, reduction of height of the disk and change of its form. At this stage the pulpal nucleus moving in the disk occurs, that resulted in disk protrusion characterized by change

of the fibrous ring contours owing to moving of pulpal nucleus and its fragments in direction to the spinal canal. During deepening of the process the disk extrusion occurs expressed by prolapse of disk fragment into the spinal canal with compression of the dural sac contents. This appeared to be acquired soft tissue stenosis in the lumbar part of the spine.

## Conclusion

Diagnosis of the intervertebral disk lesions remains to be the current important issue of the radiological diagnosis.

The current advances in the diagnosis of soft tissue stenosing structures of the spinal canal have been reached due to introduction of the MRT methods into the clinical practice.

The knowledge about roentgenological and MRI features of intervertebral disk hernia allows detailed study of genesis of the neurological deficit and correct development of the strategy of therapeutic measures.

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