Recieved: 15 May 2015/ Accepted: 31 May 2015/ Published online: 15 June 2015

# Magnetic Resonance Imaging in the Diagnostics of Spinal Disc Herniations

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## ABSTRACT

### BACKGROUND

Currently the preoperative detection of degenerative disc diseases does not always correlate with neurological symptoms and present status of a patient. This paper outlines the possibilities of using magnetic resonance imaging in evaluation of thethe grade of severity of intervertebral disc herniations.

### METHODS

A total 20 patients of the disc herniations with age group between 20 to 81 y were diagnosed and studied on «Avanta» highfield Magnetic Resonance Imaging machine by «Siemens» (Germany).
The MRI scans were obtained in T2-mode with impulse sequence spine-echo, analyzed with programs RadiAnt DICOM Viewer v1.9.16 and IpSquare v3.0 to following parameters: localization of pathology; hernial width (H), length (L) and area (S); diameter (D) and area of cerebrospinal canal (S').

### RESULTS

The total number of disc herniation detection was 30 cases. Lumbar disc herniation which was most common and revealed in 23 cases (i.e. 76.67% of total cases). Cervical disc herniation was seen in 6 cases (i.e. 20 % of total cases). And there was only one case of thoracic disc herniation (i.e. 3.3 % of total cases). There were 13 patients (65%) with isolated herniations and 7 patients (35%) with multiple failure (from 2 to 4 discs). The Spearman correlation analysis between patients' age (A) and herniations' localization (Loc), number of herniation cases (Num) was observed negative low-force links: r (A/Loc)= -0.04278226 and r (A/Num)= -0.15083. Also we analyzed ratios between all lineal and plane parameters of hernia and cerebrospinal canal: H and D (r (H/D)= -0.0447), L and D (L/D) (r (L/D)=0.2763), S and S' (r(S/S')= -0.3382).

### CONCLUSION

Lumbar disc herniation was the most common pathology. In case of plane parameters analysis r(S/S')= -0.3382 revealed negative average-force link between S and S' that consider this method to be more objective in the MRI-evaluation of hernia compression into the spinal canal.

### KEYWORDS

Spinal Canal, Nerve Compression Syndromes, Intervertebral Disc, Neurologic Examination, Diagnostic Imaging

## INTRODUCTION

Currently, the third ranked general morbidity of Belarus is the diseases of bones and joints (10.48%), conceding to cardiovascular diseases and diseases of the respiratory system. In the structure of disability from diseases of bones and joints the spine degenerative diseases constitute 20.4% of all patients [1]. This group of spinal diseases encompasses up to 40% of neurological and orthopedic pathology [2]. Moreover, backache is the most frequent cause of physical activity limitation in the adult population [3, 4].

One possible source of chronic low back pain is a degenerated intervertebral disc [2,3,5,6]. Degenerative diseases of spine present by osteochondrosis, deforming spondylosis, deforming spondylarthrosis and spinal disc herniation. It is important to note that disc degeneration and senescence is the same process with different rate [7].

The use of microsurgical and endoscopic techniques increases the requirements for pre-operative diagnosis, visualization level, character and the nature of spinal cord lesions [8, 9]. MRI is a useful diagnostic tool for diagnosis, management strategy determination and assessment of treatment results [3, 5, 7, 10].

Though disc herniation is a widespread pathology, there is a diagnostics problem that the degree of compression of the spinal canal is evaluated subjectively using hernial and spinal canal in the pathological location linear parameters [5, 7]. This principle doesn't always correlate with the disease's clinical severity and doesn't allow having reliable

information about the current patient's state [8, 9, 11]. It's necessary to accent the last researches confirmed the high reliability of the area measurements [12, 13]. But there are no examination with usage of hernia and cerebrospinal canal's configuration plane parameters which can be more representative for diagnostics tasks [5, 14, 15].

The purpose of the present study was to analyze the possibilities of MRI in diagnostics of spinal disc herniation by measuring the following parameters: localization of pathology; hernial width (H), length (L) and area (S); diameter (D) and area of cerebrospinal canal (S') and to correlate measurements as method of improving MRI-evaluation of hernia compression into the spinal canal.

## METHODS

The present study was conducted on the base of Republic Scientific Practice Centre of Traumatology and Orthopedics from February to March, 2015. A total 20 patients of the disc herniations with age group between 20 to 81 y were diagnosed and studied on «Avanta» highfield Magnetic Resonance Imaging machine by «Siemens» (Germany) using the superconducting magnet with intensity of magnetic field 1,5 T and phased coil «FLEX».

Patients with diagnosis "disc herniation" confirmed by clinical symptoms of the disease and X-ray examination were included in the study after obtaining a verbal consent [16, 17].

Because of widespread character of the disease we didn't set any limits to the patients' age. The MRI scans were obtained in T2-mode with impulse sequence spine-echo, analyzed with programs RadiAnt DICOM Viewer v1.9.16 and IpSquare v3.0 to following parameters: localization of pathology; hernial width (H), length (L) and area (S); diameter (D) and area of cerebrospinal canal (S').

The Kolmogorov-Smirnov test revealed that the received sample had no normal distribution, therefore methods of nonparametric statistics were chosen for further analysis. The link between analysed parameters was researched with Spearman correlation analysis and results were considered to be significantly valued if P values less than 0.05.

## RESULTS

All of determined characteristics and measurements are given at the Table 1 and Figure 1. As seen in Table 1 there were a total 30 disc herniations, so per patients average 1,5 disc involvements were found.

There were 13 patients (65%) with isolated herniations and 7 patients (35%) with multiple failure (from 2 to 4 discs).

The Spearman correlation analysis between patients' age (A) and herniations' localisation (Loc), number of herniation cases (Num) were observed negative low-force links: r (A/Loc)= -0.04278226 and r (A/Num)= -0.15083.

The total number of disc herniation detection was 30 cases. Lumbar disc herniation which was most common and revealed in 23 cases (i.e. 76.67% of total cases). Cervical disc herniation was seen in 6 cases (i.e. 20 % of total cases). And there was only one case of thoracic disc herniation (i.e. 3.3 % of total cases) (Table 2).

Than we analyzed ratios between all lineal and plane parameters of hernia and cerebrospinal canal: hernia length and cerebrospinal diameter (H/D) (Figure 2), hernia's width and cerebrospinal diameter (L/D) (Figure 3), areas of hernia and cerebrospinal canal in the pathological location (S/S') (Figure 4).

In first case (Figure 2) Spearman rank correlation coefficient was r (H/D)= -0.0447 that submitted to negative low-force link between H and D.

After collated hernia's width and cerebrospinal diameter (Figure 3), we get rank coefficient was equal to r (L/D) = 0.2763. So, between these lineal parameters we saw positive low-force link.

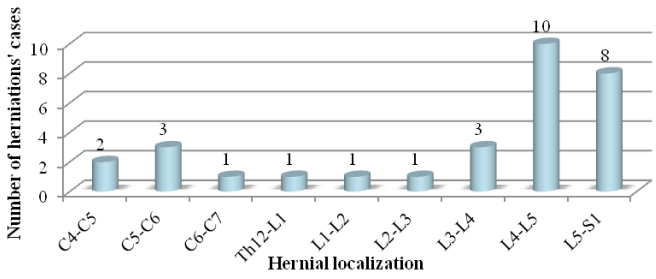
Spearman correlation analysis between areas of hernia and cerebrospinal canal (Figure 4) showed that the rank coefficient in this case was equal to r(S/S')= -0.3382 that submitted negative average-force link between S and S' to be existed.

| Patient № | Age (A) | Herniation localisation (Loc) | Hernial area (S), cm2 | Cerebrospinal area (S'), cm2 | Hernial width (H), cm | Hernial length (L),cm | Cerebrospinal diameter (D),cm |
|---|---|---|---|---|---|---|---|
| 1 | 24 | L4-L5 | 0.90 | 1.10 | 1.46 | 0.89 | 1.34 |
| 2 | 40 | L4-L5 | 1.10 | 1.70 | 1.82 | 1.36 | 1.73 |
| 3 | 58 | L4-L5 | 1.10 | 1.30 | 2.14 | 0.60 | 1.48 |
| 4 | 57 | Th12-L1 | 1.40 | 1.80 | 1.06 | 2.46 | 1.30 |
| 5 | 52 | C5-C6 | 0.40 | 1.30 | 2.02 | 0.60 | 1.48 |
| 6 | 57 | L3-L4 | 1.50 | 1.50 | 2.24 | 0.38 | 1.12 |
| 6 | 57 | L4-L5 | 1.30 | 1.60 | 2.28 | 0.49 | 1.15 |
| 7 | 71 | C4-C5 | 0.60 | 1.80 | 1.63 | 0.40 | 1.0 |
| 8 | 66 | L4-L5 | 1.80 | 0,80 | 3,10 | 0,57 | 1,54 |
| 8 | 66 | L4-L5 | 1.20 | 1.00 | 2.65 | 0.75 | 1.15 |
| 8 | 66 | L5-S1 | 1.50 | 1.00 | 2.50 | 0.65 | 1.10 |
| 8 | 66 | L5-S1 | 1.70 | 1.30 | 3.01 | 0.74 | 0.80 |
| 9 | 34 | L5-S1 | 0.80 | 1.00 | 1.78 | 0.53 | 1.00 |
| 9 | 34 | L5-S1 | 0.90 | 1.60 | 1.61 | 0.58 | 1.42 |
| 10 | 48 | L1-L2 | 1.00 | 2.40 | 1.85 | 5.70 | 1.52 |
| 11 | 81 | L3-L4 | 2.50 | 1.00 | 3.06 | 1.03 | 0.83 |
| 12 | 35 | C4-C5 | 0.30 | 1.80 | 1.24 | 0.32 | 1.36 |
| 12 | 35 | C5-C6 | 0.40 | 1.80 | 1.24 | 0.44 | 1.36 |
| 13 | 40 | L4-L5 | 0.90 | 1.90 | 1.62 | 0.65 | 1.37 |
| 14 | 48 | C5-C6 | 0.60 | 1.20 | 1.66 | 0.45 | 0.95 |
| 15 | 65 | L2-L3 | 2.20 | 0.80 | 2.53 | 1.21 | 1.27 |
| 16 | 39 | C6-C7 | 0.50 | 1.10 | 1.52 | 0.46 | 1.00 |
| 16 | 39 | L5-S1 | 0.60 | 1.00 | 1.48 | 0.67 | 1.01 |
| 17 | 42 | L5-S1 | 0.70 | 0.90 | 1.77 | 0.59 | 1.18 |
| 18 | 54 | L5-S1 | 1.00 | 1.40 | 1.70 | 0.55 | 1.34 |
| 19 | 20 | L4-L5 | 1.10 | 1.00 | 2.20 | 0.62 | 0.97 |
| 19 | 20 | L3-L4 | 0.80 | 1.50 | 1.84 | 0.44 | 1.37 |
| 19 | 20 | L4-L5 | 0.90 | 1.40 | 1.95 | 0.54 | 1.44 |
| 20 | 52 | L4-L5 | 1.50 | 1.20 | 0.98 | 0.65 | 1.00 |
| 20 | 52 | L5-S1 | 1.10 | 1.20 | 1.65 | 0.51 | 0.95 |

Table 1. Determined characteristics and measurements in intervention group

| Localisation | C4-C5 | C5-C6 | C6-C7 | Th12-L1 | L1-L2 | L2-L3 | L3-L4 | L4-L5 | L5-S1 |
|---|---|---|---|---|---|---|---|---|---|
| Number of herniation cases | 2 | 3 | 1 | 1 | 1 | 1 | 3 | 10 | 8 |
| Total | 6 | | | 1 | 23 | | | | |

Table 2, Figure1. Localisation and frequency of disc herniations



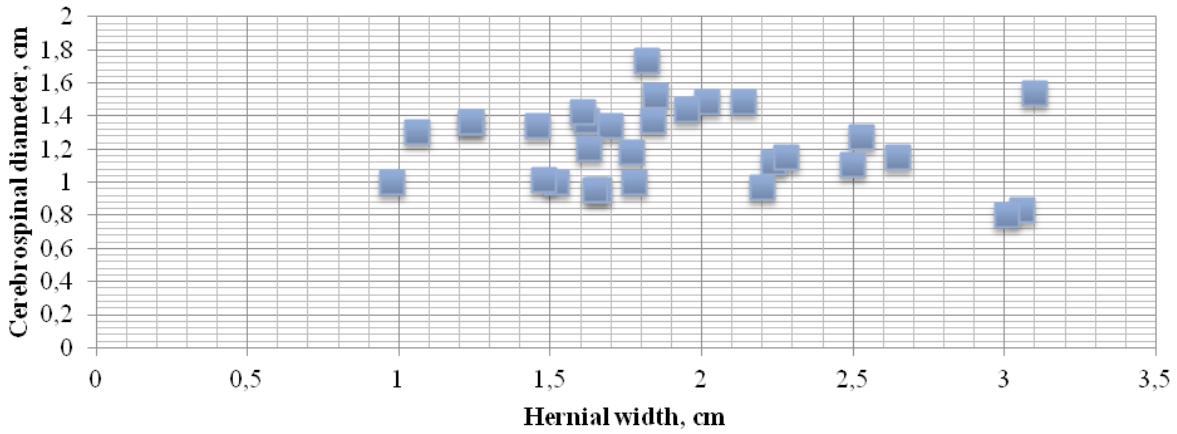



Figure 2. Ratio between hernia width and cerebrospinal diameter in pathological location (H/D)

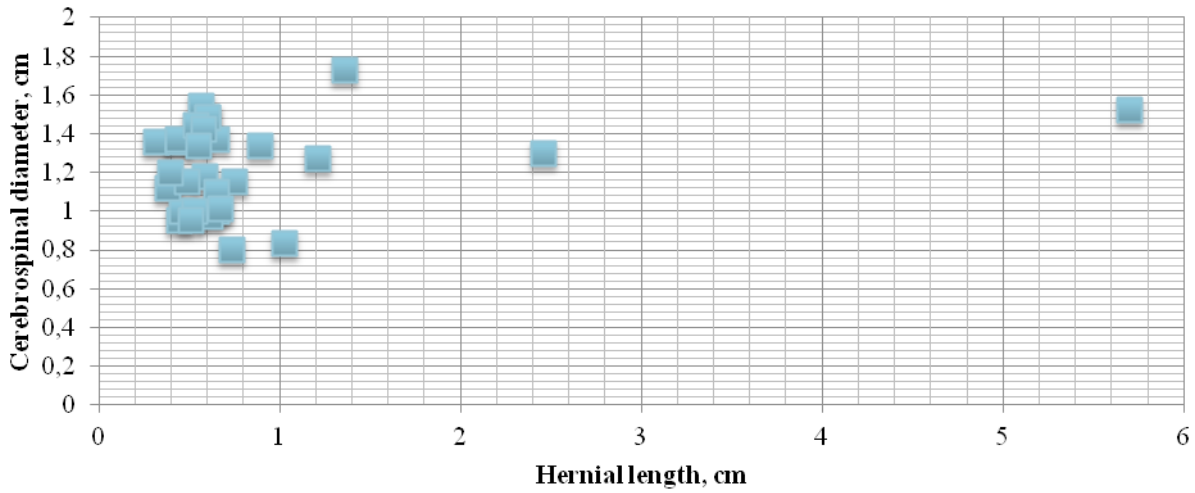



Figure 3. Ratio between hernia length and cerebrospinal diameter in pathological location (L/D)

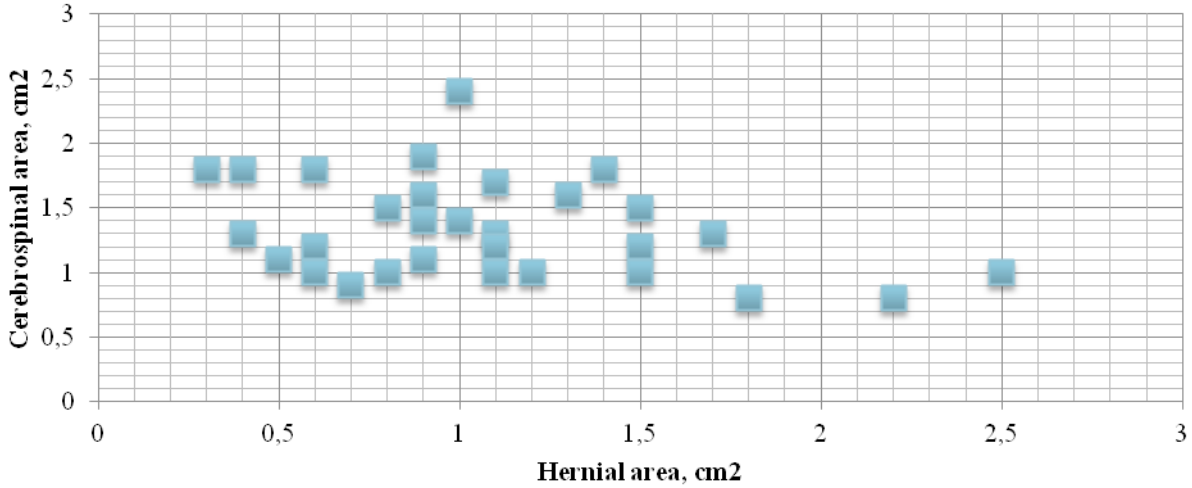



Figure 4. Ratio between hernia and cerebrospinal areas in pathological location (S/S')

## DISCUSSION AND CONCLUSION

The sample materials revealed that the most frequent localisation of disc herniation is lumbar area (76.67% of total cases), more seldom – cervic (20 %), rarely – thoracic (3.3 %). There were 13 patients (65%) with isolated herniations and 7 patients (35%) with multiple failure (from 2 to 4 discs). This tendency traced in other researches [5, 6, 18] and is explained by the features of strain rate on spine.

The Spearman correlation analysis between patients' age (A) and herniations' localisation (Loc), number of herniations' cases (Num) were observed negative low-force links: r (A/Loc)= -0.04278226 and r (A/Num)= -0.15083. These results confirm widespread character of disease [19, 20].

The low meanings of rank correlation coefficient in case L/D (r=0.2763) and H/D (r= -0.0447) are suggested us to the statement that using lineal configuration of herniation is unrepresentative to diagnostics of these disease and it is important to exclude these measurements from the arsenal of diagnostics procedure. Furthermore, there are many described cases when high meaning of hernial width of length hadn't approved any determined neurological symptoms or in contrary low hernial lineal parameters had manifested by increasable backache and tunnel syndrome [8, 12, 17]. Measuring none of these data doesn't solve a problem of significant correlation between the general status of intervertebral disc as the actual source of the pain. However, in case of plane parameters analyze the rank Spearman coefficient was observed r(S/S')= -0.3382. This result shows negative average-force link between S and S'. There were no researches that described ratio between this measurements before.

In the present study, we achieved the purpose. Conducted investigations convince that MRI is the most commonly employed and sensitive technique in quantifying the biochemical changes of disc degeneration [5, 6, 13].

We have shown that measuring areas of herniation and cerebrospinal canal in pathological localisation may represent more reliable data that lineal parameters of herniation and cerebrospinal canal. Thus, this method can be more objective in the MRI-evaluation of hernia compression into the spinal canal and be useful for preoperative diagnostics [20, 21].

**ACKNOWLEDGEMENTS**

None

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