Acta Scientific Orthopaedics (ISSN: 2581-8635)

Volume 5 Issue 12 December 2022

Research Article

Neuroimaging Semiotics of Non-greasy Compressing Factors in Patients with Persistent Compression of the Lumbar and Sacral Roots in Degenerative-dystrophic Lesions of the Spine

Mokhov Nikita Valeryevich[1,2]*, Danilov Valeriy Ivanovich[1,2], Padiryakov Viktor Nikolaevich[1], Bulgakov Evgeny Pavlovich[1,2] and Ibatullin Murat Masgutovich[1,2]

[1]Department Neurology and Neurosurgery, Kazan State Medical University, Faculty Advanced Training and Professional Retraining of Specialists, Kazan, Russia

[2]Department of Neurosurgery, GAUZ "Interregional Clinical and Diagnostic Center", Kazan, Russia

***Corresponding Author:** Mokhov Nikita Valeryevich, Department Neurology and Neurosurgery, Kazan State Medical University, Faculty Advanced Training and Professional Retraining of Specialists, Kazan, Russia.

Received: September 21, 2022

Published: November 12, 2022

Abstract

Compression of the lumbar and sacral roots in dystrophic pathology of the spine is polyfactorial. Among the factors of compression of these roots, the proportion of non-greasy compression options is high. This determines the need to optimize the diagnosis of patients with degenerative spinal lesions using modern methods of neuroimaging. Each non-gnaw factor of persistent compression of the lumbar and sacral roots has its own characteristic neuroimaging semiotics, the knowledge of which will allow to more accurately determine the indications for surgical treatment and the amount of surgical intervention.

Keywords: Polyfactorial Persistent Compression of Cauda Equina Roots; Neuroimaging Semiotics; Multifactor Resistant Compression of Cauda Equina Roots; Neuroimaging Signs

Patients with degenerative disease of spine have multifactorial compression of lumbar and sacral roots. Among the compression factors of the roots there is a high percentage of non-herniated factors. It is very important to optimize the diagnosis of patients with degenerative diseases of spine by using modern neuroimaging. Every non-herniated factor of resistant compression of lumbar and sacral roots has its own neuroimaging signs. It will determine the indications for surgical treatment and volume of surgical intervention more accurately.

In neurology and neurosurgery, the problem of persistent compression of the lumbar and sacral roots in degenerative-dystrophic diseases of the vertebrate is very relevant due to the large number of patients with this pathology [3,4]. The polyfactorial compression of the lumbar and sacral roots in degenerative-dystrophic lesions of the spine was established [1-5]. The most informative method for diagnosing compression factors is currently n-eirovisualization of the spine and it allows you to establish an accurate diagnosis [6-9]. The formation of vertebral compression factors of the lumbar and sacral roots, as evidenced by the data of neuroimaging, is determined by the spatial relations of the vertebral and neural formations of the spinal canal and is associated with the anatomical features of the spinal canal (the structure of the posterior parts of the central part of the spinal canal and its metric characteristics, the shape of the intervertebral joints, the position and thickness of the yellow ligaments) [1,2]. CT examination of the spine shows that the transformation of vertebral dystrophic changes into factors of lumbosacral radicular disorders often occurs with the simultaneous participation of several factors in a number of pathological [1,2]. The causes of secondary spinal canal stenosis are herniated intervertebral discs, hypertrophied yellow ligaments, inflammation and adhesions of epidural tissue, varicose veins of epidural veins, osteophytes of the vertebral bodies, anomalies in the structure of the arches, spondylolisthesis, cysts of the mesh joints, often against the background of primary stenosis [3,4].

The purpose of the publication is to describe the neuroimaging semiotics of non-greasy factors of compression of the lumbar and sacral roots in dystrophic lesions of the spine, features of the diagnosis of polyfactorial variants of compression of the roots.

Material and Methods

The materials of the medical histories of 4,00 patients operated on for compression forms of degenerative-dystrophic pathology of the lumbosacral spine were analyzed. All patients were on inpatient treatment in the neurosurgical department of the State Educational Institution «Interregional Clinical and Diagnostic Center» M Health Care Institutions of the Republic of Tatarstan in the Period from 2012 to 2013 Preoperative imaging included radiography of the lumbosacral spine, including with functional tests, MRI, RCT of the lumbar spine no more than 1 month before the operation.

Preliminary interventions were carried out in conjunction with the revision of the spinal canal and the indication of intraoperative finds (the compressing factor) in the protocol of the operation.

The frequency of occurrence of various compression factors, the results of neuroimaging before surgery in comparison with intraoperative findings (the percentage of coincidence of the description of the results of preoperative neuroimaging with intraoperative findings) was determined. The reliability of the indicators was assessed using the Student's t-test.

The main neuroimaging criteria for assessing the semiotics of non-greasy factors of persistent compression were: the density characteristics of the compressive agent, the degree of narrowing (stenosis) of the spinal canal (shape and size of the spinal canal), the degree of narrowing of the radicular canal (foraminal zone) (Figure 1), the localization of the factor in the spinal canal in relation to the roots, the stage of the degenerative process on the Pfirrmann scale [6] (Figure 2) and Modik (Figure 3).

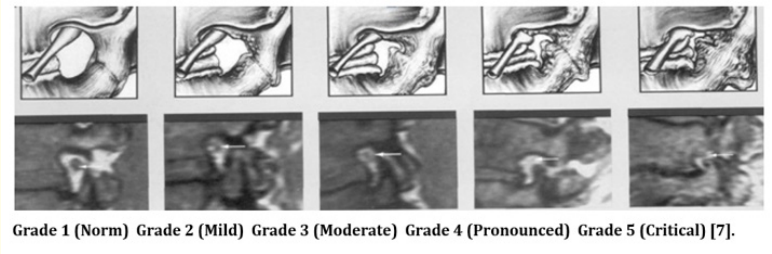

Figure 1: Degree of narrowing of the radicular canal (foraminal zone).

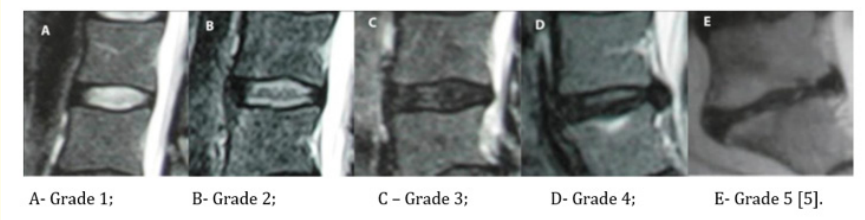

Figure 2: Stages of the course of the degenerative process on MRI (Pfirrmann C.W., 2001).

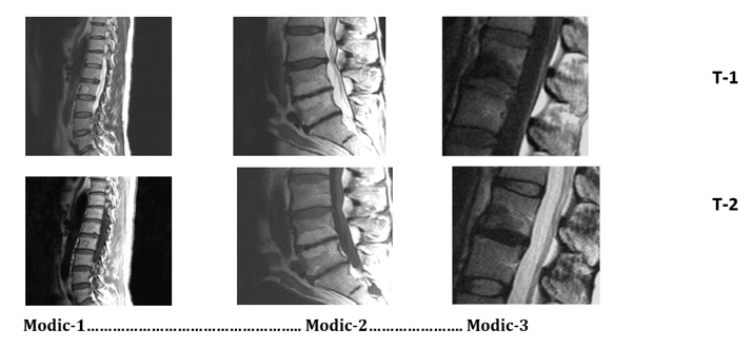

Figure 3: Focal changes in the vertebral bodies according to Modic (1-Avascular fibrosis (T2 + and T1); 2-Fatty degeneration (T2 + and T1 +); 3-Sclerosis (T2- and T1-)) [6].

Results

Of the 400 observations, male patients accounted for 57% (227 people), female - 43% (173 people). The figures given indicate the predominance of the pathological process in men ($p < 0.01$). The age of the examined patients ranged from 19 to 80 years. Most of the operated patients - almost 3/4 (73%) - regardless of gender, were patients at the most able-bodied age - from 31 to 60 years. The levels of predominant localization of compressive agents were L 4-L 5 and L5 – S1 ($p < 0,01$) (Figure 4).

According to the results of neuroimaging, a significant group of patients with persistent compression of the roots by non-gnaw factors was identified. Persistent compression of the roots in degenerative lesions of the spine is compression that cannot be stopped by non-surgical methods for a month, or immediately after the development of compression, the lack of alternatives to treatment is obvious - urgent decompression of the root (roots) (Figure 5 and 6).

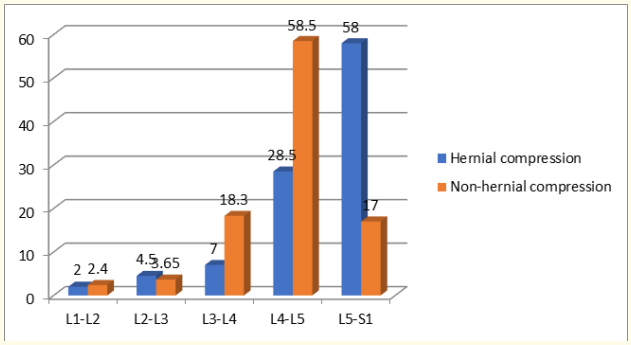

Figure 4: Distribution of patients with compression of a hernial and non-hernial nature depending on the level of damage.

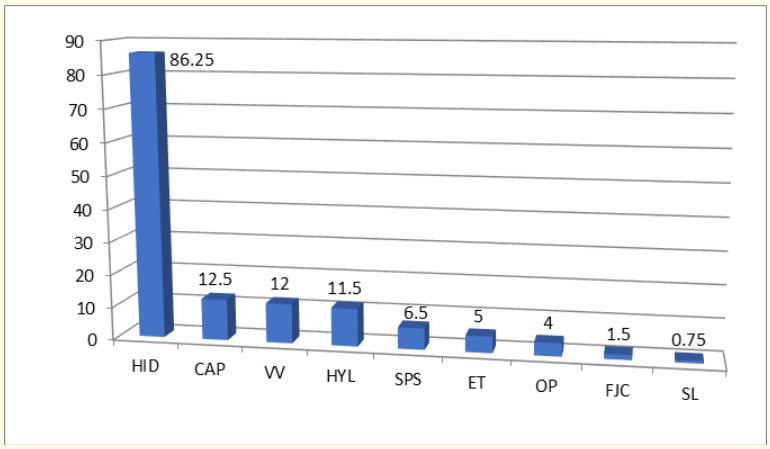

Figure 5: Compression factors of lumbar and sacral roots: HID - Herniated Intervertebral Disc; CAP - Cicatricial Adhesion Process; VV - Varicose Veins; HYL - Hypertrophy of the Yellow Ligament; SPS - Spinal Canal Stenosis; ET - Edematous Tissue: OP - Osteophytes; FJC - Facet Joint Cyst; SL - Spondylolisthesis [1].

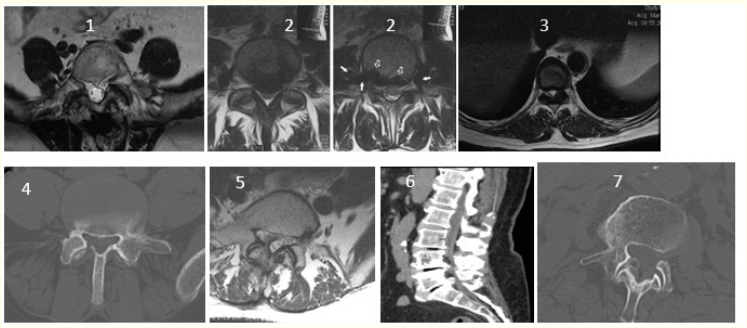

Figure 6: Factors of compression according to the results of neuroimaging: 1 - Cicatricial Adhesion Process; 2 - Varicose Veins; 3 - Hypertrophy of the Yellow Ligament; 4 - Spinal Canal Stenosis; 5 - Edematous Cellular Tissue; 6 - Osteophytes; 7 - Cyst of the Facet Joint.

The most common cause among the negro factors were changes in the tissues of the epidural space - the reaction of the epidural tissue to chronic irritation mainly in the form of an adhesion process (50 (12.5%) observations).

In 7 (1.75%) patients, compression by scars and inflamed epidural cells was monofactorial, in 43 (10.75%) patients polyfactorial compression was observed in combination with a herniated disc. According to the results of neuroimaging, the density of this compression factor is from 100 to 130 HU, which is higher than the density of a herniated disc (70-110 HU).. The predominant localization of the pathological process is the foraminal zone in conjunction with the nose of the radicular canal (Figure 7).

In patients of this group, radicular canal stenosis was observed, mainly of moderate and pronounced degree. In 41 (82%) patients, the degree of degenerative process of the lumbar spine modic-1; in 9 (18%) patients of Modik-2. On the Pfirmann scale, 4 (8%) patients have grade 3 degenerative process; 43 (86%) grade 4 patients; and 3 (6%) grade 5 patients.

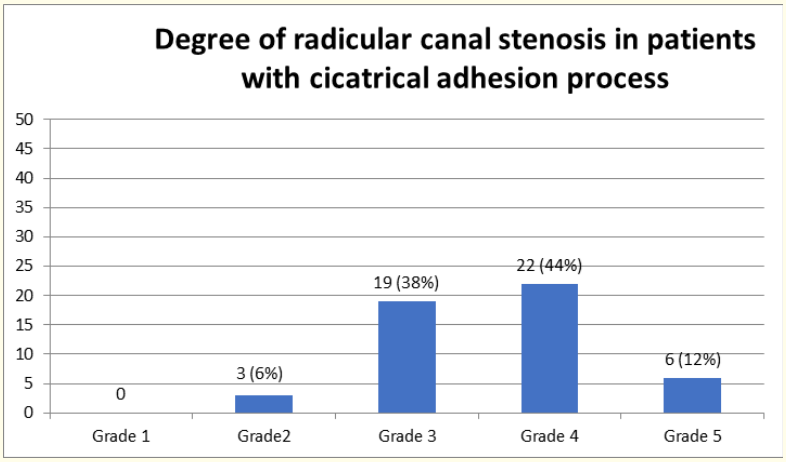

Figure 7: Distribution of patients with cicatricial adhesion process according to the degree of radicular canal stenosis.

Varicose veins, which have a pathological effect on nerve structures, were diagnosed in 48 (12%) observations, and in 9 (2.25%) of them they were the only cause of compression of nerves to nuts.

Most often, varicose veins of epidural veins are observed in combination with other compression factors (hernia of the disc, spinal canal stenosis). The most sensitive diagnostic method is MRI, however, during RCT, it is also possible to diagnose the formation of 40-70 HU in density, localized mainly on the ventral surface in the central or subarticular zones. In 40 (83%) patients, the degree of degenerative process of the lumbar spine is Modik-1; in 8 (17%) patients of Modik-2. On the Pfirmann scale, 5 (10%) patients have grade 3 degenerative process; 39 (81%) grade 4 patients; and 4 patients (9%) grade 5.

Hypertrophy of the yellow ligament was the cause of compression of the roots in 46 (11.5%) patients, in 8 (2%) of them - as a single cause.

According to the results of neuroimaging, the density characteristics of hypertrophied yellow ligaments can be different from 70 to 140 HU. It depends on the stage of the degenerative process and the degree of their calcification and ossification. Hypertrophied yellow ligaments cause dorsal compression, leading to stenosis of the spinal canal and a change in its shape in the anteroposterior direction.

To assess the severity of spinal canal stenosis, the Harwod Nash and Petersson scale of 1992 was used: no stenosis - an area of more than 250 square millimeters; stenosis of the 1st degree - from 170 to 249 square millimeters; stenosis of the 2nd degree - from 100 to 169 square millimeters; stenosis of the 3rd degree- from 1 to 99 square meters. mm. with an average area, the spinal canal can be narrowed only in the anteroposterior direction. So the stenosis of the spinal canal is considered to be its narrowing in the anterioradoma on a rule of less than 11.5 mm (Figure 8).

This group of patients was dominated by patients with grade 2 stenosis. Patients with grade 1 and grade 3 spinal stenosis were an equal number. In 35 (76%) patients, the degree of degenerative process of the lumbar spine is Modik-1; in 5 (11%) patients modic-2; in 6 (13%) patients of Modik-3. On the Pfirmann scale, 5 (11%) patients have grade 3 degenerative process; 34 (74%) grade 4 patients; and 7 patients (15%) grade 5.

Primary withtenosis of the spinal canal was observed in 26 patients (6.5%), of which as monofactorial compression in 19 (4.75%) observations. This group of patients included patients mainly with primary (arthrogenic - due to hypertrophy and deformation of the arcuate joints) stenosis (Figure 9).

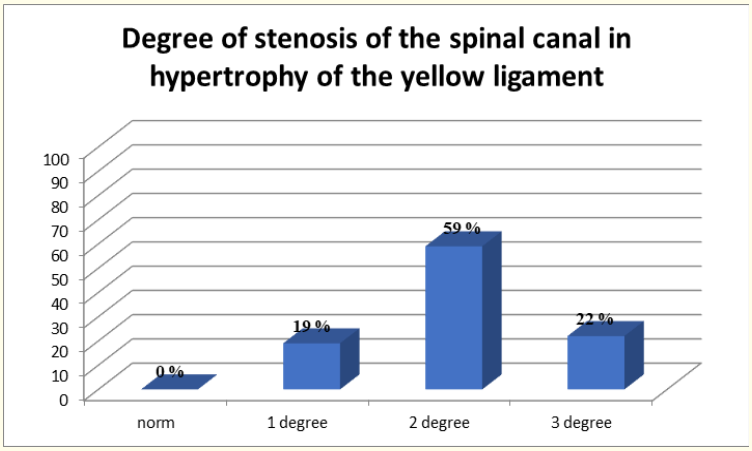

Figure 8: Distribution of patients with hypertrophy of the yellow ligament according to the degree of spinal canal stenosis.

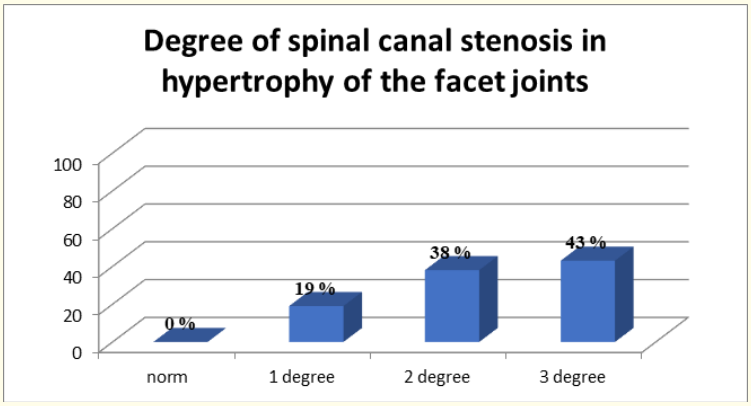

Figure 9: Distribution of patients according to the degree of spinal canal stenosis in hypertrophy of the facet joints.

The most sensitive method in the diagnosis of spinal canal stenosis is RCT and MRI in hydrography (Muyr). According to neuroimaging, we can see the hypertrophy of the facet joints, measure the area of the spinal canal, clarify the shape and deformation of the spinal canal and foraminal zone, and in the mode of MRI hydrography to clarify cerebrospinal fluid dynamics.

This group is dominated by patients with more pronounced stenosis (2 and 3 degrees) than in the group of patients with macular ligament hypertrophy. This is due to the fact that with hypertrophy of the facet joints, compression is carried out in the dorsal and lateral directions. A more gross change in the shape of the spinal canal leads to its more pronounced stenosis compared to stenosis of the spinal canal with hypertrophy of the yellow ligaments, when compression is carried out only in the anteroposterior direction. In 9 (37%) patients, the degree of degenerative lumbar spine process Modic-1; in 11 (42%) patients modic-2; in 6 (23%) patients of Modik-3. On the Pfirmann scale, 5 (19%) patients have grade 3 degenerative process; 9 (37%) patients have Grade 4; and 12 patients (46%) grade 5.

Edema of the epidural tissue was detected in 20 (5%) patients and only in polyfactorialcoma pressing, mainly in combination with a herniated disc. With neuroimaging, the localization of this compression factor coincided with the localization of the disc herniation. However, according to the results of RCT, the epidural

tissue edema zone has different density characteristics from the disc herniation of 40-60 HU (less dense than the disc herniation). This should be taken into account at the preoperative stage for two main reasons: 1) the size of the hernia itself may be small, which affects the plan and volume of surgical intervention; 2) revision of the indications for surgery in favor of conservative therapy. We considered persistent compression to be the ineffectiveness of conservative therapy for 2 months or more.

In this group, 17 (85%) patients had a degree of degenerative lumbar spine called Modik-1; 3 (15%) patients had Modik-2. On the Pfirmann scale, 5 (25%) patients had Grade 3 degenerative process; 13 (65%) Grade 4 patients; and 2 patients (10%) Grade 5.

Posterior osteophytes were the cause of compression of the nerve roots in 16 (4%) observations, in three (0.75%) of them - as the only cause. According to the results of RCT, a pathological formation of bone density located in the paramedical subarticular zones is detected, leading to stenosis of the vertebral or radicular canal with a compression of the nerve roots.

In 2 (12.5%) patients, the degree of degenerative process of the lumbar spine ka Modik-1; in 3 (18.75%) patients modic-2; in 11 (68.75%) patients of Modik-3. On the Pfirmann scale, in 1 (6.25%) patients, the degree of degenerative process Grade 3; in 3 (18.75%) patients of Grade 4; and in 12 patients (75)% Grade 5.

In 6 (1.5%) patients, the clinic of persistent compression of the nerve roots was caused by a facet joint cyst. Cysts can be synovial and ganglionic. Cystic formations located in the lateral parts of the spinal canal, having a connection with the arcuate joint and lined from the inside with synovial epithelium, are called synovial cysts. These formations over time can lose contact with the synovial cavity of the intervertebral joint. After that, the cysts lose their synovial lining and can ossify. About brasses located in the periarticular zone, but losing contact with the joint cavity and deprived of an internal synovial lining, are called ganglionic (nodular) cysts.

On the results of neuroimaging of a facet joint cyst - extradural volumetric formation of a homogeneous structure, tightly adjacent to the medial wall of the facet joint or spreading from it, compressing neural structures, with single fatty inclusions, an average density of 40-60 HU according to RCT data, hypointense in a T1-weighted image or isointense in a T2-weighted image according to MRI data.

In 3 (50%) patients, the degree of degenerative process of the lumbar spine Modik-2; in 3 (50%) patients of Modic-3. On the Pfirmann scale, 3 (50%) grade 4 patients; and 3 (50%) Grade 5 patients.

In 3 (0.75%) patients with a clinic of persistent compression of the nerve roots, the diagnosis of van spondylolisthesis was diagnosed.

In order to assess instability in the vertebral-motor segment at the level of spondylolisthesis, radiography with functional tests was performed. Most often, the clinic of persistent compression of the nerve roots in unstable spondylolisthesis is due to deformation and stenosis of the initial parts of the radicular canal. Therefore, RCT is of great diagnostic importance in order to assess the foraminal zone and determine the degree of radicular canal stenosis. In all patients, the degree of radicular canal stenosis was pronounced (Grade 4); on the Modic scale, the stage of the degenerative process Modic-3 in all patients; on the Pfirmann Grade-5 scale also in all patients.

Discussion and Conclusion

Herniated disc is the most common cause of persistent compression of the lumbar and sacral roots (86.25%) and its neuroimaging semiotics is currently described quite well [1,4,6,7]. However, a significant group of 55 patients (13.75%) with persistent compression of the roots by non-gnaw factors was identified. And the description of the neuroimaging semiotics of non-greasy factors of persistent compression of the lumbar and sacral roots in order to improve the results of treatment of this group of patients is an urgent task.

In 27 (6.75%) patients, negro factors occurred in combination with a herniated disc. It was confirmed that in part of the patients 47 (57.3%) compression of nerve structures is due to only one factor (monofactorial), while in the rest of 35 (42.7%) compression was the result of exposure to several factors (polyfactorial), and both combinations of herniated discs with non-gnaw factors and a combination of several factors of a non-gnaw nature were observed.

Conclusion: The dependence of the predominance of a certain n-acne factor of the compress on the stage of the degenerative process of the spine on the Modik and Pfirmann scale is revealed (Figure 10, 11). So in the earlier stages of the degenerative process (Modik-1, Pfirmann 3-4), there is a predominance of the cicatricial-adhesion process, edematous tissue, varicose veins, and in the later stages (Modik 2-3, Pfirmann-5), compression factors such as osteophytes, facet joint cysts, spinal canal stenosis, spondylolisthesis prevail. This dependence can be used in the description neuroimaging semiotics of negrox compression factors (as universal scales Modik and Pfirmann).

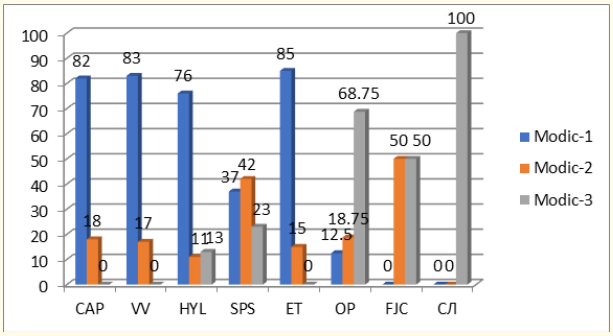

Figure 10: Distribution of patients with non-hernial compression according to the stage of the degenerative process in the vertebrae on the Modic scale. CAP - Cicatricial Adhesion Process; VV - Varicose Veins; HYL - Hypertrophy of the Yellow Ligament; SPS - Spinal Canal Stenosis; ET - Edematous Cellular Tissue; OP - Osteophytes; FJC - Facet Joint Cyst; SL - Spondylolisthesis.

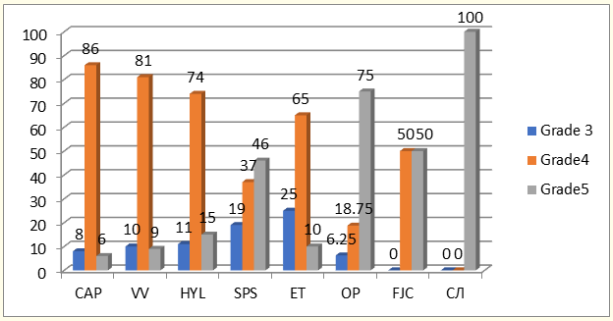

Figure 11: Distribution of patients with non-hernial compression by stage of the degenerative process in the discs on the Pfirrmann scale. CAP - Cicatricial Adhesion Process; VV - Varicose Veins; HYL - Hypertrophy of the Yellow Ligament; SPS - Spinal Canal Stenosis; ET - Edematous Cellular Tissue; OP - Osteophytes; FJC - Facet Joint Cyst; SL - Spondylolisthesis.

Findings

- Compression of the lumbar and sacral roots in dystrophic pathology of the spine is polyfarna. The causes of compression are herniated intervertebral discs, hypertrophied yellow ligaments, edema and adhesive changes in the epidural tissue, varicose veins, osteophytes of the vertebral bodies, primary spinal stenosis, facet joint cysts, spondylolisthesis.
- Among the factors of compression of the lumbar and sacral roots in dystrophic pathology of the spine, the proportion of neg red compression options is high (13.7 5%).
- The polyfactorial compression of the lumbar and sacral roots in degenerative diseases of the spine and the large proportion of non-greasy factors of persistent compression determine the need to optimize the algorithm for examining this group of patients using modern methods of neuroimaging (MRI, CT, radiography with functional tests).
- The non-male factors and persistent compression of the lumbar and sacral roots have their own characteristic neuroimaging semiotics.
- Neuroimaging semiotics of compressive factors allows you to accurately determine the indications for surgical treatment and the amount of surgical intervention.

Bibliography

1. Altunbaev RA. "Clinical-computer of ternaya-tomographic evaluation of the regularities of the formation of vertebrogenic lumbosacral radicular syndromes: autoref". *dis. cand. med. nauki* (1995): 20.

2. Altunbaev RA., *et al*. "Clinical-visual parallels of vertebrogenic lumbar-sacral meningo-radicular lesions". State Medical University, *Kazan Medical Journal* 83.4 (2002): 280-286.

3. Danilov VI., *et al*. "Compressive factors and indications for surgical treatment in patients with persistent compression lumbar and sacral radiculopathies in dystrophic lesions of the spine". Kazan State Medical University. *Vertebroneurology* 3.4 (2006): 58-64.

4. Popelyansky AY., *et al*. "Propaedeutics of vertebrogenic diseases of the nervous system". Kazan (1985): 86.

5. Popelyansky YY., *et al*. "Vertebrogenic diseases of the nervous system". Vertebrogenic syndromes of lumbar osteochondrosis. – Kazan. Ed. KSU, 1 (1974): 285.

6. Brant-Zawadzki MN., *et al*. "Low Back Pain". *Radiology* (2000): 321-330.

7. Kendrick DE., *et al*. "Radiography of the lumbar spine in primary care patients with low back pain: randomised controlled trial". *BMJ* 322 (2001): 400-405.

8. Maureen GC., *et al*. "Influence of Imaging on Clinical Decision Making in the Treatment of Lower Back Pain". *Radiology* (2001): 393-399.

9. Weishaupt DA., *et al*. "Painful Lumbar Disk Derangement: Relevance of Endplate Abnormalities at MR Imaging". *Radiology* (2001): 420-427.