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CT and 3D NLS-diagnostics of degenerative-dystrophic damages of intervertebral discs

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Numerous studies prove that two thirds of people seek medical advice due to low-back pain. The most frequent reason of low-back pain is degenerative changes of intervertebral discs.

Main objective of diagnostics is to distinguish age-related changes in discs morphology from changes related to pathological degeneration of discs leading to neural compression. However it is quite possible that pathological degeneration of discs is just speeding up of normal ageing process; pathophysiology of this process is rather complicated and unknown in many aspects.[5]

Degenerative changes of intervertebral discs may be registered after first 10 years of life of a man and 10 years later in women.[2] However etiology of neurologic symptomatology at lumbodynia is much more complicated than simple mechanical compression of neural structures. Origins of pain are described in many studies: issues concerning roles of chemical stimuli, autoimmune complexes, etc. are debated.[4]

It is well known that in many cases weak correlation between results of radio examination and clinical symptoms is registered, i.e. in patients with marked degenerative-dystrophic damages no clinical presentations are registered, at the same time in patients with severe clinical symptoms radiologist detects minor signs of vertebral region degeneration only.

Scientific progress provided therapist with high-precision methods of spine examination, such as computed tomography (CT).

Some people believe that routine methods of spine radio research, such as radiography, myelography and discography became things of the past and represents historical interest only. Sometimes clinician has no exact idea for what kind of examination low-back pain patient should be subjected to.

There is an opinion that computed tomography replaces all other diagnostic methods and must be applied as the only diagnostics method, but it is not true. Three-dimensional NLS-graphy method,[7,8] introduced in recent years, with its usability and low price, in many cases is more informative and, in general, more available than computed tomography. Objective of this study is to demonstrate potentials of both methods in diagnostics of spine degenerative-dystrophic damages.

Investigation of patients with degenerative-dystrophic diseases of intervertebral discs should start with radiology examination of damaged part of spine with functional (dynamic) test. According to its results, the therapist chooses further tactics of patient examination. Radiography of spine may detect conditions related to pathological changes of mainly bone structures of spine and, which is more important, to detect instability of spine, as evidenced by more than 4 – 5 mm forward or backward dislocation of vertebra .[3,5]

Concerning such invasive research method as myelography: with available modern CT and NLS equipment practicability of myelography application may be considered only for examination of patients with spinal stenosis combined with scoliosis.[5]

CT provides required information about topographic and anatomical relations in spinal segment, specifies the charecter of bone tissue pathological damages and visualises the vertebral canal and paravertebral area structures. CT has high sensitivity in detection of protrusions and vertebral hernia, allowing us to specify their localisation and degree of volumetric damage. In the first place CT

is prescribed in cases when according to radiology reason of pain syndrome is, probably changes of in the bone structure of vertebrae like osteophytes, stenosis of vertebral canal, dysplasia, development abnormalities, spondylolisthesis, spondylolysis, spondylarthrosis and tumors.

Taking into consideration radio stress, CT examination is usually limited by two intervertebral discs, where radicular syndrome is detected clinically.

Nowadays, in our opinion, the most accurate method of degenerative damages diagnostics is 3D NLS-scanning together with spectral-entropy analysis (SEA) of cartilaginous and bone tissue in affection area.

Thanks to high resolution of NLS-equipment, this method not only reveals morphological damages, but also provides information about degree of changes in degenerating discs.[10]

Degeneration of intervertebral disc results in its tissue dehydration, which leads to gradual constriction of disc space and increasing of signal chromogeneity at images. The latter is related to changes in proteoglycan structure of intervertebral disc; but it is not caused by absolute changing of water content. Loss of water by disc results in a decrease in disc height and elimination of border between nucleus pulposus and fibrous ring.

Together with the increasing degeneration, small fissures filled with liquid appear. They are detected as linear areas of high hyperchromeity (5 – 6 points according to Fleindler's scale). Later on in degenerating discs calcipexis may happen.

We can single out (without protrusion place topics):

1. Disc protrusion – displaced disc (nucleus pulposus)stretches fibrous ring, in its outer part micro fissures appear, but not perforating it.

2. Disc prolapse – parts of disc perforate fibrous ring and come out to epidural cavity;

3. Disc sequestrum – substance of nucleus pulposus migrates above or below disc level.

Typical changes of bone-marrow tissue NLS-picture in adjacent to degenerative discs parts of vertebras can be divided into three types for convenience: vascular, fatty and sclerotic. Due to this fact in majority of cases adequate amount of research includes the following examinations: two-dimensional scanning of damaged disc in sagittal projection and axial projection at the level of detected changes. Application of three-dimensional scanning method is practical to emphasise closing plates in order to detect their erosion and condition bone-marrow tissue.

Application of NLS-microscanning is important for evaluation of deformation degree and constriction of dural sac, condition of dural funnels in order to detect their deformation and dislocation.

Taking into account non-invasive character and absence of ionising radiation, NLS-method may be used for dynamic monitoring of post-operative changes. To distinguish recurrent disc hernia from post-operative scar we use spectral-entropy analysis. Mature scar tissue has its specific specter differing from disc tissue, which can be perfectly seen at SEA.[9]

We developed single treatment and diagnostics algorithm of lumbodynia patients management.We present following results of two patients examination as an example of combined application of NLS-methods, which allowed us to diagnose accurately and choose correct tactics of treatment.

Patient B., performed NLS-examination of lumbosacral spine segment detected osteophyte of S1 vertebra together with marked degenerative-dystrophic damage of discs and sequestrum at L5 vertebra body level; it was confirmed by SEA and further on resulted in correction of operative intervention tactics.

Patient G., NLS-microscanning registered, besides L5 – S1 disc prolapse, areas of hyperchromic (6 points) NLS-signal in epidural cavity. Three-dimensional NLS-graphy with SEA confirmed destruction of nucleus pulposus in this area.

Therefore, patient suffering from spondylogenic pain syndrome should be subjected, first of all, to radiology examination of spine with functional tests. In cases when there is clinical picture of irritation or spine neural structures compression and radiography did not register significant deformation of vertebras bone elements, it is recommended to carry out NLS-microscanning of damaged area with SEA.

Optimal algorithm of patients with degenerative-dystrophic diseases of spine examination makes possible not only to decrease material expenses of a healing institution and a patient, but also to optimise diagnostics process which promotes increasing of patients treatment quality.

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