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X-ray capabilities in the diagnosis of lumbar stenosis of the spine

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Abstract: This article describes the X-ray capabilities in the diagnosis of lumbar stenosis of the spine which is an anatomical and pathological condition involving narrowing of the spinal canal of the lumbar spine or one or more lumbar foraminal openings. The vital method of examination is X-ray which is usually the first step to detect a degenerative process, and in this article the authors try to maximize the capabilities of diagnosis of a degenerative process like lumbar stenosis of the spine.

Keywords: Lumbar Stenosis, Intervertebral Disc, Depression, X-Ray, Vessels, Spinal Canal.

Introduction

Lumbar stenosis of the spine (LSOS) - is an anatomical and pathological condition involving narrowing of the spinal canal (central stenosis) of the lumbar spine or one or more lumbar foraminal openings (foraminal/lateral stenosis).

The human spinal cord has 33 segments and 5 lumbar segments, which form 5 pairs of spinal nerves. In LSOS, the following structures of the spine are most often involved in the pathological process. Intervertebral disc, between each pair of vertebrae, with the exception of the first cervical segment, the atlas, there is one intervertebral disc. Its central part is called the nucleus pulposus. This nucleus is surrounded by an annulus fibrosus (peripheral part), which contains several layers of fibrocartilage. The intervertebral disc functions as a shock absorber. Facet joints. These are synovial joints located on the back side of the main part of the spine. Each such joint is formed by the superior articular process of the underlying vertebra and the inferior articular process of the overlying vertebra. The facet joints connect the vertebrae to each other and provide backward movement.

The foramina are openings between the vertebrae through which the spinal nerves exit the spine and travel to various parts of the body.

Ligaments. Fibrous ribbons of connective tissue that connect two or more bones and help stabilize joints. They support the spine, preventing the vertebrae from slipping out of line as it moves. A major ligament often involved in LSOS is the ligamentum flavum, which is located between the vertebral arches.

Spinal cord and nerve roots. Throughout the spine there is a spinal canal in which lies the spinal cord, which is a long, thin, tubular bundle of nervous tissue. The spinal cord is part of the central nervous system, providing a link between the brain and the rest of the body.

Ponytail. A bundle of nerve roots that begins at the level of the lumbar region, where the spinal cord ends, and continues down to provide neurological function to the lower body. Thus, the spinal canal is a cavity inside the spinal column, in which the spinal cord is located with the corresponding nerve roots and blood vessels. Subject to variation, the spinal cord occupies the upper two-thirds of the spinal canal and ends approximately in the middle of the L1 vertebral body.

Epidemiology

The prevalence of relative and absolute LSOS increases from 16.0% to 38.8%, respectively, and from 4.0% to 14.3%, between ages <40 years and 60+ years, respectively. If we take a closer look at the 60-69 year old group, the prevalence of acquired stenosis increases with age to a relative 47.2% and an absolute 19.4% (Costandi, 2015; Kalichman, 2009). It is a serious problem in the elderly, manifested by pain, disability, risk of falls and depression. The incidence of this pathology increases significantly in people over 50 years of age and varies from 1.8 to 8%. Signs of LSS are observed in 80% of patients aged 70 years and are recorded annually with a frequency of ≥ 5–11.5 cases per 100 thousand population. For example, according to the national register of Sweden, the average annual level of neurosurgical interventions for LLS increased from

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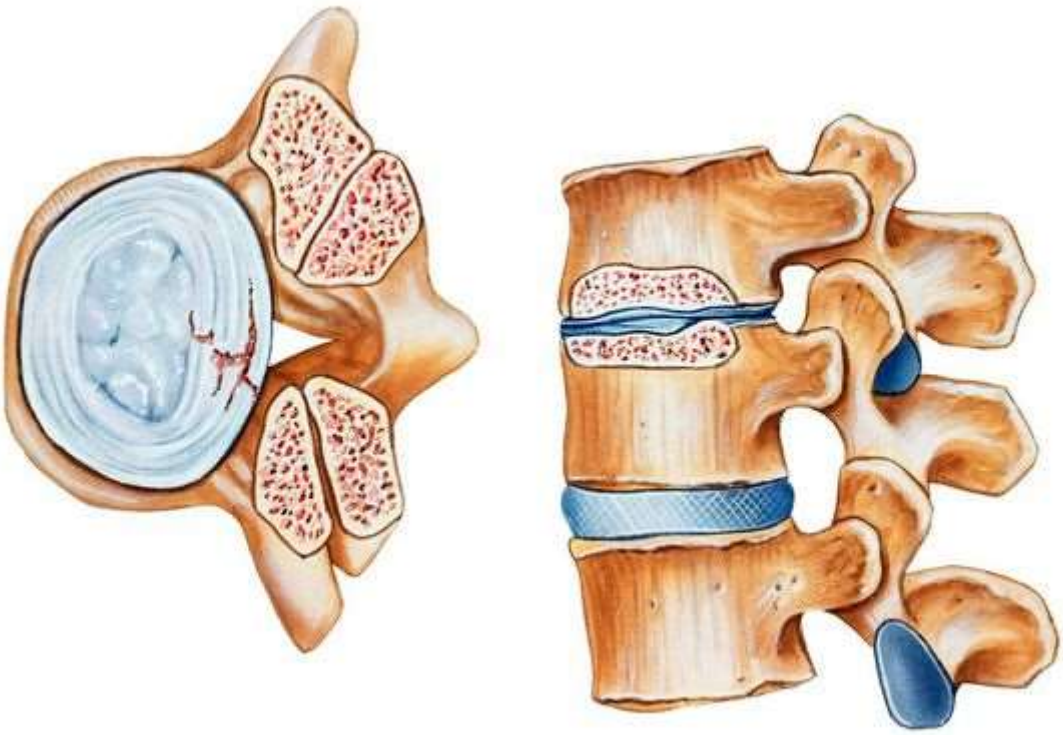
10–15 per 100,000 inhabitants in 2003 to 30–35 per 100,000 in 2013. It is worth noting that there is still no clear understanding in approaches to the treatment of this pathology, as evidenced by at least the presence of several groups of specialists (neurosurgeons, orthopedic traumatologists, chiropractors, neurologists, physiotherapists, osteopaths, etc.) who have opposite views on the choice of LSS treatment methods.



Classification of LSS. According to anatomical criteria: central stenosis is a decrease in length from the posterior longitudinal ligament to the nearest opposite point on the arc at the base of the spinous process. lateral stenosis - narrowing of the radicular canal and intervertebral foramen to ≤ 4 mm. Central stenosis occurs due to pathological processes in the structures that form the intervertebral disc (IVD), vertebral body (TA), facet joint, yellow and posterior longitudinal ligament. Lateral stenosis is detected in one or more of the 3 anatomical regions of the root canal - in the entry zone (lateral recess), the middle zone and the exit zone (intervertebral foramen). The lateral depression (recessus) is formed posteriorly by the superior articular process, medially by the dural sac, laterally by the pedicle of the TP, caudally by the TP, and anteriorly by the IVD. Normally, the height of the lateral recess is 5 mm.

History and symptoms.

About 20–33% of older people have asymptomatic LSS, which is confirmed only by instrumental examination data. LSS is most commonly seen at L4–5, followed by L3–4, L2–3, and least frequently at L5–S1 and L1–2. The syndrome of neurogenic intermittent claudication is caused by chronic compression of the neural and vascular structures of the canal. Due to chronic compression, the volume of blood supply to the neural structures does not meet their needs.

The amount of incoming blood decreases, and ischemia of the root (with lateral stenosis) or cauda equina (with central) develops. Complaints of pain, numbness and weakness in the legs with LSS occur when walking. The pathogenesis of this syndrome is determined by the fact that at the moment of walking, the blood filling of the epidural veins increases, which leads to additional compression of the neural structures in the lumbar spine. Patients with LSS try to assume a sitting position, which flattens the lordosis in the lumbar spine or causes kyphosis. This increases the lumen of the PC and foraminal openings, which contributes to the restoration of normal blood flow. With flexion, the height of the foraminal opening increases by 12%, with

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extension it decreases by 15%. Since one of the causes of LSS is arthrosis of the DOS, patients may present complaints specific to the facet syndrome, namely, drawing pains in the area of the affected DOS, aggravated in the morning, when moving (in the lumbar spine) or for a long stay in a horizontal position, during rotation, extension, and decreasing after a warm-up. Due to spondylarthrosis, pain can radiate to the hips, buttocks and groin. LSS can develop against the background of PDS instability. In addition to pain, typical symptoms of LSS include neurogenic intermittent claudication, symptoms of lumbar root tension, sensory disturbances, etc.

Various variants of lateral stenosis are manifested mainly by pain monoradicular syndrome. Pain in lateral stenosis has a lesser tendency to decrease in the prone position (curled up) or sitting (squatting with the body tilted forward), does not increase with coughing and sneezing, pain in the lumbar spine is less pronounced, symptoms of Lasegue and Wasserman are not characteristic . The pain is permanent and rarely recurs. For IVD hernia, pain intensification is characteristic in the sitting position, they have a more acute onset and are aggravated by the Lasegue and Wasserman tests. Instability in the PDS is one of the most common pathologies of the spine. A.I. Sold et al. use the term "dynamic LSS", ie. narrowing of the PC with PDS instability and balloting IVD hernia, which leads to the corresponding clinical symptoms in the standing position.

Material & methods

X-ray is usually the first step to detect a degenerative process (disc degeneration, osteophytes, facet joint hypertrophy). It is also useful for assessing curvature, disc height loss, and osteophyte formation. In oblique views, a defect in the interarticular ligament can be detected, and in dynamic views, instability. Instability is confirmed if, on examination, a displacement of more than 5 mm or rotation of more than 10-15 degrees is detected. A change in the normal geometry of the disc, widening posteriorly and narrowing anteriorly, may also indicate instability. The diagnosis of spinal stenosis can be made by detecting bony narrowing, obliteration of epidural fat, and spinal deformity on x-ray (Lee, 2015). Some other features of POIS include narrowing of the intervertebral foramen and intervertebral disc space, facet joint hypertrophy, short pedicles, thick lamina, and deep posterior concavity of the vertebral bodies. According to radiography, quantitative (frontal and sagittal PC dimensions) and qualitative (changes in lumbar lordosis, presence of scoliosis, developmental anomalies, changes in IVD height and other pathological changes in TP) indicators are evaluated.
Visualization: 1. General characteristics: The most significant diagnostic sign: o The shape of the spinal canal of the lumbar spine in the form of a trefoil on axial images • Localization: o The most common localization is the lower lumbar spine, where the mobility of the vertebrae is greatest (L4-L5) • Dimensions: o Sagittal diameter of the bony spinal canal of the lumbar spine < 12 mm is considered a relative stenosis o Sagittal diameter of the bony spinal canal of the lumbar spine < 10 mm is considered an absolute stenosis • Morphology: canal of the lumbar spine on axial images. X-ray data of acquired central stenosis of the lumbar spine: Radiography: Reducing the height of the interbody spaces, osteophytes, Osteoarthritis of the facet joints, spondylosis, spondylolisthesis, When combined with congenital stenosis of the spine - a decrease in interpedicular intervals.

Results

25 studies reporting on radiological signs of LSS and four systematic reviews related to the evaluation of different treatments were found. Ten different parameters were identified to quantify lumbar spinal stenosis. Most often reported measures for central stenosis were antero-posterior diameter (< 10 mm) and cross-sectional area (< 70 mm(2)) of spinal canal. For lateral stenosis height and depth of the lateral recess, and for foraminal stenosis the foraminal diameter were typically used. Only four of 63 primary studies included in the systematic reviews reported on quantitative measures for defining inclusion criteria of patients in prognostic studies.

Conclusions

There is a need for consensus on well-defined, unambiguous radiological criteria to define lumbar spinal stenosis in order to improve diagnostic accuracy and to formulate reliable inclusion criteria for clinical studies.

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