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# Histopathological Features of Lumbar Disc Protrusion: Clinical Findings

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**ABSTRACT**

*Lumbar disc protrusion, the main symptom of low back pain and leg pain, is disease that is highly prevalent in the 30s to 40s, causes temporary disability and causes pain to patients if not treated in time. The type and classification of lumbar disc protrusion is often based on the location and type of protrusion based on MRI or radiographic images. Currently, there is growing body of research to classify disc prolapse into four types of tissue types : damage-herniation type, degenerative-protrusion type, osteochondrosis with disc protrusion type and intervertebral disc cysts, to assess disease status according to each histotype and to provide concurrent treatment. We aimed to investigate the clinical features of lumbar disc protrusion according to the histopathological pattern. The study population included 96 patients (54 men and 42 women) who were diagnosed with lumbar disc protrusion and treated surgically for 3 years. H-E staining was prepared according to the conventional tissue preparation method using surgical excised male nucleus and fibrous annulus under the diagnosis of lumbar disc protrusion. In the vertebral pulp-fibrous ring, degeneration, destruction, thickening and sclerosis indices, the appearance cells were observed for inflammatory cells, chondroid crypt cells, mature bone cells and synovial epithelial cells. The incidence of histological type was 29.1% with the type of damage-herniation type, 52.0% with degenerative-protrusion type, 15.6% with osteochondrosis with disc protrusion type and 3.1% with degenerative-protrusion type. The incidence of lumbar disc protrusion was calculated according to the histopathological pattern of the patients' subjective symptoms and electromyographic findings and significance tests were performed for each histological type. The clinical features of lumbar disc protrusion are as follows : Subjective symptoms included low back pain disconnected in the damage-herniation type, lumbar lordosis and severe muscle atrophy in the degenerative-protrusion type and heavy back pain and neurogenic claudication in the osteochondrosis with disc protrusion type. Electromyography showed high H-wave elevation in the form of damage-herniation type, moderate conduction velocity delay and H-wave loss in the degenerative-protrusion type and severe conduction velocity delay.*

**Keywords:** ***Lumbar disc protrusion*.**

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## INTRODUCTION

Lumbar disc protrusion, the main symptom of low back pain and leg pain is a disease that is highly prevalent in the 30s to 40s, causes temporary disability and causes pain to patients if not treated in time[1,4,10]. The pathogenesis of disc protrusion can be divided into two broad categories known as endogenous(genetic, developmental and degenerative) and exogenous (stress, nutrition, fatigue, trauma, etc.). The type and classification of lumbar disc protrusion is often based on the location and type of protrusion based on MRI or radiographic images[3,7,8]. However, the pattern of prolapse is not always consistent with clinical signs and is closely related to variety of pathological changes. Therefore, the combination of histological changes and imaging of the disc in lumbar disc protrusion and postoperative histopathology of the disc is used to classify lumbar disc protrusion as


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histological type. Currently, there is growing body of research to classify disc prolapse into four types of tissue types: Damage-herniation type, degenerative-protrusion type, osteochondrosis with disc protrusion type and intervertebral disc cysts, to assess disease status according to each histotype and to provide concurrent treatment[2,9].

The pattern of Damage-herniation type was revealed by the destruction of the normal structure of the fibrous ring and the nucleus of the medulla under light microscope with local infiltration of loose fibers, damaged tissues, inflammatory cells and angiogenic factors. In normal staining, inflammatory cells including angiogenesis are infiltrated and inflammatory responses are evident. In the microscopic examination of the degenerative-protrusion type, the structure of the male nucleus and the fibrous annulus is relatively less damaging. The medullary component is low and compact and the fibrous ring is thickened, dense and disordered and cartilaginous crypt cells and collagen fibers are seen.

In the osteochondrosis with disc protrusion type, light microscopy shows peri-angiogenesis and formation of granulation tissue and degeneration of fibrocartilage matrix within the prolapsed disc tissue. In the prolapsed cartilage proliferation, we can see the mature lamina bone formed by the histologically prolapsed male nucleus, fibrous annulus, cartilaginous terminal plate and epiphyseal ring. The intervertebral disc cysts pattern was composed of dense fibrous connective tissue with hemocyte and mucus degeneration in the disc wall but no cell arrangement, disc tissue, nerve tissue, tumor tissue, angiogenesis and cell infiltration were observed. The cyst contains clear fluid of blood or serum-like appearance and its walls are connected to adjacent tissues.
The wall of the disc capsule contains disc tissue such as cartilage[5,6].
If the different clinical manifestations of lumbar disc protrusion predict its preoperative histopathology, appropriate preoperative surgery and treatment can be established.
We aimed to investigate the clinical features of lumbar disc protrusion according to the histopathological pattern.

## SUBJECTS AND METHODS

The study population included 96 patients (54 men and 42 women) who were diagnosed with lumbar disc protrusion and treated surgically for 3 years at the Department of Neurosurgery and Orthopedic Surgery of Pyongyang University Hospital of Medical Sciences with median age of 45.4 years and male to female ratio of 1.3:1 with 43.7% in all men and women being 40 years. H-E staining was prepared according to the conventional tissue preparation method using surgical excised male nucleus and fibrous annulus under the diagnosis of lumbar disc protrusion.

In the vertebral pulp-fibrous ring, degeneration, destruction, thickening and sclerosis indices, the appearance cells were observed for inflammatory cells, chondroid crypt cells, mature bone cells and synovial epithelial cells. The clinical and pathological diagnosis and diagnosis of disc protrusion were made according to clinicopathological diagnosis and treatment guidelines published by the Ministry of Public Health, DPRK.

Histopathologically, there was destruction of the medullary-fibrous ring and appearance of inflammatory cells in the damage-herniation type, degeneration of the medullary-fibrous ring and chondroid crypt cell appearance in the degenerative-protrusion type, sclerosis of the medullary-fibrous ring and appearance of mature osteocytes in the osteochondrosis with disc protrusion type, thickening of the medullary-fibrous ring and appearance of the bursal epithelial cells in the intervertebral disc cysts. The incidence of histological type was 29.1% with damage-herniation type, 52.0% with degenerative-protrusion type, 15.6% with osteochondrosis with disc protrusion type and 3.1% with intervertebral disc cysts.

The incidence of lumbar disc protrusion was calculated according to the histopathological pattern of the patients' subjective symptoms and electromyographic findings and significance tests were performed for each histological type.

Significance tests were performed by Student's t-test for the mean of the study results and by Chi-square test for the percentage of the study results.

 

## RESULTS

**Table 1: Differences in histological types of lumbar disc protrusion according to clinical parameters**

| Clinical parameters | | Damage-herniation Type N=28 | Degenerative-protrusion Type N=50 | Osteochondrosis with Disc Protrusion Type N=15 | Intervertebral Disc Cysts N=3 |
|---|---|---|---|---|---|
| Back pain | A Sense Of Cuckoo | 2(7.1) | 29*(58.0) | 3(20.0) | 1(33.3) |
| | Sense Of Break | 20*(71.4) | 12(24.0) | 1(6.6) | 1(33.3) |
| | Sense Of Negligence | 2(7.1) | 6(12.0) | 8*(53.3) | 1(33.3) |
| | Fire Sensation | 4(14.2) | 3(6.0) | 3(20.0) | - |
| Leg pain | A Tingling Sensation | 7(25.0) | 9(18.0) | 11*(73.7) | 1(33.3) |
| | Low Sensation | 11(39.2) | 36*(72.0) | 7(46.6) | 2(66.6) |
| | A Sense Of Bursting | 19*(67.8) | 23(46.0) | 5(33.3) | 1(33.3) |
| Gait | Leg Clipper | 23*(82.1) | 34*(68.0) | 4(26.6) | 2(66.6) |
| | Neurogenic Claudication | 5(17.8) | 16(32.0) | 11*(73.3) | 1(33.3) |
| Lumber property | Lumber Curvature | 4(14.2) | 42*(84.0) | 10*(66.6) | 1(33.3) |
| | Physiological Curvature Loss | 6(21.4) | 36*(72.0) | 6(40.0) | 1(33.3) |
| | Lumbar Dorsal Muscle Tension | 26*(92.8) | 37*(74.0) | 3(20.0) | 1(33.3) |
| tenderness | Spinous Process | 19*(67.8) | 25(50.0) | 3(20.0) | 2(66.6) |
| | Piriform Root | 11(39.2) | 31*(62.0) | 4(26.6) | 1(33.3) |
| | Paravertebral Region | 5(17.8) | 10(20.0) | 10*(66.6) | 1(33.3) |
| Neuromuscular examination | Lasegue's Sign | 27*(96.4) | 40*(80.0) | 9(60.0) | 2(66.6) |
| | Neri's Sign | 24(85.7) | 35(70.0) | 12*(80.0) | 1(33.3) |
| | Dejerin's Sign | 14(50.0) | 29(58.0) | 6(40.0) | 2(66.6) |
| Tendon reflex disorder | Patellar Tendon Reflex Depression | 1(3.5) | 17(34.0) | 2(13.3) | - |
| | Calcaneal Tendon Reflex | 4(14.2) | 18(36.0) | 5(33.3) | 1(33.3) |

| Clinical parameters | | Damage-herniation Type N=28 | Degenerative-protrusion Type N=50 | Osteochondrosis with Disc Protrusion Type N=15 | Intervertebral Disc Cysts N=3 |
|---|---|---|---|---|---|
| | Depression | | | | |
| | No Depression | 23*(82.1) | 15(32.0) | 8(53.3) | 2(66.6) |
| Muscle strength disorder | Hypoflexor Of Halluces Longus | 8(28.5) | 31*(72.0) | 9(60.0) | 1(33.3) |
| | Hypoextensor Of Halluces Longus | 4(14.2) | 7(14.0) | 3(20.0) | 1(33.3) |
| | No Degradation | 16*(57.1) | 12(24.0) | 3(20.0) | 1(33.3) |
| Muscle atrophy | Mild | 19*(67.8) | 17(34.0) | 6(40.0) | 2(66.6) |
| | Severe | 9(32.1) | 33*(66.0) | 9(60.0) | 1(33.3) |
| H wave | Elimination | 6(21.4) | 33*(66.0) | 3(20.0) | 1(33.3) |
| | Hypo | 7(25.0) | 15(30.0) | 11*(73.3) | 2(66.6) |
| | Hyper | 15*(53.5) | 2(4.0) | 1(6.6) | - |
| Conduction veloicity | Mild Delay | 7(25.0) | 6(12.0) | 2(13.3) | 1(33.3) |
| | Moderate Delay | 17*(60.7) | 11(22.0) | 3(20.0) | 1(33.3) |
| | Severe Delay | 4(14.2) | 33*(66.0) | 10*(66.6) | 1(33.3) |

***():%, *:P<0.05 (compared with histotype).***

As shown in the table, there were significant reductions in lumbar disc protrusion such as disconnected lumbar back pain, broken leg pain, leg limbs, bradystonia, psoas tenderness, spinal tenderness, Lasegue's sign, mild muscle atrophy, hyper-H wave, moderate degree delay, wide back pain in the degenerative-protrusion pattern, low leg pain, leg rest, lumbar curvature and physiological curvature loss and decreased muscle pressure, and decreased muscle flexion, and decreased muscle flexion, and decreased muscle flexion, and decreased muscle flexion, and decreased abdominal flexion.

In the osteochondrosis with disc protrusion type, there were significantly more painful back pain, swelling leg pain, neurogenic claudication, lumbar scoliosis, paravertebral tenderness, Neri's sign, H wave depression, and severe delay in conduction velocity.

## DISCUSSION

We evaluated the incidence of symptoms of autonomic involvement and the presence of EMG parameters according to the histopathological pattern of lumbar disc protrusion. According to the literature, lumbar disc protrusion is the main symptom of low back pain and leg pain with varying characteristics in low back pain. The results of the low back pain syndrome showed 54% cuckoo, 11% low-pitched, 18% cut-off, and 21% silent. We found that lumbar pain according to histological pattern in lumbar disc protrusion was significantly more likely to be degenerative protrusion type( 58.0%), broken wound protrusion type(71.4%), and non-direct cartilaginous protrusion( 53.3%).

The different patterns of lumbar pain in lumbar disc protrusion are thought to be due to the different individual responses of the degenerated disc, local inflammatory response at the interface of the nerve root and the immune response of the body. According to the literature, leg pain is more severe when walking, standing, changing posture, and when lying down and stretching the leg, the rate of pain-related characteristics is 39% and 45% of numbness.

Our findings showed that the incidence of leg pain according to histotype in lumbar disc protrusion was significantly higher in the form of achondroplasia (73.7%), hypophoric

 

degenerative-protrusion (72.0%) and burst-wound damage-herniation (67.8%). According to the literature, leg pain gait disturbances are present in 58% of lumbar disc protrusions and neuronal claudication is present in 80% of cases complicated by spinal canal stenosis. In our study, the incidence of gait changes according to histotype in lumbar disc protrusion was significantly higher in the injury-prone and degenerative-protrusion types (82.1% and 68.0%, individually), and neuronal claudication in the osteochondrosis with disc protrusion type (73.3%).

According to the literature, the physiological lordosis of the lumbar spine is reduced or disappeared in lumbar disc prolapse, and the more lumbar lordosis is, the more the degree of disc prolapse increases, the more neuromuscular stimulation is, the patient will flex his lumbar spine spontaneously to reduce pain and reduce lumbar lordosis. The lumbar side is also the patient's defensive posture to relieve pain. The direction of the lateral curvature varies depending on whether the herniated ridge is inside or outside the nerve root. If the ridge is inside the nerve root, only the contralateral side is present, whereas if it is outside the nerve root, only the ipsilateral side is present. Physiological ankylosis loss was found to be 28.4%, lumbar only 44.1% and lumbar dorsal muscle tenderness 84%.

In our study, the incidence of lumbar status changes according to histotype in lumbar disc protrusion was significantly higher in the lumbar side with cartilage prolapse(66.6%), with physiological lordosis degenerative-protrusion type (72.0%), and with lumbar dorsal muscle tension in the form of damage-herniation type and degenerative-protrusion type (92.8% and 74.0%, individually).

The predominance of lumbar dorsal muscle tension in the form of damage-herniation type in lumbar disc protrusion is likely due to the relatively long duration of disease compared to other histotypes. According to the literature, lumbar gluteal tenderness is a typical symptom of lumbar disc protrusion, often with a spinal and interspinous tenderness of 70%, paravertebral tenderness of 45%, and piriformis tenderness of 36%.

The evidence suggests that the cause of tenderness is hyperintense innervation of the muscles of the nerve by stimulation of the segmental nerve, which is secondary to the initial and adherent regions of the muscle, and this is again a primary pathological stimulus.

Our results showed that the presence of tenderness index in lumbar disc protrusion was significantly greater in the form of damage-herniation type(67.8%), degenerative-protrusion type (62.0%) in the piriform muscle and osteochondrosis with disc protrusion type (66.6%) in the paravertebral region. According to the literature, positive Lasegue's test in lumbar disc protrusion was found in 78% and positive Neri's sign in 48%, which is neuromuscular irritation symptom due to the increased hip angle and the downward stretching of the nerve root in the lower lumbar spine during the examination.

In our series of neuromuscular parameters according to histological type in lumbar disc protrusion, Lasegue's syndrome was significantly more likely to be damage-herniation and degenerative-protrusion type (96.4% and 80.0%, individually). According to the literature, musculotendinous reflex dysfunction in lumbar disc protrusion is present in 33.4% of cases, and abnormal patellar reflex is observed in the segments of L2-L3 and L3-L4, sometimes in the compression of the L4-L5 nerve roots. It is also known that the impairment of the musculotendon reflex occurs when the S1 nerve root is impaired between L5 and S1.

Our findings showed that the incidence of dystonia in lumbar disc protrusion was significantly higher in the degenerative-protrusion group, with a reduction in patellar tendon reflex and a reduction in calcaneal tendon reflex (34.0% and 36.0%, individually).Given the prevalence of low patellar tendon reflexes and low calcaneal tendon reflexes in the form of degenerative-protrusion type, a history of lumbar disc protrusion is likely to be more severe in the setting of more chronic course. According to the literature, the muscular strength of the innervated nerve root is impaired by prolapse of the nucleus, and the dystonia of the dorsal and hypoflexion of the pollicis is associated with a higher rate of disease progression, and higher level of stimulation of the corresponding nerve root.

We found that the incidence of muscle weakness according to the histotype in lumbar disc protrusion was significantly higher in the degenerative-protrusion type(72.0%) in the low dorsal flexion of the pollicis longus and in the absence of depression(57.1%). The literature shows that in patients diagnosed with lumbar disc protrusion, the incidence of lower limb muscle atrophy is 24% with median duration of 15 months, and the incidence rate reaches 58% with duration of 2 years or more.

Our findings showed that the incidence of lower limb muscle atrophy in lumbar disc protrusion was significantly higher in the form of mild damage-herniation type (67.8%) and severe degenerative-protrusion type compared to the form of damage-herniation type . According to the literature, electrophysiological examination of patients diagnosed with lumbar disc protrusion showed positive H-wave test with loss, reduction, or hypersensitivity of H-wave reflex of 97.1%.

We found that the incidence of H-wave changes in lumbar disc protrusion according to histotype was significantly higher in degenerative-protrusion type (53.5%), decreased osteochondrosis with disc protrusion type (73.3%), and hyperactivity in the form of damage-herniation type (53.5%). According to the literature, high rate of positive results due to delayed nerve conduction velocity on EMG in lumbar disc protrusion is obtained at high rate of 98.7%. We found that the incidence of change in conduction velocity with histotype in lumbar disc protrusion was significantly higher in the form of lesion prolapse(60.7%), severe prolapse in the form of degenerative-protrusion type and osteochondrosis with disc protrusion type (66.0% and 66.6%, individually).

## CONCLUSION

The clinical features of lumbar disc protrusion are as follows :

1) Subjective symptoms included low back pain disconnected in the damage-herniation type, lumbar lordosis and severe muscle atrophy in the degenerative-protrusion type, and heavy back pain and neurogenic claudication in the osteochondrosis with disc protrusion type.

2) Electromyography showed high H-wave elevation in the form of damage-herniation type, moderate conduction velocity delay, and H-wave loss in the degenerative-protrusion type, and severe conduction velocity delay.

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