

Analysis of lumbar disc degeneration: 82 cases

Huseyin Ozevren¹, Abdurrahman Cetin², Murat Baloglu³

¹Dicle University, Faculty of Medicine, Department of Neurosurgery, Diyarbakir, Turkey

²HSU Gaziyasargil Training and Research Hospital, Department of Neurosurgery, Diyarbakir, Turkey

³HSU Gaziyasargil Training and Research Hospital, Department of Physical Medicine and Rehabilitation, Diyarbakir, Turkey

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Abstract

Aim: The purpose of this study was to investigate if the grade of lumbar disc degeneration. Intervertebral disc degeneration is a common degenerative disease.

Material and Methods: A retrospective analysis on 34 males and 48 females with intervertebral discs degeneration and a mean age of 51.5 years. Using MRI, the grade of lumbar intervertebral discs degeneration was assessed according to the Pfirrmann classification.

Results: There was a high correlation ($R = 0.385$) and significant association (pearson correlation, $p < 0.01$) between L3/L4 disc degeneration and the aging. There was also a high correlation ($R = 0.56$) and significant association (pearson correlation, $p < 0.001$) between the L3/L4 disc degeneration and the L4/L5.

Conclusion: For many years, excessive or abnormal mechanical load was thought to be the main cause of disk degeneration. Rates of aging and lumbar disc degeneration have gradually increased over the years. It is important to note that there is a significant relationship between aging and L3 / L4 disc degeneration and that L4 / L5 disc degeneration may also be present in patients with L3 / L4 disc degeneration.

Keywords: Intervertebral disc degeneration; magnetic resonance imaging; Pfirrmann classification

INTRODUCTION

Lumbar disc degeneration (LDD) is caused by many factors and has various consequences. Changes in the vertebral endplate disrupt the feeding of the disc, causing degeneration. Aging, apoptosis, collagen abnormalities, changes in vascular structure, disc overload and abnormal proteoglycan production are other factors contributing to disc degeneration. After degeneration, reduction of height of the movement segment occurs. The exact pathophysiology of LDD is not fully understood, but it often starts at a quite young age with a disequilibrium in the interplay of biomechanics, cell behavior, and extracellular matrix, ending up in a cascade of degeneration (1). Multiple initiating factors have been identified that can force the intervertebral disc into the poor cycle of degeneration, like mechanical overloading by heavy physical loading or systemic inflammatory disorders (2, 3).

The etiology and pathophysiology of lumbar disc degeneration is still controversial. It is believed to arise as a result of the interaction of biomechanical factors. Although

it is not known exactly what the initiating factors are, the decrease in aggregate, which is the main proteoglycan of the nucleus pulposus is known to be characteristic of the early stage of the disease (4). Decrease in proteoglycan content biochemically means disruption of normal anabolic and catabolic functions in nucleus pulposus cells, decreased synthesis or increased destruction. The gradual decrease in proteoglycan content leads to dehydration, which causes deterioration of hydrostatic and biochemical properties (4). LDD is clinically characterized by radiological findings, the decreased signal intensity of magnetic resonance imaging (MRI), T2-weighted imaging (5), and disc height depressing (6). LDD is thought to result from micro-environmental changes affected by multiple contributing factors, including aging, gender, predisposing injury, genetics, and environment (7, 8).

As aging and skeletal maturation are completed, the connections between NP (nucleus pulposus) and AF (annulus fibrosus) begin to loosen and the nucleus gradually becomes fibrotic and stiff. Over time, annular lamellae become irregular, disintegrate, collagen and

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Corresponding Author: Abdurrahman Cetin, HSU Gaziyasargil Training and Research Hospital, Department of Neurosurgery, Diyarbakir, Turkey E-mail: acetin2147@gmail.com

elastin connections break down. Tears extending towards the nucleus, cell clusters within the nucleus and necrotic cells are detected (9).

Rates of aging and lumbar disc degeneration have gradually increased over the years. It is important to note that there is a significant relationship between aging and lumbar disc degeneration.

In literature, the correlation between aging and lumbar disc degeneration or effect of degeneration on each disc, and Pfirrmann grade research study are not sufficient. Therefore, we aimed to investigate lumbar disc degeneration and its relationship with each other.

MATERIAL and METHODS

Between February 2015 and December 2018, lumbar degenerative disc disease was obtained from 82 patients. It consists of 34 men and 48 women. Routine MRI scans of the lumbar spine were taken for each patient, and the degree of disc degeneration was graded based on the T2-weighted images using the Pfirrmann classification (5) (Figure 1). Lumbar spine MRI was performed using the same protocol on a 1.5-T MRI superconducting imaging system (Siemens, Avanto, Germany). All individuals were scanned by the same MRI scanner, but excluded from this study if they had metabolic bone disease, surgery, trauma, osteoporosis, spondylolisthesis, or malignancy in the lumbar spine. Those with significant renal disease, major cardiovascular diseases, or morbid obesity, were also excluded.



Figure 1. The T2-weighted image using the Pfirrmann classification at Lumbar spine MRI of 35 years old male patient

The degenerated discs were assessed and the samples were subdivided into four groups (Grade II, III, IV, V) using the Pfirrmann grading system (5).

All statistical analyses were performed using SPSS 17.0 software (SPSS Inc), and the graphs were generated using the GraphPad Prism 5 Software (Graph Pad Software, Inc) and results were expressed as mean \pm standard deviation. Paired t tests, Student's t tests and Pearson's correlation tests were used to analyze the disc degeneration grade in patients. P values (two-tailed) <0.05 were considered to indicate statistical significance.

RESULTS

Between February 2015 and December 2018, lumbar degenerative disc disease was obtained from 82 patients (mean age: 51.49 ± 15.13 ; range: 19–85 years). It consists of 34 men (50.82 ± 15.55) and 48 women (51.96 ± 14.98). No statistically significant difference was found between men and women in terms of age ($p=0.74$) (Figure 2A). There was no statistically significant difference between females and males in terms of disc degeneration (Figure 2B) There was a high correlation ($R=0.385$) and significant association (pearson correlation, $p < 0.01$) between L3/L4 disc degeneration and the aging (Figure 2C). There was also a high correlation ($R=0.56$) and significant association (Pearson correlation, $p < 0.001$) between L3/L4 disc degeneration and L4/L5 (Figure 2D).

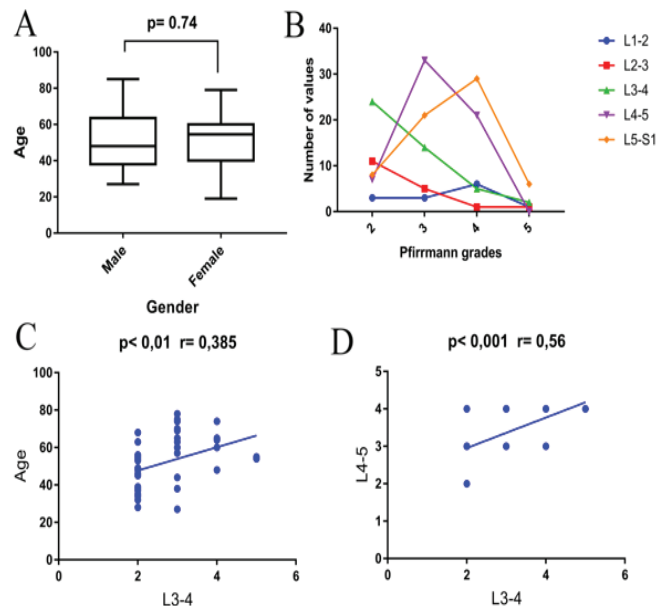


Figure 2. Comparison of the degeneration data of the disc (A). No statistically significant difference was found between men and women in terms of age ($p=0.74$), (B). No statistically significant difference between females and males in terms of disc degeneration. (C). High correlation ($R=0.385$) and significant association (pearson correlation, $p < 0.01$) between L3/L4 disc degeneration and the aging. (D). High correlation ($R=0.56$) and significant association (pearson correlation, $p < 0.001$) between L3/L4 disc degeneration and L4/L5

DISCUSSION

The etiology and pathophysiology of lumbar degenerative disc disease is still controversial and is believed to result from the interaction of biological and biomechanical factors. Although the exact initiator factors are not known, it is known that the decrease in aggregate, which is the main proteoglycan of the nucleus pulposus is characteristic of the early stage of the disease (4).

In addition, blood flow to the vertebral bodies of the lumbar spine is abundantly supplied by the lumbar arteries, branches of the abdominal aorta (10). However, the IVD (intervertebral disc) is an avascular structure, except for the outermost layer of the AF (11). Essential nutrients, such as oxygen and glucose, are supplied to the discs by capillaries that arise in the vertebral bodies and penetrate the subchondral bone (12). Due to decreased mobility or instability, mechanical and abnormal forces varying at a level are transmitted to neighboring segments and initiate degeneration there. Severe degeneration in a spinal movement segment reduces movement at this level. This leads to higher load on the upper and lower levels, leading to degenerative changes at each new level (13).

Cyron and Hutton (14) deduced that the AF on the side with greater coronal orientation may undergo a higher compressive load and increased rotational stress. Hence, the loading disequilibrium would accelerate the degeneration of the facet joints and intervertebral discs. (15).

As the degeneration process is highly correlated with aging, its pathologic changes occur starting from the second decade of life (16). Substantial changes in biochemical composition and progressive loss of structural integrity are hallmarks of IVD degeneration (17).

The disc Pfirrmann classification is generally based on disc height and signal intensity, as visualized in T2-weighted images, which shows the changes in morphology and water content that occur in IVD degeneration. Thus, it became a common clinical method for evaluating and quantifying IVD degeneration. We classified IVD according to the modified grading of Pfirrmann score (5).

Hoppe et al. (18) obtain T2-weighted mapping cross-sectional images of 93 patients with lumbar disease using 1.5 T MRI, and quantitatively evaluated the integrity structure of lumbar IVD. Their findings proved that T2-weighted mapping is effective in detecting early IVD degeneration, which can be used to evaluate and grade spinal diseases. The above results are consistent with those of our study. From the perspective of the mechanism of MR T2-weighted mapping imaging, the T2-weighted value mainly reflects the water content, cartilage composition and collagen structure (19). If these components are increased, then the T2-weighted value is increased, and vice versa. When the IVD is severely degenerated, however, the amount of water in the disc is lost, the cartilage and collagen structure is disordered, or even destroyed, and thus, the T2-weighted value is reduced. But, early degeneration can also cause a change of T2-weighted value. The change can contribute to the

release of inflammatory cytokines and related proteins during the early stages of inflammation, which can lead to an increase in the composition of the disc such as moisture and protein in the NP (nucleus pulposus), in turn leading to higher T2-weighted values.

LDD is thought to result from micro-environmental changes affected by multiple contributing factors, including aging, gender, predisposing injury, genetics, and environment (7, 8). In our study, it was not statistically significant in terms of gender.

Although morphological changes in the spine are not observed in the first two decades of life, it is reported that the first signs of degeneration are seen in the 11-16 age group and 20% of this age group has mild degeneration findings (20, 21). In our study, lumbar degeneration was seen in patients starting from 19 years of age.

The most severely impacted segments are L4/5 and L5/S1; these segments are the main subjects of stress, which suggests that mechanical stress plays an important role in the progression of intervertebral disc degeneration (22). In our study, it was seen that the L3 / 4 disc was exposed to more disc degeneration with increasing age.

Kong et al. (23) found a higher incidence of highly degenerated discs at L4/5, which was observed. Many biomechanical studies reported that facet joints and discs may carry parallel loading in the lumbar spine (24). In our study, a significant statistical correlation was found between L3/4 and L4/5 disc degeneration.

Nowadays, treatment methods for disc degeneration have focused on providing pain control and improving quality of life. For this purpose, various conservative treatment methods, algological blockage methods and surgical treatment methods (decompression, stabilization, disc prostheses) are applied from bed rest to analgesic and anti-inflammatory medical treatments to physical therapy to acupuncture. However, the success rates of these treatments are not very high and permanent.

CONCLUSION

In conclusion, excessive or abnormal mechanical load was thought to be the main cause of disk degeneration. Rates of aging and lumbar disc degeneration have gradually increased over the years. It is important to note that there is a relationship between aging and L3 / L4 disc degeneration and that L4 / L5 disc degeneration may also be present in patients with L3 / L4 disc degeneration. Treatment of lumbar disc degenerations, which is a growing health problem, has started to be directed towards etiology rather than the symptom. We think that our studies will shed light on these studies which are still in the beginning period.

Competing interests: The authors declare that they have no conflict of interest.

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Ethical approval: This study was approved by the Institutional Ethics Committee and conducted in compliance with the ethical principles according to the Declaration of Helsinki.

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