

## FİZİKSEL TIP

### RELATIONSHIP BETWEEN CLINICAL CHARACTERISTICS, COMPUTERED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING FINDINGS IN LUMBAR DISC HERNIATION

## LOMBER DİSK HERNİASYONUNDA KLİNİK KARAKTERİSTİKLER İLE BİLGİSAYARLI TOMOGRAFİ VE MAGNETİK REZONANS GÖRÜNTÜLEME BULGULARI ARASINDAKİ İLİŞKİ

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#### SUMMARY

Computed tomography (CT) and magnetic resonance imaging (MRI) are commonly used imaging techniques in the diagnosis of lumbar disc herniation (LDH). The aim of this study was to determine the correlation between clinical characteristics, MRI and CT findings in patients diagnosed as LDH.

**Design and Methods:** 30 patients (22 female, 8 male) who admitted to our outpatient clinic with the complaint of low back pain (LBP) and had diagnosed as LDH were included in the study. Ages of the patients ranged between 22 and 78 years and duration of symptoms were between 1 and 40 months. Patients had no systemic disease. Musculoskeletal system examination was performed for all patients. Visual analogue scale, lumbar spine motion, paravertebral muscle spasm, tenderness of sciatic valveix points, stretch tests for femoral and sciatic nerves were evaluated. Findings of motor, sensory and reflex examinations were recorded from all patients. Both CT and MRI were used as investigation techniques. Disc herniation types were grouped as bulging, protrusion, extrusion and sequestration and direction of disc herniations were grouped as median, paramedian and posterolateral from MRI and CT reports. Spearman correlation test was used for statistical analysis.

CT and MRI reports correlated with each other in all disc herniation levels, herniation types and directions ( $p < 0.05$ ). Stretch tests for femoral and sciatic nerves and tenderness of sciatic valveix points had correlation with corresponding disc levels in CT ( $r: 0.56$ ,  $p < 0.0001$  and  $r: 0.32$ ,  $p < 0.05$  respectively). Neurologic deficits showed a strong correlation with MRI disc herniation levels ( $r: 0.85$ ,  $p < 0.01$ ). Lumbar motion restriction related to CT and MRI findings ( $p < 0.05$ ).

**Conclusion:** These findings suggest that not all LDH patients but the ones with neurologic deficits are the candidates for MRI and CT as valuable as MRI in the diagnosis of LDH.

**Key words:** Lumbar disc herniation, computed tomography, magnetic resonance imaging.

#### ÖZET

**Amaç:** Bilgisayarlı tomografi (BT) ve manyetik rezonans görüntüleme (MRG) lomber disk herniasyonunun (LDH) tanısında sıklıkla kullanılan görüntüleme yöntemleridir. Bu çalışmanın amacı LDH tanısı almış hastaların klinik özellikleri ile MRG ve BT bulguları arasındaki korelasyonu araştırmaktır.

**Materyal ve metod:** Polikliniğimize bel ağrısı yakınmasıyla başvuran ve LDH tanısı alan 30 hasta (22 kadın, 8 erkek) çalışmaya alındı. Hastalarımızın yaşları 22 ile 78 yıl, semptom süreleri ise 1 ile 40 ay arasındaydı. Hastalarımızın hiçbirinde sistemik hastalık mevcut değildi. Tüm hastalara muskuloskeletal sistem muayenesi yapıldı. Vizüel analog skala, lomber bölge hareketleri, paravertebral kas spazmı, siyatik valleks hassasiyeti, femoral ve siyatik sinir germe testleri değerlendirildi. Hastalarda belirlenen motor, refleks ve duyu defisitleri kaydedildi. Görüntüleme yöntemi olarak BT ve MRG'nin her ikisi de tüm hastalara uygulandı. Disk herniasyon tipleri bulging, protrüzyon, ekstrüzyon ve sekestrasyon olarak, disk herniasyonlarının yönelimi median, paramedian ve posterolateral olarak MRG ve BT raporlarına göre gruplandı. İstatistiksel analizlerde Spearman korelasyon testi kullanıldı.

**Sonuçlar:** BT ve MRG raporları disk herniasyon tipleri ve yönelimleri ve disk herniasyon seviyeleri açısından birbirleriyle koreleydi ( $p < 0.05$ ). Femoral ve siyatik sinir germe testleri ve siyatik valleks hassasiyeti ile BT'deki disk herniasyon seviyeleri arasında korelasyon mevcuttu (sırasıyla  $r: 0.56$ ,  $p < 0.001$  ve  $r: 0.32$ ,  $p < 0.05$ ). Nörolojik defisitler ile MRG'da disk herniasyon seviyeleri arasında güçlü korelasyon mevcuttu ( $r: 0.85$ ,  $p < 0.01$ ). Lomber hareket kısıtlılığı BT ve MRG bulguları ile korele bulundu ( $p < 0.05$ ).

**Sonuç:** LDH'lu hastaların tümünde MRG gereği yoktur, ancak nörolojik defisit varlığında istenmelidir. BT, LDH tanısında MRG kadar değerlidir.

**Anahtar kelimeler:** Lomber disk herniasyonu, bilgisayarlı tomografi, manyetik rezonans görüntüleme.

#### INTRADUCTION

Low back pain (LBP) due to spinal disorders are the most frequent cause of activity limitation below the age of 45 years old. The rate of physician visits caused by LBP is second only

to cardiovascular problems among chronic disorders. LBP can be due to vertebral or extravertebral causes. Disc herniation, disc degeneration, spondylolisthesis, spondylitis, tumour, muscle weakness, fracture and coccygodynia can be listed among the vertebral causes(1). Many investigation techniques

can be used for the diagnosis of LBP due to disc herniation. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are most popular methods used in recent years(1-3). In literature in some studies CT is found to be more sensitive than MRI in detecting early annular tears and in predicting recurrent disc herniation but its specificity is low. In other studies no significant difference between CT and MRI is reported (2-5).

The aim of the present study was to investigate the correlation of clinical findings in lumbar disc herniation (LDH) with CT and MRI findings and to search whether one investigation technique is superior to the other.

## METHODS

30 subjects (22 females, 8 males) who had the complaint of low back pain and/or leg pain and diagnosed as LDH participated in the study.

Evaluation of systems and laboratory tests were normal in all patients. Musculoskeletal system was examined. Subjects with the clinical diagnosis of LDH were investigated by CT (L2 to S1 level) and MRI of lumbar region.

History of trauma and duration of LBP were inquired. visual analogue scale (VAS) (0-10) was used for pain intensity.

Examination of lumbar region consisted of lumbar motion, existence of paravertebral spasm (PVS), tenderness on sciatic valleix points (SVT), femoral and sciatic stretch tests (FST, SST). Additionally in lower extremities sensory and motor deficits and reflex disorders were examined.

From the CT and MRI reports disc herniation levels, types and directions were detected. Disc herniation types were grouped as bulging, protrusion, sequestration and extrusion. Directions of herniation were grouped as paramedian, median, posterolateral. Also narrowing of neural foramina due to disc herniation was recorded.

Spearman correlation test (SPSS package program for Windows) was used in statistical analysis.

## RESULTS

The subjects aged 22 to 78 years (mean:49.03 ± 14.28) and duration of lumbar disc herniation was between 1 to 40 years. (mean: 6.53 ± 7.86 years)

74% of subjects were female and 26% were male. From the inquiry forms having a trauma or lifting a heavy object was found as the initiating factor of LBP in 80% of subjects.

In physical examination PVS was positive in all subjects. Lumbar motion was limited in 73% of subjects. Distribution of patients with respect to SVT, SST, FST is shown in Table 1.

**Table I.** Distribution of patients in respect to Sciatic Valleix Tenderness, Sciatic Stretch Tests, Femoral Stretch Tests.

	Right	Left
Sciatic valleix tenderness	40%	20%
Sciatic Stretch Tests	60%	50%
Femoral Stretch Tests	17%	14%

In neurologic examination sensory deficit existed in 26% at right(R), 7% at left(L) side at L5 dermatome; in 17% at R, 4% at L side at S1 dermatome; no sensory deficit was found at L2, L3, L4 dermatomes.

Motor deficit was detected at L4 level in 7% at R and 7% at L; at L5 level in 24% at R, 4% at L;and at S1 level 5% in both R and L side. No motor deficit was found at L2 and L3 level.

While patellar tendon reflex was normal in all subjects, achilles tendon reflex was absent in 10% at R and 7% at L side. The neurologic examination results was shown in Table 2.

**Table II.** Percentage of motor, sensory and reflex deficits in patients

Neurologic Examination	L2		L3		L4		L5		S1	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Sensory Deficit	-	-	-	-	-	-	26%	7%	17%	4%
Motor Deficit	-	-	-	-	7%	7%	24%	4%	5%	5%
Reflex Deficit	-	-	-	-	-	-	-	-	10%	7%

The CT reports revealed that at L4-L5 level 50% had bulging, 40% had protrusion. Sequestration or extrusion was not detected in any of the patients. 63% had narrowing in neural foramina. The direction of disc herniation at this level was paramedian in 20%; median in 27% and posterolateral in 7%.

At L5-S1 level, bulging was detected in 30% and protrusion in 30%. Narrowing in neural foramina existed in 20%. Direction was towards paramedian in 80%, median in 15% and posterolateral in 5% (Table 3).

**Table III.** Disc type and orientation from CT

CT REPORTS	L4-L5	L5-S1
Bulging	50%	30%
Protrusion	40%	30%
Extrusion	-	-
Sequestration	-	-
Narrowing neural foramina	63%	20%
Paramedian	20%	80%
Median	27%	15%
Posterolateral	7%	5%

From MRI reports at L4-L5 level bulging, protrusion and extrusion percentages were found as 40%, 45% and 5% respectively; 45% had narrowing of neural foramina and direction of the herniations were 35% paramedian, 35% median and 30% posterolateral. Finding at L5-S1 level were bulging in 30%, protrusion in 30%, extrusion in 5% and sequestration in 5%. Neural foramen was narrowed in 27%. Herniations were paramedian in 40%, median in 30% and posterolateral in 30% (Table 4).

**Table IV.** Disc type and orientation from MRI

MRI REPORTS	L4-L5	L5-S1
Bulging	40%	30%
Protrusion	45%	30%
Extrusion	5%	5%
Sequestration	5%	5%
Narrowing neural foramina	45%	27%
Paramedian	35%	40%
Median	35%	30%
Posterolateral	30%	30%

CT and MRI findings correlated with each other in herniation type and direction in all levels ( $r:0.5$   $p<0.05$ )

In CT the type and direction of herniation at L5-S1 correlated negatively with lumbar motion ( $r = -0.35$ ,  $p < 0.005$ ,  $r = -0.54$   $p < 0.05$  respectively). FST and SVT had a positive correlation with disc levels ( $r:0.56$ ,  $p < 0.01$ ;  $r:0.32$   $p < 0.05$ ). The correlation of motor, sensory and reflex deficits with the disc levels were  $r:0.17$ ,  $r:0.18$ ,  $r:0.10$  respectively;  $p < 0.05$ .

In MRI evaluations VAS points correlated with the herniations at L4-5 levels (higher VAS scores was found at L4-5 level ( $p:0.47$   $p < 0.01$ )).

Lumbar motion correlated negatively with disc herniation type at this level ( $r: -0.42$ ,  $p < 0.005$ ). FST correlated with L3-4 disc herniation and SVT correlated with L5-S1 herniation. ( $r:0.59$ ,  $r:0.3$   $p > 0.05$  respectively).

## DISCUSSION

LBP is an important health issue in our society which leads to work and economic loss. For this reason it is imperative to select a method of visualization which both is inexpensive and minimizes erroneous results in the diagnosis of LBP(6). Direct X-Ray studies are ineffective because of their lack of visualization of soft tissues (intervertebral discs, ligaments, paravertebral muscles) which may lead to LBP. It is stated that direct radiography is ineffective in the diagnosis and the prognosis of acute and chronic LBP and although it may be issued for once in the assessment of the disease(7).

CT is a fast and inexpensive method which is equally effective in the diagnosis of pain resulting from either bone or soft tissue. MRI is the best visualization method in diagnosing soft tissue disorders, having unprecedented features such as a high contrast and spatial resolution. It can visualize ligaments, intervertebral discs, nucleus and annulus elements and paravertebral muscles. Nevertheless, there still exists such problems as medical contraindications (metallic prosthesis, cochlear implants, etc.) and its being an expensive method which prohibit its usage(6,8).

LDH is characterized by clinical findings and symptoms such as radicular pain, paresthesia, sensory deficits, motor and deep tendon reflex loss and muscle atrophy. Diagnosis must be primarily based on clinical assessment whereas myelography, CT and MRI must be considered as a means of identifying the actual place of herniation and establishing a diagnostic plan.

Physical examination findings differ according to the segmental level of the compressed spinal nerve. LDH is seen most frequently in L4-5 level and frequently in L5-S1 level(1,9,10). L4-5 and L5-S1 joints are the most mobile segments of the lumbar vertebrae. Mobility leads to an increase in the probability of degeneration(11). Level of degeneration is in concordance with the literature.

Lumbar examination in patients with LDH frequently reveals PVS, limitation in lumbar movements and a positivity in FST and SVT. Stretching tests indicate irritation in nerve roots. Due to mechanical pressure, inhibition of endoneural circulation or chemical irritation because of the proteoglycans which are released from the ruptured disc, intraneural inflammation ensues in LDH. This inflammatory reaction is characterized by edema,

cell infiltration and local demyelination. Spinal nerve becomes very sensitive to impulses. In our cases, stretch tests and sensitivity in SVT were positively correlated with levels of discs. In this study, pain was present in all of our patients. Furthermore, PVS was present in all patients and functional loss in lumbar muscles was present in 73 percent of our patients. Pain-muscle spasm relationship which is validated in a study by Tuzun et al. was also present in our patients. Type and direction of herniation as seen by CT was negatively correlated with lumbar motion(1,5,12,13).

Motor, sensory and reflex examination is performed in neurologic examination in order to identify the nerve root which is involved (1,12). Approximately half of our patients had motor and sensory deficit and this was in correlation with the levels of discs involved.

Disc lesions were categorized as bulging, protrusion, extrusion and sequestration. They were also classified as median, paramedian and posterolateral according to the orientation of the disc lesion(14). In our cases, CT and MRI results were correlated according to the herniation types and orientation in all levels. Disc lesion is seen most frequently in posterolateral and paramedian directions as the most weak region of an annulus fibrosis is the posterolateral part(1). This was also verified in our study.

Lesions in L4-L5 levels tend to have more symptomatic and atypical neurologic findings. Occurrence of symptoms are rare in the L5-S1 levels as opposed to L4-L5 levels because the spinal canal is wider in this region. Furthermore, a nerve root can have fibers from the neighbouring segments. In other words, L4 root can carry fibers coming from the neighboring L3 and L5 roots. Other than that, herniation in one disc can lead to a pressure on two nerve roots. This is especially the case for L4-L5 discs. Disc herniations in these levels can press not only upon L5, but on S1 as well (1,11). Sensitivity and specificity of clinical evaluation is reported to be around 90 percent (9,13). Physical examination findings in LDH is directly related with the level of the nerve that is compressed (9,15). We have also found a correlation between motor, reflex and sensory deficits and levels of discs involved. Nerve stretch tests correlated with the levels of discs involved and types of lesions as shown by CT and MRI. Nerve stretch tests were positively cor-

related with levels of discs. FST was found to be correlated with L3-L4 lesion whereas SVT was correlated with L5-S1 disc lesion in MRI.

Collins et al. have stated that it is not possible to define the symptomatic level caused by the disc degeneration by utilizing MRI. They have stated that there are no specific properties of damaged and undamaged discs which could be discriminated by MRI(16). In one study, abnormal MRI results were found to have a high incidence in patients with asymptomatic LDH. Because of this, it is stated to be important that the history and physical examination findings correlate with MRI (17).

As a result our findings indicate that not all of patients with disc herniation are candidates of MRI. MRI is only indicated in patients with a neurologic deficit. But none of the visualization methods, even in our technological age, is superior to the physical examination. CT is as valuable as MRI in diagnosis of LDH.

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