

# Degenerative Disc Disease of the Lumbar Spine on MRI

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## ABSTRACT

*A retrospective analysis was done of all patients referred for MRI of the lumbar spine at the University Hospital of the West Indies, Kingston, Jamaica, during the three-year period January 1, 2005 and December 31, 2007. Data were collected to determine patients' age, gender, weight and the presence or absence of degenerative disc disease (DDD). The patients' presenting symptoms were not evaluated. There were 362 patients examined: 154 males, 204 females and four uncharacterized, aged between 8 and 87 (mean age = 50.45) years. Degenerative Disc Disease (DDD), was found in 283 (78.2%) patients: 121 males, 159 females and three unidentified, with a total of 669 degenerate discs.*

*L 4/5 and L 5/S 1 were most frequently affected accounting for 31.2% and 30.6% of degenerate discs respectively. Patients with DDD were significantly heavier and significantly older than patients without disc disease. Gender was not predictive of DDD in general nor of involvement of any particular disc though a marginally significant tendency was found for males to more frequently have DDD at L1/2 and L5/S1.*

**Conclusion:** *Degenerative disc disease of the lumbar spine occurred more frequently in older and heavier patients. Gender did not affect the presence or the extent of the disease; compared to females, males showed a marginally increased tendency to have DDD at L1/2 and L5/S1.*

**Keywords:** Degenerative disc disease, lumbar spine, MRI

# La Enfermedad Degenerativa del Disco de la Espina Lumbar en IRM

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## RESUMEN

*Se realizó un análisis retrospectivo de todos los pacientes remitidos para IRM de la espina lumbar en el Hospital Universitario de West Indies, Kingston, Jamaica, durante el periodo de tres años comprendido de enero 1 de 2005 a diciembre 31 de 2007. Se recogieron datos de los pacientes a fin de determinar su edad, género, peso y la presencia o ausencia de la enfermedad degenerativa del disco (EDD). Los síntomas presentes en los pacientes no fueron evaluados. Se examinaron 362 pacientes: 154 varones, 204 hembras y cuatro no caracterizados, de edades entre 8 y 87 (edad promedio = 50.45) años. La enfermedad degenerativa del disco (EDD) se halló en 283 (78.2%) pacientes: 121 varones, 159 hembras y tres no identificados, para un total de 669 discos degenerados.*

*L 4 / 5 y L 5 / S 1 fueron los más frecuentemente afectados, representando el 31.2% y 30.6% de los discos degenerados, respectivamente. Los pacientes con EDD tenían significativamente más peso y mayor edad que aquellos sin la enfermedad del disco. El género no era en general predictivo de EDD ni de involucración de disco alguno en particular, si bien se halló marginalmente una tendencia significativa a una mayor frecuencia en la manifestación de EDD en L1 / 2 y L5 / S1 entre los varones*

**Conclusión:** *La enfermedad degenerativa del disco de la espina lumbar se presentó en pacientes de mayor edad y mayor peso. El género no afectó la presencia o la magnitud de la enfermedad. Sin*

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*embargo, en comparación con las hembras, los varones mostraron una tendencia marginalmente mayor a presentar EDD en L1/2 y L5/S1.*

**Palabras claves:** Palabras claves: Enfermedad degenerativa del disco, espina lumbar, IRM

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## INTRODUCTION

The sequelae of Degenerative Disc Disease (DDD) are a common cause of disability in adults during their working years. The aetiology of the condition is complex and not yet fully understood. Mechanical, traumatic, nutritional and genetic factors are all thought to play a role although to a variable degree in different individuals (1).

Studies on cadavers have confirmed the role which mechanical factors play both as a severe acute injury and chronic low grade stress (2–6). The discs receive nutrition by diffusion of fluid from the marrow of the vertebral bodies and *via* the *annulus fibrosus* from the blood vessels surrounding it. Changes within the vertebral body and the cartilaginous endplate with ageing may interfere with disc nutrition and further the degenerative process (7).

In a study of 115 identical twins, Battie *et al* found that exposure to commonly suspected environmental risk factors for DDD had only modest effects. They inferred a significant genetic influence in the disease (8). Hestbaek *et al* also demonstrated significant genetic influence on susceptibility to DDD in a study on Danish twins (9). Matsui *et al* performed a case – controlled study “*To evaluate the significance of a family history of operated lumbar disc herniation in the development of lumbar disc degeneration and lumbar disc herniation*”. They found that there was significant correlation again confirming a genetic component to the disease (10).

There is confusion in the literature between changes in the disc due to ageing and the pathological process of degeneration and attempts have been made to clearly distinguish the two and also to standardize the descriptions used in DDD (11).

In the radiology department, discs are said to be degenerate if the following are present:

- \* on T2-weighted images, the central disc signal intensity is markedly decreased and at distinct variance to that seen in unaffected discs of the same individual.
- \* the disc height is decreased.
- \* there are associated endplate changes which produce altered signal on T1 and T2 weighted sequences. Endplate changes are classified as Modic Types 1, 2 and 3. Types 1 and 2 represent vascularized fibrous tissue in and local fatty replacement of the marrow respectively. Type 3 is due to sclerosis of the endplate of the vertebral bodies.
- \* there is fissuring in the annulus fibrosus.

Although degenerative lumbar disc disease is a common clinical finding to our knowledge, there is no literature detailing the pattern of the disease and the patient profile in a Jamaican population. This study was undertaken to provide a descriptive analysis of the affected discs and patient profile in patients undergoing MRI of the lumbar spine at the University Hospital of the West Indies, Kingston, Jamaica.

## SUBJECTS AND METHOD

A retrospective study was done of all reports from MRI of the lumbar spine performed during the period January 1, 2004 and December 31, 2007. Reports were obtained using the Microsoft Word Search option of the Radiology Department’s report database. The reports provided data on the patients’ age, gender and presence or absence of disc disease. The patient’s weight was obtained from the data stored on the MRI scan which requires weight as a scanning parameter. Patients are weighed before being placed in the scanner.

All scans were performed with a GE Signa 1.5 Tesla unit (General Electric Wisconsin, USA). The data obtained were analysed statistically using independent samples, *t*-tests and chi-squared tests.

## RESULTS

There were 362 patients examined, 154 males, 204 females and four unidentified, aged between 8 and 87 (mean age = 50.45, SD = 16.35) years. Degenerative disc disease was 283 (78.2%): 59 (16.3%) at L1/2, 79 (21.9%) at L2/3, 117 (32.3%) at L3/4, 209 (57.7%) at L4/L5 and 205 (56.6%) at L5/S1 for a total of 669 degenerate discs (Table 1). Of the

Table 1: Disc levels *versus* number of degenerate discs

Discs Level	Number of Degenerate Discs	% of All Degenerate Discs
L 1/2	59	8.9
L 2/3	79	11.8
L 3/4	117	17.5
L 4/5	209	31.2
L 5/S1	205	30.6
<b>Total</b>	<b>669</b>	<b>100</b>

283 patients with disc disease, 100 (35.3%) had disease at one disc, 82 (29%) at two discs, 43 (15.2%) at three discs, 14 (4.9%) at four discs and 44 (15.5%) at all five discs (Table 2).

Table 2: Number of degenerate discs vs patients with this number of degenerate discs

Number of degenerate discs	Patients with degenerate discs	% of Population
1	100	35.3%
2	82	29.1%
3	43	15.2%
4	14	4.9%
5	44	15.5%
<b>Total</b>	<b>283</b>	<b>100</b>

There was no significant difference in age between males and females in the sample but males were heavier ( $M = 80.4$  vs  $M = 76.9$ ;  $t(283) = 1.87$ ,  $p = 0.063$ ).

Patients with DDD were significantly heavier ( $M = 79.4$  vs  $M = 73.3$ ;  $t(286) = 2.97$ ,  $p = 0.003$ ) and significantly older ( $M = 53.0$  vs  $M = 41.4$ ;  $t(357) = 5.81$ ,  $p < 0.001$ ) than patients without disc disease.

Gender was not predictive of disc disease in general ( $\chi^2(1) = 0.64$ ,  $p = 0.800$ ) nor of involvement of any particular disc ( $0.071 < p < 0.250$ ), though a marginally significant tendency was found for males to have DDD at L1/2 (20.1% vs 13.7%;  $\chi^2(1) = 2.62$ ,  $p = 0.071$ ) and L5/S1 (61.0% vs 53.4%;  $\chi^2(1) = 2.07$ ,  $p = 0.092$ ).

## DISCUSSION

The findings in this study are consistent with others that reported that DDD of the lumbar spine occurs most commonly at L4/5 and L5/S1. In a review of MRI scans of the lumbar spine in 246 consecutive patients who suffered from persistent back and leg pain, DeCandido *et al* found that degenerative changes in the discs increased with age until the fifth decade of life. Significant dehydration and degeneration occurred in less than 5% of the upper two disc spaces while L4/5 and L5/S1 had marked changes in greater than 20% (12).

The mean age of patients with DDD was 52.9 years and the mean weight 79.8 kg, approximately 11 years older and 7 kg heavier than patients without DDD. Body Mass Index was not assessed in this study but Hangai *et al* have reported that in elderly Japanese, high BMI is associated with DDD at L2/3, L3/4, L4/5 and L5/S1.

They also reported that ageing correlated significantly with DDD of L1/2, L2/3, L3/4 and L4/5 and that occupational lifting is associated with DDD at L1/2 and sports activities with DDD at L5/S1 (13). The last two considerations may account for the marginal increased tendency of males in our population to have DDD at L1/2 and L5/S1. Liuke *et al* found that in Finnish males BMI above 25 kg/m<sup>2</sup> increased the risk of DDD and that high BMI seemed to be particularly detrimental in the young (14).

Gender did not influence the presence of the disease in the present study. There was also no significant difference in

age between males and females with DDD. There were no reports seen in the literature of gender differences in the pattern of DDD. Magnetic resonance imaging is an important modality for evaluating DDD and its sequelae as it provides excellent multi-planar views of the spinal components. Despite the excellent detail in the images obtained, however, there is no simple correlation between the imaging findings and pain symptoms (13, 14).

In most studies which sought to correlate MRI findings and back pain, the lumbar spine was examined with the patient supine. This technique cannot assess the effect of posture and gravity on the spine, however these may be assessed if the patient were scanned sitting using the newer "positional" MRI technology. Weishaupt *et al* demonstrated minor neural compromise more frequently using positional MRI imaging than with conventional supine imaging (16). Willen and Danielson found that axial compression of the lumbar spine provided additional useful information in 69% of patients with neurogenic claudication, 14% of patients with sciatica and 0% of patients with low back pain (17).

The aetiology of DDD has been found to be more complex than originally thought. The condition has been attributed to the accumulation of factors such as mechanical insults and injuries, cigarette smoking and atherosclerosis imposed on normal ageing. However, several studies which attempt to evaluate these risk factors produced inconsistent findings related to the fact and degree of association with disc degeneration (18–22). In contrast, several studies have demonstrated an association between genetic influences and DDD (8, 11, 23–25). Genetic factors are now thought to be more important than mechanical stress though the expression of the disease is the result of both factors. Chan *et al* published a review of the genetic factors. These include the vitamin D receptor (VDR) and genes which code for molecules that contribute to or affect the integrity/function of the extra-cellular matrix present in cartilage and are responsible for the mechanical properties of intervertebral discs,

The genetic component raises the possibility that the patient profile may vary between populations. However, the distribution of the disease and the effect of factors such as age, gender and weight on affected individuals in the present study appear similar to those in Japan and Finland (13, 14).

We did not seek to determine the patients symptoms or the indications for the MRI scans as the objective was to provide a case descriptive series of the occurrence of degenerative disc seen on MRI and to correlate this with patient demographics rather than to clinical presentations.

In conclusion, this is a retrospective review of degenerative disc disease of the lumbar spine in 362 consecutive patients who had MRI at the UHWI. Heavier and older patients were more likely to have disc disease. Males and females are as likely to have degenerative disc disease and there is no significant difference in the age at which the disease occurs between the two groups. There is a slight

increased tendency for males to have disc disease at L1/2 and L5/S1. This last finding may be due to increased occupational lifting and sporting activity.

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