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INSPIRA NETWORK

MORPHOLOGICAL FINDINGS IN PATIENTS WITH LOW BACK PAIN AND SCIATICA

HALLAZGOS MORFOLÓGICOS EN PACIENTES CON LUMBALGIA Y CIÁTICA

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ASTRACT

Introduction: Low back pain is a major cause of disability and absenteeism from work. Its pathophysiological substrate, mainly, is radiculopathy due to lumbar spondylosis or herniated discs. The objective of this study is to describe the alterations in the complementary tests (MRI and EMG), in patients with lumbociatalgia, with clinical suspicion of lumbosacral radiculopathy, in the context of herniated disc or spondylosis.

Materials and methods: Retrospective study of 217 patients in which age and sex were analyzed; by MRI protrusions and herniated discs, disc-osteophyte complexes, arthropathy, spondylolisthesis, canal stenosis, hypertrophy of the yellow ligament, sagittal vertebral alignment; neurogenic findings in muscles dependent on the spinal nerves from L3 to S1 have been analyzed by electrodiagnosis.

Results: The mean age was 57.54 ± 12.31 years. The mean number of protrusions and herniated discs per spine was 1.26 ± 1.99. The number of patients with elements of spondylosis was: osteophytes n = 75, listhesis n = 40, canal stenosis n = 35, arthropathy n = 133, hypertrophy of the yellow ligament n = 72. Higher incidence of protrusions and herniated discs in L4-L5 (n = 144), of discoosteophytic complexes in L5-S1 (n = 42) and of neurogenic findings in the L5 spinal nerve (n = 169). The most characteristic vertebral alignment was preserved lordosis (n = 151). The elements of spondylosis increased with age significantly. Motor radiculopathies and discopathies increased with age in a non-significant way. Arthropathy, osteophytes, and L4 and L5 motor radiculopathies were more frequent in men.

Conclusions: The poor anatomical correlation between the neurogenic findings in the muscles of a specific spinal nerve and the space-occupying lesions at the level of the homonymous intervertebral foramen, suggests that the rootlets of the cauda equina are damaged within the vertebral canal, due to occupying lesions of the cauda equina space, cranial to the expected intervertebral foramen.

Key words: Electromyography, spondylosis. herniated disc, lumbar spine, radiculopathy, nuclear magnetic resonance.

RESUMEN

Introducción: El dolor lumbar es una de las principales causas de discapacidad y absentismo laboral. Su sustrato fisiopatológico, de manera mayoritaria, es la radiculopatía por espondilosis lumbar o hernia de disco. El objetivo de este estudio es describir las alteraciones en las pruebas complementarias (RM y EMG), en pacientes con lumbociatalgia, con sospecha clínica de radiculopatía lumbosacra, en el contexto de hernia discal o espondilosis.

Materiales y métodos: Estudio retrospectivo de 217 pacientes (130 mujeres y 87 hombres) en el que se han analizado edad y sexo; mediante RM, protrusiones y hernias discales, complejos discoosteofitarios, artropatía, espondilolistesis, estenosis de canal, hipertrofia del ligamento amarillo y la alineación vertebral sagital; mediante electrodiagnóstico se han analizado los hallazgos neurógenos en músculos dependientes de los nervios espinales de L3 a S1.
Resultados: La edad media fue 57,54 ± 12,31 años. La media de protrusiones y hernias discales por columna fue de 1,26 ± 1,99. El número de pacientes con elementos de espondilosis fue: osteofitos n = 75, listesis n = 40, estenosis de canal n = 35, artropatía n = 133, hipertrofia del ligamento amarillo n = 72. Mayor incidencia de protrusiones y de hernias de disco en L4-L5 (n = 144), de complejos discoosteofíticos en L5-S1 (n = 42) y de hallazgos neurógenos en el nervio espinal L5 (n = 169). La alineación vertebral más característica fue la lordosis conservada (n = 151). Los elementos de la espondilosis aumentaron significativamente con la edad. Las radiculopatías y discopatías motoras aumentaron con la edad de forma no significativa. La artropatía, los osteofitos y las radiculopatías motoras L4 y L5 fueron más frecuentes en los hombres.
Conclusiones: La escasa correlación anatómica entre los hallazgos neurógenos en los músculos de un nervio espinal específico y las lesiones ocupantes de espacio a nivel del foramen intervertebral homónimo, sugiere que las raicillas de la cola de caballo se dañan dentro del canal vertebral, debido a lesiones ocupantes de espacio, craneales al foramen intervertebral esperado.

Palabras clave: Electromiografía, espondilosis, hernia de disco, espina lumbar, radiculopatía, resonancia magnética nuclear.

INTRODUCTION

Low back pain is a clinical picture of pain in the lumbar region. It can be divided into mechanical (about 90 %), which originates in the vertebral and paravertebral structures; and not mechanical, which does not yield with rest. Low back pain is the world's leading cause of disability and one of the leading causes of absenteeism. More than 80 % of people will experience low back pain at some point in their life (1,2).

Around 5-10 % of patients with low back pain will present pain that descends towards the lower limb, called sciatica, whose pathophysiological substrate, in most, is lumbosacral radiculopathy (RAD). Clinically, it is characterized by the presence of pain, sensory disturbances (dysesthesia, paraesthesia, hypo or anesthesia) and motor (paresis), in a dermatome or myotome of one or more lumbosacral spinal nerves. The estimated prevalence is 3-5 % for adults, with similar rates for men and women (3). The most common cause of lumbosacral radiculopathy is spinal nerve compression, caused by elements of spondylosis or herniated disc (HDL) that stenosis the intervertebral foramen (IVF) (3).

The lumbar region includes the lower back, from the last ribs to the sacrum. Its skeleton is the 5 lumbar vertebrae that form a lordotic curvature. The spinal cord ends, through the medullary cone, between L1 and L2 (4). Each spinal nerve is formed by the union of two roots: the anterior motor, which emerges from the anterior collateral groove of the cord and is formed by the axons of the motor neurons of the anterior horn; and the posterior sensory root, which enters the medulla through the posterior collateral sulcus and houses the axons of neurons found in the spinal ganglion.

All lumbar and sacral spinal roots originate between vertebral levels T10 and L1, and descend into the vertebral canal until reaching their IVF. The two roots unite in the vicinity of the spinal ganglion (4). The spinal root can be compressed by space-occupying lesions, herniated discs, and elements of spondylosis, cranial to its homonymous conjunct foramen (5).

The pathophysiology of spondylosis is not fully known and it is suspected that it consists of a progressive degenerative process of the intervertebral discs (IVD) and of the articular facets, which will be associated with a bone reaction with formation of osteophytes and joint deformation, hypertrophy of the longitudinal ligaments and the ligamentum flavum (LF). Canal stenosis is common in advanced ages and is usually accompanied by stenosis of several IVFs, which can cause compression of the nerve roots and root symptoms with lumbociatalgia (3,6). In addition, the presence of elements of spondylosis and disc disease can affect vertebral alignment, while loss of lumbar lordosis can cause uneven load distribution and contribute to disc degeneration.

The distribution of symptoms in a radiculopathy depends on the affected spinal nerve. L1 radiculopathy is rare, as is L1-L2 discopathy. Symptoms are pain and hypoesthesia in the groin region. Sometimes slight paresis on hip flexion. L2 radiculopathy presents a sensory deficit in the outer and anterior thigh, motor deficit in the psoas and quadriceps, without reflex alterations. L3 radiculopathy presents sensory deficit in the inner area of the lower thigh, motor deficit in the psoas and quadriceps. L4 radiculopathy presents sensory deficit in the lower leg, motor deficit in the tibialis anterior and quadriceps, while the patellar reflex is reduced. The L2, L3 and L4 radiculopathies are grouped together, since there is a marked overlap in their innervation, which makes their identification by electrodiagnosis (EDX) difficult. L5 radiculopathy is the most common, it presents a sensory deficit in the external area of the leg and a motor deficit in ankle dorsiflexion. In S1 radiculopathy, pain radiates from the lumbar region down the back of the leg to the foot. They may present paresis for leg extension and for plantar flexion of the ankle. Achilles hiccups or areflexia are present (3,7). There are no universally accepted criteria for the diagnosis of RAD (3,7,8), which is based on medical history, physical examination, and complementary tests such as magnetic resonance imaging (MRI) and EDX (7). The first test of choice when RAD is suspected is MRI (3,7,8), since it allows obtaining images of soft tissues. The EDX is useful for the diagnosis of motor radiculopathies, as it helps to determine the anatomical level, the degree of involvement and the evolution (9-11).

The medical records and diagnostic tests, MRI and EDX, of 217 patients with low back pain were reviewed. The objectives of this study were twofold. With MRI, describe the appearance of protrusions, HDL, elements of spondylosis and the type of sagittal curvature and its relationship with age and sex. Using the EDX, describe the presence of neurogenic damage, its probable anatomical location, and its relationship with age and sex.

MATERIALS AND METHODS

Retrospective case series study of 217 patients with lumbociatalgia and suspected lumbosacral RAD who underwent lumbosacral MRI and lower limb EMG between August 2016 and August 2018. The reports of these tests were reviewed. The study was approved by the Ethics Committee.

Inclusion criteria: patients from the age of 18 with lumbociatalgia and suspected lumbosacral RAD who attended the Complexo Hospitalario Universitario de Lugo, initially explored by a specialist in traumatology, rehabilitation, neurosurgery or neurology, and later by a clinical neurophysiologist. Patients who underwent MRI on a Ge Signa HDxt superconducting magnet (1.5 T). Patients who underwent EMG with concentric needle electrodes on a DANTEC KEYPOINT® device one month after the onset of symptoms. The time between the two tests did not exceed three months.

Exclusion criteria: patients under 18 years of age and over 85 years of age. Mellitus diabetes. Underlying neurological disease: myelopathy, motor neuron disease, cauda equina syndrome, plexopathies, polyneuropathies, neuromuscular junction disorders, and myopathies (12). Seronegative spondyloarthropathy. Sacroiliitis. Scoliosis. Pathological dorsal kyphosis. Congenital vertebral stenosis. Spinal surgeries, fractures, tumors and infections.

A descriptive statistical analysis of measures of central tendency and dispersion of quantitative variables and proportions of qualitative variables was carried out. The cut-off point for statistical significance was an alpha of $p < 0.05$. Statistical analysis was performed with the IBM SPSS Statistics 22.0 software.

The following variables were analyzed: age (categorized into three groups) and sex. Spondylosis (osteophytes, arthropathy, listhesis, canal stenosis and LF hypertrophy) was evaluated with MRI; the osteophytes were counted at each lumbosacral level from L1-L2 to L5-S1 as disc osteophyte complexes (CD); the number of spaces with disc pathology and the type (protrusion or HDL); and curvature in the sagittal plane (rectification or lumbar lordosis).

For the study and classification of disc pathology, the nomenclature recommendations of the North American Spine, American Society of Spine Radiology and the American Society of Neuroradiology, updated in 2014, were followed (13,14). The following sequences were performed: sagittal T1, sagittal FSE T2, sagittal FSE T2 fat and axial FSE

T2.

EMG was performed on a DANTEC KEYPOINT® equipment to evaluate the presence of acute or chronic neurogenic motor findings in muscles dependent on the spinal roots from L3-L4 to S1-S2. For EDX and classification of radiculopathies, the recommendations of the American Association of Neuromuscular & Electrodiagnostic Medicine (15) were followed.

Nerve conduction studies (ENG) and EMG with concentric needle were performed in lower limbs. ENG was used to explore motor (posterior tibial, deep peroneal) and sensory (sural, superficial peroneal) nerves. EMG was used to evaluate signs of acute denervation (fibrillations and positive waves), and chronic neurogenic motor unit potentials (MUAP) (amplitude from 5 mV and more than 16 ms in duration). Polyphasic reinnervation MUAPs were not assessed. The following muscles were evaluated as a guide for each lumbosacral root (15,16). Roots L2-L3: iliopsoas. Root L4: vastus medialis, vastus lateralis, anterior tibialis. Root L5: tibialis anterior, peroneus longus, biceps femoris (short head). Root S1: Medial and lateral gastrocnemius. Paravertebral muscles were not used to locate the affected level (15).

RESULTS

Retrospective study of 217 patients, 130 women (59.9 %) and 87 men (40.1 %). The minimum age was 20 years and the maximum was 85. The mean age in the general sample was 57.54 ± 12.31 (women: 57.82 ± 12.48; men: 57.13 ± 12.11). Three age groups were established: 45 years or less (GE1: men 11, women 17), 28 patients (12.9 %); 46 to 60 years (GE2: men 46, women 61), 107 patients (49.3 %); and over 61 years (GE3: men 30, women 52), 82 patients (37.8 %).

Discopathies (DIS)

The mean number of discopathies, protrusions and HDL, by spine, has been, in each age group, as follows: GE1: total 1.54 ± 1.26; men 1.82 ± 1.40; women 1.35 ± 1.17. GE2: total 1.90 ± 1.17; men 1.83 ± 1.21; women 1.95 ± 1.15. GE3: total 2.26 ± 1.33;

men 2.17 ± 1.26; women 2.31 ± 1.39. In the total sample: 1.99 ± 1.26; in men 1.94 ± 1.25 while in women 2.02 ± 1.27.

The frequency of DIS and the type, at each intervertebral level studied, is shown in Table 1. The intervertebral space with the most global protrusions and DIS has been L4-L5, with n = 120 and n = 144, respectively. The intervertebral space with the most HDL was L5-S1 (n = 33). The frequency of DIS in each intervertebral space, according to age group and sex, is shown in Table I.

DIS L3-L4 has had a statistically significant relationship with aging (p = 0.000). In contrast, no discopathy has been associated with sex. DIS L3-L4 has presented a statistically significant relationship with the presence of osteophytes (41/75; 54/142; p = 0.019), arthropathy (68/133; 27/84; p = 0.006), canal stenosis (36/53; 59/164; p = 0.000) and with LF hypertrophy (39/72; 56/145; p = 0.030). The discopathies L1-L2, L2-L3, L4-L5 and L5-S1 did not present a statistically significant relationship with any of the elements of spondylosis studied.

Spondylosis

MRI was used to evaluate the presence of osteophytes (n = 75; 34.56 %); arthropathy (n = 133; 61.29 %); spondylolisthesis (n = 40; 18.43 %), spinal canal stenosis (n = 53; 24.42 %) and LF hypertrophy (n = 72; 33.18 %). The number of intervertebral levels with DC per column was 0.59 ± 1.03 (mean ± SD). The distribution of osteophytes per column in the sample according to GE and sex was: GE1, total, 0.25 ± 0.28; men, 0.64 ± 1.28; women, 0.00 ± 0.00. GE2, total, 0.62 ± 1.05; men, 0.70 ± 1.05; women 0.56 ± 1.05. GE3, total, 0.68 ± 1.05; men, 0.87 ± 1.13; women 0.58 ± 0.99. Overall, total, 0.59 ± 1.03; men, 0.75 ± 1.12; women, 0.49 ± 0.97.

The highest averages were for GE3 in both men and women. The presence or absence of osteophytes in each intervertebral space was evaluated and was higher at the L5-S1 level, with 19.35 % (n = 42), followed by the L4-L5 space, with 16.13 %, (n = 35). The level with the lowest amount of osteophytes was L1-L2 with 4.61 % (n = 10). The frequency of appearance of the elements of spondylosis, according to age group and sex, is shown in Table II.

Osteophytes (*p* = 0.009), arthropathy (*p* = 0.000), listhesis (*p* = 0.000), spinal canal stenosis (*p* = 0.000) and LF hypertrophy (*p = 0.018*) have shown a statistically significant relationship with aging, being the most prevalent variables in GE3. Osteophytes and arthropathy have presented a statistically significant relationship with male sex (*p = 0.044*; *p* = 0.000). The presence of osteophytes has had a statistically significant relationship with arthropathy (57/133; 18/84; *p* = 0.001). For its part, arthropathy has also been associated with spondylolisthesis (35/133; 5/84; *p* = 0.000), with canal stenosis (49/133; 4/84; *p* = 0.000) and with LF hypertrophy (71/133; 1/84; *p* = 0.000). Spondylolisthesis has also shown a statistically significant relationship with canal stenosis (22/40; 31/177; *p* = 0.000) and with LF hypertrophy (18/40; 54/177; *p* = 0.009). Finally, canal stenosis has been associated with hypertrophy of the LF (31/53; 41/164; *p* = 0.000).

Curvatures in the sagittal plane

The presence of rectification of the physiological lumbar lordosis was evaluated by MRI in the supine position, and it appeared in 66 patients (30.41 %), while 151 had preserved lumbar lordotic curvature in 69.58%. Rectification has not been associated with age (GE1: 5/28; GE2: 35/107; GE3: 26/82; *p* = 0.299) or sex (man: 31/87; woman: 35/130; *p* = 0.172). The type of sagittal vertebral curvature has not been associated with any of the elements of spondylosis or with the disc diseases studied.

EMG findings

The root with the most neurogenic motor findings was L5, (n = 169; 77.88 %), followed by L4 (n = 150; 69.12 %) (Table III). The root with the lowest number of acute or chronic motor neurogenic findings was L2-L3 (n = 17; 7.8 %). We have not observed a relationship between the presence of neurogenic findings and age. On the contrary, the neurogenic findings in the L4 and L5 roots have been statistically significant in men (L4, *p* = 0.032. L5, *p* = 0.037).

Regarding the presence of DIS and neurogenic findings, RAD L5 has presented a statistically significant relationship with DIS L5-S1 (19/48; 96/169; $p = 0.035$). RAD S1 has presented a statistically significant relationship with DIS L1-L2 (15/23; 84/194; $p = 0.046$).

Regarding DC, RAD L5 has shown a relationship with CD L4-L5 (32/35; 137/182; $p = 0.035$) and RAD S1 with CD L1-L2 (9/10; 90/207; $p = 0.004$) and CD L4-L5 (26/35; 73/182; $p = 0.000$).

Finally, RAD L3 has presented a statistically significant relationship with LF hypertrophy (10/72; 7/145; $p = 0.019$); and RAD S1 with the presence of osteophytes (43/75; 56/142; $p = 0.012$) and with rectification of the sagittal vertebral alignment (38/66; 61/151; $p = 0.019$).

DISCUSSION

In our sample of patients with low back pain, the number of DIS has progressively increased with age, although without statistically significant results, except at the L3-L4 level ($p < 0.05$), or differences between the sexes. In contrast, other authors reported that HDL is more common between the ages of 30-50 years and in women (16,17). In a study of MRI findings in asymptomatic patients, Jensen et al. also found that the levels with the highest frequency of protrusions were L4-L5 and L5-S1 (Figure 1), and the lowest were L1-L2 (18). In addition, they did not find a relationship between the protrusions with the age or sex of the patients.

The elements of spondylosis, in any region of the spinal column, are more frequent after 60 years (19,20). Thus, all the elements of spondylosis studied have presented a statistically significant relationship with aging ($p < 0.01$). On the other hand, only osteophytes and arthropathy had a statistically significant relationship with male sex. Symmons et al., in patients between 45 and 64 years, found that 85.5 % had osteophytes, while in our sample only 34.58 % in that age range, and 42.69 % in GE3 (21). However, our research has only counted osteophytes in vertebral bodies, so the expected number is lower. Zukowski et al., in a sample of 76 skeletons, found that the severity of osteophytes in the vertebral bodies increased with age in both sexes (22).

Unlike our investigation in the cervical spine, in which DCs were the most frequent (23), the most characteristic element of spondylosis in this study was zygapophyseal arthropathy (n = 133), followed by DC (n = 75), which can be explained by the distribution of loads towards the posterior column. DCs have been more prevalent in the L5-S1 space (n = 42), like HDL, followed by the L4-L5 space (n = 35). This coincides with the vertebral segments subjected to greater biomechanical stress (7).

The relationship between increasing age and zygapophyseal arthropathy had previously been described (24). According to Kirkaldy Willis (1978) (25) and Vernon-Roberts and Pirie (1977) (26), the initial event in the spinal degenerative cascade would be the degeneration of the IVD, due to failure of the end plates, and the changes of the zygapophyseal joint would happen later. In addition, they are a frequent source of low back pain (27).

Degenerative listhesis usually appears after the age of 40. The articular facets undergo subluxation in the unstable vertebral segment, which will cause the displacement of one vertebra over another in the sagittal plane. It is most common in the L4-L5 space (28). In our series it has appeared in 40 patients and coincides with what has been published that it is more frequent in women (28), but the results have not been statistically significant.

LF hypertrophy can be unilateral or bilateral and usually occurs in the lower lumbar spine (Figure 2). It has been assumed that it is the product of segmental instability, secondary to disc degeneration and the growth of osteophytes due to biomechanical stress, since, in an attempt to stabilize the intervertebral segment, the ligament becomes thicker and harder (28). In our study, LF hypertrophy has presented a statistically significant relationship ($p < 0.05$) with GE3, with HDL L3-L4, with zygapophyseal arthropathy and with canal stenosis. Furthermore, it has also been associated with L3 motor radiculopathy. On the other hand, he has not presented it with sex, in the same way as Safak in his research, although it has been more frequent in men (29).

Acquired, from the sixth to the seventh decade of life, in many patients the vertebral canal becomes stenosed due to space-occupying lesions, such as facet arthropathy, CD, HDL, spondylolisthesis, and LF hypertrophy (30). In our study, canal stenosis showed a statistically significant relationship ($p < 0.01$) with aging, with zygapophyseal arthropathy, with listhesis and with LF hypertrophy. Furthermore, canal stenosis has presented a statistically significant relationship with HDL L3-L4 ($p < 0.01$). On the contrary, it has not had a significant relationship with sex, although it has been more frequent in men; neither with CD nor with any specific motor radiculopathy.

Lumbar canal stenosis produces morphological alterations in the dural sac and compression and ischemia in the roots of the cauda equina (Figure 3). Although in many people it is asymptomatic, the symptoms range from low back pain to gait claudication and even loss of sphincters (3,7); symptoms will depend on the axial and sagittal location of the stenosis.

Lumbociatalgia is mainly caused by compressive radiculopathies by elements of spondylosis or HDL that stenosis the vertebral canal and IVF, causing radiculopathies (2,3). In our study, there have been more neurogenic findings in muscles dependent on the L5 spinal nerve (n = 169), which is in agreement with Hsu PS et al. (7), followed by L4 (n = 150). While the spinal nerve with the least neurogenic findings was L3 (n = 17). The greatest biomechanical stress occurs at the L4-L5 and L5-S1 levels, so radiculopathies are more frequent at these levels (3,7). L4 and L5 motor radiculopathies have presented a statistically significant relationship with males (L4: 53/87; 97/130; $p < 0.05$. L5: 74/87; 95/130; $p < 0.05$). On the contrary, no radiculopathy has presented a statistically significant relationship with age. Regarding the relationship between space-occupying lesions and neurogenic findings, L5 RAD has been associated with L5-S1 DIS and L4-L5 CD; RAD S1 has been associated with DIS L5-S1, with CD L1-L2, with CD L4-L5, with osteophytes and with rectification of lordosis; RAD L3 has done it with LF hypertrophy.

The relationship between apical space-occupying lesions and radiculopathies at distal levels supports the theory that the roots are also damaged within the vertebral canal, before reaching their homonymous IVF (3,5,7,23). The main limitation in the interpretation of diagnostic tests in lumbosacral RAD is the absence of a gold standard [3,7,8]. To date, the literature has focused on comparing the performance of MRI and EMG (31-33). The main limitation of MRI is its low specificity, since spondylosis in any spinal region abounds in asymptomatic patients and increases with age (3,7,8,18).

According to Brinjikji et al., in a systematic review of articles on MRI findings in asymptomatic patients, the prevalence of protrusion increased from 29% in those aged 20 years to 43% in those aged 80 years (34). The main limitation of EMG is that it only studies motor axonal integrity, it is observer dependent, and acute denervation is not detected in the first 20 days (10,11,15).

In summary, in patients with low back pain, disc disease and spondylosis have increased with age. However, its relationship with sex in a global way is not significant. The sum of the degenerative findings may explain the poor correlation between the anatomical location of the space-occupying lesions and the neurogenic damage observed by EMG for the same expected anatomical level.

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Table I. Discopathies by age group and sex.

	Protrusion	LHD	DIS	GE 1 (28)	GE2 (107)	GE3 (82)	*p*	Men (87)	Women (130)	*p*
L1-L2	21	2	23	1	10	12	*0.218*	6	17	*0.147*
L2-L3	42	3	45	3	22	20	*0.504*	22	23	*0.176*
L3-L4	87	8	95	2	46	47	*0.000*	37	58	*0.761*
L4-L5	120	24	144	15	72	57	*0.293*	62	82	*0.211*
L5-S1	82	33	115	18	52	52	*0.304*	44	71	*0.559*

Table II. Spondylosis findings by age group and sex.

	+	%	GE1 (28)	GE2 (107)	GE3 (82)	*p*	Men (87)	Mujeres (130)	*p*
Osteophytes	75	34.56	3	37	35	*0.009*	37	38	*0.044*
Arthropathy	133	61.29	9	54	70	*0.000*	84	49	*0.000*
Listhesis	40	18.43	0	13	27	*0.000*	12	28	*0.149*
Canal stenosis	53	24.42	0	17	36	*0.000*	25	28	*0.227*
LF Hypertrophy	72	33.18	5	31	36	*0.018*	32	40	*0.357*

Table III. EMG findings by age group and sex.

Root	+	%	GE1 (28)	GE2 (107)	GE3 (82)	*p*	Men (87)	Women (130)	*p*
L2-L3	17	7.8	2	5	10	*0.160*	6	11	*0.674*
L4	150	69.1	20	71	59	*0.683*	53	97	*0.032*
L5	169	77.9	20	84	65	*0.673*	74	95	*0.037*
S1	99	45.6	11	42	46	*0.054*	44	55	*0.231*

Figure 1: MRI with sagittal section and FSE T2 sequence. Herniated discs L4-L5 and L5-S1.

Figure 2. MRI with sagittal section and FSE T2 sequence. Herniated discs L4-L5 and L5-S1. Hypertrophy of the yellow ligament with lumbar canal stenosis.

Figure 3. Sagittal section in cadaver. Herniated disc with complete lumbar canal stenosis. Courtesy of Dr. Anna Carrera.