Relationship Of Foramen Conjunctiva Diameter And Electromyography In Degenerative Disease Of The Lumbar Spine

Electromyography and lumbar spine degeneration

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Abstract.

Introduction. Degenerative disease of the lumbar spine is an important cause of disability worldwide. Currently there is little evidence that imaging and neurophysiological studies present a significant correlation with the diagnosis of radiculopathy.

Objective. To evaluate the relationship between the diameter of the foramen conjunctiva and electromyography in degenerative disease of the lumbar spine.

Material and methods. Retrolective, non-probabilistic study; 58 patient records of INR LGII patients with diagnosis of degenerative lumbar spine prosperous lumbar region with pre-surgical electrodiagnostic studies in the year 2018 were included.

Results. The relationship between the level of involvement by Electromyography (EMG) and the level of involvement by Magnetic Resonance Imaging (MRI) in patients with a diagnosis of degenerative lumbar spine disease was obtained. A correlation was found between the diagnosis by means of MRI with the diameter of the foramen conjunctiva and the results obtained in the EMG. Although it is not significant, there is a tendency to present data of membrane instability when the foramen of conjunction is narrower.

Conclusion. There is a relationship between the diameter of the foramen of conjunction and electromyography in degenerative disease of the lumbar spine.

Keywords— ***Electromyography, Magnetic Resonance Imaging, Degenerative disease, Lumbar spine, Radiculopathy.***

INTRODUCTION

Degenerative lumbar spine disease is a major cause of disability worldwide; it encompasses conditions such as intervertebral osteochondrosis, facet degenerative joint disease, and spinal stenosis. Associated with a variety of clinical symptoms, including lower extremity pain, weakness, and low back pain of varying levels of severity, the degenerative lumbar spine disease can lead to reduced quality of life [1].

This is due to changes in the bony structures and soft tissues of the spine, caused by aging, dynamic changes and sometimes genetic alterations [2].

At the epidemiological level, mechanical, inflammatory, vascular and autoimmune factors are involved in low back pain of mechanical-degenerative cause. The presence of degenerative changes has been demonstrated in elderly patients; however, changes have been found in 50% of the population at the end of the fourth decade, in 70% at the end of the fifth decade and in 90% at the age of 70 years [3,4].

Each year, 266 million individuals (3.63% of the population) worldwide are diagnosed with the degenerative low back disease; the highest estimated incidence is in Europe (5.7%; 5668 per 100 000) and the lowest was in Africa (2.4%). Thirty-nine million individuals (0.53%) worldwide were diagnosed with spondylolisthesis, with the highest estimated incidence in Europe (0.83%) and lowest in Africa (0.36%). Nearly 400 million individuals (5.5%) are diagnosed with pathological disc degeneration worldwide annually. A total of 102 million individuals (1.4%) was found to be diagnosed with spinal stenosis worldwide [1,5].

Degenerative disease of the lumbar spine is established by multiple factors of pathological character or by isolated situations that occur during life, which may be conditioned by the traumatic events of variable degree, such as microtraumas or by medium and high impact sports activities, which modifies the conditions of dynamic stability or structural alignment of the various elements that make up the spine [2,6].

Electrodiagnostic examination in the initial stage has been often normal. During the progression of the pathology, electrophysiological changes occur, including conduction disturbances, axon loss, and demyelination. Sensory neuroconduction and motor nerve studies remain normal until axonal loss progresses [7].

The literature indicates that 35% to 64% of patients with radicular pain has abnormal changes on electromyography and 51% to 86% of those with abnormal neurological examinations. Electromyography has 72% sensitivity and 85% specificity in abnormal neurological patients [8,9].

It has been proven that electrodiagnostic studies carry little weight in the diagnosis of lumbar stenosis compared to history, physical examination and imaging studies; however, electrodiagnostic studies are indicated when clinically there is neurological involvement to make a differential diagnosis with polyneuropathy, so correlation with imaging studies is important [10].

Studies have shown a high diagnostic accuracy of MRI imaging (93.57%) in the detection of the compressed nerve root (L5 and S1). The accuracy of detection of the compressed root by EMG is also higher than with MRI, the combination of these methods with neurological examination: MRI (57.6% - 81.8%), EMG (51% -86%). The higher diagnostic accuracy of EMG may be attributed to the close relationship between lumbar nerve roots and lower extremity muscles [11].

There is an association electrodiagnostic study with imaging studies, however, EMG is significantly more related to the clinical picture than MRI. Therefore, EMG can be a useful diagnostic tool to establish necessary management and prevention protocols, as it tells us about the function of the nervous system starting from the spinal cord root. However, MRI provides better visualization of anatomical parameters and structural details that may or may not be associated with degenerative changes [12].

The diameter of the constitutional canal is unmodifiable and can be measured in conventional radiology (distance between the vertebral body and the posterior aspect of the laminae). Its mean value is 19 mm from L1 to L5 and 20 mm from L5 to S1. It is considered that there is a relative reduction when this diameter is between 10 and 12 mm. Below 10 mm in length of the anteroposterior diameter, an absolute reduction of the lumbar canal is considered to exist [13].

Other authors consider that the measurement of the foramen of conjunction at the lumbar level in its vertical diameter from 11.6 to 14.2 and transverse from 9.7 to 12.2 mm. Considering decrease below 10 mm [14].

To date, there are no studies that relate the measurement of the foramen of conjunction with the findings of electrodiagnostic studies, however, there have been attempts to relate some MRI findings. One of the most frequent MRI findings is a protrusion (37.8%) and the most frequent EMG finding was reinnervation (59.5%). Of the EMG findings that are normal in more than 50% there may be anatomical alterations on MRI [10,11]. Based on this background the aim of the present work was to establish the relationship of the diameter of the foramen of conjunction and electromyography in degenerative disease of the lumbar spine.

MATERIALS AND METHODS:

Study design:

Fifty-eight records were included patients with a diagnosis of degenerative lumbar spine, post-operated in the lumbar region, who had a pre-surgical electrodiagnostic study, attended at the Instituto Nacional de Rehabilitación LGII (National Rehabilitation Institute LGII, Mexico City, Mexico). In a non-probabilistic retrolective study. The records of the automated intrahospital system (SAIH) were reviewed and the database was created with this information.

The file number of patients surgically treated at the INR LGII from January to December 2018, with a diagnosis of degenerative disease of the lumbar spine (disc herniation, lumbar spondylosis, ductal stenosis) was requested, subsequently the files of patients who had standard electrophysiological studies (NCM, NCS, and EMG) were reviewed in the hospital information access system (SAIH). Under the following inclusion criteria: Individuals over 18 years of age, of both sexes who had an electrophysiological study, measurement of the conjunctival foramen and who underwent surgical treatment for a diagnosis of degenerative lumbar spine. Files with infectious pathology, tumors or rheumatic disease were eliminated. The sample size was calculated as 68 patients for a confidence level of 95% and a statistical power of 80%, and 120 patients for a power of 95%. This study was conducted in accordance with the Declaration of Helsinki. Privacy and confidentiality of the data in the clinical records were maintained by signing a confidentiality letter. This study is an investigation with minimal risk, according to the Regulations of the General Health Law (Second Title, Chapter I, art. 17). It was carried out in accordance with the provisions of the Nuremberg Code, the Declaration of Helsinki of the World Medical Association in the conduct of medical research on human beings, revised in Tokyo in 2000, and the Regulations of the General Law on Health Research for Health, Official Mexican Standard NOM-O12-SSA3-2012.

STATISTICAL ANALYSIS

Means and standard deviations, frequencies and percentages were determined. The chi-square test and Student's t-test was applied. Statistical analysis was performed with the SPSS v22 program. Statistical significance was $p \leq 0.05$, with a 95% confidence interval.

Results

In relation to lumbar degeneration, we observed that the time of evolution had a range of 2 to 20 years and a mean of 43.19±4.49 months, which is approximately 3.5 years. The mean time of evolution was greater in the male vs female sex (49.29±39.76 vs 40.38±48.14 months), however, it was significantly different ($p>0.05$). 74.1% (43 cases) did not present positive smoking, nor comorbidities. 8.6% (5 cases) mentioned that they used tobacco/cigarettes, 6.9% (4 cases) had a diagnosis of diabetes mellitus, 3.4% (2 cases) had a rheumatic disease and 6.9% (4 cases) had another comorbidity. It was not possible to assess obesity because not all patients had a record of their body weight and height.

The relationship between the root level affected by EMG and the level affected by MRI, in which a concordance of 6.89% was obtained for membrane instability alterations in the EMG at L4/L5/S1 levels and MRI alterations at the L4 level, as well as 3.44% of the L4/L5 levels by MRI. The EMG affectation of the L5 level was related in 5.17% with L4/L5 levels affected by MRI, at L5 and S1 levels altered by EMG a 10.3% relationship was found with L4 and L5 levels by MRI. It was observed that even though in some cases there was an MRI image with alterations there were no changes in the electromyography, on the other hand, there are also cases where data of membrane instability are found in an image study without alterations. The concordance when all lumbar levels are affected in the EMG was 0 for levels L1 to L4 and 1.72% (1/58 cases) for level L5 by MRI, likewise the highest concordance was found when levels L4, L5 and S1 are affected by EMG with the levels affected by MRI in 6.89% (4/58 cases) for L4.

In cases in which the voluntary activity phase was not performed in the EMG to assess the reinnervation data, 24.13% (14/58 cases) were found to present alterations in the MRI at the L4/ L5 levels. When no level presented alterations in the EMG, it was found that 24.13% (14/58 cases) presented alterations in the MRI at the L4 and L5 levels. There was no concordance between the result of electromyography with reinnervation data (EEGr) and the result of MRI for L3. There was no coincidence when L5 presented EMGr alteration with MRI. When alterations were found in L4/L5 by EMGr, alterations were found only in 3.44% (2/58 cases) in L4 by MRI, in the alteration of L4/L5/S1 by EMGr, alterations were found only in 1.72% (2/58 cases) in L4 by MRI, and when alterations were found in L5/S1 by EMGr, no level was found to affected by MRI or only L4/L5 in 3.44-% (2/58 cases) respectively.

No concordance was found when all roots were affected by EMG and the surgical level, only concordance was observed when L5 root was affected by EMG was 5.17% with L4/L5 surgical level of 5.17% (3/58 cases), and 10.3% (6/58 cases) of L5/S1 levels by EMG and L4/L5 surgical levels. 6.89% (4/58 cases) had concordance between the L4/L5/S1 levels affected by EMG and the L4 surgical level and 5.17% with the L4/L5 level (Table 1).

When it comes to reinnervation findings vs. surgical level, the highest concordance is found when the L5/S1 level is affected by EMGr with the L4/L5 surgical level. It was also found that, although there is no data of reinnervation by EMG, the most frequent surgical levels were L4 and L5.

Table 1. Relationship between the root level affected by EMG and the surgical level.

		Surgical root level							
P=0.001 N=58		L2/L3/ L4	L3	L3/L4	L3/L4/ L5	L3/L5	L4	L4/L5	L5
Root level affected by EMG	None	0	1.72% (1)	0	0	0	3.44% (2)	6.89% (4)	0
	L1/L2/ L3/L4/ L5/ S1	0	0	0	0	0	0	0	1.72% (1)
	L2/L3/ L4/L5	0	0	0	0	0	1.72% (1)	0	0
	L2/L3/ L4/L5/ S1	0	0	1.72% (1)	1.72% (1)	0	0	1.72% (1)	0
	L2/L4/ L5	0	0	0	0	0	0	0	1.72% (1)
	L3	0	0	0	0	0	0	0	1.72% (1)
	L3/L4/ L5/S1	0	0	1.72% (1)	0	0	0	0	0
	L4	0	0	0	0	0	1.72% (1)	0	1.72% (1)
	L4/L5	0	1.72% (1)	1.72% (1)	0	0	1.72% (1)	0	0
	L4/L5/ S1	0	0	0	1.72% (1)	0	6.89% (4)	5.17% (3)	3.44% (2)
	L4/S1	0	0	1.72% (1)	1.72% (1)	0	0	0	0
	L5	0	0	0	0	0	0	5.17% (3)	1.72% (1)
	L5/S1	1.72% (1)	0	5.17% (3)	0	1.72% (1)	3.44% (2)	10.3% (6)	5.17% (3)
	S1	0	0	0	0	0	1.72% (1)	1.72% (1)	3.44% (2)

EMG=Electromyography; MRI=Magnetic resonance imaging

The concordance between the L5 level altered by EMGr and surgical level was 1.72% (1/58 cases) (Table 2).

Tabla 2. Relationship between the root level affected by EMG (reinnervation data) and the Surgical level.

		Surgical root level							
P=0.01 N=58		L2/L3 / L4	L3	L3/L 4	L3/L4 / L5	L3/L 5	L4	L4/L5	L5
EMG-affected root level (reinnervation		1.72% (1)	1.72 % (1)	8.62 % (5)	0	1.72 % (1)	8.62% (5)	24.13 % (14)	8.62% (5)
	None	0	1.72 % (1)	1.72 % (1)	3.44% (2)	1.72 % (1)	24.13 % (3)	1.72% (1)	24.13 % (3)
	L3	0	0	0	0	0	0	0	1.72% (1)
	L4/L5	0	0	0	0	0	3.44% (2)	0	0
	L4/L5 , S1	0	0	0	0	0	1.72% (1)	0	0
	L5	0	0	0	0	0	0	0	1.72% (1)
	L5/S1	0	0	0	0	0	0	24.13 % (3)	0
	S1	0	0	0	0	0	1.72% (1)	3.44% (2)	0

EMG: Electromyography

It was found that the foramen of conjunction at the L4-L5 levels measures on average 10.89 mm ± 3.41 when there is data of membrane instability and 11.79 mm ± 7 when there is no data, likewise at these levels when there is data of reinnervation it measures 10.57 mm ±3.65 and 13.74 mm ±4.0 when there is no data (table 3), these data show that there is a tendency to present data of membrane instability when the foramen of conjunction is narrower.

Table 3. Relation of the diameter of the foramen conjunctiva to the EMG

		Membrane instability			Reinnervation	
	Vertebral level (root)	Yes Mean ±DE	No Mean±ED		Yes Mean±DE	No Mean ±ED
Diámeter (mm)	L1-L2 (L1)	15	-	Diámeter (mm)	-	-
	L2-L3 (L2)	12 ±4.24	-		-	15
	L3-L4 (L3)	10 ±2.62	-		8	11.6 ±3.13
	L4-L5 (L4)	10.89 ±3.41	11.79 ±7		10.57±3.65	13.74±4.03
	L5-S1 (L5)	10.44±3.04	9.55±4.49		10.21±3.65	11.46 ±4.29

EMG= Electromyography, SD=Standard Deviation.

Table 4 shows that in the study population was found that the most affected levels or the most frequent combination of them, was L5/S1 with 27.6% (16/58 cases); followed by L4/L5/S1 with 17.2% (10/58 cases) and in 12.1% of the cases that EMG was performed, no data of membrane instability were obtained.

Table 4. Frequency of the root level affected by membrane instability, according to the EMG result.

	N=58	% (n)		% (n)
Affected root level	nONE	12.1 (7)	L5/S1	27.6 (16)
	L3	1.7 (1)	L2/L4/L5	1.7 (1)
	L4	3.4 (2)	L4/L5/S1	17.2 (10)
	L5	6.9 (4)	L3/L4/L5/S1	5.2 (3)
	S1	6.9 (4)	L2/L3/L4/ L5	1.7 (1)
	L4/L5	5.2 (3)	L2/L3/L4/ L5/S1	5.2 (3)
	L4/S1	3.4 (2)	L1/L2/L3/L4/L5/S1	1.7 (1)

EMG= Electromyography

The frequency with which data of membrane instability were found by radicular level, the levels with data of reinnervation were the combination L5/S1, and S1 alone with 12.5% (3/24 cases) respectively, likewise it is observed that 50% of the cases (12/24) did not present data of reinnervation. And the frequency of root level surgically intervened, where it can be observed that the root levels that were mostly intervened were L4/L5 with 34.5%, followed by L5 and L4 levels separately with 20.7% respectively, and L3/L4 levels by 12.1%.

In MRI, the levels with the highest frequency of involvement were L4/L5 with 32.8%, followed by L4 and L5 separately with 20.7% and 15.5%, respectively.
Of the total files analyzed, 20.7% (12/58 cases) had only a diagnosis of intervertebral osteochondrosis, 8.6% (5/58) with a diagnosis of facet degenerative joint disease, central spinal stenosis 17.2% (10/58) and foraminal spinal stenosis 5.2% (3/58). However, there is

a combination of these pathologies, the most frequent being the combination of the three pathologies with 15.5%.

Among the results obtained, we also found that of the 58 cases analyzed, 87.9% (51/58 cases) presented data of membrane instability, likewise, of the studies performed, only 48% (24/58 cases) of the cases underwent the voluntary activity phase to measure reinnervation data and of these, 50% presented positive data for reinnervation.

For the measurement of disc height, it was found that the roots of the L3-L4 levels had a mean of 7.4mm ±2.92, L4-L5 8.55 mm ±2.86 and L5-S1 levels 7.5mm ±2.54. For the same levels, the measurement of the foramen of the conjunction was found to be 10 mm ±2.62, 11.03 mm ±3.67 and 10.34 mm ±3.16, respectively.

When the measurement of the foramen of conjunction at the L4-L5 and L5-S1 levels was related to the levels by EMG it was found that the smallest mean corresponds to the L4 EMG levels with 8 mm ±3.67 and L3, L4, L5, S1 with 8.87±0.80. The smallest disc height was for the L3, L4, L5, S1 combination of EMG with the L4-L5 level and L2, L3, L4, L5, S1 for the relation with L5-S1.

The MRI diagnoses most associated with membrane instability data were Intervertebral Osteochondrosis with 18.96%, followed by central canal stenosis with 15.51% and the combination of OI+EADF+EEC with 13.79% (Table 5).

Table 5. Relationship between MRI diagnosis and membrane instability data in EMG.

	p=0.98	Membrane instability EMG diagnosis		
		Yes % (n=51)	No % (n=7)	Amount (N=58)
MRI diagnosis	NE	5.15%(3)	1.72%(1)	6.89%(4)
	OI	18.96%(11)	1.72%(1)	20.68%(12)
	OI+EADF	6.89%(4)	1.72%(1)	8.62%(5)
	OI+EADF+EEC	13.79%(8)	1.72%(1)	15.51%(9)
	OI+EADF+EEF	1.72%(1)	0	1.72%(1)
	OI+EEC	3.44%(2)	0	3.44%(2)
	OI+EEF	3.44%(2)	0	3.44%(2)
	EADF	6.89%(4)	1.72%(1)	8.62%(5)
	EADF+EEC	5.15% (3)	1.72%(1)	6.89%(4)
	EADF+EEF	1.72%(1)	0	1.72%(1)
	EEC	15.51%(9)	1.72%(1)	17.24%(10)
	EEF	5.15% (3)	0	5.15%(3)

EMG= Electromyography; MRI= Magnetic resonance imaging; IO= Intervertebral osteochondrosis; FJD= Degenerative facet joint disease; CSD= Central spinal stenosis; FSS= Foraminal spinal stenosis; NS= not specified.

Discussion

The main objective of the present work was to establish the relationship between the diameter of the foramen of conjunction and electromyography in degenerative disease of the lumbar spine.

Since this degenerative disease is a major cause of disability in the world; it encompasses conditions such as intervertebral osteochondrosis, facet degenerative joint disease and spinal stenosis, associated with a variety of clinical symptoms, including lower extremity pain, weakness, and low back pain of varying levels of severity, degenerative lumbar spine disease can lead to a reduction in quality of life [1].

We know from the literature that low back pain is the main reason why patients come to the doctor's office. Different factors are involved in this pathology, such as mechanical, inflammatory, vascular and autoimmune factors. The presence of degenerative changes has been demonstrated in elderly patients; however, changes have been found in 50% of the population at the end of the fourth decade, in 70% at the end of the fifth decade and in 90% at the age of 70 years or more [3,4].

Our results showed that 69% of the populations were female and 31% male. This information is especially useful since there are few reports on the proportion of this variable. The mean age was 53±15.41 years, with a minimum age of 20 and a maximum of 86 years. No differences were observed in relation to age and sex, however, women had an average age 3 years older than men. This is consistent with what has been reported in the literature [16].

In relation to lumbar degeneration, we observed that the time of evolution had a range of 2 to 20 years and an average of 43.19±4.49 months, which is approximately 3.5 years. The mean time of evolution was greater in the male vs. female sex, however, it was not significantly different (p>0.05). Several studies have shown that this behavior is due to degenerative changes in the lumbar spine, which are due to multiple pathological factors or conditions due to congenital malformations or traumatic events, which impact on bony structures of the spine and soft tissues; these changes can predispose or accelerate degeneration [15]. The mechanical-degenerative pathology of the spine can affect the spinal nerve or its roots at various levels: vertebral body and intervertebral disc, root canal, and foramen of conjunction. Nerve involvement is not only caused by compression. Therefore, irritative-inflammatory, tension and stretching phenomena affecting the nerve fiber and its vascularization should always be assessed [3,17].

Regarding other factors that may influence the degenerative process, there is comorbidity. Since various associated pathologies can accelerate deterioration in the lumbar spine. Factors that may contribute to this type of pathology have been

proposed, such as the inclination of the inferior interdiscal line and the intervertebral disc, alteration of the orientation of the facet joints; in addition to the patient's weight, sedentary lifestyle, work activity and above all the comorbidities associated with this lifestyle [3,18,19].

Degenerative disease of the lumbar spine is established by multiple factors of pathological character or by isolated situations that occur during life, which may be conditioned by traumatic events of variable degree, such as microtraumas or by medium and high impact sports activities, which modify the conditions of dynamic stability or structural alignment of the various elements that make up the spine [2,6].

The clinical manifestations of degenerative changes in the lumbar spine lack specificity to be able to define the altered anatomical structure. However, some authors mention that the most important symptoms are pain, sensory disorders and muscle weakness, with which it is possible to orient towards the probably affected structure [6,18]. Therefore, the results in the affected roots provide us with indications of the damage and pain that patients with this pathology may present. We can consider this relationship with the results we found in relation to the affected root level detected by EMG and the affected level detected by MRI, in which we observed a concordance of 6.89% for membrane instability alterations in the EMG at L4/L5/S1 levels and MRI alterations at the L4 level, as well as 3.44% of the L4/L5 levels by MRI.

It is important to emphasize that we found some cases where there was an MRI image with alterations, but there were no changes in the electromyography, although there were cases where there were data of membrane instability with an imaging study without alterations.

Previous studies have shown that there is a high diagnostic accuracy of magnetic resonance imaging (93.57%) in the detection of the compressed nerve root (L5 and S1). The accuracy of detection of the compressed root by EMG is also higher than with MRI, so it is of vital importance to combine these methods with neurological examination: MRI (57.6% - 81.8%), EMG (51% -86%). The higher diagnostic accuracy of EMG may be attributed to the close relationship between lumbar nerve roots and lower extremity muscles [11].

Although in our study there was no coincidence between the results of electromyography with reinnervation data (EMGr) with the result of MRI for L3. There was no concordance when L5 presented EMGr alteration with MRI. When there were alterations in L4/ L5 by EMGr only alteration in L4 was found by MRI, in L4/L5/ S1 alteration by EMGr, and alteration in L4 by MRI, in addition, alteration in L5/S1 was found by EMGr but was not seen at any level affected by MRI.

It has been shown that diagnostic neuroimaging, in the study of degenerative disorders of the spine, has a great relevance [6,10]. Especially MRI, which includes multiple vertebral segments in a single field of study, also allows a reduction in study time, with faster availability of images, better anatomical definition, optimal sensitivity and effective informative specificity [20,21].

However, EMG has shown great efficacy in early diagnosis. Our work showed that in some cases there was more sensitivity than imaging studies.

Since it is difficult to make a diagnosis without considering both tests (MRI and EMG), it is worth mentioning that sometimes no relationships or concordances are found between these studies and the surgical decision. To give an example, we did not find concordance when all the roots were affected by EMG and the surgical level; concordance was only observed when the L5 root was affected in the EMG with the L4/L5 surgical level. This result is of vital importance, since the treating physician must make the surgical decision based on previous studies.

However, it was found that the foramen of conjunction at the L4-L5 level measures on average 10.89 mm ± 3.41 when there is data of membrane instability and 11.79 mm ± 7 when there is none, likewise at these levels when there is data of reinnervation it measures 10.57 mm ±3.65 and 13.74 mm ±4.03 when there is none. These data show that there is a tendency to present membrane instability when the foramen of conjunction is narrower [22]. In EMG studies, abnormal spontaneous activity is obtained as fibrillation potentials and positive waves (data of membrane instability) in two or more muscles that share the same spinal nerve, but different peripheral nerve and paraspinal muscles, mainly in the diagnosis of lumbosacral radiculopathy [23,24]. Hence the importance of performing both phases of electromyography in patients with lumbar pathology.

In the study population, it was found that the most affected levels or the most frequent combination of these was L5/S1; followed by L4/L5/S1 and of the cases that EMG was performed, no data of membrane instability were obtained.

Although spinal radiographs are the first imaging study recommended [10,18]. Lumbar degeneration can be suspected in simple studies, but it should be considered that narrowing due to osteophytes or fibrotic changes in its non-calcified phase will not be detected in simple radiology. In general, this technique does not allow defining a positive diagnosis, but it helps to detect congenital or acquired problems prone to cause

stenosis [4,25]. The evaluation of the patient with degenerative lumbar spine consists of electromyography (EMG), sensory neuroconduction of the sural nerve, superficial peroneal nerve and motor neuroconduction of the tibial and peroneal nerve, late responses, and somatosensory and dermatomal evoked potentials [8,26].

On the other hand, intervertebral osteochondrosis, associated with multidirectional bulging, disc extrusion and protrusion, affects L4-L5 and L5-S1 to a greater degree. The main location of disc herniations is posteromedial [6]. Lumbar roots may be irritated or compressed due to pathological conditions such as disc herniations, degenerative foraminal stenosis, trauma and tumors [16].

In this investigation, we found that of the total number of records analyzed, 20.7% had only a diagnosis of intervertebral osteochondrosis, 8.6% with a diagnosis of facet degenerative joint disease, central spinal stenosis 17.2% and foraminal spinal stenosis 5.2%. However, there is a combination of these pathologies, the most frequent being the combination of the three pathologies with 15.5%.

Among the results obtained, we also found that of the 58 cases analyzed, 87.9% presented data of membrane instability; likewise, of these studies, only 48% of the cases underwent the voluntary activity phase to measure reinnervation data and of these, 50% presented positive data for reinnervation.

The literature mentions that the diameter of the constitutional canal is unmodifiable and can be measured in conventional radiology (distance between the vertebral body and the posterior face of the laminae). Its average value is 19 mm from L1 to L5 and 20 mm from L5 to S1. A relative reduction is considered to exist when this diameter is between 10 and 12 mm. Below 10 mm in length of the antero-posterior diameter, an absolute reduction of the lumbar canal is considered to exist [27].

Our results showed that the foramen of conjunction at the L4-L5 level measures on average 10.89 mm ± 3.41 when there is data of membrane instability and 11.79 mm ± 7 when there is none, likewise, at these levels when there is data of reinnervation, it measures 10.57 mm ±3.65 and 13.74 mm ±4.0 when there is none, these data show us that there is a tendency to present data of membrane instability when the foramen of conjunction is narrower. This data is of utmost importance when contrasted with what is reported in the literature.

Finally, we were able to corroborate that the MRI diagnoses most related to membrane instability data were intervertebral osteochondrosis with 18.96%, followed by central canal stenosis with 15.51% and the combination of OI+EADF+EEC with 13.79%.

The relevance of this study was to emphasize the importance of electrophysiological tests that are frequently used together with imaging modalities for the evaluation of low back pain, which radiates to the extremities, mainly to establish the presence or absence of radiculopathy. The efficacy of EMG and neurological examination for prediction of electrodiagnostic testing is limited. A normal neurological examination in a patient with suspected radiculopathy cannot eliminate abnormal electrodiagnostic test results; similarly, finding abnormalities on neurological examination does not mean finding pathology on electrodiagnostic testing [7,26].

Focusing this research on early and timely detection will improve the patient's quality of life. Since pain is the main symptom, mainly due to the discomfort of varying individual perception and intensity, its frequency of presentation and disability [19,20].

On physical examination, low back pain or lower extremity symptoms may be elicited with lumbar extension. Objective sensory findings, such as diminished sensation along a specific dermatome or motor weakness, suggest long-standing neural compression. Radicular symptoms are most often seen in patients with lateral recess or foraminal stenosis [4,28].

Electrodiagnostic examination in the early stage is often normal. During the progression of the pathology, electrophysiological changes occur, including conduction disturbances, axon loss, and demyelination. Sensory neuroconduction and motor nerve studies remain normal until axonal loss progresses [16].

The literature indicates that 35% to 64% of patients with radicular pain has abnormal changes on electromyography and 51% to 86% of those with abnormal neurological examinations. Electromyography has a sensitivity of 72% and specificity of 85% in abnormal neurological patients [8,9].

There is an association electrodiagnostic study with imaging studies, however, EMG is significantly more related to the clinical picture than MRI. Therefore, EMG can be an especially useful diagnostic tool to establish necessary management and prevention protocols, since it indicates the function of the nervous system from the spinal cord root, and earlier electrophysiological changes.

However, we should not discard the important relationship between the electrodiagnostic study and MRI, since the latter offers a better visualization of anatomical parameters and structural details that may

or may not be associated with degenerative changes 12,16].
Therefore, both studies should be considered for an intervention that leads to better results.

CONCLUSION

The relationship between the diameter of the foramen of conjunction and electromyography in degenerative disease of the lumbar spine was established.
The relationship between the level of EMG involvement and the level of involvement in MRI in patients diagnosed with degenerative disease of the lumbar spine was identified.

Ethical considerations

The authors declare that the procedures followed conformed to the ethical standards of the committee on responsible human experimentation and in accordance with the World Medical Association and the Declaration of Helsinki 2008.
Confidentiality of data. The authors declare that no patient data appear in this article.
Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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