ELECTROPHYSIOLOGICAL RELATIONSHIP ON THE RADIOGRAPHIC MEASUREMENT OF INTERVERTEBRAL FORAMS IN PATIENTS WITH DEGENERATIVE DISEASE OF THE LUMBAR COLUMN

Electrophysiology in lumbar degeneration

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***Abstract*— Degenerative disease of the lumbar spine is a frequent cause of attention in our population. The somatosensory evoked potentials (SSEPs) of the tibial and dermatomal nerve (SSEPD) have been implemented as a diagnostic tool to evaluate pathology of the lumbar spine, however the existing literature is limited and their association with radiographic measurements of the intervertebral foramina is not mentioned. lumbar involved. The main was to determine the relationship between the latency and amplitude values of the tibial nerve SSEPS, L5 and S1 with the diameters of intervertebral foramina L4-L5 and L5-S1 in patients operated on the lumbar spine for degenerative disease. Retrolective, cross-sectional, descriptive study was made. Medical records of patients operated in 2018 on the lumbar spine for degenerative disease with studies of SSEPs and SSEPD were reviewed. Information was obtained from latency and amplitude measurements of evoked potentials (from tibial nerve and bilateral L5 and S1 dermatomes) and from measurements of foraminal diameters by radiographic study of the lumbar spine. Statistical analysis was performed using measures of central tendency and Pearson's test. No significant correlation was found between the latency values of the tibial nerve SSEPS, L5 and S1 with the diameters of the intervertebral foramina L4-L5 and L5-S1 (p> 0.05), however in the case of the amplitude it was observed a negative correlation in L5 but only on the left side (p <0.05). The present study does not show an association between the diameters of the intervertebral foramina L4-L5 and L5-S1 with the prolongation of latencies or decrease in amplitude of the L5 and S1 dermatomal and tibial nerve PESSs.**

Keywords—Intervertebral forams, Lumbar degeneration, Electrophysiology, Radiographic measurement, Lumbar column, Degenerative disease

I.- INTRODUCTION

Degenerative disease of the lumbar spine occurs in the normal evolution of human body aging with modifications of the bone structures of the spine and soft tissues that, associated with congenital or acquired factors, can predispose or accelerate the deterioration of the various elements that make up the spine. [1] These alterations are usually accompanied by degenerative changes in the muscle groups that support the spine, predisposing to degeneration of intervertebral discs and articular facets, as well as thickening of the yellow ligaments and the formation of hypertrophic processes in the vertebral bodies causing spinal stenosis. [2]

At the lumbar level, the intervertebral foramina (IVF) have an oval shape with a long vertical axis. The L5-S1 foramen is the roundest and smallest of the lumbar IVFs. The collapse of lumbar IVFs is equivalent to the reduction of the foraminal height. IVF has numerous components, nerve roots, spinal nodes, foraminal fat, foraminal veins, radicular arteries, lymphatic vessels, meningeal nerves, and foraminal ligaments. The total area of the neurovascular bundle is estimated to occupy between 20-50% of the total foraminal area. [3]

In any of the foramina, compression of nerve elements can occur that, in general, produce a painful clinic and / or radicular syndrome, according to the American Association of Neurosurgeons, this group of diseases corresponds to the herniated discal, spondylosis and duct stenosis. Although the literature lacks concise epidemiological data, it frequently affects the economically active population, with repercussions on global productivity, low back pain is the second cause of absenteeism from work and around 25 million people lose one or more days of work due to low back pain. Patients with chronic back pain account for 80% to 90% of all health care expenses; [4] most reports estimate approximately a 3-5% prevalence rate of lumbosacral radiculopathy in patient populations. Low back pain is estimated between 13% and 31%, the incidence of radicular symptoms varies between 12% and 40%. [5] Evoked potentials are the responses of the central nervous system to external stimuli, and somatosensory evoked potentials (SEPs) are produced as a result of stimulation of peripheral afferent nerve fibers assess the integrity of the somatosensory pathway from cutaneous receptors or myelinated peripheral nerves (type IA) to the primary somatosensory cortex. [6]

The SSEPs recording represents an objective measure of the integrity of the somatosensory system and helps to locate sites of injury by determining abnormalities that impair conduction. Abnormalities in the amplitude, latency, and spinal conduction time of

the response uncover conduction blocks of the somatosensory pathway. The waves recorded in the cortex when performing tibial nerve stimulation show a negative / positive complex called P37 and N45, the P37 latency measurement and the amplitude of the recorded potential are analyzed to determine if they are within normal parameters and are compared Between the two sides of the patient, if there is a significant difference between the two, it is also determined as altered and is useful for diagnosis. [7]
Dermatomal SSEPs (PESSD) have been used since the 1980s, finding that they have many limitations and little diagnostic value compared to standard electrodiagnostic techniques. Various investigations that have correlated imaging studies such as MRI with SSEPD are inconclusive, in addition, there is not always a direct relationship between abnormal SSEPD levels and stenotic levels found by imaging. [8] For this reason, the objective of this work is to determine the relationship between the latency and amplitude values of the tibial nerve SSEPs, L5 and S1 with the diameters of intervertebral foramina L4-L5 and L5-S1 in operated patients lumbar spine due to degenerative disease within the "Luis Guillermo Ibarra Ibarra" National Rehabilitation Institute.

II.- MATERIAL AND METHODS

A retrolective, cross-sectional and descriptive study was carried out. Included in this study were adult individuals of both sexes who have a study of SSEPs of the tibial nerve and SSEPD of levels L5 and S1, who have received surgical treatment of the lumbar spine in 2018 for degenerative spinal disease, among which are patients with lumbar stenosis, degenerative disc disease and spondylolisthesis among others. On the other hand, patients with infectious or tumorous pathology of the lumbar spine, patients with rheumatological disease affecting the lumbar spine, and patients with a history of lumbar spine surgery were excluded from the study. Patients whose files have incomplete information or do not have a pre-surgical SSEPs study were eliminated.

For convenience, the records of patients who received surgical treatment at this institution between January 1, 2018 and December 30, 2018 were analyzed, so a specific sample size is not determined for this study. The files of the automated intrahospital system (SAIH) were reviewed and the data was emptied into a data collection sheet.

Permission was requested from the Spine Surgery service to use the database of patients who were surgically treated with a diagnosis of degenerative disease of the lumbar spine (herniated disc, lumbar spondylosis, duct stenosis). Subsequently, permission was requested from the Electrodiagnostic service to access the electronic clinical records through the intrahospital system (SAIH) and the imaging studies viewer. The records of patients who were treated surgically with a diagnosis of degenerative disease of the lumbar spine and who have electrophysiological studies of somatosensory evoked potentials of the tibial nerve and L5 and S1 dermatomes were reviewed. When reviewing the records, patient data was identified: sex, age, weight, and height. Radiographic measurements of the L4-L5 and L5-S1 intervertebral foramina were obtained on their vertical axis. Finally, data obtained from the files were recorded and encoded in a database.

- *Statistic analysis*

Means and standard deviations (quantitative variables), frequencies and percentages (qualitative variables) were determined. The Kolmogorov-Smirnov tests, Student's t, ANOVA and Pearson's correlation were applied. The analysis was carried out in the SPSSv20 program. A value of $p < 0.05$ was taken as statistical significance.

- *Ethical and biosecurity aspects*

In accordance with the Definitions of Risk of Research of the Regulation of the General Health Law on Research for Health in chapter I "Of the ethical aspects of research in human beings", article 17, this The research is classified as risk-free, since retrospective documentary research techniques and methods are used, without intervention or intentional modification in the variables of the individuals participating in the study, keeping their identity anonymous.

III.- RESULTS

A total of 64 patients diagnosed with degenerative lumbar spine disease were studied, who were treated surgically at the Luis Guillermo Ibarra Ibarra National Rehabilitation Institute from January 2018 to December 2018, in the present work 13 patients were included, the 51 The remaining patients were eliminated due to the lack of somatosensory evoked potential studies and a complete clinical record.

13 cases were analyzed, of which 61.5% (8 cases) were female and 38.5% (5 cases) were male. The average age was 60.85 ± 14.88 years, with a maximum of 86 years and a minimum age of 28 years. No difference was observed between the average age of women vs men ($p > 0.05$).

The most frequent diagnosis was narrow lumbar duct with 30.8% (4 cases), followed by degenerative spondylolisthesis, lytic spondylolisthesis, degenerative scoliosis and degenerative disc disease with 15.4% (2 cases) respectively and lastly, degenerative disc herniation with 7.7 % (1 case).

Of the cases studied, according to magnetic resonance studies, the most frequently affected level was L4-L5 found in 10 of the 13 patients, which corresponds to 76.9% of the cases, followed by L5-S1 in 6 corresponding patients at 46%, L3-L4 in 4 patients, with 30.7%, L2-L3 in 2 patients (15.4%) and L1-L2 in 1 patient, with 7.7%.

Table 1 shows the diagnoses of the alterations observed in the study of evoked potentials that were performed on patients with degenerative lumbar disease. For the right tibial nerve, a higher frequency of amplitude alterations was observed, on the left side the frequency of alterations was similar. In the case of L5 and S1 dermatomes, a higher frequency of

alteration in latency was observed. Measurements of the diameter of intervertebral foramina L4-L5 show a minimum value of 8.3 mm, an average of 15.1 ± 3.7 mm and a maximum of 22.4 mm. For the L5-S1 intervertebral foramen, the minimum value was 6.6 mm, the mean was 11.68 ± 2.64 mm, and the maximum was 15.3 mm. Regarding sex, no differences were observed, however if it can be seen that in the case of the foraminal diameter L4-L5 the women had smaller diameters (mean 14.07 ± 3.59 mm, range 8.3 to 18 mm vs mean 16.8 ± 1.59 mm, range 13.4 to 22.4 mm, p> 0.05), while the L5-S1 foraminal diameter was lower in men (mean 12.44 ± 2.13 mm, range 9.5 to 15.3 mm vs mean 12.44 ± 2.13 mm, range 6.6 to 15 mm, p> 0.05).

Table 1. Diagnoses of the alterations observed in the study of evoked potentials that were performed on patients with degenerative lumbar disease. n=13

Right side	Latencies % (n)	Amplitudes % (n)	Left side	Latencies % (n)	Amplitudes % (n)
Tibial	46.2 (6)	69.2 (9)	Tibial	69.2 (9)	69.2 (9)
Dermatome L5	61.5 (8)	38.5 (5)	Dermatome L5	76.9 (10)	15.4 (2)
Dermatome S1	69.2 (9)	46.2 (6)	Dermatome S1	61.5 (8)	46.2 (6)

Table 2 shows the comparison of latencies and amplitudes of SSEPD L5 in patients diagnosed with degenerative lumbar disease. Degenerative scoliosis was the most affected diagnosis, finding two cases in which a bilateral response was not obtained. For the cases where a response was obtained, the lumbar duct showed greater prolongation of latency in the SSEPD L5 on the right side, for the left side it was degenerative disc disease. Degenerative scoliosis was the most affected pathology with two non responders, bilaterally. For the cases where a response was obtained, on the right side a lower amplitude was observed in degenerative disc disease, while on the left side the lower amplitude was observed in lytic spondylolisthesis.

Table 2. Comparison of latencies and amplitudes of SSEPD L5 in patients diagnosed with degenerative lumbar disease. n=13

	LATENCIES	
	Right Mean ± SD (n)	**Left** Mean ± SE (n)
Espondilolistesis degenerativa	46.3 ±0.35 (2)	51.1 ± 2.54 (2)
Hernia discal degenerativa	41.0 (1)	40.8 (1)
Conducto lumbar estrecho	51.68 ±7.3 (4)	50.5 ± 4.77 (4)
Enfermedad discal degenerativa	48.6 (2)	51.1 ±7.14 (2)
Espondilolistesis lítica	48.4 ±3.67 (2)	46.4 ±2.19 (2)
Escoliosis degenerativa	NR (2)	NR (2)
Value p	0.59	0.38
	AMPLITUDES	
	Right Mean ± SE (n)	**Left** Mean ± SE (n)
Degenerative spondylolisthesis	0.68 ±0.12 (2)	0.65 ± 0.21 (2)
Degenerative disc herniation	0.70 (1)	0.84 (1)
Narrow lumbar duct	0.60 ±0.11 (4)	0.68 ± 0.31 (4)
Degenerative disc disease	0.14 ±0.19 (2)	0.70 ±0.47 (2)
Lytic spondylolisthesis	0.45 ±0.20 (2)	0.58 ±0.16 (2)
Degenerative scoliosis	NR (2)	NR (2)
P value	0.006	0.21

SSEPD= Somatosensory Evoked Potential Dermatomal, SE= Standar Deviation; NR= Non response

Table 3 shows the comparison of latencies and amplitudes of SSEPD S1 in patients with diagnoses of degenerative lumbar disease. Degenerative scoliosis was the pathology with the greatest affectation, presenting two patients in whom no response was obtained bilaterally. For the responding cases, the right S1 dermatomal showed a higher latency in degenerative spondylolisthesis while the left S1 dermatomal showed a longer latency in degenerative spondylolisthesis. Degenerative scoliosis was the most affected diagnosis, with two cases in which no response was obtained bilaterally. For responding cases, the right side showed a lower amplitude in degenerative disc disease, while the lower amplitude was observed in degenerative spondylolisthesis on the left side.

Table 3. Comparison of latencies and amplitudes of SSEPD S1 in patients with diagnoses of degenerative lumbar disease. n=13

	LATENCIES	
	Right Mean ± SE (n)	**Left** Mean ± SE (n)
Degenerative spondylolisthesis	53.0 (2)	53.1 (2)
Degenerative disc herniation	44.5 (1)	46.0 (1)
Narrow lumbar duct	52.6 ±7.3 (4)	51.03 ± 6.74 (4)
Degenerative disc disease	45.4 (2)	45.3 (2)
Lytic spondylolisthesis	46.1 ±1.41 (2)	42.4 ±0.28 (2)
Degenerative scoliosis	NR (2)	NR (2)
P value	0.63	0.50
	AMPLITUDES	
	Right Mean ± SE (n)	**Left** Mean ± SE

		(n)
Degenerative spondylolisthesis	0.20 ±0.28 (2)	0.04 ±0.06 (2)
Degenerative disc herniation	0.72 (1)	0.81 (1)
Narrow lumbar duct	0.58 ±0.38 (4)	0.51 ± 0.27 (4)
Degenerative disc disease	0.18 ±0.26 (2)	0.53 ±0.74 (2)
Lytic spondylolisthesis	0.65 ±0.19 (2)	0.46 ±0.04 (2)
Degenerative scoliosis	NR (2)	NR (2)
P value	0.21	0.31

SSEPD= Somatosensory Evoked Potential Dermatomal, SE= Standar Deviation; NR= Non response

Table 4 shows the correlation between the latency and amplitude values of the tibial nerve SSEPs, L5 and S1 with the diameters of the intervertebral foramina L4-L5 in patients operated on the lumbar spine for degenerative disease. No significant correlation was observed in any of the SSEPs evaluated for latency (p> 0.05), however in the case of amplitude a negative correlation was observed in L5 but only on the left side (p <0.05). We show too the correlation between the latency and amplitude values of the tibial nerve SSEPs, L5 and S1 with the diameters of the intervertebral foramina L5-S1 in patients operated on the lumbar spine for degenerative disease. No significant correlation was observed in any of the evaluated PESS (p> 0.05).

Table 4. Correlation between the latency and amplitude values of the tibial nerve SSEPs, L5 and S1 with the diameters of the intervertebral foramina L4-L5 in patients operated on the lumbar spine for degenerative disease. n=13

		L4-L5			
		Right side		Left Side	
		r	Value P	r	P value
Latencies	Tibial	-0.029	0.92	-0.15	0.63
	L5	-0.04	0.90	-0.10	0.76
	S1	-0.14	0.70	-0.29	0.43
Amplitude	Tibial	-0.34	0.24	-0.05	0.86
	L5	-0.43	0.14	-0.62	0.02
	S1	0.09	0.75	-0.35	0.23
		L5-S1			
		Right side		Left Side	
		r	Valor P	r	P value
Latencies	Tibial	-0.35	0.25	-0.44	0.14
	L5	-0.282	0.43	0.99	0.77
	S1	-0.32	0.39	-0.30	0.41
Amplitude	Tibial	-0.24	0.42	-0.11	0.69
	L5	-0.10	0.74	0.01	0.95
	S1	-0.22	0.45	-0.22	0.46

IV.- DISCUSSION

In the present work, an electrophysiological correlation of somatosensory evoked potentials (SSEPs) was carried out with the radiographic measurement of intervertebral foramina in patients with degenerative lumbar spine disease, and the association between latency and amplitude values of the PPSS of Mixed nerve and dermatomal with the diameters of neural foramina in patients operated on the lumbar spine for degenerative disease.

The work was retrolective, transversal, descriptive. With a study universe of 64 files, of which an "n" of 13 was obtained, which met the inclusion criteria.

In a study carried out by Asil and Yaldiz, they showed that 73.0% (n = 54) were women and 27.0% (n = 20) were men. The mean age was 54.86 ± 7.87 years (range 34-74). Which agrees with our study where 61.5% (8 cases) were female and 38.5% (5 cases) male. And it agrees with the average age that was 60.85 ± 14.88 years, although we had a maximum of 86 years and a minimum age of 28 years. These data give us relevant information, because this pathology affects the economically active population, which results in absenteeism from work and to the detriment of the economy of the patients' families, it should be noted that there is very little information in the literature on these epidemiological data, so this study provides useful data to be taken into account by the health sector, especially in the field of prevention. [9]

Regarding the most frequent diagnosis, we found that it is the narrow lumbar duct with 30.8%, followed by degenerative spondylolisthesis, lytic spondylolisthesis, degenerative scoliosis and degenerative disc disease with a percentage of 15.4% in each one and degenerative disc herniation with 7.7%. It should be noted that this agrees with what has been reported in the literature where the diagnosis with a higher number of cases has always been that of a narrow lumbar duct. This is because degenerative disc disease and spinal stenosis lead to various symptoms. Spinal stenosis is defined as narrowing of the spinal canal and intervertebral foramen below a critical value, and frequently presents with claudication, leg pain, low back pain, paresthesia, and loss of strength due to ischemia as a result of compression of the neural or vascular structure. [10,11] Degeneration in the facet joints also adds to this degenerative process with aging. Degeneration of the facet joint leads to spinal instability. [10,12]

Regarding spondylolisthesis, there is possibly a relationship between proximal sacral kyphosis and the degree of said lysis in the case of L5 isthmic spondylolisthesis. [13]

On the other hand, in the results obtained from magnetic resonance imaging, the most frequently affected level was L4-L5 in 76.9% of patients, followed by L5-S1 in 46%, L3-L4 in 30.7%, L2-L3 in 15.4% and L1-L2 at 7.7%. These data are important since a higher risk of vascular injury is possibly found when it comes to the L4-L5 segment. [14] We know that degenerative disease of the lumbar spine has clinical implications that impact the psychosocial and work life

of people who suffer from it, the diagnosis is made, mainly, through magnetic resonance imaging studies (IRM), however, its high cost limits its use, especially in economically vulnerable populations. The main finding that has been reported by MRI is the bulging disc and the frequency of disc protrusion in healthy individuals, so its presence in symptomatic patients is not necessarily a cause of low back pain. [15] Therefore, SSEPs studies have been used in the diagnosis of disc disease and lumbar stenosis, in which an excellent correlation has been shown in numerous studies, between SSEPs and root involvement. [16,17]

Regarding the comparison of tibial nerve SSEPs latencies in patients diagnosed with degenerative lumbar disease. In the right tibial nerve, a longer latency was observed in degenerative spondylolisthesis, while in the left tibial nerve, a longer latency was observed in degenerative scoliosis. Studies of this type have been carried out with different approaches, such as stimulation in the tibial and peroneal nerves, composed of several nerve roots, where they found that it does not provide the required sensitivity, so in order to obtain more accurate data they used the potentials Somatosensory Evoked Dermatome (SSEPD) which consists of stimulating the skin in a dermatomal area, recording cortical responses. [18,19,20]

However, in the PPSS study performed on patients with degenerative lumbar disease, we found that the right tibial showed a higher frequency of amplitude alterations, on the left side, the frequency of alterations was similar. In the case of L5 and S1 dermatomes, a higher frequency of alteration in latency was observed. Therefore, the importance of SSEPD improvement contralateral to the symptomatic leg is emphasized. Direct compression of a nerve root by a herniated disc is probably not the only explanation for referred leg pain. [21]

Measurements of the diameter of intervertebral foramina L4-L5 show a minimum value of 8.3 mm, an average of 15.1 ± 3.7 mm and a maximum of 22.4 mm. For the L5-S1 intervertebral foramen, the minimum value was 6.6 mm, the mean was 11.68 ± 2.64 mm, and the maximum was 15.3 mm. Regarding sex, no differences were observed, however, if it can be seen that in the case of the L4-L5 foraminal diameter, the women had smaller diameters ($p > 0.05$), while the L5-S1 foraminal diameter was smaller in the men ($p > 0.05$).

Comparison of tibial nerve SSEPs amplitudes in patients diagnosed with degenerative lumbar disease. In degenerative scoliosis, the lower average amplitude was observed for the right and left side compared to the other pathologies, this had a significance of $p < 0.001$.

Comparison of SSEPD L5 latencies in patients diagnosed with degenerative lumbar disease. Degenerative scoliosis was the diagnosis in which the greatest involvement was observed, presenting two cases in which no response was obtained bilaterally. For those who did obtain a response, a greater latency was observed in the narrow lumbar duct, while on the left side a longer latency was observed in degenerative disc disease.

In patients without pre-existing instability, laminectomy for lumbar stenosis can alter the stability of the spine and cause iatrogenic spondylolisthesis. The degree of decompression of the facet joints, the number of levels decompressed, and the height of the preoperative disc space can help assess the risk of postoperative spondylolisthesis. Patients who develop recurrent radiculopathy after decompressive lumbar laminectomy should be evaluated for possible iatrogenic spondylolisthesis. [22]

In the comparison of amplitudes of SSEPD L5 in patients diagnosed with degenerative lumbar disease, degenerative scoliosis was the diagnosis in which the greatest affectation was observed, presenting two cases in which no response was obtained bilaterally. In contrast, for those who did obtain a response on the right side, $P < 0.006$ was highly significant. Where less amplitude was observed in degenerative disc disease, while on the left side the lowest amplitude was observed in lytic spondylolisthesis.

To complete this correlation, we found that when comparing SSEPD S1 latencies in patients diagnosed with degenerative lumbar disease. Degenerative scoliosis was the diagnosis in which the greatest involvement was observed, presenting two cases in which no response was obtained bilaterally. This finding shows us the degree of involvement in the deviation of the spine. Data that will help us to preventively recommend alignment therapy.

For those that did obtain a response, a greater latency in degenerative spondylolisthesis was observed in the right and left dermatomal S1. These results contrast with a recent study where a proximal sacral kyphosis was reported in both types of spondylolisthesis, greater in the lytic type. In contrast, the control group had a proximal sacral lordosis. The differences were statistically significant. Therefore, they concluded that there was a proximal sacral kyphosis in patients with degenerative lytic and isthmic spondylolisthesis, but could not determine whether it is a cause or a consequence of it. [13]

It should be noted that the results presented in this study show the importance of diagnosing this pathology by means of SSEPs and its correlation with imaging studies. As we have shown the areas where there is an abnormality in the lumbar spine. It has the characteristic of producing pain that the patient refers to as intense, hence the importance of analyzing each phase of this research in order to reduce this discomfort and improve the patient's quality of life. Likewise, the comparison of SSEPD S1 amplitudes in patients diagnosed with degenerative lumbar disease. Degenerative scoliosis was the diagnosis in which the greatest involvement was observed, presenting two cases in which no response was obtained bilaterally. On the other hand, in those that did show a response, a lower amplitude was observed in degenerative disc disease on the right side, while on the left side the

lower amplitude was observed in degenerative spondylolisthesis, although this was not significant.

In the correlation between the latency and amplitude values of the tibial nerve SSEPs, L5 and S1 with the diameters of intervertebral foramina L4-L5 in patients operated on the lumbar spine for degenerative disease. No significant correlation was observed in any of the SSEPs evaluated for latency (p> 0.05), however, in the case of amplitude, a negative correlation was observed in L5 but only on the left side (* p <0.05).

On the other hand, the correlation between the latency and amplitude values of the tibial nerve SSEPs, L5 and S1 with the diameters of intervertebral foramina L5-S1 in patients operated on the lumbar spine for degenerative disease. It was not significant in any of the SSEPs evaluated (p> 0.05).

These results show us that the degenerative disease of the lumbar spine has clinical implications that impact on the psychosocial and work life of the people who suffer from it, the diagnosis is made, mainly, through imaging studies (MRI) but, as mentioned above, they reduce the economy of the patient.

For this reason, in recent years neurophysiological studies, such as somatosensory evoked potentials, have become relevant for the diagnosis of this pathology because it allows to assess functional alterations of the sensory pathways affected in this disease. In addition, its lower cost and high tolerability to be carried out in the patient, since it is not required to maintain the same position for a long time, makes neurophysiological tests accessible to the population.

Currently, published studies address effects of the correlation of neurophysiological tests with complex imaging studies that compare imaging findings, clinical data and Electrodiagnostic studies, without taking into account the diameter of the affected neural foramen. The medical literature does not report investigations that correlate neurophysiological tests with simpler imaging methods, such as X-ray imaging (X-ray), and that take into account the diameter of the affected neural foramen. Due to the lack of information in a population such as ours, this work will allow us to carry out a more comprehensive descriptive research on these variables in the future. We can conclude that the combination of PPSS can quantitatively evaluate the time course of changes in spinal cord conductors in and below the lumbar spinal cord enlargement in the treatment of degenerative lumbosacral diseases and imaging studies, such as X-rays. And that both are complementary diagnoses for the most accurate diagnosis of degenerative lumbar spine disease.

V.- CONCLUSION

Prolonged latency, decreased amplitude or the complete absence of responses are associated by physiological principles with dysfunction of the afferent pathway, for which the combination of the tibial and dermatomal nerve SSEPs could quantitatively evaluate the functional changes of these pathways in patients with degenerative disease of the lumbar spine, however its association with the diameters of the lumbar intervertebral foramina assessed by x-ray remains a question since more studies will be required to allow it to be analyzed with a larger sample than that generated in this study.

VI.- ETHICAL RESPONSIBILITIES

Protection of people. The authors declare that the procedures followed were in accordance with the ethical standards of the responsible human experimentation committee and in accordance with the World Medical Association and the Declaration of Helsinki.

Confidentiality of the 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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