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ORIGINAL ARTICLE

Changes in Electromyographic Results of Patients With Lumbar Radiculopathy: A Follow-Up Study

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Abstract

Objective: To assess the neurophysiologic changes in a group of patients with lumbar radiculopathy 5 to 12 months after their first electromyographic examination.

Design: A prospective group of patients with a case definition of lumbar radiculopathy was reassessed between 5 and 12 months after their first clinical, functional, imaging, and neurophysiologic evaluation. Both the lumbar paraspinals (in which the mini-mapping technique was used) and the same lower limb muscles were explored in every patient. Relevant abnormalities were (1) positive sharp waves/fibrillation potentials, (2) polyphasic motor unit potentials, and (3) large-amplitude/long-duration motor unit potentials. Patients were sorted into 5 groups based on the type and distribution of neurophysiologic abnormalities: from 0 (no abnormalities) to 4 (denervation signs in 2 lower limb muscles and paraspinals). Patients' subjective perception of any improvement or worsening of their condition was also recorded.

Setting: A referral center for neurophysiologic evaluation.

Participants: A consecutive sample of patients (N=91) with a clinical definition of lumbar radiculopathy (lumbar pain radiating down the leg and below the knee) referred for neurophysiologic assessment was selected for an initial clinical, functional, and neurophysiologic evaluation. Patients were called for a second evaluation (between 5 and 12mo). Thirty-eight (42% of the initial sample) were willing/eligible for the second evaluation.

Interventions: Not applicable.

Main Outcome Measures: Changes in (1) electromyographic results; (2) patients' subjective perception of pain; and (3) quality of life, based on the Roland-Morris Questionnaire and Medical Outcomes Study 36-Item Short-Form Health Survey scores.

Results: Paraspinal muscles were most frequently affected. Neurophysiologic abnormalities had improved on reassessment. Clinical improvement was more significant for those patients with initially abnormal electromyographic results.

Conclusions: There was clinical as well as electromyographic improvement in patients with lumbar radiculopathy within the first year of the initial diagnosis.

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Lumbar radiculopathy resulting from disk herniation is an important cause of lumbar and lower limb pain. Diagnosis is based on clinical findings, magnetic resonance imaging (MRI), and electrophysiologic findings.

The utility of electrodiagnostic testing in assessing patients with lumbosacral radiculopathy has been established in other studies.[1] Electromyographic abnormalities are more likely to be found in patients who have lumbar pain, radicular symptoms, and abnormal findings on physical examination than in patients who only have lumbar pain and have normal findings on physical examination.[2] Nevertheless, some patients with lumbar pain and normal findings on physical examination may also have electromyographic abnormalities.[2]

Electromyography is the most useful diagnostic test to objectively support nerve root disease in patients with clinically suspected lumbar radiculopathy; additionally, electromyography supplements MRI.[3] Furthermore, electromyogram (EMG) abnormalities are useful to establish the severity of root disease (via the recruitment

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pattern) and the time course of the disease (via motor unit changes and size of fibrillation potentials [FPs]), and are useful in the differential diagnosis (eg, lumbar plexus disease, polyneuropathy, or focal mononeuropathy).[4] An additional advantage is that unlike MRI, EMG produces false-positive results less frequently.[5] While MRI is useful for assessing intervertebral disks, the assessment of radicular damage may be uncertain using this method.

Although most patients with lumbar radiculopathy caused by disk herniation improve spontaneously, there is always concern about neurologic deterioration, especially in severe cases.[6] Most follow-up studies in lumbar radiculopathy do not include EMG findings; rather, they are solely based on morphologic assessments of intervertebral disks.[7,8] EMG abnormalities become apparent during the first month of disease and persist during an indeterminate period.[4] In animal-based experiments, it has been observed that after radicular lesions caused by disk herniation, EMG abnormalities increase in the first month and, afterwards, gradually disappear. In these animal-based experiments, it has also been shown that in the presence of normal EMG findings, chronic pain may be found.[9] The scarce studies of lumbar radiculopathy that have used EMG as a follow-up tool are retrospective and do not have a well-defined protocol for assessment.[10] Elsewhere, it has been observed that patients with disk herniation and lumbar radiculopathy whose symptoms have disappeared may continue to have EMG abnormalities.[11] In spinal stenosis, EMG abnormalities have been shown to persist while no clinical worsening is observed.[12]

The usefulness of EMG as a follow-up instrument in lumbar radiculopathy has not been established. In fact, EMG changes over time are not well known. For instance, it is not clear whether EMG abnormalities disappear in patients with clinical improvement, whether they persist, or even whether they worsen in patients without clinical improvement.

It may be useful to know the pattern of EMG changes in lumbar radiculopathy, as well as whether the distribution of EMG abnormalities can contribute toward the prognosis (eg, whether patients with severe EMG abnormalities have a higher risk of neurologic deterioration). In either case, repetition of the EMG examination would be useful in clinical practice during individual follow-up evaluation of patients with persistent symptoms.

The objective of this study was to describe EMG changes during a 1-year follow-up in a group of patients with clinically diagnosed lumbar radiculopathy.

Methods

A sample of consecutive patients with clinically defined lumbar radiculopathy (lumbar pain radiating down the leg and below the knee) referred for neurophysiologic assessment was selected. All the patients signed a document acknowledging informed consent. In addition, the review boards of all the institutions that were involved in this project approved this study before its implementation.

List of abbreviations:

EMG	**electromyogram**
FP	**fibrillation potential**
MRI	**magnetic resonance imaging**
MUP	**motor unit potential**
SF-36	**Medical Outcomes Study 36-Item Short-Form Health Survey**

A physiatrist (J.J.F.), who did not know the MRI results, performed a complete assessment of every patient. First, a structured survey was given. It specifically asked patients (1) how long ago (in months) the pain began; (2) whether they had pain in the lower limb; (3) whether they had numbness in the lower limb; and (4) whether they had radiation of the lumbar pain below the knee. Other characteristics of the pain were assessed: diurnal or nocturnal pain, more severe pain in the lower limb or in the back, and radiation of the pain to the neck.

Subsequently, patients underwent a clinical examination that included evaluation of muscle strength, sensory evaluation, and evaluation of deep tendon reflexes.

Finally, patients received a functional evaluation, which consisted of both the lumbar pain−related questions of the Roland-Morris Disability Questionnaire[13] and the bodily pain and physical function scales of the short form of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36).

Afterward, the physiatrist (J.J.F.) formed a clinical impression based on the mentioned clinical instrument. Images were not taken into account for this impression.

Patients were excluded from the study if they had polyneuropathy, diabetes, inflammatory back pain, vascular disease, or rheumatic disease; had undergone spine surgery; or had received an epidural injection.

The physiatrists who performed the EMG examination (J.D.-R., F.O.-C.) were also blinded to the images but not to the clinical evaluation. The EMG examination was performed in a Sierra Wave EMG machine[a] according to the following standardized protocol: lumbar paraspinal muscles were assessed according to the mini-mapping technique, with 3 needle insertions in each of the levels L2, L3, L4, and L5 with a 50- to 75-mm monopolar electrode.[14] Severity of mini-mapping abnormalities was described in the usual way, and an ordinal score was assigned in the following manner: (+) represented a single, reproducible train of FPs and was assigned the numerical value of 1; (++) represented more than 1 train of FPs and different configurations or depths, and was assigned the numerical value of 2; (+++) represented numerous FPs at more than 1 depth and was assigned the numerical value of 3; and (++++) represented FPs that filled the screen and was assigned the numerical value of 4. Abnormality was defined as a total score >4 with the paraspinal mini-mapping technique.[15]

Additionally, in the most symptomatic lower limb, the following muscles were always evaluated: gluteus maximus (L5, S1, S2), medial gastrocnemius (S1, S2), extensor hallucis longus (L5, S1), tibialis anterior (L4, L5), and vastus medialis (L2, L3, L4). Abnormality was defined as persistent FPs in at least 2 areas of the muscle—where FPs had to be reproducible and last more than 1 second.[12,16] Also taken into consideration as a factor of abnormality were high-amplitude and long-duration motor unit potentials (MUPs) and, in addition, polyphasic MUPs—where high amplitude was defined as peak-to-peak amplitude >3mV; long duration was defined as longer than 15 milliseconds; and polyphasic MUPs were defined as being ≥ 5 phases. These values were based on the reference values of our laboratory.[16,17]

EMG abnormalities were classified into 5 groups according to published diagnostic criteria[18,19] with some modifications (table 1). This is not a precise system of classification; instead, it is an attempt to sort EMG abnormalities into the most representative group for better describing EMG changes during follow-up.

A neuroradiologist (A.L.-C.) conducted a blinded review of the image findings. MRI findings were graded on an ordinal scale (0−5) according to the probability of root impingement. On this