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Original Article

The Diagnostic Role of Adding the Hoffman Reflex for L5 Radiculopathy in the Electrodiagnostic Laboratory: A Cross-sectional Study

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Abstract

Objectives: To investigate changes in the H-reflex in patients with monoradiculopathies involving L5 or S1 levels by stimulating the sciatic nerve and recording simultaneously from the tibialis anterior (TA), peroneus longus (PL), and soleus (S) muscles. **Methods**: Patients with unilateral radicular back pain with L5 or S1 root compression on MRI, participated in this cross-sectional study. The H-reflex over the TA, PL, and S muscles was simultaneously recorded by sciatic nerve stimulation. The H-reflex latency was compared with that of the contralateral extremity. **Results**: Fifty-eight patients (29 patients L5; 29 patients S1 radiculopathy) were included in the study. There were significant delays in the latency of the H-reflex over TA (30.95±2.31-29.21±1.4) and PL (31.05±2.85-29.02±1.99) muscles on the affected side in patients with L5 radiculopathy. However, the latency of the S H-reflex was similar on both sides. In contrast, in patients with S1 radiculopathy, there was a significant delay in the latency of soleus H reflex (32.76±3.45-29.9±3.19), while the significant delay was not detected in the TA and PL muscles. However, the cutoff values for the H-reflex latency of all muscles were not found to have clinical significance. **Conclusions**: The study presents that the H-reflex study, recorded from the TA, PL, and S muscles by sciatic nerve stimulation, is of interest but has minimal contribution to radiculopathy diagnosis in conventional electrodiagnostic tests.

Keywords: Electroneuromyography, H-reflex, Lumbosacral Mono-radiculopathy, Magnetic Resonance Imaging, Radiculopathy

Introduction

Hoffmann et al. were the first to define the H-reflex. The H-reflex is one of the most popular topics in reflexology and one of the late responses involved in routine nerve conduction studies in the electromyography (EMG) laboratory[1]. A monosynaptic or oligosynaptic reflex network that contains both motor and sensory fibers is evaluated by the H-reflex. Assessment of the integrity of proximal peripheral nerve segments is enabled by this reflex without using invasive procedures[2].

The H-reflex is generally recorded from the gastrocnemius-soleus muscles (tibial H-reflex) by stimulating the tibial nerve in the lower extremity[3,4]. However, it is also obtained from the flexor carpi radialis muscles by stimulating the median nerve in the upper extremities[5]. Similarly, it can also be obtained by stimulating other peripheral nerves by applying simple modifications[6].

The authors have no conflict of interest.

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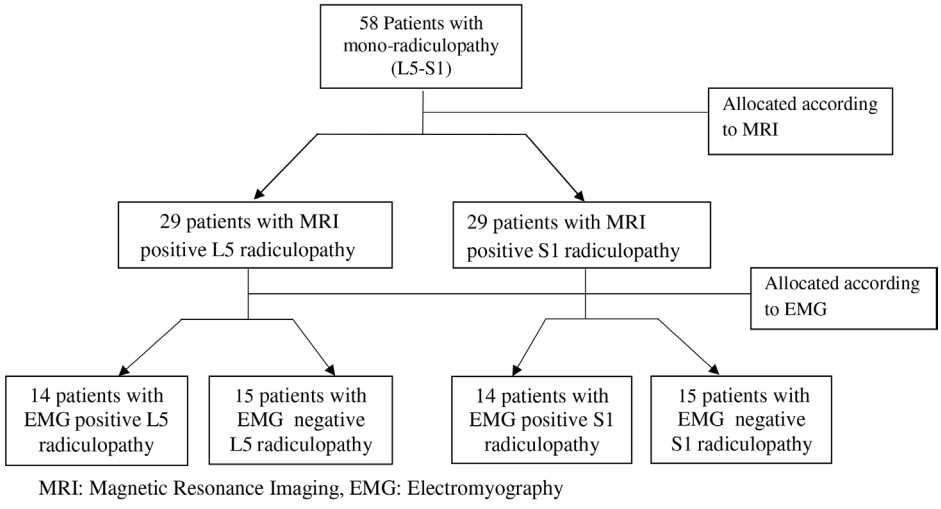

Figure 1. Study Flow chart.

Triceps surae, which is innervated by the sacral 1 (S1) root, is evaluated electrophysiologically with the H-reflex, while in physical examination it is evaluated by the Achilles' reflex, which is a deep tendon reflex. Therefore, efferent and afferent S1 fibers are evaluated by this procedure[7]. It can be mentioned that the H-reflex is a sensitive measurement for examining S1 radiculopathy[7-10]. At the same time, it also becomes relatively abnormal in the early development of radiculopathy, showing fiber dysfunction in the proximal region of the dorsal root ganglia[11]. It cannot be fully understood in some cases where the root is predominantly affected, as lumbar 5 (L5) and S1 are the most involved[12]. Hence, it can be claimed that using the H-reflex can be beneficial in distinguishing between L5 and S1 radiculopathies.

Hoffman et al.[13] developed a method for simultaneously evaluating the H-reflex obtained from different muscles with single peripheral nerve stimulation. With this method, H-reflex measurement can be performed in three leg muscles, including the tibialis anterior (TA), peroneus longus (PL), and soleus (S), with sciatic nerve stimulation[13]. Thus, the L5 and S1 roots can be evaluated separately with a single stimulation.

In the literature, there were several studies on the H reflex of the S muscle in S1 radiculopathy[7-12,14]. However, the studies including the H reflex for the diagnosis of L5 radiculopathy were limited. To the best of our knowledge, this is the first study in which L5 and S1 mono-radiculopathies are evaluated by recording the H-reflex from three different muscles simultaneously (e.g., TA, PL, and S) after sciatic nerve stimulation. In this direction, the current study aimed to investigate the role of the H-reflex by using a different method for the distinction between L5 and S1 radiculopathies.

Methods

Study Design

Patients were included in this cross-sectional study from the Department of Physical Medicine and Rehabilitation outpatient clinics. This study was conducted between December 2017 and December 2019.

Study participants

A total of 58 patients admitted to the outpatient clinics due to unilateral radicular back pain and who had L5 or S1 root compression on magnetic resonance imaging (MRI) participated in this study. While evaluating the study results, the unaffected extremities of patients were compared with the affected side. Two different physicians performed H-reflex measurements with physical and EMG examinations. According to EMG results, patients were re-evaluated and assigned to the following four groups: 1) L5 EMG-negative, 2) L5 EMG-positive, 3) S1 EMG-negative, and 4) S1 EMG-positive. The flow chart of this study was shown in Figure 1. Repeated measures were performed using the same method before the study to ensure specific standardization among the physicians.

For enrolling in the study, the inclusion criteria of the patients were (1) between 18 and 65 years of age, (2) low back pain for at least three months, (3) radicular pain in one extremity, (4) disc herniation that matches painful dermatome and root compression in MRI, (5) MRI and physical examination findings compatible with root compression, and (6) no contraindications to EMG.

The exclusion criteria applied to patients were as follows: patients who had (1) bilateral radicular symptoms, (2) multiple levels of

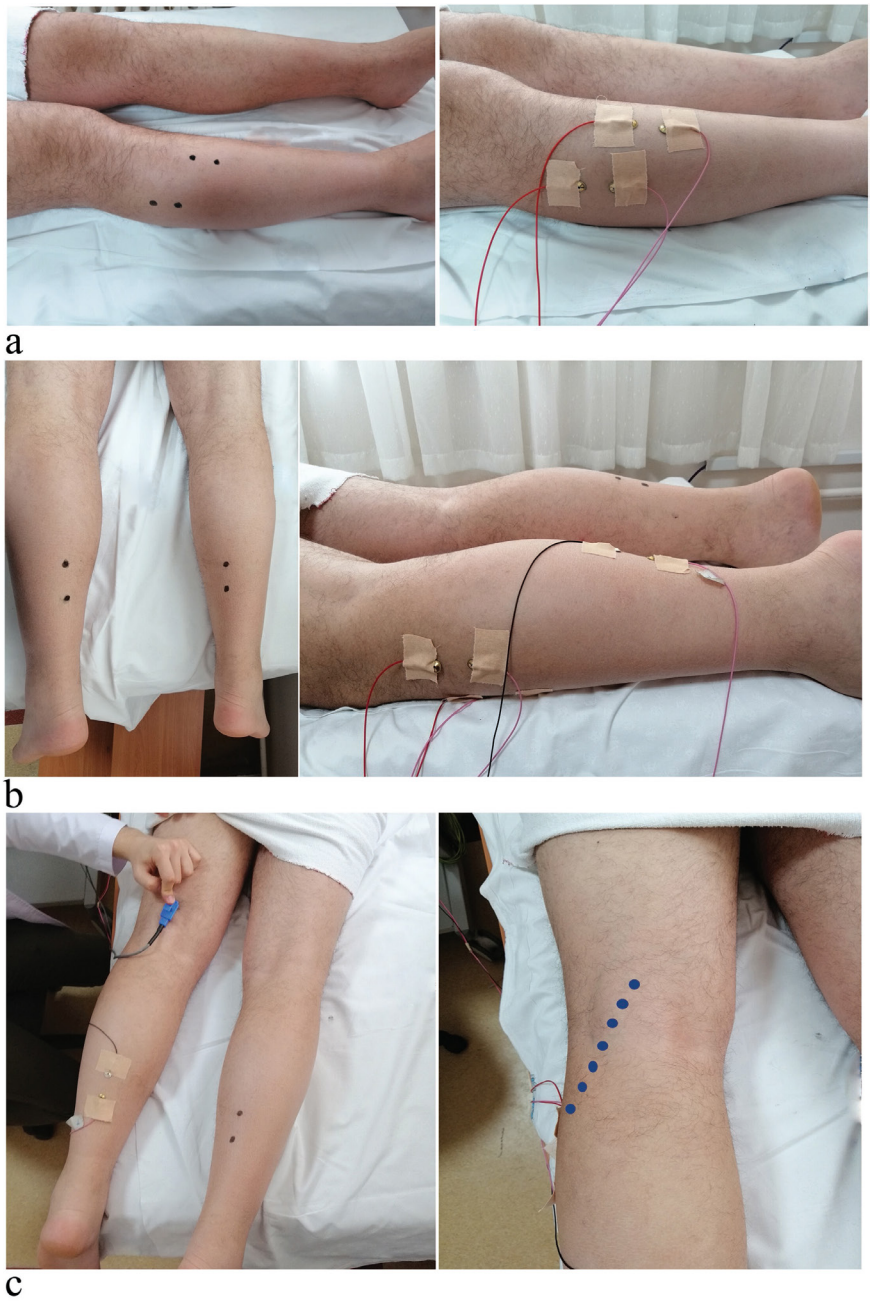

Figure 2. a: Placement of recording electrodes on the tibialis anterior and peroneus longus muscles in the supine position. b: Placement of soleus muscle recording electrodes in the prone position. c: Placement of stimulation electrodes in the prone position.

radiculopathy, (3) diabetes, (4) polyneuropathy, (5) rheumatic diseases, (6) a history of malignancies, (7) lumbosacral region spine surgery, (8) lumbar spinal stenosis, (9) spondylolisthesis, (10) previous peripheral neuropathy in the lower extremities, (11) different causes of radiculopathy other than disc herniation (e.g. tumor, infection and other), (12) central system disorders, (13) muscular diseases, and (14) who were over 65 and under 18 years old were not included in this study. Moreover, pregnant women were not included in this study.

Clinical assessment

Detailed physical examinations were performed by taking anamnesis for the complaints of the patients who

were included in the study. A straight leg raise test (SLR) was conducted to evaluate L5-S1 radicular pain. When performing the SLR test, the patient is positioned in supine. The physician stands at the tested side and lifts the patient's leg while keeping the knee in a fully extended position. The physician continues to lift the patient's leg by flexing at the hip until the patient complains of pain or tightness in the back or back of the leg[15]. Then, muscle strength was assessed by using a manual muscle test. The deep tendon (Achilles and patellar) and pathological (e.g., Babinski) reflexes in the lower extremity were evaluated, and sensory examinations were performed.

The diagnosis of radiculopathy was evaluated as disc herniation radicular lower back pain for at least three months, the extension of pain toward the L5 or S1 dermatomal distribution, and root compression on MRI corresponding to the painful dermatome[16]. Foerster's dermatome map was used for describing the painful dermatome[17]. The same radiologist evaluated the MRI findings for all patients. Furthermore, disc herniation was considered as tissue shifting of the nucleus, cartilage, shattered apophyseal bone, and fragmented annular beyond the intervertebral disc cavity, as described by the American Society of Neuroradiology[18].

Electrodiagnostic Studies

The electrodiagnostic study was performed as a radiculopathy protocol for patients diagnosed with L5 or S1 radiculopathy using MRI[19]. EMG evaluation of the patients was performed using Natus Ultra 100® (Denmark, 2014) and Viasys Medelec Synergy® (the United Kingdom, 2005) EMG devices. The filter settings of both devices were calibrated the same for the radiculopathy protocol and the H-reflex measurements. This protocol included nerve conduction studies and needle EMG. In nerve conduction studies, bilateral sural and peroneal superficial nerve sensory conduction studies, motor conduction studies of the tibial and common peroneal nerves, and F wave studies of tibial and common peroneal nerves were examined. Vastus lateralis, tibialis anterior, peroneus longus, medial gastrocnemius muscles, and L3, L4, L5, and S1 paraspinal muscles were evaluated on the affected extremities by needle EMG examination. If any of these muscles had abnormal findings, the muscles innervated by the same myotome with different peripheral nerves were also examined. These muscles were determined to be the gluteus maximus for the S1 myotome and the gluteus medius for the L5 myotome[19].

Abnormal spontaneous activity at rest (e.g., positive sharp waves, fibrillation, among others), motor unit action potential (MUP) analysis of the minimum voluntary contraction of the muscle, and recruitment pattern in maximal muscle contraction were evaluated during needle EMG examination. The presence of the following findings in at least two different muscle sites was considered abnormal for that muscle: abnormal spontaneous activity potentials at rest (fibrillation, positive sharp wave), neurogenic findings (high amplitude and long-duration MUPs), or both in the MUP analysis. Additionally, EMG was considered positive when there were abnormal findings in the lower extremity muscle and the corresponding paraspinal muscle and/or neurogenic findings in two different lower extremity muscles innervated by the same myotomes but two other peripheral nerves[16,20]. After the needle EMG procedure was completed, the H-reflexes of the bilateral peroneus longus, tibialis anterior, and soleus muscles were examined.

H-Reflex Examination

The H-reflex was evaluated simultaneously using the method developed by Hoffman et al. using superficial recording electrodes in a 3-channel way from the TA, PL, and S muscles[13]. The device was calibrated for the H-reflex, and the low and high-pass filters were set to 20 Hz and 10 kHz, respectively. The duration of the stimulation was 1 msec, and the amplifier sensitivity was set at 1 mV/division.

Active recording electrodes were placed over the belly of the PL (2-3 cm distal to the fibula head and midpoint of the muscle), TA (4-5 cm distal of the tuberositas tibia and 1.5-2 cm lateral of the edge of the tibia), and S (the middle part of the calf and distal one-third of the leg) muscles. Reference electrodes were placed 3 cm from the active electrodes (Figures 2a and 2b). The ground electrode was placed over the lateral malleolus. Stimulation was applied to the sciatic nerve at the popliteal fossa and just above the common peroneal nerve and tibial nerve division point when the patient was in the prone position (Figure 2c). Beginning at the head of the fibula with a stimulus intensity strong enough to elicit a motor response in either the PL or the TA, the stimulating electrode progressed in a superior medial direction toward the center of the knee in the popliteal fossa. This method was continued along the common peroneal nerve until a response was observed in the soleus. Herein, it was found that the location of the sciatic nerve bifurcation[13]. Then, data were collected from all muscles. The stimulation intensity was increased with increments of 2 mA until the maximum H-reflex and M-response amplitudes were elicited. Latency was recorded when the maximum H-reflex amplitude was obtained. The onset of H-reflex latency was marked and measured for each muscle (Figure 3). The method of determination of H-reflex latency was about the first deflection from baseline.

Statistical Analysis

The sample size was calculated on the basis of the significant statistical findings obtained by Nishida et al.[10] The alpha level was set at 0.05 with a power of 80%. This experimental setting meant that at least 14 patients were required for the current study.

SPSS for Windows® (version package 24.0) was used for statistical analysis. Descriptive statistics were represented as mean, standard deviation, and percentage. Data compliance with normal distribution was tested with the Shapiro-Wilk test. The Kruskal-Wallis test was also used to compare the demographic characteristics of the four subgroups. To

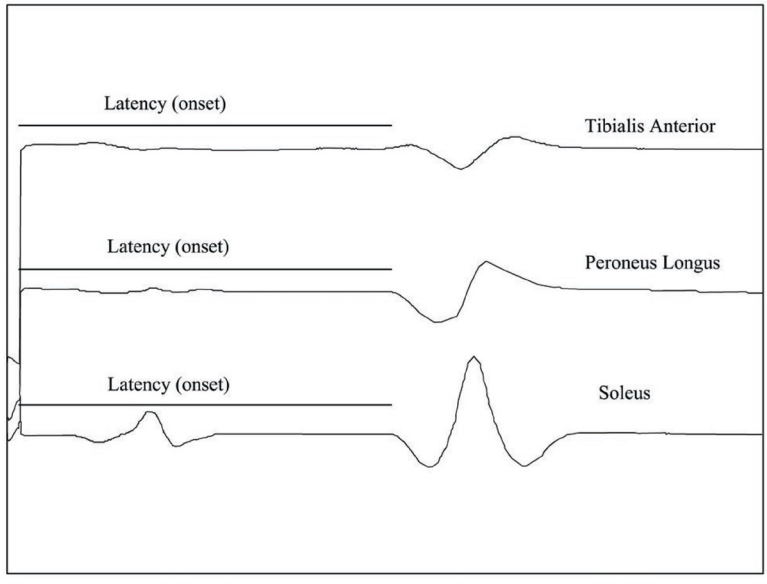

Figure 3. Recording of the three-channeled H-reflex latency of the tibialis anterior, peroneus longus, and soleus muscles (1mV/division).

Table 1. Demographic characteristics of participants.

	All patients (n=58)	L5 EMG negative (n=15)	L5 EMG positive (n=14)	S1 EMG negative (n=15)	S1 EMG positive (n=14)	*P*
Age (year), mean±SD	40.1 ± 10.87	40.53 ± 8.43	41.21 ± 12.55	39,07 ± 8,23	39.64 ± 14.43	0.97
BMI (kg/m^2), mean±SD	27.91 ± 4.48	29.15 ± 5,37	26.95 ± 3.75	26.75 ± 5	28.78 ± 3.32	0.32
Height (cm), mean±SD	169.53±7.94	168.6±6.52	169.14±8.8	171±8.45	168.5±8.25	0.42
Weight (kg), mean±SD	80.12±13.17	82.46±13.56	77.28±12.94	79±15.72	81.64±10.47	0.36
Gender, female, n (%)	30 (0.52)	8 (53.3)	7 (50)	8 (53.3)	7 (50)	0.99

Abbreviations: L5: lumbar 5; S: sacral 1; SD: Standard Deviation, BMI: Body Mass Index; EMG: Electromyography; P value was calculated by Kruskal-Wallis test to compare between demographic characteristics of four subgroups.

compare the H-reflex latencies of muscles in affected and non-affected extremities, the Mann-Whitney U test was used to compare non-normally distributed variables, and the Student's t-test was used to compare with normal distribution variables. Receiver operating characteristic (ROC) analysis was used to calculate the cut-off values of the H-reflex latencies. When significant cut-off values were observed, the sensitivity and specificity values were presented. The statistically significant level (p) was set at 0.05.

Results

Fifty-eight patients were included in this study. A total of 29 patients (50%) belonged to 1) L5 radiculopathy group and 29 of them (50%) belonged to 2) S1 radiculopathy group according to the MRI results. After EMG examination, patients were divided into the following four groups: 1) L5 EMG-negative, 2) L5 EMG-positive, 3) S1 EMG-negative, and 4) S1 EMG-positive (Figure 1).

Demographic characteristics were compared among all the groups. There were no significant between-group differences in age, weight, height, body-to-mass index (BMI), and gender. All these parameters are summarized in Table 1.

There were no significant differences in H-reflex latency recorded from the TA, PL, and S muscles in the L5 MRI-positive EMG-negative group (p=0.86, 0.25, and 0.90, respectively) when the affected and non-affected extremities were compared (Table 2). On the other hand, there was a significant delay in H-reflex latency recorded between the

Table 2. H-reflex comparison in affected and non-affected extremity L5 radiculopathy subgroups.

Muscle	L5 MRI+ EMG Negative (n:15)			L5 MRI+ EMG Positive (n:14)		
	Affected extremity latency (msec) (mean±SD)	Non-affected extremity latency (msec) (mean ± SD)	*P1*	Affected extremity latency (msec) (mean ± SD)	Non-affected extremity latency (msec) (mean ± SD)	*P2*
Tibialis anterior	30.09 ± 2.14	29.96 ± 1.88	0.86	30.95 ± 2.31	29.21 ± 1.4	**0.02**
Peroneus longus	29.73 ± 1.82	28.95 ± 1.91	0.25	31.05 ± 2.85	29.02 ± 1.99	**0.04**
Soleus	30.42 ± 2.27	30.52 ± 2.24	0.90	30.55 ± 1.96	30.12 ± 2	0.57

MRI: Magnetic Resonance Imaging; EMG: electromyography; L5: lumbar 5; P1 and P2 values were calculated by Mann-Whitney U (non-normally distributed variables) and Student T-test (normally distributed variables) to compare between the H-reflex latencies of muscles in affected and non-affected extremities.

Table 3. H-reflex comparison in affected and non-affected extremity S1 radiculopathy subgroups.

Muscle	S1 MRI+ EMG Negative (n:15)			S1 MRI+ EMG Positive (n:14)		
	Affected extremity latency(msec) (mean ± SD)	Non-affected extremity latency (msec) (mean ± SD)	*P1*	Affected extremity latency(msec) (mean ± SD)	Non-affected extremity latency (msec) (mean ± SD)	*P2*
Tibialis anterior	30.08 ± 2.15	29.45 ± 2.04	0.42	29.5 ± 3.22	29.97 ± 3.53	0.90
Peroneus longus	30.93 ± 5.93	29.25 ± 2.02	0.68	29.72 ± 3.24	29.3 ± 3.54	0.55
Soleus	30.7 ± 2.44	30.14 ± 2.21	0.52	32.76 ± 3.45	29.9 ± 3.19	**0.04**

MRI: Magnetic Resonance Imaging; EMG: electromyography; S1, sacral 1; P1 and P2 values were calculated by Mann-Whitney U (non-normally distributed variables) and Student T-test (normally distributed variables) to compare between the H-reflex latencies of muscles in affected and non-affected extremities.

Table 4. Magnetic Resonance Imaging positive (+) radiculopathy group (L5 and S1) affected and non-effected extremity comparison.

Muscle	S1 MRI+ Radiculopathy group(n:29)			L5 MRI+ Radiculopathy group(n:29)		
	Affected extremity latency(msec) (mean ± SD)	Non-affected extremity latency (msec) (mean ± SD)	*P1*	Affected extremity latency(msec) (mean ± SD)	Non-affected extremity latency (msec) (mean ± SD)	*P2*
Tibialis anterior	29.86 ± 2.55	29.7 ± 2.82	0.72	30.52 ± 2,23	29.6 ± 1.68	0.08
Peroneus longus	30.42 ± 4.92	29.28 ± 2.8	0.47	30.37 ± 2.42	28.98 ± 1.91	**0.02**
Soleus	31.57 ± 3.03	30.02 ± 2.68	**0.04**	30.49 ± 2.09	30.33 ± 2.1	0.77

MRI: Magnetic Resonance Imaging; L5: lumbar 5; S1: sacral 1; P1 (S1 MRI+ Radiculopathy group) and P2 (L5 MRI+ Radiculopathy group) values were calculated by Mann-Whitney U (non-normally distributed variables) and Student T-test (normally distributed variables) to compare between the H-reflex latencies of muscles in affected and non-affected extremities.

TA and PL muscles (p=0.02 and 0.04, respectively) in the L5 MRI-positive EMG-positive group. However, there was no significant delay in the S muscle (p=0.57) (Table 2).

No significant difference was found in H-reflex latency from the TA, PL, and S muscles in the S1 MRI-positive EMG-negative group (p=0.42, 0.68, 0.52, respectively) when the affected and non-affected extremities were compared (Table 3). On the other hand, the S1 MRI-positive EMG-positive group only had a significant delay in H-reflex latency from the S muscle (p=0.04) (Table 3).

A significant and considerable delay in the H-reflex latency from only the PL muscle in the L5 MRI-positive radiculopathy group was detected when the affected and non-affected extremities were compared (p=0.02) (Table 4). Similarly, a significant delay was detected in the H-reflex latency only for the S muscle in the S1 MRI-positive radiculopathy group when

the affected and non-affected extremities were compared (p=0.04) (Table 4).

ROC analysis was performed to determine cutoff values for statistically significant latencies between groups. TA and PL latencies in the L5 EMG-positive group and S latency in the S1 EMG-positive group were analyzed. The area under the curve (AUC) for TA and S latencies was significant, but not for PL [TA: AUC=0.73(95% CI 0.548-0.922); p:0.03], [S: AUC=0.74(95% CI (0.545-0.935) p:0.043], [PL: AUC=0.71 (95% CI 0.52-0.903); p: 0.052]. The cutoff value of TA latency in the L5 EMG-positive group was 29.74 ms (sensitivity=64.3%; specificity=42.9%) while the cutoff value of S latency in the S1 EMG-positive group was 30.4 ms (sensitivity=72.7%; specificity=28.6%). However, no significant cutoff value was obtained for PL.

Discussion

The current study investigated whether adding the H-reflex study, obtained by simultaneously recording TA, PL, and S muscles while stimulating the sciatic nerve, provides advantages in the electrodiagnostic laboratory for L5 and S1 radiculopathy patients. This study revealed that this method is of interest, but has a minimal contribution to radiculopathy diagnosis in conventional electrodiagnostic tests.

A new protocol for H-reflex was developed in the study conducted by Hoffman et al. This protocol can be described as obtaining the H-reflex by simultaneous sciatic nerve stimulation from the TA, PL, and S muscles[13]. The latency differences in H-reflexes from muscles predominantly innervated by L5 and S1 roots were evaluated using the same method used in this study. The latency of the H-reflex recorded from the L5 innervated muscles was prolonged on the affected extremity compared with that on the other side, whereas the H-reflex from the S1 innervated muscles was similar in the L5 radiculopathy group. According to these results, information for the differential diagnosis of L5 radiculopathy may be provided with this recording method. Similarly, prolonged H-reflex latency was recorded from the S muscle in patients with S1 radiculopathy, while no changes were found in the TA and PL muscles. One of the critical outcomes of this study was stimulation of the sciatic nerve, simultaneous recording of L5 and S1 innervated muscles, and the tibial H-reflex with soleus muscle recording.

In this study, cutoff values were calculated for TA in the L5 EMG+ group and S H-reflex latencies in the S1 EMG+ group (29.74 and 30.4 ms; respectively). No significant cutoff value was obtained for PL. Although a statistically significant cutoff value was found for the TA and S muscles, the confidence interval was wide and the sensitivity and specificity were low. Therefore, the cutoff values for H-reflexes obtained with this method could not be distinctive in the diagnosis of radiculopathy alone. This study demonstrated that H-reflexes obtained by sciatic nerve stimulation in the TA, PL, and S muscles have no additional clinical advantage in L5-S1 radiculopathy in patients in whom EMG is not diagnostic.

The H-reflex latency recorded from the triceps surae with stimulation of the tibial nerve has been suggested in the literature as a potential tool to help differentiate S1 radiculopathy from L5[12]. There was no difference in H-reflex latency in the L5 radiculopathy group when the affected and non-affected extremities were compared in the study, which involved 15 patients with L5 radiculopathy and 17 patients with S1 radiculopathy. However, a significant latency difference was observed in the S1 radiculopathy group. On the other hand, the muscles predominantly innervated by the L5 root were not evaluated in this study. To the best of our knowledge, this is the first study in which these muscles in monoradiculopathies involving L5 and S1 roots were assessed.

Simultaneous H-reflex recording was easily performed in this study, and no technical obstacles were observed. Simultaneous recording is allowed by most new EMG devices. It is important to note that the H-reflex recording parameters must be set to a multichannel format on the device. Moreover, using a single stimulation point has the advantage of this method. However, the study may be conducted using repeated stimulations and single-channel recording if the use of simultaneous multichannel recording is not allowed by the device.

The examination of the soleus H-reflex is almost a part of routine studies in diagnosing S1 radiculopathy in many laboratories[4-9]. The use of the H-reflex alone in the diagnosis of radiculopathy is controversial. Because the tibial H-reflex can be normal in the presence of proven S1 radiculopathy[14]. This condition may reduce the value and use of the H-reflex alone. This situation can be explained by the tibial H-reflex representing a long neural pathway, and the affected segment is minuscule in radiculopathy compared with the rest of the way. Therefore, electrophysiological tests such as the H-reflex, which represents the entire pathway, may lack abnormality, which involves relatively shorter segments[21]. Thus, routine EMG (needle EMG and nerve conduction studies) should be performed, and the H-reflex may be used as a supportive tool.

In our study, the H-reflex latency was compared with that of the contralateral extremity. The H-reflex amplitude difference and asymmetry between the two sites were not evaluated because of low sensitivity. In the previous literature, there were controversial results about using the H reflex amplitude for radiculopathy[10,11]. Alrowayeh et al.[11] suggested that asymmetry in the H-reflex amplitude may be an early symptom of nerve root involvement compared with latency differences. On the other hand, Nishida et al. showed that the amplitude of the tibial H-reflex was less sensitive in S1 radiculopathy than the latency of the H-reflex due to its wide normal range. Additionally, it is known that the H-reflex amplitude can be affected by many different factors, such as muscle activity, cognitive status, and extremity position. Diagnostic reliability may be reduced by these factors[22-24].

There were no significant delays in H-reflex latency obtained from patients in the MRI-positive and EMG-negative groups in this study. For this reason, in the diagnosis of radiculopathy,

it should be used together with clinical examination, MRI, and other electrophysiological studies. Furthermore, the absence of latency delay in the EMG-negative groups can be explained by the high sensitivity of MRI. MRI abnormalities have also been reported in asymptomatic patients in the literature[25-28]. Therefore, MRI should be preferred in patients with suspected radiculopathy on clinical examination.

The potential limitation of this study is that although patients with unilateral L5 or S1 radiculopathy on MRI were enrolled, the patients had some other spinal conditions, such as disc degeneration and mild bulging (pre-protrusion). Multilevel disc pathologies caused by degenerative disc disease in older ages are commonly detected because of high MRI sensitivity, even if there are no symptoms. Notwithstanding, as previously stated the patients who had a compression of the roots at other spinal levels were excluded from the study.

This study is a special technique obtained by recording three leg muscles (TA, PL, and S) with sciatic nerve stimulation[13]. However, this technique has various limitations. Due to the proximity of the recorded leg muscles, there may be a risk of volume conduction. Therefore, it is necessary to pay attention to the morphology of the H-reflex potentials during nerve stimulation. In addition, using monopolar or concentric needle EMG instead of superficial electrodes in TA, PL, and Soleus recordings may potentially contribute to the identification of distinct responses.

In routine, the H-reflex is most commonly obtained from the gastro-soleus muscles. Although it is theoretically possible to obtain H-reflexes from all muscles, there are various difficulties in the elicitation and interpretation of H-reflexes in most muscles. The limited number of studies on the H-reflex obtained from other muscles also lead to variations in the methodological standards for obtaining the H-reflex in different muscles. According to these studies, it is observed that the latency of the H-reflex obtained from PL and TA are varied[29,30]. Kim et al. evaluated patients with L5 radiculopathy recorded from the TA muscle with stimulation of the common peroneal nerve[30]. However, in our study, we evaluated radiculopathy with TA, PL, and S muscle H-reflexes, which were observed to stimulate of the sciatic nerve. As a result, the spread of potentials between the muscles could not be completely ignored. This issue is one of the limitation of the Hoffman method. Therefore, the reflexes obtained using this technique cannot be considered pure and cannot be compared with reflexes obtained using methods in which a single peripheral nerve is stimulated[13].

In conclusion, this study suggests that the H-reflex study, which is simultaneously recorded from the TA, PL, and S muscles by sciatic nerve stimulation, is of interest. However, this method has contributed very little to the diagnosis of radiculopathy in conventional electrodiagnostic tests. Although this method is particularly useful in EMG-positive patients, it cannot replace nerve conduction studies and needle EMG. In routine radiculopathy protocols, the use of this method alone does not contribute to the diagnosis when electrodiagnostic studies fail to establish a diagnosis. Relying solely on this method for the diagnosis of radiculopathy can result in overdiagnosis and ultimately lead to an increase in surgical interventions. Today, conventional electrophysiological procedures remain valid when managing patients with radicular compression in MRI.

Ethics approval

The study was approved by the local ethics committee (Selçuk University Faculty of Medicine local ethics committee No: 2017/300), and the Helsinki Declaration was considered.

Consent to participate

Each participant signed an informed consent form prior to participating in the study.

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