Sciatic Neuropathy with Preserved Sensory Nerve Action Potentials, A Case Series

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ABSTRACT

Background. Sciatic neuropathy is differentiated from lumbosacral radiculopathy based on the finding of abnormal sensory nerve action potentials (SNAPs). Cases of sciatic neuropathy with intact SNAPS have not been well described.

Methods. A retrospective analysis of 12 patients with sciatic neuropathy in a single institution.

Results. We describe 12 patients in whom a sciatic neuropathy was diagnosed based on a combination of history, physical exam, radiological and electrodiagnostic (EDX) findings. Lower extremity SNAPs were found to be within normal range in all patients, although SNAP amplitude asymmetry between both sides was observed in 3. Included patients were young (mean age of 40.3 years) and mostly female (9 patients).

Conclusions. Sciatic neuropathy may occur with a relative sparing of sensory fibers. Recognition of this group of patients should help to avoid making a misdiagnosis of lumbosacral radiculopathy.

Keywords: *sciatic nerve, sciatic neuropathy, radiculopathy, nerve conduction study, sensory nerve action potential, electromyography.*

Introduction

The sensorimotor function of the sciatic nerve includes innervation of muscles and skin in the regions of the posterior thigh, the lower leg, and the foot. Due to sciatic nerve's large size, either the peroneal (fibular) or the tibial branch could be preferentially affected while leaving the other branch relatively spared.[1-4] However, sciatic neuropathy affecting predominantly motor or sensory branches has not been well characterized. In the current study, we describe 12 patients with sciatic neuropathy showing preserved sensory responses on nerve conduction studies (NCS).

Methods

The study was approved by our institutional review board. The electronic medical record at our institution was searched for patients who presented to the neuromuscular center with lower extremity sensorimotor symptoms and received electrodiagnostic (EDX) testing between 2004 and 2018. Patients with clinical and electrophysiological diagnosis of sciatic neuropathies, but showing normal sural and superficial sensory nerve action potentials (SNAPs) defined by laboratory standards were included.

Data collection included patient age, sex, past medical history, affected side, mechanism of injury, onset time, sensory deficit, muscle strength examination, time until EDX study, EDX and radiological findings, and follow-up information.

Results

Clinical information

Twelve patients were identified (Table 1). The average age was 40.3 years old (range 16-59), and 9 were females. Left sciatic neuropathy was present in 5 patients and right in 6. In addition, patient 12 had a significant right sciatic neuropathy, and a coexisting mild left sciatic neuropathy. Only data related to the right sciatic neuropathy from patient 12 were included for further analysis. Limited data on 4 patients were included in one prior publication.[4]

Sensory complaints of paresthesia, numbness and pain were present in all patients. On exam, reduction of pinprick and/or touch sensation was documented in 10 patients, reduction of vibration sensation in 2, and normal sensory exam in 1. Lower extremity muscle weakness was encountered in 11. In all patients, initial symptoms occurred at the distal lower extremity, and none presented with lower back or radicular pain. Magnetic resonance imaging (MRI) of the lumbar spine was performed in 8 patients. None showed contributory findings with the exception of 1 patient (patient 3), in whom a moderate left L5 nerve root compression was observed, though her clinical presentation and EDX findings were consistent with a left sciatic neuropathy.

Electrophysiological findings

On sensory NCS, bilateral superficial peroneal SNAPs were obtained in all patients, and bilateral sural SNAPs in 10 (Table 2). All SNAP responses were present, with their amplitudes and latencies falling within the normal ranges based on our laboratory standards. In 7 patients (patients 1 to 7), no significant asymmetry was observed on bilateral superficial peroneal and sural SNAPs. Amplitude asymme-

Table 1. Clinical Information of 12 patients with sciatic neuropathy

Patient No.	Age	Sex	Affected Side	Etiology	Time to deficit	MRI of pelvis or thigh
1	35	F	left	perioperative, trans-vaginal hysterectomy	immediate	normal
2	48	F	left	popliteal nerve block	unknown	normal
3	59	M	left	vasculitis: Churg-Strauss syndrome	10 days	not done
4	48	F	right	chronic exertional activity (yoga)	immediate	normal nerve, abnormal surrounding soft tissue
5	20	F	right	perioperative, colectomy	immediate	normal nerve, abnormal surrounding soft tissue
6	41	F	left	perioperative, hip surgery	unknown	nerve difficult to visualize, abnormal surrounding soft tissue
7	41	F	left	perioperative, breast reduction	immediate	not done
8	49	F	right	perioperative, foot surgery	unknown	not done
9	52	F	right	awaken from sleep	unknown	enlarged nerve with enhancement
10	45	F	right	fall	immediate	normal nerve, abnormal surrounding soft tissue
11	16	M	left	perioperative, hip surgery	immediate	normal nerve, abnormal surrounding soft tissue
12	30	M	right>left	prolonged sitting	immediate	not done

Abbreviations: F, female; M, male

try (defined as being less than 50% of that on the unaffected sided) on the superficial peroneal SNAP was observed in patients 8 and 10, and on the sural in patient 9. On motor NCSs, abnormally reduced peroneal or tibial compound muscle action potentials (CMAPs) were observed in 10 patients. Amplitude asymmetry on the peroneal or tibial CMAPs was observed in patients 8 and 9, respectively (Table 2). No distal latency prolongation, conduction slowing, conduction block or temporal dispersion was observed on motor NCS. Frequencies of abnormal electromyography (EMG) findings (fibrillations, positive wave discharges, long duration motor unit potentials, or reduced recruitment) on needle EMG of individual lower extremity muscles are listed in Table 3. EMG exam of the gluteus medius (N=12), gluteus maximus (N=11) and lumbosacral paraspinal muscles (N=9) were normal.

Etiology analysis

In 6 patients (patients 1, 5, 6, 7, 8, and 11), sciatic neuropathy occurred perioperatively. In patient 4, MRI revealed severe gluteus minimus tendonitis, greater trochanter bursitis, and edema in the long head of the biceps femoris muscle producing compression of the sciatic nerve. These were felt to be related to exertional activity associated with intense Yoga practice of long duration. In patient 9, sciatic neuropathy developed upon awakening from sleep, and resolved gradually within the next 8 months. A similar right sciatic neuropathy occurred 6 years prior, also resulting in a complete recovery within 6 months. It was felt the sciatic neuropathy in patient 9 was secondary to a compressive etiology due to liability to external pressure. In patients 10 and 12, sciatic nerve compression occurred following falling accident and prolonged sitting, respectively. In patients 2 and 3, sciatic neuropathy was related to a popliteal nerve block procedure and a partially treated eosinophilic granulomatosis with polyangiitis (Churg-Strauss syndrome), respectively.

Radiological findings and follow-up

Eight patients underwent MRI of the pelvis and/or the thigh for the evaluation of sciatic nerve (Table 1). MRIs were normal in 2, showed abnormal sciatic nerve in 1, and revealed surrounding soft tissue abnormality without clear abnormalities in the sciatic nerve itself in the remaining 5 patients.

Three patients (25%) were lost to follow up. Among the remaining 9 patients with a follow-up period ranging from 7 days to 31 months, 4 patients (33%) had no or suboptimal

Table 2. Sensory and motor nerve conduction studies

Patient No.	Timing of EDX study (days)	Side	Sural SNAP amplitude/latency (uV/ms)	Superficial peroneal amplitude/latency (uV/ms)	Peroneal-EDB amplitude/latency (mV/ms)	Peroneal-TA amplitude/latency (mV/ms)	Tibial-AH amplitude/latency (mV/ms)
1	30	**L**	18.3/3.4	23.1/3.0	1.3/5.2	6.3/3.1	16.5/3.4
		R	22.5/4.0	28.4/2.8	5.1/4.5	NA	NA
2	520	**L**	5.2/4.3	5.2/2.6	3.8/4.0	4.6/3.2	2.0/4.3
		R	9.3/3.2	10.0/2.8	4.4/4.8	4.5/3.5	8.9/3.8
3	210	**L**	11.5/3.6	8.5/3.1	2.4/4.0	NA	11.4/3.7
		R	11.2/3.2	6.5/3.1	NA	NA	NA
4	1100	L	20.3/3.1	17.0/2.8	NA	NA	9.6/3.6
		R	16.2/3.0	14.5/2.8	4.2/3.5	7.5/3.0	4.6/4.4
5	40	L	30.6/3.4	26.8/2.5	7.4/4.8	6.3/1.4	19.8/2.4
		R	22.6/4.0	21.9/2.9	5.6/3.0	7.4/1.6	14.0/4.8
6	21	**L**	12.7/4.0	9.4/4.0	4.2/5.5	2.7/3.1	10.4/5.3
		R	12.8/3.8	9.8/3.4	6.8/5.1	6.0/3.0	10.1/5.0
7	28	L	13.0/3.3	10.8/3.0	5.9/2.9	4.2/2.1	8.1/3.1
		R	14.8/3.0	9.2/2.9	0.9/3.4	5.5/2.9	8.2/3.5
8	65	L	15.3/3.7	12.1/2.8	10.6/3.5	6.7/5.5	NA
		R	11.3/3.8	5.9/3.3	4.6/3.1	5.9/5.3	9.2/4.1
9	30	L	14.7/3.7	18.4/2.4	3.8/3.6	7.4/2.6	10.8/4.4
		R	5.9/4.6	11.2/3.6	1.8/4.7	6.8/3.8	4.7/5.0
10	32	L	7.8/4.0	15.3/2.2	3.8/3.8	6.0/3.9	13.5/3.1
		R	6.7/3.6	6.9/2.9	NR	4.3/3.8	2.0/6.3
11	90	**L**	9.2/3.6	7.7/2.8	0.6/4.6	5.7/3.6	NR
		R	NA	10.0/3.0	2.6/3.8	5.0/3.0	11.6/3.3
12	43	L	NA	15.2/2.2	1.3/4.3	5.0/2.9	NA
		R	25.7/3.3	16.7/2.6	1.9/3.9	5.0/2.7	17.8/3.4

Bolded indicates involved side of sciatic neuropathy. Underlined numbers indicate abnormal results based on lab reference ranges.

Abbreviations: EDX, electrodiagnostic; L, left; R, right; SNAP, sensory nerve action potential; mV, millivolt; ms, millisecond; S, superficial; EDB, extensor digitorium brevis; TA, tibialis anterior; AH, abductor hallucis; NA: not assessed. NR: no response.

recovery, and 5 patients (42%) had a complete or near-complete recovery of sensorimotor deficits. No surgical decompression of the sciatic nerve was performed in any patients.

Discussion

The differential diagnoses of sciatic neuropathy include common fibular neuropathy, lumbosacral (L5 or S1) radiculopathy, and lumbosacral plexopathy. EDX testing is frequently needed to achieve a definite diagnosis. Among these entities, lumbosacral radiculopathy is the most common, being associated with normal sensory NCSs.[1] In our patients, a diagnosis of lumbosacral radiculopathy was ruled out based on the following: (1) an initial presentation of unilateral distal lower extremity sensory and motor deficits rather than lower back or radicular pain; (2) etiologies or circumstances rendering the sciatic nerve to compression or inflammation; (3) normal needle examination findings of the gluteus medius, gluteus maximus and/or lumbosacral paraspinal muscles; and (4) lack of significant findings on MRI of the lumbar spine in the majority of patients. A diagnosis of lumbosacral plexopathy was additionally ruled out with a lack of gluteus medius and gluteus maximus involvement on EMG.

Table 3. Needle electromyography findings

Patient No.	Side	EDB	TA	PL	AH	BFLH	TP/FDL	BFSH	ST	MG
1	L	abnl	abnl	abnl	NA	NA	nl	abnl	nl	abnl
2	L	abnl	abnl	NA	abnl	NA	abnl	nl	nl	nl
3	L	abnl	abnl	NA	abnl	NA	abnl	NA	nl	nl
4	R	abnl	abnl	abnl	NA	abnl	NA	NA	abnl	abnl
5	R	abnl	abnl	NA	abnl	abnl	abnl	abnl	abnl	abnl
6	L	abnl	abnl	abnl	nl	abnl	nl	abnl	abnl	nl
7	R	abnl	abnl	abnl	nl	abnl	abnl	abnl	abnl	nl
8	R	abnl	nl	abnl	abnl	nl	abnl	nl	nl	nl
9	R	abnl	abnl	l	abnl	NA	nl	abnl	abnl	abnl
10	R	abnl	abnl	abnl	abnl	NA	abnl	abnl	abnl	abnl
11	L	abnl	abnl	NA	abnl	NA	abnl	nl	abnl	nl
12	R	abnl	abnl	NA	abnl	NA	abnl	nl	nl	abnl
% of abnl		100	92	86	80	80	73	60	58	50

Abbreviations: EDB, extensor digitorium brevis; TA, tibialis anterior; PL, peroneus longus; AH, abductor hallucis; BFLH, biceps femoris long head; TP/FDL, tibialis posterior/flexor digitorum longus; BFSH, biceps femoris short head; ST, semitendinosus; MG, medial gastrocnemius; L, left; abnl, abnormal; NA, not assessed; nl, normal; R, right.

Previously, Yuen et al[2] described a series of 100 patients with sciatic neuropathy. In 9% of patients, normal unilateral sural and superficial peroneal sensory SNAPs were recorded. However, interpretation was limited due to a lack of sensory NCS of the contralateral lower extremity. In our study, bilateral superficial peroneal sensory NCSs were performed in all 12 patients and bilateral sural sensory NCSs in 10. All obtained SNAPs fell within the normal range according to our laboratory standard. Therefore our study confirmed the presence of a group of sciatic neuropathies that may relatively spare sensory fibers. Amplitude asymmetry on sural or superficial peroneal SNAPs was observed in 3 patients, with lower amplitudes being seen on the affected side but still falling within normal range. Thus it is important to perform sensory NCSs on both sides in the evaluation of unilateral sciatic neuropathy. It is worthwhile pointing out that all patients in this study had sensory complaints and/or abnormal sensory examination findings despite preserved SNAPs.

Our observations seem to indicate that sensory and motor fibers in the sciatic nerve can be differentially affected, either due to anatomical separation within the sciatic nerve or intrinsic quality differences between sensory and motor fibers. The interpretation based on anatomical separation seems to be supported by several previously published studies demonstrating the somatotopic fascicular organization of human sciatic nerves.[5-6] Results of human sciatic nerve dissection and fascicle mapping by Gustafson et al[6] revealed that fibers of the superficial peroneal, deep peroneal and sural cutaneous remains fascicular and independent within the sciatic nerve. Therefore it seems plausible that the selective involvement of the motor fibers seen in our patients be explained on the basis of fascicular anatomy.

This group of patients with sciatic neuropathy was mostly young, and had a higher female to male ratio when compared to previous studies.[2,4] Yuen et al[2] previously reported that most of their patients with intact SNAPs revealed mild axonal loss changes with normal or near normal CMAP amplitudes. In our study, a reduction of CMAP amplitude was observed in 10 patients, and sensory sparing were seen in patients with both mild (e.g., patient 5) and severe (e.g. patient 11) sciatic neuropathies.

We are uncertain about the evolutional changes on EDX studies due to a lack of follow-up EDX data. SNAPs

likely evolve with the disease course and may improve with the removal of triggering factors or worsen as the disease progresses. Three patients in our study had a disease course of longer than 6 months. This seems to suggest the relative sparing of sensory fibers in sciatic neuropathy may persist for an extended duration in some patients.

In conclusion, our study demonstrates that the presence of intact sural and superficial peroneal SNAPs does not rule out a diagnosis of sciatic neuropathy. A diagnosis of sciatic neuropathy should be based on a combined analysis of clinical circumstance, symptoms and signs, EDX data and radiological findings. Sciatic neuropathy with preserved SNAPs is preferentially seen in young females. The mechanism for the differential involvement sensory and motor fibers in the sciatic nerve merits further study.

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References

[1] Distad BJ, Weiss MD. Clinical and electrodiagnostic features of sciatic neuropathies. Phys Med Rehabil Clin N Am. 2013;24(1):107-120.

[2] Yuen EC, So YT, Olney RK. The electrophysiologic features of sciatic neuropathy in 100 patients. Muscle Nerve. 1995;18(4):414-420.

[3] Katirji B, Wilbourn AJ. High sciatic lesion mimicking peroneal neuropathy at the fibular head. J Neurol Sci. 1994;121(2):172-175.

[4] Cherian RP, Li Y. Clinical and Electrodiagnostic Features Of Nontraumatic Sciatic Neuropathy. Muscle Nerve. 2019;59(3):309-314.

[5] Bäumer P, Weiler M, Bendszus M, Pham M. Somatotopic fascicular organization of the human sciatic nerve demonstrated by MR neurography. Neurology. 2015;84(17):1782-1787.

[6] Gustafson KJ, Grinberg Y, Joseph S, Triolo RJ. Human distal sciatic nerve fascicular anatomy: implications for ankle control using nerve-cuff electrodes. J Rehabil Res Dev. 2012;49(2):309-321.