ORIGINAL CONTRIBUTION

Magnetic Resonance Neurography in Extraspinal Sciatica

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Background: Sciatica without evidence of lumbosacral root compression is often attributed to piriformis syndrome. However, specific diagnostic tools have not been available to demonstrate sciatic nerve entrapment by the piriformis muscle.

Objective: To evaluate the use of magnetic resonance (MR) neurography in identifying abnormalities of the sciatic nerve in patients with unexplained sciatica.

Design: Case series from a retrospective medical record review.

Patients: Fourteen patients with sciatic distribution pain and normal results on MR imaging for lumbosacral radiculopathy were referred for MR neurography of the lumbosacral plexus and sciatic nerves.

Results: In 12 patients, MR neurography demonstrated increased fluid-attenuated inversion recovery signal in the ipsilateral sciatic nerve. In most patients, this abnormal signal was seen at the sciatic notch, at or just inferior to the level of the piriformis muscle. To date, 4 patients have undergone surgical decompression, with excellent relief of symptoms in 3 of them.

Conclusion: Magnetic resonance neurography often identifies an abnormal increased signal in the proximal sciatic nerve in patients with extraspinal sciatica and allows more accurate diagnosis of sciatic nerve entrapment in suspected cases.

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SOME PATIENTS WITH LEG PAIN resembling lumbosacral radicular sciatica have normal results on lumbar magnetic resonance (MR) imaging. In such patients, the symptoms have often been attributed to entrapment of the sciatic nerve in the buttock by the overlying piriformis muscle or by an adjacent band of fascia. However, the diagnosis of piriformis syndrome is controversial, and it has been difficult to obtain objective evidence for the existence of such an entity. We report herein that MR neurography, a sensitive imaging technique for detecting peripheral nerve pathologic features on axial and coronal T1-weighted and short tau inversion recovery (STIR) sequences, reveals signal abnormalities within the sciatic nerve in most patients with extraspinal sciatica.

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METHODS

We performed a retrospective medical record review of 14 patients with unexplained sciatic distribution pain who were referred by neurologists, neurosurgeons, and orthopedic spine specialists for MR neurography at the University of California, San Francisco, between August 1, 2003, and May 30, 2005. In each patient, prior results of MR imaging of the lumbosacral spine were normal or demonstrated findings that were determined by the clinician to be incompatible with the patient's history and examination. Three other patients with sciatica and normal results on lumbar MR imaging who were diagnosed as having non–sciatic-related pelvic pathologic features on MR neurography were used as control subjects. In all patients, coronal and axial T1-weighted and STIR sequences were obtained of the lumbosacral plexus and sciatic nerves using a 1.5-T magnet (1.5-T Gyroscan Intera; Phillips Medical Systems, Best, the Netherlands) (resolution time, 2530 milliseconds; echo time, 20 milliseconds; inversion time, 160 milliseconds; section thickness, 3-3.5 mm; field of view, 34 cm; with a number of excitations 3 phased-array body coil). Images were interpreted by 1 of us (C.T.C.) who specializes in reading MR neurograms at our institution. Written approval was obtained from the committee on human research at our institution before the medical record review.

RESULTS

Demographic data, examination findings, and electrodiagnostic and MR neurography results in the 14 patients are given in the **Table**. All patients had unilateral sciatic

Table. Characteristics of 14 Patients With Unexplained Sciatic Distribution Pain Referred for Magnetic Resonance (MR) Neurography

Patient No./Sex/Age, y	Symptoms		Examination Findings*					MR Neurography Findings	
	Paresthesias or Numbness	Weakness	Motor	Reflexes	Sensory	Straight Leg Raise Test	Electrodiagnostic Findings	Increased STIR Sequence Signal in Sciatic Nerve	Changes in Muscle
1/F/56	Yes	Yes	Moderate weakness of TA, EHL, tibialis posterior, gastrocnemius, peroneius	Absent bilaterally at knees and ankles	Hyperalgesia R lateral leg, dorsum and plantar surfaces of foot	Not performed	Low R peroneal compound motor action potential amplitudes, fibs, long duration MUAPs in R TA and gastrocnemius but normal in biceps femoris (long and short heads)	From inferior border of R piriformis muscle to ischial tuberosity and intermittently in proximal thigh	Normal
2/F/51	Yes	Yes	Mild R TA weakness	Normal	Hyperalgesia in R S1 dermatome	Negative	Minimally delayed R H reflex	Normal	Asymmetric, enlarged R piriformis muscle with mild diffuse increased T2-weighted signal and enhancement
3/M/64	Yes	No	Normal	Normal	Normal	Positive	. . .	At level of L sciatic notch	Relative L piriformis muscle atrophy
4/M/72	No	No	Normal	Normal	Normal	Negative	. . .	At level of R sciatic notch	Mildly enlarged R gemellus muscle
5/M/64	Yes	Yes	Mild weakness of R TA, peroneus, EHL, gastrocnemius	Absent at ankles bilaterally	Mildly decreased to light touch in R L5 dermatome	Negative	Mildly reduced recruitment of long-duration MUAPs in R TA and peroneus longus	At level of R sciatic notch	Atrophy of R semimembranosis, semitendinosis, biceps femoris (long head) and peroneus longus and brevis
6/F/39	Yes	No	Normal	Normal	Normal	Mildly positive	. . .	At level of R sciatic notch	Increased STIR sequence signal in R gluteus maximus
7/F/67	Yes	No	Mild weakness of R peroneus and EHL	Absent at R ankle	Moderately decreased to light touch in R L5 dermatome	Not performed	Negative (twice)	At level of R sciatic notch	Normal
8/M/55	No	No	Normal	Normal	Decreased in L S1 dermatome	Not performed	Negative	At level of L ischial tuberosity	Normal
9/M/35	No	No	Limited because of pain	Normal	Decreased over L lateral leg	Not performed	Absent H reflex, positive sharp waves and fibs, reduced recruitment of long-duration MUAPs in gastrocnemius and biceps femoris (long head)	At level of L sciatic notch	Atrophy of L piriformis and gluteus medius muscles with increased signal and enhancement
10/F/51	No	No	Normal	Slightly decreased at R ankle	Normal	Not performed	Negative	At level of R piriformis muscle and in distal R S1 root as traverses pelvis	Relative atrophy of all L-sided muscles†
11/F/68	Yes	Yes	Mild weakness of L TA and EHL	Normal	Mildly decreased to pinprick in L L5 and S1 dermatomes	Mildly positive	. . .	Normal	Normal
12/F/49	Yes	No	Mild R TA weakness	Normal	Normal	Not performed	Negative	At level of R sciatic notch	Normal
13/F/40	Yes	No	Normal	Normal	Normal	Not performed	. . .	At level of sciatic notch bilaterally	Normal
14/F/46	Yes	No	Normal	Normal	Mildly decreased to light touch over R lateral knee	Not performed	Negative	Just inferior to R sciatic notch	Normal

Abbreviations: EHL, extensor hallucis longus; fibs, fibrillation potentials; L, left; MUAPs, motor unit action potentials; R, right; STIR, short tau inversion recovery; TA, tibialis anterior; ellipses, no study completed on that patient.

*Sciatic notch palpation tenderness examination was performed in 3 patients only, with the following findings: patient 12 (present on R), patient 13 (present on L), and patient 14 (present on R).

†This patient has a baseline L hemiparesis.

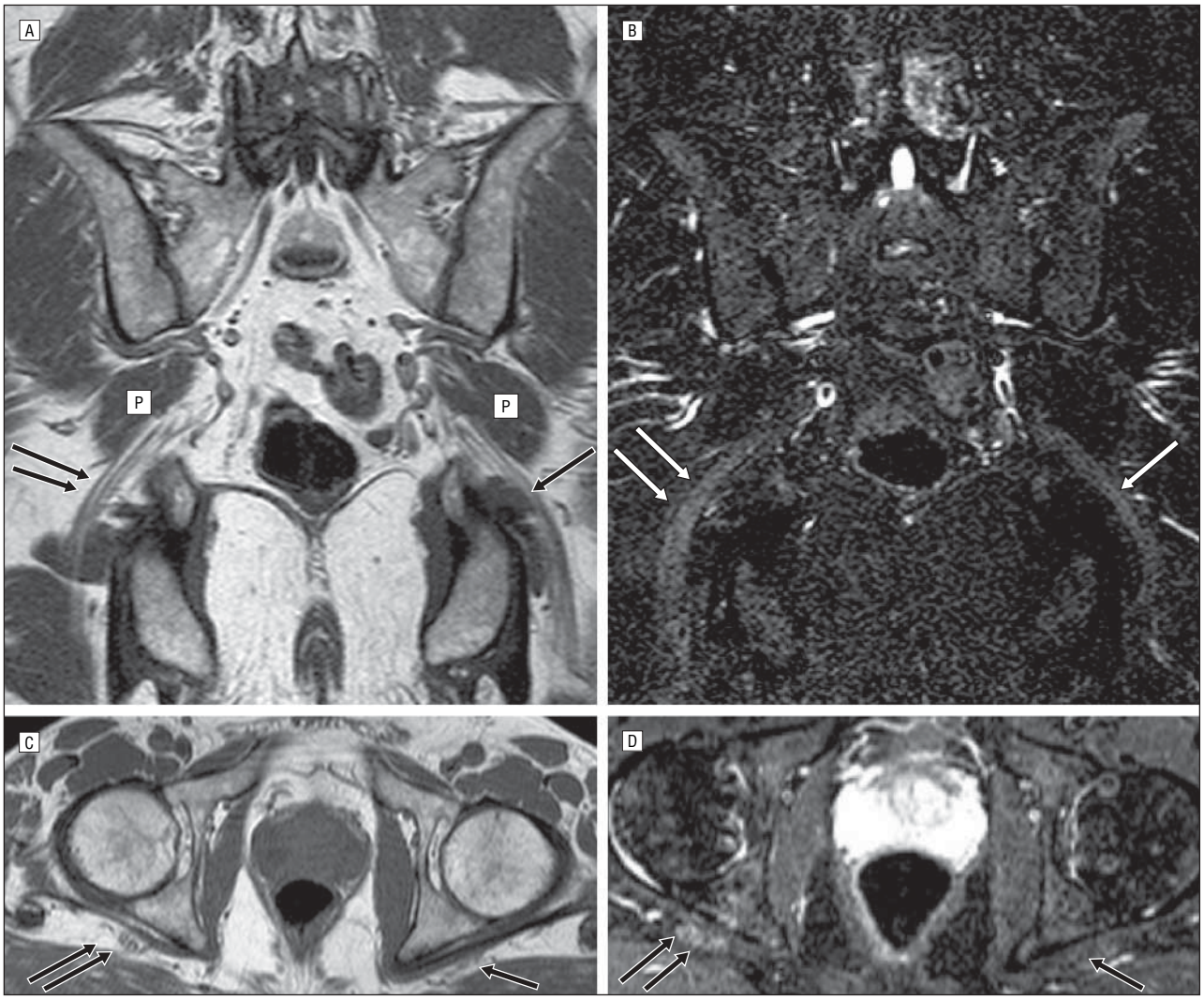

Figure 1. Coronal and axial T1-weighted (A and C) and short tau inversion recovery (STIR) (B and D) sequences through the lumbosacral plexus and sciatic nerves bilaterally. A and C, The anatomical T1-weighted sequences demonstrate the course of the sciatic nerves (double arrows and single arrows) exiting the sciatic notch beneath the piriformis muscles (P). B and D, The STIR sequences demonstrate the right sciatic nerve (double arrows) to be larger and higher in signal compared with the left sciatic nerve (single arrows) as it exits the sciatic notch.

distribution pain that consisted of buttock pain, usually radiating down the posterior thigh into the leg. In 6 patients, the pain first appeared shortly after trauma or strenuous exercise. The pain was often aggravated by sitting, exercise, or bending at the waist. Neurological deficits were mild or absent, and results of electrodiagnostic studies were normal in most patients.

In 12 patients, MR neurography demonstrated abnormal increased STIR sequence signal in the ipsilateral sciatic nerve. In 8 of these patients, the abnormal signal was seen at or just inferior to the level of the sciatic notch and piriformis muscle (**Figure 1** and **Figure 2**). In 1 patient, the sciatic nerve was focally hyperintense at the level of the ischial tuberosity. The MR neurography in 1 other patient demonstrated abnormal signal in both sciatic nerves, despite symptoms in only 1 leg. Four patients (including 1 patient with a normal-appearing ipsilateral sciatic nerve) had an abnormal ipsilateral piriformis muscle; these included 2 patients with denervation atrophy (patients 2 and 10) and 2 patients with relative hypertrophy (patients 3 and 9). In patient 9, atrophy of the ipsilateral gluteus medius was also observed. In patient 4, the ipsilateral gemellus muscle, located just inferior to the piriformis muscle, was hypertrophied. In patient 5, there was atrophy of all ipsilateral sciatic-innervated muscles. In patient 6, the gluteus maximus on the affected side exhibited increased STIR sequence signal, a nonspecific finding consistent with muscle edema or inflammation. Patient 10, who had a baseline hemiparesis on the side contralateral to her symptoms due to secondary progressive multiple sclerosis, exhibited diffuse atrophy of all muscles in the paretic limb. Patient 11 had a normal MR neurographic image. The sciatic nerve and piriformis muscle appeared normal on MR neurography in all 3 control subjects.

To date, patients 9, 10, 11, and 12 have undergone surgical exploration and decompression of the sciatic nerve. Patient 11 had normal results on MR neurography. All patients had intraoperative evidence of entrapment by the piriformis muscle or an associated fibrous band. Two months after surgery, 3 of these patients reported almost complete resolution of their symptoms. Patient 10, with multiple sclerosis, still reports pain in the symptomatic leg.

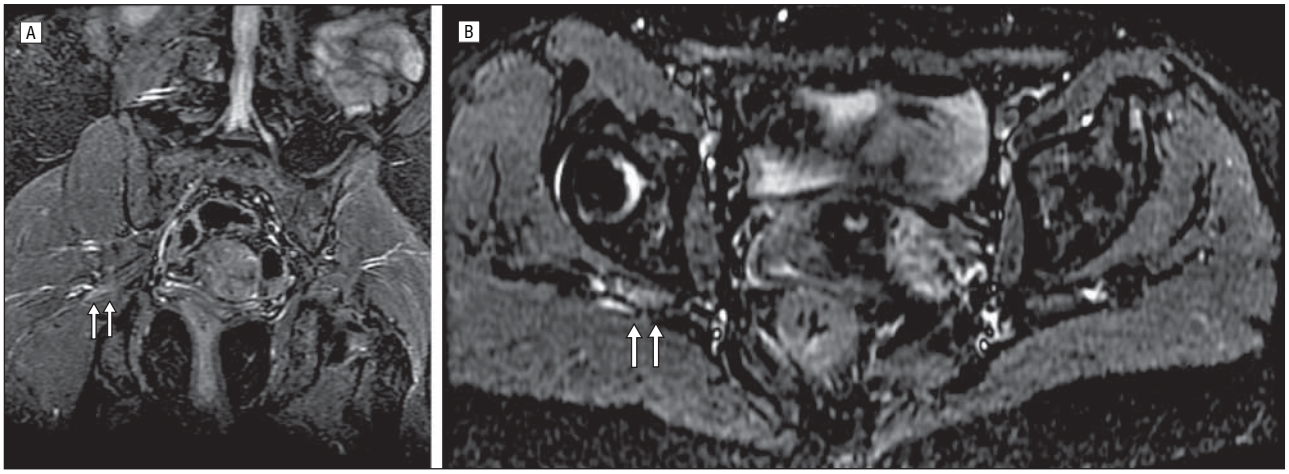

Figure 2. Coronal (A) and axial (B) short tau inversion recovery sequences at the level of the sciatic notch, again showing enlargement and high signal within the right sciatic nerve (double arrows).

COMMENT

Magnetic resonance neurography is an imaging technique that increases the conspicuity of the nerve by suppressing the signal from adjacent tissue (primarily fat-containing structures such as bone and muscle).[1,2] The nerve contains little fat, so its signal remains unsuppressed. The fluid-attenuated inversion recovery sequence is sensitive to increased water content, as seen with edema or other pathological processes. It also has inherent fat suppression. This makes STIR sequences ideal for imaging nerve roots and peripheral nerves.

The controversy over whether sciatica originating distal to the lumbosacral foramina can in some patients be attributed to entrapment by the piriformis muscle has persisted for many years. Stewart[3] argued that the piriformis syndrome has been overdiagnosed and proposed that a definitive diagnosis would require surgical exploration to identify compression of the sciatic nerve by the piriformis muscle or by an associated fibrous band. However, MR neurography in our study demonstrated focal signal abnormalities within the sciatic nerve in the buttock in almost all patients with unexplained sciatica. Similar findings were recently reported in a larger series by Filler et al.[4] Together, these results suggest that until now the piriformis syndrome has probably been underdiagnosed, rather than overdiagnosed, and that MR neurography is the diagnostic procedure of choice.

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