ORIGINAL ARTICLE

Measurement of Motor Nerve Conduction Velocity of the Sciatic Nerve in Patients With Piriformis Syndrome: A Magnetic Stimulation Study

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ABSTRACT. Chang C-W, Shieh S-F, Li C-M, Wu W-T, Chang K-F. Measurement of motor nerve conduction velocity of the sciatic nerve in patients with piriformis syndrome: a magnetic stimulation study. Arch Phys Med Rehabil 2006;87: 1371-5.

Objective: To assess the motor nerve conduction of the sciatic nerve by a magnetic stimulation method in patients with piriformis syndrome.

Design: Prospective study.

Setting: An electrodiagnostic laboratory in a university hospital.

Participants: Twenty-three patients with piriformis syndrome and 15 healthy persons for control.

Interventions: Not applicable.

Main Outcome Measures: Motor nerve conduction velocity (MNCV) of the sciatic nerve was measured at the gluteal segment by magnetic stimulation proximally at L5 and S1 roots and distally at sciatic nerve at gluteal fold and recording at the corresponding muscles. Diagnostic sensitivities were measured in the magnetic stimulation method and the conventional nerve conduction, long latency reflex, and needle electromyography studies.

Results: The mean MNCV of the sciatic nerve ± standard deviation at the gluteal segment in L5 component was 55.4±7.8m/s in patients with piriformis syndrome, which was slower than the mean value of 68.1±10.3m/s obtained in healthy controls (P=.014). The MNCV of the sciatic nerve in S1 component showed no significant difference between the patients and controls (P=.062). A negative relation was found between the disease duration and the MNCV values of sciatic nerves in patients with piriformis syndrome (r=−.68, P<.01). The diagnostic sensitivity by magnetic stimulation is .467.

Conclusions: Magnetic nerve stimulation provides a painless, noninvasive, and objective method for evaluation of sciatic nerve function in patients with piriformis syndrome.

Key Words: Magnetics; Nerve conduction; Rehabilitation; Sciatic nerve.

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PIRIFORMIS SYNDROME IS defined by a loose cluster of symptoms arising from the entrapment of the sciatic nerve passing the sciatic notch, and it may lead to buttock or hamstring pain. Causes for anatomic abnormalities of the piriformis muscle and the sciatic nerve may result in irritation of the sciatic nerve by the piriformis muscle. Clinically, it often mimics sciatica caused by the spine. Although some available evaluation methods, including imaging studies of piriformis syndrome as shown by Rossi[1] and Filler[2] and colleagues, have greatly enhanced diagnostic specificity and sensitivity to anatomic abnormalities, there are still limited electrodiagnostic tools to examine functional entrapment of the sciatic nerve at the crossing level of piriformis muscle. In the previous study by Fishman and Zybert,[3] the H-reflex was used to evaluate patients with piriformis syndrome. Their study showed that H-reflex was normal at rest, but there were delayed latencies in the FAIR position (hip flexion, adduction, and internal rotation). Nakamura et al[4] reported another method for the diagnosis of piriformis syndrome by using a recording evoked potential from an epidural electrode at the lumbar spine and stimulation of the peroneal nerve at the fibular head. The previously reported methods are all valuable. However, their results are limited in sensory evaluation, and there is difficulty in specifying the lesion localization because of the delayed latency in the long reflex course. Chang and Lien[5] showed an invasive method for spinal nerve root stimulation to evaluate patients with sciatica and lumbosacral radiculopathy. They used a monopolar needle for nerve root stimulation proximally and near sciatic nerve stimulation distally at the gluteal fold. Motor nerve conduction velocity (MNCV) of the sciatic nerve at gluteal segment could be measured by this method, and it is useful for evaluating radiculopathy and could possibly be used in patients with piriformis syndrome. However, electric stimulation with a needle is invasive and somewhat painful.

In the present study, we propose a new method for assessment of motor nerve conduction at the gluteal segment of the sciatic nerve by magnetic stimulation in patients with piriformis syndrome and compare it with the conventional electrodiagnostic methods.

METHODS

Patient Profile

Twenty-three patients with a clinical diagnosis of piriformis syndrome, drawn from outpatients referred to the electrodiagnostic laboratory of a university hospital from 2003 to 2005, participated in this study. They included 15 women and 8 men, with ages ranging from 40 to 67 years (mean, 53.8y). The clinical diagnosis of piriformis syndrome was according to the criteria of Fishman et al,[6] including the accepted signs of (1) sciatica or gluteal pain in the FAIR position, (2) local tenderness at the gluteal area between the piriformis muscle and the sciatic nerve, and (3) positive Lasègue sign at supine position. Patients with diabetes, neuritis, traumatic nerve injury, spinal operation, hip joint replacement, or blood dyscrasia were excluded.

Among the 23 patients with piriformis syndrome, 16 had unilateral symptoms and 7 suffered from bilateral involvement. The disease duration from the onset of the symptoms to the nerve conduction studies was between 2 and 26 months (mean, 6.6mo). In addition, 15 healthy persons ranging from 36 to 60 years (mean, 51.1y) were included as control subjects. Therefore, there were 30 affected limbs and 16 unaffected limbs in the patients with piriformis syndrome and 30 limbs in the controls for the present study.

Selection of Nerve Stimulation and Muscle Recording

The sciatic nerve is a major nerve arising from the lumbosacral plexus, originating from the ventral rami of L4 to S3 roots. The peroneal portion is composed of posterior divisions of L4 to S2 roots, and the tibial portion is composed of the anterior divisions of L4 to S3 roots. The nerve root contributions fuse to form a single trunk within the pelvis, which then exits through the sciatic notch inferior to the piriformis muscle.[7] The L5 root is the major component of peroneal nerve portion supplying dorsiflexors of ankle and toes extensors. The tibialis anterior muscle is dominantly supplied by the L5 component and was selected for recording in the present study. The S1 root is the major component of the tibial nerve portion supplying the hamstring and the calf muscles. The medial head of the gastrocnemius muscle is mainly supplied by the S1 component and was also used for recording in the present study.

Magnetic Stimulation Study

Magnetic nerve stimulation was performed by using a Magstim 220 stimulator,[a] which was connected to a figure-of-8 coil of 70mm in diameter (type 9925[a]) for each external circular coil. The calibration of the shield was performed at the room temperature of 24°C by using a Mag-03MS magnetometer[b] that was cross-calibrated with the Magstim system. The stimulation intensity was set at 100% of the maximum output with peak magnetic field of 2.2T and peak electric field strength of 660V/m. The distribution of the magnetic fields excited by the figure-of-8 coils yielded higher values of the induced electric field in the regions below the coil surface. The radial displacement from the coil center was 12mm, and the spatial distribution on depth was up to 30mm and for instances to 100mm.[8]

For studying the L5 spinal nerve component of sciatic nerve, the stimulating coil was focused on the L5 root at the midpoint between the L5 spinal process and the posterior iliac crest, whereas the distal stimulation was placed over the sciatic nerve at the gluteal fold, which is located at the midpoint between the ischial tuberosity and the greater trochanter of the femur. The paired recording electrodes of a Neuroline 710[c] with a self-adhesive ring and Ag-AgCl content were placed on the tibialis anterior muscle and its tendon by a standard belly-tendon method. For studying the S1 spinal nerve component of sciatic nerve, the stimulating coil was focused on the S1 root at 2cm lateral to the S1 spinal process, whereas the distal stimulation was over the sciatic nerve at the gluteal fold. The active recording electrode was placed on the medial head of the gastrocnemius muscle and the reference electrode was placed on the Achilles' tendon. The ground electrode was placed on the posterior aspect of the midthigh.

The magnetic stimulation was reproduced 5 times for each site. The interval between the applications of single stimulation was 5 seconds, during which the magnetic stimulator could be fully charged. The shortest conduction latency and the largest amplitude of the compound muscle action potential (CMAP) were selected. From the distance measured by an obstetric caliper between the nerve root and the gluteal fold, the MNCV of sciatic nerve at gluteal segments in L5 and S1 components then could be obtained by the latency difference between the proximal and distal stimulations.

Conventional Electrodiagnosis

Motor and sensory nerve conduction and long latency reflex studies were performed in each patient with piriformis syndrome and controls. The examinations included the motor nerve conduction studies of tibial and peroneal nerves at leg segments, sensory nerve conduction studies of superficial peroneal and sural nerves, F wave of tibial and peroneal nerves, and H-reflex in bilateral tibial nerves. The Synergy T2[d] electromyography and nerve conduction system was used in the present study. The motor nerve conduction studies of tibial nerves were performed by using a standard belly-tendon method for recording on the abductor hallucis muscle and a supramaximal stimulation of the tibial nerve distally at the ankle and proximally at the popliteal fossa. The peroneal nerves were evaluated by recording on the extensor digitorum brevis muscles and stimulation of the peroneal nerves distally at the ankle and proximally at the fibular head. Sensory nerve conduction studies of the sural nerves were evaluated by an antidromic method by placing the recording electrodes at the lateral heel and the stimulating electrodes on the sural nerves at the middle third of the posterior aspect of the calf. Conduction studies of the superficial peroneal sensory nerves were performed by placing the recording electrodes on the medial dorsal cutaneous nerves at the ankle and the stimulating electrodes on the superficial peroneal nerves at the lower third of lateral leg. Skin temperature of the ankle was kept constantly above 31°C by using an infrared lamp, if necessary.

Electromyography with a disposable concentric needle[e] was performed in each patient with piriformis syndrome. The examined muscles included the paraspinal muscles at L5 and S1 levels, gluteal maximus, gluteal medius, tibialis anterior, and medial head of gastrocnemius muscles. Fibrillations and positive sharp waves were counted together and considered as an acute neuropathy with denervation hypersensitivity when found at more than 1 site of the testing muscle. Mean duration of motor unit action potentials greater than 20ms or fractional polyphasic waves greater than 30% in the testing muscle was also categorized as abnormal and considered as a chronic neuropathy.

Statistical Analysis

Statistical analysis of comparisons between the patients with piriformis syndrome and the controls were performed with the Wilcoxon rank-sum test and paired *t* test. A logic regression test was used to study the relation between the MNCV of sciatic nerve and the disease duration in patients with piriformis syndrome. The maximal level of significance was .05.

RESULTS

The basic data and the results of motor nerve conduction studies by magnetic stimulation in patients with piriformis syndrome and controls are summarized in table 1. The mean value for MNCV of the sciatic nerve at the gluteal segment from L5 nerve root to gluteal fold was significantly slower than the mean value of the same segments in controls ($P=.014$). The mean value for MNCV of the sciatic nerve at the gluteal segment from S1 nerve root to gluteal fold was slower than the mean value of the same segments in controls. However, the