Sonography of the Normal Ulnar Nerve at Guyon’s Canal and of the Common Peroneal Nerve Dorsal to the Fibular Head

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ABSTRACT: Purpose. This study was conducted to evaluate the ability of sonography to visualize the ulnar nerve at Guyon’s canal and the common peroneal nerve dorsal to the fibular head and to test for correlations between nerve measurements and subject characteristics.

Methods. We used a 5–12-MHz linear-array transducer in sonographic evaluation of 15 healthy adult volunteers. We evaluated the correlations between nerve diameters and surface areas and subject body mass index and height. We also tested for differences between nerve measurements in women and men and between nerve measurements from the left and right sides of the body.

Results. Both nerves were visualized in all subjects. Subject height correlated significantly with the anteroposterior diameter of the right ulnar nerve. Body mass index correlated significantly with the surface area of both ulnar nerves, with the anteroposterior diameter of both ulnar nerves, with the transverse diameter of the left ulnar nerve, and with the transverse diameter of the right common peroneal nerve. There was a statistically significant difference in anteroposterior diameter of the left ulnar and left common peroneal nerves between women and men. There were no significant differences between left- and right-side measurements for the combined data from the entire group of subjects.

Conclusions. A 5–12-MHz linear-array transducer readily allows for visualization of the ulnar nerve at Guyon’s canal and the common peroneal nerve dorsal to the fibular head.

Keywords: ultrasonography; ulnar nerve; common peroneal nerve; entrapment neuropathy

In the past, diagnosis of peripheral neuropathy was based on the patient’s history, findings on physical examination, and results from electrophysiologic tests. Electrophysiologic tests do not provide morphologic information about a nerve and surrounding tissues, which could help determine the etiology of the neuropathy. Furthermore, nerve conduction measurements reflect the status of only the best surviving fibers and consequently can yield normal results if even only a few fibers remain unaffected by a disease process.

Improved sonographic technology—including high-frequency broadband transducers, compound imaging, high near-field resolution, and extended field-of-view techniques—makes noninvasive evaluation of peripheral nerves and neuropathies possible. MRI is another appropriate method for noninvasive diagnosis of nerve disorders, but it is more expensive, more time consuming, and less widely accessible than sonography.

Until now, most sonographic investigations of nerves have been focused on the median nerve in carpal tunnel syndrome and on the ulnar nerve in cubital tunnel syndrome. However, the systematic sonographic identification of the normal ulnar nerve at Guyon’s canal has not been investigated. In addition, only Heinemeyer and Reimers have systematically evaluated the ability of sonography to visualize the common peroneal nerve dorsal to the fibular head. Using a 7.5-MHz linear-array transducer, they could not depict the common peroneal nerve in any of 50 healthy subjects.
In the present study, we investigated the ability of sonography to detect the ulnar nerve at Guyon’s canal and the common peroneal nerve dorsal to the fibular head in 15 healthy adult volunteers. We also measured the diameters and surfaces of these nerves’ cross sections at these sites and investigated possible correlations between these measurements and patients’ heights and body mass indices (BMIs). Furthermore, we investigated whether there are significant differences in measurements between women and men and between the left-hand nerves and right-hand nerves.

SUBJECTS AND METHODS

The study group comprised 15 randomly selected healthy adult volunteers (7 women and 8 men), drawn from the population of medical students and residents in the Department of Radiology at our institution. Neuromuscular disease, peripheral nerve lesions, diabetes mellitus, alcoholism, and other possible causes of neuropathy excluded subjects from the study. Subjects gave their oral informed consent to participate. The subjects’ ages ranged from 21 to 32 years (mean, 25.1 years), they had a mean body weight of 66.9 kg (range, 48–95 kg), a mean height of 1.72 m (range, 1.63–1.84 m), and a mean BMI of 22.4 (range, 17.6–28.1). All subjects were right-handed.

An HDI 5000 ultrasound scanner (Philips-ATL, Bothell, WA) equipped with a 5–12-MHz linear-array transducer was used. Compound imaging and high-definition zoom features were used. Care was taken not to apply excessive compression to the tissues examined before measuring the nerve diameters and cross-sectional areas. Sonographic examination of the ulnar nerve was performed with the dorsal side of the forearm resting on the examination table (Figure 1A); the patient lay in the prone position on the examination table for examination of the common peroneal nerve (Figure 1B).

On sonograms, nerves appear as multiple hypoechoic parallel linear areas separated by hyperechoic bands on longitudinal scans and as hypoechoic, rounded areas embedded in a hyperechoic background on transverse scans.2,4,5 The hypoechoic structures correspond to fascicles of axons, and the hyperechoic background corresponds to the interfascicular endoneurium.

We could easily visualize the ulnar nerve lying between the pisiform and the ulnar artery. Systematic scanning on transverse planes allowed us to follow the common peroneal nerve continuously from its origin from the sciatic nerve at the apex of the popliteal fossa until it emerged dorsal to the fibular head.

All nerves were scanned bilaterally, in both transverse and longitudinal sections. The anteroposterior (AP) and transverse (TR) diameters of the nerves were measured on the transverse images (Figures 2A and 3A), as was the cross-sectional area. The cross-sectional area was calculated automatically using the continuous trace method (Figures 2B and 3B).

We calculated the arithmetic mean and 95% confidence interval for all the measurements. The Pearson’s test was used to evaluate possible correlations between the various nerve measurements and the subjects’ BMI and height. A p value less than 0.05 in 2-tailed tests was considered significant. The nonparametric Wilcoxon’s signed-rank test was used to evaluate differences between nerve measurements in women and men and between nerve measurements from the left and right sides. Again, p less than 0.05 was considered significant.
significant. All statistical analyses were performed using the Statistical Package for Social Sciences for Windows (SPSS, Chicago, IL).

RESULTS

The ulnar nerve at Guyon’s canal and the common peroneal nerve dorsal to the fibular head could easily be visualized in all 15 subjects. The nerves were visualized more easily using compound imaging (Figure 2C and 3C) than using other techniques. The ulnar nerve presented with a circular, oval, or elliptic shape. The common peroneal nerve appeared more flattened.

Table 1 shows the mean values and 95% confidence intervals for measurements of the surface area, AP diameter, and TR diameter of the right and left ulnar and common peroneal nerves for the entire subject group. Subject height correlated...
significantly with the AP diameter of the right ulnar nerve ($r = 0.566; p < 0.05$). BMI correlated significantly with the surface area of the right ulnar nerve ($r = 0.618; p < 0.05$), the surface area of the left ulnar nerve ($r = 0.627; p < 0.05$), the AP diameter of the right ulnar nerve ($r = 0.572; p < 0.05$), the AP diameter of the left ulnar nerve ($r = 0.564; p < 0.05$), the TR diameter of the left ulnar nerve ($r = 0.573; p < 0.05$), and the TR diameter of the right common peroneal nerve ($r = 0.533; p < 0.05$). There were no significant differences in measurements between the right and left ulnar and common peroneal nerves for the entire subject group.

The mean values and 95% confidence intervals for measurements of the surface area, AP diameter, and TR diameter of the nerves are listed separately for women and men in Tables 2 and 3, respectively. Women and men had a statistically significant difference in the AP diameter of the left ulnar nerve ($p < 0.05$) and in the AP diameter of the left common peroneal nerve ($p < 0.05$).

**DISCUSSION**

Direct sonographic visualization of nerves can reveal a focal abnormality, differentiate neural Image 1 from extraneural tumors, and show the extent of a lesion and its relationship with vascular structures. In addition to compression of the median nerve in carpal tunnel syndrome and the ulnar nerve in cubital tunnel syndrome, entrapment neuropathies that are suited for sonographic examination are compression of the ulnar nerve in Guyon’s tunnel, compression of the common peroneal nerve at the fibular head, compression of the tibial nerve at the tarsal tunnel, and compression of the interdigital nerves in the intermetatarsal spaces. Currently, sonography is not routinely used for the clinical assessment of these nerve pathologies because many radiologists and clinicians are still unaware of its potential for this application. Current ultrasound equipment efficiently identifies the median, digital, ulnar, and radial nerves in the upper limbs and the sciatic, common peroneal, superficial peroneal, posterior tibial, medial and lateral plantar, calcaneal, and even interdigital nerves in the lower limbs.

Knowledge of nerve location and anatomic relations between the nerve and the surrounding structures is essential for sonographic identification. Examination of the nerves along transverse planes is preferable to longitudinal scanning because it allows following the nerves continuously throughout the limb. Because of the wide range of causes of neuropathies of the ulnar nerve at Guyon’s canal and of the common peroneal nerve dorsal to the fibular head, sonographic visualization of these nerves at these locations is of diagnostic importance.

Although a true osteofibrous tunnel does not exist at the level of the fibular head, entrapment of the common peroneal nerve typically occurs in the tight space between the fibular head and the fascia as the nerve winds around the back of the fibular neck, just under the skin. Any change in the normal alignment of the nerve with the bone (eg, by misalignment after fibular fracture) may therefore result in entrapment syndrome. The differential diagnosis for peroneal neuropathy includes mononeuritis, idiopathic peroneal palsy,
intrinsic and extrinsic nerve tumors, and extra-
neural compression by a synovial cyst, ganglion
cyst, soft tissue tumor, bone tumor, or large
fabella.17 Traumatic injury of the nerve may occur
secondary to a fracture or dislocation, surgery,
application of skeletal traction, or a tight cast or
bandage.17 Even prolonged sitting with crossed
legs and pressure during sleep have been reported
to cause peroneal nerve compression.18 Direct com-
pression of a nerve may also be caused by posttrau-
matic hematoma or callus formation, as well as
postoperative scars. Nerve sheath ganglia most
frequently involve the large nerves around the
knee, especially the peroneal nerve at the level of
fibular head.

Grossly, at the apex of the popliteal fossa, the
sciatric nerve divides into 2 branches, the larger
tibial and the smaller common peroneal nerve. The
common peroneal nerve descends from the apex of
the popliteal fossa obliquely through the popliteal
fossa, winding around the lateral and anterior
aspect of the fibular head and neck and passing
laterally to the anterior compartment musculature
and deeply to the 2 heads of the peroneus longus
musculature to divide into deep and superficial
branches. At the level of the popliteal fossa, the
common peroneal and tibial nerves have different
sonographic appearances. The tibial nerve shows
the typical echo pattern, with multiple hypoechic
parallel linear areas separated by hyperechic bands
appearing on longitudinal scans and hypoechic,
rounded areas embedded in a hyperechic back-
ground appearing on transverse scans. The common
peroneal nerve has fewer and thicker fascicles, with
less echogenic internal component. The difference
in appearance is most likely related to the difference
in the number of fascicles within those 2 nerves.7 In
1999, Heinemeyer and Reimers30 could not detect
the peroneal nerve behind the fibular head using a
7.5-MHz linear-array transducer.3 Until now, visu-
alization of the nerve at this site has been described
in only 1 patient by Fornage.4

The ulnar nerve at Guyon’s canal lies lateral to the
pisiform and at the medial and dorsal aspect of the
ulnar artery. Common causes of ulnar neuropathy at
Guyon’s canal are ganglion cysts involving or affect-
ing the pisotriquetrum joint,15,19–22 occupational
neuritis, laceration, ulnar artery disease (eg, pseudo-
aneurysms, arteritis), fractures (eg, of the hook of
the hamate bone), retractile scar tissue, anomalous
muscles (eg, accessory abductor digitii minimi,
anomalous hypothenar adductor), lipomas,23–25
giant cell tumors,26 neurofibromas, and intraneural
cysts. Chronic repeated external pressure by tools,
canehandles, or crutches is the usual cause of ulnar
nerve entrapment at Guyon’s canal.1

Some more generalized diseases can affect both
the ulnar nerve and common peroneal nerve, as
well as other nerves. Hereditary neuropathy with
liability to pressure palsies, an autosomal dominant
inherited disorder characterized by a tendency to
develop focal painless neuropathies after trivial
trauma, affects the peroneal nerve at the fibular
head, the ulnar nerve at the elbow and at Guyon’s
canal, the radial nerve at the spiral groove, and the
median nerve at the carpal tunnel.28 Sonography
may demonstrate nerve enlargement and hypo-
ecogenicity. Furthermore, nerve hypertrophy is
seen in the Charcot-Marie-Tooth syndrome (heredi-
tary motor and sensory neuropathy types I and II),3
and in Hansen’s disease, a chronic infectious dis-
ease caused by Mycobacterium leprae, which in its
various clinical forms primarily involves the skin
and nerves.29,30 By measuring the nerve cross-
sectional area sonographically, it was found that
increased nerve size correlates with the presence
of acute reactive states.30

The present study was conducted to determine
whether the ulnar nerve at Guyon’s canal and the
common peroneal nerve dorsal to the fibular head
can be detected using a 5–12-MHz transducer of the
type commonly used for soft tissue examination.
Our results indicate that these nerves can easily
be visualized and measured at these sites in healthy
adult subjects. Furthermore, our results show cor-
relations between BMI and some diameters and
surface areas of the nerves. There seem to be no
significant differences in these parameters based on
subject gender or side of the body. Given the rela-
tively small sample in our study, further data are
required to confirm these correlations.

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