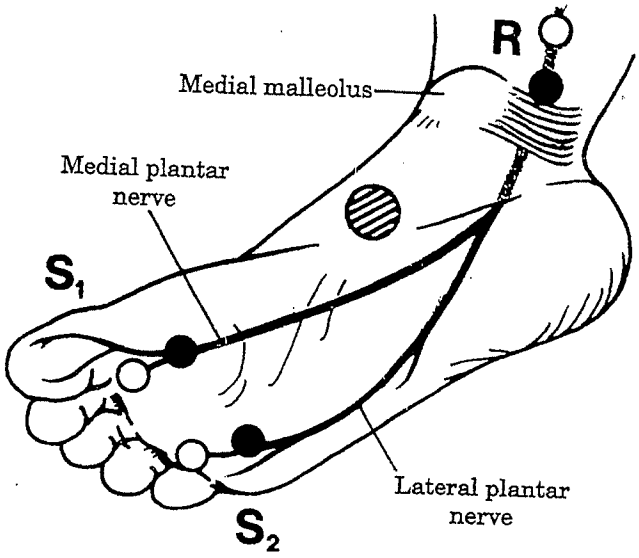


Figure 11.86. Ponsford's method of sensory nerve conduction of the plantar nerves.

Table 11.14.
Medial Plantar Sensory Nerve Conduction

Age (yr)	Onset Latency (msec)		Peak Latency (msec)		Amplitude (μV)		NCV (m/sec)	
	Mean	N Limit[a]	Mean	N Limit	Range	N Limit	Mean	N Limit
10–19 (N = 14)	2.7	3.4	3.3	3.9	10–26	10	49.4	39.9
20–29 (N = 13)	2.5	2.8	3.1	3.6	10–30	10	54.2	45.5
30–39 (N = 16)	2.5	3.0	3.2	3.9	7–20	7	54.1	45.9
40–49 (N = 18)	2.7	3.7	3.4	4.7	5–20	5	52.2	42.0
50–59 (N = 11)	2.9	4.3	3.6	5.4	3–15	3	52.3	45.4
60–69 (N = 11)	2.8	3.5	3.4	4.2	4–8	4	48.7	37.4
70–79 (N = 10)	3.3	5.4	4.2	7.0	2–5	2	49.4	22.3
≥80 (N = 7)	3.7	5.5	4.8	7.0	2–7	2	40.6	29.1
Total (N = 100)	2.9	3.9	3.6	4.9	2–30	2	50.1	38.5

[a]N limit, Normal limit. For the latencies, mean + 2 SD. For the amplitudes, the lower range. For the NCVs, mean - 2 SD.

MEASUREMENT: The latency to onset and the negative peak are measured from the stimulus onset. The maximal NCV is calculated by dividing the distance by the latency to the onset of the potential. Amplitude is measured by the conventional method. The method for distance measurement is not given.

TEMPERATURE: Skin temperature is controlled at 30–32°C at the medial malleolus and sole.

NORMAL DATA: See Tables 11.14 and 11.15.

COMMENTS: Medial plantar CNAPs were readily obtained in all normal subjects, including those aged over 80 yr. Lateral plantar CNAPs were obtained in all normal subjects below the age of 60 but were absent in the majority above this age. Compared with Oh and Guiloff's methods (99, 103), these authors claimed that the amplitude of CNAPs was larger. The amplitude of CNAPs decreased with age. There was no difference between NCVs with increasing age.

Mixed Nerve Conduction

Saeed and Gatens (105) described a technique for recording mixed nerve conduction in the medial and lateral plantar nerves (Fig. 11.87).

RECORDING: An active surface electrode is placed on the posterior tibial nerve just proximal to the flexor retinaculum.

Table 1 Medial plantar and lateral plantar sensory nerve action potential values in healthy subjects

	Latency (ms)				Velocity (m/s)				Amplitude (μV)			
	Mean	SD	Range	ULN	Mean	SD	Range	LLN	Mean	SD	Range	LLN
MP	2.2	0.3	1.5–3.0	2.7	57.5	7.8	40.7–76.5	41.8	5.9	2.6	2.5–12.8	2.8
LP	2.4	0.5	1.4–3.2	3.2	59.4	10.5	39.6–77.9	38.7	3.5	2.3	0.3–10.7	1.1

MP medial plantar, *LP* lateral plantar, *ULN* upper limit of normal, *LLN* lower limit of normal

Table 2 Distribution of MP sensory NAP parameters in the two age subgroups

	66–69 years ($n = 46$)	70–84 years ($n = 35$)	*P*
Velocity (m/s)			
Mean ± SD	57.8 ± 7.9	57.3 ± 7.9	0.723
LLN	42.0	41.5	
Amplitude (μV)			
Mean ± SD	6.2 ± 1.5	5.0 ± 1.7	0.529
LLN	2.9	1.7	

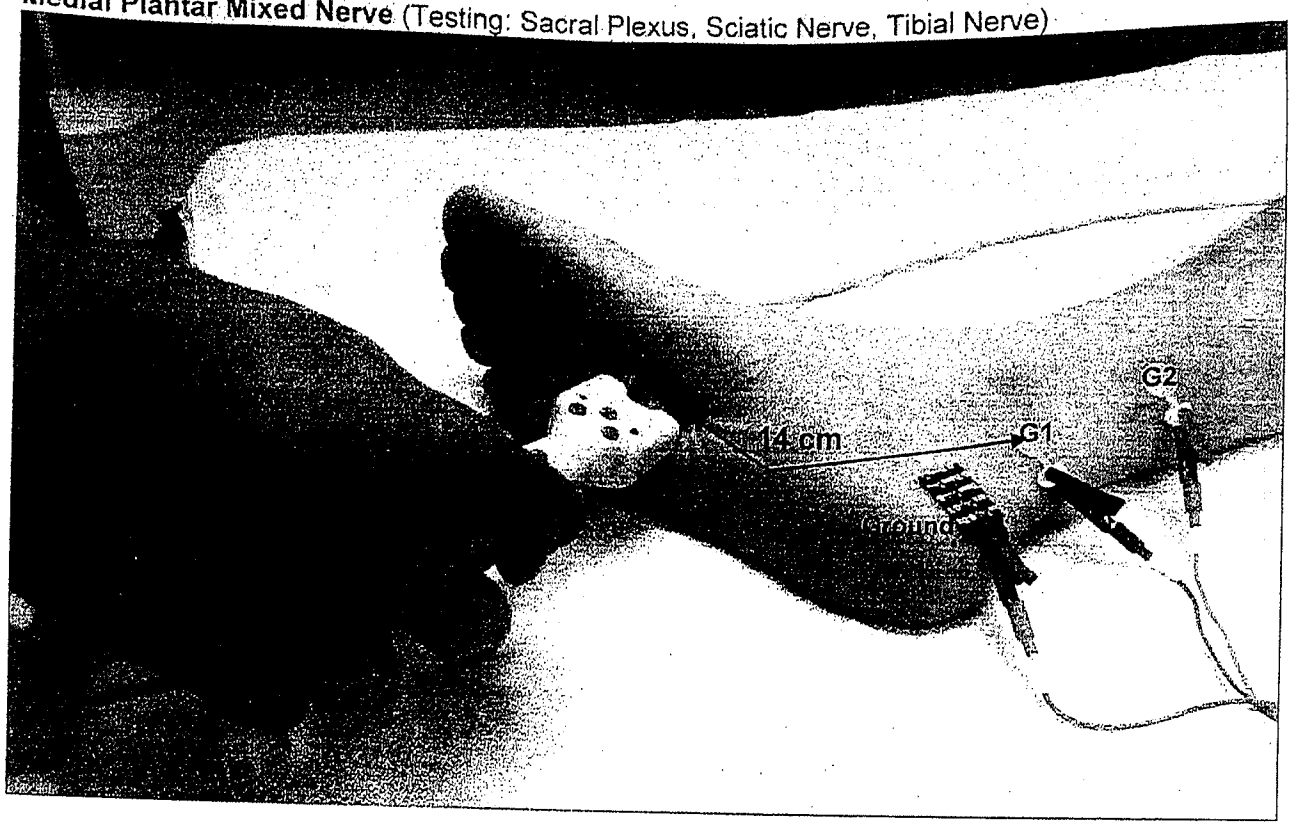
LLN lower limit of normal

>60 years [18]. As such, sural responses are not a consideration in many laboratories in patients aged >60 years [3]. Moreover, although distal nerves in the foot were shown to be better than the sural nerve for detecting neuropathy, sural sensory NAP remains an electrophysiological gold standard for diagnosing large-fiber sensory nerve dysfunction [4]; therefore, it is clear that there is a need to determine the reliability of plantar nerve NCSs and to determine normal values for these nerves in elderly patients. Yet, recent studies have done little to clarify the clinical utility of NCS of the plantar nerves in the feet in elderly individuals; therefore, the present study aimed to directly address this uncertainty.

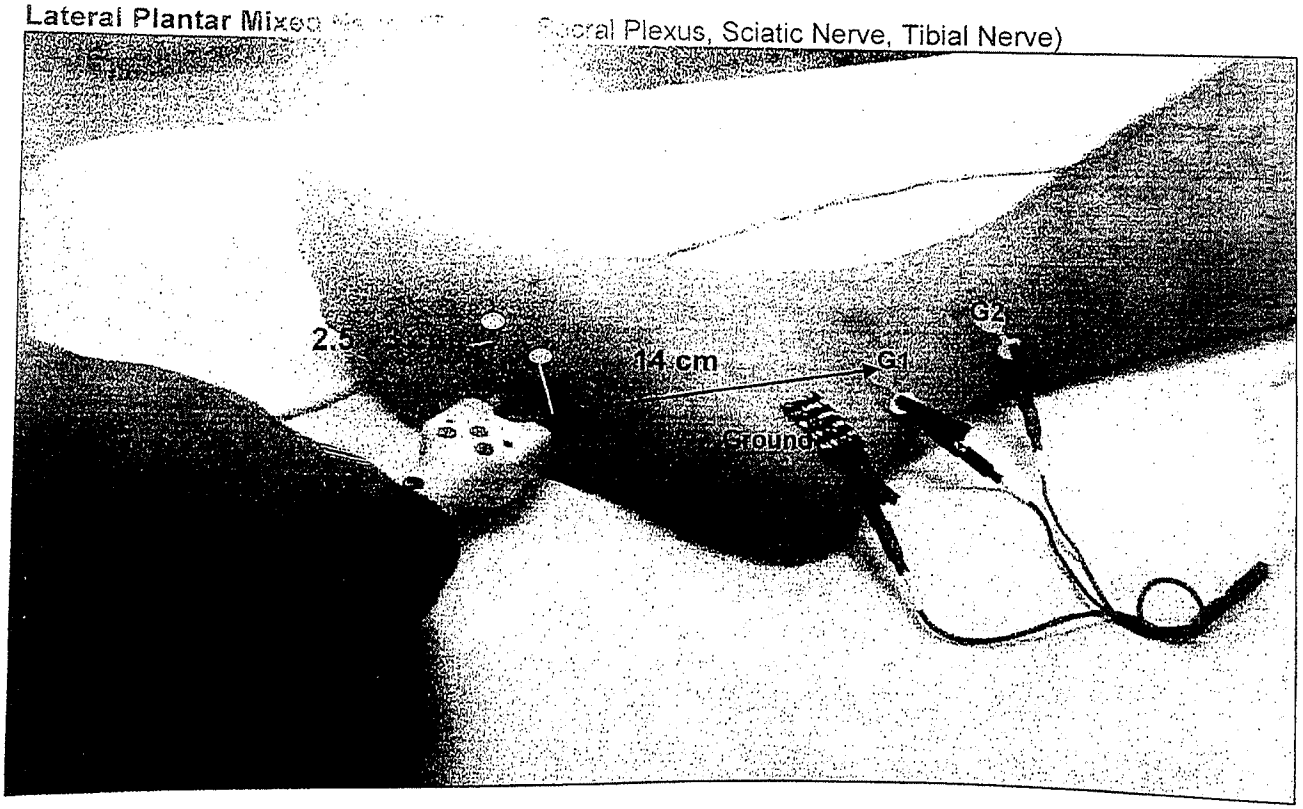
NCS parameters change with age [1–3]. Although NCV data are inconsistent, there is no doubt that response amplitude is diminished in the elderly [3], which is supported by anatomical evidence of a reduction in the number of nerve fibers with age [19–21]. Reference NCS data for different age groups is fundamentally important for differentiating healthy individuals from those with pathology. Many electrophysiology laboratories have tables of normative values for different age groups [17]; however, few data have been published for the plantar nerves. In the present study, NCS was performed in 81 healthy individuals aged >65 years who did not have neuropathy or risk factors for neuropathy, but had normal neurological examination findings, and reference data for MP and LP nerves were obtained. The present findings show that MP nerve recording was a reliable method for evaluating the function of this specific nerve in individuals aged ≤72 years. Moreover, MP response was rarely absent in the present study's controls aged >70 years. Guiloff and Sherratt suggested an orthodromic method to record sensory conduction in the MP nerve and reported that they could not obtain MP NAPs in only 3 individuals (aged 60, 71, and 81 years) among 69 healthy volunteers aged 13–81 years [8]. Hemmi et al. [10] suggested a novel technique for recording distal sensory nerve conduction of the MP nerve and compared their technique to Guiloff and Sherratt's method. They reported that they could not obtain MP NAPs using their method in only 1 (aged 63 years) of 64 controls, whereas MP NAPs were not obtained using Guiloff and Sherratt's method in 4 controls (aged 58, 63, 68, and 75 years). They used ring electrodes for orthodromic stimulation at the hallux and recorded MP sensory NAPs by placing surface electrodes on the sole to evaluate 64 healthy participants aged 13–81 years [10]. Mean MP nerve amplitude in individuals aged 60–69 years ($n = 6$) was 2.0 ± 1.7 versus 1.7 ± 0.5 μV in those aged 70–81 years ($n = 7$). Compared with that study, the amplitude values in the present study were pretty high in each decade. The differences in findings between studies might be related to a higher number of participants in the present study, differences in the distance between stimulus and recording sites and fibers being stimulated from more proximal site according to Hemmi's method [10].

The NCS technique used in the present study was reported to be a reliable method for assessing MP nerve function in individuals aged <70 years [4, 7]. Nodera et al. performed MP NCS in 133 patients with DSP and in 108 normal subjects (aged 30–89 years) [4] and reported that MP NAPs were unobtainable in 3 of 8 of those individuals aged >70 years [4]. In Loseth et al.'s study, MP nerve responses were obtained in all of the 98 healthy individuals aged 19–79 years, except 1 that was aged 72 years [7]; however, the investigators did not mention about the number of individuals >65 years. As in these earlier studies, regression analysis in the present study showed that in those aged >72 years an unobtainable MP NAP was of uncertain significance and was not classified as abnormal. A similar technique was used by Ponsford, who reported obtaining MP NAPs in all 59 controls, including those aged >80 years [9]; however, the investigator noted

Medial Plantar Mixed Nerve (Testing: Sacral Plexus, Sciatic Nerve, Tibial Nerve)

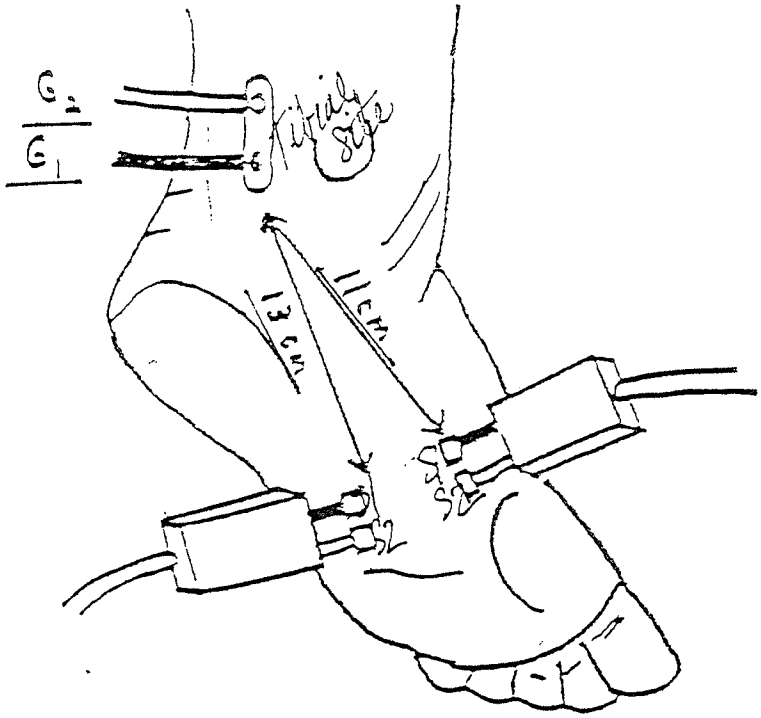


Lateral Plantar Mixed (Testing: Sacral Plexus, Sciatic Nerve, Tibial Nerve)



Medial and Lateral Plantar (Mx) (orthodromic)

Procedure: Place a bar electrode with G1 distal in the hollow on the medial side of the ankle between the medial malleolus and the Achilles tendon over the posterior tibial nerve. For the medial response, measure a distance of 11 cm. from G1 in a straight line between the great and second toes. This is the stimulation site. For the lateral plantar response, measure a distance of 13 cm. from G1 in a straight line between the fourth and fifth toes. This is the stimulation site.



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