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Electrodiagnostic Study Of Medial And Lateral Plantar Nerves Among Healthy Individuals At Tertiary Care Hospital

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Abstract:

Background: The tibial nerve divides into its terminal branches, medial and lateral plantar nerves in the tarsal tunnel or just proximal to it. Foot pain is a common disorder reported in 24% of adults and can be a cause of disability. Among the causes of foot pain is the entrapment of the tibial nerve or one of its branches a condition known as tarsal tunnel syndrome.

Objective: To study electrodiagnostic nerve conduction study of medial and lateral plantar nerves among healthy individuals.

Methodology: A cross-sectional study was conducted among 50 healthy individuals in the Department of Neurology of Saveetha Medical College and Hospital during 2021-2022. Both outpatient and inpatients referred from the Department of Neurology were evaluated as per inclusion and exclusion criteria.Prior permission was obtained from the Institutional Ethics Committee, and Informed consent was taken before conducting of the test. Electrodiagnostic nerve conduction tests of medial and lateral plantar nerves were done and responses were recorded.

Results: Out of 50 study participants, 30 participants were male and 20 participants were female and male to female ratio was 3:2. The mean amplitude of medial plantar nerve of the total study participants was 15.40±4.42μv, the mean latency was 3.72±1.48ms and mean nerve conduction velocity was 29.66±8.51 m/s. The mean amplitude of lateral plantar nerve of the total study participants was 3.793±0.804Mv, the mean latency was 3.07±0.67ms, latency and mean nerve conduction velocity was 21.49±3.20m/s NCV.

Conclusion: Electrodiagnostic nerve conduction tests of medial and lateral plantar nerves were helpful for early detection of peripheral neuropathies.

Keywords: Electrodiagnostic nerve conduction test, Medial plantar nerve, Lateral plantar nerve.

Introduction:

The tibial nerve divides into its terminal branches, medial and lateral plantar nerves in the tarsal tunnel or just proximal to it, below the flexor retinaculum, at the medial malleolus-calcaneal axis.[1-4] The medial plantar nerve runs in the foot deep to the abductor hallucis brevis, supplies motor innervation to it and divides into three common digital plantar nerves and seven proper digital plantar nerves. The lateral plantar nerve is a terminal

branch of the tibial nerve. It arises within the tarsal tunnel – an area posterior to the medial malleolus at the ankle.It enters the foot by passing deep to the proximal attachment of the abductor hallucis muscle. It then passes in a plane between quadratus planus and flexor digitorum brevis . The medial and lateral plantar branches of the tibial nerve provide innervation to all the intrinsic muscles of the foot (except the extensor digitorum brevis, which is innervated by the deep fibular nerve) . The medial plantar nerve supplies sensation to the skin of the medial two thirds of the sole and medial three and a half toes. The lateral plantar nerve supplies sensation to the lateral third of the sole of the foot and the lateral one and a half toes. [1-4]

Foot pain is a common disorder reported in 24% of adults and can be a cause of disability.[5] Among the causes of foot pain is the entrapment of the tibial nerve or one of its branches a condition known as tarsal tunnel syndrome (TTS).[6]The Entrapment of Medial plantar nerve causes heel pain, known as medial Plantar Neurapraxia or jogger's foot. The pain in plantar entrapment is often chronic intractable and aggravated by high impact activities. According to the literature, this condition is considered uncommon, and its diagnosis seems to be difficult.[7] Diagnosis of TTS is suspected by the patient's symptoms and established based on electrodiagnostic tests that have been considered a gold standard test.[8] During standing the compression of the distal part of the tibial and plantar nerves increases due to its contact with the medial process of the talus.[9]Also, foot eversion and ankle dorsiflexion can exacerbate the symptoms. Pressure on the medial side of the ankle along the course of the tibial nerve is believed to be painful in 60 to 100% of those affected and to worsen paraesthesia.[10] Finding an easy, reliable Electrodiagnostic test procedure to confirm the diagnosis of suspected TTS remains a challenge.

Objectives:

- To determine the electrodiagnostic nerve conduction study of medial and lateral plantar nerves among healthy individuals.

Materials & methods:

Study design: A descriptive cross-sectional study

Study setting: Department of Neurology of Saveetha Medical College and Hospital

Study period: 2021-2022

Study population: Both outpatient and inpatients referred from the department of Neurology were evaluated as per inclusion and exclusion criteria.

Inclusion criteria:

- Healthy Patients included.
- Individuals who were cooperative and who gave informed consent.
- Pediatric to elderly patients were also included.

Exclusion criteria:

- Individuals who were diagnosed with peripheral neuropathy or related symptoms of any cause.
- family history of an inherited neuropathy, frequent alcohol consumption , diabetes mellitus, treatment for tuberculosis, local trauma in the ankle or foot region, surgery on the back, or leg were not included in this study
- Individuals who were un co-operative and who didn't give informed consent.

Study procedure:

The basic machine consists of a computer, the associated hardware and software. All basic electrodiagnostic software allows the clinician to perform both NCS, EP, EMG and to Collect data and also Help to analyze

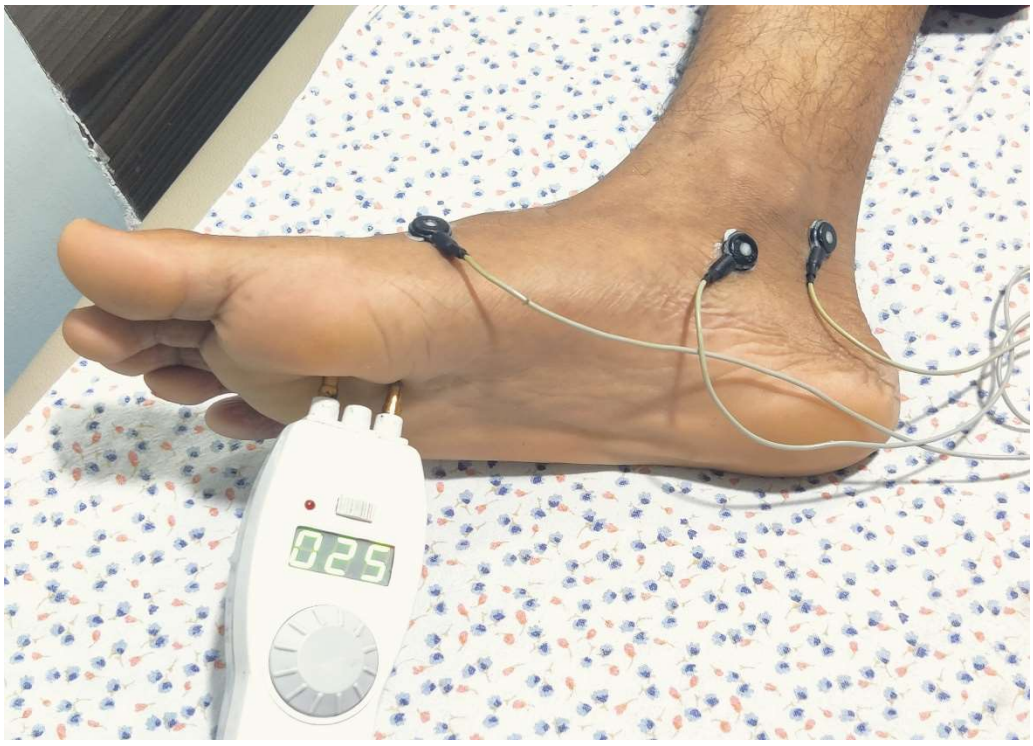
results (through automatic calculations that are usually preprogrammed) and to Store the information. Data entry through the keyboard. Information displayed on the screen (EMG has both audio and visual data).

The test procedure was clearly explained to the patients. After getting patient's informed consent test was conducted. Thenthe test sites were properly cleansed. In Medial Plantar motor studies, the active electrode(G1) was placed at Abductor hallucis brevis (AHB) muscle at 1 cm proximal and 1cm inferior to the navicular prominence. The reference electrode(G2) was placed over the metatarsal phalangeal joint of the great toe.The stimulation site was Medial ankle- above and posterior to the medial malleolus and Distal distance was 9cm for AHB; variable for ADQP.

In lateral Plantar motor studies, the active electrode(G1) was placed at Abductor digitiquintipedis (ADQP) muscles on the lateral foot, at halfway between the lateral sole of the lateral malleolus. The reference electrode(G2) was placed over the metatarsal phalangeal joint of the little toe. The stimulation site was Medial ankle- above and posterior to the medial malleolus and the Distal distance was 9 cm for AHB; variable for ADQP.

MEDIAL PLANTAR STIMULATION SITE :

LATERAL PLANTAR STIMULATION SITE :



Ethical considerations: Prior permission was obtained from Institutional Ethics Committee was obtained and Informed consent was taken before conduction of the test.

Statistical analysis:

Data was entered and analyzed by using MS Excel. Qualitative data was represented as percentages and Quantitative data was represented as means and standard deviation.

Results:

Nerve conduction study done on 50 healthy individuals who fulfilled inclusion criteria and recordings were analysed.

Table 1 : Gender distribution of study participants

Gender	Frequency	Percentage
Male	30	60%
Female	20	40%
Total	50	100%

Out of 50 study participants, 30 participants were male and 20 participants were female and male to female ratio was 3:2.

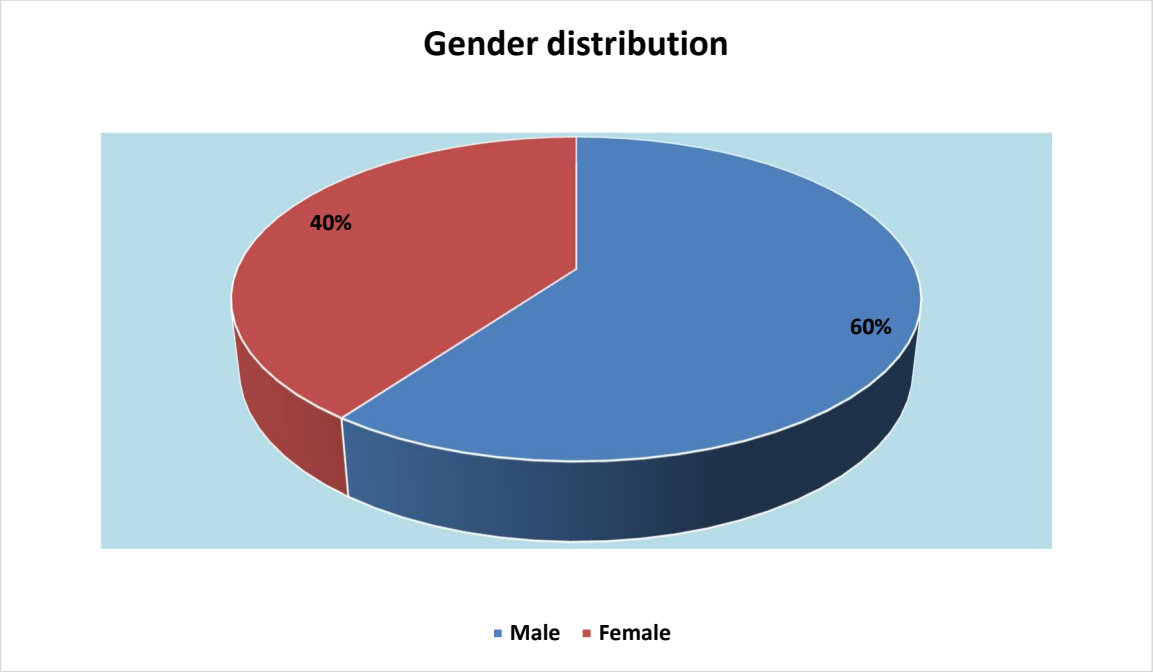


Figure 1: Distribution of study population by gender

Table 2: Age group distribution of the study population

Age group	Male	Female
1-10 years	7 (23.3%)	3 (15%)
11-20 years	5 (16.7%)	5 (25%)
21-30 years	6 (20%)	4 (20%)
31-40 ears	5 (16.7%)	5 (25%)
>40 years	7 (23.3%)	3 (15%)
Total	30 (100%)	20 (100%)

Table 2 shows the age group distribution of study participants. Age groups were equally distributed in both gender groups.

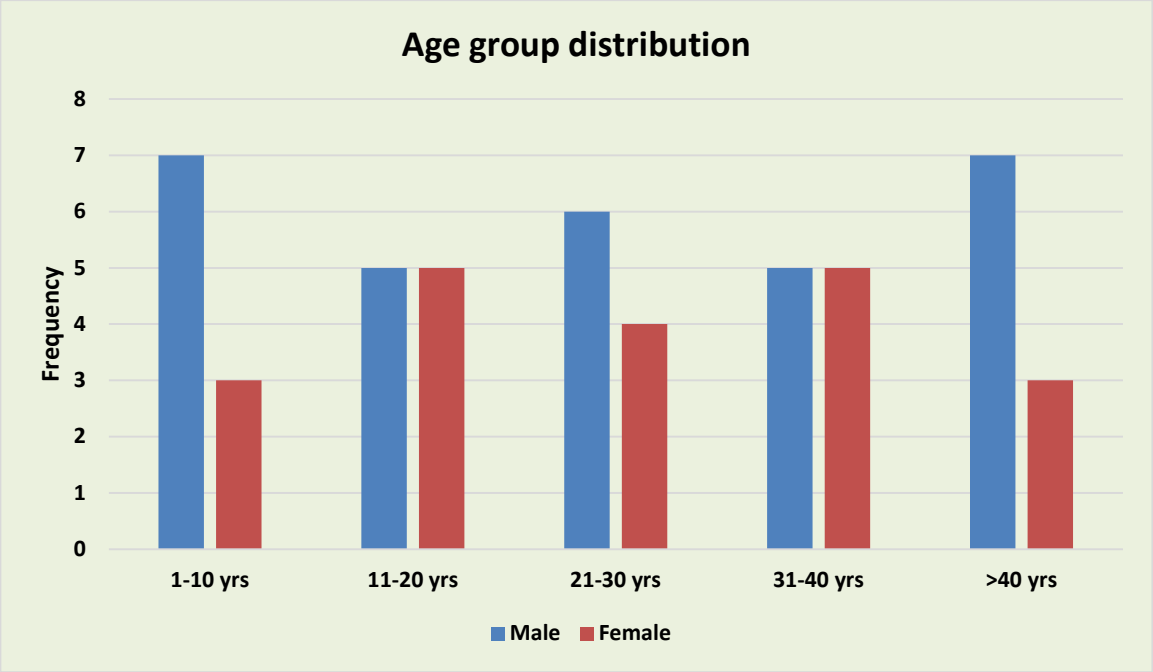


Figure 2: Distribution of study participants based on age group

Table 3: Sensory action potential of medial and lateral plantar nerve

Nerve	Latency	Amplitude	CV
Medial plantar nerve	3.72 ± 1.48	15.40 ± 4.42	29.66 ± 8.51
Lateral plantar nerve	3.07 ± 0.67	3.79 ± 0.80	21.4 ± 3.20

The normative data of the medial plantar nerve was found to be 3.72±1.48ms latency, 15.40±4.42mvamplitude, and 29.66±8.51 m/s NCV.

The normative data of lateral plantar nerve was found to be 3.07±0.67ms latency, 3.793±0.804mv amplitude,and 21.49±3.20m/s NCV.

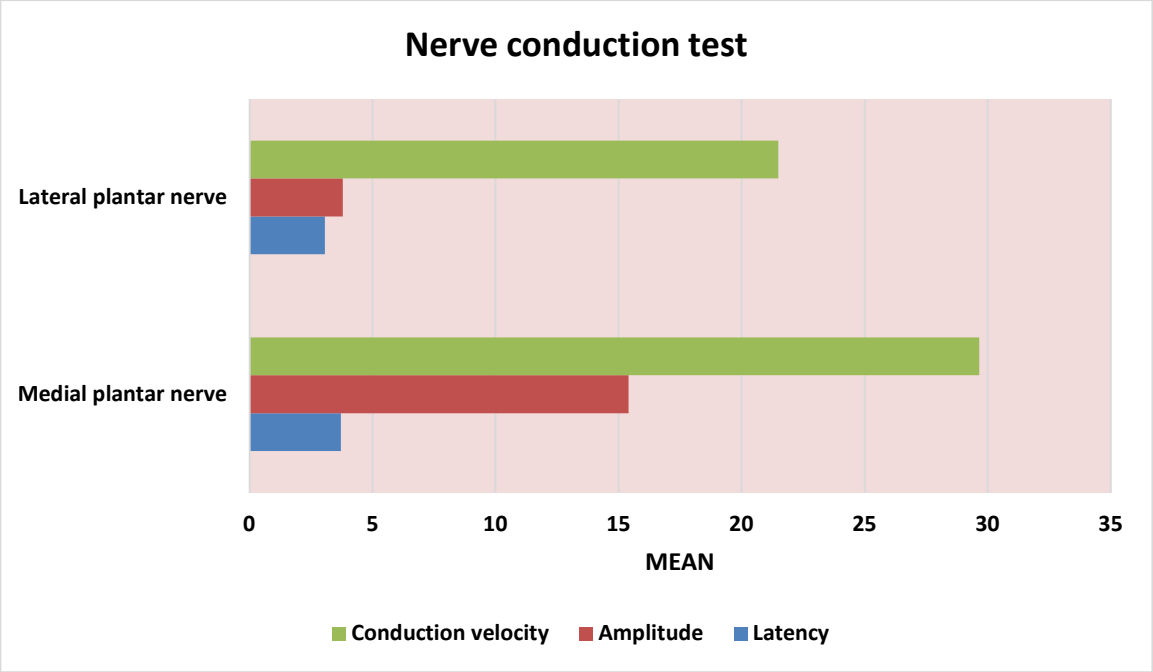


Table 4:Age vs. nerve conduction study of medial plantar nerve

Age group	Latency	Amplitude	CV
1-10 years	2.82±0.61	17.23± 4.51	32.25±7.61
11-20 years	2.54±0.52	16.01±5.78	30.62±6.48
21-30 years	2.61±0.84	13.52±6.21	29.51±5.24
31-40 years	2.28±0.43	9.85± 3.17	28.24±4.25
>40 years	2.10±0.24	6.12± 4.62	29.62±3.62

Age-wise distribution of mean amplitude, mean latency and mean conduction velocities of medial plantar nerve of study participants were examined

Table 5: Age vs. nerve conduction study of Lateral plantar nerve

Age group	Latency	Amplitude	CV
1-10 years	2.81±0.42	8.62±5.61	22.32±5.63
11-20 years	2.49±0.23	7.45±6.54	23.12±5.78

21-30 years	2.61±0.29	5.42±4.26	22.67±4.58
31-40 years	2.34±0.15	6.12±3.21	21.63±3.56
>40 years	2.10±0.11	4.14±2.13	21.05±1.42

Age-wise distribution of mean amplitude, mean latency, and mean conduction velocities of lateral plantar nerve of study participants were examined.

Discussion:

The purpose of this study was to determine and standardize an easy and convenient method of studying the latencies, Amplitude of the medial and lateral plantar nerves for clinical purposes using conventional equipment.

The Electrodiagnostic study of medial and lateral plantar nerves conducted among 50 healthy individuals. Out of 50 study participants 30 were male and 20 were female. Age groups were equally distributed in both gender groups. The normative data of the medial plantar nerve was found to be 3.72±1.48ms latency, 15.40±4.42μv amplitude, and 29.66±8.51 m/s NCV. Similar findings were found in a study done by S N Ponsford.[11]The mean amplitude for each decade examined was consistently larger than those found by Guiloff and Sherratt.[12] This might be due to the relative preservation of responses in older subjects and presumably reflect a large number of axons at the point of stimulation.

In the present study, the normative data of lateral plantar nerve was found to be 3.07±0.67ms latency, 3.793±0.804Mv amplitude, and 21.49±3.20m/s NCV. The present study findings were consistent with the study done by S N Ponsford.[11]

These medial and lateral plantar motor nerve conduction test values is useful for laboratory study purpose. Medial and Lateral plantar Motor nerve conduction was performed. The Latency and Amplitude of the both lower limb is noted. These standard values should allow more accurate assessment of tarsal tunnel syndrome (TTS), diabetic neuropathy, sports injuries and peripheral neuropathies

Conclusion:

The mean amplitude of medial plantar nerve of the total study participants was 15.40±4.42μv, the mean latency was 3.72±1.48ms and mean nerve conduction velocity was 29.66±8.51 m/s. The mean amplitude of lateral plantar nerve of the total study participants was 3.793±0.804Mv, the mean latency was 3.07±0.67ms, latency and mean nerve conduction velocity was 21.49±3.20m/s NCV.Electrodiagnostic nerve conduction tests of medial and lateral plantar nerves were helpful for early detection of peripheral neuropathies. More long term studies were needed to evaluate the ability of early diagnosis to change the clinical outcome.

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