

A study on Normative Data for Saphenous nerve SNAPs in healthy volunteers at a tertiary centre in south India.

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Cite this paper as: Sowmya Radhamani Venkataramanappa, Sathish Kumar Mallikarjuna, Nirumal Khumar, Vinoth Kanna S, Vasudevan Devanathan (2024) A study on Normative Data for Saphenous nerve SNAPs in healthy volunteers at a tertiary centre in south India.. *Frontiers in Health Informatics*, 13 (3), 4239-4246

Abstract

The saphenous nerve is a pure sensory nerve that supplies the medial surface of the leg. Normative data for saphenous nerve sensory nerve action potentials (SNAPs) is vital for diagnosing nerve pathologies. This study aims to establish normative values for saphenous nerve conduction in healthy volunteers. Forty adult volunteers (20 males and 20 females) aged 1 to 60 were tested using Natus nerve conduction equipment. The right saphenous nerve showed a mean latency of 3.30 ± 1.485 ms, amplitude of 9.40 ± 4.421 μ V, and conduction velocity of 39.66 ± 8.510 m/s. The left saphenous nerve had a mean latency of 2.93 ± 1.285 ms, amplitude of 10.30 ± 4.421 μ V, and conduction velocity of 40.33 ± 8.51 m/s. These values align with previous studies, except for slightly lower conduction velocities. This study provides robust normative data that can guide clinical practice and future research in diagnosing saphenous neuropathies and related conditions.

Objectives

The objective of the study is to study the normative data of the saphenous nerve.

Materials and methods

Sensory nerve conduction of the Saphenous nerve was conducted in 40 healthy volunteers aged 1 to 60 years using Natus nerve conduction machine at Saveetha Medical College and Hospital from 2022 to 2023 after taking ethical clearance. Key parameters including latency, amplitude, and conduction velocity were measured from stimulation sites at the medial calf and recording sites at the ankle.

Outcome

Results indicated mean latency values of 3.30 ± 1.485 ms and 2.93 ± 1.285 ms, average amplitudes of 9.40 ± 4.421 μ V and 10.30 ± 4.421 μ V, and conduction velocities of 39.66 ± 8.510 m/s and 40.33 ± 8.510 m/s for the right and left saphenous nerves, respectively. Comparative analyses with existing literature underscored the consistency and reliability of our findings.

Conclusion

These normative data provide essential benchmarks for clinical assessments and surgical interventions involving the saphenous nerve, contributing to enhanced diagnostic accuracy and treatment outcomes.

Keywords

Saphenous nerve, Normative data, Sensory action potentials, Nerve conduction study, Healthy volunteers, Femoral nerve.

Normative Data for Saphenous nerve SNAPs in healthy volunteers

Saphenous nerve is a pure sensory nerve that supplies the medial surface of the leg. It is the terminal cutaneous branch of the femoral nerve. It becomes superficial approximately 4 inches above the medial femoral epicondyle¹. It arises as a posterior division of the femoral nerve at the proximal thigh. At the level of the medial femoral condyle it splits into two branches; the sartorial branch which travels across the great saphenous vein distal to the knee joint and the infrapatellar branch which runs along the tibial border²⁻⁶. At the knee, it gives infrapatellar branch which forms the patellar plexus below the knee with other cutaneous nerves of the thigh. The territory supplied by saphenous nerve include skin below the knee. It mainly supplies the strip extending along the medial and anterior surface of the leg to the outer side of the foot. The Territories of the Lateral cutaneous nerve of the calf and superficial peroneal nerve territories forms saphenous nerve anterior border and sural nerve territory forms the posterior border. Nerve pathology is contributed by several anatomical features. It is derived from the L3 and L4 roots of the lumbar plexus. With main femoral nerve it travels under the inguinal ligament. It is closely adherent to superficial femoral artery and travels in hunter's canal or subsartorial fascia. It leaves the hunters canal either by passing through the sartorius muscle or passes under this muscle. It may also leave the hunter's canal by passing through the sartorius tendon. The infrapatellar branch of the saphenous nerve accompanies the saphenous vein in the leg. While travelling down the leg its relationship with the saphenous vein may vary.¹

There are several places where the SN can get injured. Three possible locations for entrapment include the adductor canal, the medial femoral condyle, and the sartorius muscle. Genu varum, tibial torsion, and increasing body weight are risk factors for entrapment. It is uncommon to have isolated saphenous neuralgia^{7,8}

Due to its distinctive territory, diagnosis of saphenous neuropathy is straight forward. Its symptoms include burning sensation, pins and needle sensation and vice like pressure along the medial aspect of the leg. Pain may be markedly aggravated on standing and walking. Patient clearly maps the territory of saphenous neuropathy. In addition to reduced sensory perception allodynia may be present. In Saphenous nerve entrapment syndromes patients complain of pain but without sensory loss. The injury to the saphenous nerve can occur from trauma and accidental laceration. The most common causes of injury to the nerve are damage during vascular surgical procedures in both leg and thigh and during knee surgeries¹. Knee surgeries causing saphenous nerve damage are medial arthrotomy, meniscectomy, complete knee replacement and arthroscopic anterior cruciate ligament repair. In addition, lower limb contusions may be accompanied by SN damage. Injuries from contact sports, ganglion cysts, and pes anserine bursitis can potentially cause compression of the SN^{5,8}. Local compression by braces or stirrups are other causes of the injury. L4 radiculopathy or femoral nerve lesion can damage saphenous nerve. Saphenous nerve blocking is clinically significant in surgical procedures performed distal to knee.

Aims and objectives

The objective of the study is to study the normative data for Saphenous Nerves SNAPs in healthy volunteers.

Methodology and recording procedure:

The saphenous nerve normative study was conducted for 40 normal adult volunteers using Natus nerve

conduction machine in department of Neurology from 2022-2023 at Saveetha medical college and hospital. Institutional ethical committee clearance is obtained for the study.

Inclusion criteria

Healthy volunteers of ages ranging 1 to 60 years.

Exclusion criteria

Patients with peripheral nerve injury.

Patients with tingling and numbness

Diabetic and hypothyroid patients

Toxic diseases

Hereditary and genetic neuropathy

Radiculopathy

The test procedure was clearly explained to the healthy volunteers. After obtaining their informed consent, the test was conducted. The sites at which test was conducted were cleaned and recorded.

Recording site:

Active electrode was placed on medial or anterior part of the ankle:

G1 was placed between the medial malleolus and the tibialis anterior tendon

G2 was placed 3–4 cm distally.

Stimulation Site:

Medial calf: The saphenous nerve was stimulated in the groove between tibia and the medial part of the gastrocnemius muscle.

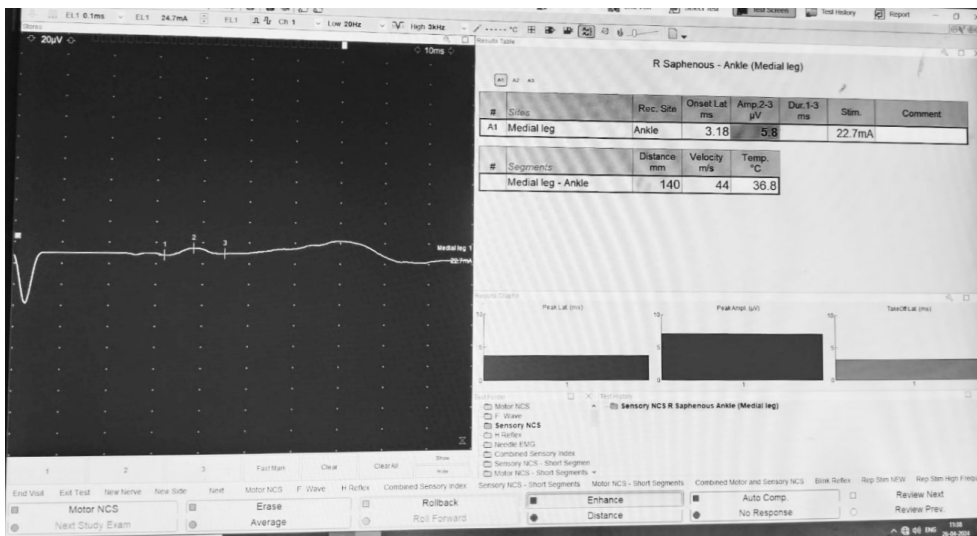
Distal Distance:

The standard distance to be followed is 14cm but distances shorter than 14cm may be useful.

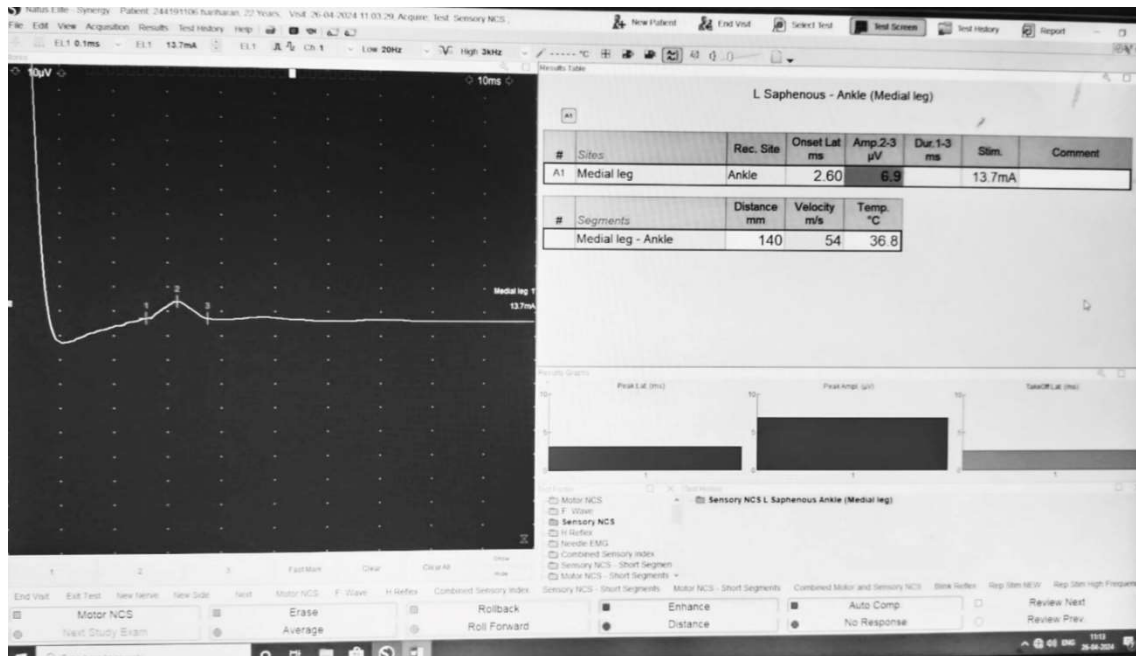
Saphenous sensory study: Stimulation site at the medial calf between the tibia and medial gastrocnemius; recording electrodes are placed between the medial malleolus and tibialis anterior tendon.



(Fig 1: Picture showing the recordings from the right saphenous nerve.)



(Fig 2: Picture showing the recordings from the left saphenous nerve.)



(Fig 3: Picture showing the recordings from the left saphenous nerve)

Key Points:

- In many people, the nerve is considerably easier to activate at a shorter distance (usually 10–12 cm), even though the normal value for peak latency is based on the conventional distance of 14 cm. At low stimulation intensity (e.g., 5–25 mA), supramaximal stimulation can typically be attained. Try a shorter distance of 10–12 cm if the reaction is not evident at 14 cm or if strong currents are required. If a good response is obtained, onset latency is considered rather than peak latency to calculate the conduction velocity.
- Could be abnormal in lumbar plexus or femoral nerve lesions.
- The recording electrodes may need to be moved back to their initial position, either laterally or slightly medially, in order to optimize the response.
- Amplitude and latency comparisons side by side are necessary.

• In normal controls, especially those over 40, response is frequently minimal, unpredictable, or non-existent. Before commenting as low or absent potential, it is important to perform and compare sensory conduction studies of Saphenous nerve on both the sides.

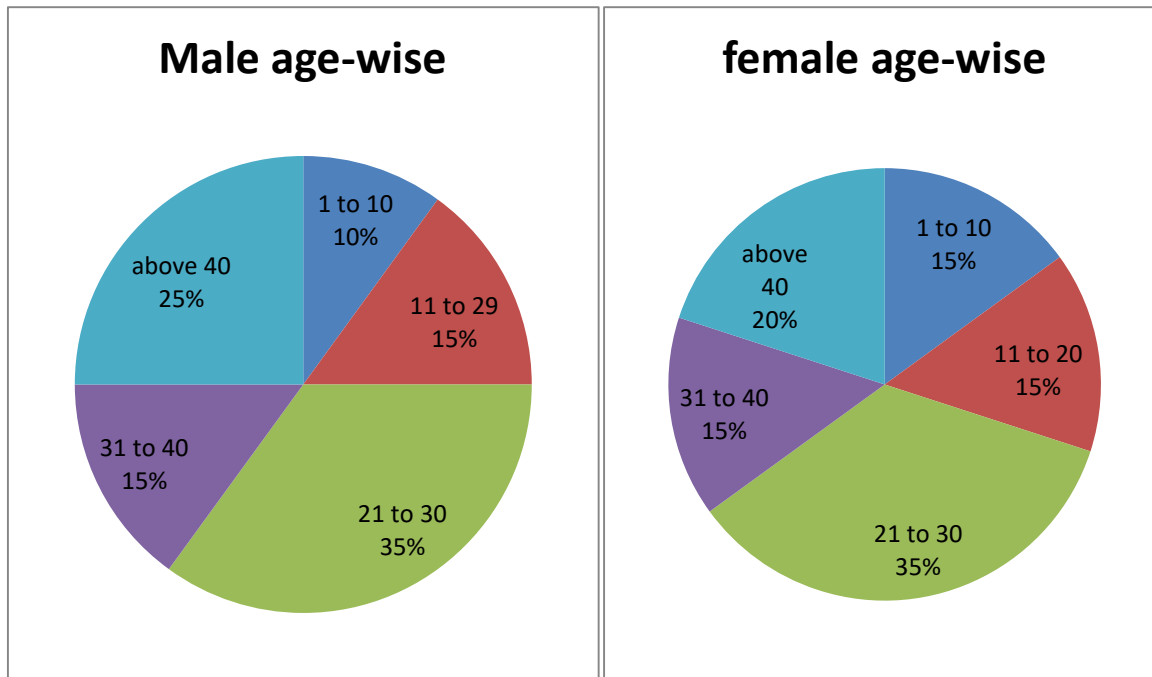
OBSERVATIONS AND RESULTS:

Recording from 40 healthy subjects who fulfilled the inclusion criteria yielded analysable nerve conduction study data.

Among 40 volunteers twenty were male and twenty were female of ages ranging one to sixty.

Values were presented according to age and gender as pie chart. Standard values for the right and left Saphenous nerves are presented in table 1 and 2 respectively.

SEX DISTRIBUTION IN PERCENTAGE



(Pie chart

depicting male and female patients)

TABLE 1

RIGHT SAPHENOUS NERVE CONDUCTION STUDIES:

	LAT	AMP	CV
AVERAGE	3.30 ± 1.485	9.40 ± 4.421	39.66 ± 8.510
SD	0.66019	1.55727	1.8096

TABLE 2

LEFT SAPHENOUS NERVE CONDUCTION STUDIES:

	LAT	AMP	CV
AVERAGE	2.93 ± 1.285	10.30 ± 4.421	40.33 ± 8.510
SD	0.75014	2.5083	2.454417

DISCUSSION:

The study was performed to arrive at normative data at our institute. In our study the normative data of right Saphenous sensory nerve's mean latency was found to be 3.30 ± 1.485 ms, average amplitude was 9.40 ± 4.421 micro volt and conduction velocity was 39.66 ± 8.510 m/s and the normative data of left Saphenous sensory nerve's mean latency was found to be 2.93 ± 1.285 ms, average amplitude was 10.30 ± 4.421 micro volt and conduction velocity was 40.33 ± 8.51 m/s. In our study we obtained response in all the nerves (80) and there was no difference between left and right.

Buschbacher et al analysed 230 healthy volunteers showed mean onset latency of 2.1 to 3.9 milliseconds, peak latency of 2.3 to 4.6 msec, onset to negative peak amplitude ranged from 1-15 micro volt, peak to peak amplitude ranged from 1 to 24 micro volt⁹.

Chiodo et al included 230 healthy volunteers. The peak-to-peak amplitude was 1micro V, whereas the onset to peak amplitude was 2microV and a mean distal latency of 3.8ms, peak latency of 4.4ms, and duration of 1.9ms¹⁰

Weinapel et al included 40 healthy volunteers. The amplitude was 9.4 micro volt and the peak latency was 3.60 ms¹¹.

Izzo et al analysed 80 healthy subjects. Response was obtained in 83% of volunteers with mean amplitude of 5.42 micro volt, average peak latency was 3.50ms and the average onset latency was 2.90 ms¹².

Kimura et al included 28 healthy volunteers aged 20 to 56 years obtained a conduction velocity of 59m/s, distal latency of 2.5ms with a mean amplitude 10.2V¹³. The conduction velocity was slightly lower in our study population when compared to the above study.

Except Kimura et al study, our values were concordant with the studies done by other authors mentioned above.

CONCLUSION:

In conclusion, our study provides robust normative data for saphenous nerve sensory conduction parameters, reinforcing its utility in clinical neurophysiology and guiding future research and clinical practices in related fields.

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