Peripheral nerve function of the median nerve

Becca Ray
NEUR 301
Lake Forest College
Lake Forest, Illinois 60045

Introduction

The median nerve is known for its role in controlling movements of the arm, fingers, hand, and wrist.[1] With one median nerve on each side of the body, it begins in the armpit and goes all the way down the inside of the upper arm, the inside of the elbow, and to the hand where it enters through the carpal tunnel and branches into the palm to the fingers. Dysfunction of the median nerve is linked with carpal tunnel syndrome, which causes hand pain and weakness.[2]

We looked at the peripheral nerve function of the median nerve by examining the latency of electrical signals at different stimulus points along the nerve and the nerve conduction velocity. Latency is quantified as the time from stimulus onset to motor response, in this case the time from which an electrical signal is sent to the median nerve to when a motor response in the hand is seen. The latency of the median nerve differs depending on where along the nerve the stimulus is administered. Higher up the forearm means the signal must travel farther and therefore has a longer latency than it would closer to the wrist.[3] Based on this knowledge of nerve latency, we first hypothesized that the latency of the median nerve would be longer when the stimulus was administered farther away from the hand and would decrease the closer we got to the wrist.

Nerve conduction velocity is the rate at which electrical signals travel down a nerve and is used to determine the health of a nerve to help diagnose certain neuropathies and nerve dysfunctions.[4] Previous studies looking at the nerve conduction velocity of the median nerve found that the electrical signals from a stimulus traveled down the nerve at a range of 54m/s to 59m/s on average.[5,6] Based on these previous findings, we estimated that the nerve conduction velocity of our participant and participants in other class lab groups would fall within close range of these values.

Methods

For this experiment we used the LabChart program to record the electrical activity in response to nerve stimulation. A stimulating bar electrode was connected to PowerLab along with a dry earth strap placed on the participant's wrist. Prior to any stimulation, the participant's skin was washed with antibacterial wipes and all jewelry was removed. Two ECG electrodes were then placed on the participant's abductor pollicis brevis muscle (the big muscle of the inner thumb). Electrode paste was put on the metal pads of the stimulating bar electrode and then the bar was placed on the participant's wrist along the median nerve.

The pulse current was set to 8mA and then we administered a serious of shocks, moving the stimulating bar electrode around slightly until the participant's thumb twitched and the median nerve was successfully stimulated. Small twitches of the upper thumb joint or of other fingers did not qualify as a response. Only substantial twitches of the full thumb were considered a response. If a response could not be obtained at 8mA, the current was increased in 2mA increments until a response was seen.

After electrical activity from the wrist was collected, we moved the stimulating bar electrode to the elbow and followed the same procedure. However, after multiple attempts and increasing the pulse to 20mA, we were unable to get a response from that high up on the arm, so we moved the stimulating bar electrode back down to about mid forearmWe followed the same shock procedure and were able to get a response. Using the electrical activity data we recorded, we analyzed the nerve conduction velocity and latency between the two stimulus points: wrist and mid forearm.

Results

We found that the latency of nerve conduction at the two stimulus points were different.For the wrist, which was 0.1m away from the thumb, the nerve conduction latency was 0.009s. For the mid forearm, which was 0.2m away, the nerve conduction was 0.0105s.

We also found that the nerve conduction velocity differed across individuals when comparing our data to that of two other participants from other lab groups . Our calculated nerve conduction velocity of the median nerve was 66.67m/s. The nerve conduction velocities of the two other participants were 65.0m/s and 70.9m/s.

$$Conduction\ velocity = \frac{distance\ mid\ forearm - wrist}{latency\ mid\ forearm - wrist} = \frac{0.2 - 0.1m}{0.0105 - 0.009s} = 66.67m/s$$

Discussion

We found that the latency of the median nerve differed between two locations along the nerve, the wrist and the mid forearm. This confirms our first hypothesis that the farther away from the thumb the shock was administered, the longer the latency would be because the signal has to travel farther down the nerve.

We also found the median nerve conduction velocity of our participant was 66.67m/s, which was slightly outside the range of nerve conduction velocities found in previous studies on the median nerve. All three of the participants from our class lab groups were higher than the velocities previously found. This discrepancy could be due to general individual differences between the participants in the lab as well as situational differences between the experiment our participants experienced and those from previous studies.Experimenter or mechanical error could also be at play. For our participant, we were unable to get a response from the elbow so we had to move our second point of stimulus, which was much closer to the first point, and the smaller distance difference could have affected accuracy of the velocity calculations. The machinery we used for this experiment could also not be exactly precise and could cause misjudgments about latency between stimulus onset and motor response.

Regardless, we were able to quantify the peripheral nerve function of the median nerve in members of our class. Having an understanding of the baseline for nerve conduction velocity is important for monitoring the heath of the median nerve as well as other peripheral nerves. When tendons surrounding the median nerve get irritated and swell, the median nerve gets compressed which can lead to carpal tunnel syndrome. Nerve conduction velocity evaluations are commonly used to diagnose carpal tunnel syndrome and velocities slower than 50m/s are considered indications for diagnosis.[7] Ourparticipant's nerve velocity was well over that threshold, but data on nerve conduction velocity in healthy patients can help us understand how a functional median nerve works and how dysfunctions of the median nerve can result in serious complications.

References

1. Cleveland Clinic. (n.d.). *Median nerve: What is it, anatomy, function & common conditions.* Retrieved March 9, 2023.
2. U.S. Department of Health and Human Services. (n.d.). *Carpal tunnel syndrome*. National Institute of Neurological Disorders and Stroke. Retrieved March 11, 2023.
3. Kasius, K. M., Claes, F., Verhagen, W. I., & Meulstee, J. (2019). Motor nerve conduction tests in carpal tunnel syndrome. *Frontiers in Neurology*, 10.
4. Chung, T., Prasad, K., & Lloyd, T. E. (2014). Peripheral neuropathy: Clinical and electrophysiological considerations. *Neuroimaging Clinics of North America*, 24(1), 49–65.
5. Sathiamoorthy, A., & Sathiamoorthy, S. S. (1990). Limb dominance and motor conduction velocity of median and ulnar nerves. *Indian J Physiol*

Pharmacol, 34(1), 51–53.
6. Chouhan, S., Tiwari, V., Sharma, H., & Singh, R. (2021). Motor nerve conduction velocity in median nerve: An observational study in adult healthy males with intact palmaris longus for normative reference value. *National Journal of Physiology, Pharmacy and Pharmacology*, 11(7), 782–788.
7. Rosario, N. B., & De Jesus, O. (2022). *Electrodiagnostic evaluation of carpal tunnel syndrome.* National Center for Biotechnology Information. Retrieved March 11, 2023.

	Distance from thumb (m)	Latency (s)
Wrist	0.1	0.009
Mid forearm	0.2	0.0105

Table 1. Distance from thumb and latency of the median nerve taken from stimulus points on the wrist and mid forearm.

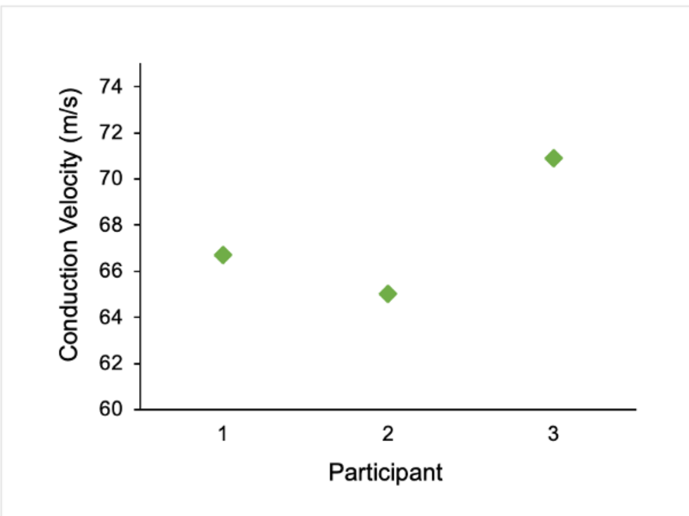

Figure 1. Nerve conduction velocity of three participants. Our participant is Participant 1. Data from Participants 2 and 3 were taken from other lab sections.