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ORIGINAL ARTICLE

Effect of Hand Size on the Stimulation Intensities Required for Median and Ulnar Sensory Nerve Conduction Studies

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Abstract

Objectives: To examine the effect of hand size on median and ulnar sensory nerve conduction study (NCS) stimulation intensities and pain scores.

Design: Prospective, single group design to compare main outcomes by using a standard distance of 14cm versus the proximal wrist crease in 3 different hand sizes.

Setting: Electrodiagnostic laboratory in a department of rehabilitation medicine.

Participants: Healthy volunteers (N=25) aged 20 to 30 years.

Interventions: Hand size was determined, based on the distance between the proximal wrist crease and the base of the long finger, resulting in 3 groups (≤11cm, >11−12cm, >12cm) with 12 hands per group. Antidromic median and ulnar sensory NCSs were performed. The nerves were randomly stimulated at the proximal wrist crease and 14cm from the recording electrode.

Main Outcome Measures: Supramaximal stimulation intensities and 10-cm visual analog scale (VAS) pain scores at each stimulating site were recorded and compared.

Results: Thirty-six hands from 25 young healthy volunteers were studied. There was no correlation between the body mass index (BMI) and stimulation intensity, and BMI and VAS ($r<0.3$) in both median and ulnar nerves. Overall analysis showed that the stimulation intensity and VAS at 14cm were significantly greater than at the proximal wrist crease. Subgroup analysis showed the same result in all groups for the median sensory NCS, but in only the small hand group for the ulnar sensory NCS.

Conclusions: When the same distance is used for NCSs regardless of patient size, smaller individuals required greater stimulation and reported greater discomfort. This may reflect greater nerve depth and suggests that one size fits all may not be the best approach with NCSs.

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Although electrodiagnosis has been found useful in diagnosing a number of neuromuscular disorders, a recognized drawback is the pain incurred during testing. Much has been written about pain during needle examination[1-6]; however, only a few articles have addressed pain during nerve conduction studies (NCSs).[7,8]

Sensory NCS techniques often specify the same distance irrespective of patient size.[9-15] This seems logical to allow for a comparison of values, but it may not be anatomically logical. The median and ulnar nerves are closest to the surface at the wrist and become deeper as they run more proximally (fig 1).[16-18] The same distance in a smaller extremity may give a stimulation site with greater nerve depth and hence may require a larger stimulation intensity to achieve a supramaximal response. The purpose of this study was to examine the effect of hand size on median and ulnar sensory NCS stimulation intensities and pain scores.

Methods

Participants

Volunteers were recruited by posting information throughout our hospital and medical school. All hands were divided into 3 groups, based on the distance between the proximal wrist crease and the base of the long finger: small, ≤11cm; medium, >11 to 12cm; and large, >12cm. There were 12 hands in each group. Subjects did

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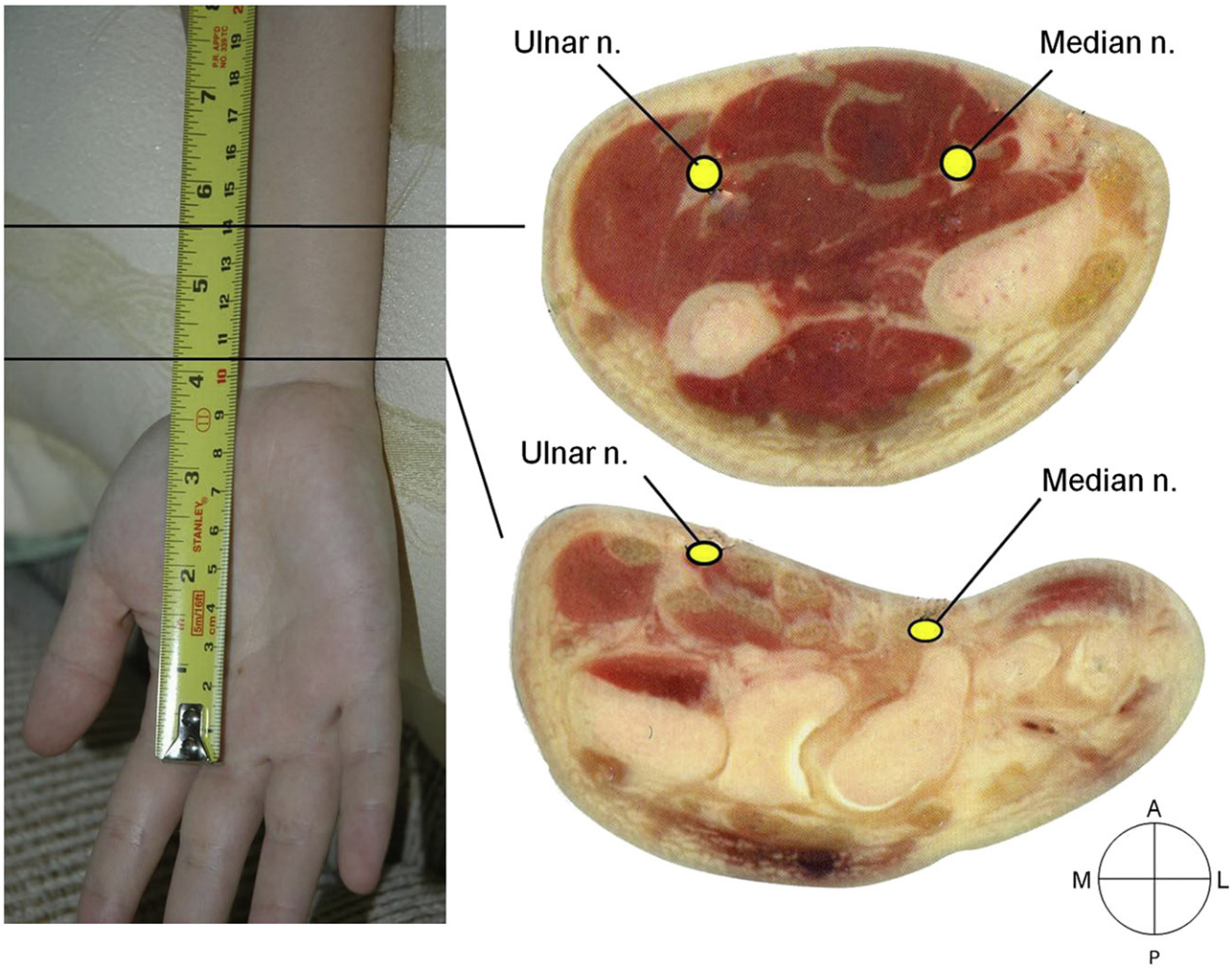

Fig 1 Cross-sectional anatomy showing position of median and ulnar nerves at wrist and distal forearm level. Abbreviations: A, anterior; L, lateral; M, medial; n., nerve; P, posterior.

not have deformities, a history of injury to the upper extremities, or an underlying disease that might affect the peripheral nerves. The hospital institutional review board approved the study, and informed consent was obtained.

Interventions

Hand size was determined by measuring the distance between the proximal wrist creases and the base of the long finger, with a flexible measuring tape. Sex, height, weight, and calculated body mass index (BMI) were recorded.

With the use of a technique described by Buschbacher,[15] antidromic median and ulnar sensory NCSs were performed with ring electrodes on the long finger and little finger, respectively, and the reference electrode was placed 4cm distal to the active electrode. Hand temperature, as measured on the dorsum of the hand, was deemed acceptable at >32°C. A Medelec Synergy electromyography machine[a] was used. Frequency bandpass was set at 20 to 20,000Hz. Stimulations were performed with a constant current stimulator set initially at .05 milliseconds. Supramaximal stimulation intensity was determined by seeking the smallest stimulus intensity to obtain a maximal amplitude response, then increasing by 20%. If the supramaximal intensity was not reached at a .05-millisecond duration, the pulse duration was increased to 0.1 milliseconds and the process was continued. Supramaximal responses were sought for the median and ulnar nerves at the proximal wrist crease and at 14cm from the proximal ring electrode, as measured by a flexible measuring tape. The choice of first and second stimulation site (proximal wrist crease vs 14cm) was made by alternating the order from subject to subject (eg, subjects 1, 3, and 5 would be started at 14cm, while subjects 2, 4, and 6 would be started at the proximal wrist crease).

The visual analog scale (VAS) was recorded using 100-mm, nonhatched VAS pain score paper, with the anchors of 0 indicating no pain and 100mm indicating the worst pain imaginable.

To avoid observer bias, all studies were performed by only 1 independent electromyographer throughout the study. This

List of abbreviations:

BMI **body mass index**
NCS **nerve conduction study**
VAS **visual analog scale**