Ulnar (motor)/abductor digiti minimi (10, 48, 50)

I. Position of Patient
   A. Patient is supine with upper extremity supinated and extended at side.
   B. Upper extremity is supported by the bed at all times.
II. Equipment
   A. 2 disc electrodes (G1 active, G2 reference)
   B. 1 ground (G0)
   C. 1 bipolar stimulator (S1 cathode, S2 anode)
III. Machine Settings
   A. Sweep speed (ms/div)—2 to 5
   B. Gain (mv)—1 to 10
   C. Filters—1.6(Hz), 8(KHz)
IV. Electrode Placement
   A. G0 (ground)—palm of hand between G1 and distal S1
   B. G1 (active)—over the belly of the muscle abductor digiti minimi (hypothenar group), approximately one half the distance from the wrist to the base of the fifth finger, over the fifth metacarpal bone.
   C. G2 (reference)—midportion of the proximal phalanx of the fifth finger.
V. Stimulation Sites and Measurements
   A. Wrist (distal):
      1. Stimulate—S1, anterior to the flexor carpi ulnaris tendon, 2 to 4 cm proximal to the distal wrist crease.
      2. Measure—distance from S1 to G1 in a straight line. On adults use distance between 4.5 cm and 6.5 cm.
   B. Elbow:
      1. Stimulate—S1, 3 to 5 cm proximal to the ulnar groove on the medial side of the arm.
      2. Measure—distance from elbow-S1 to wrist-S1 through the ulnar groove following the contour of the medial aspect of the forearm.
   C. Below Elbow:
      1. Stimulate—S1, 5 to 7 cm distal to the ulnar groove on the medial side of the arm and at least 10 cm from elbow-S1.
      2. Measure—distance from below elbow-S1 to wrist-S1 following the contour of the medial aspect of the arm.
   D. Axilla (not shown):
      1. Stimulate—S1, in the medial apex of the axilla.
      2. Measure—distance from axilla-S1 to wrist-S1 through the ulnar groove following the contour of the medial aspect of the arm.

E. Erb's Point (see illustration below):
   1. Stimulate—S1, proximal to the clavicle bone 3 to 5 cm lateral to the clavicle head with S1 angled distal. Single prong stimulator may be used with S1 positioned as above and S2 on the posterior portion of the shoulder directly behind S1. (Position of the arm same with wrist and elbow stimulation).
   2. Measure—distance from Erb's point-S1 to wrist-S1 in a straight line with the arm supinated (palm up) and abducted at a 90 degree angle from the body.

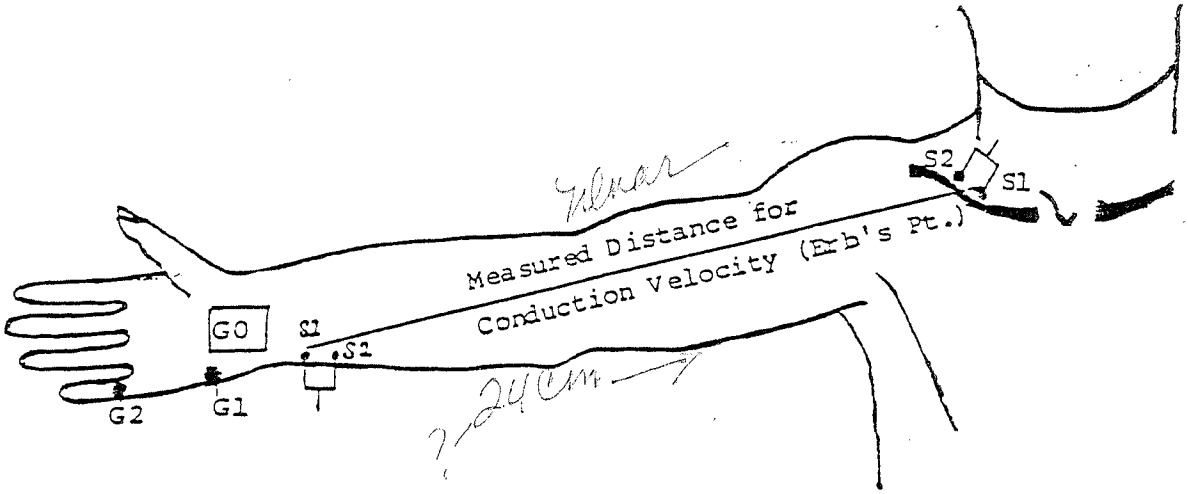


Figure 3-1

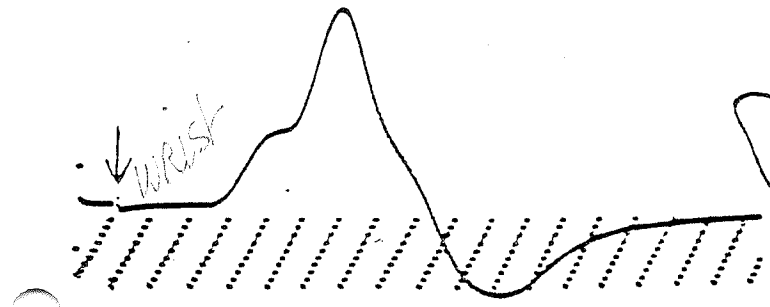
VI. Calculations
   A. Distal Latency—Calculate from shock artifact to the takeoff of the negative deflection of the distal response.
   B. Amplitude—Calculate from baseline to the peak of the negative deflection of the distal response.
   C. Conduction Velocity—Using latencies measured to the takeoff, subtract the distal from the proximal latency, divide the difference into the distance between proximal-S1 and distal-S1, and multiply by 10.

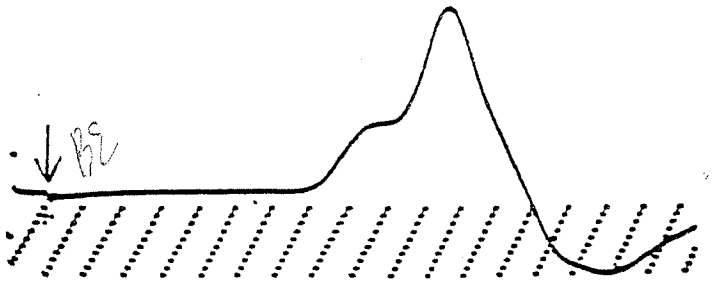
VII. Variations and Pitfalls
   A. Amplitude and configuration of response may vary depending on the placement of G1.
   B. If amplitude drops more than 2 mv from wrist to elbow:
      1. Check for maximal stimulation.
      2. Check for median to ulnar crossover (see Chapter 5).
   C. If amplitude or configuration changes between proximal and distal stimulation:

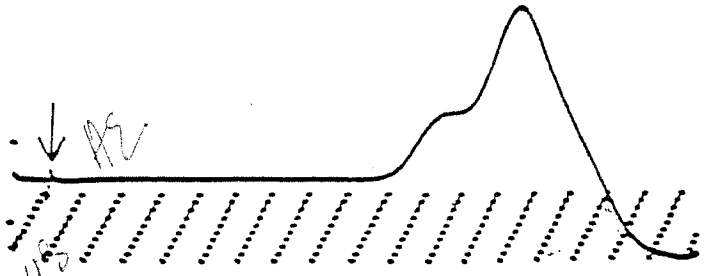
ULNAR (motor) / abductor digiti minimi

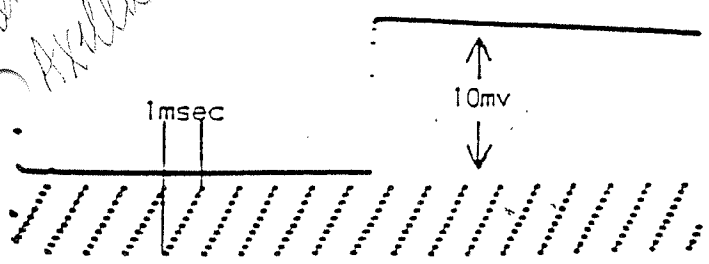
ace = 44

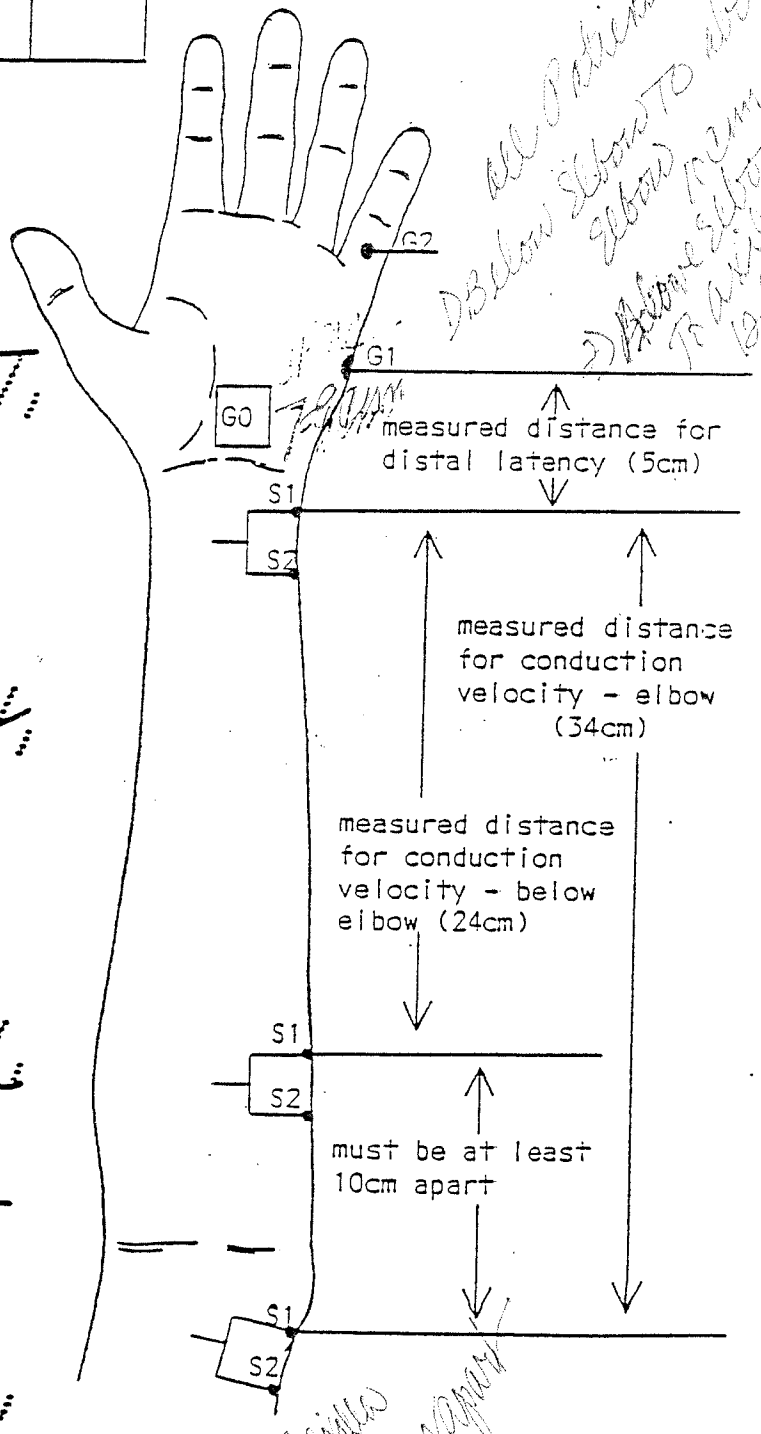
Stimulation Site	Amp. mv	Latency msec	Dist. cm	C.V. M/sec
elbow	11.0	8.8	34.0	55
wrist	12.0	2.6	5.0	
		6.2		
below elbow	11.5	6.8	24.0	57
		2.6		
		4.2		











1. Check for electrode movement.
2. Check to see if stimulation is maximal at both points.

D. If elbow and axilla distances are not measured through the ulnar groove, the conduction velocity may be significantly changed.

E. Because the percentage of error is significantly increased with shorter distances, conduction velocities should not be calculated between two proximal stimulation sites.

VIII. Normal Values (Cleveland Clinic Foundation EMG Laboratory)

AGE	AMPLITUDE mv	DISTAL LATENCY m/sec	CONDUCTION VELOCITY m/sec
0-9	5.5-12 (8)	1.6-2.4 (2.0)	52-63 (58)
10-19	8-18 (13)	1.9-2.9 (2.4)	52-67 (60)
20-29	8-18 (13)	2.0-3.0 (2.5)	52-69 (60)
30-39	8-20 (13)	2.0-3.0 (2.5)	50-65 (58)
40-49	7-18 (12)	2.0-3.0 (2.5)	50-66 (58)
50-59	7-18 (11)	2.0-3.0 (2.5)	50-65 (57)
60-69	7-16 (11)	2.0-3.1 (2.6)	50-66 (55)
70-	7-14 (10)	2.0-3.1 (2.6)	50-61 (55)

Ulnar (motor)/first dorsal interosseous (10)

I. Position of Patient
- A. Patient is supine with upper extremity supinated and extended at side.
- B. Upper extremity is supported by the bed at all times.

II. Equipment
- A. 2 disc electrodes (G1 active, G2 reference)
- B. 1 ground (G0)
- C. 1 bipolar stimulator (S1 cathode, S2 anode)

III. Machine Settings
- A. Sweep speed (ms/div)—2 to 5
- B. Gain (mv)—1 to 10
- C. Filters—1.6(Hz), 8(KHz)

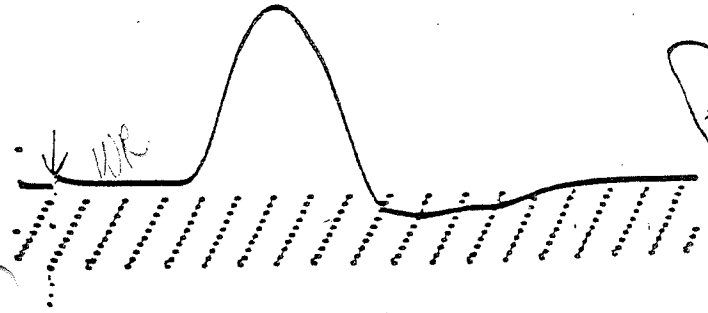
IV. Electrode Placement
- A. G0 (ground)—palm of hand, between G1 and distal S1.
- B. G1 (active)—over the belly of the muscle first dorsal interosseous.
- C. G2 (reference)—midportion of the proximal phalanx of the thumb.

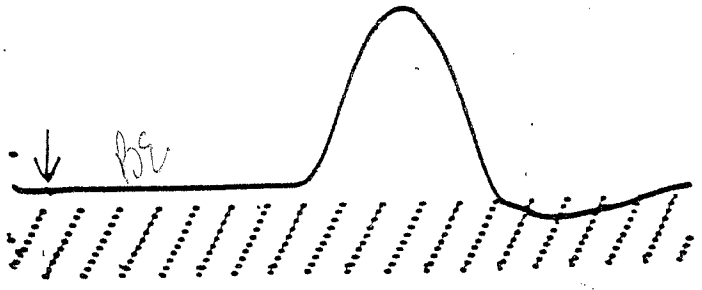
V. Stimulation Sites and Measurements
- A. Wrist (distal):
  1. Stimulate—S1, anterior to the flexor carpi ulnaris tendon, 2 to 4 cm proximal to the distal wrist crease.
  2. Measure—distance from S1 to G1 across the back of the hand. On adults use distance between 10.0 and 14.0 cm.

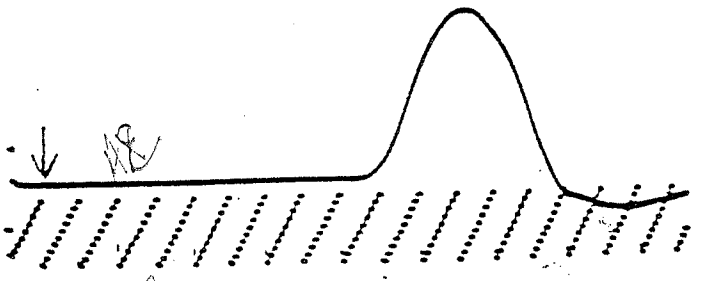
ULNAR (motor) / first dorsal interosseus

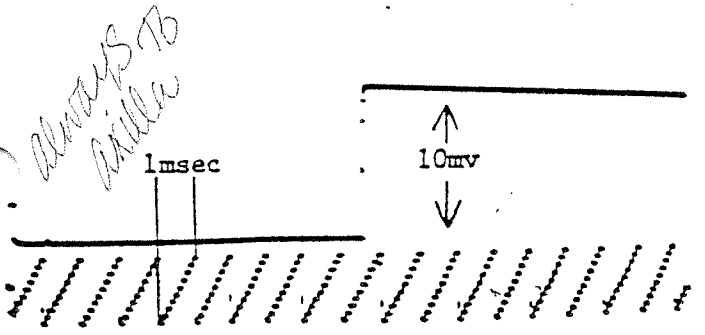
age = 32

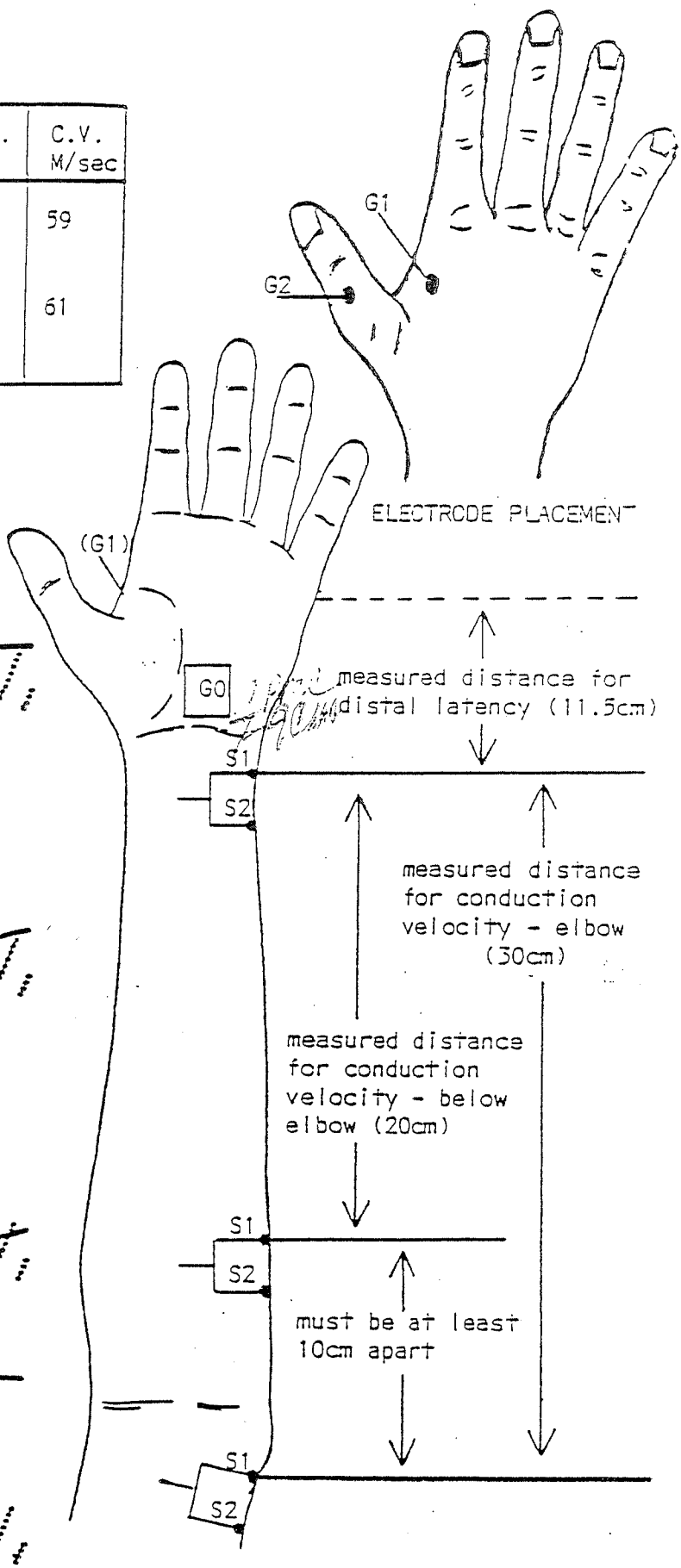
Stimulation Site	Amp. mv	Latency msec	Dist. cm	C.V. M/sec
elbow	11.0	8.6	30.0	59
wrist	11.0	3.5	11.5	
		5.1		
below elbow	11.0	6.8	20.0	61
		3.5		
		3.3		











B. Elbow
   1. Stimulate—S1, 3 to 5 cm proximal to the ulnar groove on the medial side of the arm.
   2. Measure—distance from elbow-S1 to wrist-S1 through the ulnar groove following the contour of the medial aspect of the forearm.

C. Below Elbow:
   1. Stimulate—S1, 5 to 7 cm distal to the ulnar groove on the medial side of the arm and at least 10 cm from elbow-S1.
   2. Measure—distance from below elbow-S1 to wrist-S1 following the contour of the medial aspect of the arm.

VI. Calculations
   A. Distal Latency—Calculate from shock artifact to the takeoff of the negative deflection of the distal response.
   B. Amplitude—Calculate from baseline to the peak of the negative deflection.
   C. Conduction Velocity—Using latencies measured to the takeoff, subtract the distal from the proximal latency, divide the difference into the distance between proximal-S1 and distal-S1, and multiply by 10.

VII. Variations and Pitfalls
   A. Amplitude and configuration of response may vary depending on the placement of G1.
   B. If amplitude drops more than 2 mv from wrist to elbow:
      1. Check for maximal stimulation.
      2. Check for median to ulnar crossover (see Chapter 5).
   C. If amplitude or configuration changes between proximal and distal stimulation:
      1. Check for electrode movement.
      2. Check to see if stimulation is maximal at both points.
   D. Because the percentage of error is significantly increased with shorter distances, conduction velocities should not be calculated between two proximal stimulation sites.
   E. Amplitude and configuration changes may be seen with axilla and Erb's point stimulation due to volume conduction of the median innervated hand muscles.

VIII. Normal Values (Cleveland Clinic Foundation EMG Laboratory)

ULNAR Motor

AGE	AMPLITUDE mv	DISTAL LATENCY m/sec	CONDUCTION VELOCITY m/sec
0-9	5.5-12 (8)	2.6-3.9 (3.3)	52-63 (58)
10-19	8-20 (13)	2.9-4.4 (3.7)	52-67 (60)
20-29	8-25 (13)	3.0-4.4 (3.7)	52-69 (60)

AGE	AMPLITUDE mv	DISTAL LATENCY m/sec	CONDUCTION VELOCITY m/sec
30-39	8-20 (13)	3.0-4.4 (3.7)	50-65 (58)
40-49	7-20 (12)	3.0-4.4 (3.7)	50-66 (58)
50-59	7-20 (11)	3.0-4.4 (3.7)	50-65 (57)
60-69	7-16 (11)	3.0-4.5 (3.8)	50-66 (55)
70-	7-14 (10)	3.0-4.5 (3.8)	50-61 (55)

Ulnar (sensory-antidromic)/dorsum of hand (30)

I. Position of Patient
   A. Patient is supine with upper extremity either supinated or pronated and extended at side (see Variations and Pitfalls A and B).
   B. Upper extremity is supported by the bed at all times.

II. Equipment
   A. 2 disc electrodes (G1 active, G2 reference)
   B. 1 ground (G0)
   C. 1 bipolar stimulator (S1 cathode, S2 anode)

III. Machine Settings
   A. Sweep speed (ms/div)—1 to 2
   B. Gain (μv)—5 to 20
   C. Filters—32(Hz), 1.6(KHz)

IV. Electrode Placement
   A. G0 (ground)—between G1 and S1
   B. G1 (record)—on the dorsal surface of hand slightly distal to the base of the anatomical "V" formed by the fourth and fifth metacarpal bones.
   C. G2 (reference)—midportion of the proximal phalanx of the fifth finger.

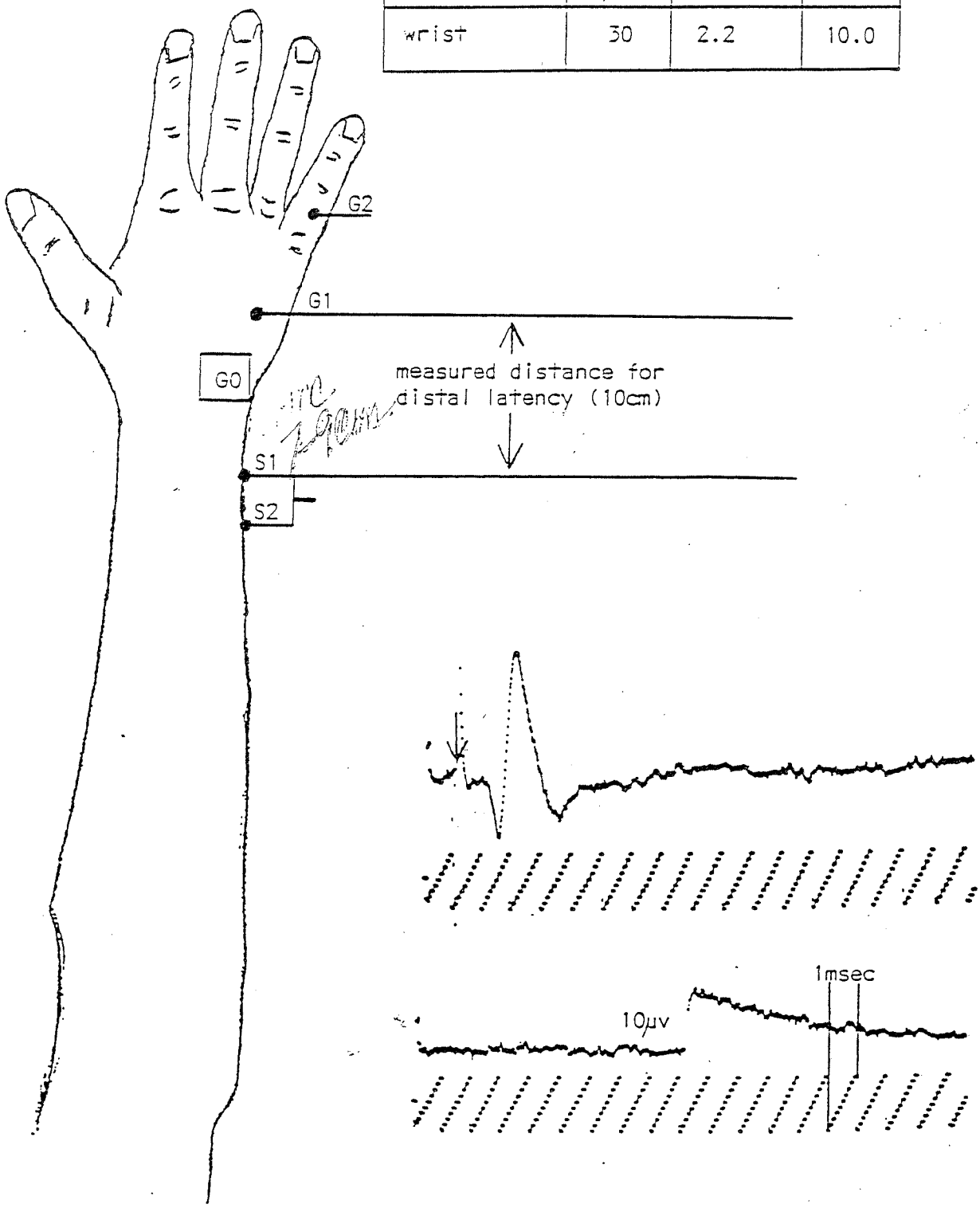
V. Stimulation Sites and Measurements
   A. Wrist (distal):
      1. Stimulate—S1, 10 cm proximal to G1 on the dorsal ulnar side of the arm 5 to 7 cm proximal to the base of the ulna bone usually between the ulna and the flexor carpi ulnaris tendon.
      2. Measure—distance from S1 to G1 following the contour of the arm. On adults use a distance of 10 cm if possible.
   B. Elbow (proximal not shown):
      1. Stimulate—S1, 3 to 5 cm proximal to the ulnar groove.
      2. Measure—distance from elbow-S1 to wrist-S1 through the ulnar groove following the contour of the forearm.

VI. Calculations
   A. Distal Latency—Calculate from the shock artifact to the peak

ULNAR (sensory-antidromic) / dorsum of hand

age = 32

Stimulation Site	Amp. μv	Latency msec	Dist. cm
wrist	30	2.2	10.0



of the negative deflection of the distal response.

B. Amplitude—Calculate from the positive peak to the negative peak of the deflection.

C. Conduction Velocity—Using latencies measured to the takeoff, subtract the distal from the proximal latency, divide the difference into the distance between proximal-S1 and distal-S1, and multiply by 10.

VII. Variations and Pitfalls

A. Because the recording electrode is very near the fifth dorsal interosseous, frequent increase of motor units and muscle artifact is seen with wrist and, to a greater extent, the elbow stimulation sites.

B. This test may be performed with the palm up or down depending on which gives less artifact.

C. Occasionally the dorsal branch of the ulnar nerve will divide proximal to the wrist stimulation site. If this happens a distance longer than 10 cm (G1 to S1) must be used.

D. Cold may cause a prolonged distal latency with a normal amplitude.

VIII. Normal Values (30)

A. The distal latency, amplitude, and conduction velocity are based on a side-to-side comparison. Careful measurements must be made to insure accurate comparisons.

B. The same position of the hand (palm up or palm down) must be used on both sides.

C. Amplitude range is 14 to 22 μv.

D. Peak latency range is 1.9 to 2.5 msec.

Ulnar (sensory-antidromic)/fifth finger (10, 48, 50)

I. Position of Patient

A. Patient is supine with upper extremity supinated and extended at side.

B. Upper extremity is supported by the bed at all times.

II. Equipment

A. 2 sensory clip electrodes (G1 active, G2 reference)

B. 1 ground (G0)

C. 1 bipolar stimulator (S1 cathode, S2 anode)

III. Machine Settings

A. Sweep speed (ms/div)—1 to 2

B. Gain (μv)—5 to 20

C. Filters—32(Hz), 1.6(KHz)

IV. Electrode Placement

A. G0 (ground)—palm of hand between G1 and distal S1

B. G1 (active)—midportion of the proximal phlanx of the fifth finger.
C. G2 (reference)—midportion of the middle phlanx of the fifth finger, 2.5 to 3 cm from G1.

V. Stimulation Sites and Measurements
A. Wrist (distal):
1. Stimulate—S1, anterior to the flexor carpi ulnaris tendon, 2 to 4 cm proximal to the distal wrist crease.
2. Measure—distance from S1 to G1 in a straight line. On adults use distance of 11 cm if possible.
B. Elbow:
1. Stimulate—S1, 3 to 5 cm proximal to the ulnar groove on the medial side of the arm.
2. Measure—distance from elbow-S1 to wrist-S1 through the ulnar groove following the contour of the medial aspect of the forearm.
C. Below Elbow:
1. Stimulate—S1, 5 to 7 cm distal to the ulnar groove on the medial side of the arm and at least 10 cm from elbow-S1.
2. Measure—distance from below elbow-S1 to wrist-S1 following the contour of the medial aspect of the arm.

VI. Calculations
A. Distal Latency—Calculate from the shock artifact to the peak of the negative deflection of the distal response.
B. Amplitude—Calculate from baseline to the peak of the negative deflection.
C. Conduction Velocity—Using latencies measured to the takeoff, subtract the distal from the proximal latency, divide the difference into the distance between proximal-S1 and distal-S1, and multiply by 10.

VII. Variations and Pitfalls
A. If distance other than 11 cm is used, add or subtract 0.2 msec for each cm difference.
B. Cold may cause a prolonged distal latency with a normal amplitude.

VIII. Normal Values* ULNAR SENSORY - ANTIDR

AGE	AMPLITUDE μv	DISTAL LATENCY msec	CONDUCTION VELOCITY msec
0-9	18-56 (34)	1.6-2.4 (2.0)	
10-19	18-70 (32)	2.0-2.8 (2.5)	54-74

*Ulnar sensory conduction velocities should (1) be in the normal range and (2) be the same or faster than the ulnar motor conduction velocities.

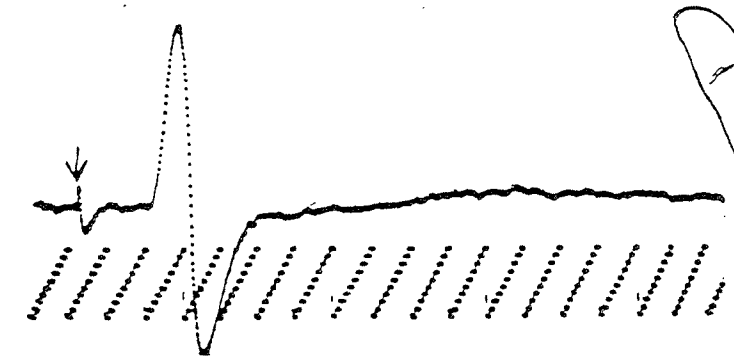
ULNAR (sensory-antidromic) / fifth finger

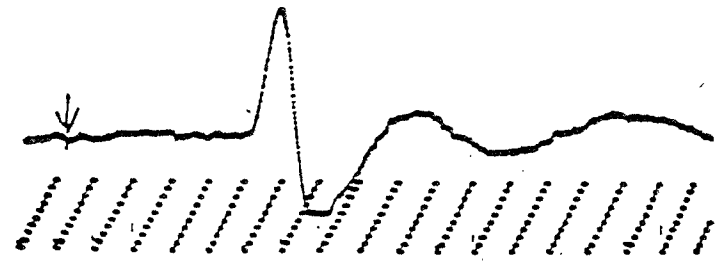
age = 35

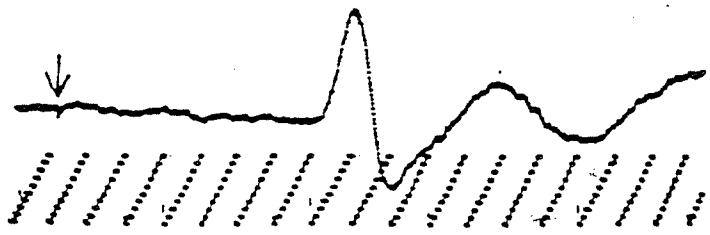
Stimulation Site	Amp. μv	Latency msec	Dist. cm	C.V. M/sec
elbow	28	(7.1)	32	64
wrist	45	(2.1)2.8	11	
		(5.0)		
below elbow	32	(5.1)	20	67
		(2.1)		
		(3.0)		

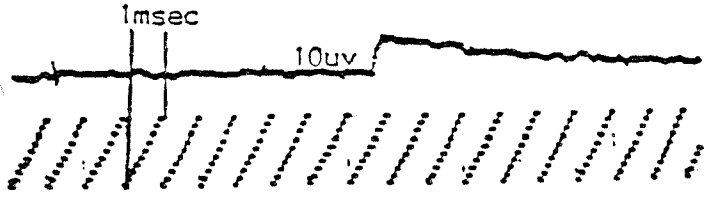
( ) = take off

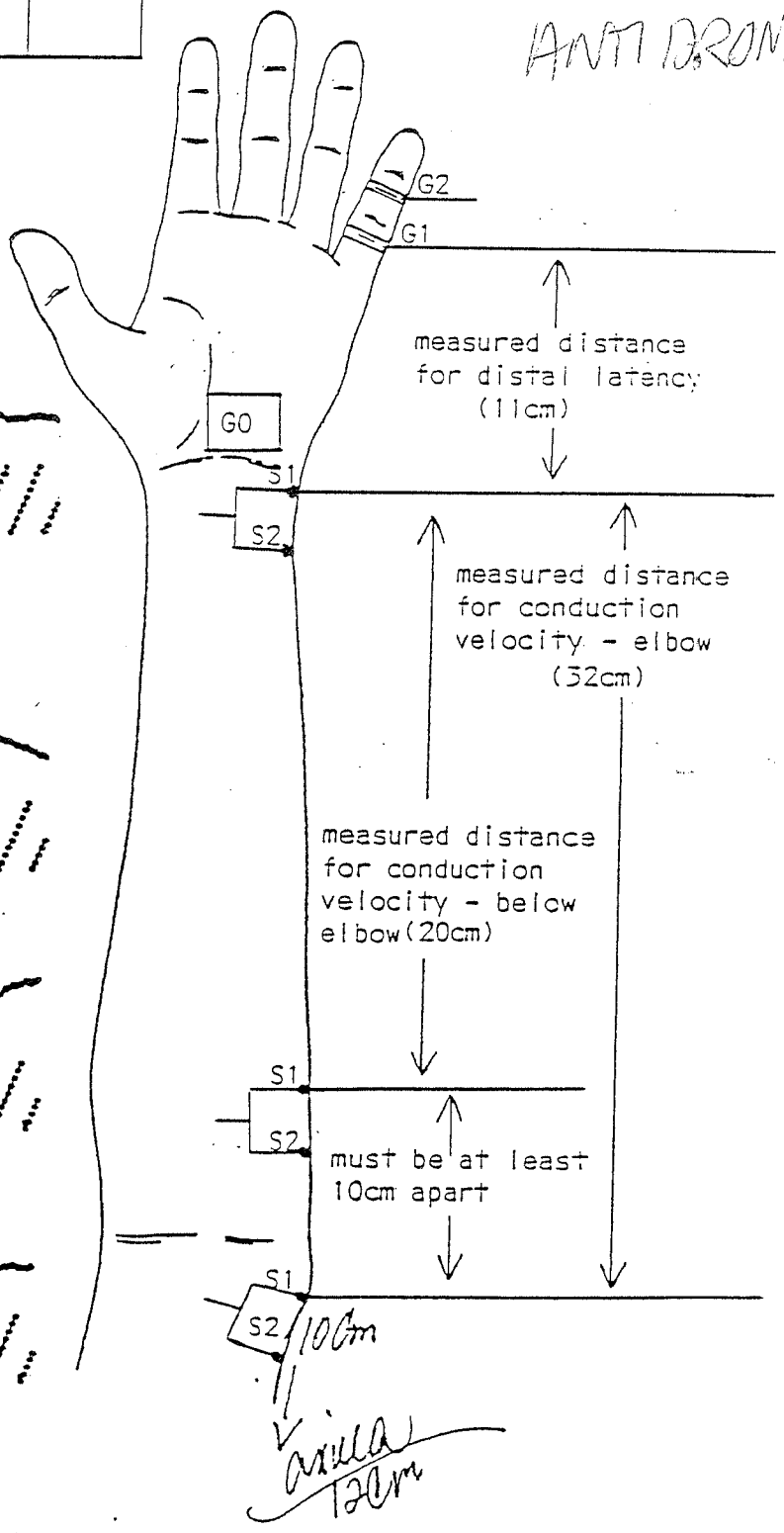
This is ANTIDROMIC











AGE	AMPLITUDE μv	DISTAL LATENCY msec	CONDUCTION VELOCITY msec
20-29	18-66 (38)	2.0-3.0 (2.6)	"
30-39	14-70 (34)	2.0-3.0 (2.6)	"
40-49	12-56 (27)	2.0-3.1 (2.6)	"
50-59	10-56 (24)	2.1-3.1 (2.7)	"
60-69	5-44 (20)	2.1-3.2 (2.7)	52-70
70-	5-36 (15)	2.1-3.2 (2.8)	"

Ulnar (sensory-orthodromic)/wrist (48)

I. Position of Patient
   A. Patient is supine with upper extremity supinated and extended at side.
   B. Upper extremity is supported by the bed at all times.

II. Equipment
   A. 2 disc electrodes (G1 active, G2 reference)
   B. 1 ground (G0)
   C. 2 sensory clip stimulating electrodes (S1 cathode, S2 anode)

III. Machine Settings
   A. Sweep speed (ms/div)—1 to 2
   B. Gain (μv)—5 to 20
   C. Filters—32(Hz), 1.6(KHz)

IV. Electrode Placement
   A. G0 (ground)—palm of hand between G1 and S1
   B. G1 (active)—anterior to the flexor carpi ulnaris tendon, 2 to 4 cm proximal to the distal wrist crease
   C. G2 (reference)—3 cm proximal to G1, anterior to the flexor carpi ulnaris tendon.

V. Stimulation Sites and Measurements
   A. Finger (fifth)
      1. Stimulate—S1, midportion of the proximal phalanx of the fifth finger. S2, midportion of the middle phalanx of the fifth finger.
      2. Measure—distance from S1 to G1 in a straight line. On adults use distance of 11 cm if possible.

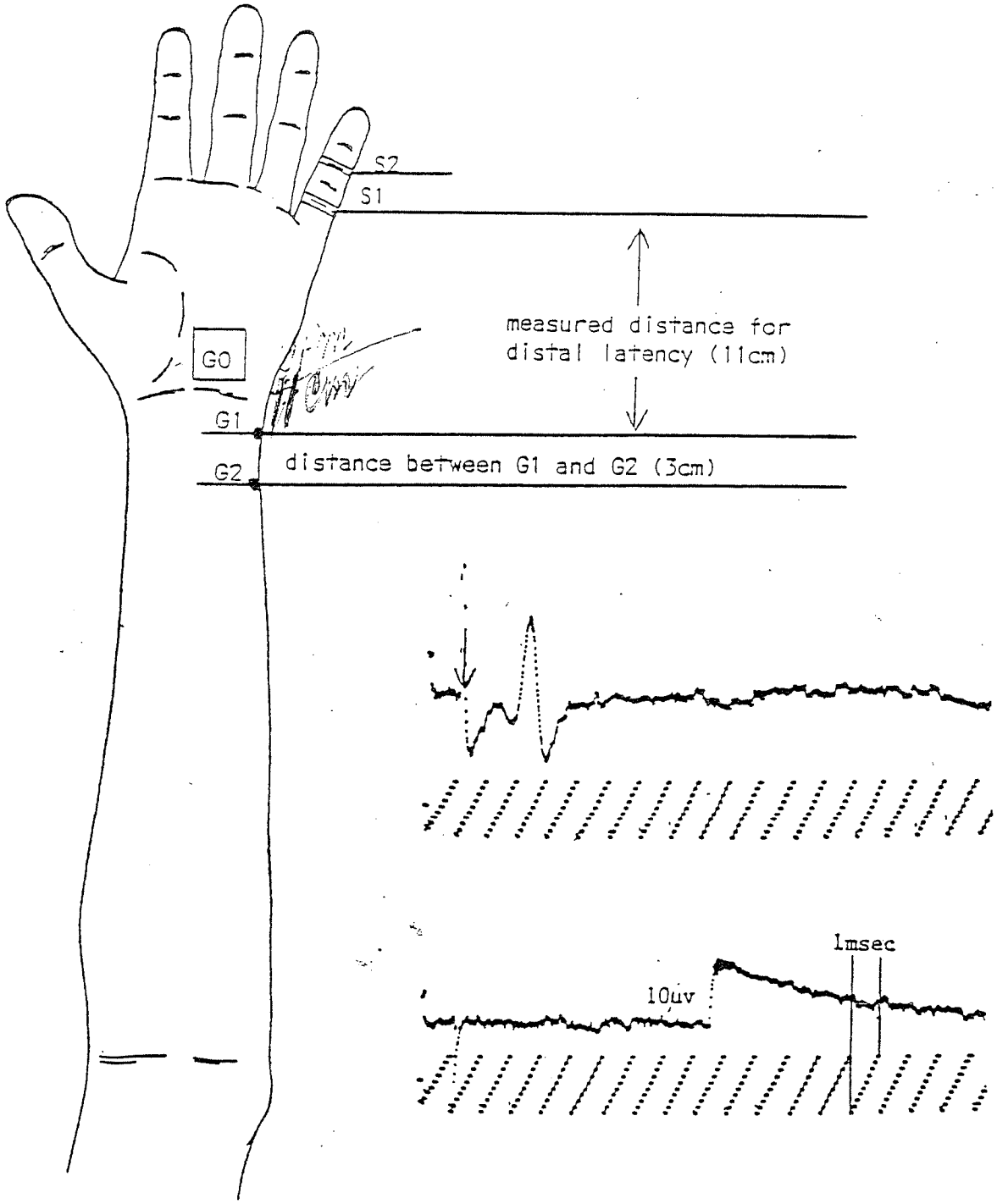
VI. Calculations
   A. Distal Latency—Calculate from the shock artifact to the peak of the negative deflection of the distal response.
   B. Amplitude—Calculate from baseline to the peak of the negative deflection.

VII. Variations and Pitfalls
   A. If distance other than 11 cm is used, add or subtract 0.2 msec for each cm difference.

ULNAR (sensory-orthodromic) / wrist

ace = 40

Stimulation Site	Amp. μv	Latency msec	Dist. cm
fifth finger	15	2.5	11



B. Cold may cause a prolonged distal latency with a normal amplitude.

VIII. Normal Values (48)

ULNAR SENS - ORTHODR

AGE	AMPLITUDE μv	DISTAL LATENCY msec
16-65 yrs	5-15	2.1-3.0
over 65	0-10	2.2-3.3

Ulnar (sensory-palmar)/wrist (12, 48)

I. Position of Patient
   A. Patient is supine with upper extremity supinated and extended at side.
   B. Upper extremity is supported by the bed at all times.

II. Equipment
   A. 2 disc electrodes (G1 active, G2 reference)
   B. 1 ground (G0)
   C. 1 bipolar stimulator (S1 cathode, S2 anode)

III. Machine Settings
   A. Sweep speed (ms/div)—1 to 2
   B. Gain (μv)—5 to 20
   C. Filters—32(Hz), 1.6(KHz)

IV. Electrode Placement
   A. G0 (ground)—palm of hand between G1 and S1
   B. G1 (active)—anterior to the flexor carpi ulnaris tendon, 2 to 4 cm proximal to the distal wrist crease
   C. G2 (reference)—3 cm proximal to G1, anterior to the flexor carpi ulnaris tendon.

V. Stimulation Sites and Measurements
   A. Palm:
      1. Stimulate—S1, lateral to the hypothenar eminence at the fifth metacarpal interspace. S2, distal to S1, lateral to the hypothar eminence.
      2. Measure—distance from S1 to G1 in a straight line. On adults use distance between 7 and 9 cm.

VI. Calculations
   A. Distal Latency—Calculate from the shock artifact to the peak of the negative deflection of the distal response.
   B. Amplitude—Calculate from baseline to the peak of the negative deflection.

VII. Variations and Pitfalls
   A. Excessive shock artifact caused by the use of short distances may cause a poor takeoff.

ULNAR (sensory-palmar) / wrist

age = 35

Stimulation Site	Amp. μv	Latency msec	Dist. cm
palm	36	1.8	7.5