

# The MLD initiative

## Standard operating procedure

### NERVE ULTRASOUND STUDIES

Version	1.0
Status	Definitive version
Date	06/03/2024
Purpose of this document	Describe the standard operating procedure for conducting nerve ultrasound studies in patients with metachromatic leukodystrophy to enable cross-center comparison and analysis.

#### Version control

Version number	Revision date	Summary of major changes

## A) Baseline parameters

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**1) Patient information**

- Recorded patient information must include: sex, age, body weight, and height

**2) Procedural information (please keep constant across measurements)**

- Recorded procedural information must include: measurement side and exact location of measuring

**3) Source data**

- Provide result tables, preferably also graphical views and used normative values

## B) Laboratory Procedures

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**1) Measurement side**

- Measurements are always taken on the right side of the body. The left side is optional.

**2) Locations of ultrasound measurement of the nerves  
(please keep constant across measurements)**

- Cross-sectional areas of the nerve (in mm<sup>2</sup>) are measured in adults and children.

- Cross-sectional areas of individual nerve fascicles are measured inside the hyperechoic rim of the fascicles (corresponding to the measurement of the nerve cross-sectional area) at the level of the upper arm in case of the median nerve and the ulnar nerve and at level of the popliteal fossa in case of the fibular nerve.

**2.1) Median nerve**

Locations: Mid-upper arm

Elbow

Mid-forearm

Wrist

Individual fascicle at mid-upper arm

**2.2) Ulnar nerve**

Locations: Mid-upper arm

Elbow

Mid-forearm

Wrist

Individual fascicle at mid-upper arm

**2.3)**

**Radial nerve**

Locations:

Superficial branch, *at the level proximal to the Frohse arcade where you can see superficial and deep branch on the same image*

Posterior interosseous nerve, *at the level proximal to the Frohse arcade where you can see superficial and deep branch on the same image*

**2.4)**

**Tibial nerve**

Locations:

Popliteal fossa

Medial malleolus, *in the medial retromalleolar region (beneath the vascular arcade)*

**2.5)**

**Fibular nerve**

Locations:

Popliteal fossa, *proximal of fibular head*

Lateral malleolus, *at the fibular superficial nerve. After piercing the crural fascia and before bifurcation into the medial dorsal cutaneous and intermediate dorsal cutaneous branches, which typically occurs approximately 10 cm proximal to the lateral malleolus in adults.*

Individual fascicle, *at the level of the popliteal fossa*

**2.6)**

**Sural nerve**

Locations:

Distal calf *next to the saphenous vein in the medial retromalleolar region*

**2.7)**

**Vagus nerve**

Locations:

Level of the carotid triangle

**3)**

**Locations of ultrasound measurement of the nerve roots  
(please keep constant across measurements)**

- Diameters (in mm) are measured laterally to the transverse process directly after leaving the intervertebral foramen.

**3.1)**

**C5**

3.2) C6

3.3) C7 (if possible, usually only in thin adults and children)

4) Normative values

Age (years)	2 - 4	5 - 7	8	9	10	11	12	13	14	15	16	17	>17
<b>Median nerve</b>													
Mid-upper arm (mm <sup>2</sup> )	≤8.0	≤9.0	≤8.5	≤9.0	≤9.0	≤9.5	≤10.0	≤10.5	≤11.5	≤12.0	≤13.0	≤14.0	<12.0
Elbow (mm <sup>2</sup> )	≤8.0	≤8.5	≤8.0	≤8.0	≤8.0	≤8.5	≤8.5	≤9.0	≤10.0	≤11.0	≤12.0	≤13.0	<12.0
Mid-forearm (mm <sup>2</sup> )	≤7.0	≤7.0	≤7.0	≤7.0	≤7.0	≤7.5	≤7.5	≤8.0	≤8.5	≤9.0	≤9.5	≤10.0	<10.0
Wrist (mm <sup>2</sup> )	≤8.0	≤9.0	≤9.0	≤9.0	≤9.5	≤9.5	≤10.0	≤10.5	≤11.0	≤11.5	≤12.0	≤13.0	<12.0
Individual fascicle (mm <sup>2</sup> )	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<5.0
<b>Ulnar nerve</b>													
Mid-upper arm (mm <sup>2</sup> )	≤6.0	≤6.5	≤6.5	≤6.5	≤6.5	≤6.5	≤7.0	≤7.5	≤8.0	≤8.5	≤9.0	≤9.5	<9.5
Elbow (mm <sup>2</sup> )	≤5.0	≤6.0	≤5.0	≤5.0	≤5.0	≤5.0	≤5.5	≤6.0	≤6.5	≤7.5	≤8.5	≤9.5	<10.0
Mid-forearm (mm <sup>2</sup> )	≤5.5	≤6.0	≤5.5	≤5.5	≤5.5	≤6.0	≤6.5	≤6.5	≤7.0	≤7.0	≤7.5	≤7.5	<8.5
Wrist (mm <sup>2</sup> )	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Individual fascicle (mm <sup>2</sup> )	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<3.0
<b>Radial nerve</b>													
Superficial branch (mm <sup>2</sup> )	≤2.0	≤2.5	≤1.5	≤1.5	≤1.5	≤1.5	≤2.0	≤2.0	≤2.0	≤2.5	≤2.5	≤2.5	<3.0
Posterior interosseous nerve (mm <sup>2</sup> )	≤2.0	≤2.5	≤2.0	≤2.0	≤2.0	≤2.0	≤2.5	≤2.5	≤3.0	≤3.0	≤3.0	≤3.0	N.A.
<b>Tibial nerve</b>													
Popliteal fossa (mm <sup>2</sup> )	≤22.0	≤26.0	≤25.0	≤26.0	≤26.0	≤27.0	≤28.0	≤29.0	≤31.0	≤32.0	≤34.0	≤36.0	<33.0
Medial malleolus (mm <sup>2</sup> )	≤7.5	≤8.5	≤9.0	≤9.0	≤9.0	≤9.0	≤9.0	≤10.0	≤10.5	≤10.5	≤10.5	≤11.0	<14.0
<b>Fibular nerve</b>													
Popliteal fossa (mm <sup>2</sup> )	≤5.0	≤7.0	≤6.0	≤6.0	≤6.0	≤6.0	≤6.5	≤7.0	≤8.0	≤9.0	≤10.0	≤11.0	<11.5
Lateral malleolus (mm <sup>2</sup> )	N.A.	N.A.	≤2.5	≤2.5	≤2.5	≤3.0	≤3.0	≤3.0	≤3.5	≤3.5	≤3.5	≤3.5	<3.5
Individual fascicle (mm <sup>2</sup> )	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	<4.0
<b>Sural nerve</b>													
Distal calf (mm <sup>2</sup> )	≤2.0	≤2.5	≤2.5	≤2.5	≤2.5	≤2.5	≤2.5	≤3.0	≤3.0	≤3.0	≤3.5	≤3.5	<3.5
<b>Vagus nerve</b>													
Carotid triangle (mm <sup>2</sup> )	≤2.0	≤2.5	≤2.5	≤2.5	≤2.5	≤2.5	≤2.5	≤2.5	≤2.5	≤3.0	≤3.0	≤3.0	<3.5
<b>Nerve roots</b>													
C5 (diam. mm)	≤2.5	≤2.5	≤2.7	≤2.7	≤2.7	≤2.7	≤2.7	≤2.8	≤2.8	≤2.9	≤2.9	≤2.9	<2.9
C6 (diam. mm)	≤3.3	≤3.3	≤3.9	≤3.9	≤3.9	≤3.9	≤4.0	≤4.0	≤4.1	≤4.1	≤4.2	≤4.2	<4.2
C7 (diam. mm)	≤3.5	≤3.9	≤4.1	≤4.1	≤4.2	≤4.2	≤4.2	≤4.8	≤4.8	≤4.8	≤4.8	≤4.8	≤4.8

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Grimm, A. S., Schubert, C., Grimm, A., Stahl, J. H., Küpper, H., Horber, V., ... & Groeschel, S. (2020). Normative observational nerve ultrasound values in school-age children and adolescents and their application to hereditary neuropathies. *Frontiers in Neurology*, 11, 303.

Wang, W., & Wang, Q. (2020). Sonographic measurements of normal C5-C8 nerve roots in children. *Muscle & nerve*, 61(5), 649-653.