

**American Academy of Neurology
Neuromuscular Section
Resident Core Curriculum**

10/03/01

1. Introduction:

Neuromuscular disorders are a significant component of the diseases of the nervous system that neurologists must deal with. It is imperative that all neurologists be familiar with these disorders and recognize the complexities involved in diagnosis and treatment.

2. Goals and objectives:

The goal of this document is to provide the framework for resident training in neuromuscular disorders. It will outline the disorders that the resident should be exposed to, the disciplines they should be familiar with as well as the basic science concepts they should understand. The document will also suggest a general method of instruction that can accomplish these goals.

At the completion of their residency, every neurology resident should be familiar with the anatomy and physiology of the peripheral nervous system, understand the pathology and pathophysiology of the various neuromuscular diseases, have the ability to take an appropriate history and perform an examination that addresses the specific issues of the peripheral nervous system. They should be able to develop a differential diagnosis and a diagnostic evaluation that leads to correct diagnoses. They should understand the value of the different diagnostic tests including laboratory tests, electrodiagnostic testing and biopsy. They should know how to manage these patients and recognize when it is advantageous to refer the patient to neuromuscular sub-specialists.

3. Definitions:

Neuromuscular disorders are a subsection of neurology that includes diseases of the peripheral nervous system. These include abnormalities of the anterior horn cell, nerve roots, peripheral nerves, neuromuscular junction and muscle.

4. Content of subjects to be taught:

Background Knowledge of PNS

- Neuroanatomy
- Neurophysiology
- Neuropathology
- Neuropharmacology

Procedures

- Electromyography and Nerve Conduction Studies
- Autonomic Functions Testing
- Muscle Biopsy

Nerve Biopsy
Quantitative Sensory Testing (QST)
Skin Biopsy

The resident should be familiar with all the above procedures used in the diagnosis of Neuromuscular diseases. Even though some of these procedures such as QST and skin biopsy may not be available at all institutions and may only be used for primarily clinical research trials, the resident should understand their utility and limitations.

Disorders that should be covered include inherited and acquired diseases of children and adults.

The resident should be familiar with the following groups of disorders:

Anterior Horn Cell Disorders

- Spinal Muscular Atrophy
- Amyotrophic Lateral Sclerosis
- Poliomyelitis

Dorsal Root Ganglion

- Paraneoplastic
- Drug toxicity
- Inflammatory/Immune

Nerve Roots

- Compressive Radiculopathies
- Lumbar spinal stenosis
- Polyradiculopathies

Brachial and Lumbar Plexus

- Traumatic
- Parsonage-Turner
- Metastatic
- Inflammatory/immune mediated

Peripheral Nerve

- Compressive/traumatic
- Metabolic
- Immune/inflammatory
- Toxic
- Deficiency states

Neuromuscular Junction

- Myasthenia Gravis
- Eaton-Lambert Syndrome
- Botulism

Muscle

- Muscular Dystrophies
- Other inherited disorders
- Inflammatory
- Metabolic
- Periodic paralyses and channelopathies

5. Prerequisites for the trainee:

The trainee should be in an approved neurology residency.

6. Personnel needed for the training:

While a good general neurologist can teach much of the basics of neuromuscular disease to the resident, training programs should have at least one neuromuscular sub-specialist faculty member that can devote time to training the residents in neuromuscular disorders. There should be at least one electromyographer.

Expertise in interpreting nerve and muscle biopsies should be available. It is preferable if the resident was also exposed to physicians expert in neuromuscular rehabilitation. Neuromuscular fellows, EMG technicians, physical therapists, speech and swallowing therapists, neuromuscular nurses and pulmonologists also provide valuable teaching.

7. Qualifications of the trainers:

It is recommended that the residents be trained by a neurologist who has received fellowship training in neuromuscular disorders and/or who has dedicated much of his career to the neuromuscular sub-specialty. Electromyographers should have had fellowship experience in EMG or have demonstrated clinical expertise. It is desirable that they have board certification in Clinical Neurophysiology by ABPN and/or in EMG by ABEM.

8. Facilities needed for the training:

The emphasis on out-patient evaluations and treatment of neurologic patients is particularly applicable to neuromuscular disorders. There should be an adequate out-patient environment for the education of the resident. The EMG laboratory should be designed to provide the resident as much exposure to the patients as possible. Access to the neurologic literature should be available through the hospital and medical school library, departmental library and electronic media.

9. Setup for the training

The training in neuromuscular disorders must be coordinated into the overall residency. The Residency Director must ensure that all aspects of neurology be included during the 3 years of training. It is recommended that the head of the neuromuscular section advise the residency director regarding neuromuscular training.

The resident should be exposed to patients with neuromuscular disorders at all levels of their training. While some aspects of this can be accomplished during their rotations on the in-patient service and resident clinics, it is recognized that many neuromuscular patients are seen only in sub-specialty clinics. The residency should provide rotations for all residents in neuromuscular clinics- preferably the equivalent of 2-3 months during their residency. The adult neurology residents should be exposed to pediatric neuromuscular patients in a

similar manner. It could be included as part of the 3 month pediatric neurology rotation.

A rotation in the EMG laboratory is an excellent way for residents to see a variety of neuromuscular patients, understand the physiologic aspects of these disorders, and learn when to order studies and how to interpret EMG results. It should be understood that the practice of electromyography requires extensive training and post-training experience. This is usually not possible to obtain during a short rotation during residency. Residents interested in performing EMG examinations in their future practice are encouraged to pursue further training in a fellowship.

Residents should be present at Neuromuscular conferences-certainly when they are on EMG and neuromuscular rotations and preferably throughout the residency. Nerve and muscle biopsy reading sessions should include residents.

Electives in neuromuscular diseases should be available to residents. This rotation should provide an intensive experience of all aspects of neuromuscular medicine.

Research opportunities should be made available, to expose the resident to the investigative aspects of the discipline.

Neuromuscular topics should be included in Grand Rounds presentations, Research Seminars, Journal Clubs and basic science lecture series (neurophysiology, neurochemistry, neuroanatomy, neuropharmacology) and other conferences. The chief of the neuromuscular section should work with the coordinators of these activities to ensure appropriate representation.

10. Methods of training:

Much of the methodology of training is mentioned above. It is important that the resident have the opportunity to independently evaluate patients, come up with their own differential diagnosis and diagnostic/treatment plans. There should be adequate time for discussion with a neuromuscular specialist. In addition, the resident should observe the specialist as he/she evaluates patients.

The resident should take an active role in teaching neuromuscular topics to medical students, residents of other services and to those neurology residents who have less training.

11. Timetable for training:

As mentioned above, the neurology resident should be exposed to neuromuscular patients and the neuromuscular discipline throughout the residency. By the time they have completed the residency they should have independently evaluated patients with the most common neuromuscular disorders and been exposed to most of the less common problems.

12. Methods of evaluation of the trainee:

The evaluation of the resident in neuromuscular disorders should be included in his overall evaluation. Specifically, the resident should be evaluated during their EMG rotation and during the periods of time they are in neuromuscular clinic. Any practical examination or “mock board” should include at least one neuromuscular patient. The neuromuscular training process should be evaluated annually. Input from the residents and fellows is important in this evaluation. A review of the in-service examination should provide clues as to the effectiveness of the training. A meeting of the neuromuscular faculty with the possible inclusion of the residency director and representative residents may provide important dialogue. Appropriate changes in the curriculum should be made to assure that all the residents are receiving an adequate neuromuscular education .

14. Mechanisms of feedback:

The mechanisms of feedback are mentioned above. In addition, it is important for the neuromuscular faculty to encourage frank discussions by the residents. The faculty “door should be open” and an atmosphere free of intimidation should be encouraged. Along with written resident evaluations of faculty, we recommend that the residents also evaluate the various sub-specialty training programs, including that of neuromuscular disease.

15. Methods of constantly upgrading knowledge:

Along with the conferences mentioned above, participation in national professional and scientific conferences should be encouraged. Reports from these meetings should be brought to the attention of the residents.

16. List of references:

Muscle Pathology

Dubowitz V. Muscle Pathology: A Practical Approach. 2nd Ed. Baillière Tindall, 1985

Carpenter and Karpati. Pathology of Skeletal Muscle. 2nd Ed. Oxford University Press. 2001.

Nerve Pathology

Midroni G, Bilbao JM. Biopsy Diagnosis of Peripheral Neuropathy. Butterworth-Heinemann, 1995

Richardson EP Jr., De Girolami U. Pathology of the Peripheral Nerve. WB Saunders Co, 1995

Vital C, Vallat J-M. Ultrastructural Study of the Human Diseased Peripheral Nerve. 2nd Ed. Elsevier, 1987

Electrodiagnosis

Aminoff, MJ. Electromyography in Clinical Practice. 3rd Ed. Churchill Livingstone, New York, 1998.

Kimura J. Electrodiagnosis in Disease of Nerve and Muscle. 3rd Ed. Oxford University Press, 2001.

Oh, S. Clinical Electromyography. 2nd Ed. Williams & Wilkins, 1993

Preston D, Shapiro B. Electromyography and Neuromuscular Disorders. Butterworth-Heinemann, 1998

Disorders of Peripheral Nerve

Griffin J, Low P, Poduslo J. Peripheral Neuropathy. 3rd Ed. W.B. Saunders Co., 1993

Mendell JR, Kissel JT, Cornblath DR. Diagnosis and Management of Peripheral Nerve Disorders. Oxford, Oxford University Press, 2001.

Disorders of Muscle

Engel A, Franzini-Armstrong C. Myology. 2nd Ed. McGraw-Hill, 1994

Griggs R, Mendell J, Miller R. Evaluation and Treatment of Myopathies. Philadelphia: F.A. Davis Co., 1995

Karpati G, Hilton-Jones D, Griggs, RC eds. Disorders of Voluntary Muscle, 7th edition, Cambridge, Cambridge University Press 2001

Neuromuscular Journals:

Muscle & Nerve
Journal of the Peripheral Nervous System
Journal of Neuromuscular Disorders